

TECHNICAL MANUAL

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

FIRE FIGHTING SYSTEM

FOR

LARGE TUG (LT)

NSN 1925-01-247-7110

This technical manual is an authentication of the manufacturer's commercial literature and does not conform with the format and the content requirements normally associated with Army technical manuals. This technical manual does, however, contain all essential information required to operate and maintain the equipment.

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**HEADQUARTERS, DEPARTMENT OF THE ARMY
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DEPARTMENT OF THE ARMY
WASHINGTON D.C., 30 November 2003

**Unit, Intermediate Direct Support
And Intermediate General Support Maintenance
Manual (Including Repair Parts and Special Tools List)**

**Fire Fighting System
For
Large Tug (LT)**

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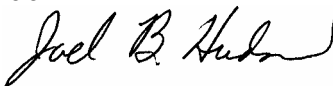
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WARNING

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.

In areas protected by HALON 1301 agent, personnel have only 25 seconds (Paint Locker)/60 seconds (Engine Room and Auxiliary Machine Room No.1) to evacuate these areas after the alarm sounds.

After 25 or 65 seconds have elapsed, the areas are flooded with HALON 1301 smothering agent. Exposure to this agent may cause suffocation.

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.

TECHNICAL MANUAL
NO. 55-1925-227-24&P

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FIRE FIGHTING SYSTEM
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LARGE TUG (LT)
NSN: 1925-01-247-7110

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028 (Recommended Changes to Publications and Blank Forms), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is <http://aeprs.ria.army.mil>. If you need a password, scroll down and click on "ACCESS REQUEST FORM". The DA Form 2028 is located in the ONLINE FORMS PROCESSING section of the AEPS. Fill out the form and click on SUBMIT. Using this form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax or email your letter, or DA Form 2028 direct to: AMSTA-LC-CI/TECH PUBS, TACOM-RI, 1 Rock Island Arsenal, Rock Island, IL 61299-7630. The email address is TACOM-TECH-PUBS@ria.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

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Section:

- I. Operation, Installation and Maintenance for Fire Detection System.
- II. Operation and Maintenance Manual for Halon 1301 Fire Suppression System.

NOTE

Not applicable to Hull No. LT801, LT804, LT805
 Reference TM 55-1925-207-10 Para. 2-65
 and section III of this manual for FM-200 operation.

- III. Installation, Operation and Maintenance Manual for Marine FM-200 Fire Suppression System.
- IV. Installation and Maintenance Manual Prosser/ENPO Submersible Pump.
- V. Portable Fire Fighting Pump Model P-250
- VI. Foam Turret
- VII. Roper Pumps Model 2F75-17
- VIII. Kwik-Draw Sampling Pump Operation and Maintenance Manual with Brochure 08-00-02, Detector Tubes and Kwik-Draw Pump.
- IX. Appendix A Maintenance Allocation Chart (MAC)
- X. Appendix B Repair Parts and Special Tools List, Material Safety Data Sheets for: Hydrogen Fluoride (HG) Gas, FM-200, Nitrogen and Carbon Dioxide (CO2)
- XI. Appendix C Component Manufacturer's Data Sheets for FM-200 and Water Washdown System Installation with distributor listing.
- XII. Appendix D As Built/Installation Drawings.
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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).

NOTE

Not applicable to Hull No. LT801, LT804, LT805
Reference TM 55-1925-207-10 Para. 2-66 for FM-200
Operation and Preparation for Storage/Shipment procedures.

- 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

Operation, Installation and Maintenance for Fire Detection System

**OPERATION INSTALLATION, AND MAINTENANCE MANUAL
FOR
FIRE DETECTION SYSTEM**

U. S. ARMY LARGE TUGS

PREPARED FOR:

**ROBERT E. DERECKTOR OF RHODE ISLAND, INC.
MIDDLETOWN, RHODE ISLAND 02840**

PREPARED BY:

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3710 LAKESIDE COURT
MOBILE, ALABAMA 36693**

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- IV. COMPONENT DATA SHEET

- V. SPARE PARTS LIST

- VI. SYSTEM DRAWINGS

INTRODUCTION

The following manual is intended to be used by personnel responsible for operation, general periodic maintenance, service and repair of the Fire Detection System. Whenever you undertake to inspect, test, maintain, or service this system, always keep in mind that you are accepting responsibility for the safety of people's lives and protection of property and equipment. This equipment is designed and manufactured to meet the highest requirements. However, if this equipment is not maintained properly, it may not be capable of doing the job it is intended to do.

OPERATION

In normal standby operation, all switches should be in normal position. The system power lamp should be on and the system alarm, system trouble lamps, zone alarm, zone trouble, audible signal circuit trouble LED indicators and all other indicators should be off.

When System Alarm Sounds

A. If system is used for fire detection, follow the response plan approved by the authority having jurisdiction. Check that every one is accounted for. Then, notify the Fire Department (If the system is connected to the Fire Department or a Central Station. this is done automatically by the control equipment). Keep in mind that the Fire Department or Central Station should be notified when resetting the system.

B. Audible device circuits associated with the silencable alarm output may be silenced by momentary operation of the ALARM SILENCE switch. Subsequent alarm conditions from another zone will cause the above audibles to again sound. **DO NOT RESET THE SYSTEM.** The zone LEDs will indicate the zone in which the alarming device is located. Locate the device initiating the alarm. This device will have its base lamp* on.

C. When the cause of the alarm has been located and corrected, reset the system by moving the RESET/LAMP TEST switch momentarily to RESET position. Reset all other switches that have been operated.

When a Trouble Condition Develops

A. The system trouble lamp and horn are activated. Call your authorized Pyrotronics Service Representative. The trouble should be diagnosed and repaired immediately.

B. The trouble buzzer may be silenced by moving the TROUBLE SILENCE switch to the SILENCE position. The trouble lamp will remain illuminated.

MAINTENANCE

To insure proper and reliable operation, the following inspection and testing schedule is recommended.

Every Six Months

A. Inspect all ionization detector heads for dust accumulations and when excessive, contact your authorized Pyrotronics Service Representative or factory for service.

B. Activate a detector or alarm initiating device. Check that base lamp lights* and that proper alarm and zone indications are given by the control panel. An ionization or photoelectric detector may be activated by blowing smoke into it. A thermal detector may be activated by an electric heat gun. A flame detector may be activated by holding a lighted match slightly below it.

IMPORTANT: If the system is connected to the Fire Department, or actuates an external system (fire extinguishing, etc) then move disconnect switches* to OFF position to prevent actuation. Be sure to reconnect at completion of inspection. Notify facility personnel that a system test is being performed so that any alarm soundings can be ignored during the test period.

C. Check operation of each detector/alarm initiating device on all circuits. Measure the sensitivity of each ionization detector with a Pyrotronics sensitivity checker (when applicable).

D. Check the supervisory circuits by operating the RESET/LAMP TEST switch to the RESET position. In this position, all visual indicators on the control panel should be lit and the trouble horn should sound.

Periodically Testing the System

A. The system should be tested at regular intervals to ensure its operational reliability and optimum performance. To test the system, activate a detector/alarm initiating device.

Check that all audible devices sound, that the system alarm lamp illuminates, and that the audible devices can be silenced*.

Check that the proper zone lamp responds.

B. Reset the system. Check that the system trouble lamp LEDs and horn and all zone lamps* are actuated when the reset switch is moved momentarily to the RESET position.

C. Return all switches to normal position.

D. If a disconnect switch is incorporated, and if the system is connected to a fire department, central station, or has external devices connected to it (fans, smoke door holders, fire extinguishing systems, etc) which are operated by the alarm controlled contacts, this equipment may be isolated from the alarm circuit during a test by moving the respective disconnect switch(es) to the DISCONNECT position. Operation of this switch prior to tests energizes the trouble lamp so that the switch will not be left in the DISCONNECT position inadvertently.

*When this feature is incorporated in the system.

Your local Pyrotronics authorized Service Representative is:

Name _____

Tel No. _____



Pyrotronics

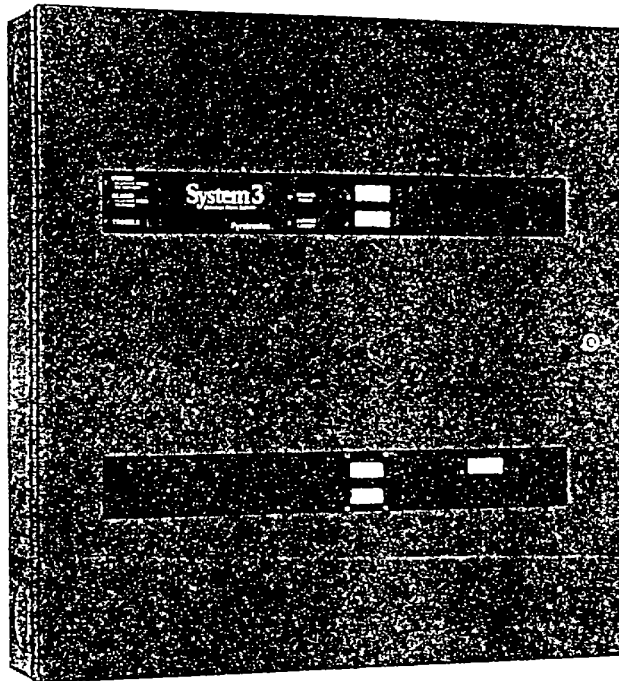
A Division of Baker Industries, Inc
Cedar Knolls, New Jersey 07927

Part No 315-084881A

These instructions should be framed and located adjacent to the control unit for ready reference.

Pyrotronics System 3

Universal Alarm Control



MODEL CP-35 CONTROL PANEL

INSTALLATION AND MAINTENANCE INSTRUCTIONS



Pyrotronics A Division of Baker Industries, Inc
8 Ridgedale Avenue, Cedar Knolls, New Jersey 07927

Part No 315-085063A

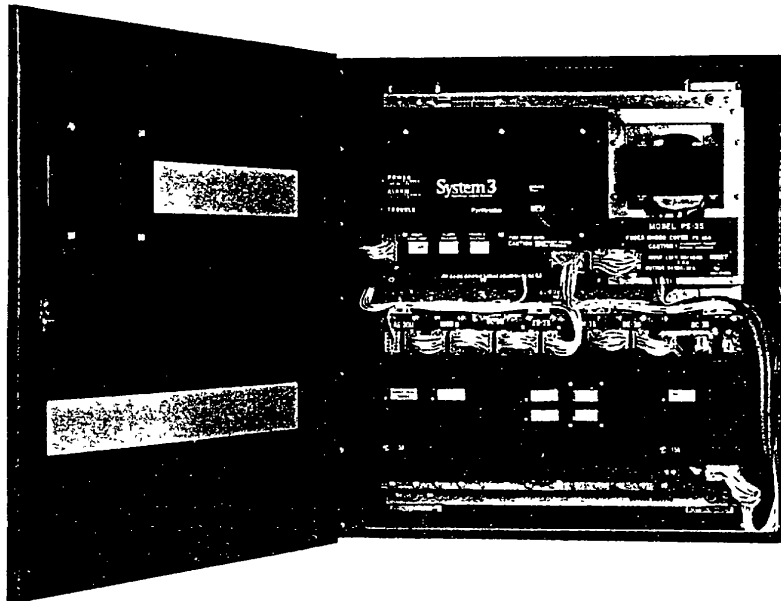


Figure 1
Interior View of CP-35
Displays Power Supply (PS-38)
and Modules Selected

INSTALLATION AND WIRING

The reliability of the Pyrotronics System 3 depends to a great extent upon proper installation of the control panel, modules, detectors, associated equipment, and wiring. These Instructions outline the requirements for a satisfactory installation. Careful completion of each detail will provide an automatic detection and control system that will be dependable and give reliable operation. Connection terminals for the Control Panel are shown in Figure 3, WIRING INFORMATION. The wiring arrangement for a typical system with control panel and modules is shown in Figure 4, TYPICAL SYSTEM WIRING.

Connection terminals for the Individual modules are shown on the **Operation and Installation Instructions** sheet provided with each of the modules.

Any questions regarding the equipment or installation should be directed to an authorized Pyrotronics Service Representative.

Mounting the Control Panel Enclosure (Figure 2)

The control panel enclosure should be securely fastened to a shock and vibration-free surface in a clean, dry area. It should be mounted with the top of the enclosure approximately six feet above the floor. The location should ensure that the control panel is easily visible and readily accessible for maintenance. Sufficient room is necessary to open the enclosure door.

Wiring should be in accordance with national and local codes for fire alarm circuits. Use knockouts provided. For AC supply power, use No 14 or larger AWG, 600V insulation wire.

The module/frame assembly should be picked up by the straps provided at the end of the wiring channels. Do not place hands behind the modules, as the circuitry may be damaged. Install the module/frame assembly in the enclosure, securing it to the studs with the 5/16 in nuts provided.

CAUTION: Do not overtighten nuts (do not use ratchet type wrench), as the studs can be broken if excessive force is applied.

Power Requirements

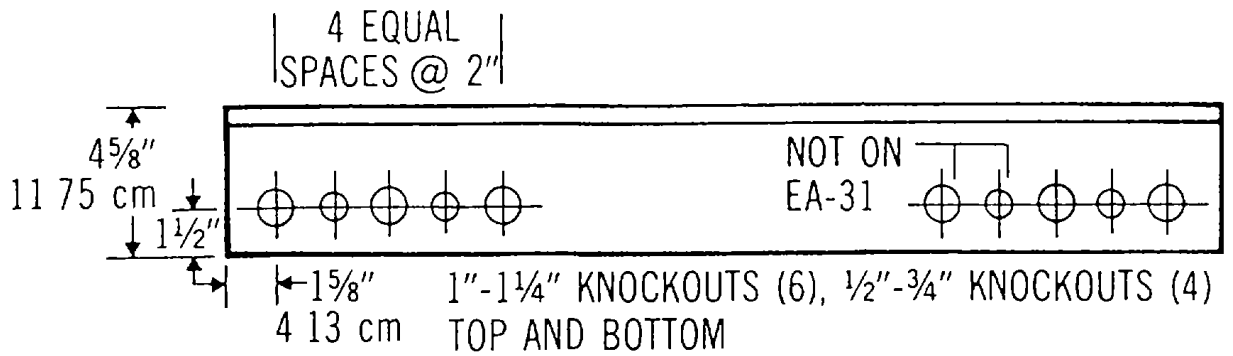
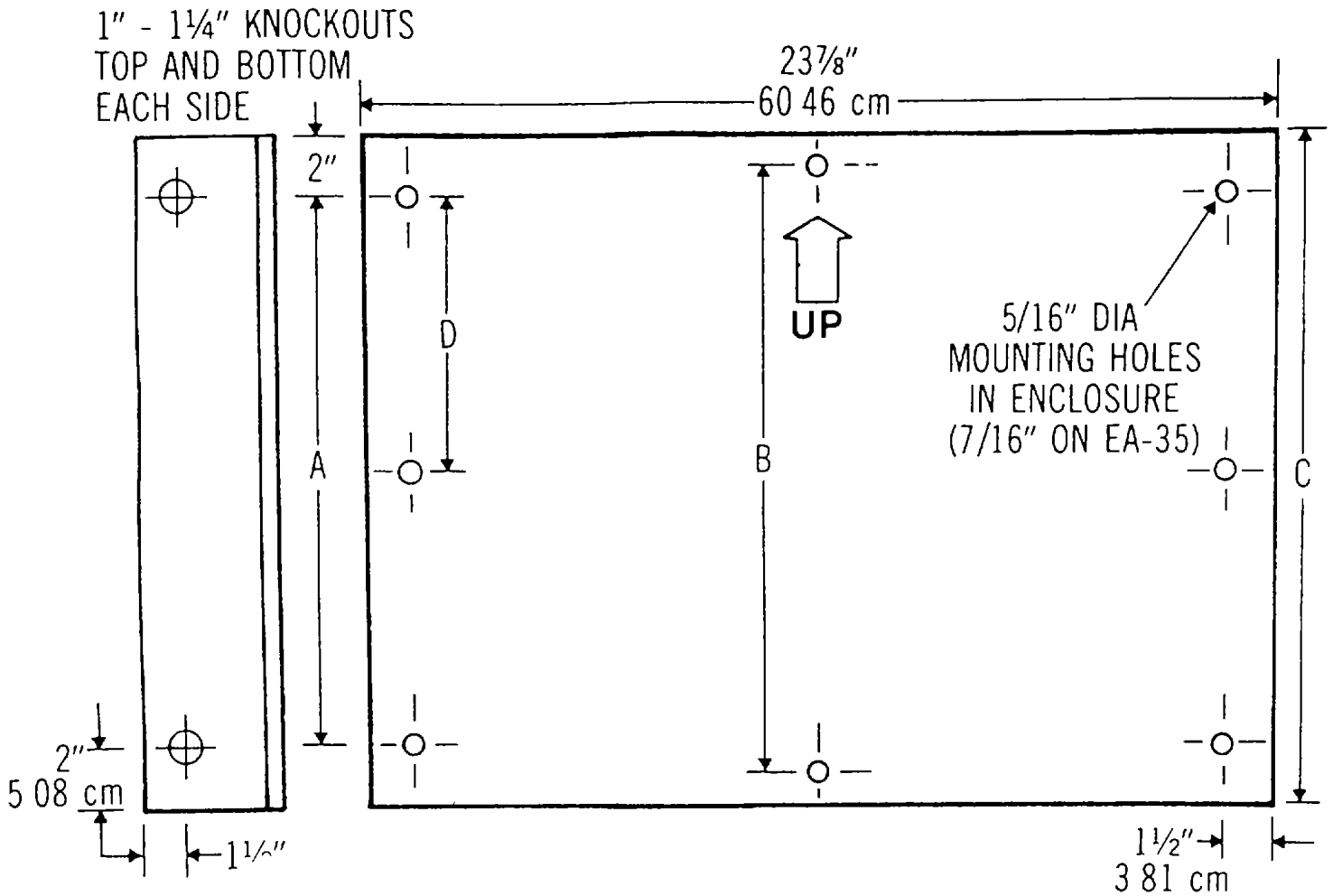
The CP-35 is designed to operate from the 24 VDC output provided from the Models PS-34 or PS-35 power supplies. Connection from the CP-35 to the power supply is made by a six-wire harness assembly.

The PS-34 or PS-35 power supply operates from a 120/240 volt, 50/60 Hz, three-wire, grounded neutral, power source. The power supply must be connected directly through separate circuit breakers or fuses, to the line side of the main power feed for the building. No other equipment may be supplied from these separate circuit breakers or fuses. Wire must run continuously from the AC power source to the PS-34/35 input terminals. Refer to Figure 3, WIRING INFORMATION.

Installing the Control Panel and Power Supply

The system power supply, PS-34 or PS-35, is installed in the upper right-hand corner of the enclosure and occupies three module spaces. Immediately to the left is the CP-35 Control Panel. These two modules together occupy the entire top tier. When the BC-35 charger/transfer module is used, it should be placed directly below the power supply module in the second tier. Battery Extender Module BE-35 and Meter Module MM-35, when used, are placed to the left of the BC-35 and an interconnecting cable to each and to the CP-35 should be engaged (See Figure 4.)

Other system modules may now be placed adjacent to the last battery associated module and connected to CP-35 at P2, via the JA-24 plug and harness assembly. Subsequent modules may then be placed to fill up the second tier and then the third, etc.



Enclosure	A	B	C	D
EA-31	10" 25.4 cm	—	14" 35.56 cm	—
EA-32	20½" 52.07 cm	22⅞" 56.83 cm	24½" 62.23 cm	—
EA-33	31" 78.74 cm	32⅞" 83.50 cm	35" 88.95 cm	15½" 39.37 cm
EA-35	52" 132.08 cm	53⅞" 136.84 cm	56" 142.24 cm	26" 66.04 cm

Figure 2
Enclosure Mounting Dimensions

Connections between adjacent modules are to be made with the JA-5 plug and harness assembly. Connections between modules of different tiers may be made using the JA-24 cable harness assembly. The module supervision circuit is completed by installation of the JS-24 or JS-64 supervisory return cable assembly from the unused bus receptacle of the last module in the system to terminal 41 of the CP-35.

Installation of Conduit Boxes or Shielded Cable

Where local codes of installation require an outlet box, use a standard 4 in octagon box for all detector mounting. Where local codes permit, the detectors may be wired using limited-energy shielded cable. The Control Panel enclosure and all detector and alarm circuit conduit or shielding must be properly grounded. Insure that all conduit and shielding makes good electrical contact between the control panel and outlet boxes.

Detection/Alarm Initiating Circuit Wiring to Zone Modules

Run wire in accordance with the Wiring Diagram. Use at least 18 AWG, 300V insulation, color coded wire for low voltage circuits where local codes require conduit. Where local codes permit, use approved limited-energy shielded cable rated at 300V. The maximum length of run (both wires) should not exceed 1/2 mile of No 18 wire (35 ohms) for standard detection/alarm initiating devices and 1500 feet of No 18 wire (20 ohms) for detectors with relays. When using the four-wire Class A type connection, the wiring run, as given above, must be reduced by one half. The wire interconnecting the devices is continuously supervised and, when the ZU-35 type modules are used, must be terminated with an EOL device (50pfd capacitor furnished with the Control Panel). The EOL device may be mounted directly in Series 3 or Series 4 bases. When DI-2 series detectors, or other large base units, are employed as the last detector on the zone circuit, the EOL device must be mounted to an EL-30 EOL device mounting assembly. Be sure to observe polarity when connecting the EOL device (Refer to the label on the EL-30). If the EOL device is installed incorrectly, the zone circuit may indicate a constant alarm condition.

NOTE: For four-wire Class A type connection, the end of line device is installed at the module (See Figure 4).

In order to keep supervision complete, no parallel branching of wires is permissible. Every base, except the last one, will have one set of incoming and one set of outgoing wires. Some alarm initiating devices such as manual stations, waterflow switches, and thermal units do not have separate mounting bases.

Connections to these devices are made directly to their internal screw terminals, based on their individual configuration.

Installing Pyrotronics Detector Bases

Remove the Pyrotronics detector base from carton. The Model DI-2 detector base is supplied with a dust shield containing a jumper. Be sure temporary jumper remains installed between terminals 4b and 5 on the detector side of the base. The jumper will be necessary later to test electrical continuity of the circuit. On the DB-4 detector base, a cardboard cover holds the contacts between terminals 4 and 5 together. This cover must be in place to test the circuit. The DB-3 base provides a jumper only, connected between terminals 1a and 1b of the base. Install detector bases and other alarm initiating devices in accordance with the wiring diagram. DO NOT install bases for ionization detectors in direct air flow of air conditioning or ventilating air ducts. Connect wires to all initiating devices following the Wiring Diagram. Remove only as much insulation as is necessary (1/2 inch). Strip back the outer casing as required and connect the third uninsulated (stranded) wire of the incoming and outgoing cable together using a wire nut. The connection should be made external to the device but internal to the 4 inch octagon box (when used). Mount the EOL device at the last base in each detector circuit, as indicated on the Wiring Diagram (Refer to *Detection/Alarm Initiating Circuit Wiring* above). Manual stations, thermal detectors, and all detector bases are to be connected to the circuit at this time. Refer to the Wiring Diagram of the specific equipment for connection details.

Installation of Audible Alarm Devices

All audible alarm device circuits are supervised and employ polarized alarm devices. Other type devices will not function properly on these circuits. For proper circuit supervision, the circuit must be terminated with a 5.6K ohm end-of-line resistor. When a DC alarm circuit is used, the EOL device is a 5.6K, 1/2W resistor (furnished with the CP-35). This resistor may be mounted in an EL-30 mounting assembly. If an AC alarm circuit is used, the EOL device must be a 5.6K, 5W resistor (furnished with the EL-32 assembly).

NOTE: The above applies when AE-30U type Alarm Extender modules are used. Class A audible alarm connections must operate from 24 VDC, and the EOL device is connected at the module terminals.

Connect all alarm devices in accordance with the Wiring Diagram. Bell or horn polarity must be observed or improper supervision will result. There must be no parallel branching and wiring should be continuous between devices. Splices, when necessary because of very long distances, must be soldered - **DO NOT** use wire nuts. Wiring for connecting bells and horns to modules should be in accordance with national and local codes for fire alarm circuits.

Tests of Wiring

Check that dust shields (DI-2 detectors), cardboard covers, or jumpers, as applicable, are in place. Install end-of-line device(s). Detector circuits should NOT be connected to modules at this time. No plug-in detectors should be in their bases. Check the detector/alarm initiating device circuit(s). Short the wires together (discharges EOL device). Using a VOM set to read high resistance (for example, a Simpson Model 260 set to the RX 10,000 range), measure the resistance of the circuit. Note: Observe polarity, connect positive side of meter to positive side of the circuit. The meter needle should quickly drop down to a low resistance reading and then slowly increase in resistance to a value greater than one megohm. If maximum resistance reached is less than one megohm, check for reversed EOL device or EOL device with excessive leakage. Also check the resistance between each side of circuit and the enclosure or ground. Infinite resistance should be indicated. If wiring reads correct resistance on meter, connect wires to proper terminals on Control Panel or module. Remove all shield covers and/or jumpers, as applicable, and install plug-in detectors in their bases.

To Test System Operation

- a. Unlock and open system enclosure door.
- b. Make certain that any and all unwanted outgoing alarm signals are disconnected in the event that the Control Panel goes into an alarm condition.
- c. Apply required power, AC and battery, to system.

Only the power lamp should be on. All disconnect and/or silencing switches, if used, should be in their normal positions. Move RESET/ LAMP TEST switch to RESET and hold. All Control Panel indicators, lamps, and the trouble horn will operate. Release RESET switch. The trouble lamp and horn should return to normal supervisory operation. To test supervision of the audible alarm circuit(s), open each circuit at the EOL device. Check that trouble indications appear at the Control Panel. If proper indications appear, reconnect the lead to return the system to normal supervisory operation.

CP-35 WIRING DIAGRAM

P/N 315-084902B

- When emergency power is provided using charger/transfer module Model BC 35 24 VDC audible devices must be used with end of line device Model EL 31 on audible device circuits. When BC 35 is not used 120 VAC audible devices may be employed by use of AC program plug Model No. JP A (black-wires) in P2 and Model EL 32 end of line device or by use of 24 VDC audible devices with program plug Model No. JP D (yellow) in P2 and Model EL 31 end of line device.

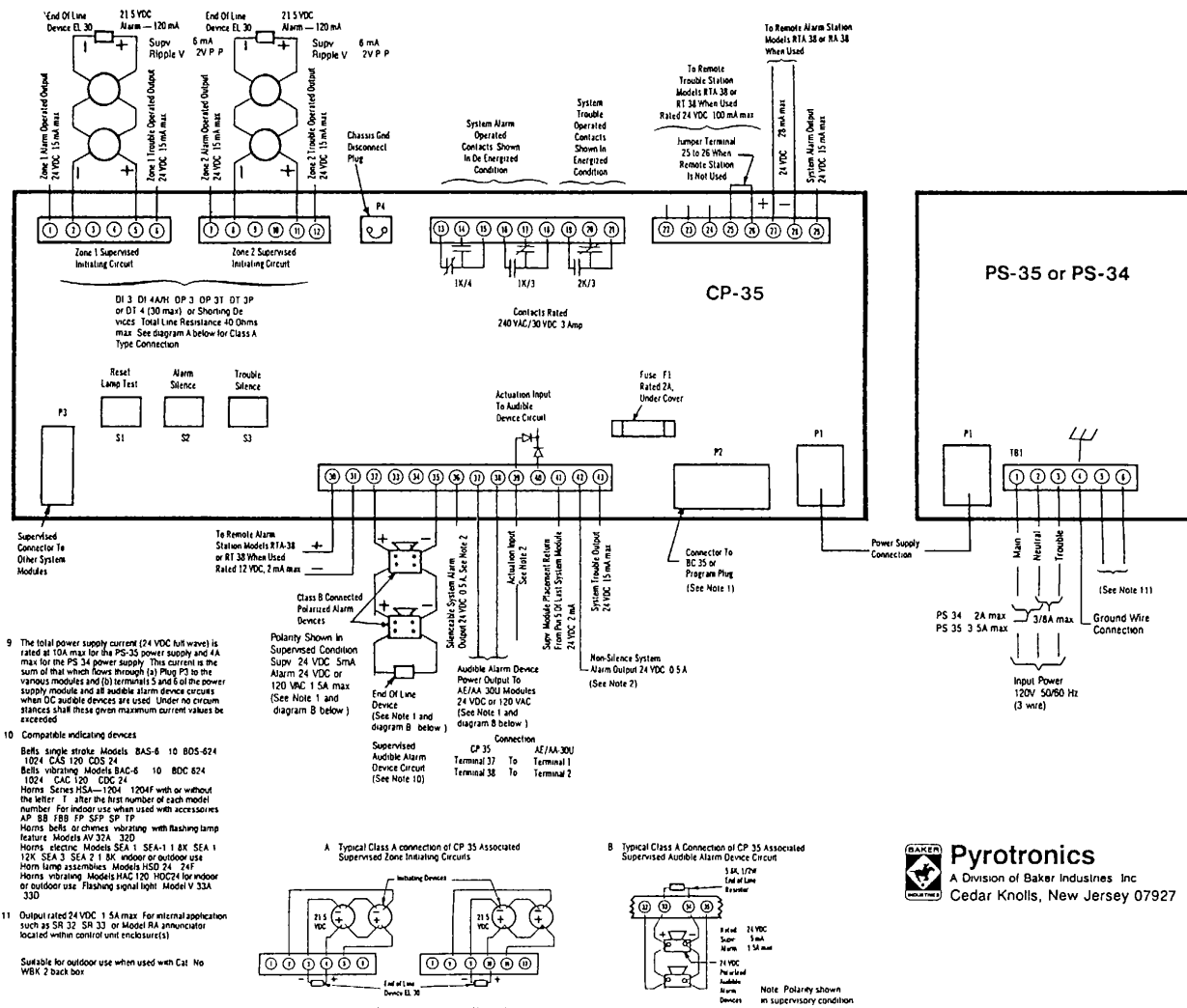
Note: When Class A type audible circuit configuration is used 24 VDC audible devices are required.

- Silenceable System Alarm output signal terminal 36 may be connected to various audible circuit actuation input terminals such as terminal 39 of the CP 35 and terminal 3 of the AE/AA 30U modules. The non-silence system alarm output signal terminal 42 may be connected to such modules as the MT 30 LP 30 and SR 30. When other alarm signals such as closing or time limit are required see individual module connection diagrams.
- When water flow devices are used employ non-silenceable system alarm output signal terminal 42 to energize audible alarm device circuits.
- Audible alarm device circuits may be coded by utilizing coder modules MC 30 or ZC 30.
- Audible alarm device circuit signal duration may be limited by utilizing the time limit output module TL 30U.

- Refer to battery manufacturer's instructions for maintenance and test of System batteries when applicable.
- Refer to appropriate module wiring diagram for specific information.

- NFPA 72B C and D require a secondary power supply source as does the inclusion of automatic Halon release. The secondary (standby) power source shall consist of one of the following:

- A storage battery which provides 24 hour capability (but 60 hour capability is required for 72B and 72C type systems).
 - An engine driven generator and storage batteries with 4 hour capability.
 - Multiple automatic starting engine-driven generators capable of supplying the energy required with the largest generator out of service.
- NFPA does not require a secondary power supply. Consult NFPA 72A B C and D standards for additional details.



- The total power supply current (24 VDC full-wave) is rated at 10A max for the PS-35 power supply and 4A max for the PS 34 power supply. This current is the sum of that which flows through (a) Plug P1 to the various modules and (b) terminals 5 and 6 of the power supply module and all audible alarm device circuits when DC audible devices are used. Under no circumstances shall these given maximum current values be exceeded.
 - Compatible indicating devices:
 - Bells, single stroke: Models BAS-6 10 BDS-624 1024 CAS 120 CDS 24
 - Bells, vibrating: Models BAC-6 10 BDC 624 1024 CAC 120 CDC 24
 - Horns: Series HSA-1204 1204F with or without the letter 'T' after the first number of each model number. For indoor use when used with accessories AP BB BBP SP SFP SP TP.
 - Horns, bells or chimes vibrating with flashing lamp feature: Models AV 32A 32D
 - Horns, electric: Models SEA-1 SEA-1 1 BK SEA-1 12K SEA-3 SEA-2 1 BK indoor or outdoor use.
 - Horn lamp assemblies: Models HSD 24 24F
 - Horns, vibrating: Models HAC 120 HOC24 for indoor or outdoor use; flashing signal light: Model V 33A 33D
 - Output rated 24 VDC 1.5A max. For internal application such as SR 32 SR 33 or Model RA annunciator located within control unit enclosure(s).
- Suitable for outdoor use when used with Cat. No. WBK 2 back box.

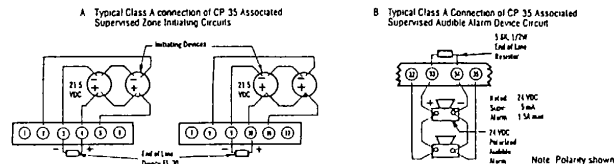


Figure 3
Wiring Information

TYPICAL SYSTEM 3 INTERCONNECTION
(USING CP-35 CONTROL UNIT)

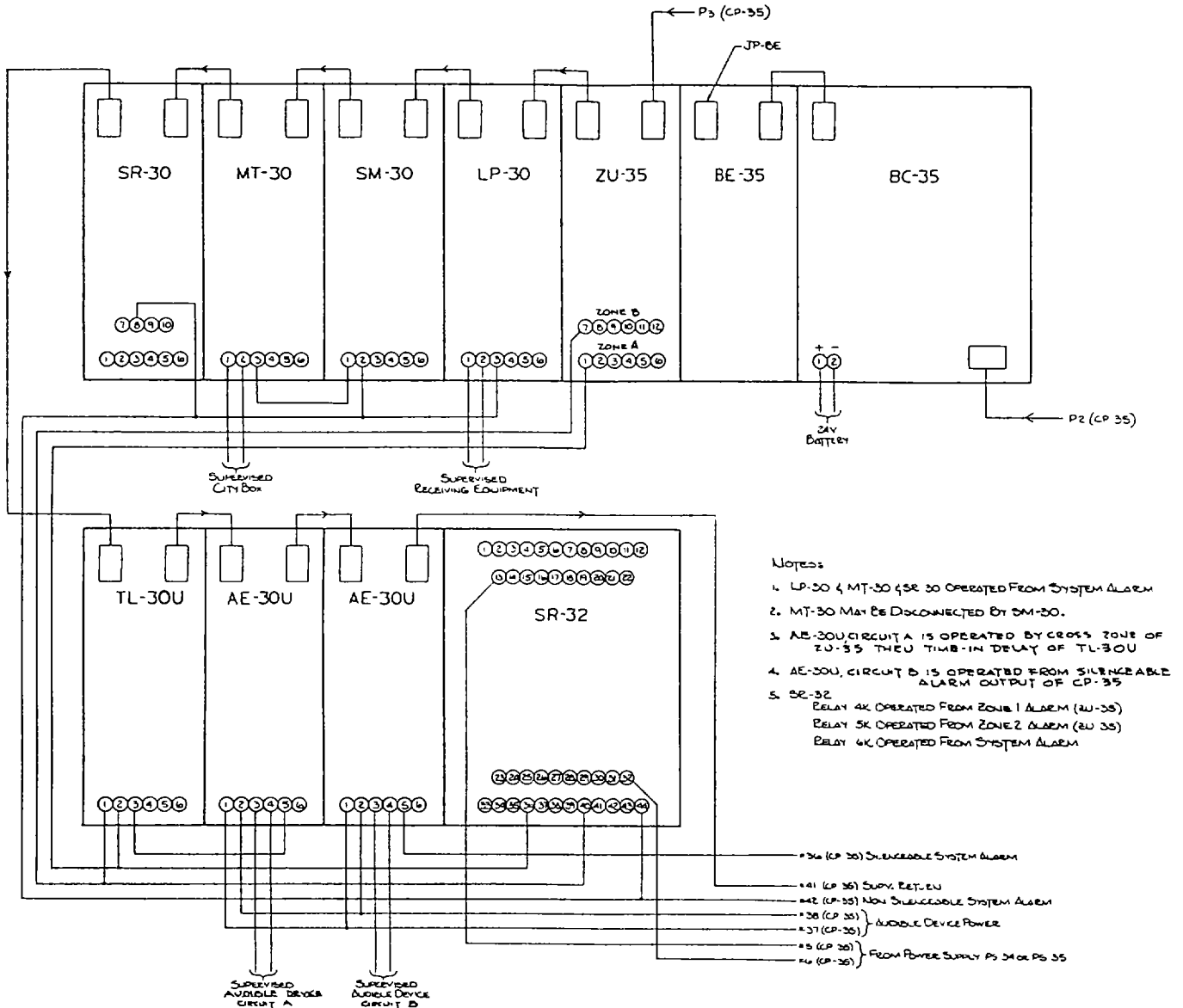


Figure 4

Typical System Wiring

To test operation of the audible alarm circuit(s), activate a detector/actuation device or manual station. Check that all audible alarm devices sound, that the alarm lamp lights, and that the audible devices can be silenced. See Note 1 below. To test operation of detection/actuation circuit(s), activate each device and manual station. Check that the detector alarm lamp lights and that alarm and zone indications are given by the Control Panel and the proper module. Each ionization or photoelectric detector may be activated by blowing smoke into it. A thermal detector may be activated by an electric heat gun (Do not heat test non-restorable thermals). A flame detector may be activated by holding a lighted match about one foot from it. Disconnect switches (See Note 2) should be used during tests to isolate any external alarm operated circuits (activation of fire extinguishing system, notification to the Fire Department, etc). When such external circuits are connected to the system, check that upon alarm, they operate when switch is in its normal position and that they do not operate when the switch is in the disconnect position. If the above tests provide proper results, close and lock the enclosure door. If not, refer to *MAINTENANCE*.

Notes:

1. When activated from silenceable alarm output terminal.
2. When this feature is used in system.

MAINTENANCE

To insure proper and reliable operation, the following inspection and testing schedule is recommended

Every Six Months

Inspect all ionization detector heads for dust accumulations, and when excessive, contact your authorized Pyrotronics Service Representative for service. Activate a detector or alarm initiating device. Check that base lamp lights and that proper alarm and zone indications are given by the Control Panel. An ionization or photoelectric detector may be activated by blowing smoke into it. A thermal detector may be activated by an electric heat gun. A flame detector may be activated by holding a lighted match slightly below it.

CAUTION: If the system is connected to the fire department, or actuates an external system (fire extinguishing, etc), then move disconnect switches to OFF position to prevent actuation. Be sure to reconnect at completion of inspection. Notify facility personnel that a system test is being performed so that any alarm soundings can be ignored during the test period. Check operation of each detector/alarm initiating device on all circuits. Measure the sensitivity of each ionization detector with a Pyrotronics sensitivity checker (when applicable). Check the supervisory circuits by operating the RESET/LAMP TEST switch to the RESET position. In this position, all visual indicators on the Control Panel should be lit and the trouble horn should sound.

Periodically Testing the System

The system should be tested at regular intervals to insure its operational reliability and optimum performance. To test the system, activate a detector/alarm initiating device. Check that all audible devices sound, that the system alarm lamp illuminates, and that the audible devices can be silenced. Check that the proper zone lamp responds. Reset the system. Check that the system trouble lamp LEDs and horn and all zone lamps are actuated when the reset switch is moved momentarily to the RESET position. Return all switches to normal position. If a disconnect switch is incorporated, and if the system is connected to a fire department, central station, or has external devices connected to it (fans, smoke door holders, fire extinguishing systems, etc.) which are operated by the alarm controlled contacts, then this equipment may be isolated from the alarm circuit during a test by moving the respective disconnect switch(es) to the DISCONNECT position. Operation of this switch prior to tests energizes the trouble lamp so that the switch will not be left in the DISCONNECT position inadvertently.

TROUBLESHOOTING THE CP-35

A system trouble condition may result from any of the following conditions

1. Module placement loop open
 - a. Check for 24 VDC with respect to system common (terminal 6 of the power supply) at terminal 41 of the CP-35
 - b. With no voltage present at terminal 41, check that all modules are in place and that the ten wire cable connectors are both present and well seated on each module connector
2. Trouble condition from a supervised zone, audible alarm, or associated module from which a trouble signal may be produced
 - a. Observe visual trouble indication on individual modules
 - b. If present, proceed to correct that individual fault condition
3. Ground fault condition
 - a. Observe that the visual ground fault indicator is illuminated
 - b. Normal voltage between chassis ground and system common (terminal 6 of power supply) should read approximately 7.5 to 8 VDC.
 - c. A higher voltage reading indicates a ground with respect to the positive voltage supply source
 - d. A lower voltage reading indicates a ground with respect to the common or minus voltage supply source
4. Auxiliary power output terminals (5 and 6) of the power supply not energized
 - a. Normal voltage value should be the supply voltage value (approximately 24 VDC)
 - b. With no voltage present, check fuse 3 of the power supply
5. Loss of 120 VAC trouble supply input to the power supply (terminals 3 and 2 of the power supply)
 - a. Check incoming supply voltage
 - b. With voltage present at terminals 3 and 2 of power supply, read voltage at P1, pin 5 with respect to terminal 2. With no voltage reading (120 VAC) present, check F1 fuse within the power supply unit
6. Loss of 120 VAC main supply input to power supply (terminals 1 and 2 of power supply) (When emergency power is provided with the BC-35, the CP-35 Control Panel power indicator will operate in a flashing manner.) When no emergency power is provided, all visual indicators are turned off and only a change of state of trouble relay 2K/4 will result
 - a. Check incoming supply voltage.
 - b. With voltage present at terminals 1 and 2 of the power supply, check circuit breaker CB1 by depressing the reset button and/or F2 fuse within the power supply unit.
7. Battery charger/transfer module fault (when used).
 - a. Observe visual trouble indication on the BC-35 module.
 - b. See individual BC-35 Installation Instructions for possible trouble conditions.
8. Key operated remote alarm station (RA38/RTA38, when used) silence switch not in normal open condition (Includes possible low resistance value between outgoing lines, terminals 30 and 31 of the CP-35).
 - a. Normal reading should be 11.5 to 12 VDC
 - b. For lower voltage value readings, check station or lines for possible shunted condition
9. Loss of 12 VDC logic supply
 - a. With terminals 30 and 31 of the CP-35 open, measure 11.5 to 12 VDC across these terminals
 - b. With no low voltage present at terminals 30 and 31 of the CP-35, check that interconnecting pin 34 connection between the main PC board and the secondary PC board of the CP-35 is securely in place.

NOTE: Make certain that plug connection is replaced in the correct pin to pin sequence. (Arrow marking on the plug connections goes to pin 1).
10. Supervision of alarm relay coil (1 K/4) open circuits. Operation of the relay by placing the Control Panel in alarm condition indicates that coil winding is intact (Before placing panel in an alarm condition, make certain that any, and all, unwanted outgoing alarm signals are disconnected)

POWER CALCULATIONS FOR U.S. ARMY LARGE TUGS

Power Calculation Sheet

Module	Quantity	Supervisory (mA)		Alarm (mA)	
CP-35		150		260 ¹	
CP-35/BC-35	1	195	195	290 ¹	290
BE-35		60		--	
AE-30U		6.5		40	
MC-30		0		15	
RC-30U		5		40	
RM-30U/30RU		4		1600	
SR-30/32	1	0		45/relay ²	180
SM-30		0		45 ³	
TC-30U		30		15	
TL-30U	1	0		45	45
ZA-30		50 ⁴		100	
ZU-35TS	2	9/zone ⁴	54	110/zone ⁵	690 ⁶
SUBTOTALS (a and b)		a	249 b	1205	
Alarm Devices	2-63mA		0	c	126 ⁷
<u>T O T A L</u> POWER REQUIREMENTS		(a + b + c)		1,580 ⁸	

1 - Includes the CP-35 audible circuit.

2 - Use the highest number of relays that will be operated when either a) any three zones, or b) 10% of the total zones are in alarm.

3 - Only when switch is operated

4 - All zones must have supervisory current calculated

5 - Minimum of three zones or 10% of total zones must be calculated.

6 - In zones with shorting devices (thermals, MSs, etc.), add 120mA.

7 - Audible alarm current draw per device: BDC-624/1024 Bells, 70mA; HDC-24 Horn, 63mA; SEA-3 Siren, 550mA; V33 Flashing Light, 170mA.

8 - Total alarm current cannot exceed 4 amps when using the PS-34 or 10 amps when using the PS-35.

CHART B
9.0 AH Rated Capacity at 20 Hour Rate

Allowable Supervisory and Alarm Currents
 For Standby Periods of 18 Hours and 36 Hours
 Alarm Duration 5 Minutes

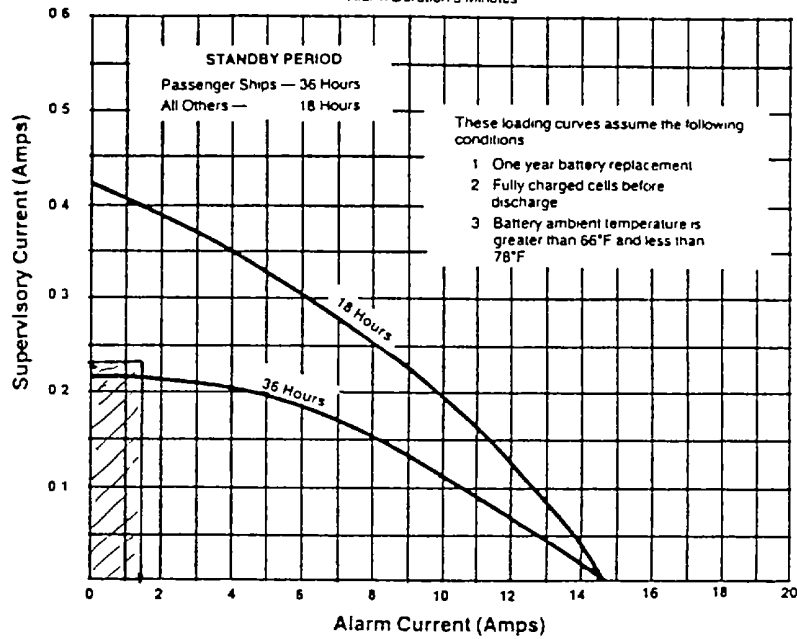
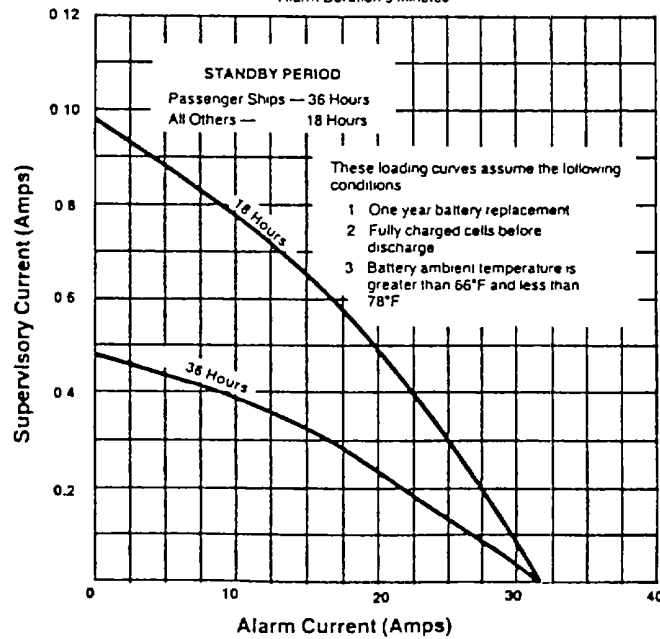


CHART C
20 AH Rated Capacity at 20 Hour Rate

Allowable Supervisory and Alarm Currents
 For Standby Periods of 18 Hours and 36 Hours
 Alarm Duration 5 Minutes




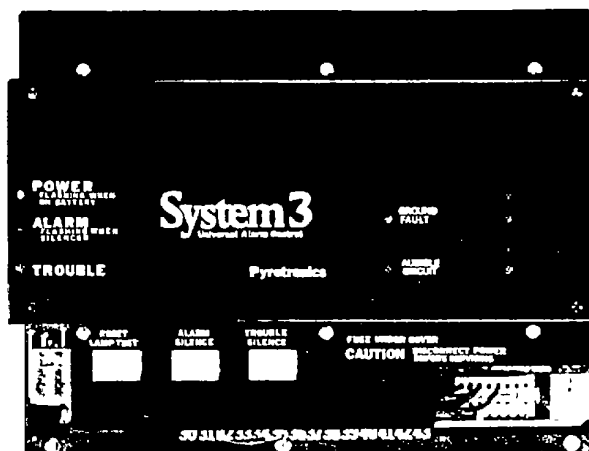


System 3™ Control Panel

ENGINEER AND ARCHITECT SPECIFICATIONS

MODEL CP-35

- Basic Two Zone System
- Expandable
- Double Supervision
- Ground Detection
- Supervised Alarm Relay Coil
-  Listed



Description

The Pyrotronics Control Panel Model CP-35 is the basic control unit for System 3 Universal Alarm Control. It is of solid state circuitry and is designed for use in commercial, institutional, industrial, and life safety applications. It is approved for service in accordance with NFPA Standards 72A, 72B, 72C, and 72D, and is Underwriters Laboratories Inc listed. The Model CP-35 with basic power supply provides circuitry for two supervised detector circuits, wired Class A or B, accommodating any of Pyrotronics low voltage detectors, manual stations, or contact type input devices. It also includes one supervised audible signal circuit utilizing either 120 Vac or 24 Vdc devices, connected in either Class A or Class B configuration. Nine visual system indicators are mounted on the face of the CP-35, a green Power On LED, a red Alarm LED, a yellow Trouble LED and a yellow Ground Fault Indicator. To monitor the two detector circuits, a red LED Zone Alarm Indicator and a yellow Zone Trouble Indicator are supplied for each zone. An additional yellow LED Audible Signal Circuit Trouble Indicator is also provided. Two momentary contact switches are mounted on the CP-35, one serving as a combination "Reset/Lamp Test" function, while the other permits "Alarm Silence". A fixed two position "Trouble Silence" switch and an internal trouble signal sounding device is provided. Also remotely located Trouble Annunciator (RT-38), Alarm Annunciator (RA-38), and Alarm and Trouble Annunciator (RTA-38) are optional.

Operation

POWER

The combination of a Model CP-35 with a PS-35, operates from a three-wire, 120/240 Vac 50/60 Hz, supply with grounded neutral, incorporating double supervision. Secondary power may be supplied with optional battery standby. The green Power LED is illuminated to show that power is normal. Each input power line is separately fused within the power supply. Loss of the main AC operating power or secondary AC supervisory power is signaled by the system audible and yellow visual trouble indicators. Restoration of power returns the panel to normal condition. When battery standby is specified, loss of main power results in an audible and visual trouble signal, and the batteries provide power to the system. The system power supply furnishes power for detector circuits and audible signal circuits. The detector circuits may be the two zones incorporated in the CP-35 Control, plus any mix of additional compatible zones, signal circuits or other fire monitoring circuits. In addition, an output rated at 24 Vdc 1.5A is provided on terminals 5 & 6 for powering modules. Internally housed and wired within the control unit enclosure.

ALARM

The Control panel alarm section circuitry responds to any zone module alarm Input signal either from the on-board zones or separate zone modules. The alarm condition is "Locked In" within the control panel and is cleared only by operation of the control panel "Reset" switch:

An alarm condition is Indicated by:

- 1 Change of state of the two SPDT alarm relay contacts
- 2 Illumination of the panel "Alarm" visual Indicator
- 3 Energizing of both the silenceable and non-silenceable alarm outputs
- 4 High going current-limited alarm signal to the supervised annunciator circuitry
- 5 Alarm signal output to the remote alarm and silence station Operation of the momentary "Alarm Silence" switch causes both the silenceable alarm output to deenergize and the visual alarm display to flash.

SUBSEQUENT ALARM

After operation of the "Alarm Silence" switch following a system alarm condition, the system visual indicator operates in a flashing mode A second or further alarm input signal will cause a renewed high going signal on this silenceable alarm output terminal, causing the associated or connected audible devices to be energized again This operation may be repeated for up to ten (10) subsequent alarm conditions. Simultaneous alarm input signals from two or more zone modules are considered to be but a single alarm Input signal. Operation of the panel mounted alarm silence switch when no alarm is present has no effect. Operation of the key-operated momentary remote alarm station silence switch will cause a system trouble condition when the panel is not In an alarm condition

TROUBLE

A trouble condition, which will illuminate the yellow system "Trouble" LED and sound the built-in audible trouble signal will be caused by any of the following

- Removal of a detector or contact device from the detector circuit or an open in the detector circuit,
- An open in a municipal tie line or remote station circuit,
- An open or shorted condition on the audible circuit lines,
- Removal of a supervised system module,
- Loss of main power (when equipped with emergency power),
- A ground fault on any detector circuit, audible signal circuit, or DC power line within the system

A control panel trouble condition is indicated by

1. Change of state of the SPDT trouble relay contacts
2. Illumination of panel "Trouble" visual Indicator
3. Sounding of the control panel audible trouble buzzer.
4. High going current-limited trouble signal to the supervised annunciator circuitry
5. Trouble output signal to the remote trouble and trouble silence station

The control panel audible trouble buzzer may be silenced by the control panel trouble silence switch or the remote trouble silence station switch, when used Trouble ringback of this buzzer is provided to indicate that either the control panel trouble silence switch or the remote trouble station trouble silence switch is in the off-normal or silence position when no panel trouble condition is present. A system trouble condition may result from any of the following conditions

1. Module placement loop open.
2. Trouble condition from any supervised zone, audible alarm circuit or associated module which may produce a trouble signal condition.
3. Ground fault.
4. Auxiliary power output fuse open (see PS-35).
5. The momentary reset switch not in its fully closed position.
6. Loss of the regulated 12 Vdc logic supply voltage.
7. Alarm relay coil open.
8. Loss of 120 Vac trouble phase input supply.
9. Key-operated remote alarm station silence switch not in normal condition and the control panel in non-alarm condition.
10. Battery charger/transfer fault condition or in an "On Battery State".

FLEXIBILITY

The use of the Pyrotronics Control Panel Model CP-35 permits expansion of system capability to incorporate additional functions over and above the two zone actuation circuits and visual and audible annunciating devices provided with the basic panel The CP-35 will accommodate a combination of the following options.

- Multiple alarm priorities
- Master Code
- Municipal tie with disconnect light and switch
- Remote station connection with disconnect light and switch
- Time limit cut out with Indicator
- Supplementary relays
- Battery standby
- Remote alarm and Trouble Silence
- Non-fire monitoring
- Reconfirmation

Architect's Specifications

The control panel for the alarm system shall be a Pyrotronics Model CP-35. It shall be listed by Underwriters Laboratories, Inc

The panel shall provide power and necessary components for the operation of the basic two zones of supervised detector circuits and one supervised audible signal circuit utilizing 24 Vdc devices The detector circuit shall accommodate ionization, photoelectric, flame, or thermal detectors as well as shorting type contact devices intermixed as desired on the same zone. The Model CP-35, with a PS-35, shall operate from a three wire 120/240 Vac 50/60 Hz supply. Each Input shall be separately fused within the panel It shall include LED's for system power, alarm, and trouble as well as LED indicators for zone alarm, zone trouble, and audible signal circuit trouble. Momentary contact switches shall be provided for "Reset/Lamp Test" and "Trouble Silence" which shall silence the internal trouble signal sounding device. Alarm receipt shall override trouble. The control panel shall be capable of powering early warning, detectors and audible signal circuits Additional circuitry and visual signaling for this capability shall be provided by Pyrotronics "Add-On" Modules and enclosures as are necessary. Interconnection of these modules to the CP-35 shall be by ten-pin plug and harness assemblies which shall

provide system power, supervision, lamp-testing functions, and such other circuitry as is necessary for an operable system.

The control panel shall have two (2) sets of normally open and normally closed alarm operated relay contacts and one (1) set of normally open and normally closed trouble operated relay contacts All contacts shall be rated at 120 Vac 3 Amp. The alarm relay coil shall be supervised. In addition, the panel shall have built-in ground detection as well as plug-in connectors for emergency power It shall be arranged so that alarm signal annunciation shall take precedence over a trouble signal. Terminals shall be provided so that the trouble Indicators and controls can be located remotely. The Model CP-35 shall permit expansion of system capability to incorporate any combination of compatible Pyrotronics System 3 modules not exceeding the maximum current demand.

Electrical Information

Power Requirement 120/240 Vac, 50/60 Hz, three-wire.

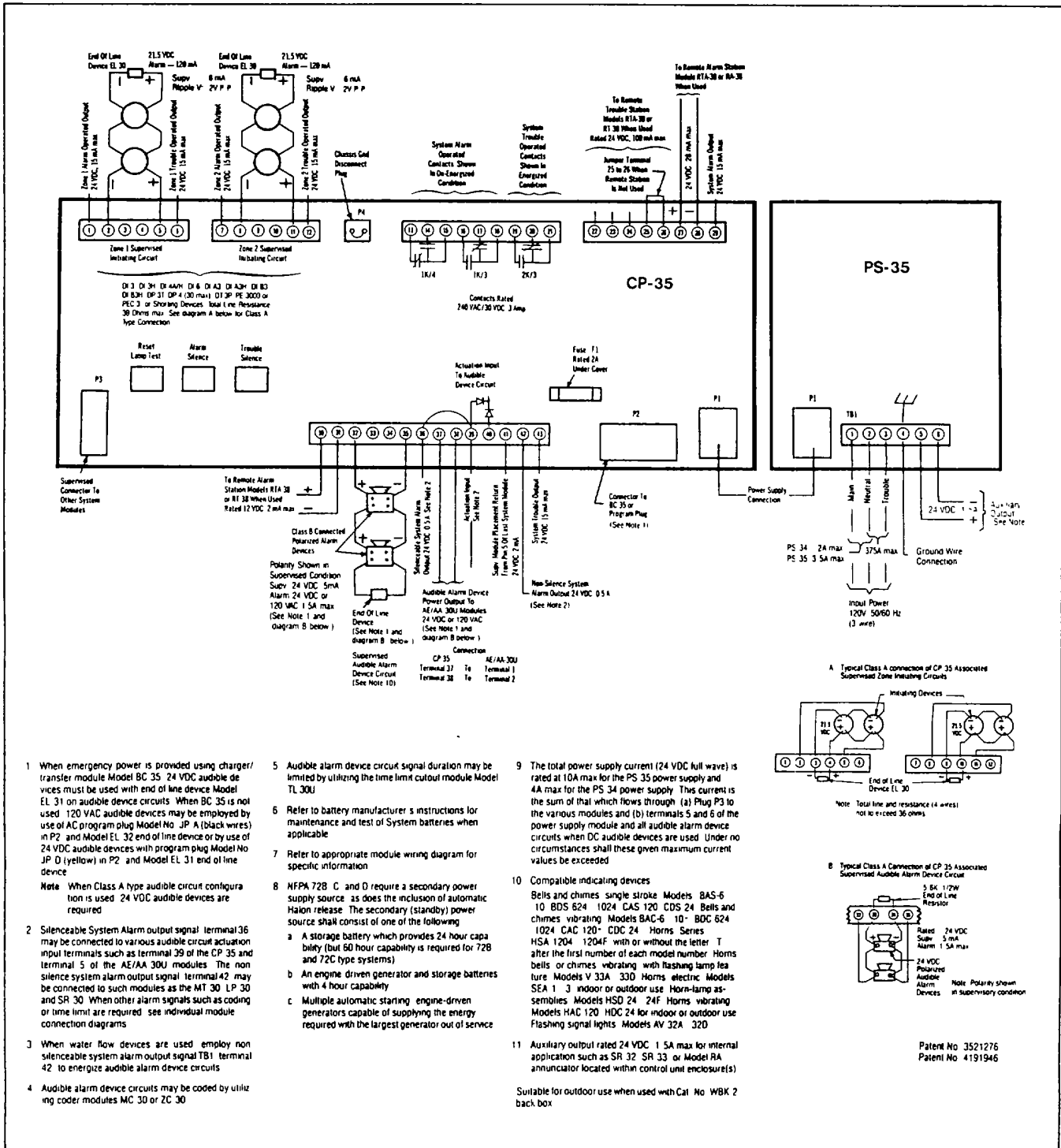
Ordering Information

The Model CP-35 occupies space normally taken by five (5) modules and must be located in the upper left-hand position of any type enclosure This should be considered when sizing the enclosure.

The Model CP-35 is normally mounted on rail/brackets, separately priced, for installation In the enclosures. Each enclosure requires a rail/bracket assembly kit of appropriate size. The size of the enclosure therefore must be noted at the time of order Rail/bracket assembly kits are shown below.

Model No.	Description	Shipping Weight	Rail/Bracket Assembly Kit	Enclosure	Module Door	Spaces
CP-35	Control Panel, w/2 zones and 1 universal signal circuit	6 lbs (3.7 kg)	EK-31	EB-31	ED-31	8
			EK-32	EB-32	ED-32	16
			EK-33	EB-33	ED-33	24
			EK-35	EB-35	ED-35	40

Typical Wiring



NOTICE The use of other than Pyrotech detectors and bases with Pyrotech control equipment will be considered a misapplication of Pyrotech equipment and as such void all warranties either expressed or implied with regards to loss, damage, liabilities and/or service problems.

Pyrotech

3 Ridgedale Avenue, Cedar Knolls, New Jersey 07927

1/88
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Printed in U S A


November 1985
Supersedes sheet dated 3/85

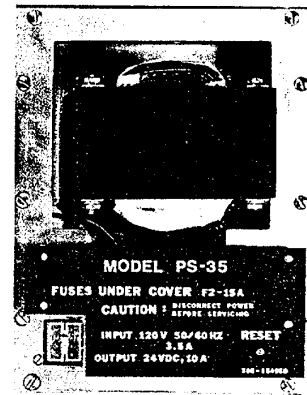


System 3™ Power Supply

ENGINEER AND ARCHITECT SPECIFICATIONS

MODEL PS-35

- Multiple Usage
- Deadfront Construction
- Modularized
-  Listed



Description

The Pyrotech Power Supply Model PS-35 is a stepdown transformer and bridge designed for use with Control Panel Model CP-35 or to provide additional DC Power for Audible Devices.

The units, which are modularized for System 3 enclosure mounting, are of deadfront construction and contain terminal strips, a circuit breaker with a reset switch on the AC input, protection fuses on the DC output, and a receptacle for jumper plug connection directly into the Control Panel, Model CP-35.

The PS-35 occupies three module positions within the System 3 enclosures.

Operation

The Model PS-35 provides a rectified, full wave 24 Vdc output from an input supply of 120 Vac, 50/60 Hz. The input consists of a main power phase and a trouble phase, each separately fused and a common neutral. The 24 volt full wave output is rated at 10 amps DC, full load. When the PS-35 is used to power the control panel system, the second output (terminals 5 & 6, rated at 24 Vdc 2 amps) is used to power modules internally housed and wired within the control unit enclosure. Surge protection is provided across both the input phases as well as the DC output.

Note: When an additional PS-35 Power Supply is used for additional audible device power in a CP-35 controlled system with emergency power, a Transfer Module TC-30U is required to supply emergency power to the audible signal circuit.

Architect's Specifications

The power supply for the alarm system shall be a Pyrotech Model PS-35. The unit shall be Underwriters Laboratories Inc. listed.

The unit shall provide a full wave rectified 24 Vdc output rated at 10 amps full load. The PS-35 shall be capable of powering 100 detection zones (50 Model ZU-35 Zone Modules and 4 fully loaded Alarm Extender Modules Model AE-30U simultaneously).

The rated output which shall be completely fused, shall be provided at a plug receptacle. A second output (terminals 5 & 6, rated at 24 Vdc 2 amps) is used to power modules internally housed and wired within the control unit enclosure.

The power supply shall be of deadfront construction and housed in a steel enclosure compatible with the modularized alarm system. Externally mounted 120 Vac/24 Vdc transformers shall not meet the intent of this specification.

Electrical Information

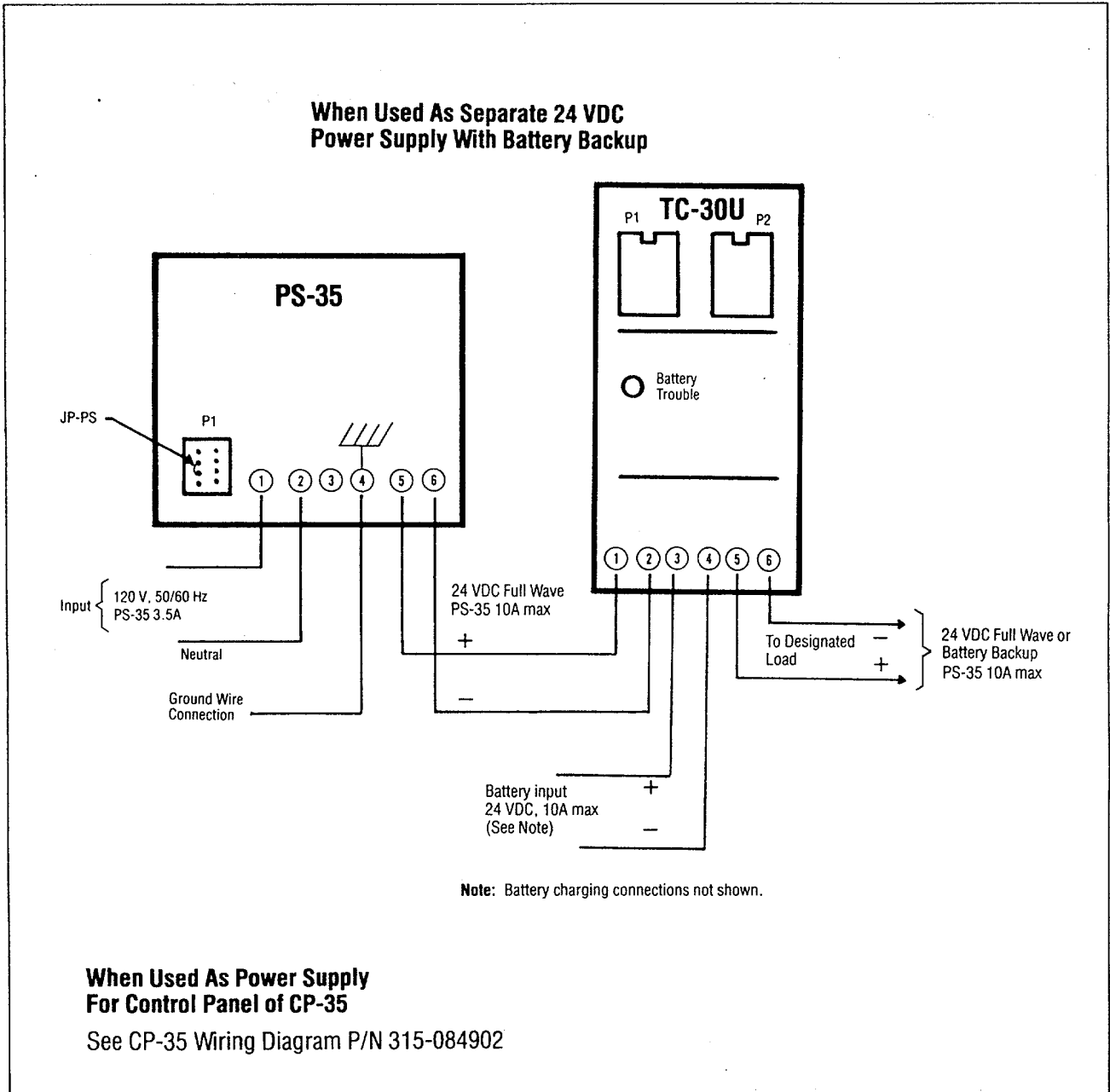
Power Requirement: 120 Vac, 50/60 Hz, three wire.
PS-35 3.5A MAX

The Model PS-35 plus the CP-35 Control Panel occupy space normally taken by 8 modules. The power supply for the CP-35 must be mounted in the upper right-hand position of a System 3 enclosure. This should be considered when sizing the enclosure.

Additional power supplies, if required, are mounted adjacent to the modules to be powered by them.

Model No.	Description	Shipping Weight
PS-35	Power Supply	16 lbs. (8.3 kg.)

TYPICAL WIRING



Note: Battery charging connections not shown.


NOTICE: The use of other than Pyrotronics detectors and bases with Pyrotronics control equipment will be considered a misapplication of Pyrotronics equipment and as such void all warranties either expressed or implied with regards to loss, damage, liabilities and/or service problems.

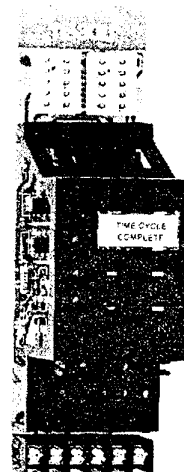


System 3™ Control Module

ENGINEER AND ARCHITECT SPECIFICATIONS

MODEL TL-30U TIME LIMIT MODULE

- Precision Timing
- LED Indicator
- Delayed Signal Capability
- Placement Supervised
- Solid State Logic Circuitry
-  Listed



Description:

The Time Limit Module, Model TL-30U is designed to provide a controlled time interval from 6 second up to 1 0 minutes, after which either a signal circuit is activated, (such as a municipal alarm) or a signal circuit is deactivated (such as alarm bells). The module is also capable of repeating the above operational sequence when a subsequent alarm signal is received in a system utilizing the Subsequent Alarm Feature.

The module, which is of solid state circuitry, is normally passive, drawing no power until an alarm signal is received. When this occurs, a binary counter is activated to control precisely, the length of the desired time limit before continuing the pre-programmed sequence of system operation. This sequence could be for silencing audible alarm devices so that the system could receive and annunciate subsequent alarms. An alternate use would be the sending of an alarm to municipal headquarters if the alarm source had not been checked or controlled, or, it could involve the actuation of an extinguishing system.

This time interval is available in two ranges as follows:

- a) 6 second to 20 seconds
- b) 30 seconds to 1 0 minutes

Standard units are preset for a 5 minute, time-out sequence, but can be changed by field adjustment.

Note: Underwriters Laboratories Inc. standards require that when time limit cutoffs are used with audible devices, they shall operate no less than 3 minutes and no more than 10 minutes.

The module contains a red LED indicator lamp which is illuminated at the end of the timing period. This lamp will remain on until the module has been reset.

The Model TL-30U module is placement supervised, providing a system trouble signal upon removal from the system.

The unit is Underwriters Laboratories Inc. listed.

Architect's Specifications

Capability for precise time control of an output signal either by delaying actuation or stopping actuation shall be provided by a Pyrotronics Time Limit Module, Model TL-30U. This module shall be system interconnected by aten-wire jumper plug and harness assembly, and shall be operable with the system main control panel.

The time in/time out duration period shall be capable of being set at any precise interval between the time frames of 6 second to 20 seconds, and 30 seconds to 1 0 minutes. This interval shall be controlled by a solid state 1 4-stage binary counter contained in the solid state circuitry of the module. At the end of the time interval, a red LED indicator lamp shall indicate completion of the time cycle, after which a subsequent alarm can be received and processed in an identical manner. The module shall be reset from the main control panel. The Model TL-30U shall be Underwriters Laboratories Inc. listed.

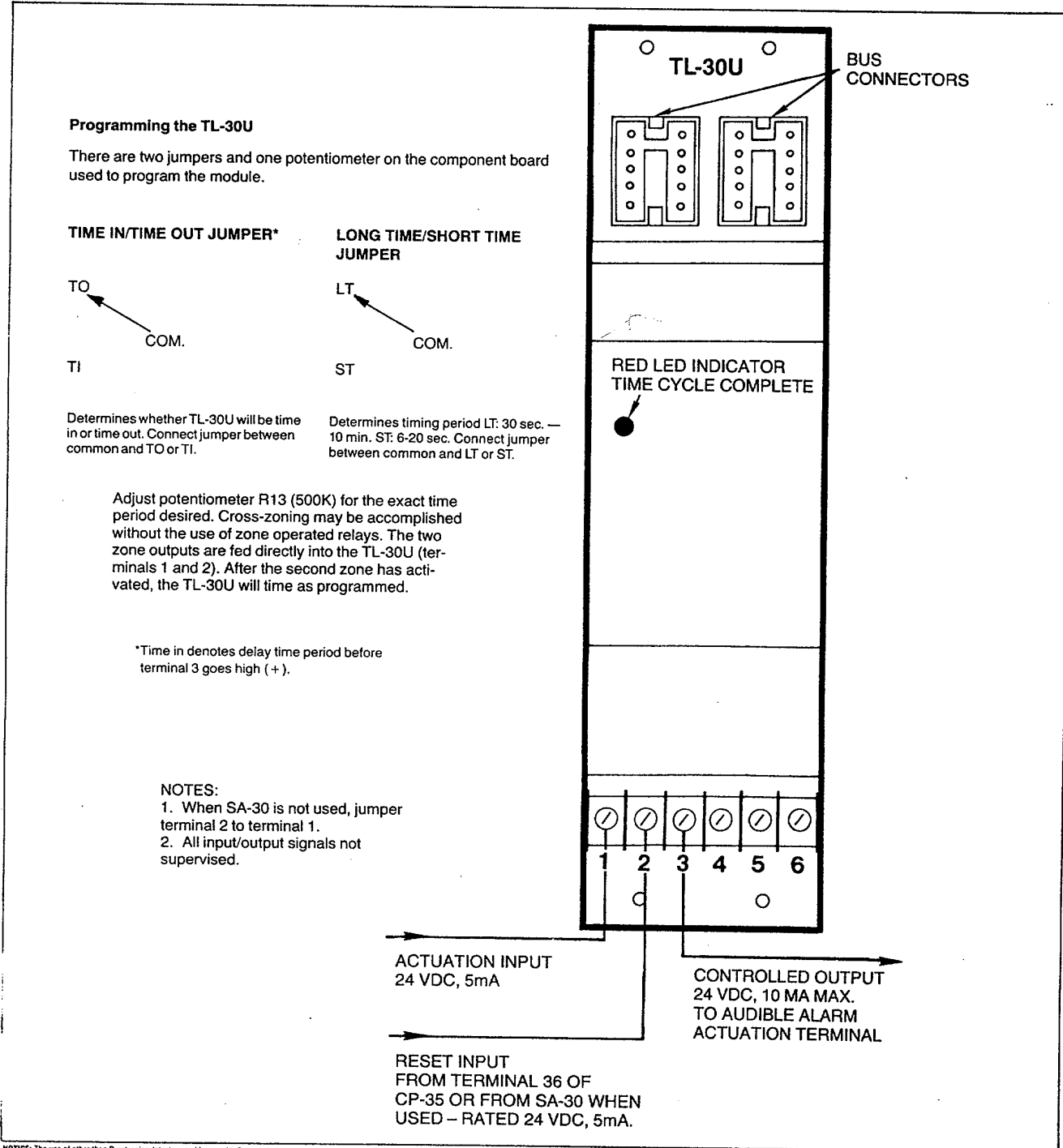
Ordering Information

Model No.	Description	Shipping Wt. Lbs.
TL-30U	Time Limit Module, 6-second, time-out	1

Electrical Information

Current Requirement: Normal - None
 Operated - 45 mA

Typical Wiring




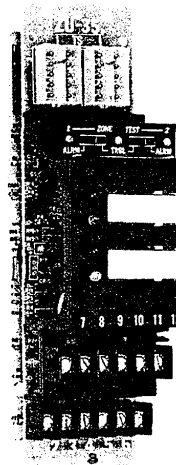
NOTICE: The use of other than Pyrotechnics detectors and bases with Pyrotechnics control equipment will be considered a misapplication of Pyrotechnics equipment and as such void all warranties either expressed or implied with regards to loss, damage, liabilities and/or service problems.

System 3™ Input Modules

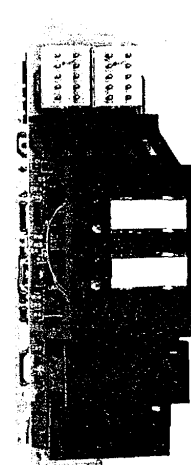
ENGINEER AND ARCHITECT SPECIFICATIONS

MODEL ZU-35, ZU-35DS, ZU-35TS DUAL ZONE

- Complete Supervision Detection Circuits
- Styles A and B
NFPA Compliance in 2 wire configuration
- Styles A, B, and D
NFPA compliance in 4 wire configuration
- Accommodates Ionization, Photoelectric, Thermal, Flame Detectors, Manuals, and Other Contact Devices
- Alarm and Trouble LEDs Per Zone
-  Listed



ZU-35DS/ZU-35TS



ZU-35

Description

ZU-35 The Pyrotronics Dual Zone Module Model ZU-35, is designed to provide two independent initiating circuits. Up to thirty standard Pyrotronics ionization and photoelectric detectors or flame detectors (except model DP-4 and DF-1 detectors) as well as any quantity of shorting type contact devices such as manual stations and thermal detectors also can be accommodated and intermixed on each initiating circuit.

Screw Terminals are provided for each circuit, in either NFPA styles A and B capability (2 wire configuration) or styles A, B and D capability (4 wire configuration).

ZU-35DS In addition to all the same features of the ZU-35, each zone is provided with a disconnect switch which will disable the zone when activated. This action will cause a zone trouble and a system trouble signal until the switch is returned to normal.

ZU-35TS The ZU-35TS is furnished with a 3 position momentary contact test switch for each zone. The normal switch position is in the center and one side position will test the zone trouble signal and the other will test a zone alarm signal. This is a requirement for US Coast Guard approval for use on marine systems, and the module is Coast Guard approved.

Operation

Upon operation of a detector or shorting type device installed on the initiating circuit, the system will lock into an alarm condition, initiating the start of the sequential functions designed into the system. These functions may be sounding

audible devices, operating alarm transmitters, closing doors, shutting down fans and equipment, recalling elevators, and other such functions required for life and property safety. In addition to the system alarm, a red Alarm LED, on the face of the dual zone module, for that particular detection circuit, will be illuminated. A trouble on either detection circuit will be similarly annunciated with a yellow LED for each circuit.

The module supplies a current limited output signal for the circuit in alarm providing for activation of supplementary modules or annunciators.

The dual zone module occupies one module space in the System 3 rail structure and is interconnected via a ten-pin plug and harness assembly.

The Dual Zone Module Model ZU-35/DS/TS are Underwriters Laboratories Inc. Listed.

Architects Specifications

Dual initiating circuit line monitoring shall be provided by a Pyrotronics Dual Zone Module, Model ZU-35, ZU-35DS or ZU-35TS. This module shall be system interconnected by a ten-pin plug and harness and shall be operable with the main control panel.

Each zone circuit shall accommodate up to thirty current model Pyrotronics detectors (except for models DP-4 and DF-3 which are limited to 20 and 5 respectively). Any quantity of shorting type contact devices such as thermals and manual stations can also be inter-

mixed on a zone circuit. Each detection circuit shall consist of either NFPA styles A and B capability (2 wire configuration) or styles A, B, and D (4 wire configuration). Upon operation of any initiating device installed in the circuit, the system shall lock into alarm and the red LED alarm indicating device (one for each circuit) mounted on the face of the module shall illuminate. A yellow LED Trouble indicator (one for each circuit) also on the face of the module shall illuminate should a break occur in the initiating circuit wiring, initiating circuit wiring leak current excessively to ground, or a detector be removed from the circuit.

Receipt of alarm conditions shall have priority over trouble and shall be annunciated over any trouble conditions.

All LED indicators shall be lamp tested from the system control panel.

The Model ZU-35, ZU-35DS or ZU-35TS shall be placement supervised and shall be Underwriters Laboratories Inc. listed.

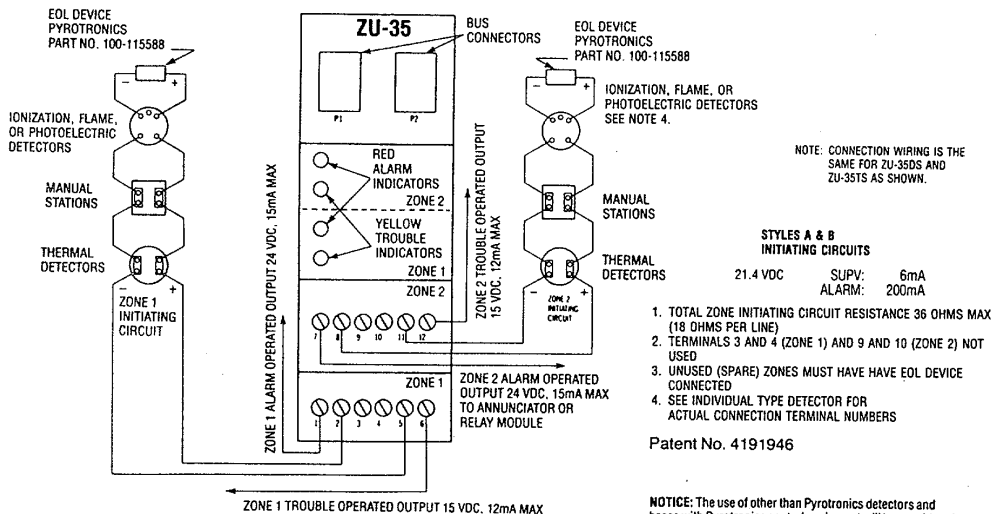
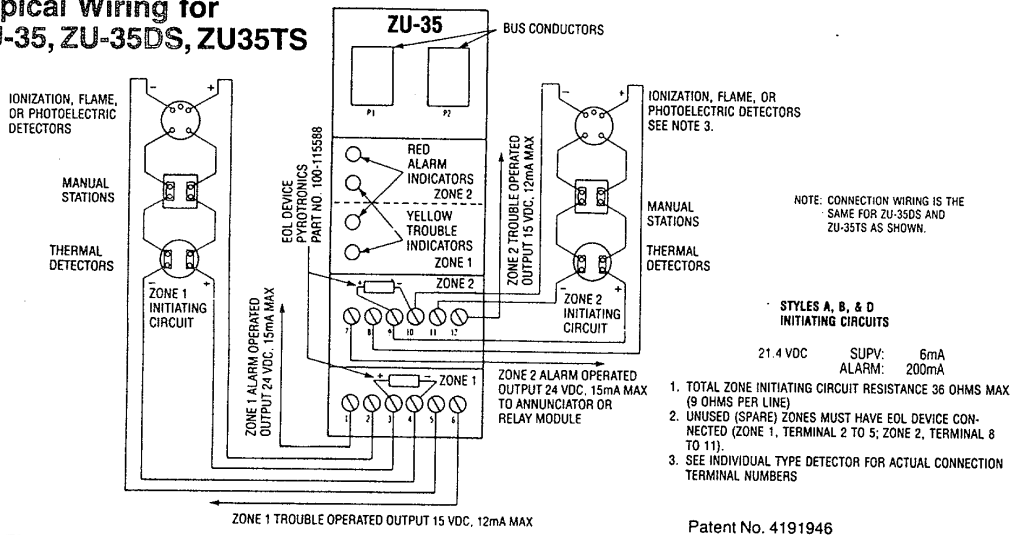
Electrical Information

Current Requirement: Supervisory- 9 ma
 Alarm - 110 ma/Circuit Ionization
 200 ma/Circuit Shorting

Ordering Information

Model No.	Description	Shipping Wt. Lbs.
ZU-35	Dual Zone Module	1 lb. (.45 kg.)
ZU-35DS	Dual Zone Module with On-Off Zone Disconnect Switch.	1 lb. (.45 kg.)
ZU-35TS	Same except w/momentary trouble & alarm test switches. U.S.C.G. approved	1 lb. (.45 kg.)

Typical Wiring for ZU-35, ZU-35DS, ZU35TS



NOTICE: The use of other than Pyrotechnics detectors and bases with Pyrotechnics control equipment will be considered a misapplication of Pyrotechnics equipment and as such void all warranties either expressed or implied with regards to loss, damage, liabilities and/or service problems.

Pyrotechnics

Ridgedale Avenue, Cedar Knolls, New Jersey 07927

15M
 12/87
 PM-S


Printed in U.S.A. December 1987
 Supersedes sheet dated 5/85

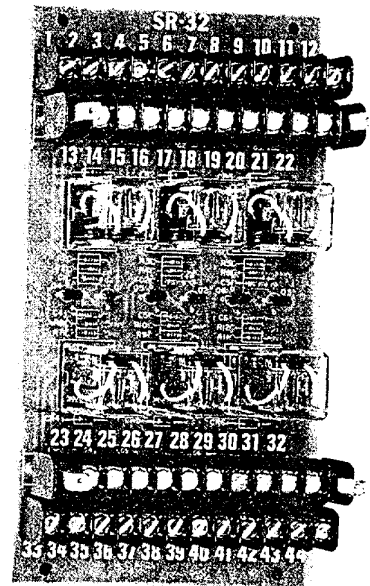


System 3™ Supplementary Relay

ENGINEER AND ARCHITECT SPECIFICATIONS

MODEL SR-32

- 6 Relays per Module
- DPDT Configuration
- Terminals for 2 #12 Wires
-  Listed



SR-32 with cover removed

Description

The Supplementary Relay Module, Model SR-32 is designed to activate or de-activate, as desired, external devices such as door releases, fan shut-down, extinguishing system release, audible alarms, etc. Actuation of the unit may come from the system control panel, a ZN or ZU Zone Module, an SM Switching Module, or any other module with appropriate signal output.

The module is fitted with six (6) independent, 24 Vdc relays, each of which provides a set of double pole, double throw (DPDT) contacts rated 3 amp. 120 Vac or 30 Vdc each. Power to operate the relays is provided from the 24 Vdc system power supply.

Actuation of each relay is from a high resistance transistor input circuit, requiring a high going dc signal from between 12 and 24 volts above system common. All terminals are of the clamp type, accommodating 2 wires of up to 12 gauge. The Model SR-32 occupies 2 standard module positions and is Underwriters Laboratories Inc. listed.

Architect's Specifications

For the control of external devices, there shall be provided a Pyrotronics Supplementary Relay Module, Model SR-32. This module shall contain six (6) independent 24 Vdc relays, fitted with DPDT contacts with a rating of 3 amp. 120 Vac or 30 Vdc each. Power to operate the relays shall be 24 Vdc furnished by the system power supply.

A separate terminal shall be provided for individual activation of each relay. All terminals shall be of the clamp type which shall accommodate 2 wires of up to #12 gauge. Therefore, no spade type, ring type, or special connectors shall be required to connect 2 wires to each input (activating) or output (contacts) terminals. The unit shall be Underwriters Laboratories Inc. listed.

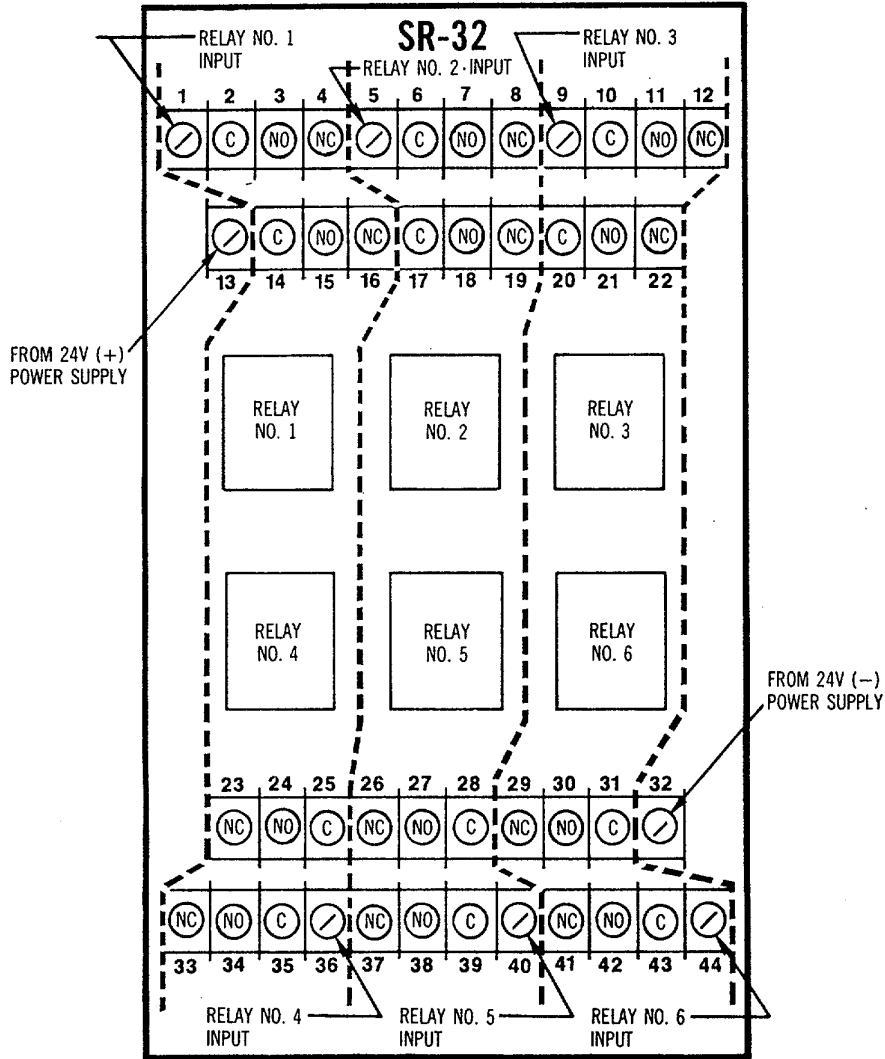
Electrical Information

Current Requirement: Relays de-energized - None
 Relays energized - 45 ma each

Ordering Information

Model No.	Description	Shipping Weight
SR-32	Supplementary Relay	3 lb. (1.4 kg)

Typical Wiring



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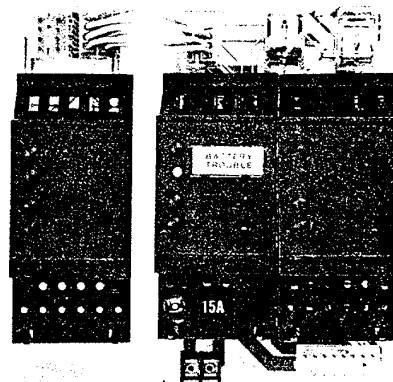


System 3™ Control Modules

ENGINEER AND ARCHITECT SPECIFICATIONS

MODEL BC-35 Battery Charger/Transfer
MODEL BE-35 Battery Extender

- Automatic Operation
- LED Trouble Indicator
- For Lead Acid or Sealed Nickel Cadmium Batteries
- Battery Circuit Supervised
- Transfers System to Battery
-  Listed



Description

The Battery Charger/Transfer Module, Model BC-35, and the Battery Extender Module, Model BE-35 provide the means of automatically supplying 24 Vdc emergency power to the basic system during main power outages. Both models are of solid state circuitry. The Model BC-35 contains a yellow LED "Trouble" indicator.

Under normal conditions, the system is powered directly from the main power supply. When the system is equipped with emergency power, the (calcium grid) lead acid or nickel cadmium batteries are maintained at full charge through the operation of the BC-35 or BC-35/BE-35 combination charging circuit. In the event of an AC power failure, the system is transferred to battery power.

The basic Charger/Transfer Module Model BC-35 provides the following circuit function features:

1. Controls charging current and float voltage values to maintain the batteries in optimal condition.
2. Provides accurate AC to battery and battery to AC transfer.
3. Shuts off battery power supply source when discharging battery reaches an unacceptable deep discharge value point.

4. Supervises battery placement along with high and low battery voltage points.
5. Withstands shorted battery terminal connections along with preventing the possibility of reversed battery polarity.
6. Charging path of BC-35 and BE-35 modules are supervised for placement.

Following are the battery capacities for this charging system:

Battery Capacity	Modules Used
4.5 to 25 AH	BC-35
26 to 55 AH	BC-35 and one BE-35
56 to 75 AH	BC-35 and two BE-35's
76 to 100 AH	BC-35 and three BE-35's

Note: An optional Meter Module (MM-35) may be connected within the BC-35/BE-35 connector loop. When used, this module is placed as the last module in the BC-35/BE-35 connection loop and serves as an end of line connector for the charging path supervisory function. When the MM-35 is not used, the last module either the BC-35 or BE-35 must use the supervisory connector Model JPBE in plug P-2.

The MM-35 indicates charging current present along with the battery voltage.

The units are Underwriters Laboratories Inc. listed.

Architects Specifications

Battery charging capability shall be provided by a Pyrotronics Battery Charger/Transfer Module, Model BC-35, and when necessary with a Battery Extender Module, Model BE-35.

These modules shall be system interconnected by a harness assembly and designed for use with 24 Vdc audible signals. Capability shall be provided to recharge sealed lead acid or sealed nickel cadmium batteries to their full capacity.

The BC-35/BE-35 combination for proper battery capacity is as follows: (select one)

Battery Capacity

A 4.5 to 25 AH
 B 26 to 55 AH
 C 56 to 75 AH
 D 76 to 100 AH

Modules Used

BC-35
 BC-35 and one BE-35
 BC-35 and two BE-35's
 BC-35 and three BE-35's

The battery shall be protected against overcharge and deep discharge. Failure of the charging system shall be identified by an indicator on the primary charging module, BC-35, and also by a system trouble, if AC power is functioning. The Models BC-35 and BE-35 shall be placement supervised and shall be Underwriters Laboratories Inc. listed.

Electrical Information

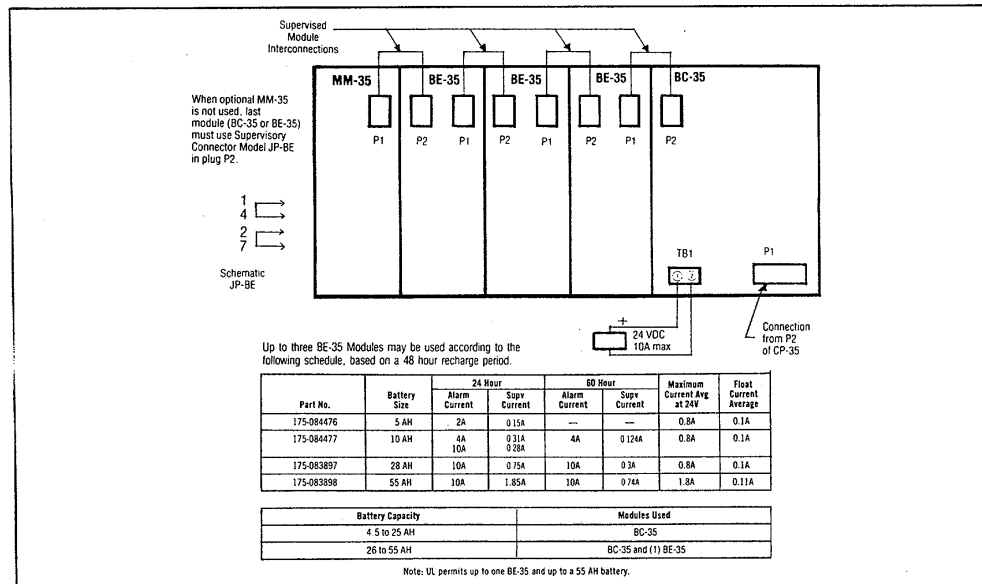
Normal Operating Current: BC-35, 46 ma
 BE-35, 2 ma
 (Excluding charging current)

Ordering Information

Model No.	Description	Shipping Weight
BC-35	Battery Charger/Transfer Module	31bs. (1.4kg.)
BE-35	Battery Extender Module	1lb. (.45kg.)

Loss of main operating power to the system shall automatically cause the system to transfer to battery power. After main power has been restored and the emergency batteries have been fully recharged, the system shall continue to float charge the batteries. The module shall be fitted with a fuse to protect against the battery overcurrent and accidental reversal of polarity.

Typical Wiring



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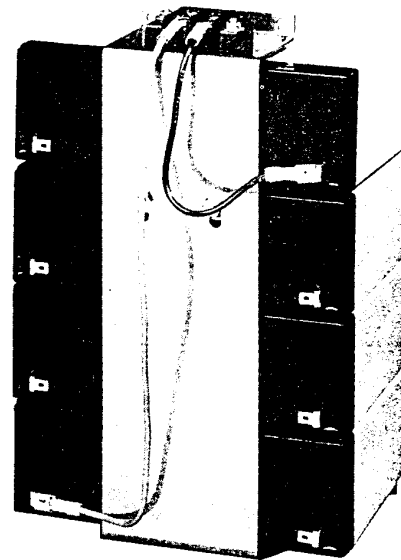
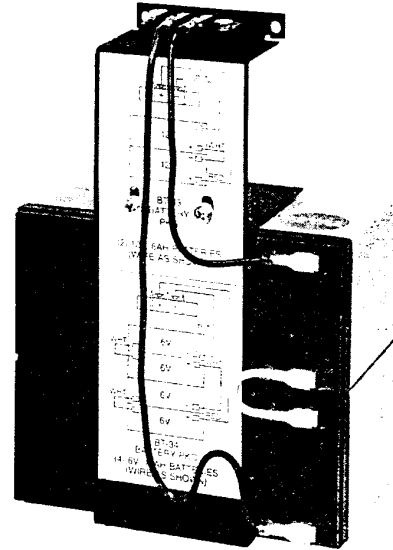
System 3™ Battery Modules

ENGINEER AND ARCHITECT SPECIFICATIONS

MODELS BK-33/BT-33 5.0 AH

- Sealed Spillproof Rechargeable Lead-Acid
- High Energy Density
- No Corrosive Fumes
- Mounts Within System Enclosure
- Long Life Cycle
- , ULC Listed

MODELS BK-33/BT-34 10.0 AH



Description

The Pyrotronics battery supply modules are designed to provide 24 volt emergency standby power to operate a System 3 Universal Control during failure of the normal commercial power source.

Pyrotronics offers 2 battery module options. Battery module option 1 contains two (2) sealed lead acid rechargeable batteries (12 volts each) model BT-33 that provide 5.0 ampere hours of energy and the model BK-33 chassis and bracket assembly.

Battery option 2 contains four (4) sealed lead acid rechargeable batteries (6 volts each) model BT-34 that provide 10 ampere hours of energy and the model BK-33 chassis and bracket assembly.

Both batteries are especially suited to high discharge currents. They are also suited for long term power when used with the proper charging circuits. Terminals are provided for connecting both battery module options to battery charger model BC-35 and the meter module model MM-35.

The BT-33/BK-33 and the BT-34/BK-33 combination occupies 3 standard module spaces and must occupy 3 of the center 4 module positions in the lowest module row of the enclosure. The BT-33, BK-33 battery module combination and the BT-34, BK-33 battery module combination are UL listed.

Engineering/Architect Specification

Ordering Information

Model	Description	Shipping Weight
BT-33	24V, 5.0 ampere hour battery pack	10 lbs. (4.5Kg)
BT-34	24V, 10.0 ampere hour battery pack	15 lbs. (6.8 Kg)
BK-33	Battery bracket for either of the above	2 lbs. (.9Kg)

NOTICE: The use of other than Pyrotronics detectors and bases with Pyrotronics control equipment will be considered a misapplication of Pyrotronics equipment and as such void all warranties either expressed or implied with regards to loss, damage, liabilities and/or service problems.

To supply standby power to the system there shall be a Pyrotronics battery module. This module shall consist of a 24 volt sealed lead acid battery system of either the gelled electrolyte type or starved electrolyte type rated at (insert 5 or 10) ampere hours at a 20 hour discharge rate.

The module shall be complete with support bracketing and screw type terminals and shall be installed on the same standard enclosure that houses the control panel and operating modules.

The battery module shall be the Pyrotronics model BT-33 battery pack and the model BK-33 battery bracket for 5 ampere hour requirements or the Pyrotronics model BT-34 battery pack and model BK-33 for 10 ampere hour requirements.

Electrical Characteristics

	BT-33	BT-34
Normal Voltage	24V	24V
*Nominal Capacity	5.OAH	10.OAH

*20/Hour Rate



System 3™ Accessory Module

ENGINEER AND ARCHITECT SPECIFICATIONS

MODEL MM-35 Meter Module

- Voltmeter
- Ammeter
-  Listed



Description

The Pyrotronics Meter Module, Model MM-35, is designed to provide visual indication of both battery voltage and charging current. It is used in conjunction with Battery Charger Modules, Models BC-35 and BE-35, in systems fitted with emergency standby power.

Both a voltmeter and an ammeter are contained in the MM-35. The voltmeter provides a voltage reading value of the battery at all times while the ammeter shows the charging current.

The Model MM-35 is placement supervised, providing a system trouble signal upon removal from the system.

The Model MM-35 is Underwriters Laboratories Inc. listed.

Architect's Specifications

Two meters shall be provided, mounted in a single module assembly for the purpose of indicating the battery voltage and the battery charging current. This module, Pyrotronics Meter Module Model MM-35 shall be system interconnected by a plug and harness assembly and shall be operable with the main control panel.

The Meter Module, Model MM-35 shall only be used in conjunction with the Battery Charger Module, Model BC-35 and BE-35.

The Model MM-35 shall be placement supervised and shall be Underwriters Laboratories Inc. listed.

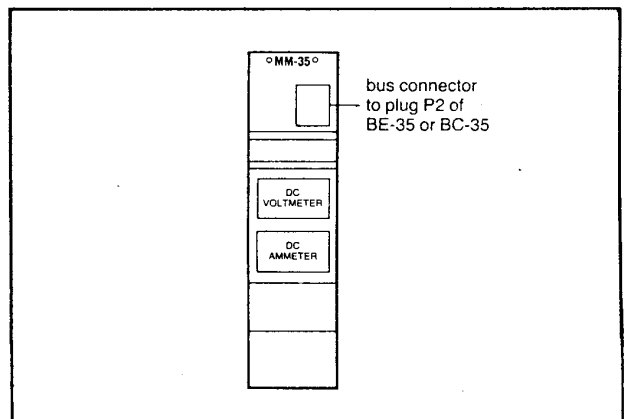
Electrical Information

Current Requirement: Normal-None

Ordering Information

Model No.	Description	Shipping Weight
MM-35	Meter Module	1 lb. (.45 kg.)

Typical Wiring



NOTICE: The use of other than Pyrotronics detectors and bases with Pyrotronics control equipment will be considered a misapplication of Pyrotronics equipment and as such void all warranties either expressed or implied with regards to loss, damage, liabilities and/or service problems.

Description


Pyrotronics

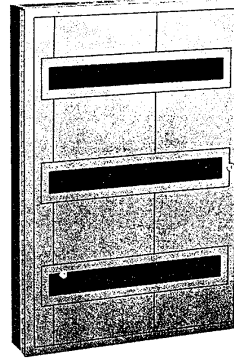
Universal
Alarm
Control



System 3™ Enclosures

ENGINEER AND ARCHITECT SPECIFICATIONS

- Attractive Styling
- Left or Right Hinged Cover
- Surface or Flush Mounting
- Key Lock
- Dead Front Construction
-  Listed



Description

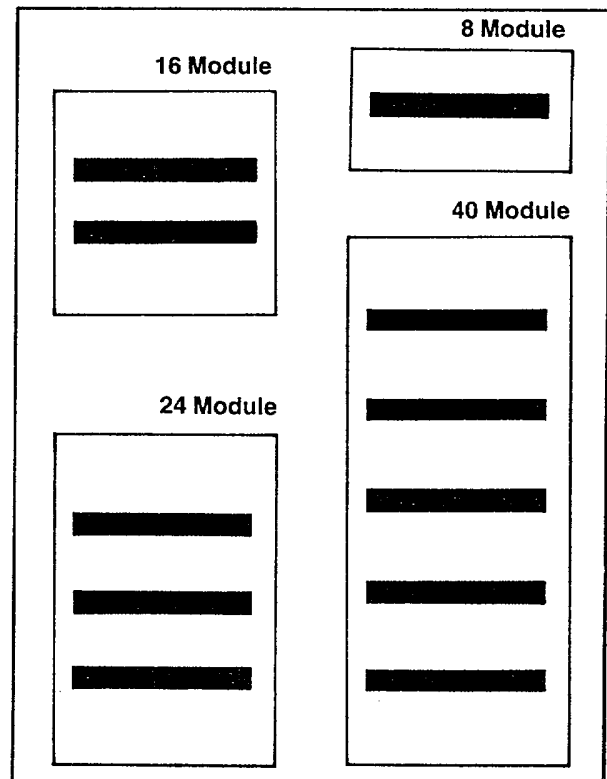
The Pyrotronics Enclosures, are designed to accommodate System 3 control panels, input and output modules, and all power supplies utilized in the system. They can be either surface or flush mounted.

Each enclosure consists of a back box and door cover assembly fabricated of heavy gauge sheet steel. The back box, which is finished in a black baked vinyl, is designed for mounting the "Z" brackets and "U" channel supports on which are mounted the controls, modules, and power supplies.

The door cover, which is attractively contrasted in medium blue vinyl is mounted with a sag resistant, steel piano hinge and is fitted with a key locking arrangement. Left hand or right hand mounting can be made on all enclosures as desired.

Each door cover contains a full-width horizontal viewing slots, to permit visual identification of each row of modules and control panel for the various functions served by the system. The inside of the door cover is fitted with brackets to accommodate blank face plates to cover those positions in the back box not occupied by the control panel, modules, or batteries.

Pyrotronics enclosures are shipped unassembled (back box and door cover) to facilitate installation. The prewired system controls, power supply, and operating modules are shipped assembled on support as one complete unit and in a ready to install condition. All that is required is to bolt the complete system assembly in position in the back box and mount the hinged door cover assembly.



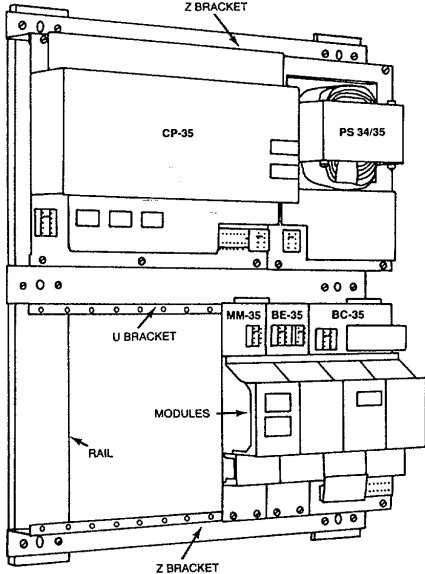
Ordering Information

Back boxes, door covers, rail/bracket kits with mounting hardware, and semi-flush mounting trim kits are available separately. To order, use the following model numbers.

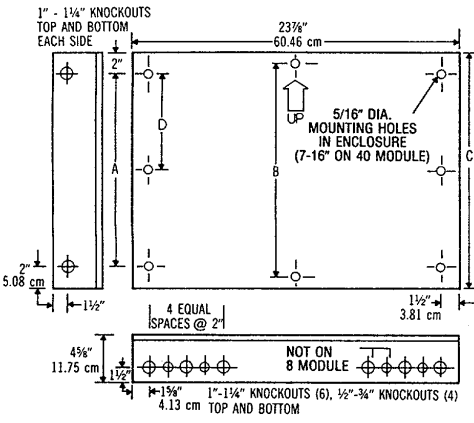
Enclosure	Back Box		Door Cover		Rail/Bracket Kit		Mount Trim Kit	
	Model Number	Ship. Weight lbs. (kg)	Model Number	Ship. Weight lbs. (kg)	Model Number	Ship. Weight lbs. (kg)	Model Number	Ship. Weight lbs. (kg)
8 Module	EB-31	13 (5.85)	ED-31	9 (4.05)	EK-31	6 (2.7)	ET-31	6 (2.7)
16 Module	EB-32	21 (9.45)	ED-32	15 (6.75)	EK-32	10 (4.5)	ET-32	7 (3.15)
24 Module	EB-33	29 (13.05)	ED-33	21 (9.45)	EK-33	14 (6.3)	ET-33	9 (4.05)
40 Module	EB-35	44 (19.8)	ED-35	31 (13.95)	EK-35	18 (8.1)	ET-35	11 (4.95)

Mounting Mode

Encl. Model	Rail		Z Bracket		U Bracket	
	Qty.	Part No.	Qty.	Part No.	Qty.	Part No.
8 Module	2	320-021059	2	320-021071	—	320-021019
16 Module	2	320-021062	2	320-021071	1	320-021019
24 Module	2	320-021063	2	320-021071	2	320-021019
40 Module	2	320-021065	2	320-021071	4	320-021019



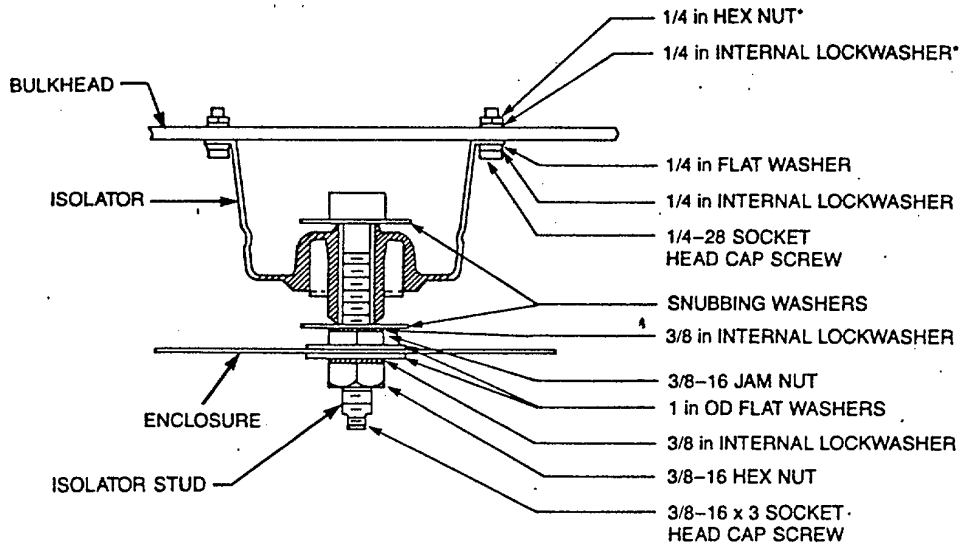
Typical Mounting Arrangement



Enclosure	A	B	C	D
8 Module	10" 25.4 cm	—	14" 35.56 cm	—
16 Module	20½" 52.07 cm	22¾" 56.83 cm	24½" 62.23 cm	—
24 Module	31" 78.74 cm	32¾" 83.50 cm	35" 88.95 cm	15½" 39.37 cm
40 Module	52" 132.08 cm	53¾" 136.84 cm	56" 142.24 cm	26" 66.04 cm

NOTICE: The use of other than Pyrotech detectors and bases with Pyrotech control equipment will be considered a misapplication of Pyrotech equipment and as such void all warranties either expressed or implied with regards to loss, damage, liabilities and/or service problems.

VIBRATION ISOLATOR DETAIL: COAST GUARD APPLICATION



PARTS USED IN STUD ASSEMBLY

*IF NUTS ARE OMITTED, LOCKWASHER IS TO BE PLACED BETWEEN SOCKET HEAD AND ISOLATOR

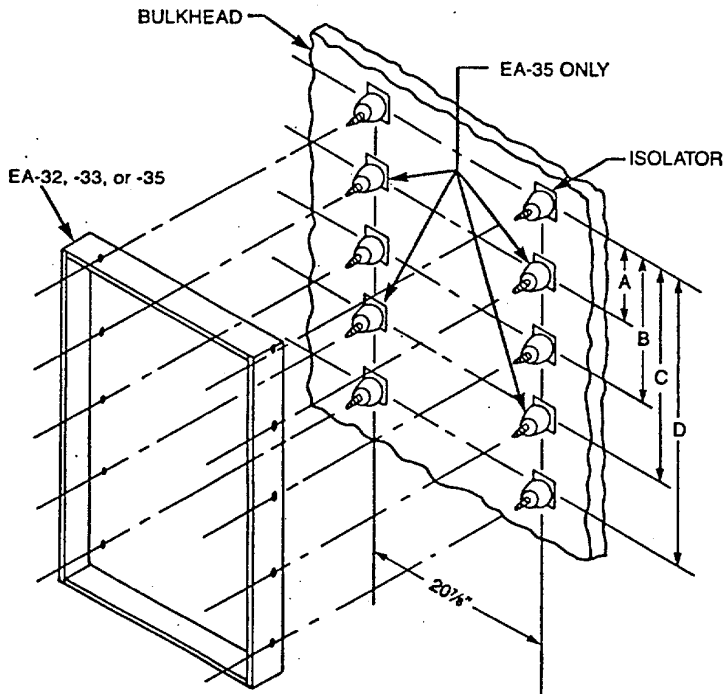


TABLE 1

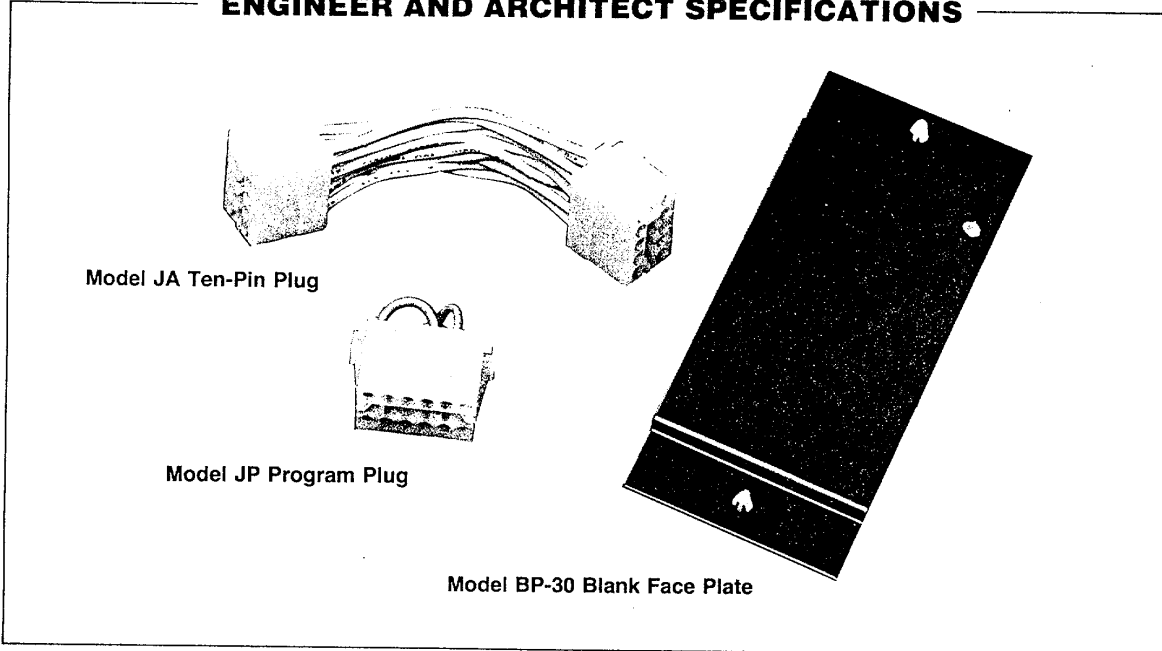
ENCLOSURE SIZE	CENTER DISTANCE (INCHES)				NO. OF ISOLATOR KITS REQUIRED
	A	B	C	D	
32	—	—	—	20½	4
33	—	15½	—	31	6
35	13	26	39	52	10

- NOTES: 1. PRIOR TO MOUNTING ENCLOSURE EA-32 OR EA-33 TO THE ISOLATOR, REDRILL THE REQUIRED EXISTING MOUNTING HOLE DIAMETERS TO 1/2 INCH.
2. PRIOR TO MOUNTING ENCLOSURE EA-35, DRILL FOUR NEW 1/2 INCH DIAMETER HOLES LOCATED VERTICALLY AT THE A AND C DIMENSIONS, IN ADDITION TO REDRILLING THE EXISTING MOUNTING HOLES TO 1/2 INCH.

MOUNTING DIAGRAM FOR EA-32, -33, AND -35 ENCLOSURES FOR COAST GUARD APPLICATION

System 3™ Accessories

ENGINEER AND ARCHITECT SPECIFICATIONS



Listed below are miscellaneous accessories for use with the Pyrotronics System 3 Universal Alarm Control.

Model JA - Ten-pin plug and harness assembly for interconnecting modules and control panels.

Model JS - Supervisory Return harness assembly.

Model JP - Program plug for use with systems not fitted with emergency power.

Model BP - Blank face plate for insertion in brackets on inside of enclosure door. The Model BP covers those positions within the enclosure not occupied by modules or control panels.

Model EL - End-of-Line device mounting plates or assembly to be mounted on single gang switch boxes, for use with audible signal circuit or detector circuit.

Model No.	Description	Shipping Wt.	
		Lbs.	Kg
JA-5	Plug/Harness Assembly, 5' for modules in a row	1	.45
JA-24	Plug/Harness Assembly, 24" for modules from row to row	2	.90
JA-48	Plug/Harness Assembly, 48" for modules from row to row	2	.90
JA-96	Plug/Harness Assembly, 96" for modules from row to row	2	.90
JS-24	Supervisory Return Harness Assembly, 24"	1	.45
JS-64	Supervisory Return Harness Assembly, 64"	1	.45
JS-98	Supervisory Return Harness Assembly, 96"	1	.45
JP-A	Program Plug (black wire) for AC signaling circuits	1	.45
JP-D	Program Plug (yellow wire) for DC signaling circuits	1	.45
BP-30	Blank Face Plate for enclosure	1	.45
EL-30/31	Wall Mounting Plate for End-of-Line Device used on System 3 DC Audible Circuit or Detector Circuit	1	.45
EL-32	End-of-Line Device for use with AC Audible Circuit	2	.90

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8 Ridgedale Avenue, Cedar Knolls, New Jersey 07927

6/87
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May 1987
Supersedes sheet
dated 11/81

CATALOG NUMBER 3350

Pyrotronics

Early Warning
Fire Detection and Alarm Systems

Engineer and Architect Specifications

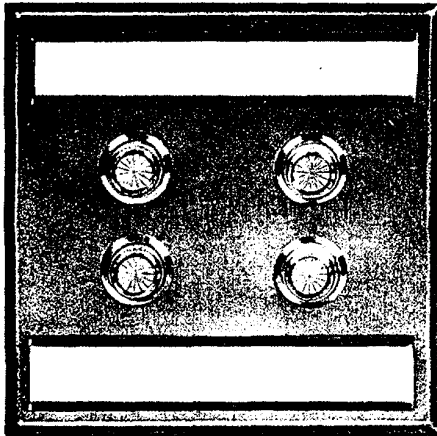
Remote Lamp Panels

MODELS RLP-4, RLP-8 & RLP-12

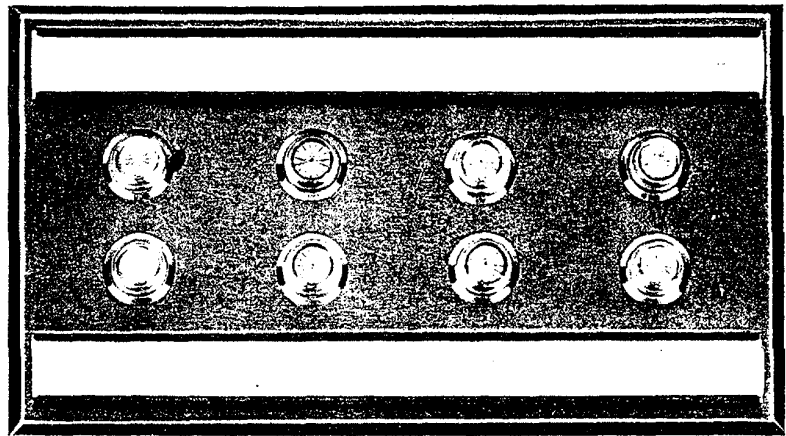
Catalog
Number

8012

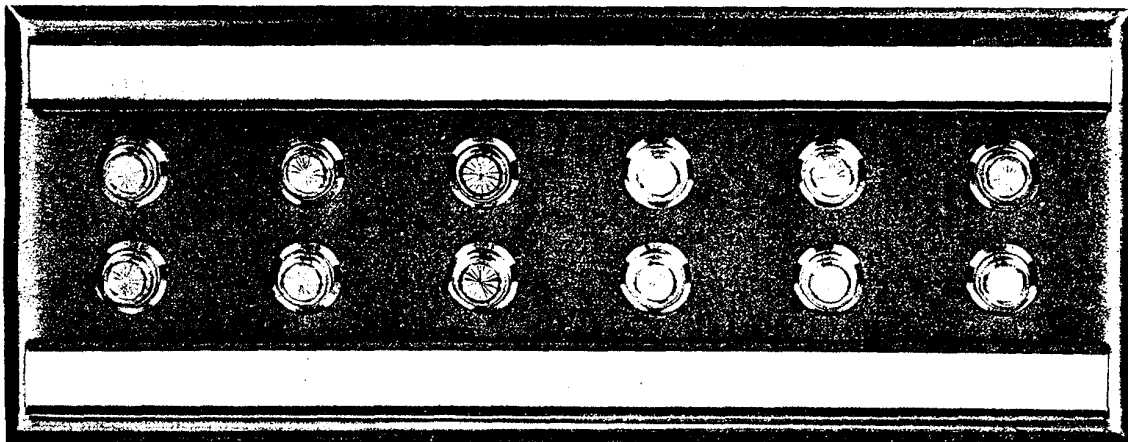
Pyrotronics **16p** PROTECTIVE SYSTEMS



MODEL RLP-4



MODEL RLP-8



MODEL RLP-12

INTRODUCTION

The Pyr-A-Larm Remote Lamp Panels, RLP-4, RLP-8, and RLP-12 are designed for use with all Pyr-A-Larm systems where remote lamp annunciation of the detection system activity is desired. This activity could be DI-2 type detector operation using 24V lamp directly or using dry contacts, one may indicate zone alarm, system alarm, trouble, power failure, etc.

The RLP Panels are normally fitted with neon lamps to duplicate the high voltage detector pulse lamp operation. However, 6-volt, 12-volt, 24-volt, 48-volt and 120-volt lamps are

available as optional items to match the electrical characteristics of any desired system.

The RLP-4 Remote Lamp Panel is equipped with 4 lamps beneath clear lenses and is designed for 2-gang switch box mounting. The RLP-8 has 8 lamps and requires 4-gang switch box mounting, while the RLP-12 has 12 lamps and requires 6-gang switch box mounting. The panels are equally attractive whether mounted vertically or horizontally.

Each panel has an upper and lower bracket to accommodate plastic nameplate strip for lamp identification.



Pyrotronics

A Division of Baker Industries, Inc.

Cedar Knolls, New Jersey 07927

February, 1973

Supersedes sheet dated 3/72

Pyrotronics **16p** PROTECTIVE SYSTEMS

MOUNTING DATA

The RLP Panel is completely assembled with screw type terminals on its printed wiring board to facilitate wiring connections. The panel is then connected to the switch box with upper and lower fastening screws. The plate mounting screws are in such a position that they are hidden by the nameplate strip after installation.

ARCHITECT'S SPECIFICATIONS

The Remote Lamp Panel for the Pyr-A-Larm system shall be the Pyr-A-Larm RLP _____ (insert 4, 8 or 12). The panel shall be capable of monitoring the condition of the Pyr-A-Larm DI-2 type detector using 24V lamp directly or using dry contacts one may indicate zone alarm, system alarm,

trouble, power failure, etc. The RLP panel shall be Underwriters' Laboratories, Inc. listed.

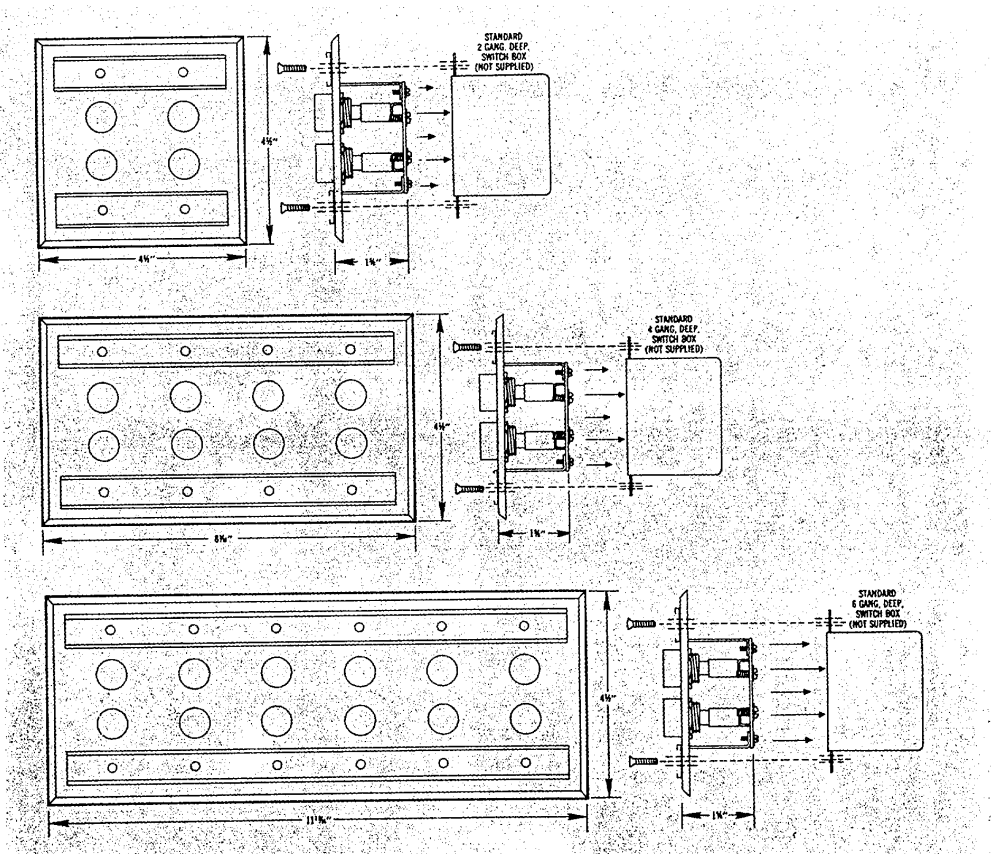
The electrical contractor shall mount the RLP-4 Panel on a 2-gang, deep switch box; the RLP-8 Panel on a 4-gang, deep switch box; and the RLP-12 on a 6-gang, deep switch box. The wiring between the panel and the system components shall be #18 AWG thermoplastic fixture wire enclosed in conduit or #18 AWG limited-energy shielded cable without conduit, if permitted by local building codes. Installation wiring shall be performed as indicated in system drawings supplied by Pyrotronics.

ORDERING INFORMATION

Model No.	Description	Shipping Weight
RLP-4	Remote Lamp Panel, 4-position	1 lb.
RLP-8	Remote Lamp Panel, 8-position	1 1/2 lbs.
RLP-12	Remote Lamp Panel, 12-position	2 lbs.

Optional Lamps (order total quantity needed)

Part No.	Description
125-216152	6-volt lamp
125-216153	12-volt lamp
125-216154	24-volt lamp
125-216155	48-volt lamp
125-216156	120-volt lamp




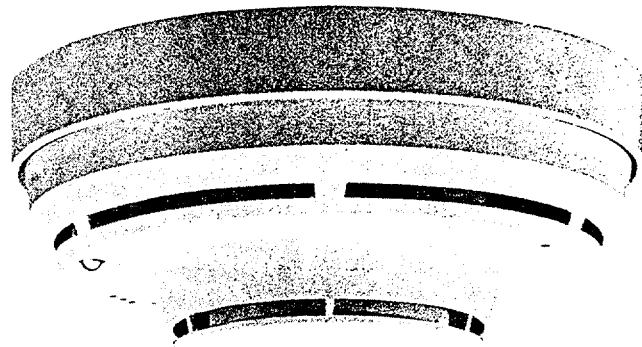


Ionization Smoke Detector

ENGINEER AND ARCHITECT SPECIFICATIONS

DI-3, DI-A3 and DI-B3

- Adjustable Sensitivity
- Dual Chamber
- Sensitivity Test Points
- Simple Twist/Lock Assembly
- Optional Auxiliary Relay
- Screw-Clamp Terminals
- Alarm
-  Listed



Introduction

The Pyrotronics DI-3, DI-A3 & DI-B3 fire/smoke detectors operate on the ionization principle. The detectors respond to the first traces of fire in the form of visible smoke or invisible products of combustion. The DI-3, DI-A3 & DI-B3 have been developed for the wide range of commercial, industrial and institutional fire detection and extinguishing applications. The DI-3 and DI-A3 are approved in environments as covered by UL 268. The DI-A3 and DI-B3 are approved in environments covered by UL 268A. The DI-B3 must be utilized with a Series 3 air duct housing.

Description

The DI-3 Series detector is a plug-in, ionization detector and is designed for two wire system operation. The DI-3 is designed with adjustable sensitivity while the DI-A3 and the DI-B3 have a fixed sensitivity designed for their individual high air flow applications.

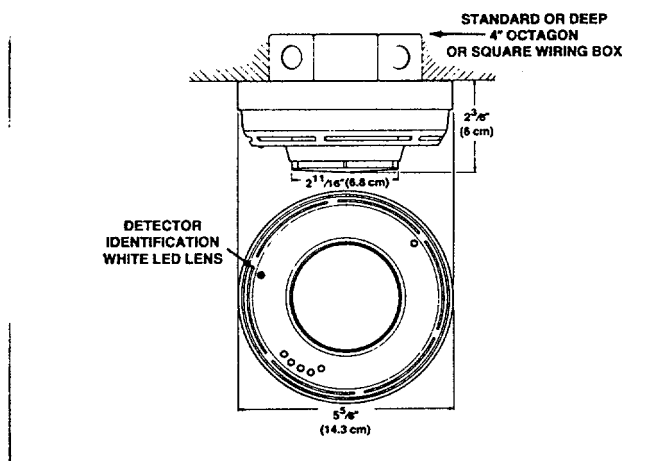
The DI-3, DI-A3 & DI-B3 consist of self-compensating dual ionization chamber and a highly stable solid state amplifier switching circuit. One chamber detects the presence of combustion products. The second chamber serves as a reference, to stabilize the detector's sensitivity for changes in environmental conditions.

As products of combustion enter the sampling chamber, the chamber current is reduced producing a voltage change. At the time the voltage change exceeds the predetermined threshold an alarm is signaled to the control unit. The detector locks in upon alarm and must be reset from the control panel.

The sensitivity of the DI-3, DI-A3 & DI-B3 is preset at the factory. The electrical sensitivity can be monitored in the field using the Pyrotronics sensitivity tester, Model SCU-3 or test module TM-13. The sensitivity test jack on the DI-3, DI-A3 & DI-B3 and the adjustment screw on the DI-3 are accessible from the front of the detector housing enabling the user to perform all sensitivity adjustments and tests without removing the detector from its base.

The detectors utilize a low profile surface mounting base. Model DB-3S, which may be attached to either a 4" octagonal or 4" square wiring box-or the audible base Model ADB-3, which must be attached to a 4" square, deep wiring box. The DB-3S base and ADB-3 audible base utilizes screw-clamp terminals for all electrical connections, self-wiping contacts for reliability and contains provision for an optional concealed locking mechanism to prevent unauthorized removal of the detector head.

Mounting Data



The DI-3 Series ionization detector has been designed to meet a wide range of system design parameters. The Dt-3 detector is designed for open area protection in areas with air velocities up to 300 feet per minute.

DI-A3 is recommended for use in high air velocity applications such as computer room underfloor areas. The Model DI-A3 contains a specially designed internal chamber cover and a pre-selected fixed sensitivity setting which provides extremely stable operation. Model DI-A3 has been UL listed for operation in air velocities of 0 to 1200 feet per minute. Since air velocity has an effect on detector sensitivity and performance, the Dt-A3 should be used only in applications which meet this established air velocity range.

The DI-B3 is designed specifically for use with the Pyrotronics Series 3 Air Duct Housings and like the Dt-A3 contains a specially designed internal chamber cover and a pre-selected fixed sensitivity setting. The DI-B3 must be utilized with the Series 3 Air Duct Housing in air duct applications with air velocities of 500-4000 FPM.

The DI-3, DI-A3 and DI-B3 are also available for high altitude applications, (3000 to 8000 above sea level) as model Numbers DI-3H, DI-A3H and DI-B3H.

The DI-3 and DI-A3 are capable of operating a remote alarm lamp. Model RL-3, or auxiliary relay, Model RR-3. The Model RR-3 relay contains one set of double pole, double throw contacts rated at 120VAC, 2 amp resistive and requires a deep outlet box when mounted to the DB-3S. The DI-B3 is capable of utilizing the remote relay as supplied in the Series 3 Air Duct Housing Model AD-3RI which contains one set of double pole, double throw contacts rated at 1 25VAC/ 24VDC, 3 amp resistive.

When multiple detector/relay combinations are used on the same circuit, the zone module current limit will restrict the number of guaranteed detector/relay actuations to one per zone.

The DI-3, DI-A3, DI-B3, DI-3H, DI-A3H and DI-B3H ionization detectors are Underwriters Laboratories, Inc. listed. The series are also FM approved.

An FM approved, intrinsically safe Dt-3 is available under Model DI-31S. The Dt-31S must be utilized with the intrinsically safe System 3 zone module, Model ZS-30.

Application Data

The Dt-3, DI-A3, DI-B3, Dt-3H, DI-A3H and DI-B3H detectors are fully compatible with other Pyrotronics System 3 compatible detectors and may be intermixed on the same zone circuit. No more than thirty (30) detectors of any type or combination (other than thermals or manual stations) may be used on any one Pyrotronics detector circuit.

This detector is applicable to the 30-foot center spacing (900 sq. ft.) as referred to in the National Fire Protection Association standard 72E. This spacing, however, is based on ideal conditions namely, smooth ceiling, no air movement, and no physical obstructions between the fire source and the detector. This spacing should be used as a guide or starting point in detector installation layout. Do not mount detectors in areas close to ventilating or air conditioning outlets. Exposed joists or beamed ceilings may also affect safe spacing limitations for detectors. It is mandatory that engineering judgment be applied regarding detector location and spacing.

Engineer/Architect Specifications

The ionization smoke detector shall be a dual chamber, plug-in unit which mounts to a twist/lock base and shall be UL listed.

The smoke detector shall operate on a two wire circuit and shall contain an alarm indicating LED which will illuminate to signal actuation of the detector.

DI-A3 The detector shall be specifically designed for use in ONLY high air velocity applications of between 0 and 1200 ft./min. Detector switch are not UL listed for the stated air velocity range shall not be accepted.

DI-B3 The detector shall be specifically designed for use in ONLY air ducts with air velocities between 500-4000 FPM when used with Pyrotronics Series 3 Air Duct Housings. Detectors not listed to UL 268A for the stated air velocity range shall not be accepted.

The detector shall be available in a model that is acceptable for and UL listed for use in altitudes of 3000-8000 ft. Above sea level if desired.

Field adjustment* and monitoring of the detector sensitivity shall be possible without removal of the detector head from its base. The measurement of detector sensitivity shall provide a discrete electrical value. Test methods which do not provide an output signal proportional to smoke concentrations shall not be considered equal. The base assembly into which the detector is installed shall be of the twist/lock design with screw-clamp terminals. The base shall utilize self-wiping contacts for reliability and shall accept other compatible plug-in detectors. A security lock shall be installed in those areas where tamper resistant installation is required as indicated on the drawings.

The detector, or group of detectors, shall require a two-wire circuit of #18 AWG thermoplastic fixture wire enclosed in conduit, or #18 AWG limited energy shielded cable without conduit, if permitted by local building codes.

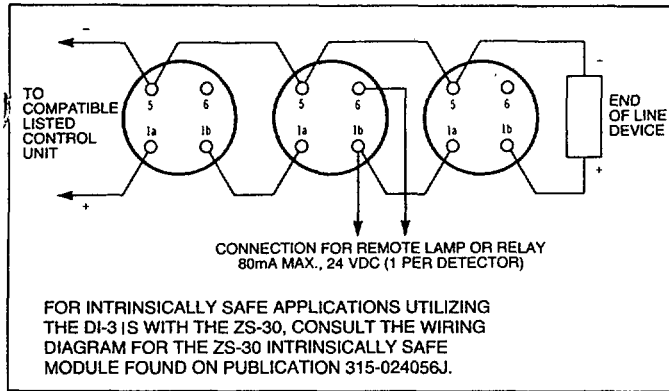
Optional auxiliary DPDT relays and/or remote alarm lamps shall be installed where indicated.

The detector assembly shall be a Pyrotronics DI- (insert number) with DB-3S mounting base, ADB-3 audible base or Series 3 Air Duct Housing.**

*DI-3, DI-3H only

**DI-B3, DI-B3H only

Typical Wiring



Technical Specifications

Current Requirements:	Normal - 100 A (350A peak surge upon application of power) Alarm -80ma
Voltage Range:	21 + 3 Vdc + 1 20°F (49°C)
Operating Temperature:	+ 32°F (0°C) to + 1 00°F (380C) per UL
Humidity:	0-93% Relative Humidity
Air Velocity:	0-300 ft./min. Model DZ-3 0-1200ft./min. Model DI-A3 500-4000 ft./min. Model DI-B3 (requires airduct housing)

Note: Consult factory for special application requirements.
For Additional Product Information, refer to Pyrotechnics DI-3
Technical Bulletin, Part No. 315-082300.

Ordering Information

Model #	Description	Shipping Wt.	
		Lbs.	Kg.
DI-3	Ionization smoke detector	1	.45
DI-31S	Ionization smoke detector (Intrinsically Safe)	1	.45
DI-3H	Ionization smoke detector (High Altitude)	1	.45
DI-A3	Ionization smoke detector (High Air Velocity)	1	.45
DI-A3H	Ionization smoke detector (High Altitude - High Air Velocity)	1	.45
DI-B3	Ionization smoke detector (Duct Use Only)	1	.45
DE-B3H	Ionization smoke detector (High Altitude- Duct Use Only)	1	.45
RR-3	Remote Relay (DPDT)		1
RL-3	Remote Alarm Lamp	1	.45
DB-3S	Low Profile Mounting Base	1	.45
ADB-3	Audible Base	1	.45
AD-31	Series 3 Air Duct Housing (See Spec Sheet 6124)	5	2.25
AD-3RI	Series 3 Air Duct Housing w/Remote Relay (See Spec Sheet 6124)	6	2.7
SA-31	Series 3, self contained Air Duct Housing (See Spec Sheet 61 24)	7	3.15
DB-LK	Series 3 Base Locking Kit	.5	.22

NOTICE: The use of other than Pyrotronics detectors and bases with Pyrotronics control equipment will be considered a misapplication of Pyrotronics equipment and as such void all warranties either expressed or implied with regards to loss, damage, liabilities and/or service problems.

Pyrotronics

8 Ridgedale Avenue, Cedar Knolls, New Jersey 07927

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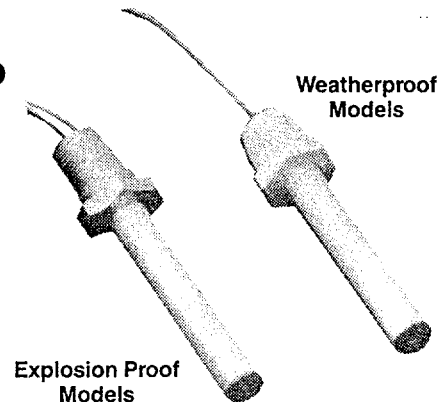
April 1987
Supersedes sheet dated 8/86



Thermal Fire Detectors Weatherproof and Explosion Proof Models

ENGINEER AND ARCHITECT SPECIFICATIONS

MODELS DT-135WP, DT-200WP DT-135EP, DT-200EP



Introduction

The Pyrotronics Weatherproof and Explosion Proof Thermal Detectors are of the rate compensation/fixed temperature type and are designed for use with either standard Pyrotronics systems or other commercially available fire alarm systems. The detector element, in all models, is selfrestoring after operation and is supplied in ratings of 135°F and 2000F.

The Models DT-135WP, DT-200WP, DT-135EP and DT-200EP can be used with any fire alarm circuit of any manufacture using open circuit direct shorting type units.

Contact ratings are 6-125 Vac, 5 amps; 6-25 Vdc, 1 amp; 125 Vdc, 0.5 amps. All Models are Underwriters' Laboratories, Inc. listed. The DT-135WP and DT-200WP are UL listed and U.S. Coast Guard approved as weatherproof. They are furnished with leads through a plastic 1/2" NPT hub that screws into a standard W.P. junction box cover. The shell is epoxy coated and offers strong resistance to corrosive atmosphere. The DT-135EP and DT-200EP explosion proof models are U.L. listed for Class 1, Groups C and D, Class 11, Groups E,F and G when installed in a listed explosion proof junction box such as Killark Series, UL or equal. The EP models should not be installed in outdoor or other wet locations.

Principle of Operation

Basically, the detector consists of an aluminum tubular shell containing two curved expansion struts under compression fitted with a pair of normally open, opposed contact points which are insulated from the shell. The tubular shell and the struts have a different coefficient of expansion.

When subjected to a rapid heat rise, the tubular shell expands and lengthens slightly. At the same time, the interior struts lengthen but at a slower rate than the shell. The rapid lengthening of the shell allows the struts to come together, thereby closing the contact points and initiating the alarm.

When subjected to a very slow heat rise, the tubular shell and the interior struts lengthen at approximately the same rate. At the detectors set temperature point 135°F or 2000F° the interior struts are fully extended, thereby closing the contact points and initiating the alarm.

These thermal detectors, which are shock and corrosion resistant, respond only to heat so they are suitable for use in areas where normal conditions would prohibit the use of other Pyrotronics detectors.

Architect's Specifications

The thermal fire detector shall be a Pyrotronics Model DT- (insert model number) and shall be of the rate compensation/fixed temperature type. The detector shall be listed by Underwriters' Laboratories, Inc.

Note: The Models DT- weatherproof or explosion proof thermal detectors shall be compatible with Pyrotronics ionization detectors, flame detectors, and manual stations on the same circuits. There shall be no limit, other than practical consideration, to the number of thermal detectors which may be installed in any one circuit.

The installing contractor shall install the detectors with #18 AWG thermoplastic wire with a 300 volt insulation rating, housed in threaded conduit.

Mounting Data

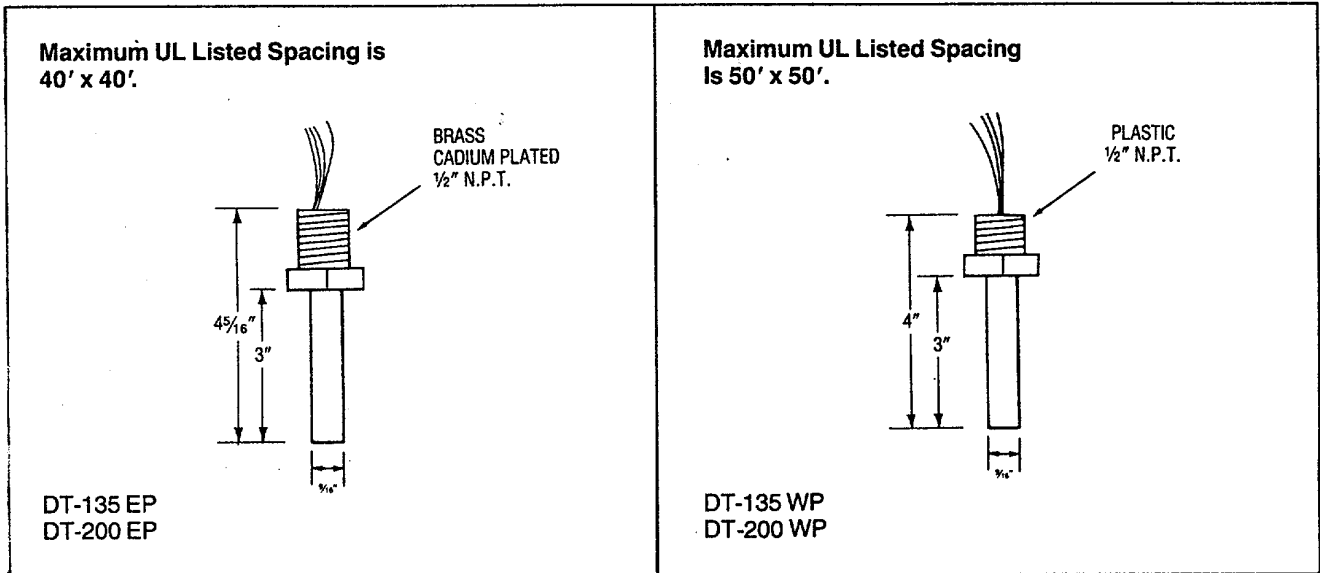
The Weatherproof (WP) models screw into the 1/2 " threaded hole of any approved weatherproof junction box cover plate.

The Explosion proof (EP) models attach to the threaded hub cover of listed explosion proof junction boxes such as Killark Series, UL or equal. The EP models should not be installed in outdoor or other wet locations.

Ordering Information

Model Number	Description	Shipping Weights
DT-135WP	Weatherproof 135° Rate Compensated/Fixed temperature detector	1 lb
DT-200WP	Weatherproof 200° Rate Compensated/Fixed temperature detector	1 lb
DT-135EP	Explosion Proof 135° Rate Compensated/Fixed temperature detector	1 lb
DT-200EP	Explosion Proof 200° Rate Compensated/Fixed temperature detector	1 lb

Dimensions

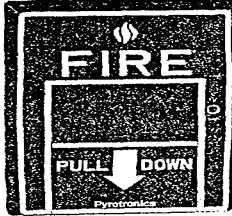



Manual Fire Alarm Station

ENGINEER AND ARCHITECT SPECIFICATIONS

SERIES MS-5

SINGLE ACTION STATION



- Optional Contact Arrangements
- Integral Alarm Lamp
- Key Switch
- Double Action With Positive Motion
- Failsafe Reset
- Latch Action Until Reset
- No Break Rods Necessary
-  Listed

DOUBLE ACTION STATION



Introduction

The Pyrotronics Series MS-5 Manual Fire Alarm Station have been designed with extreme flexibility in mind to meet a wide variety of application requirements and operational sequences.

These stations are available with two different operational modes, one being a simple single action function utilizing a "pull-down" lever; the other comprising a dual action function involving a "push-in" tab, followed by the "pull-down" lever action. Each of the above actions may operate electrical contacts to achieve various electrical sequence functions as desired.

In addition, the Series MS-5 Manual Fire Alarm Stations can be supplied with an optional alarm indicating lamp and/or a key-operated electrical switch (N.O. SPST) for operating electrical circuits without manually activating the "push-in" tab or "pull-down" lever.

The Series MS-5 Manual Fire Alarm Stations are Underwriters Laboratories Inc. listed.

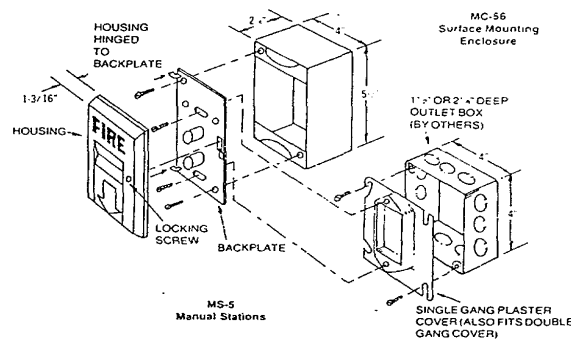
Flexibility of Application

The basic standard model is the single action Model MS-5, which contains one normally open contact. It is intended for use with Pyrotronics low voltage systems, but has a rating of 125,Vac/dc for connection to existing fire alarm systems of other manufacturers.

With the double action station, the optional switch on the first action may be used for supervisory indication of tampering with the station or for connection to a remote annunciator. It may also be used to alarm one zone of a cross-zoned fire extinguishing system where the main action would alarm the second zone, releasing the extinguishing agent.

The optional lamp may be an alarm lamp for the station, similar to the detector alarm lamp, or it may be energized from a remote source to indicate a prior alarm that has been received by the system. It may also indicate that an extinguishing agent has been released. The lamp may also be connected to the switch of the first action of a double action station to aid in discouraging pranksters from pulling the main action lever.

Mounting Data



Technical Description

The Pyrotronics Series MS-5 Manual Fire Alarm Stations are constructed of durable molded polycarbonate material, matte-finished in red with raised lettering in white. The housing for the single action station accommodates a "pull-down" lever which, when operated, locks in position after releasing a spring-loaded contact switch. Restoring the system to normal can only be accomplished by opening the cover of the hinged housing with "an uncommon tool", and then closing and locking the cover.

The housing for the double action station, in addition to the above, incorporates a "push-in" tab which must be operated first, permitting access to the "pull-down" lever. An additional spring-loaded contact switch which is released upon operation of the "push-in" tab is available on Models MS-512C, MS-513C, MS-514C, MS-517C and MS-518. Resetting of the station is as described above with the uncommon tool.

If desired, the stations can be supplied with a 24V alarm indicating lamp and/or a key-operated switch for special operating functions as necessary.

All models are fitted with screw-type terminals for system interconnection. Provision is made for surface or semi-flush mounting to conduit boxes.

Architect's Specifications

The manual fire alarm station shall be a Pyrotronics Model (See chart for number) with Underwriters

Laboratories Inc. listing.

Single Action Model

The single action station, which shall be of the non-code type, shall consist of a molded housing fitted with a "pull-down" lever, which, when operated, locks in position after releasing a spring-loaded contact switch to effect activation of the alarm circuit.

Double Action Model

The double action station, which shall be of the non-code type, shall consist of a molded housing, fitted with a "pull-down" lever and a "push-in" tab. It shall be necessary to operate the "push-in" tab first to provide access to the "pull-down" lever, which, when operated, locks in position after releasing a spring-loaded contact switch to effect actuation of the alarm circuit.

The body of the manual station shall be hinged to a back-plate assembly to which it is locked with an allen head screw. Resetting the station after operation shall require opening the station momentarily, and then locking the body to the back-plate. Provision shall be made for surface or semi-flush mounting to conduit boxes.

The manual station shall also be fitted with an alarm lamp, and a key-operated switch to achieve the electrical sequence functions as desired.

Accessories

Model No.	Description	Shipping Wt.
MC-56 500-620490	Surface Mounting Box Locking Tool Package (Contains 2 tools)	2 1/2lbs. (1.1 Kg) 1/2 lb. (.2 Kg)

Ordering and Electrical Information

	Model Number	24V Alarm Lamp	Switch Contacts & Ratings		
			Main Action	First Action	Keyswitch
SINGLE ACTION STATION	MS-51		N.O. SPST .75 A @ 125 Vac/dc		
	MS-52C	Illuminated by main action switch or by external power with resistor & jumper removed	N.O. SPST .12 A @ 28 Vac/dc		
	MS-53		N.O. SPST .75 A @ 125 Vac/dc		N.O. SPST 1 A @ 250 Vac/dc 3 A @ 125 Vac/dc
	MS-57		N.O. DPST 1 A @ 250 Vac/dc 3 A @ 125 Vac/dc		
DOUBLE ACTION STATION	MS-501		N.O. SPST .75 A @ 125 Vac/dc		
	MS-512C	Illuminated by main action switch or by external power resistor & jumper removed	N.O. SPST .12 A @ 28 Vac/dc	N.O. SPST .75 A @ 125 Vac/dc	
	MS-513C		N.O. SPST .75 A @ 125 Vac/dc	N.O. SPST .75 A @ 125 Vac/dc	N.O. SPST 1 A @ 250 Vac/dc 3 A @ 125 Vac/dc
	MS-514C	Illuminated by main action switch or by external power with resistor & jumper removed	N.O. SPST .12 A @ 28 Vac/dc	N.O. SPST .75 A @ 125 Vac/dc	N.O. SPST 1 A @ 250 Vac/dc 3 A @ 125 Vac/dc
	MS-517C		N.O. DPST 1 A @ 250 Vac/dc 3 A @ 125 Vac/dc	N.O. SPST .75 A @ 125 Vac/dc	
	MS-518		N.O. SPST .75 A @ 125 Vac/dc	N.O. SPST 3 A @ 250 Vac/dc	

NOTICE: The use of other than Pyrotronics detectors and bases with Pyrotronics control equipment will be considered a misapplication of Pyrotronics equipment and as such void all warranties either expressed or implied with regards to loss, damage, liabilities and/or service problems.



Pyrotronics

A Division of Baker Industries, Inc.

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10M


January 1987

System 3™ Audible Devices

ENGINEER AND ARCHITECT SPECIFICATIONS

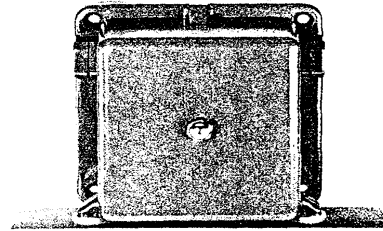
Bells, Series BAC/S, BDC/S Chimes, Series CAC/S, CDC/S

Features

- Heavy Duty
- Modular Construction
- Low Current Drain
-  Listed



BELL



CHIME

Description

Audible Devices for use with Pyrotronics Systems are available in a variety of models. Single stroke and vibrating polarized bells can be supplied in 6" and 10" sizes. In addition, polarized, single stroke and vibrating chimes are also available. All bells and chimes can be supplied for 24 Vdc or 115 Vac applications.

The use of polarized devices permits circuit supervision utilizing the exclusive Pyrotronics Supervised ac Bell Circuit (Patent No. 3521276). This circuit is unique in that it employs no voltage limiting resistors; therefore the number of devices on an audible circuit may be increased or decreased at any time without making resistor adjustments.

Pyrotronics Low Voltage Systems can accommodate either ac or dc devices depending on the type of Control Panel or Control Module incorporated in the system design.

These audible devices are designed to use a common basic mechanism with different size gongs and chimes. They represent a new high efficiency, attractiveness and effective signaling.

All bells and chimes mount on a standard 4" square outlet box. Adapter plates for other mountings are available. All audible devices are UL listed.

Electrical Information

Current requirements:

	Vibrating	Single Stroke
24 Vdc devices -	.070 amp	.36 amp
115 Vac devices-	.042 amp	.14 amp

Architect's Specifications

The audible device(s) shall be Pyrotronics Model (insert model number). The device shall be of the (insert single-stroke or vibrating) polarized type for operation on ----- (insert 24 Vdc or 115 Vac) audible circuit supply. The device shall be fully enclosed, heavy duty, and of modular design and shall be Underwriters Laboratories Inc. listed.

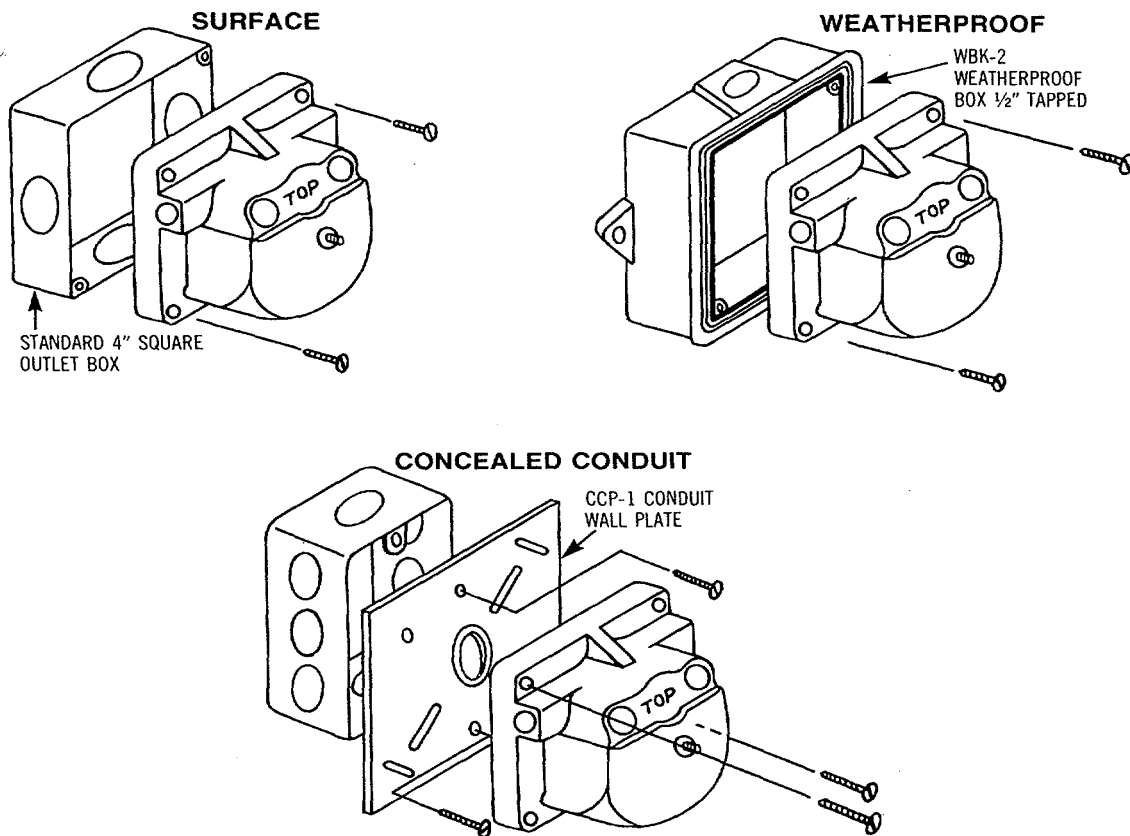
Accessories

Model No.	Description
CCP-1	Conduit Wall Plate
WBK-2	Weatherproof Box, 1/2" Tapped
BGD-2	Grill Guard
EL-2	End-of-line device, Low Voltage
EL-31	End-of-line device, System 3 dc circuits
EL-32	End-of-line device, System 3 ac circuits

Ordering Information

Model No.	Description	Vibrating	Single Stroke	115 Vac	24 Vdc	db's at 10 Ft.	Shipping Weight
BAC-6	6" Bell	X		X		95	3 lb (1.4 kg)
BAS-6	6" Bell		X	X		95	3 lb (1.4 kg)
BDC-624	6" Bell	X			X	87	3 lb (1.4 kg)
BDS-624	6" Bell		X		X	87	3 lb (1.4 kg)
BAC-10	10" Bell	X		X		102	6 lb (2.7 kg)
BAS-10	10" Bell		X	X		102	6 lb (2.7kg)
BDC-1024	10" Bell	X			X	92	6 lb (2.7 kg)
BDS-1024	10" Bell		X		X	92	6 lb (2.7 kg)
CAC-120	Chime	X		X		82	2.5 lb (1.1 kg)
CAS-120	Chime		X	X		82	2.5 lb (1.1 kg)
CDC-24	Chime	X			X	80	2.5 lb (1.1 kg)
CDS-24	Chime		X		X	80	2.5 lb (1.1 kg)

Mounting Details



NOTICE: The use of other than Pyrotronics detectors and bases with Pyrotronics control equipment will be considered a misapplication of Pyrotronics equipment and as such void all warranties either expressed or implied with regards to loss, damage, liabilities and/or service problems.

Pyrotronics

8 Ridgedale Avenue, Cedar Knolls, New Jersey 07927

1/88

2-5M Printed in U.S.A.


IG

March, 1985

Supersedes dated 4/79

• FIRE ALARM •

ENGRAVED PLATE: RED BACKGROUND,
WITH 1" WHITE LETTERS

		Post Office Box 2041 Mobile, Alabama 36652			
		SCALE	N.T.S.	REVISIONS	BY
DATE	05-31-84				
DR'N.	T.S.	CHKD.	T.S.		
AP'VD.	B.R.				
TITLE	IDENTIFICATION PLATE			NO.	1461-1574

577

RECOMMENDED SPARE PARTS

HILLER REFERENCE NO. JG-2255

FIRE DETECTION SYSTEM FOR US ARMY LARGE TUG

ITEM	QTY.	MANUFACTURER	DESCRIPTION	MODEL #	UNIT PRICE
01	2	Pyrotronics	Ionization Smoke Detector	D1-3	\$92.00
02	1	Pyrotronics	Thermal Detector 135 Degree F. WP	DT-135WP	50.00
03	5		2 AMP Fuse	3AG-2	2.00
04	5		15 AMP Fuse	3AG-15	2.00
05	5		2 AMP Fuse	AGX-2	2.00
06	2		End Line Capacitor 50MFD50VDC	100-115588	5.00
07	1		End Line Resistor 5.6KOHM1/2WATT 5%	RC-20	2.00

MARCH 1989

SECTION II

**Operation and Maintenance Manual for
Halon 1301 Fire Suppression System**

OPERATION AND MAINTENANCE MANUAL
FOR
HALON 1301 FIRE SUPPRESSION
SYSTEM

U.S. ARMY LARGE TUGS

HAZARDS:

SYSTEM 1 - ENGINE RM. & AUXILIARY MACHINERY RM. NO. 1
SYSTEM 2 - PAINT LOCKER

PREPARED FOR:

ROBERT E. DERECKTOR OF RHODE ISLAND, INC.
MIDDLETOWN, RHODE ISLAND 02840

PREPARED BY:

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3710 LAKESIDE COURT
MOBILE, ALABAMA 36693

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INTRODUCTION

The following Manual is intended to be used by Personnel responsible for operation, general periodic maintenance, service and repair of the Fire Suppression System. Whenever you undertake to inspect, test maintain or service this System, always keep in mind that you are accepting responsibility for -the safety of people's lives and protection of property, and equipment. This equipment is designed and manufactured to meet the highest requirements. However, if this equipment is not maintained properly, it may not be capable of doing the job it is intended to do.

HALON 1301

HALON 1301 fire extinguishing systems are used for controlling and extinguishing Class A (Cellulosic material), Class B (flammable liquids and gases), and Class C (electrical) fires where a clean extinguishing agent is required. The requirements for a clean agent, which leaves no residue after the fire is extinguished, is particularly applicable to high value areas where the fire protected material is susceptible to agent damage.

The Halon 1301 vapor has a low level of toxicity. Based on Underwriter's Laboratories tests with animals, the agent is classified as Group 6, which is the least toxic classification of life hazard for concentrations up to 20%. In order to provide adequate safety factors, systems used in normally occupied areas are limited to design concentrations of 10%, and may exceed 7% only when the protected area can be evacuated within one minute.

However, when the vapors are exposed to flame or hot surfaces above 9000F, halogen acids and free halogens are created as products of decomposition; These products create a greater potential toxicity problem than the vapors; the level of toxicity is dependent on the area or energy of the flames (or hot surfaces), the concentration of the Halon vapor, the time-period that the vapors are exposed to the flame (or hot surfaces), and the volume of the hazard. These factors are considered in the design of systems for occupied areas. The most important consideration is a rapid discharge of systems for occupied areas. The decomposition products have a characteristic sharp, acrid odor, even in minute concentrations of only a few parts per million. This odor provides a built-in warning system.

If it is necessary for a person to enter a fire exposed space before it is thoroughly ventilated, he may do so by using a fresh air mask or other self-contained breathing apparatus. Do not use a filter type of mask or canister gas mask when entering a Halon gas saturated area. Suitable safeguards providing prompt evacuation and preventing entry into exposed areas and safety items such as warning signs, discharge alarms and self-contained breathing apparatus shall be inspected periodically.

The affects of exposure to Halon 1301 may persist for a short period of time following exposure; however, recovery may be expected to be rapid and complete. Halon 1301 would not be expected to accumulate in the body even with repeated exposures. Anyone suffering from the toxic affects of Halon 1301 vapors should immediately move or be moved to fresh air.. Call a physician in treating persons suffering toxic affects due to exposure to this agent, the use of epinephrine (adrenaline) and similar drugs must be avoided because they may produce cardiac arrhythmias, including ventricular fibrillation.

The Halon 1301 agent is stored, in liquid form, in steel cylinders under nitrogen pressure of 360 pounds per square inch at 70 ° F. The contents are retained within the cylinder by a discharge control valve assembly. The operating principle of this valve is to use the pressure within the cylinder to affect release of the halogen agent. When the control head(s) operate, the pilot check of the discharge control valve is unseated providing a gas escape route of atmosphere. This causes a pressure drop in the chamber above the pressure balanced valve piston causing the piston to unseat and discharge the cylinder contents.

The solenoid valve control is used to activate the discharge control valve by providing a pressure escape route to atmosphere. This causes a pressure drop in the chamber above the pressure balanced valve piston, causing the piston to unseat and discharge the cylinder contents.

The nozzles are designed to distribute the halon agent at a metered rate, smoothly and evenly in a fan-shaped pattern. Nozzles are designed as straight fan nozzles or split fan nozzles; and, the nozzle type is selected for use in accordance with the installation. A straight fan nozzle is used when the nozzle is mounted on or adjacent to a wall to provide a single 180° for agent distribution pattern at- right angles to the nozzle. The split fan nozzle is used when the nozzle is installed in the center of the fire hazard area to provide 360 ° fan agent distribution pattern.

The burst disc is installed in the discharge control valve as a safety device preventing over-pressurizing the cylinder. The burst disc is designed to rupture between 750 to 900 PSIG at 70 ° F.

When ruptured by over-pressure, the ruptured disc provides an outlet to atmosphere through the disc retainer.

The pressure gauge is used to indicate pressure within the cylinder.

OPERATION

ENGINE ROOM &-AUX. MACHINERY ROOM NO. 1

GENERAL:

This Halon 1301 Fire Suppression System is operated by manual means only. If a fire is discovered, do not delay in manually operating the system. The effectiveness of Halon 1301 Agent is significantly increased by controlling the fire in its early stages.

WARNING:

Alert and evacuate personnel from fire hazard area immediately on detection of fire and where possible prior to actuation of system.

MANUAL OPERATION:

REMOTE:

Remote manual fire suppression system operation is performed as follows:

1. Proceed to location of remote control pull boxes marked for "HAZARD AFIRE".
 - A) Break glass and pull handle of Valve Control Pull Box.
 - B) Immediately break glass and pull handle of Cylinder Control Pull Box.

Alarm sounds 60 seconds prior to gas discharge, warning personnel to evacuate space.

LOCAL:

Local manual fire suppression system operation is performed as follows:

1. Proceed to agent supply cylinder assembly(s) marked for "HAZARD AFIRE".
 - A) Open Control Valve by removing locking pin and operating lever of control head mounted on Control Valve.
 - B) Discharge cylinder(s) by removing looking pin and operating lever of control head mounted on Control Cylinder(s).
 - C) If desired, discharge delay may be by-passed by removing looking pin and operating lever of control head mounted on Discharge Delay.

CAUTION:

Do not enter hazard area in which fire has been extinguished with an open flame or lighted cigarette as the possible presence of inflammable vapors may cause re-ignition or explosion.

For deep seated hazards, the hazard space should be kept tightly closed for 30 to 60 minutes after discharge of the Halon 1301 Agent. Be sure fire is completely extinguished before ventilating area. Before permitting anyone to enter the space, ventilate area thoroughly or insure self-contained breathing apparatus is being used.

OPERATION

PAINT LOCKER

GENERAL:

This Halon 1301 Fire Suppression System is operated by manual means only. If a fire is discovered, do not delay in manually operating the system. The effectiveness of Halon 1301 Agent is significantly increased by controlling the fire in its early stages.

WARNING:

Alert and evacuate personnel from fire hazard area immediately on detection of fire and where possible prior to actuation of system.

MANUAL OPERATION:

REMOTE:

Remote manual fire suppression system operation is performed as follows:

1. Proceed to location of remote Cylinder Control Pull Box marked for "HAZARD AFIRE".
 - A) Break glass and pull handle of Cylinder Control Pull Box.

Alarm sounds 25 seconds prior to gas discharge, warning personnel to evacuate space.

LOCAL:

Local manual fire suppression system operation is performed as follows:

1. Proceed to agent supply cylinder assembly(s) marked for "HAZARD AFIRE".
 - A) Discharge cylinder(s) by removing locking pin and operating lever of control head mounted on Control Cylinder(s).
 - B) If desired, discharge delay may be by-passed by removing locking pin and operating lever of control head mounted on Discharge Delay.

CAUTION:

Do not enter hazard area in which fire has been extinguished with an open flame or lighted cigarette as the possible presence of inflammable vapors may cause re-ignition or explosion.

For deep seated hazards, the hazard space should be kept tightly closed for 30 to 60 minutes after discharge of the Halon 1301 Agent. Be sure fire is completely extinguished before ventilating area. Before permitting anyone to enter the space, ventilate area thoroughly or insure self-contained breathing apparatus is being used.

MAINTENANCE

PERIODIC INSPECTION

The fire extinguishing system requires ordinary care to ensure efficient operation at all times. However, periodic inspections should be made to determine the exact condition of the system equipment.

MONTHLY

Make a general inspection survey of the system components and their immediate vicinity to ensure that accidental damage to equipment has not occurred and that no obstructions to the operation of the system or system distribution of agent are not present. Ensure that egress to the extinguisher assembly and all control pull boxes are unobstructed. Check extinguisher assembly pressure gauges for proper operating pressure.

SEMI-ANNUALLY

Check all agent supply cylinder pressure gauges for proper operating pressure. Check extinguisher assembly for proper charged weight. If charge weight or pressure has decreased, a pressure leak is apparent. Forward charged extinguisher assembly with control head removed, to a-service facility when weight loss is in excess of 5% or a loss in pressure (adjusted for temperature)-is more than 10 percent.

SERVICE

Fire extinguishing system service consists of the removal of an expended extinguisher assembly from the fire extinguishing system, recharge of the extinguisher assembly by a qualified agent and installation of the recharged extinguisher assembly into the system.

MAINTENANCE

System maintenance is performed as a result of periodic inspection, service requirement or system operation. To perform system maintenance, a maintenance contract with a qualified and approved service agency is recommended.

PREPARED FOR: R.E. DERECKTOR OF R.I., INC.
BY: HILLER SYSTEMS, INC.
HAZARD: ENGINE ROOM & AUX. MACHINERY RM. NO. 1
DATE: 07/11/89
FILE: JG2254A

SYSTEM SPECIFICATIONS

VOLUME OF HAZARD	25023.00	CU. FT.
MINIMUM OPERATING TEMPERATURE	32	F
MAXIMUM OPERATING TEMPERATURE	150	F
TOTAL WEIGHT REQUIREMENT AT MIN. TEMP.	676.00	LBS
DURATION OF LIQUID PHASE DISCHARGE	10.00	SECS
CONCENTRATION AT END OF DISCHARGE AT MIN. TEMP.	6.01	%
CONCENTRATION AT END OF DISCHARGE AT MAX. TEMP.	7.41	%
CYLINDER PRESSURE	360	PSIG
CYLINDER SIZE	350	LBS
NUMBER OF CYLINDERS	2	
HALON WEIGHT PER CYLINDER	338.00	LBS
CYLINDER FILL DENSITY	67.60	LBS/CU.FT.
AVERAGE CYLINDER PRESSURE	230.93	PSIG
PIPE SCHEDULE	40	
FITTING TYPE	Weld	
TOTAL LIQUID FLOW RATE	62.54	LBS/SEC
(Based on the liquid phase of the discharge only, per NFPA 1 2A)		
PERCENT AGENT IN PIPE	29.74	%
TOTAL PIPE VOLUME	3.428	CU.FT.

WALTER KIDDE HALON 1301 EVALUATION SYSTEM PAGE
(Version 2.1)

NO. 2

PREPARED FOR: R.E. DERECKTOR OF R.I., INC.
BY: HILLER SYSTEMS, INC.

HAZARD: ENGINE ROOM & AUX. MACHINERY RM. NO. 1
DATE: 07/11/89
FILE: JG2254A

PIPE INPUT SPECIFICATIONS

<u>FROM-TO</u>	<u>NEW HAZ?</u>	<u>NPS</u>	<u>K</u>	<u>L</u>	<u>DH</u>	<u>TT</u>	<u>ST</u>	<u>EL</u>	<u>SV</u>	<u>CV</u>	<u>MISC.</u>
4 3	Y	2.000	.500	.1	.0	0	0	0	0	0	49.9
3 2	N	3.000	.500	2.0	.0	0	1	1	0	0	0
2 1	N	3.000	1.000	.8	.0	1	0	0	0	0	0
1 2	N	3.000	1.000	33.5	2.2	0	0	5	0	0	0
2 3	Y	2.500	.640	27.5	-.8	0	1	3	0	0	0
2 401	Y	2.000	.360	3.3	.0	0	2	0	0	0	0
3 402	Y	2.000	.360	2.6	.0	0	2	1	0	0	0
3 403	Y	2.000	.280	22.0	.8	0	2	1	0	0	0

PREPARED FOR: R.E. DERECKTOR OF R.I., INC.
BY: HILLER SYSTEMS, INC.

HAZARD: ENGINE ROOM & AUX. MACHINERY RM. NO. 1
DATE: 07/11/89
FILE: JG2254A

PIPE INPUT SPECIFICATIONS

<u>PIPE SECTION FROM-TO</u>	<u>NEW HAZRD?</u>	<u>PIPE LENGTH FT.</u>	<u>EQUIV. LENGTH FT.</u>	<u>PIPE SIZE IN.</u>	<u>*FLOW RATE LBS/SEC</u>	<u>STATIC PRESSURE PSI</u>	<u>FLUID DENSITY LBS/CUFT</u>
4 3	Y	.1	50.0	2	31.27	212	66.2
3 2	N	2.0	16.3	3	31.27	214	66.9
2 1	N	.8	4.1	3	62.54	211	65.4
1 2	N	33.5	54.0	3	62.54	200	59.5
2 3	Y	27.5	45.6	2-1/2	40.46	184	51.4
2 401	Y	3.3	17.1	2	22.08	198	58.2
3 402	Y	2.6	19.2	2	22.54	181	49.8
3 403	Y	22.0	38.6	2	17.93	180	49.5

* NOTE: For flow splits into separate hazards, flow rates are corrected to compensate for initial vapor time.

PREPARED FOR: R.E. DERECKTOR OF R.I., INC.
BY: HILLER SYSTEMS, INC.

HAZARD: ENGINE ROOM & AUX. MACHINERY RM. NO. 1
DATE: 07/11/89
FILE: JG2254A

NOZZLE REQUIREMENTS

NOZZLE NUMBER	NEW HAZRD?	*PIPE SIZE IN.	CALC. KNOZZLE IN.	NOZZLE ORIFICE IN.	*PIPE THREAD IN.	NOZZLE PART NUMBER
401	Y	2	1.068	1.063	1-1/4	39341063
402	Y	2	1.144	1.141	1-1/2	39351141
403	Y	2	1.025	1.031	1-1/4	39341031

* NOTE: If pipe size and pipe thread differ, an adapter is required.

PREPARED FOR: R.E. DERECKTOR OF R.I., INC.
BY: HILLER SYSTEMS, INC.

HAZARD: ENGINE ROOM & AUX. MACHINERY RM. NO. 1
DATE: 07/11/89
FILE: JG2254A

PIPE AND FITTING SUMMARY

(FOR ESTIMATING PURPOSES ONLY)

PIPE SIZE IN.	TOTAL LENGTH FT.	UNIT WEIGHT LBS	TOTAL WEIGHT LBS	TEE	ELBOW	CHECK VALVE	STOP VALVE
2	28.00	3.652	102.26	0	2	0	0
2-1/2	27.5	5.790	159.23	1	3	0	0
3	36	7.580	275.15	3	6	0	0

NOTE: Tee listed with size of largest port. For other port sizes refer to Table of pipe layout specifications.

PREPARED FOR: R.E. DERECKTOR OF R.I., INC.
BY: HILLER SYSTEMS, INC.

HAZARD: PAINT LOCKER
DATE: 07/11/89
FILE: JG2254B

SYSTEM SPECIFICATIONS

VOLUME OF HAZARD	384.00	CU.FT.
MINIMUM OPERATING TEMPERATURE	1	F
MAXIMUM OPERATING TEMPERATURE	150	F
TOTAL WEIGHT REQUIREMENT AT MIN. TEMP.	12.00	LBS
DURATION OF LIQUID PHASE DISCHARGE	8.50	SECS
CONCENTRATION AT END OF DISCHARGE AT MIN. TEMP.	6.46	%
CONCENTRATION AT END OF DISCHARGE AT MAX. TEMP.	8.47	%
CYLINDER PRESSURE	360	PSIG
CYLINDER SIZE	20	LBS
NUMBER OF CYLINDERS	1	
HALON WEIGHT PER CYLINDER	12.00	LBS
CYLINDER FILL DENSITY	41.97	LBS/CU.FT.
AVERAGE CYLINDER PRESSURE	282.36	PSIG
PIPE SCHEDULE	40	
FITTING TYPE	Thread	
TOTAL LIQUID FLOW RATE	1.23	LBS/SEC
(Based on the liquid phase of the discharge only, per NFPA 12A)		
PERCENT AGENT IN PIPE	16.31	%
TOTAL PIPE VOLUME	.022	CU.FT.

PREPARED FOR: R.E. DERECKTOR OF R.I., INC.
BY: HILLER SYSTEMS, INC.

HAZARD: PAINT LOCKER
DATE: 07/11/89
FILE: JG2254A

PIPE INPUT SPECIFICATIONS

<u>FROM-TO</u>	<u>NEW HAZ?</u>	<u>NPS</u>	<u>K</u>	<u>L</u>	<u>DH</u>	<u>TI</u>	<u>SI</u>	<u>EL</u>	<u>SV</u>	<u>CV</u>	<u>MISC.</u>
2 1	Y	1.500	1.000	.1	.0	0	0	0	0	0	16.6
1 2	Y	.500	1.000	1.0	1.0	0	0	1	0	0	.0
2 401	Y	.500	1.000	8.8	5.3	0	2	2	0	0	11.0

PREPARED FOR: R.E. DERECKTOR OF R.I., INC.
BY: HILLER SYSTEMS, INC.

HAZARD: PAINT LOCKER
DATE: 07/11/89
FILE: JG2254A

PIPE LAYOUT REQUIREMENTS

PIPE SECTION FROM-TO	NEW HAZRD?	PIPE LENGTH FT.	EQUIV. LENGTH FT.	PIPE SIZE IN.	*FLOW RATE LBS/SEC	STATIC PRESSURE PSI	FLUID DENSITY LBS/CUFT
2 1	Y	.1	16.7	1-1/2	1.23	281	91.1
1 2	Y	1.0	2.7	1/2	1.23	279	90.3
2 401	Y	8.8	30.0	1/2	1.23	270	86.1

* NOTE: For flow splits into separate hazards, flow rates are corrected to compensate for initial vapor time.

PREPARED FOR: R.E. DERECKTOR OF R.I., INC.
BY: HILLER SYSTEMS, INC.

HAZARD: PAINT LOCKER
DATE: 07/11/89
FILE: JG2254A

NOZZLE REQUIREMENTS

NOZZLE NUMBER	NEW HAZRD?	*PIPE SIZE IN.	CALC. KNOZZLE IN.	NOZZLE ORIFICE IN.	*PIPE THREAD IN.	NOZZLE PART NUMBER
401	Y	1/2	.225	.228	1/2	39310228

* NOTE: If pipe size and pipe thread differ, an adapter is required.

PREPARED FOR: R.E. DERECKTOR OF R.I., INC.
BY: HILLER SYSTEMS, INC.

HAZARD: PAINT LOCKER
DATE: 07/11/89
FILE: JG2254A

PIPE AND FITTING SUMMARY

(FOR ESTIMATING PURPOSES ONLY)

<u>PIPE SIZE IN.</u>	<u>TOTAL LENGTH FT.</u>	<u>UNIT WEIGHT LBS</u>	<u>TOTAL WEIGHT LBS</u>	<u>TEE ----</u>	<u>ELBOW ----</u>	<u>CHECK VALVE ----</u>	<u>STOP VALVE ----</u>
1/2	9.80	.850	8.33	1	3	0	0
1-1/2	.10	2.717	.27	0	0	0	0

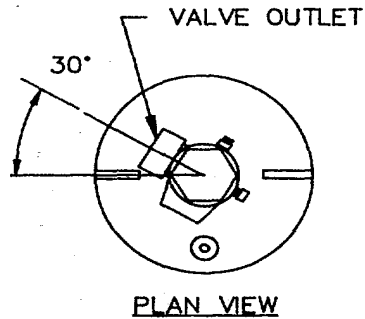
* NOTE: Tee listed with size of largest port. For other port sizes refer to Table of pipe layout specifications.

WALTER KIDDE

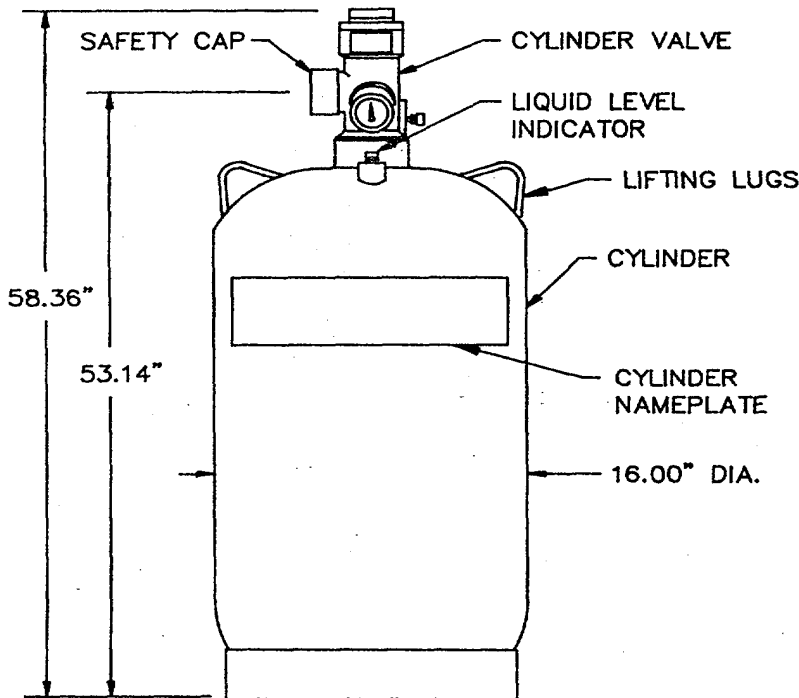
Fire Systems

COMPONENT DESCRIPTION

487 SERIES HALON 1301 CYLINDER AND VALVE ASSEMBLY 350 LB.(158.7 KG.) CAPACITY



P/N	DESCRIPTION
487350	STD
487351	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-2420 FOR ADDITIONAL INFORMATION.
3. FOR AMERICAN BUREAU OF SHIPPING (ABS) APPROVED CYLINDERS, ADD -01 TO CYLINDER PART NO.

MATERIAL:
VALVE BODY: BRASS
CYLINDER: STEEL, PAINTED RED,
WITH WHITE STRIPE

P/N - SEE TABLE

K-2360

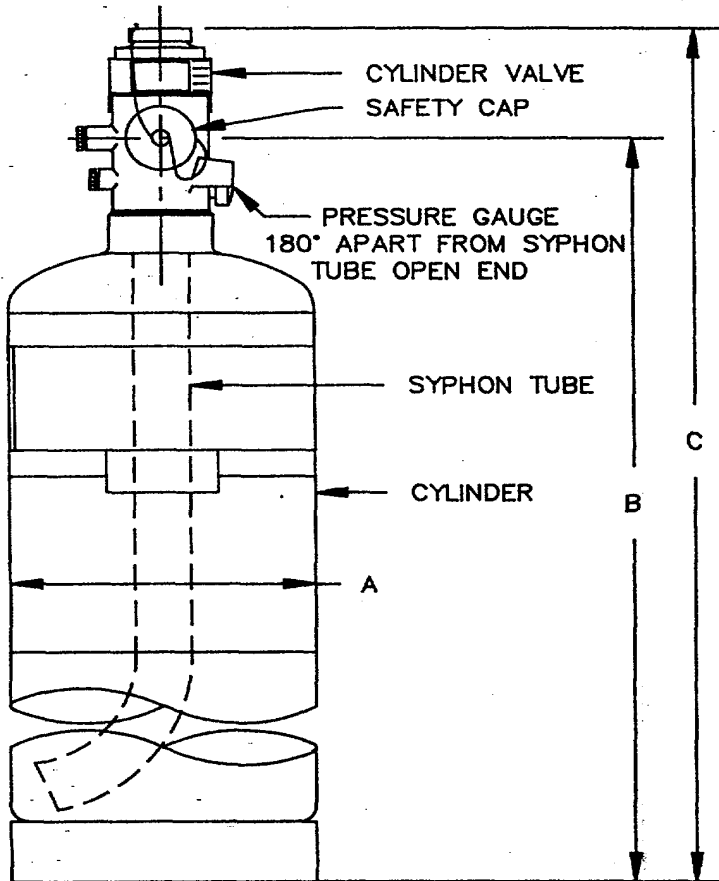


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Fire Systems

COMPONENT DESCRIPTION

487 SERIES HALON 1301 CYLINDER AND VALVE ASSEMBLIES 10 LB.(4.5 KG.) – 70 LB.(31.7 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-2420 FOR ADDITIONAL INFORMATION.
3. FOR AMERICAN BUREAU OF SHIPPING (ABS) APPROVED CYLINDERS, ADD -01 TO CYLINDER ASSEMBLY PART NO.
4. WHEN CYLINDER IS MOUNTED HORIZONTALLY, PRESSURE GAUGE MUST BE FACING UP.

PART NUMBER	CYL. SIZE	DIMENSIONS		
		A*	B*	C*
487010	10 LBS	7.07	13.34	17.30
487020	20 LBS	7.07	21.01	24.97
487040	40 LBS	9.00	22.80	26.76
487070	70 LBS	9.00	34.87	38.83

* DIMENSIONS ARE IN INCHES

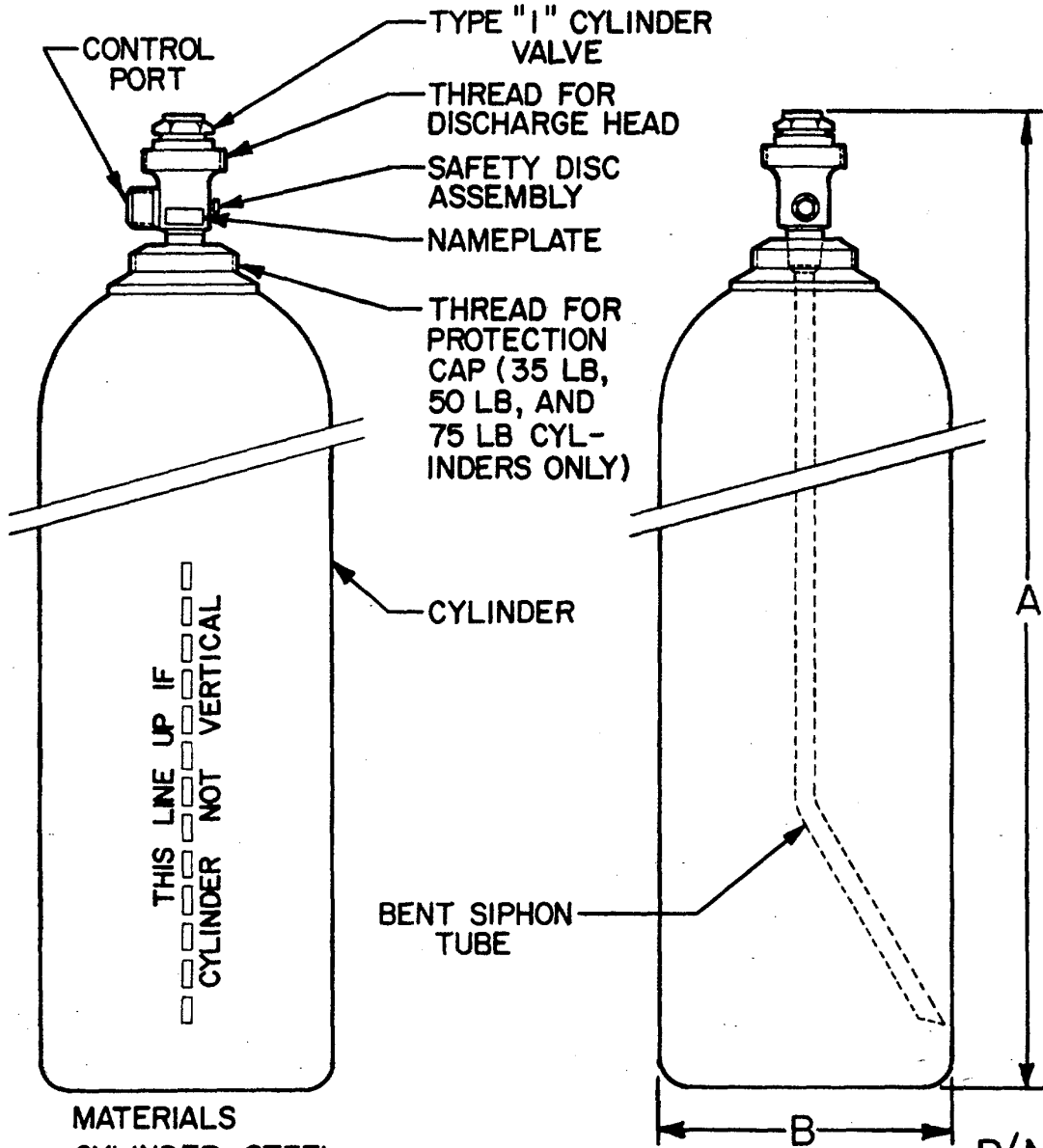
MATERIAL:
VALVE BODY: BRASS
CYLINDER: STEEL, PAINTED RED,
WITH WHITE STRIPE

P/N – SEE TABLE

K-2300



10 LB. THRU 75 LB.
 CARBON DIOXIDE CYLINDERS, BENT SIPHON TUBE



MATERIALS

CYLINDER : STEEL
 VALVE : SEE K-1040 FOR $\frac{1}{2}$ "
 SEE K-1050 FOR $\frac{5}{8}$ "
 SIPHON TUBE : ALUMINUM
 FOR DIMENSIONS AND
 ADDITIONAL DATA, SEE K-1030

PART NUMBER	CYLINDER	VALVE TYPE
870483	10 LB	5/8"
870484	15 LB	
870485	20 LB	
870486	25 LB	
982547	35 LB	
982548	50 LB	1/2"
870296	75 LB	

P/N-
 SEE TABLE



K-1020

CARBON DIOXIDE CYLINDER DATA

PART NUMBER	CYLINDER CO ₂ CAPACITY		VALVE SIZE	SAFETY DISC	SIPHON TUBE	DIM. "A" (HEIGHT)	
	LBS.	KG				IN.	MM.
870269	100	45.3	5/8"	RED	STRAIGHT	62	1570
870287	75	34.0	5/8"	RED	STRAIGHT	60	1520
982528	50	22.6	1/2"	WHITE	STRAIGHT	55	1390
870296	75	34.0	5/8"	RED	BENT	60	1520
982548	50	22.6	1/2"	WHITE	BENT	55	1390
982547	35	15.8	1/2"	WHITE	BENT	40	1010
870486	25	11.3	1/2"	WHITE	BENT	30	760
870485	20	9.0	1/2"	WHITE	BENT	31	780
870484	15	6.8	1/2"	WHITE	BENT	28	710
870483	10	4.5	1/2"	WHITE	BENT	24	600

PART NUMBER	DIM. "B" (DIAMETER)		CYLINDER VOLUME		NOMINAL CHGD. WEIGHT		DOT* CYLINDER SPECIFICATION
	IN.	MM.	IN. ³	M. ³	LBS.	KG.	
870269	10.50	266	4070	.0667	288	130.6	3AA-2300
870287	9.25	234	3055	.0501	205	92.9	3AA-2300
982528	8.50	215	2300	.0377	155	70.3	3A-2015
870296	9.25	234	3055	.0501	205	92.9	3AA-2300
982548	8.50	215	2300	.0377	155	70.3	3A-2015
982547	8.50	215	1510	.0247	114	51.7	3A-2015
870486	8.50	215	1040	.0170	84	38.1	3A-2015
870485	7.25	184	855	.0140	67	30.3	3AA-2015
870484	6.75	171	640	.0105	41.5	18.8	3AA-1800
870483	6.75	171	505	.0083	33	14.9	3AA-1800

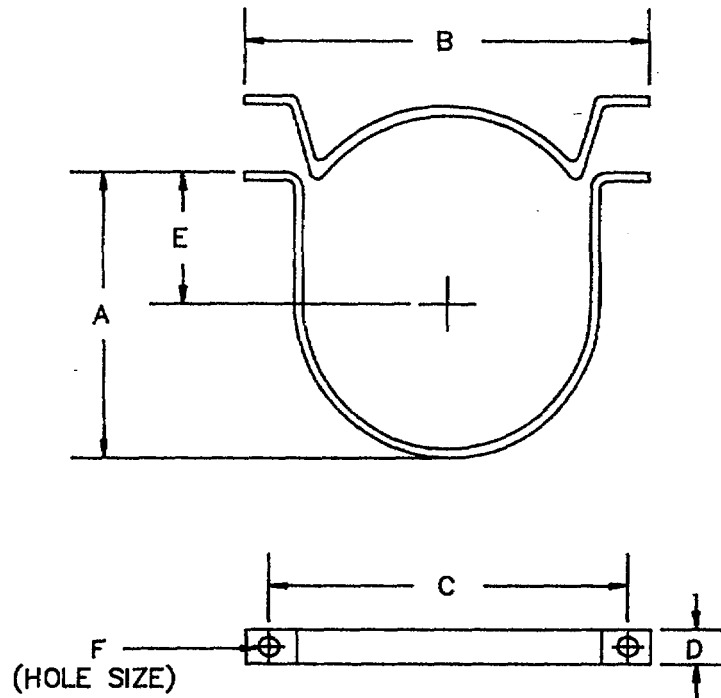
ALL CYLINDER VALVES ARE TYPE "I"



*U.S. Department of Transportation

K-1030

487 SERIES HALON 1301 MARINE BRACKET ASSEMBLY



PART NO.	CYL SIZE	CYL. O.D.*	A*	B*	C*	D*	E*	F*
486541	10,20	7.07	6.48	9.62	8.62	1.00	2.78	.437
486542	40,70	9.00	8.16	11.69	10.69	1.00	3.50	.437
486543	125,200	13.60	12.79	18.16	16.16	2.00	5.77	.687
486544	350	16.00	14.88	20.82	18.82	2.00	6.60	.812
486545	600	22.00	20.94	27.87	25.62	2.25	9.50	.938

* DIMENSIONS ARE IN INCHES

NOTE: 2 REQUIRED PER CYLINDER FOR USCG APPLICATIONS

MATERIAL: STEEL, PAINTED BLACK

P/N - SEE TABLE

K-2167

PART CODE	NO.	QUAN	COST	SPECIFICATIONS	2 CYLINDERS		3 CYL.		4 CYLINDERS		5 CYLINDERS	
					QUAN	COST	QUAN	COST	QUAN	COST	QUAN	COST
1495	9338	1-ROW CARRIAGE BOLT - MAR	2	1/2" X 13-3/8" LG. IRON	23 1/4		32 1/4		42 1/4		51 3/4	
"	9339	" " " -IND	0	" 15-3/8" " "								REAR
"	9379	2-ROW " " -MAR	0	" 23-1/8" " "	6811		6816		6821		6826	
"	9380	" " " -IND	0	" 25-1/8" " "								REAR
"	9343	3-ROW " " -MAR	0	" 32-3/4" " "			28 1/2		38		47 1/2	REAR
"	9344	" " " -IND	0	" 34-3/4" " "								REAR
"	9346	4-ROW " " -MAR	0	" 42-3/8" " "			28 1/2		38		47 1/2	REAR
"	9384	" " " -IND	0	" 44-3/8" " "								REAR
1491	3248	MACHINE BOLT - HEX. HD.	4	1/2" X 3" LG. IRON	6812		6817		6822		6827	
1519	3200	HEX. NUT	6	FOR 1/2" BOLT IRON								
1577	3200	WASHER	10	FOR 1/2" BOLT IRON								
2695		RECT. WASHER	2	1/4" IRON PLATE	6813		6818		6823		6828	REAR
1623		ANGLE IRON	0									CENTER
					6794		6799		6804		6809	CENTER
					6795		6800		6805		6810	FRONT
							30972		30973		30974	CENTER
					30976		30975		30977			FRONT
					TOTAL COST		TOTAL COST		TOTAL COST		TOTAL COST	

PART CODE	NO.	QUAN	COST	SPECIFICATIONS
4556	1 CYL. SUPPORTING ANGLE	0		2 x 2 x 1/4 ANGLE 9 1/2" LG
4648	2 " " " "			" " " 19 "
4318	3 " " " "			" " " 28 1/2 "
5029	4 " " " "			" " " 38 "
4555	5 " " " "			" " " 47 1/2 "
4647	6 " " " "			" " " 57 "
5711	7 " " " "			" " " 66 1/2 "
5977	8 " " " "			" " " 76 "
6345	9 " " " "			" " " 85 1/2 "
6074	10 " " " "			" " " 95 "
15526	11 " " " "			" " " 104 1/2 "
15427	12 " " " "			" " " 114 "
18684	13 " " " "			" " " 123 1/2 "
18685	14 " " " "			" " " 133 "
18686	15 " " " "			" " " 142 1/2 "
4624	16 " " " "	2		" " " 152 "
TOTAL COST				

REMARKS

1 1/2" CONTINUOUS ANGLE & WEIGH BAR BRACKET SUPPORT TO BE SECURELY FASTENED TO BULKHEAD. (BY OTHERS)

5 1/4" FROM BOTTOM OF CYLINDER

E OF CYLINDER

WALTER KIDDE & COMPANY, INC.		
OAK RACK - ORDER SHEET 50 LB CYLS. 9 1/2" CENTERS - WALL MOUNTING		
ROBERT E. DERECTOR OF RHODE ISL. I.I.K.		
MIDDLETOWN, RHODE ISLAND		
U.S. ARMY LARGE TIGS		
CYL. LAYOUT BY	NO. CONTRACT	REV
CHK.	10 • 2254 •	
DATE		

TOTAL COST ALL ITEMS

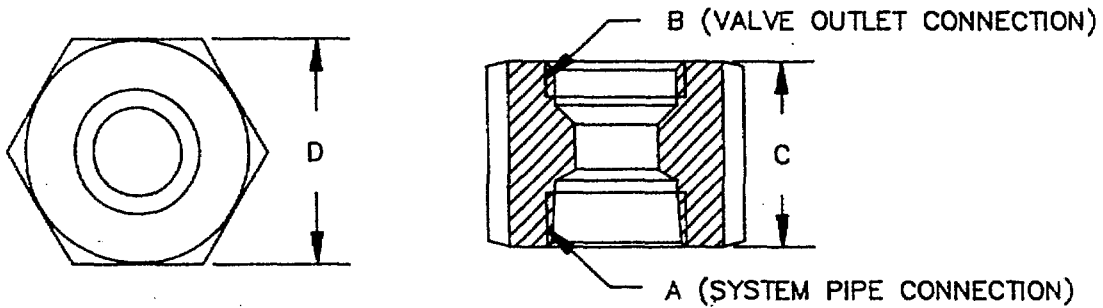
ISSUE		
DATE	NO.	TO

WALTER KIDDE

Fire Systems

COMPONENT DESCRIPTION

487 SERIES HALON 1301 VALVE OUTLET ADAPTER



PART NO.	SIZE	A*	B*	C*	D*
283904	1-1/2	1-1/2 11-1/2 NPT	1.875 12 UNJ	2.69	2.50 HEX
283905	2	2 11-1/2 NPT	2.500 12 UNJ	3.12	3.00 HEX
283906	2-1/2	2-1/2 8 NPT	3.000 12 UNJ	3.00	3.75 HEX

* DIMENSIONS ARE IN INCHES

NOTE: FOR DIRECT CONNECTION OF CYLINDER VALVE TO DISTRIBUTION PIPING.

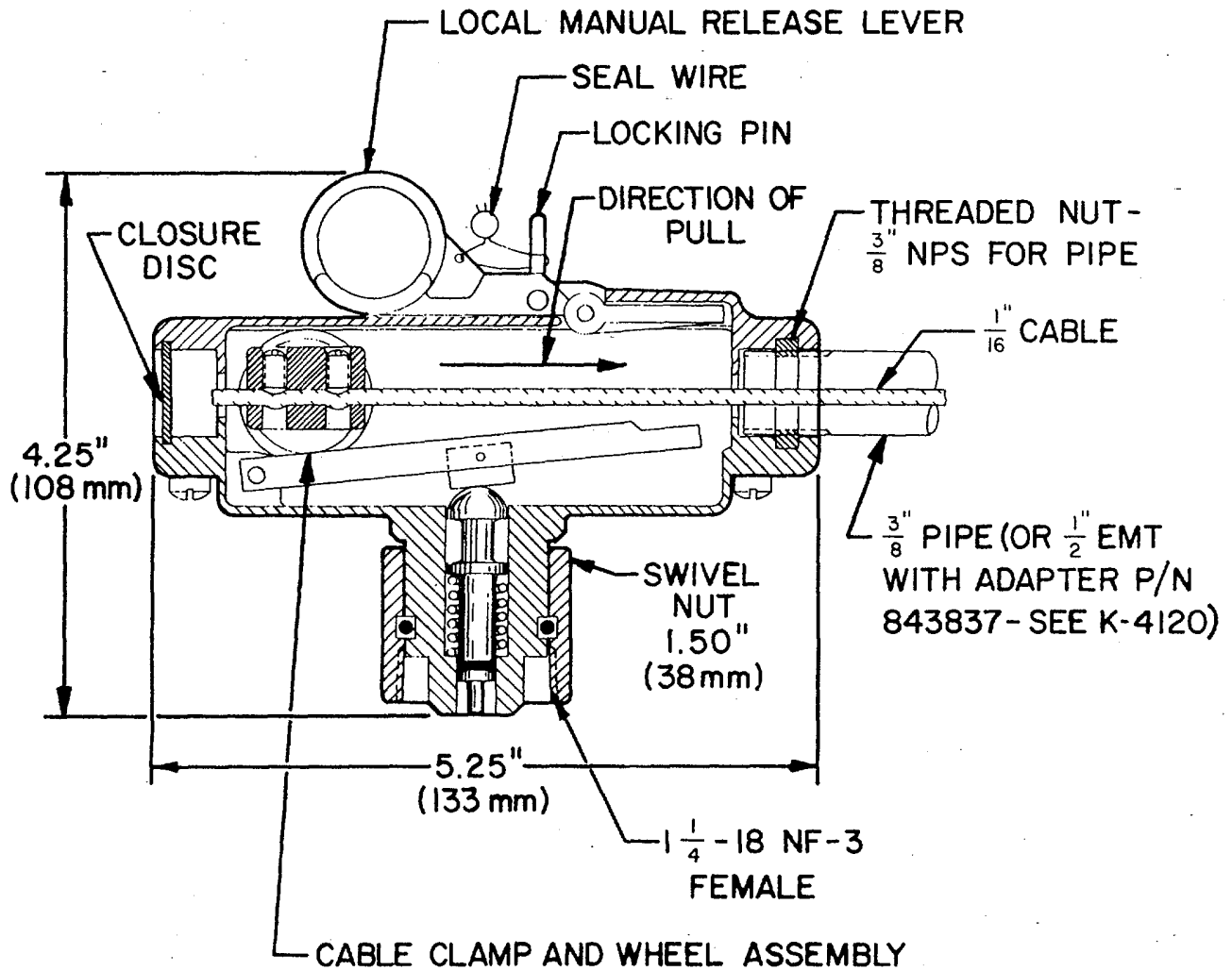
MATERIAL: BRASS

P/N - SEE TABLE

K-2106



CABLE OPERATED CONTROL HEAD



P/N 979469



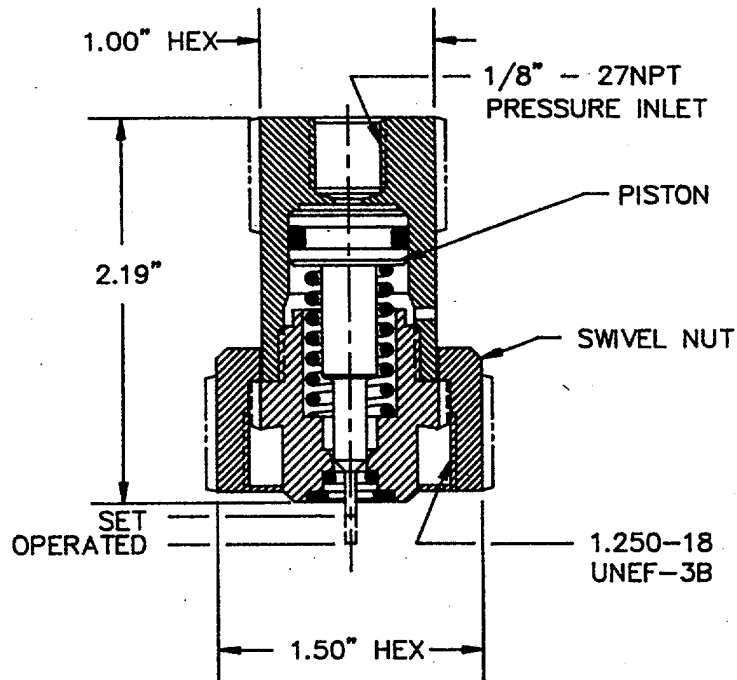
K-4020

WALTER KIDDE

Fire Systems

COMPONENT DESCRIPTION

487 SERIES HALON 1301 PRESSURE OPERATED CONTROL HEAD



MATERIAL:
BODY, RETAINING NUT,
AND PISTON: BRASS

P/N - 878737

K-3135

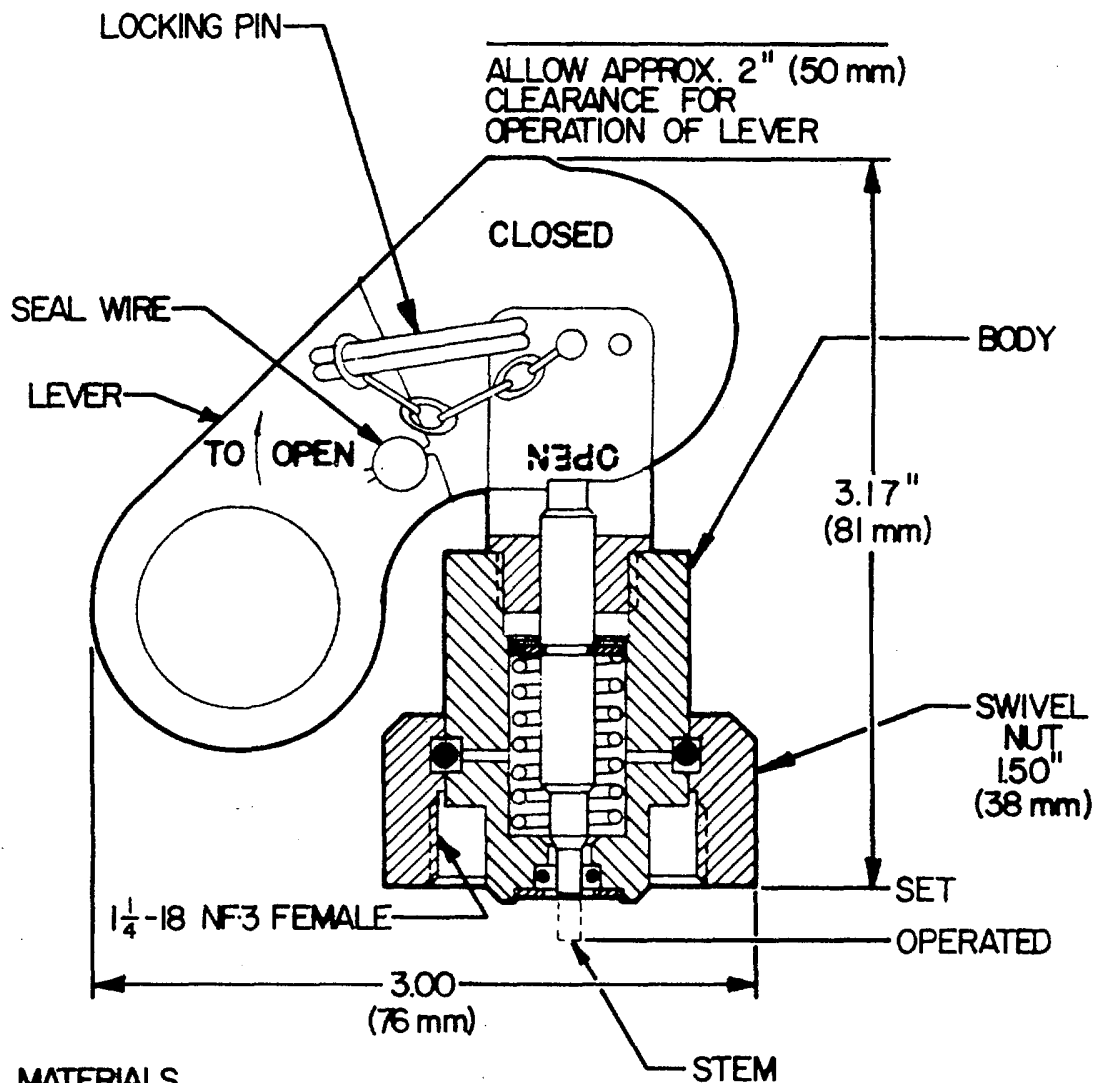


WALTER KIDDE

Division of Kidde, Inc.
Walter Kidde Dr., Wake Forest, NC 27587

COMPONENT DESCRIPTION

LEVER OPERATED CONTROL HEAD



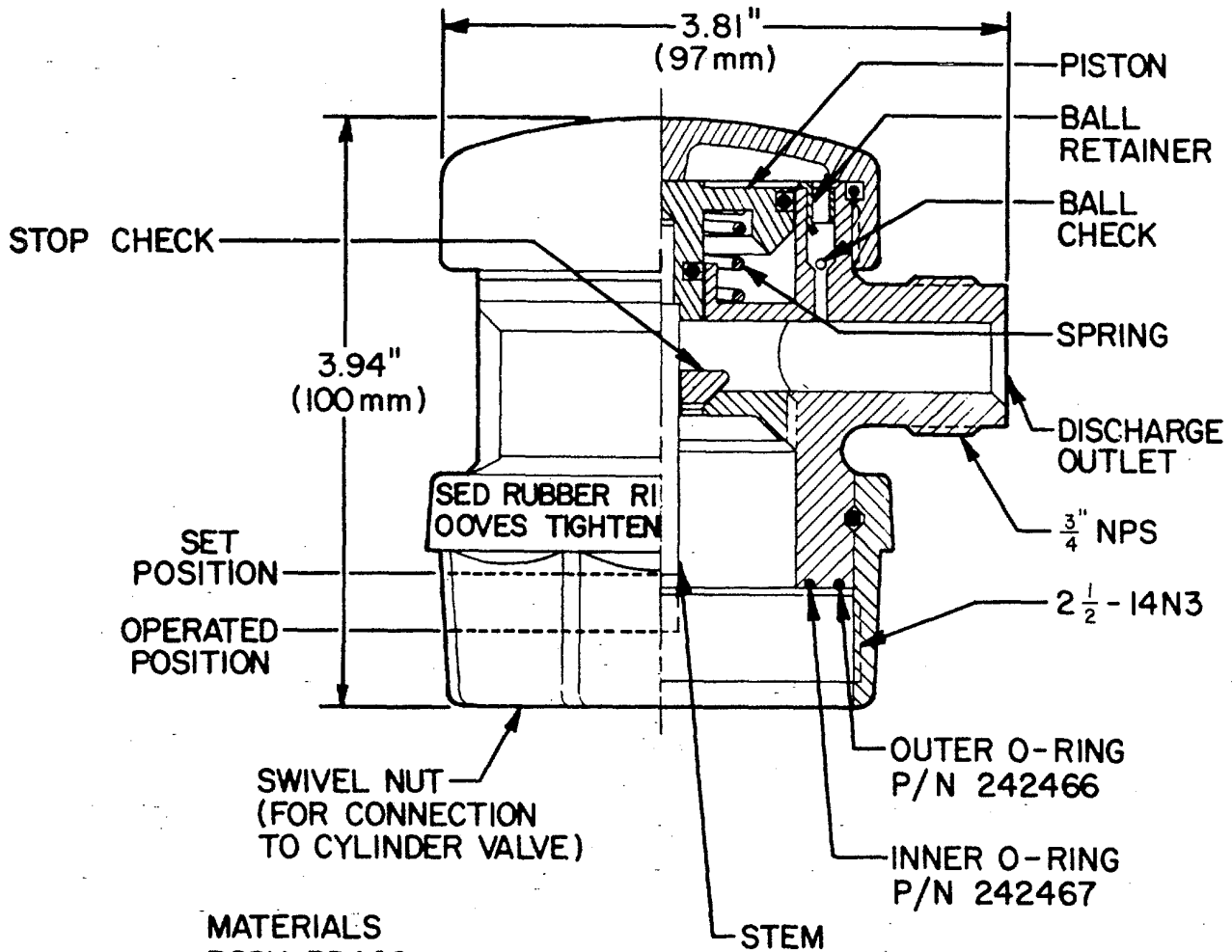
MATERIALS
LEVER: STAINLESS STEEL
BODY: BRASS

P/N 870652



K-4010

PLAIN NUT DISCHARGE HEAD



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

P N 872450



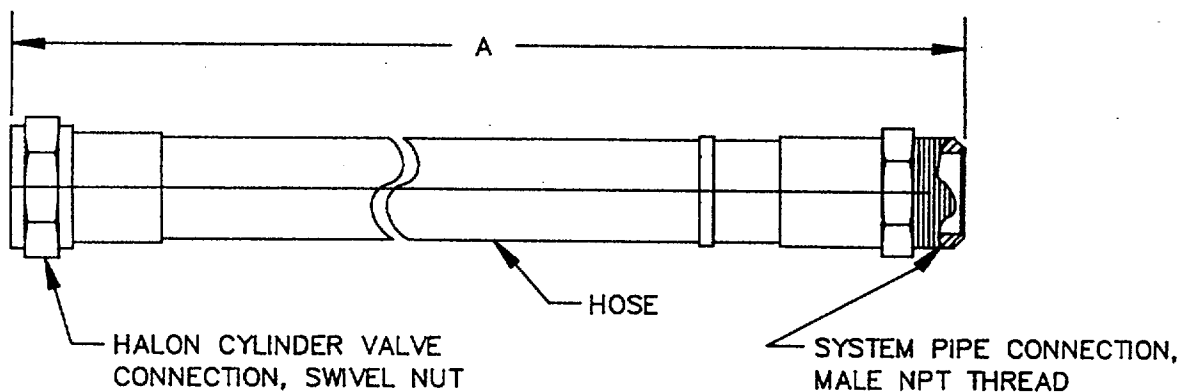
K-1060

WALTER KIDDE

Fire Systems

COMPONENT DESCRIPTION

487 SERIES HALON 1301 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

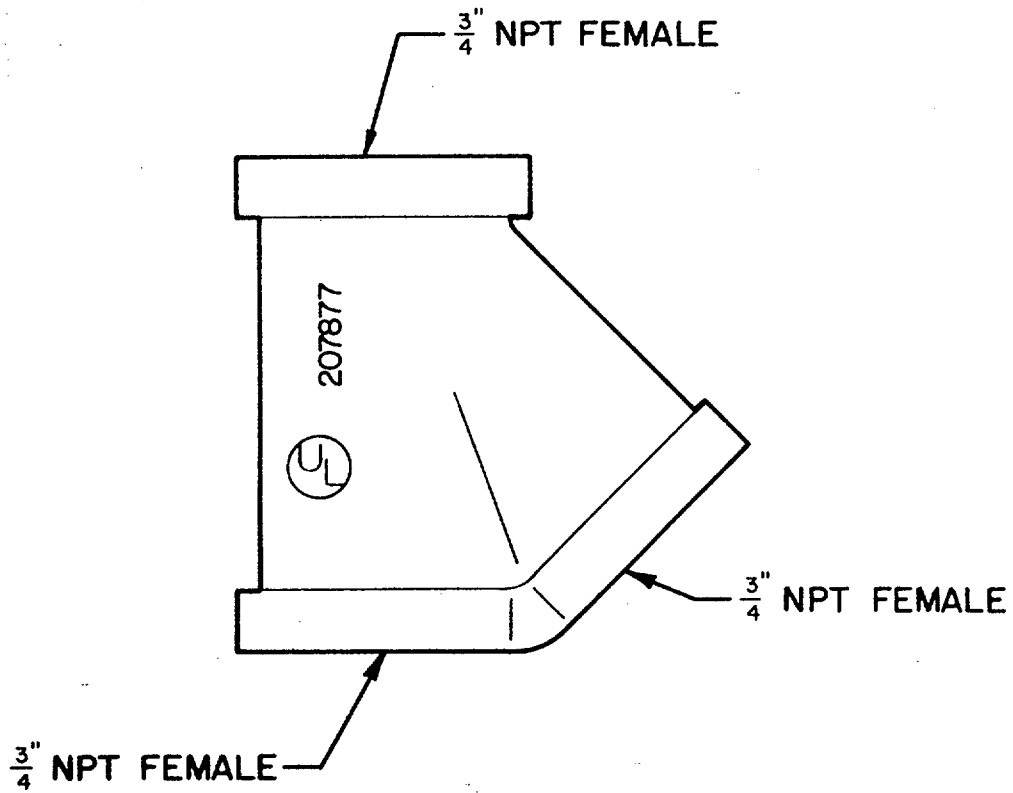
MINIMUM BURSTING PRESSURE: 2000 PSI

P/N - SEE TABLE

K-2105



MANIFOLD "Y" FITTING



MATERIAL : GALVANIZED MALLEABLE IRON

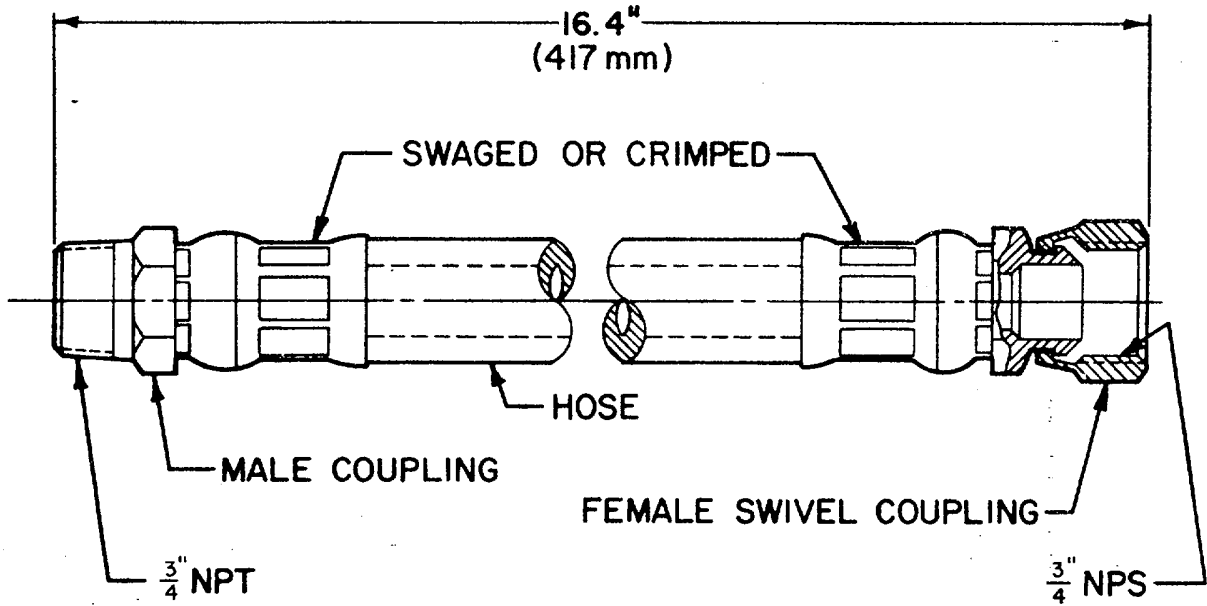
P/ N 207877

WALTER KIDDE

Division of Kidde, Inc.
Walter Kidde Dr., Wake Forest, NC 27587

COMPONENT DESCRIPTION

FLEXIBLE LOOP, $\frac{3}{4}$ " OUTLET



MATERIALS

HOSE: RUBBER WITH INTERNAL WIRE BRAID

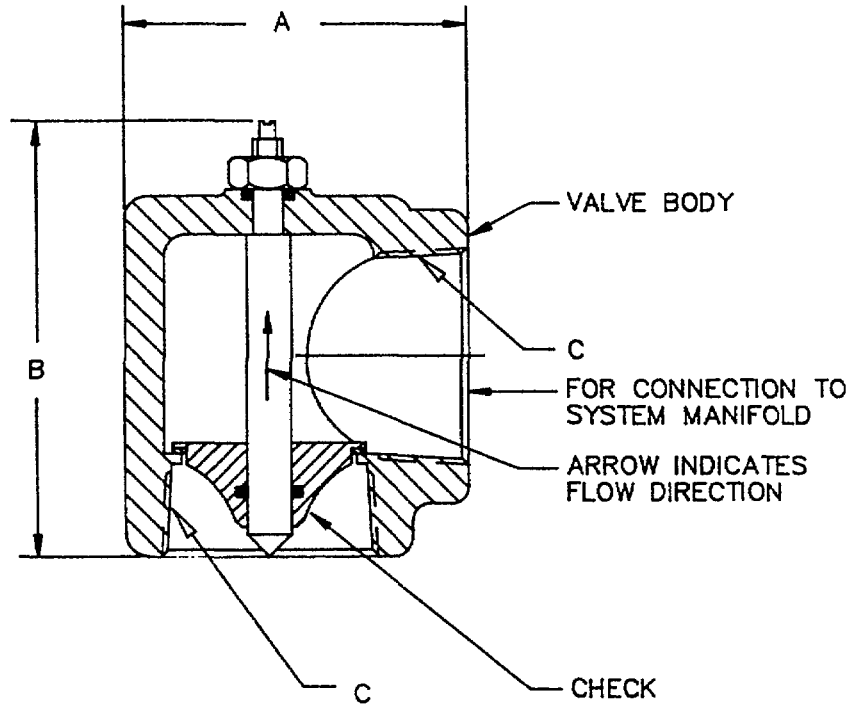
COUPLINGS: CADMIUM PLATED STEEL

P/N 251821



K-1080

MANIFOLD EL-CHECKS



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.

MATERIAL:
VALVE BODY: CAD PLATED STEEL
CHECK: STAINLESS STEEL
SEAT: NITRILE RUBBER

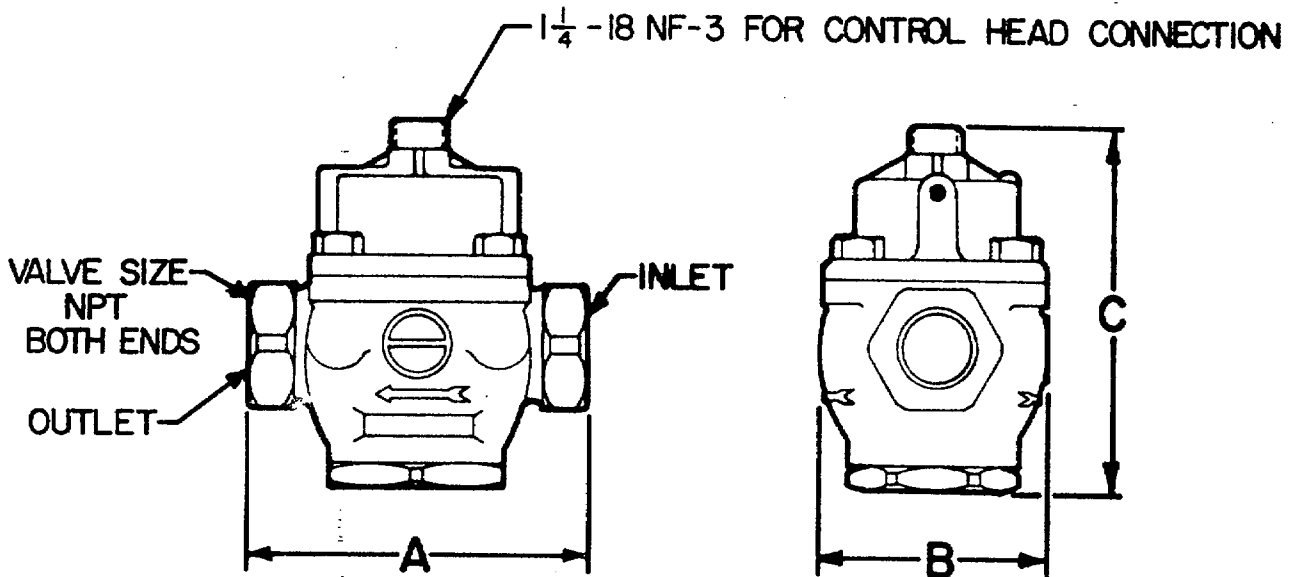
P/N - SEE TABLE

K-2110
REV.3 7/88

STOP (DIRECTIONAL) VALVES, $\frac{1}{2}$ " THROUGH 2" SIZES

NOTES

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

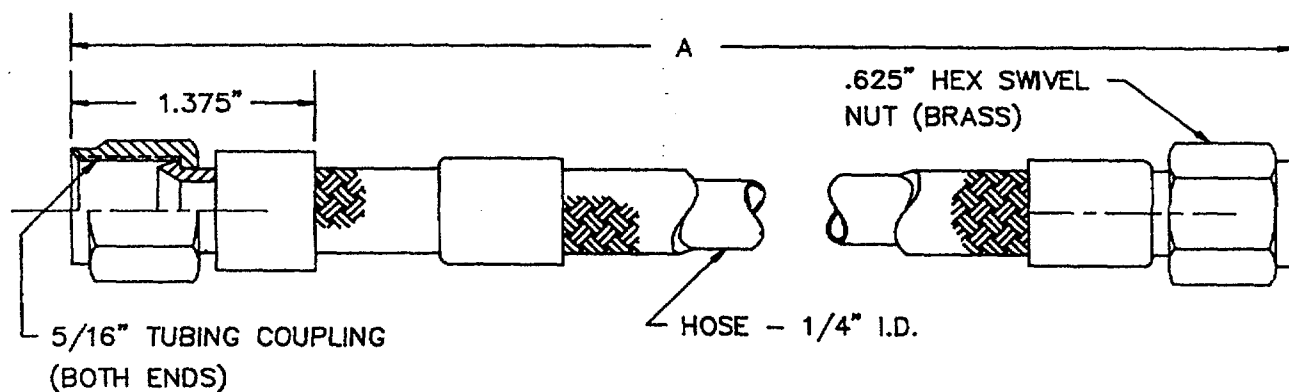


PART NUMBER	VALVE SIZE NPT	A		B		C	
		IN	mm	IN	mm	IN	mm
870023	$\frac{1}{2}$ "	3.75	95	2.5	64	4.68	119
870022	$\frac{3}{4}$ "	4.25	108	2.81	71	5.68	144
870122	1"	5.5	140	3.62	92	6.87	175
870032	$1\frac{1}{4}$ "	5.5	140	3.62	92	6.87	175
870123	$1\frac{1}{2}$ "	7.5	191	4.75	121	8.43	214
870049	2"	7.5	191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

MATERIAL
BODY: BRASS

P/N-SEE TABLE

487 SERIES HALON 1301 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"

P/N - SEE TABLE

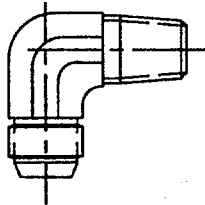
K-3035

WALTER KIDDE

Fire Systems

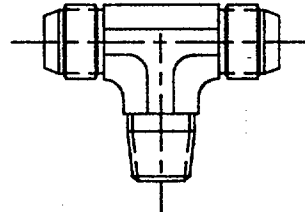
COMPONENT DESCRIPTION

487 SERIES HALON 1301 PILOT ACTUATION FITTINGS



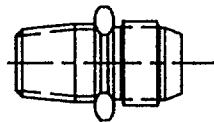
MALE ELBOW

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

P/N - SEE ABOVE

K-3015

WALTER KIDDE

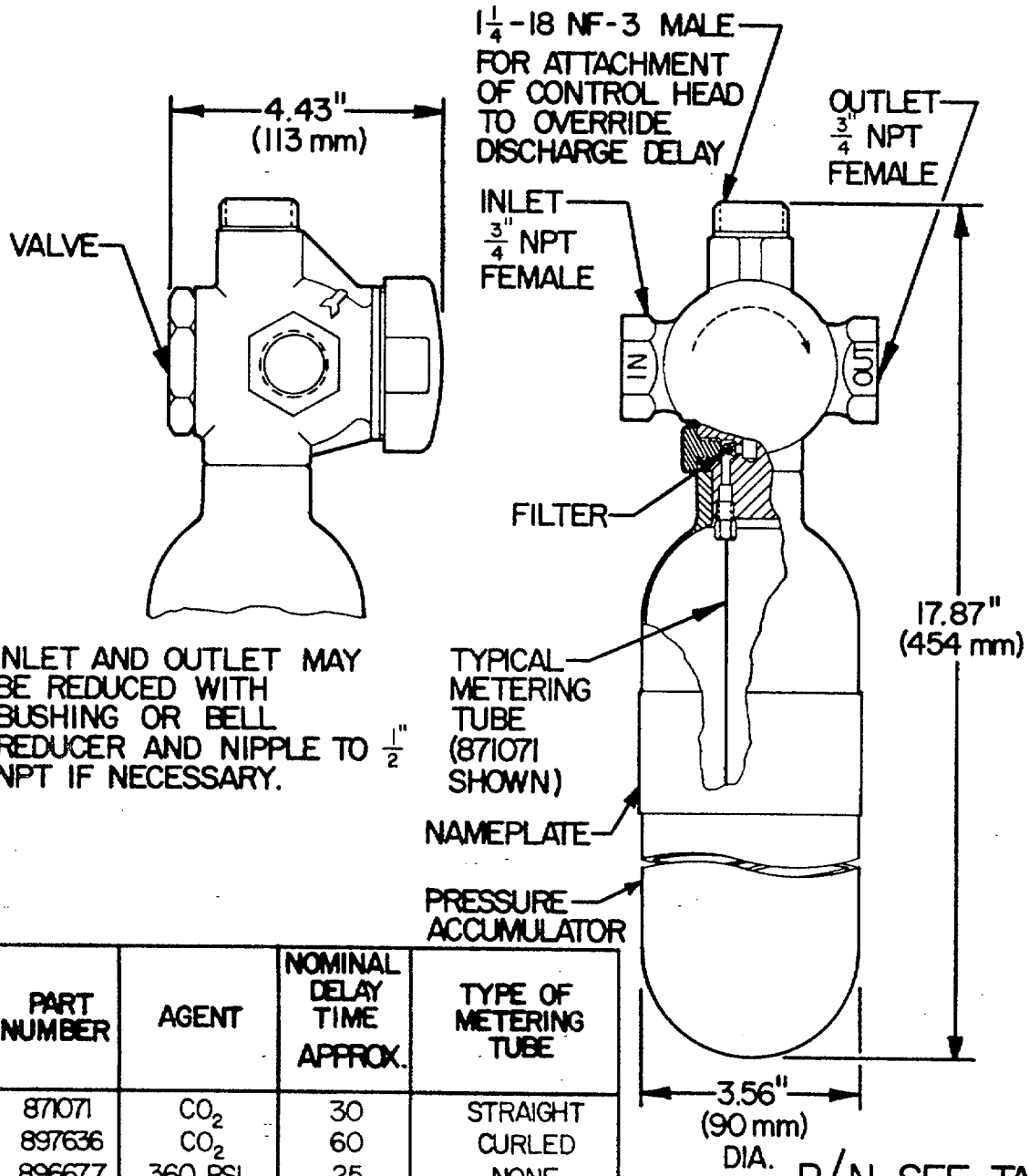
Division of Kidde, Inc.
Fire Systems Operations
Wake Forest, North Carolina 27587, U.S.A.

COMPONENT DESCRIPTION

DISCHARGE DELAYS

MATERIALS
PRESSURE ACCUMULATOR: STEEL
METERING TUBE: STAINLESS STEEL
VALVE BODY: BRASS

FINISH: RED PAINT



INLET AND OUTLET MAY BE REDUCED WITH BUSHING OR BELL REDUCER AND NIPPLE TO $\frac{1}{2}$ " NPT IF NECESSARY.

PART NUMBER	AGENT	NOMINAL DELAY TIME APPROX.	TYPE OF METERING TUBE
871071	CO ₂	30	STRAIGHT
897636	CO ₂	60	CURLED
896677	360 PSI HALON 1301	25	NONE (ORIFICE ONLY)

P/N-SEE TABLE

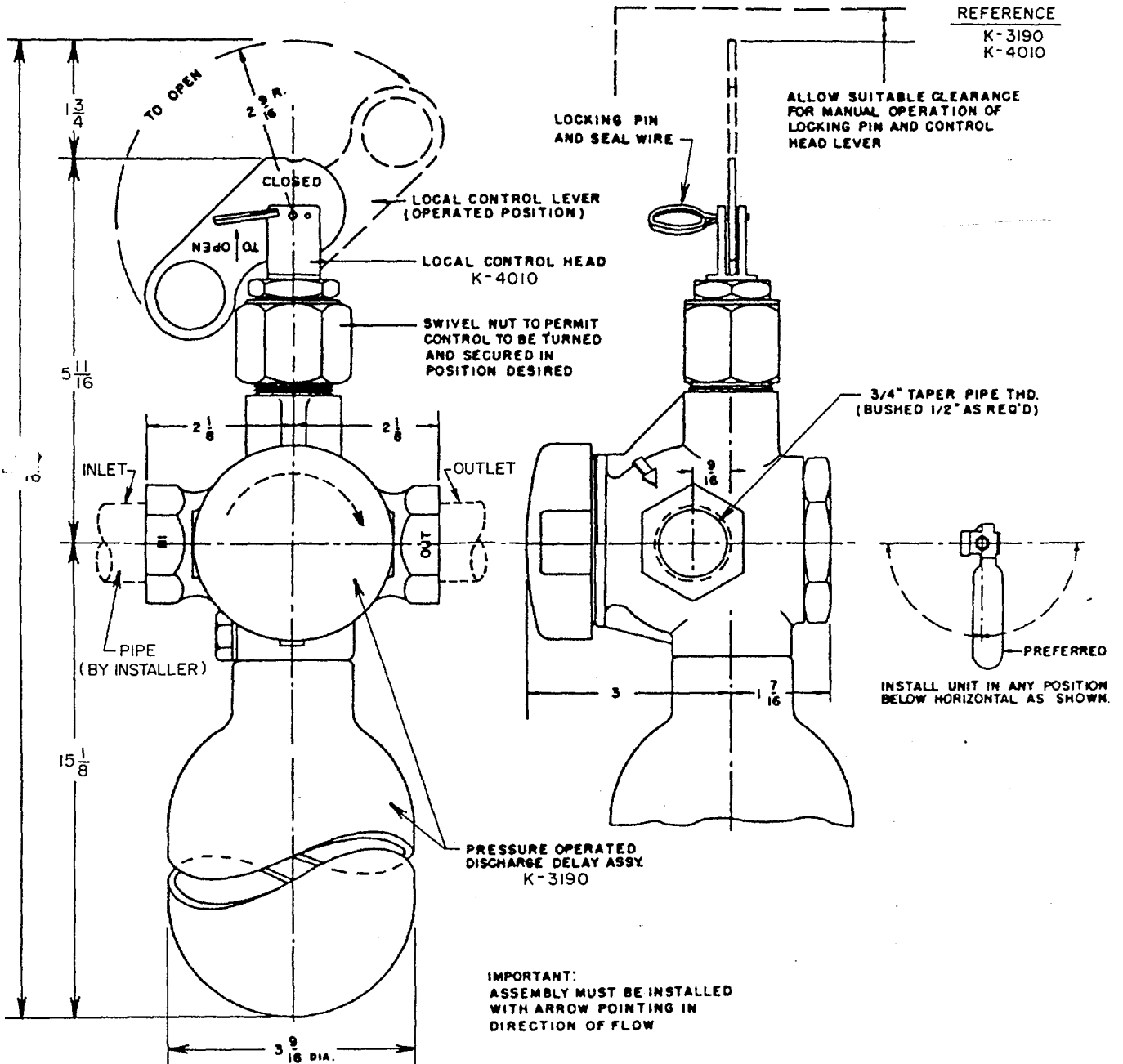


WALTER KIDDE

Division of Kidde, Inc.
Fire Systems Operations
Wake Forest, North Carolina 27587, U.S.A.

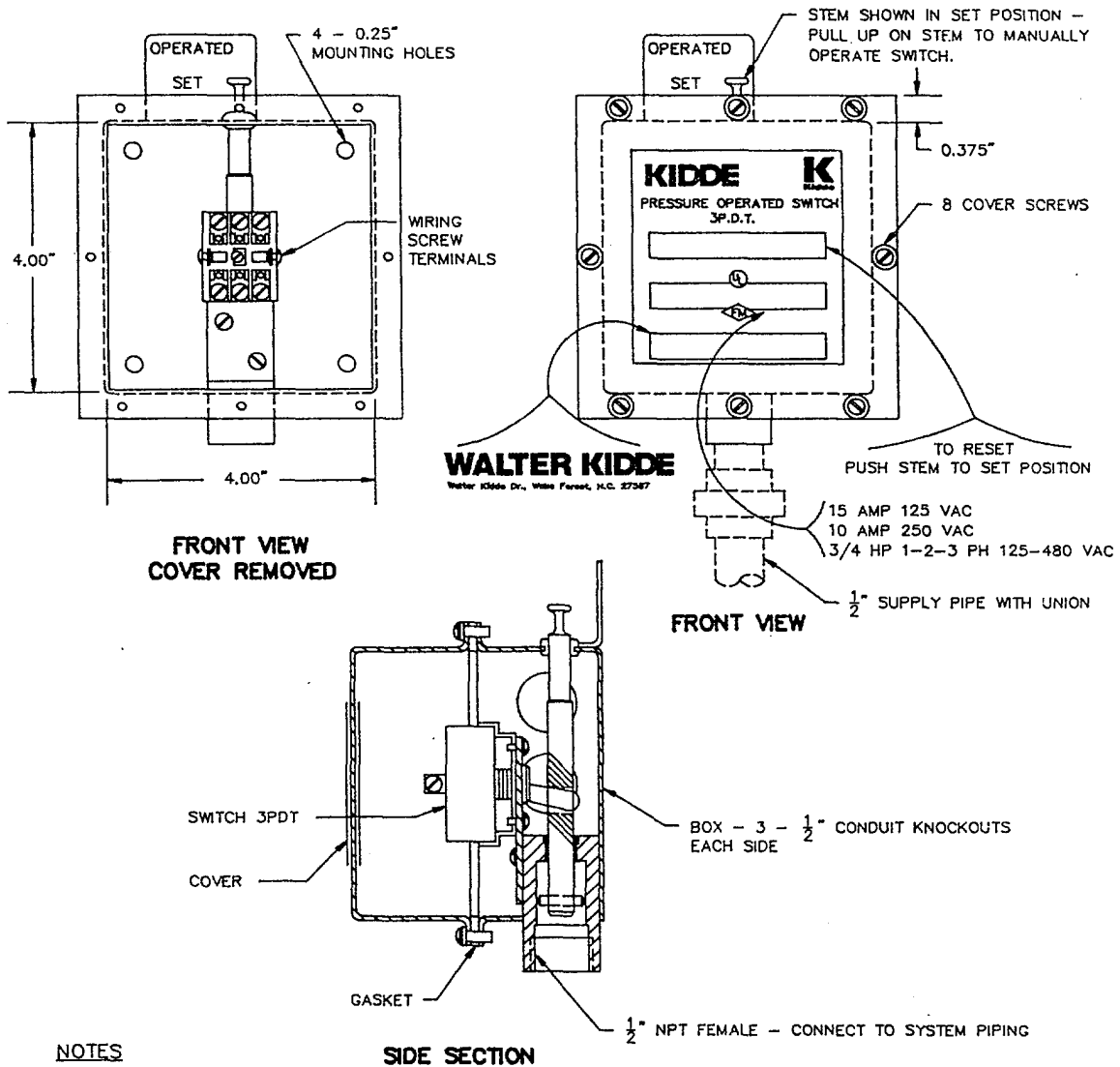
INSTALLATION DETAIL

RESSURE OPERATED DISCHARGE DELAY AND LOCAL CONTROL HEAD



K-3192

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)

P/N - 486536

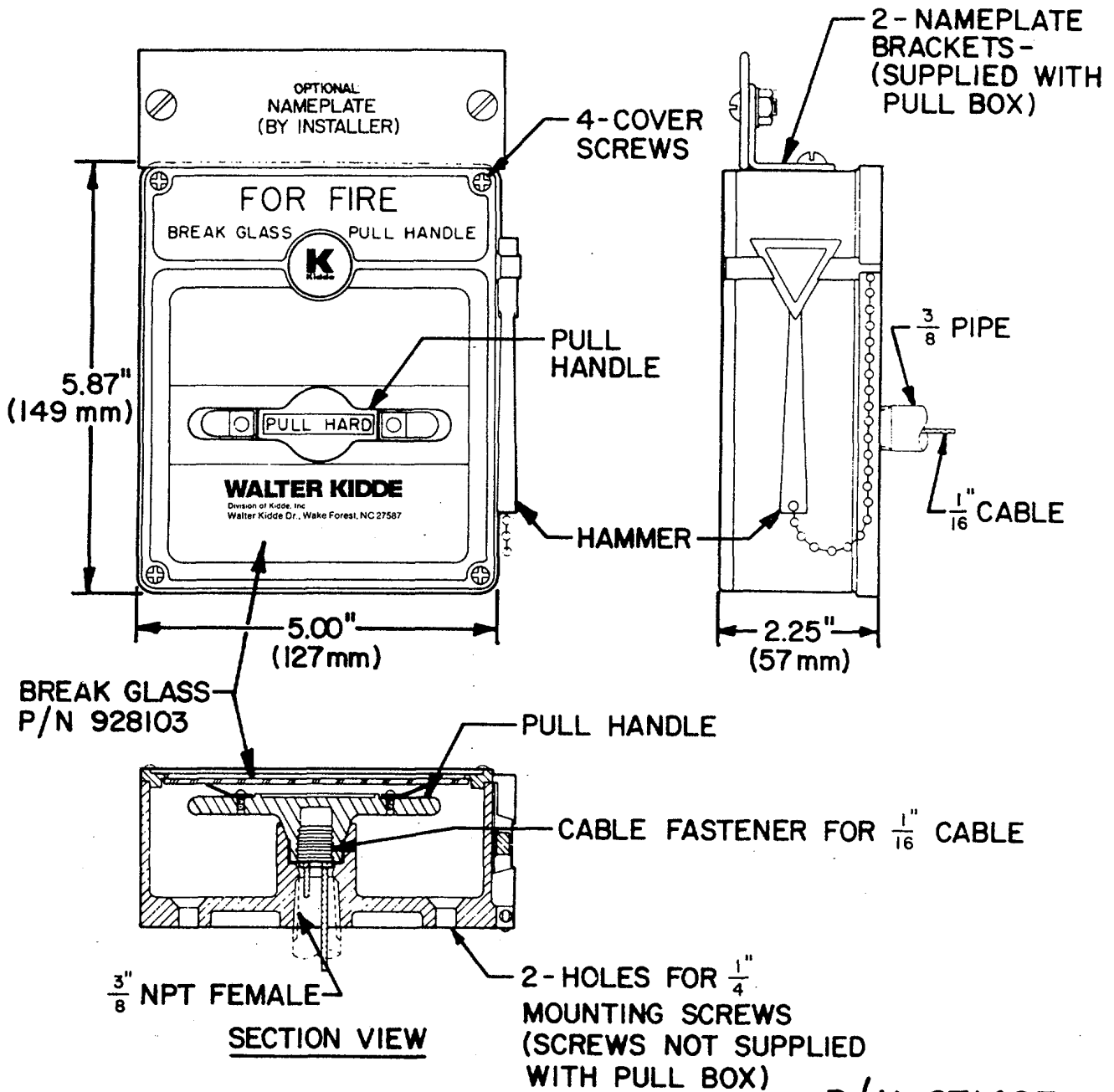
K-3161
REV.2 : 7/88

WALTER KIDDE

Division of Kidde, Inc.
Walter Kidde Dr., Wake Forest, NC 27587

COMPONENT DESCRIPTION

PULL BOX, BREAK GLASS



P/N 871403



MATERIALS
BODY: ALUMINUM
HANDLE: BRASS

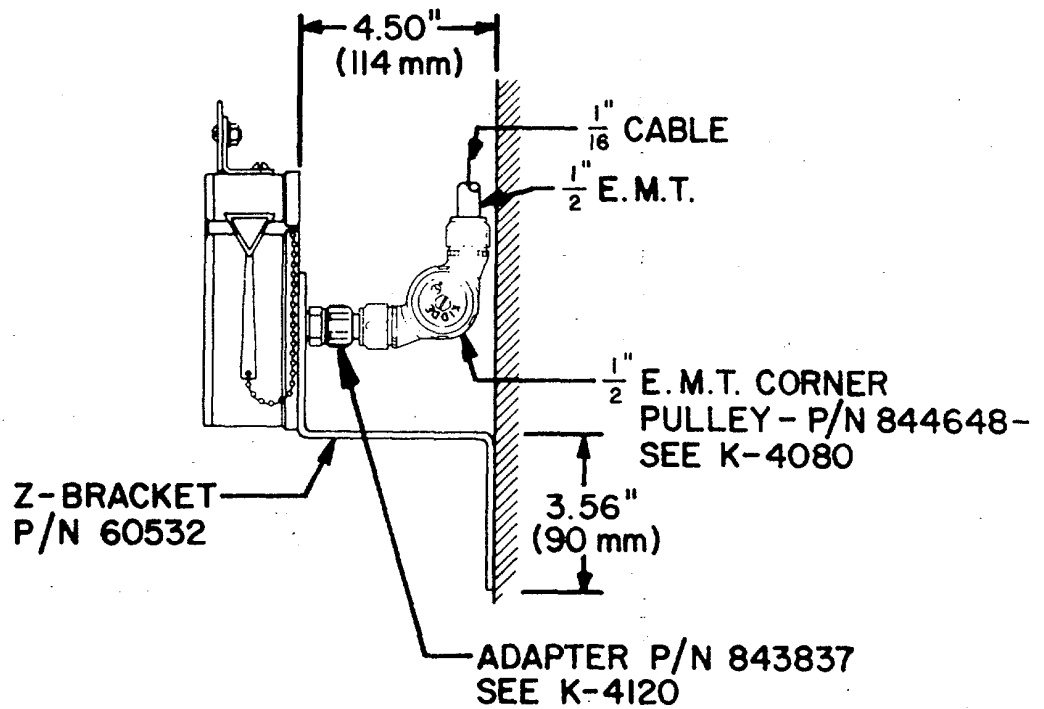
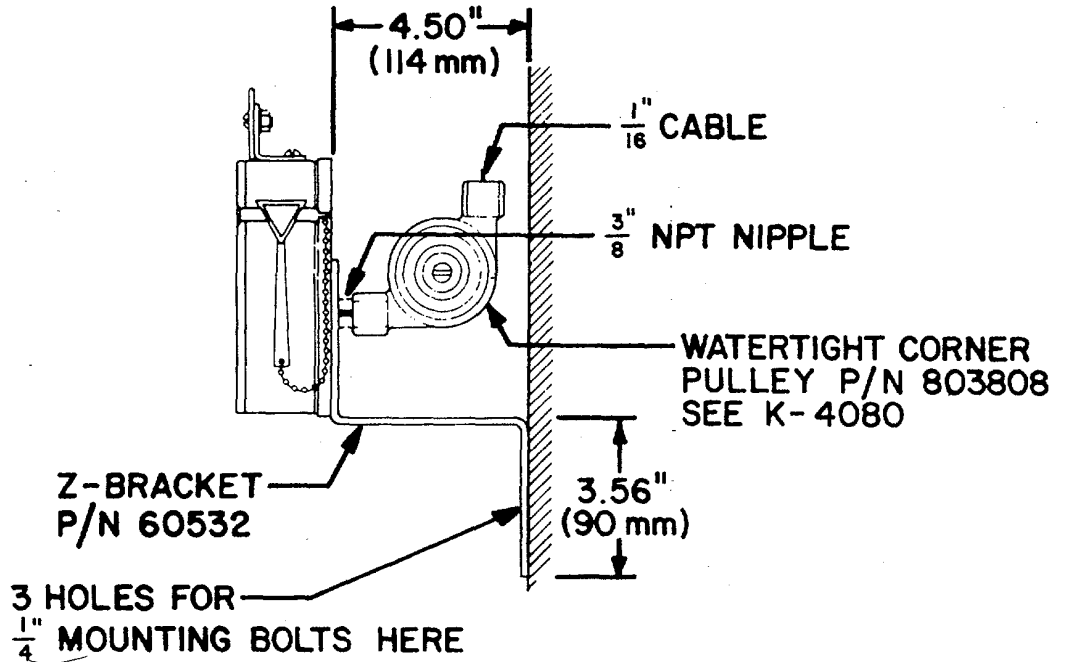
K-4040

WALTER KIDDE

Division of Kidde, Inc.
Walter Kidde Dr., Wake Forest, NC 27587

INSTALLATION DETAIL

BREAK GLASS PULL BOX USED WITH Z-BRACKET

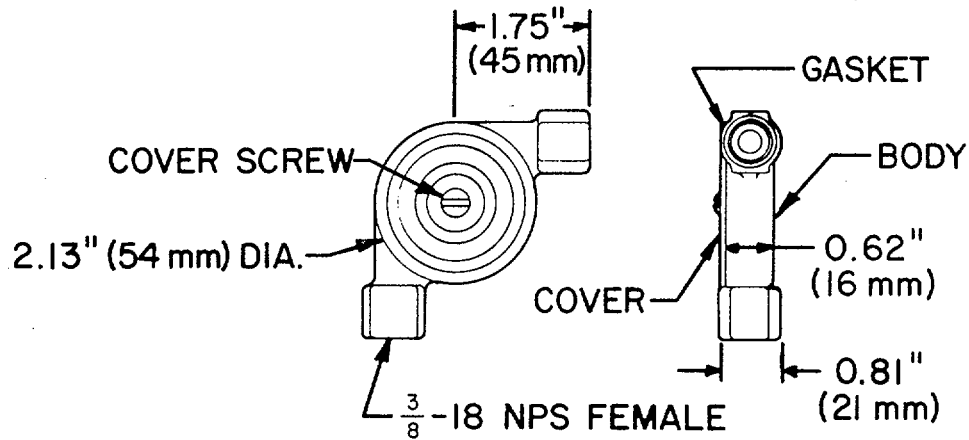


K-4041

CORNER PULLEYS

WATERTIGHT CORNER PULLEY

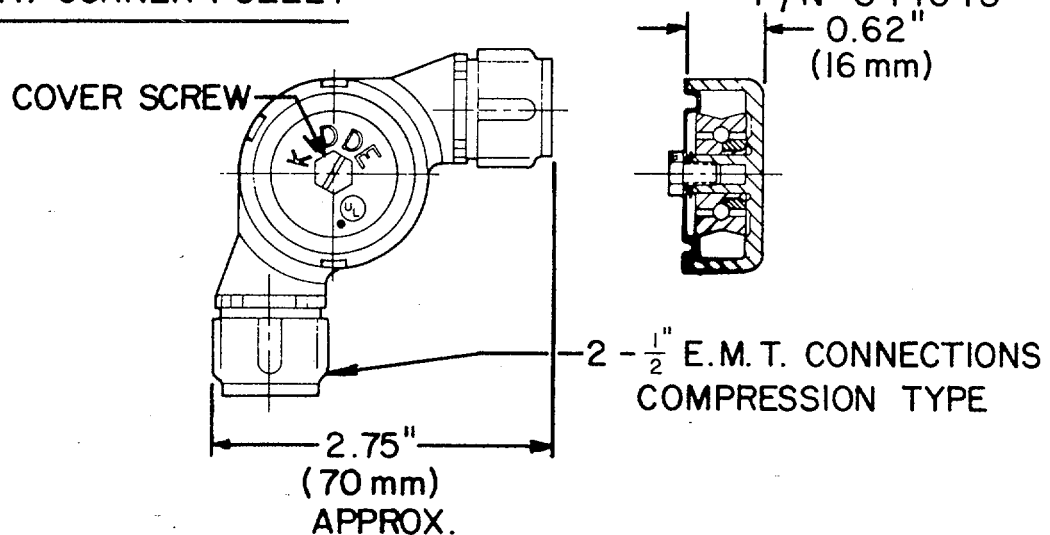
P/N 803808



MATERIALS
COVER AND BODY: BRASS
GASKET: RUBBER

1/2" E.M.T. CORNER PULLEY

P/N 844648



MATERIALS
HOUSING: ALUMINUM
COVER: CADMIUM PLATED STEEL

P/N-SEE ABOVE



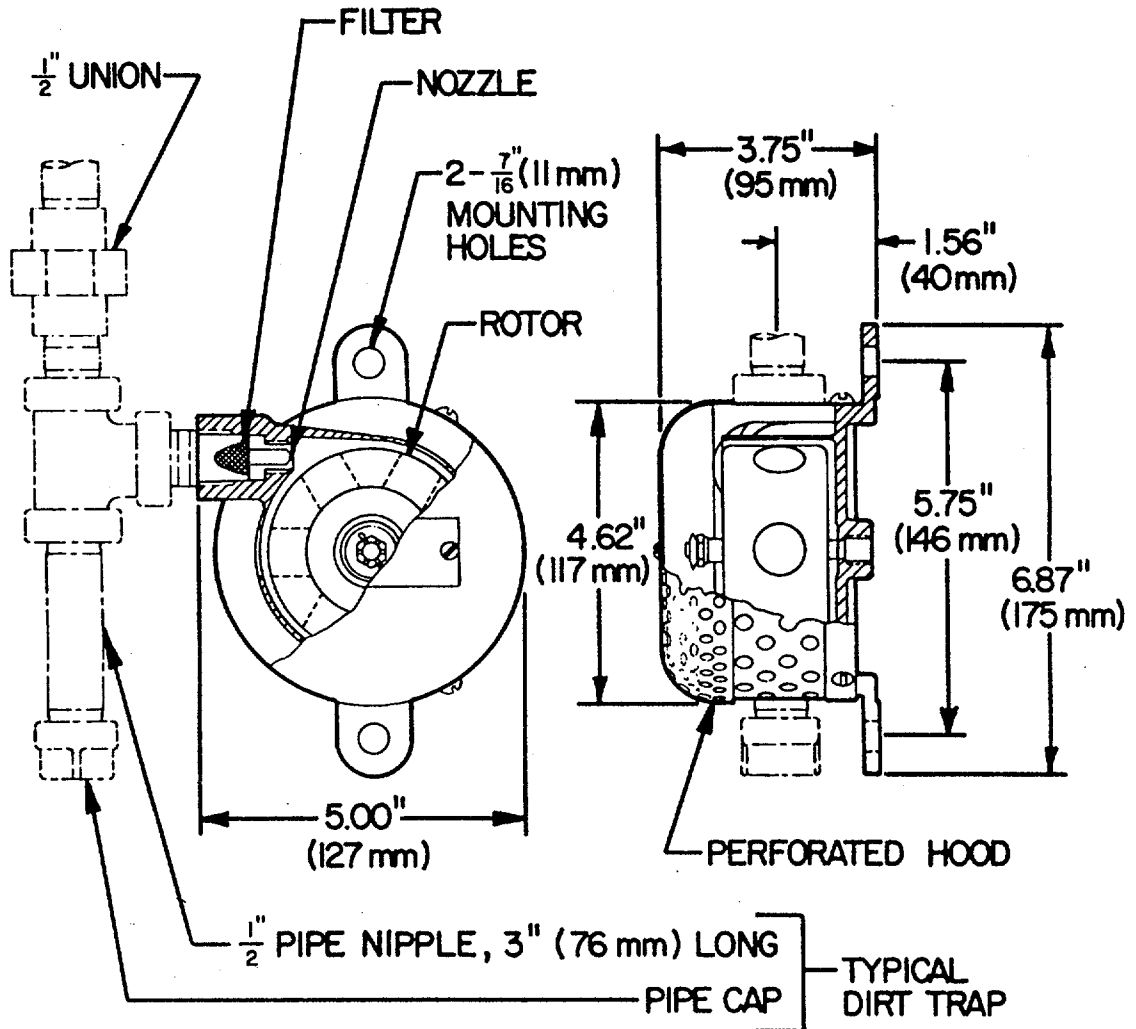
WALTER KIDDE

Division of Kidde, Inc.
Fire Systems Operations
Wake Forest, North Carolina 27587, U.S.A.

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

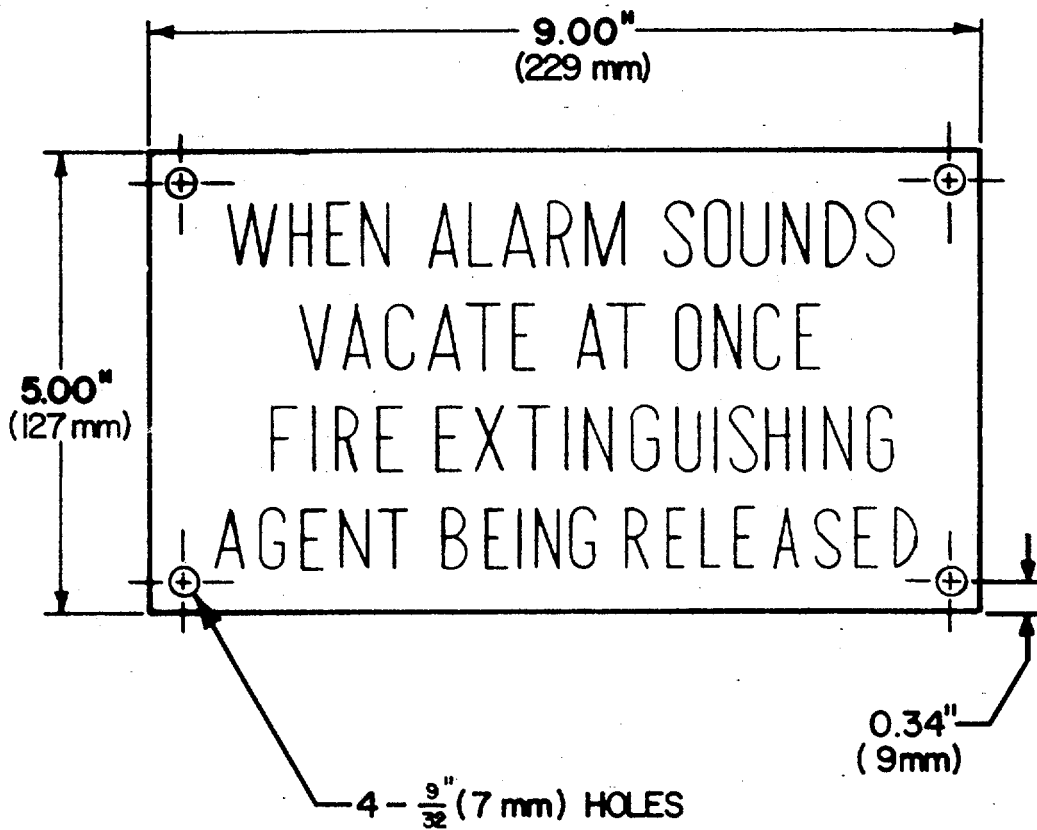
FINISH : RED PAINT

P/N 981574



K-3200
REV. I : 4/87

**WARNING NAMEPLATE
U. S. COAST GUARD APPROVED**



USE 1/4" HARDWARE FOR FASTENING

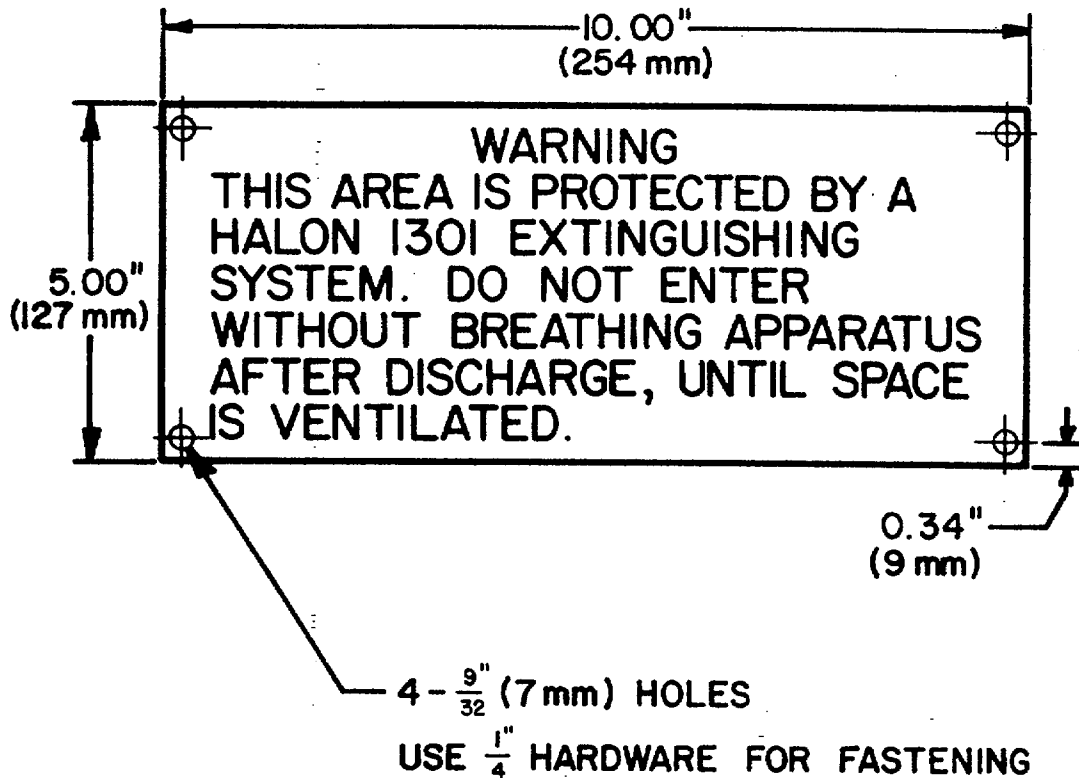
MATERIAL : ALUMINUM WITH RED PAINT LETTERS

P/N 218270



K-7040

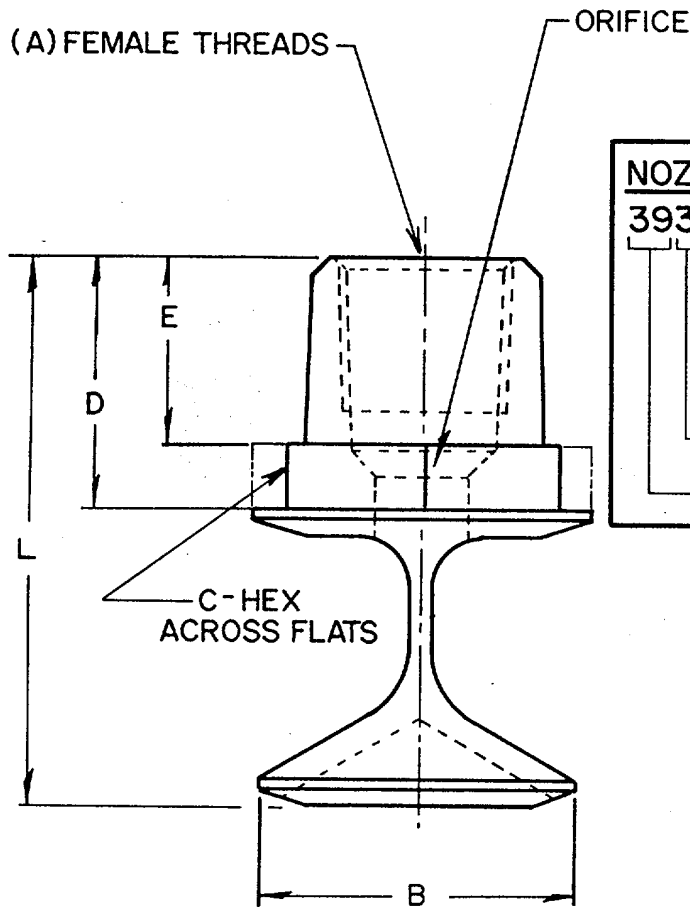
**HALON WARNING NAMEPLATE
U. S. C. G. APPROVED**



MATERIAL: ALUMINUM WITH RED PAINT LETTERS

P/N 281188

HALON 1301 DISCHARGE NOZZLE
SPLIT FAN TYPE (BRASS)



NOZZLE P/N DESCRIPTION
393XXXX

- ORIFICE DRILL DIM. CODE (IN 0.000'S OF AN INCH)
- NPT - PIPE THREADS CODE (A) (SEE TABLE)
- MAT'L & TYPE - BRONZE, SPLIT
- NOZZLE IDENTIFICATION SERIES NO.

EX. - NOZZLE 2" NPT WITH
1/8" ORIFICE: 39361625

NOTE - BLANK P/N: 393X0000

A		DIMENSIONS					ORIFICE	
NPT	CODE	B	C	D	E	L	FROM	TO
1/2	1	1.75	1.38	1.25	.95	2.81	.063	.516
3/4	2	1.75	1.62	1.38	1.00	2.97	.250	.688
1	3	1.75	1.62	1.38	1.00	2.97	.625	.875
1 1/4	4	2.38	2.49	1.63	1.09	3.44	.875	1.141
1 1/2	5	2.38	2.49	1.63	1.09	3.44	1.125	1.344
2	6	2.75	2.99	1.78	1.07	3.88	1.375	1.719

HALON 1301 FIRE PROTECTION SYSTEM FOR LOCAL OPERATION

1. OPEN CONTROL VALVE BY REMOVING LOCKING PIN AND OPERATING LEVER OF CONTROL HEAD MOUNTED ON THE **CONTROL VALVE.**
2. DISCHARGE CYLINDER(S) BY REMOVING LOCKING PIN(S) AND OPERATING LEVER(S) OF CONTROL HEAD(S) MOUNTED ON THE **CONTROL CYLINDER(S).**

IF DESIRED, DISCHARGE DELAY MAY BE BY-PASSED BY REMOVING LOCKING PIN AND OPERATING LEVER OF CONTROL HEAD MOUNTED ON DISCHARGE DELAY.



MOBILE, ALABAMA
205-432-9765
TWX: 810-741-3168

P/N 10-1003

MATERIAL: ALUMINUM - METALPHOTO



Post Office Box 2041
Mobile, Alabama 36652

SCALE	REVISIONS	BY	DATE
N.T.S.			
DATE	11-01-84		
DR'N.	T.S.	CKD.	T.S.
AP'VD.	B. Roberts		
TITLE	OPERATING INSTRUCTIONS PLATE		NO. 10-1003

HALON 1301 FIRE PROTECTION SYSTEM IN CASE OF FIRE

1. BREAK GLASS AND PULL HANDLE OF
VALVE CONTROL PULL BOX.

2. IMMEDIATELY BREAK GLASS AND PULL
HANDLE OF **CYLINDER CONTROL
PULL BOX.**

ALARM SOUNDS 60 SECONDS PRIOR TO GAS
DISCHARGE, **WARNING** PERSONNEL TO
EVACUATE SPACE, EQUIPMENT AND
VENTILATION SYSTEMS WILL SHUTDOWN.

MATERIAL:
ALUMINUM METALPHOTO



MOBILE, ALABAMA
205-432-9765
TWX: 810-741-3168

P/N 10-1010



Post Office Box 2041
Mobile, Alabama 36652

SCALE	REVISIONS	BY	DATE
NOT TO SCALE			
DATE			
AUG. 20, 1986			
DR. N.	CKD.		
T. H.	H		
APVD.			
TITLE	NO.		
OPERATING INSTRUCTIONS PLATE	10-1010		

HALON 1301 FIRE PROTECTION SYSTEM FOR LOCAL OPERATION

1. DISCHARGE CYLINDER(S) BY REMOVING LOCKING PIN(S) AND OPERATING LEVER(S) OF CONTROL HEAD(S) MOUNTED ON THE CONTROL CYLINDER(S).


IF DESIRED, DISCHARGE DELAY MAY BE BY-PASSED BY REMOVING LOCKING PIN AND OPERATING LEVER OF CONTROL HEAD MOUNTED ON DISCHARGE DELAY.

P/N: 10-1017



MOBILE, ALABAMA
205-432-9765
TWX: 810-741-3168

MATERIAL: ALUMINUM METALPHOTO

		Post Office Box 2041 Mobile, Alabama 36652	
<small>SCALE</small> NOT TO SCALE	<small>REVISIONS</small>	<small>BY</small>	<small>DATE</small>
<small>DATE</small> AUG. 20, 1986			
<small>DR. N.</small> T. H.	<small>CHKD.</small> [Signature]		
<small>APPROVED:</small> [Signature]			
<small>TITLE</small> OPERATING INSTRUCTIONS PLATE		<small>NO.</small> 10-1017	

HALON 1301 FIRE PROTECTION SYSTEM IN CASE OF FIRE

1. BREAK GLASS AND PULL HANDLE.

ALARM SOUNDS 25 SECONDS PRIOR TO GAS DISCHARGE, **WARNING** PERSONNEL TO EVACUATE SPACE, EQUIPMENT AND VENTILATION SYSTEMS WILL SHUTDOWN.

MATERIAL
ALUMINUM METALPHOTO



MOBILE, ALABAMA
205-432-9765
TWX: 810-741-3168

P/N 10-1018



Post Office Box 2041
Mobile, Alabama 36652

SCALE	REVISIONS	BY	DATE
NOT TO SCALE			
DATE 7-5-89			
DR'N. W.M.A.	CHKD.		
AP'VD.			
TITLE OPERATING INSTRUCTIONS PLATE	NO. 10-1018		

CONTROL CYLINDER(S)

P/N 10-2000



Post Office Box 2041
Mobile, Alabama 36652

SCALE	REVISIONS	BY	DATE
FULL			
DATE			4/4/83
DR'N. B.R.	CHKD.		
AP'VD.	EAE		
TITLE			NO.
IDENTIFICATION NAMEPLATE			10-2000

MATERIAL: ALUMINUM - METALPHOTO

**CYLINDER CONTROL
PULL BOX**

P/N 10-2001

**VALVE CONTROL
PULL BOX**

P/N 10-2002

MATERIAL: ALUMINUM - METALPHOTO



Post Office Box 2041
Mobile, Alabama 36652

SCALE	REVISIONS	BY	DATE
FULL			
DATE 4/4/83			
DR. B.R. CKD.			
AP'VD. P.K.			
TITLE	NO.		
IDENTIFICATION NAMEPLATE	10-2001 10-2002		

STOP VALVE

P/N 10-2003

CONTROL VALVE

P/N 10-2004

MATERIAL: ALUMINUM - METALPHOTO



Post Office Box 2041
Mobile, Alabama 36652

SCALE	REVISIONS	BY	DATE
FULL			
DATE			
4/4/83			
DR'N. B.R. CRD.			
AP'VD.			
P.P.			
TITLE	IDENTIFICATION NAMEPLATE		NO.
			10-2003
			10-2004

SECTION III

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



FM-200[®]

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.

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CHEMICAL CORPORATION**

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 (CF₃CHFCF₃). 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 ³ (621 kg/m ³)
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)

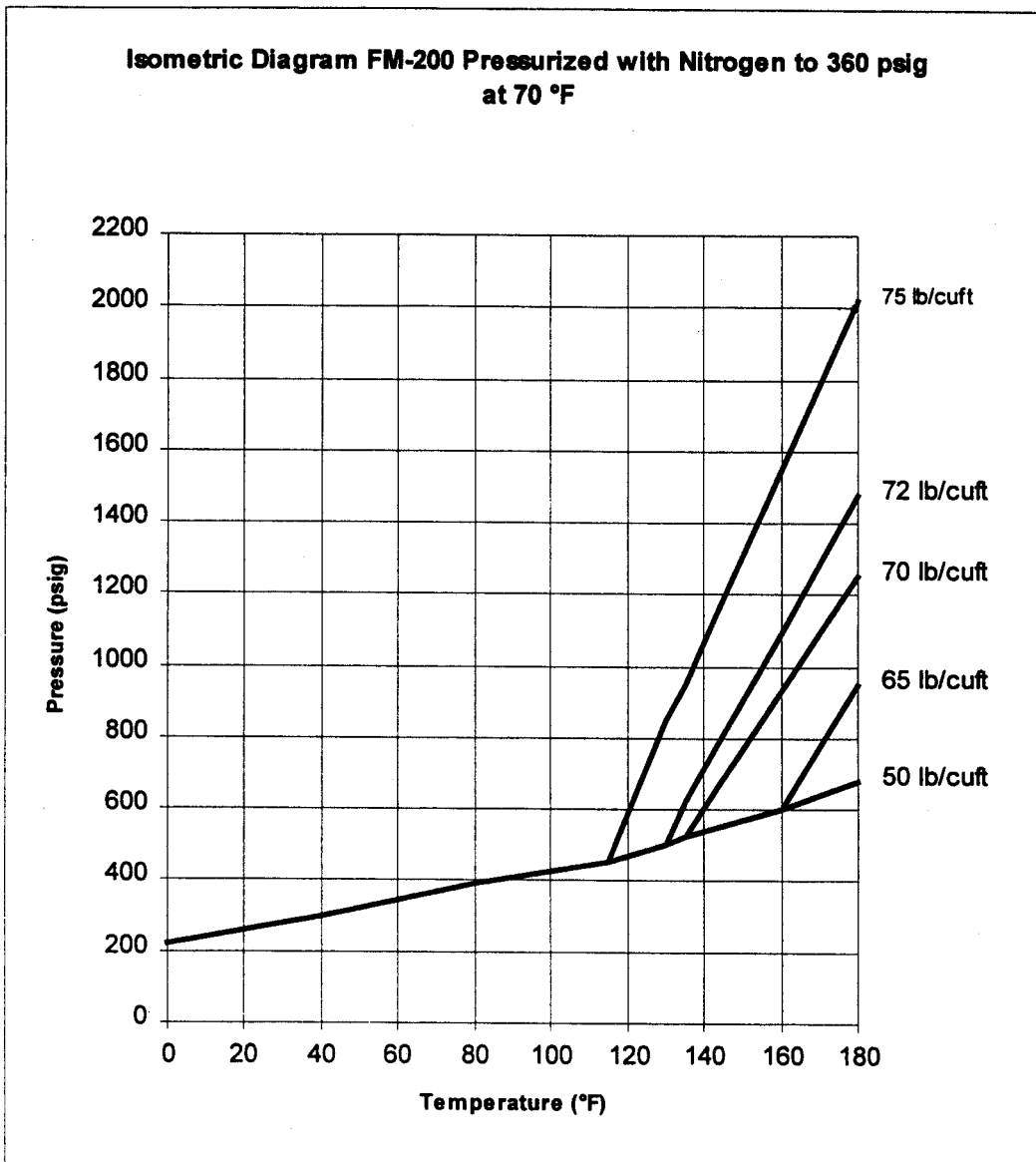


Figure 2.2.1 - FM-200 Pressure/Temperature Curve Isometric Diagram

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 ³	m ³
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./ft³. 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./ft³)**

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 ft³. Automatic actuation is required for volumes less than or equal to 6,000 ft³ 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 ft³ 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.

A		B		C					
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 (ft³)

s = specific volume of superheated FM-200 vapor (ft³/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 (ft³/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.)

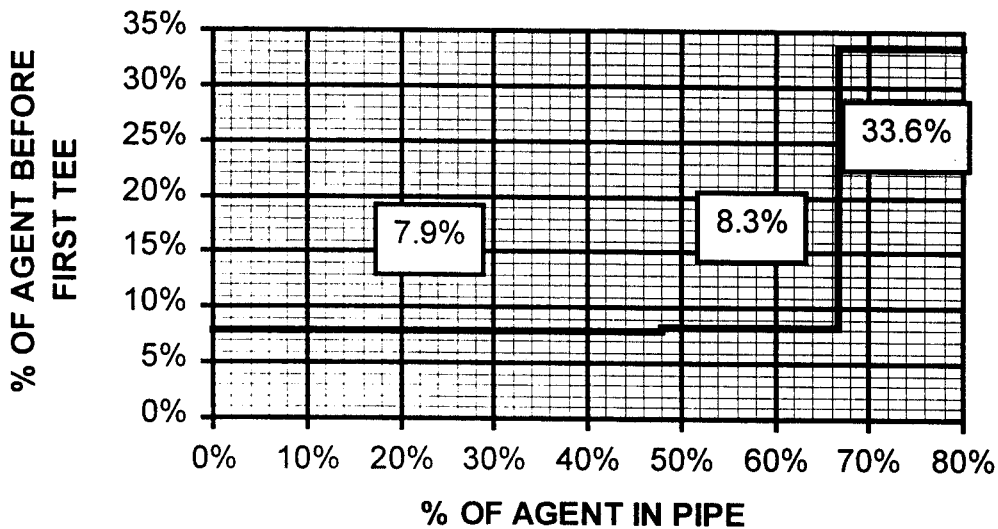


Figure 3.3.1 Percent agent before First Tee as a function of Percent agent in Pipe

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%.

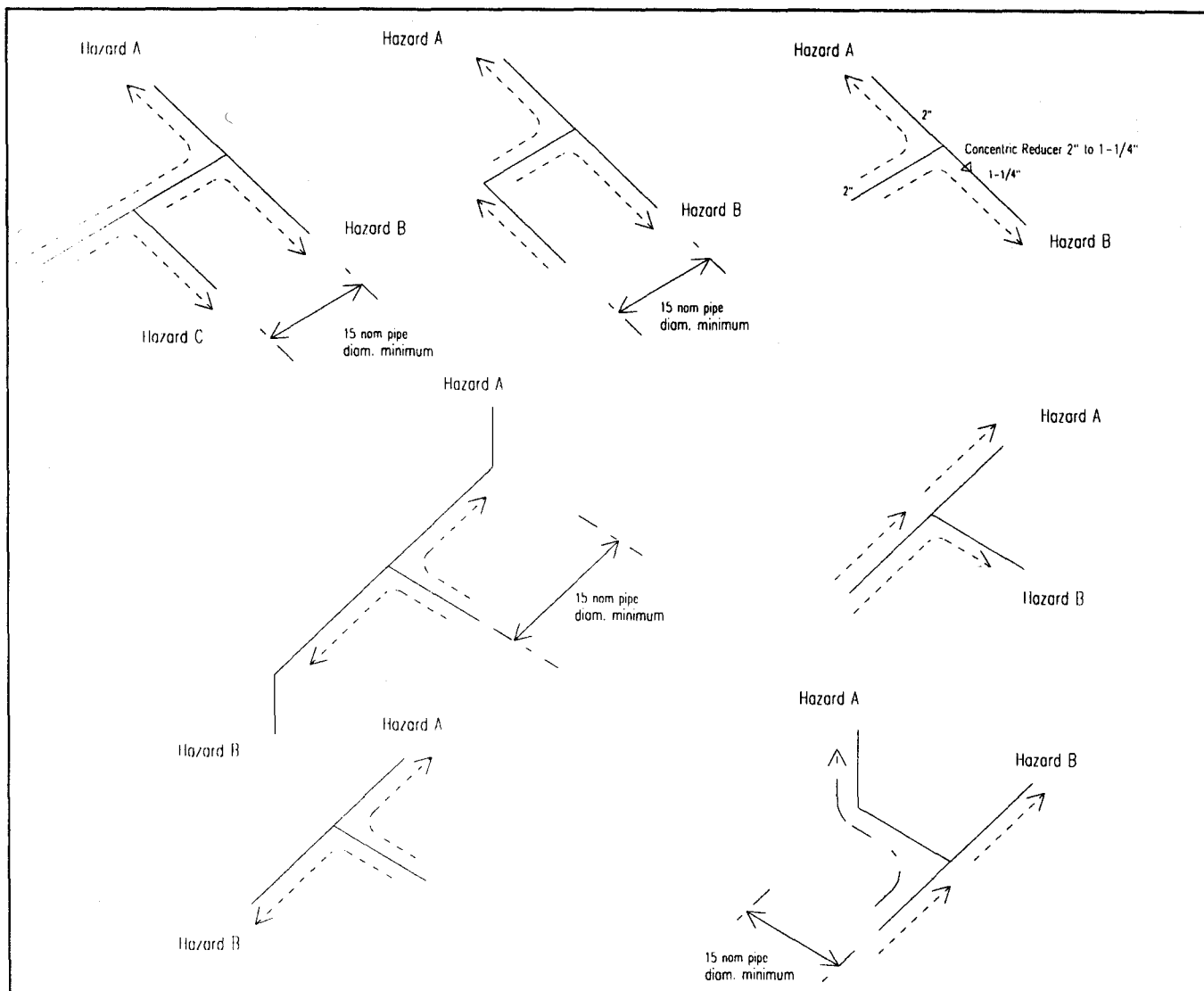


Figure 3.3.2 - Acceptable Tee Flow Splits for FM-200

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.

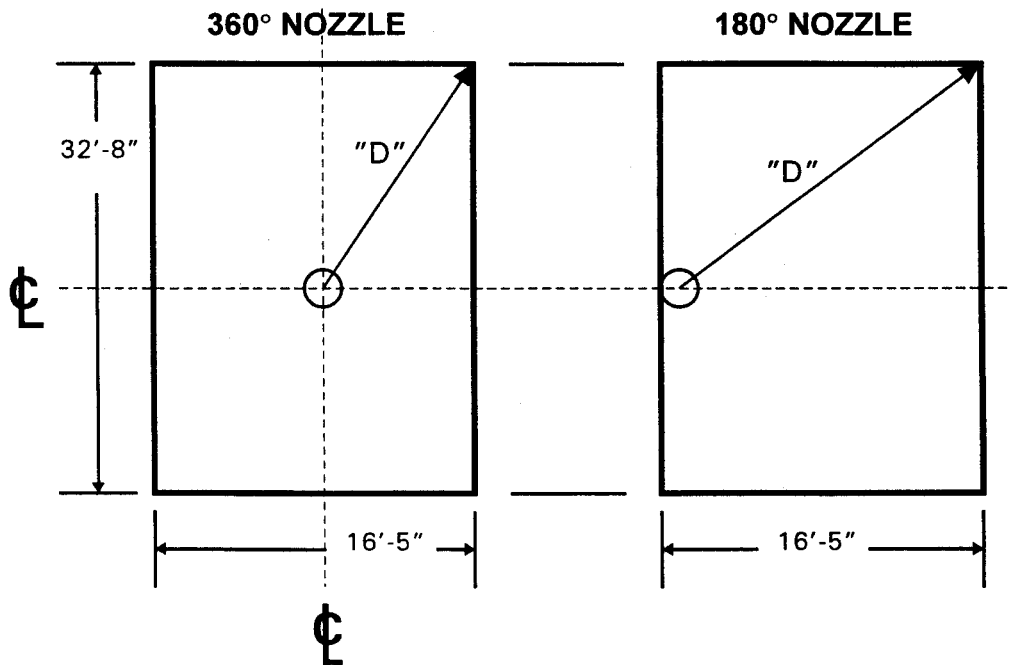


Figure 3.3.5 - Nozzle Placement and Coverage

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 ft³ must be manually actuated. Automatic actuation is allowed only for systems protecting spaces of 6,000 ft³ and under and is required when such a system is located within the protected space. Except for spaces of 6,000 ft³ 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 ft³ 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 CO₂ 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 CO₂) 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, CO₂ 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 ft³ 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.

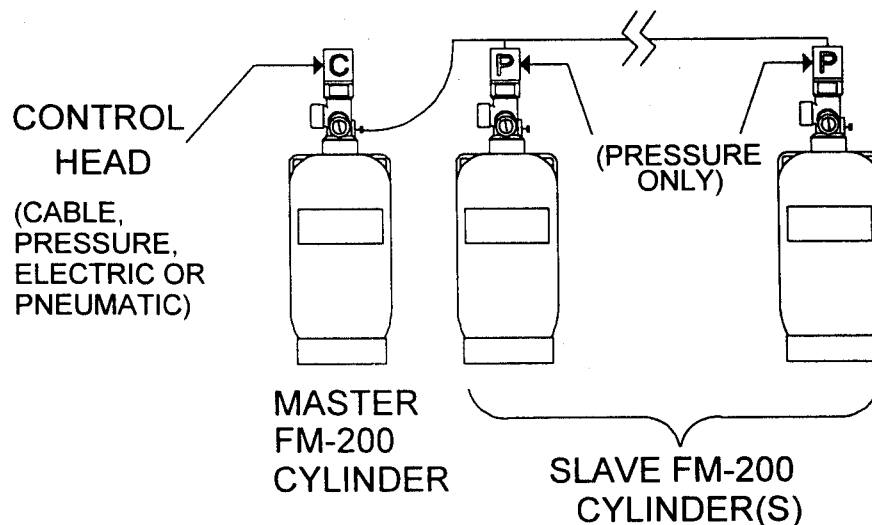


Figure 3.6 - Master & slave cylinder arrangement

When actuating FM-200 cylinders using either CO₂ 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 CO₂ pressure. This pressure would be supplied by CO₂ 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 N₂, CO₂ 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 CO₂ in situations where a CO₂ 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 CO₂ actuation cylinders can be actuated either by cable operated control heads or by pressure operated control heads (actuated by a nitrogen pilot cylinder). CO₂ 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 CO₂ cylinders which in turn actuate FM-200 cylinders. System limitations are as follows:

From actuation station to pilot CO₂ cylinders, see the cable limitations shown in 3.6.2.1.

From CO₂ 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 CO₂ cylinders to the FM-200 cylinder pilot manifold.

FM-200 cylinder arrangements and limitations are as follows:

1. Using FM-200 cylinders actuated by (CO₂) pressure operated control heads, up to 25 **close coupled** FM-200 cylinders can be actuated by CO₂ (using only K-F hose p/n's 264986 & 264987).
2. Using master & slave FM-200 cylinder arrangement(s) with master cylinders operated by (CO₂) 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.

N₂ Pilot Actuation

These systems use nitrogen pilot cylinders that operate pilot CO₂ cylinders which in turn actuate FM-200 cylinders. System limitations are as follows:

From nitrogen pilot cylinder to pilot CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ Pressure Operated Siren Limitations. The pressure operated siren (P/N 981574) consumes approximately 20 lbs of CO₂ per minute. The maximum number of pressure operated sirens is two per 50 lb CO₂ cylinder (for a maximum of four sirens per two pilot CO₂ 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.

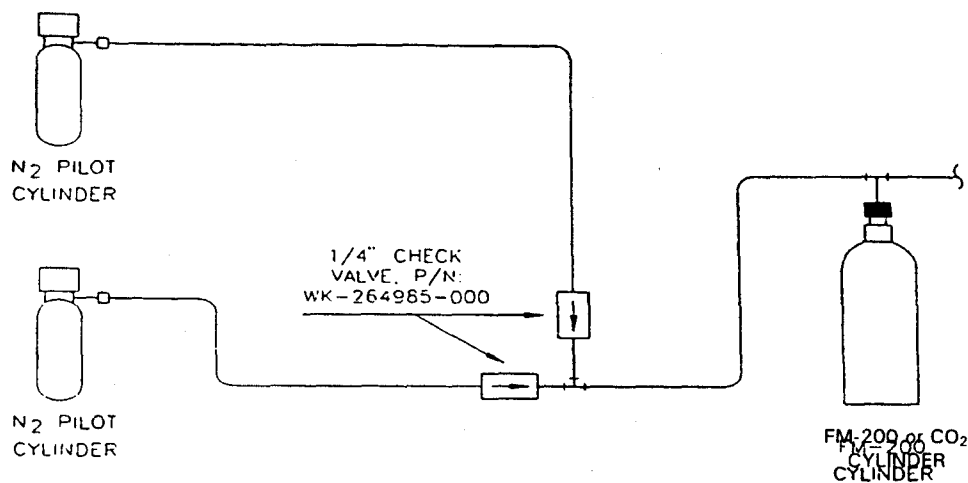


Figure 3.6.2.4 - Multiple pilot nitrogen actuation cylinders

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 ft³ 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 ft³ and under must be equipped with a time delay unless there is a suitable horizontal escape. Systems protecting spaces of 6,000 ft³ 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 CO₂ and must only be used in systems that use CO₂ 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 ft³ and any spaces greater than 6,000 ft³ 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 ft³ 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.

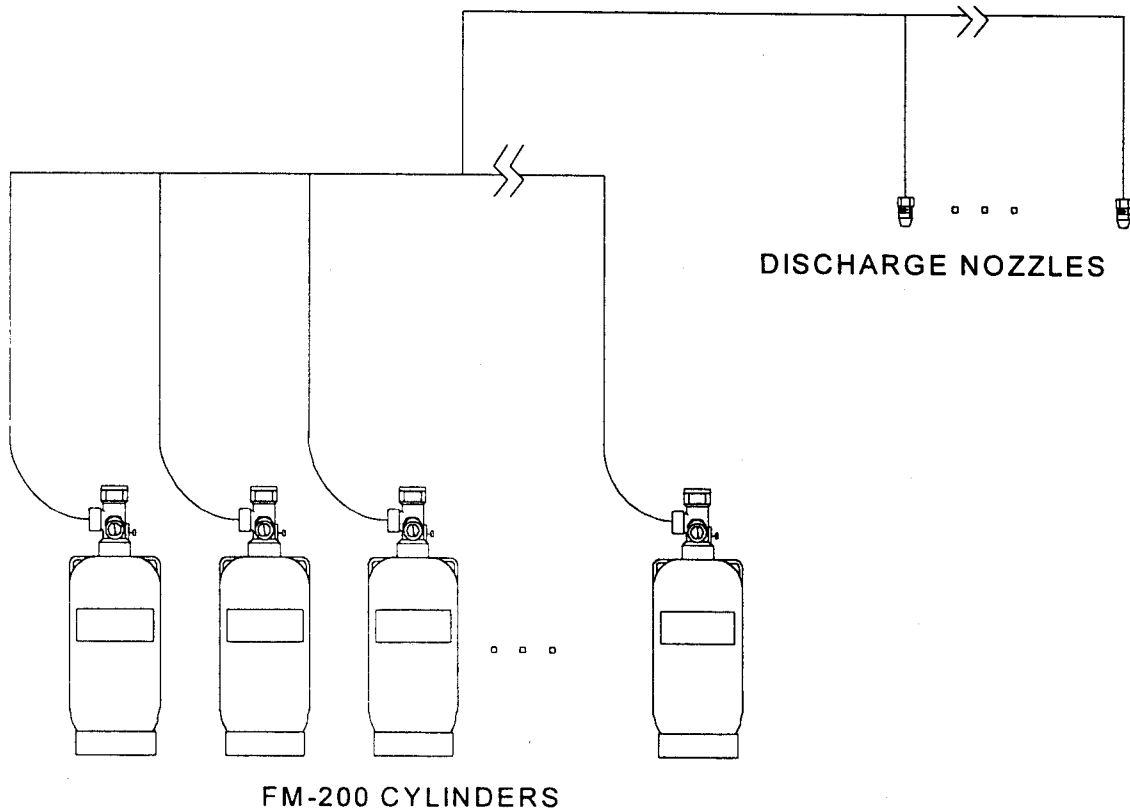


Figure 3.8.1 - Central storage system with common manifold and discharge piping (actuation components and EL-checks not shown).

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).

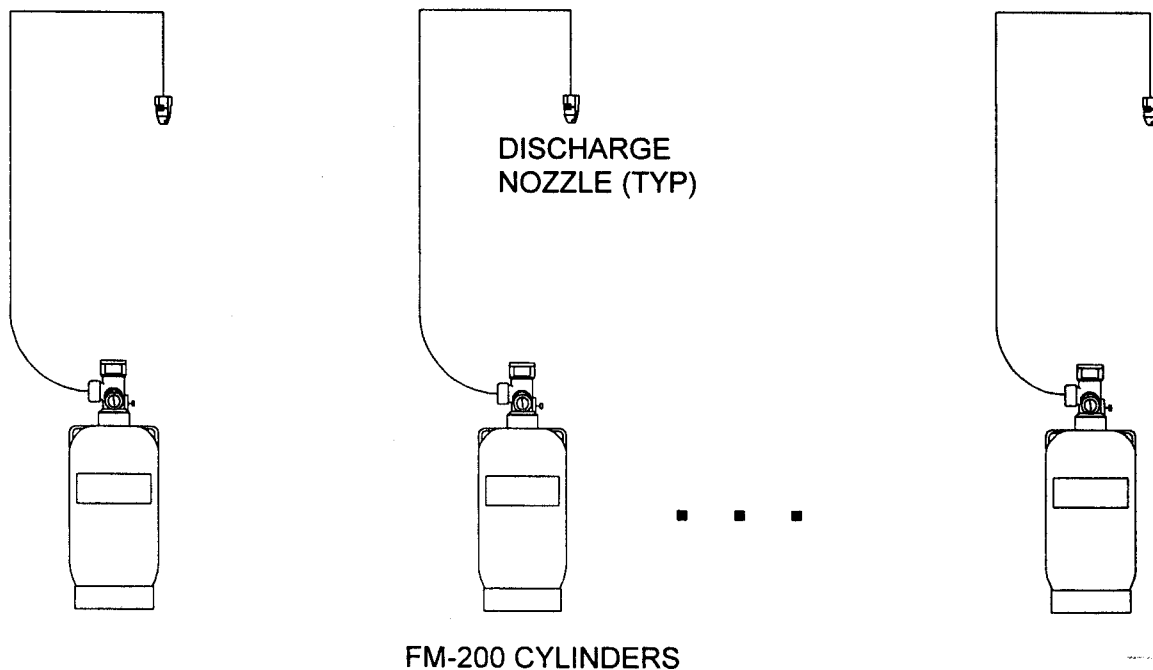


Figure 3.8.2 - Storage in multiple locations (actuation components not shown).

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 CO₂ pilot cylinders which then actuate the FM-200 cylinders. The FM-200 cylinders that are actuated by CO₂ 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 CO₂. 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 CO₂ or N₂ 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 CO₂ pilot cylinders which then actuate the FM-200 cylinders. The FM-200 cylinders that are actuated by CO₂ 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 CO₂. *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 ft³ or less. Time delay and pre-discharge alarm are not required in protected spaces of 6,000 ft³ 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

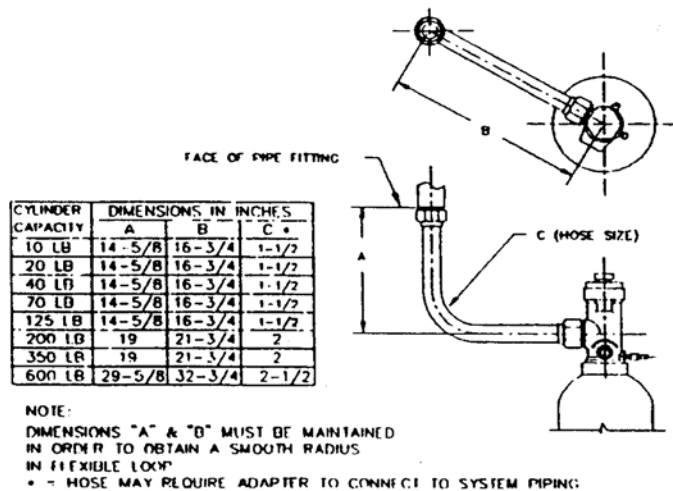


Figure 4.9.1 - Installation of the Flexible Hose Directly into System Piping

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).

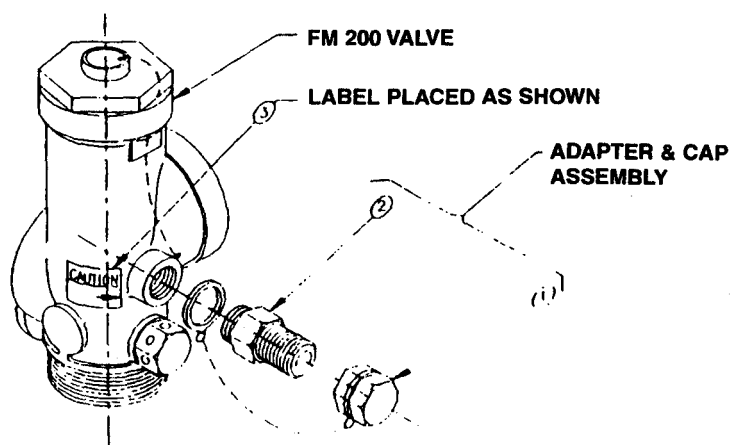


Figure 4.10 - Installation of Master Cylinder Adapter Kit

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.

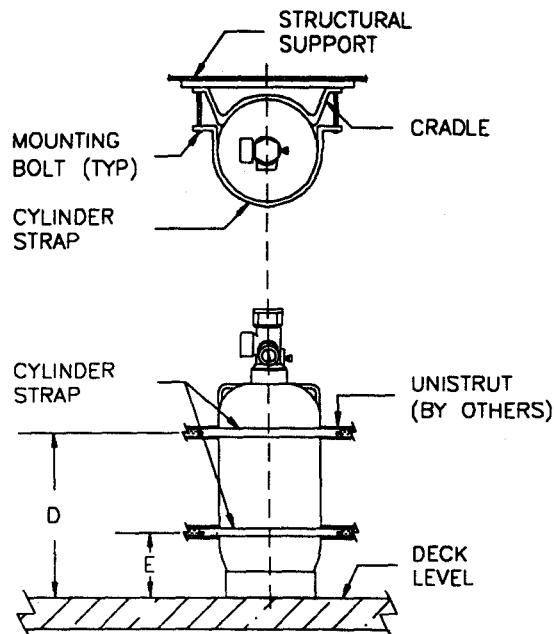


Figure 4.11.1 - Single Cylinder Installation (see Fig. 4.11.2 for "D" & "E" dimensions).

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.

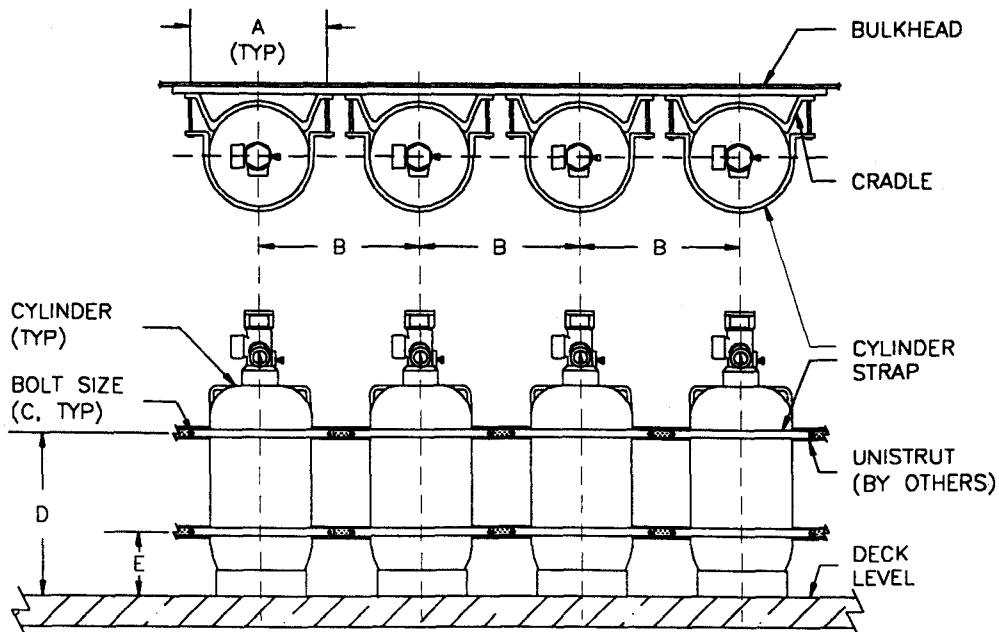
WARNING

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.

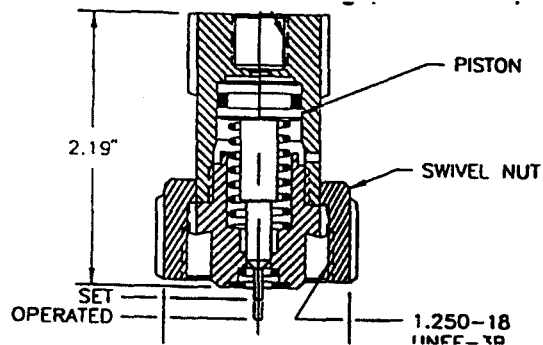


Figure 4.14 - Pressure Operated Control Head

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 ft³ 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.

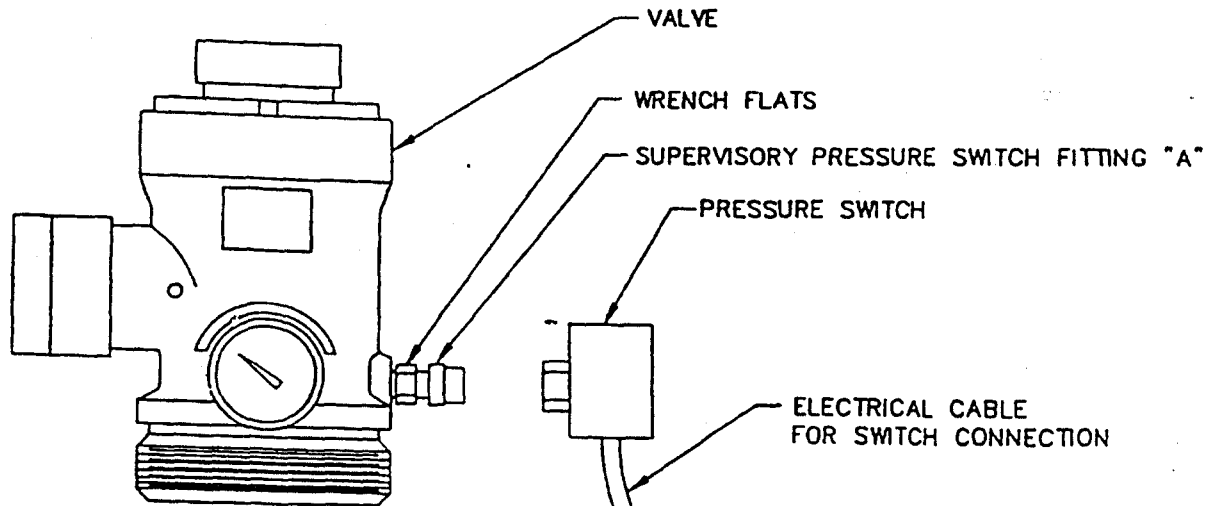


Figure 4.24 - Installation of Supervisory Pressure Switch

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 ₂ 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 ₂ 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, CO₂ 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 CO₂ 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

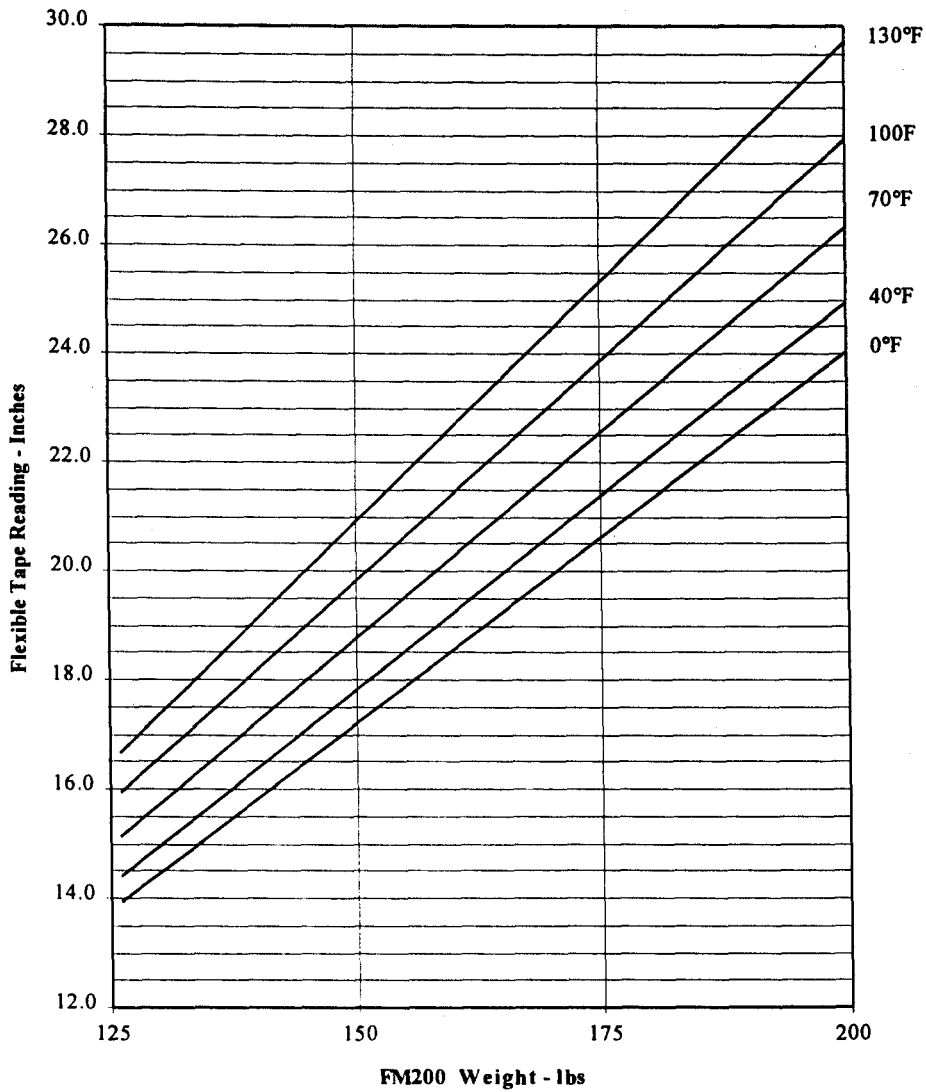


Figure 6.3.1 Calibration Chart, 200lb. Cylinder
Flexible Tape

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

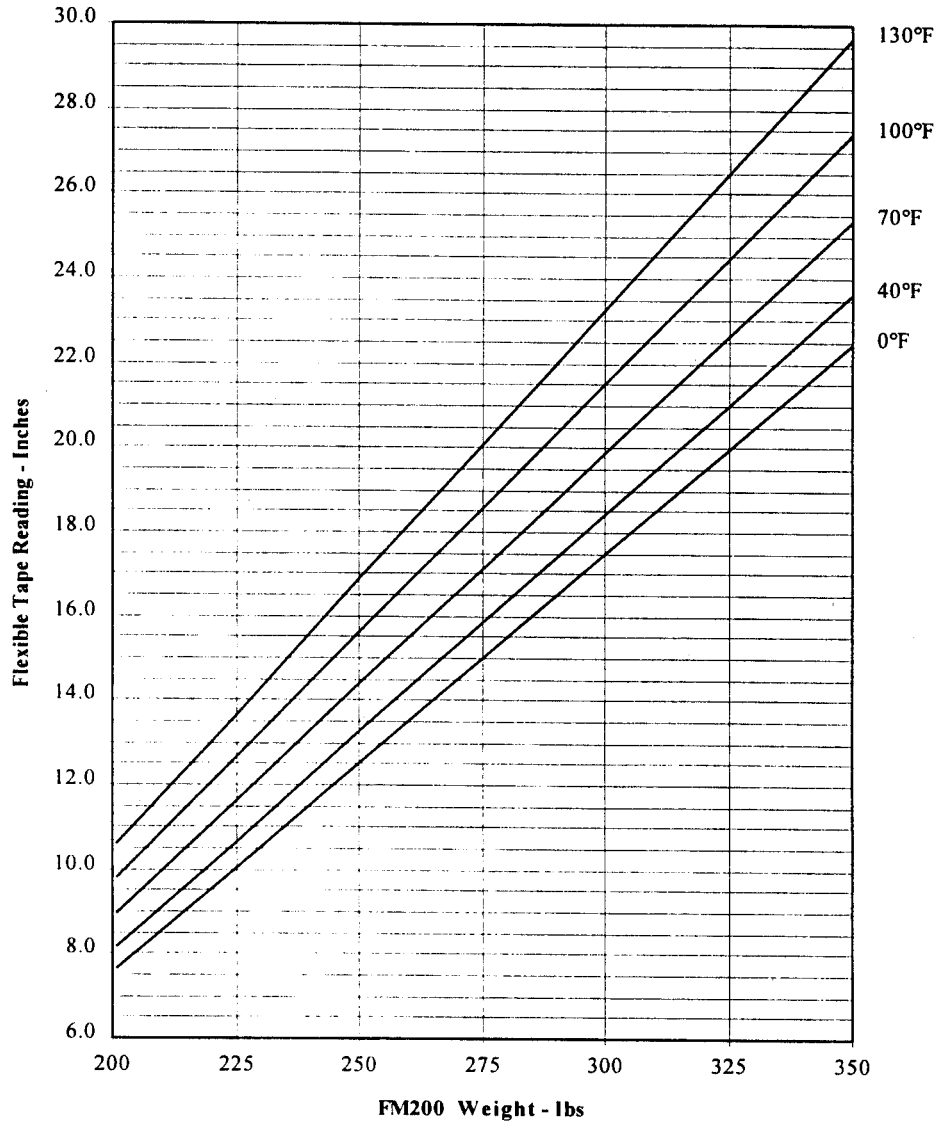
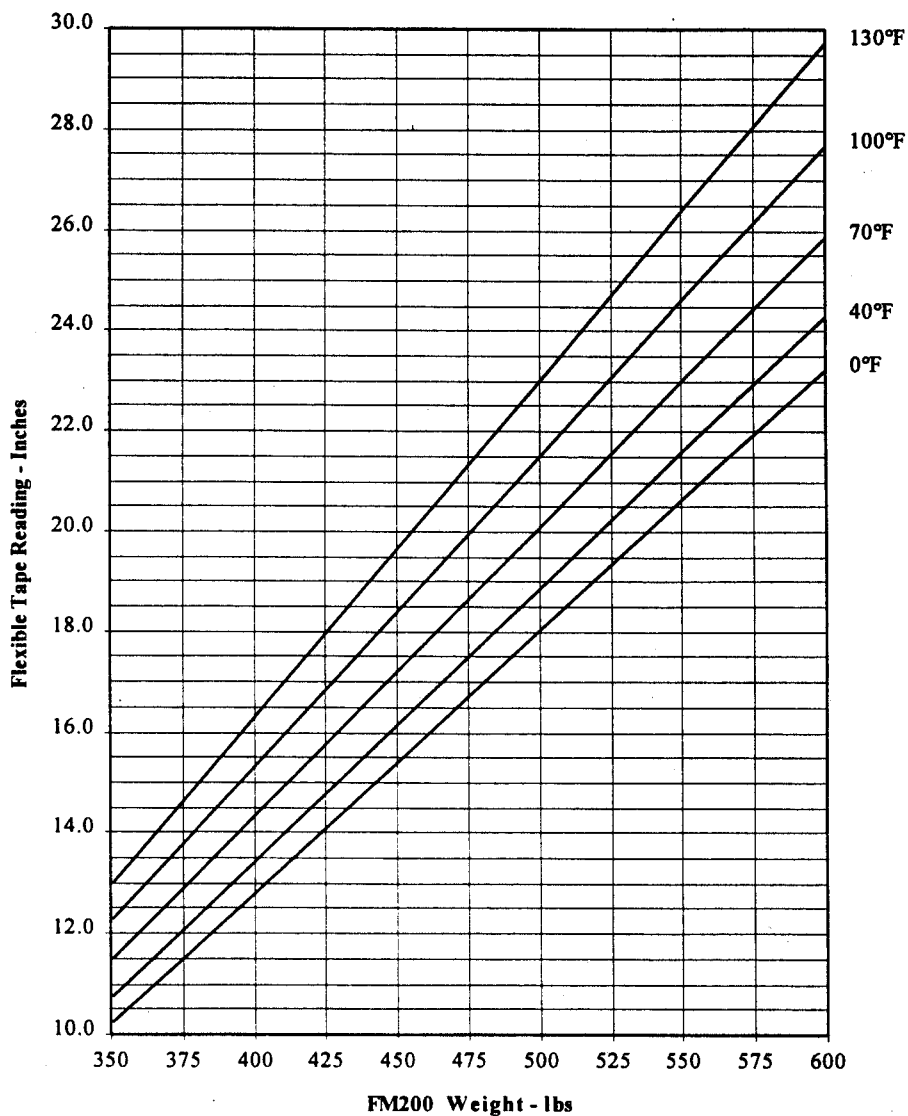


Figure 6.3.2 Calibration Chart, 350lb. Cylinder
Flexible Tape

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 CO₂ 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.

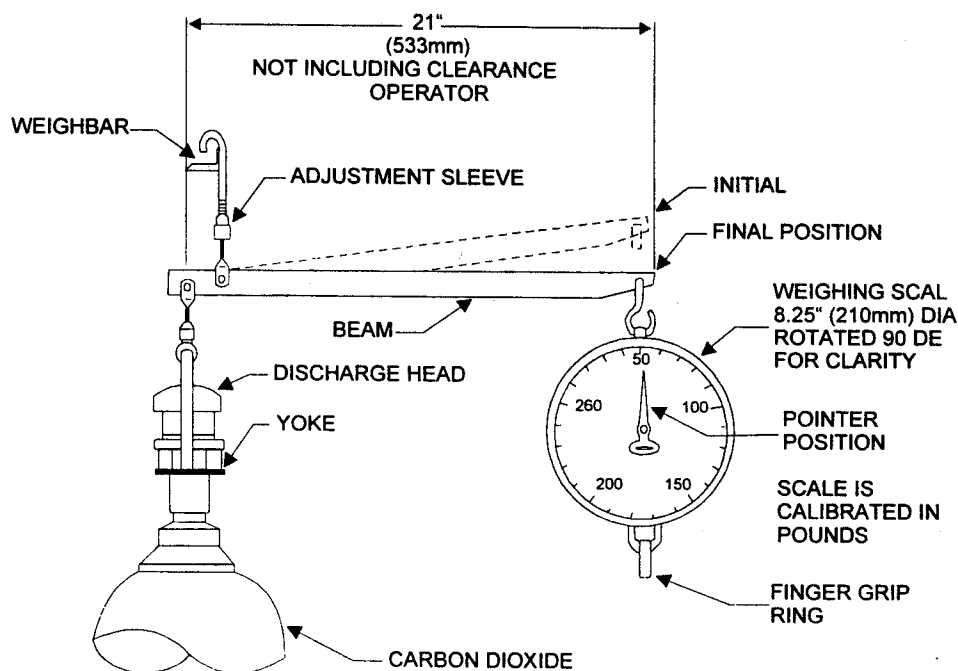


Figure 6.3.4.2 Weighing Carbon Dioxide Cylinder Using Scale P/N 982505

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.

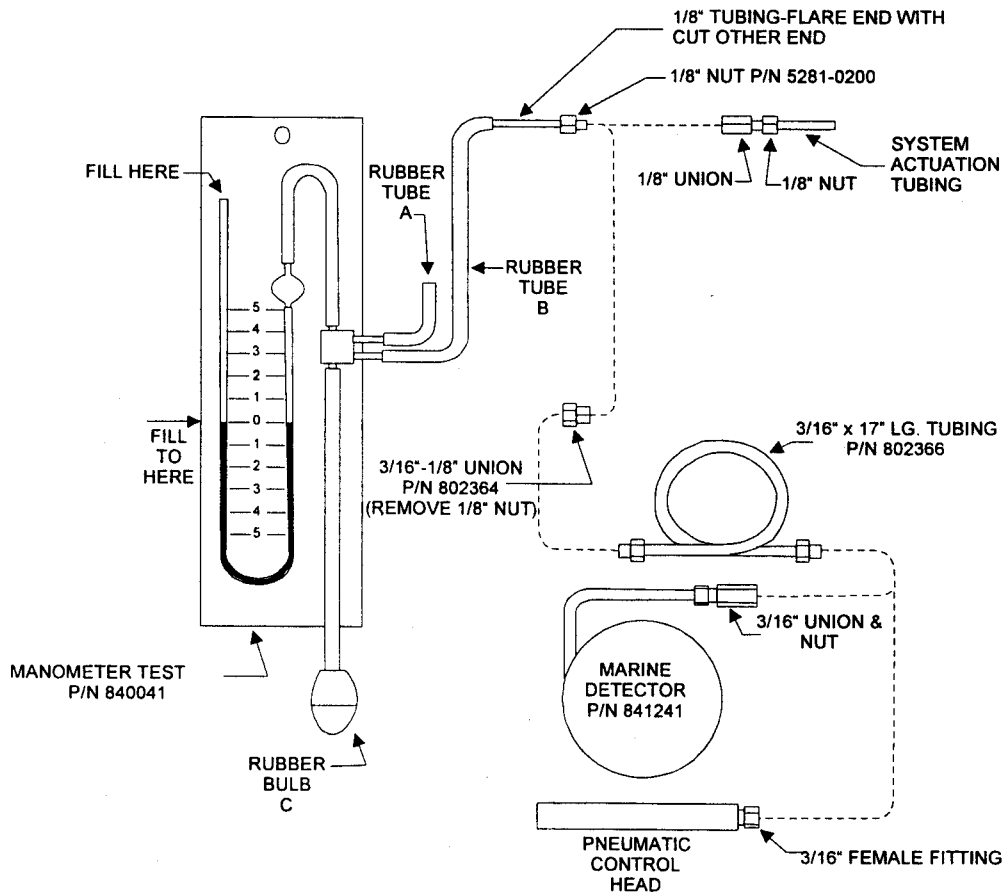


Figure 6.3.5.2.1 Manometer Test Set, P/N 840041

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

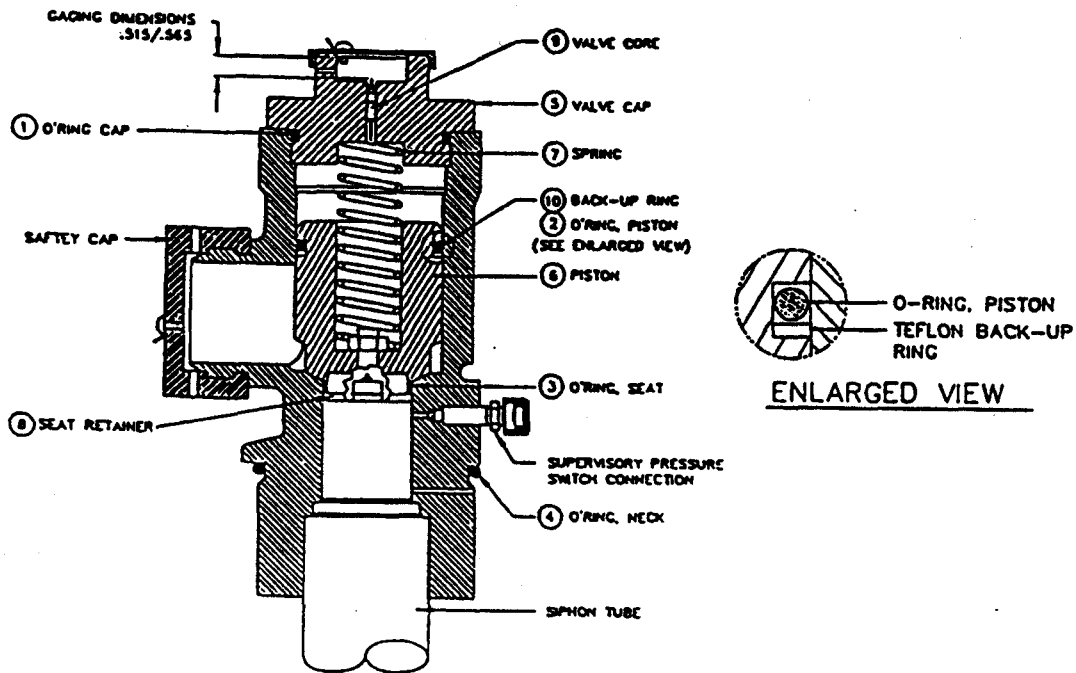


Figure 6.8.1 - Valve Assembly

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.

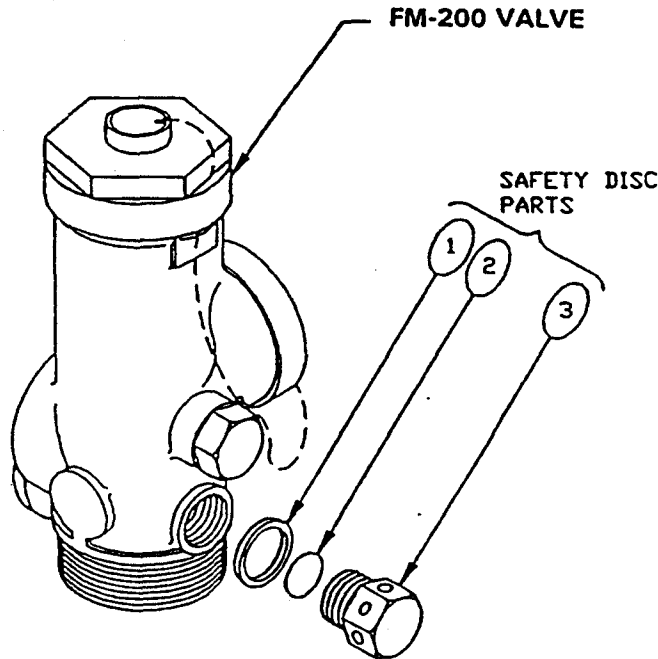


Figure 6.8.2 - Safety Disc Replacement

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

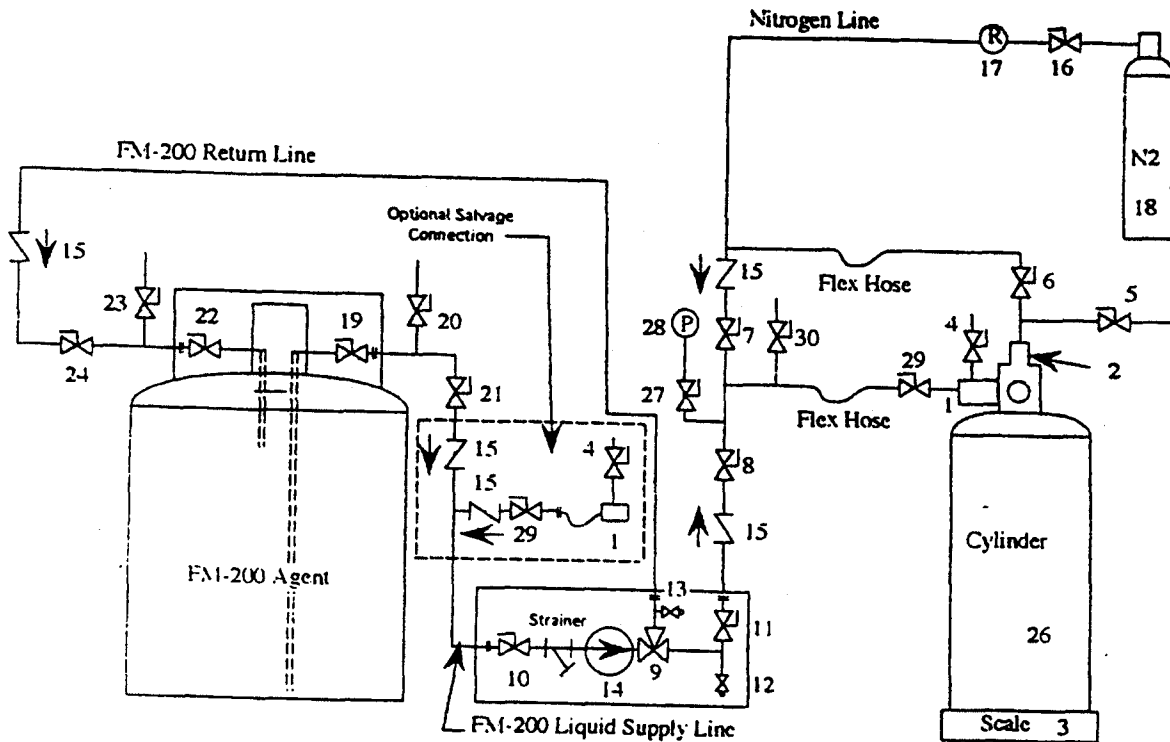


Figure 6.9.1 - Typical FM-200 Charging System Schematic

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 gauge) 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 gauge) 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./ ft³ 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/M³) 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

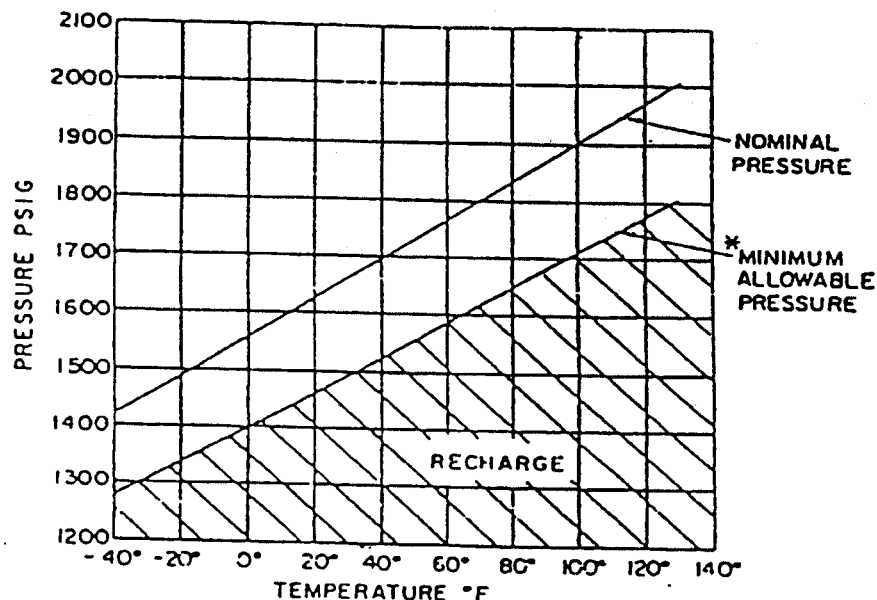
Nitrogen cylinder must be positioned so that control head, when installed, is readily accessible and cannot be obstructed during manual operation.

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.



* IF PRESSURE IS LESS THAN MINIMUM ALLOWABLE,
REPRESSURIZE WITH NITROGEN TO NOMINAL PRESSURE

Figure 6.10.1 . Nitrogen Temperature vs. Pressure Data

6.11 Inspection and Test of CO₂ Cylinders

CAUTION

These guidelines do not apply to cylinders containing commodities other than CO₂.

All Kidde-Fenwal, Inc. CO₂ 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.

CO₂ 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 CO₂ Cylinders

CAUTION

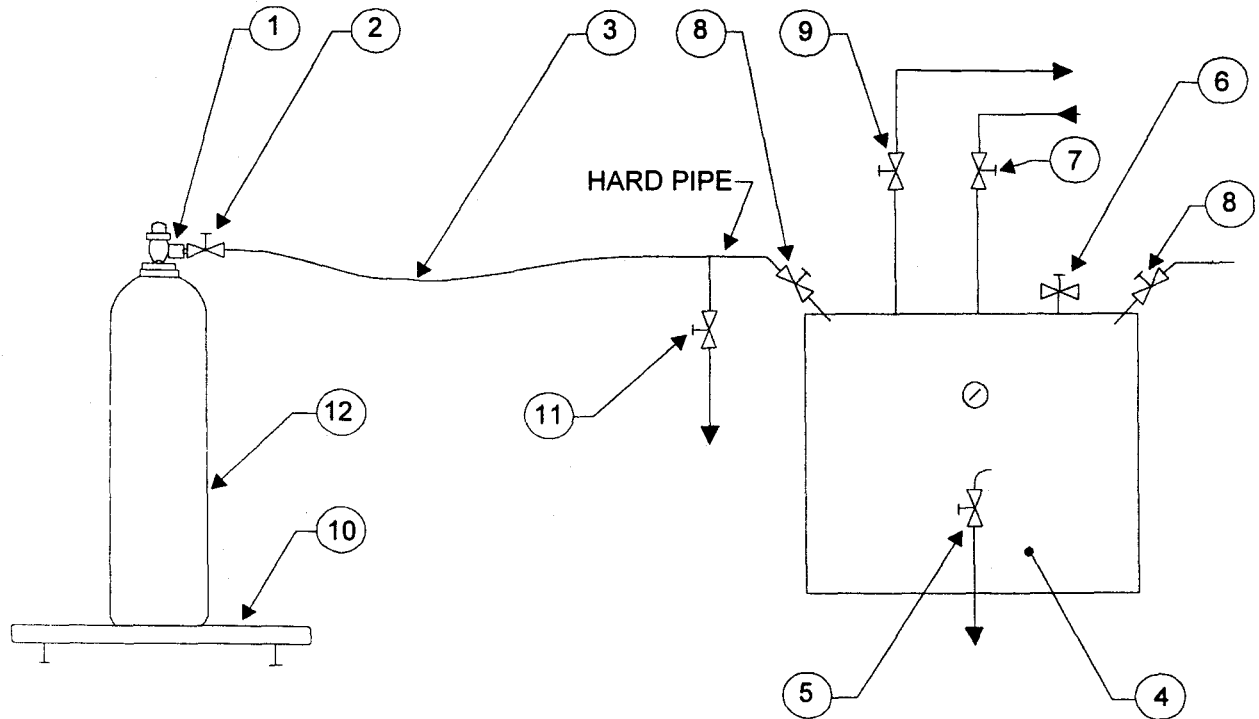
CO₂ cylinders must not be recharged without a retest if more than five (5) years have elapsed since the last test. Retest shall be in accordance with the requirements of 49 CFR, Paragraph 173.301 through 173.308 and 173.324. After retest, cylinder must be thoroughly dried and free of any water vapor.

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 ₂ supply inlet control valve |
| 2. flexible line control valve | 8. CO ₂ station valve |
| 3. flexible hose | 9. return line valve |
| 4. cylinder filling unit | 10. weigh scale |
| 5. vent valve | 11. vent valve |
| 6. CO ₂ main control valve | 12. CO ₂ cylinder/valve assembly |

Figure 6.12 Typical Carbon Dioxide Recharge Schematic

Recharge carbon dioxide cylinder as follows: (Note - CO₂ cylinders are filled by weight only, not by pressure.)

CAUTION

CO₂ 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 CO₂ 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 CO₂ 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 ₂ 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 ₂ /CO ₂)	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

CO₂ Actuation Equipment

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

90-FM200M-021
 Version 1.0 May 1998

**KIDDE FM-200 ECS Series Engineered Fire Suppression System
Design, Installation, Operation, and Maintenance Manual for Marine FM-200 Systems
US Coast Guard Rules**

Listed 180 degree nozzles						
Area (in ²)	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			

KIDDE FM-200 ECS Series Engineered Fire Suppression System
 Design, Installation, Operation, and Maintenance Manual for Marine FM-200 Systems
 US Coast Guard Rules

Listed 180 degree nozzles						
Area (in ²)	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 F₇C₃H 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 LC₅₀ 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

Precautions to be Taken in Handling and Storing

Protect containers from damage.

Other Precautions

DOT: Compressed gas, n.o.s. (Halogenated alkane), UN 1956

SECTION VIII - CONTROL MEASURES

Respiratory Protection

Wear NIOSH approved self-contained breathing apparatus in emergency situations.

Ventilation

Local Exhaust - Use to minimize exposure to gas Special - None

Mechanical - Use for general area control Other - None

Protective Gloves - Use lined neoprene gloves if handling liquid

Eye Protection - Chemical splash goggles when handling liquid.

Other Protective Equipment - None

Work Hygienic Practices - Ensure piping is empty before doing maintenance work.

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.

RMO:eh:104

MATERIAL SAFETY DATA SHEET

CARBON DIOXIDE



LIQUID CARBONIC INDUSTRIES

810 JONE BLVD. - DAN BROOK, L 60321-0216 • 706 872-7600

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: CO₂
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 (H₂O=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. CO₂ 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)

SECTION VI--REACTIVITY DATA

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

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.

SECTION IX--SPECIAL PRECAUTIONS

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 CO₂ Systems at Consumer Sites;" G-5.3, "Carbon Dioxide Cylinder Filling and Handling Procedures for Beverage Plants, NSDA TD01."

(Continued on Supplemental Sheet)

No warranty is made as to the accuracy of any data or statement contained herein. While this material is furnished in good faith, NO WARRANTY EXPRESS OR IMPLIED OF MERCHANTABILITY, FITNESS OR OTHERWISE IS MADE. This material is offered only for your consideration, investigation and verification and Liquid Carbonic shall not in any event be liable for special, incidental or consequential damages in connection with its publication.

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 ₂	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 ₂ 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

L-4631-B

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.*

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.

VENTILATION	LOCAL EXHAUST —Preferred.
	MECHANICAL (general) —Acceptable.
	SPECIAL —Not applicable.
	OTHER —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



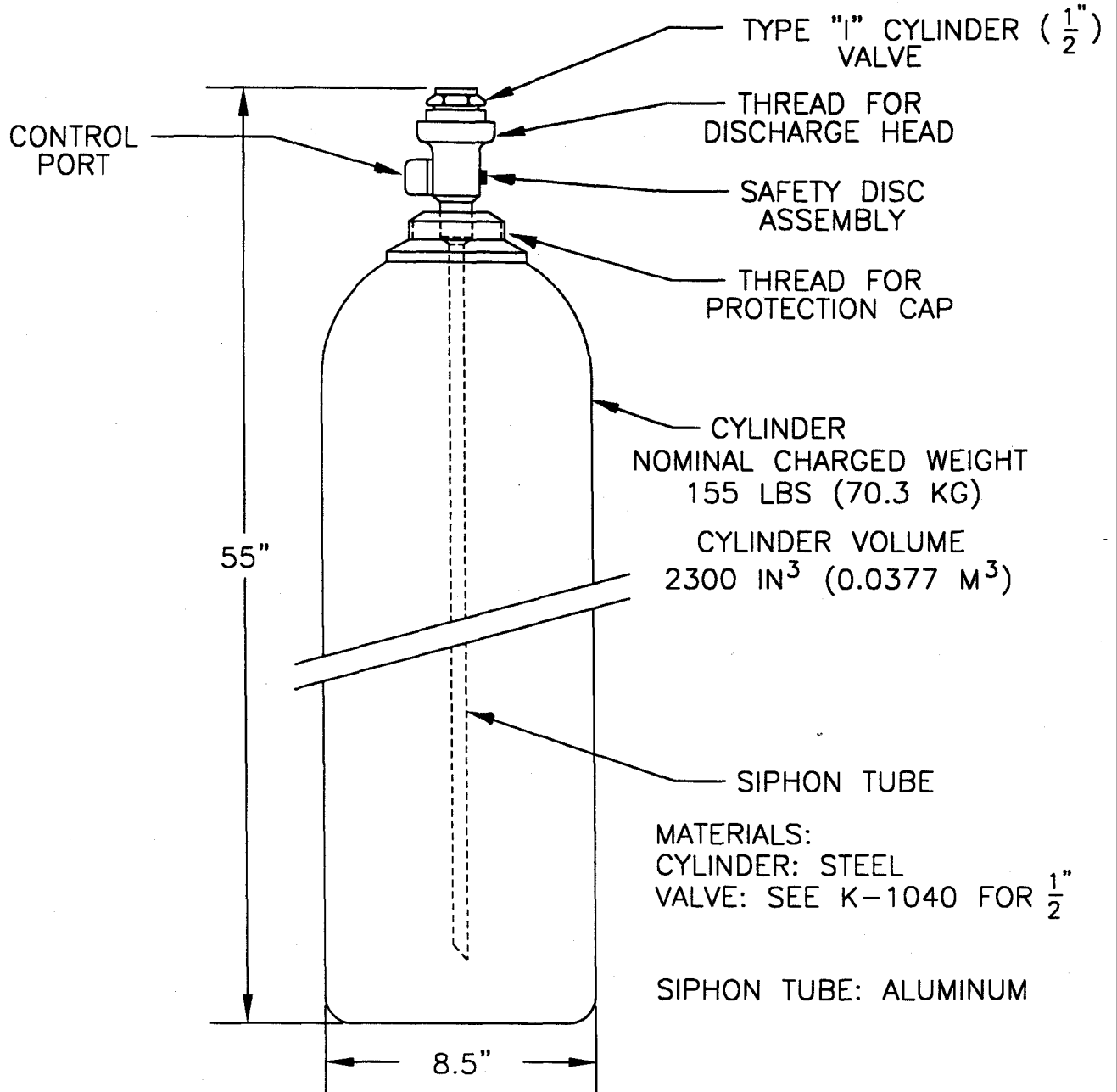
IN THE USA:
Union Carbide Corporation
Linde Division
39 Old Ridgebury Road
Danbury, CT 06817-0001

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

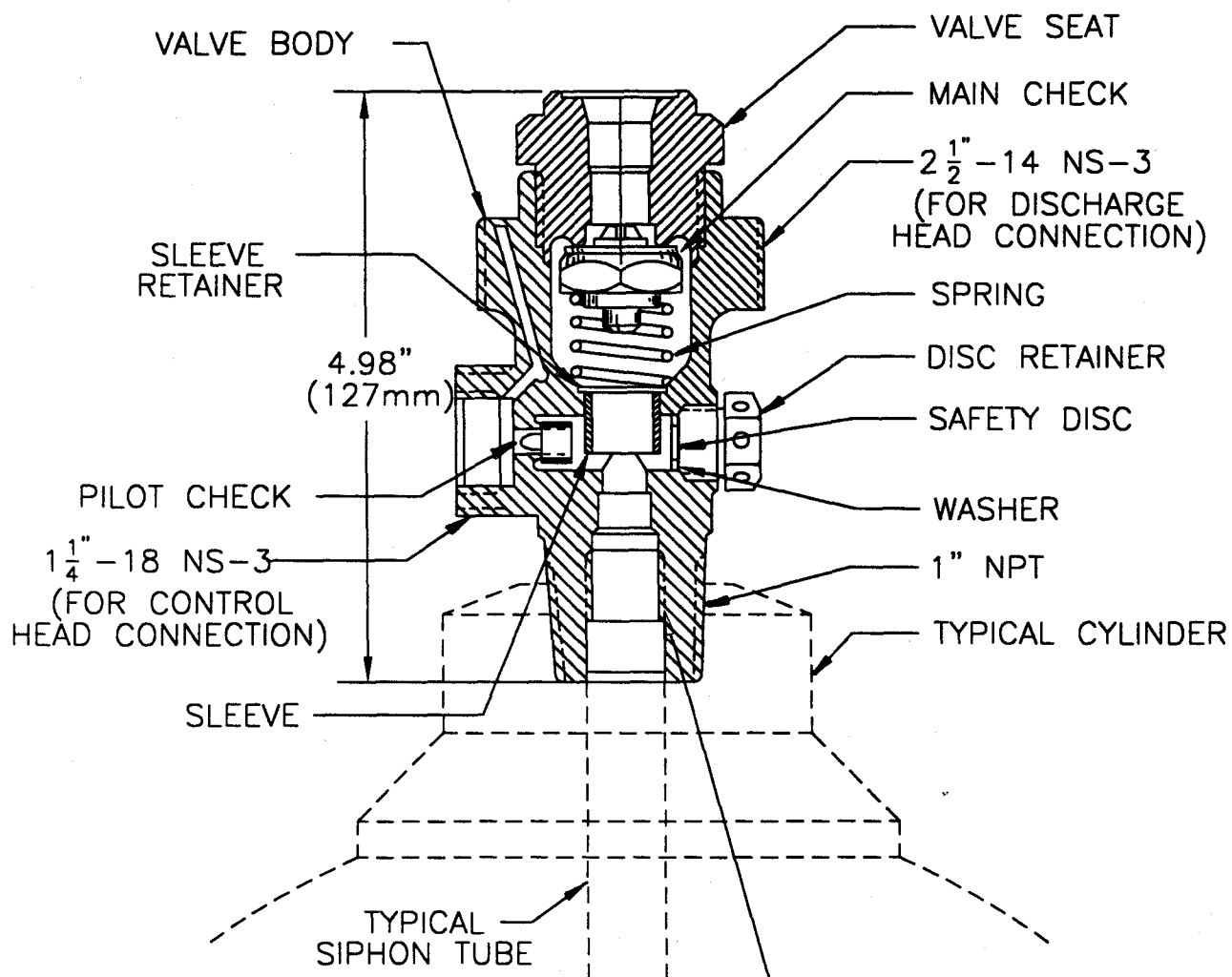


50 LB CARBON DIOXIDE CYLINDER

P/N 982528

K-1010M

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

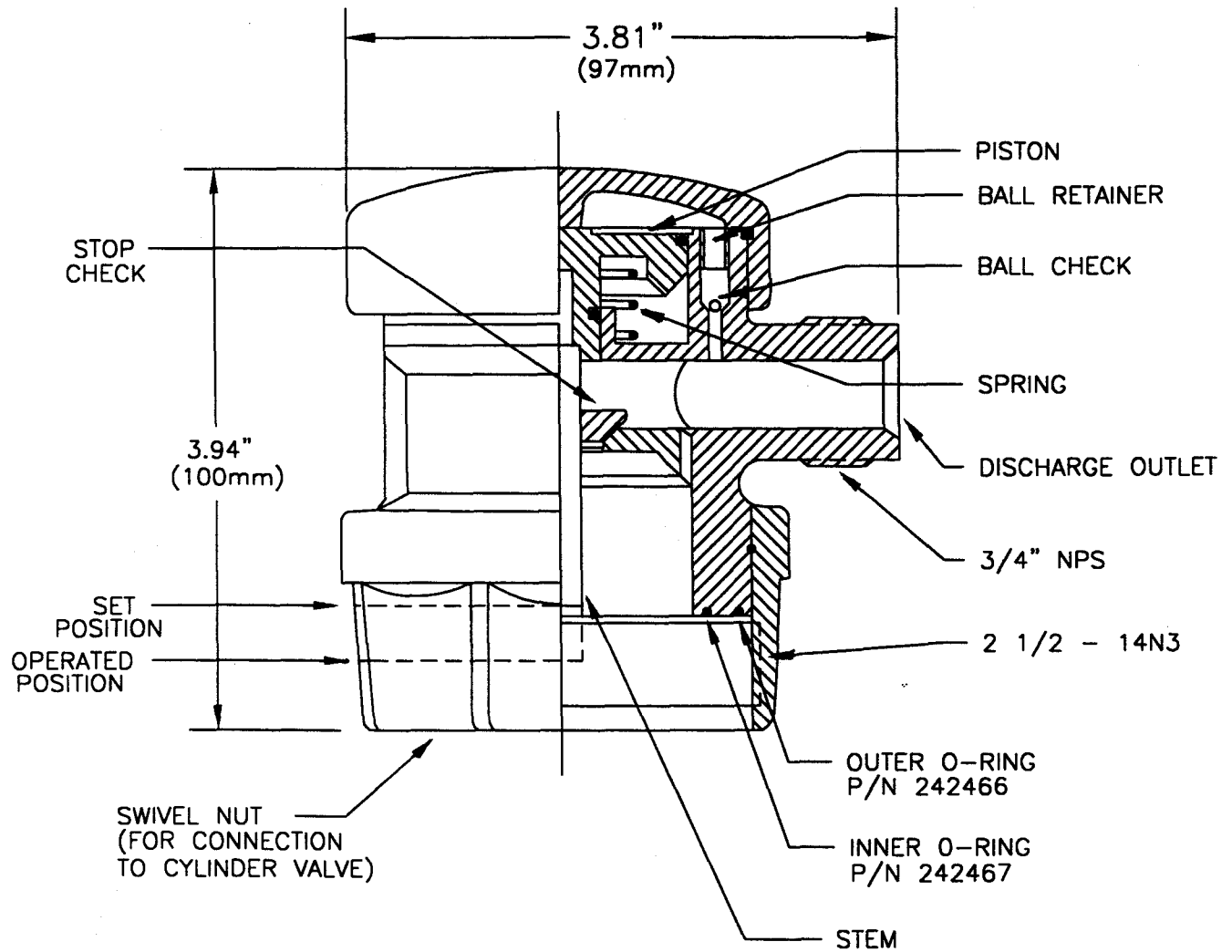
SIPHON TUBE
THREADED IN PLACE -
3/8" NPS

PRODUCT	USE
CO ₂	X
FE-13	
FM-200	
HALON 1301	

P/N - 981372

K-1040

DISCHARGE HEAD, PLAIN NUT

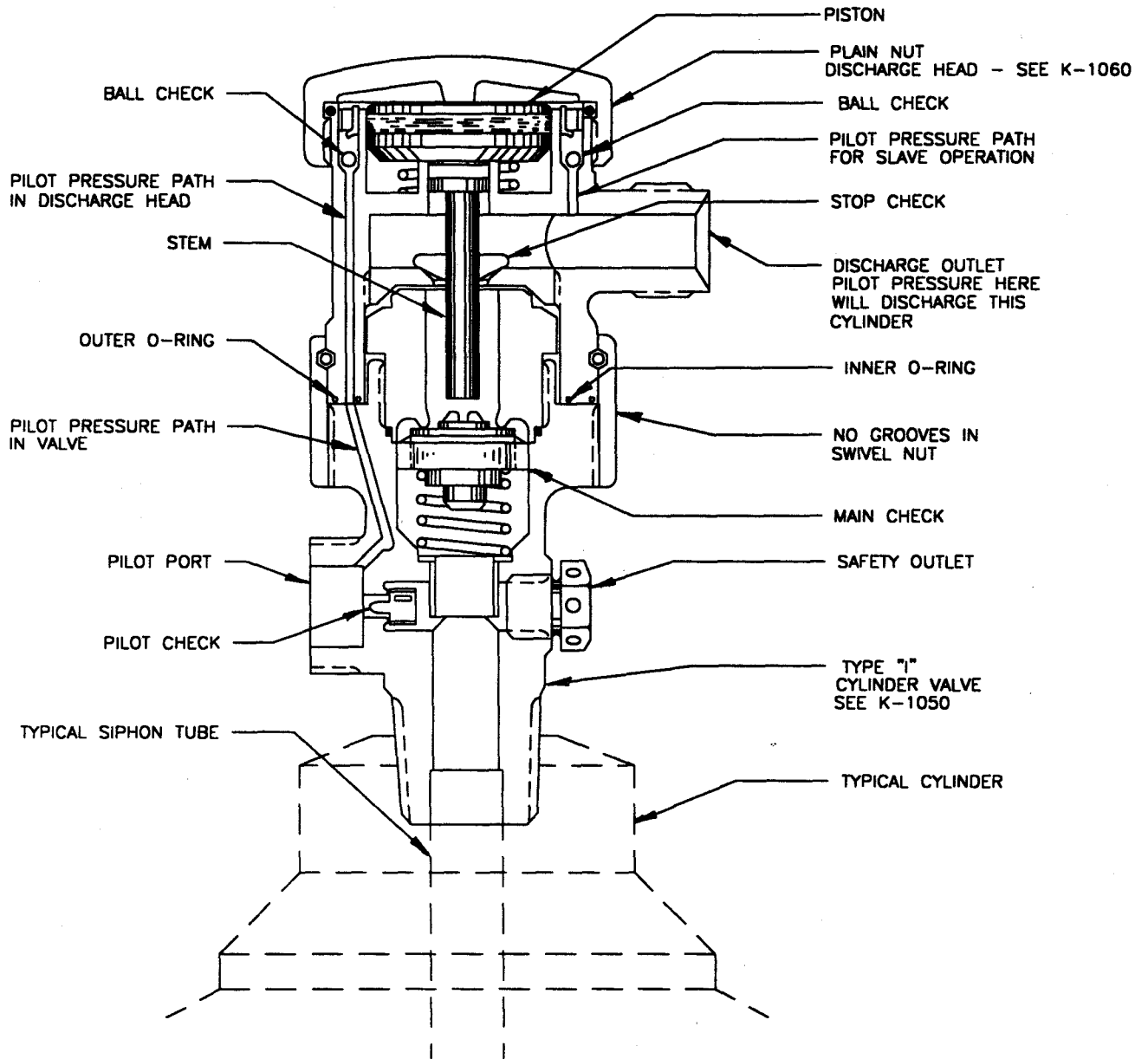


PRODUCT	USE
CO ₂	X
FE-13	
FM-200	
HALON 1301	

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



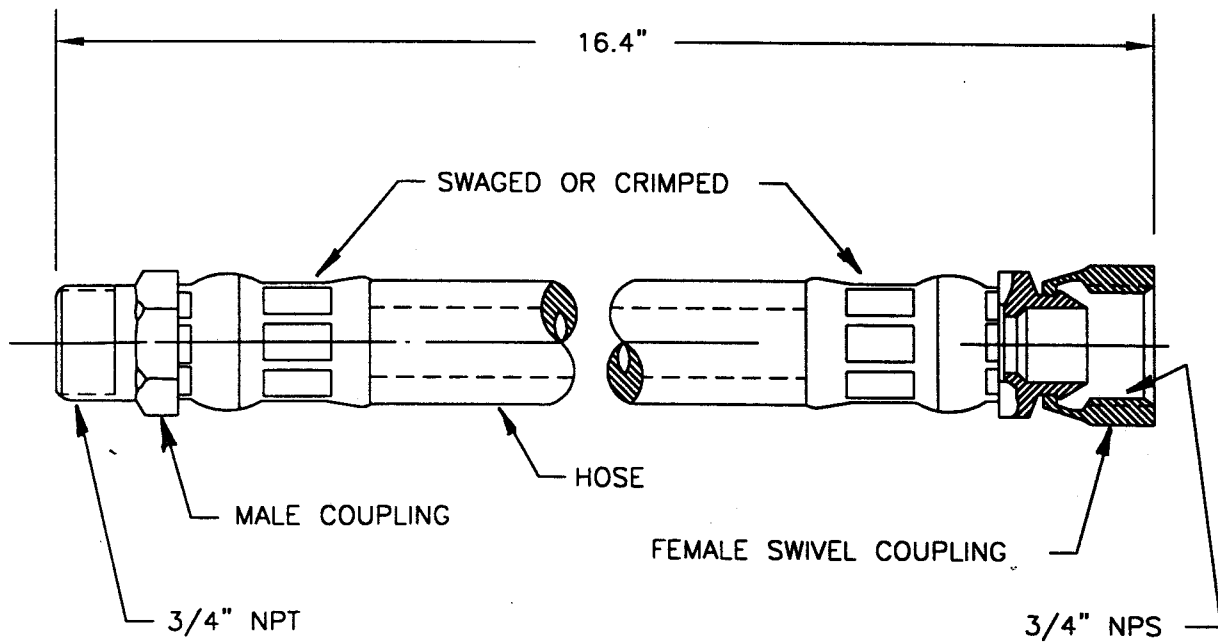
CAUTION

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 ₂	X
FE-13	
FM-200	
HALON 1301	

K-1061

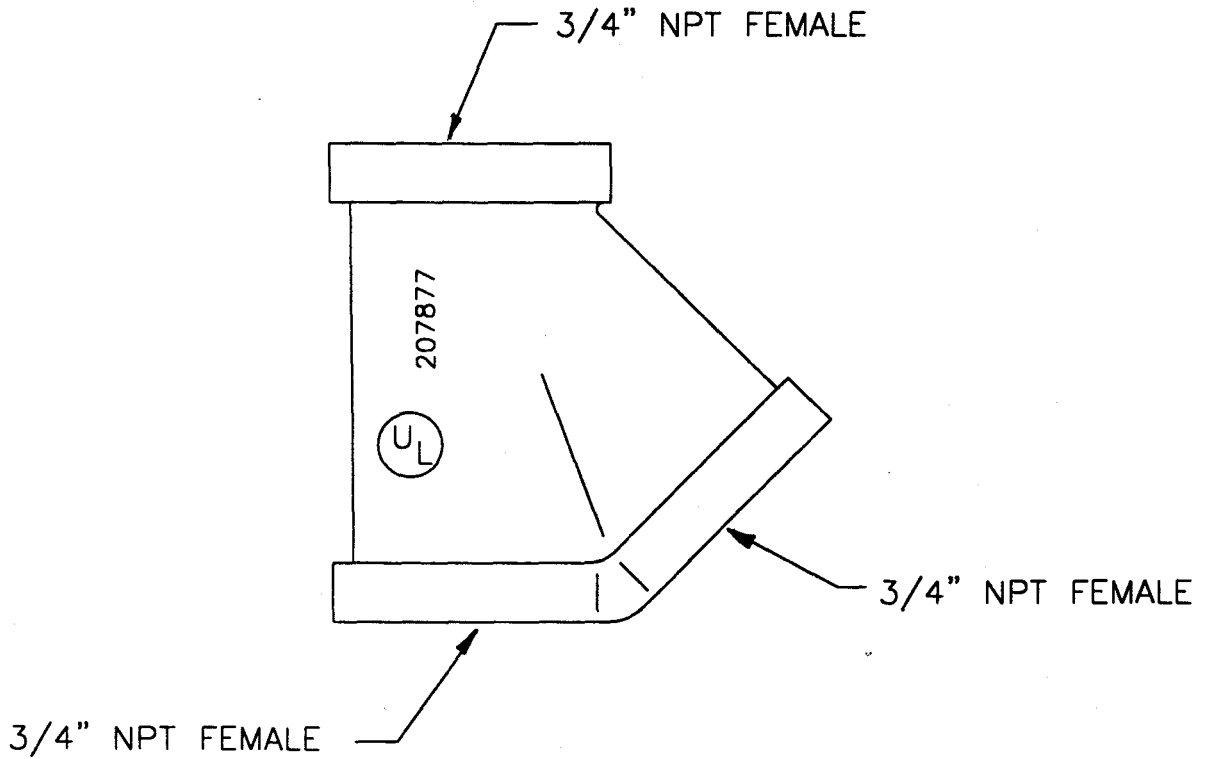
FLEX HOSE - 3/4"



PRODUCT	USE
CO ₂	X
FE-13	
FM-200	
HALON 1301	

P/N - 251821
K-1090

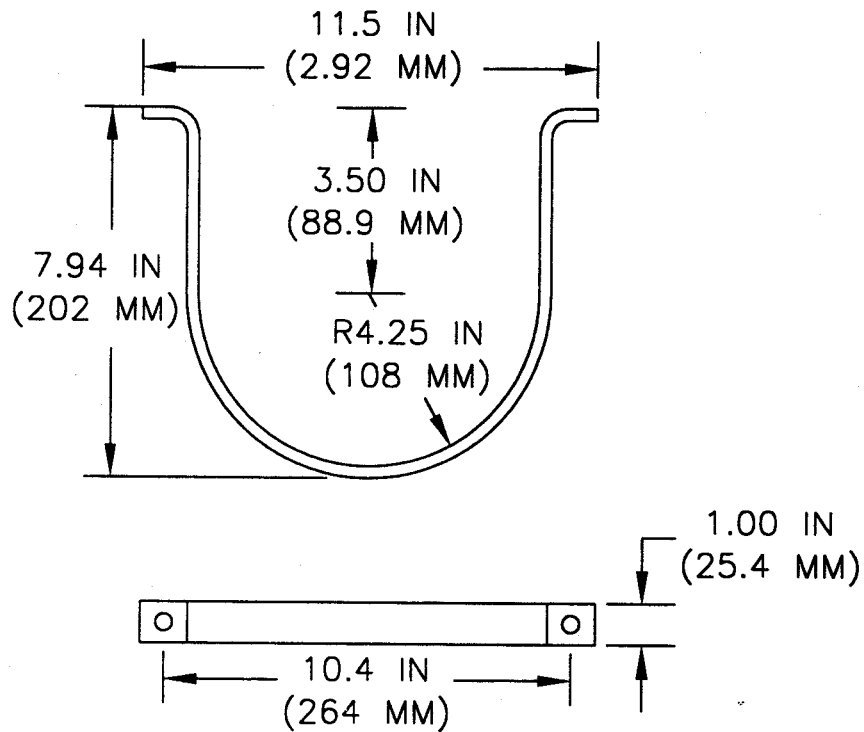
MANIFOLD "Y" FITTING



MATERIAL: GALVANIZED MALLEABLE IRON

PRODUCT	USE
CO ₂	X
FE-13	
FM-200	
HALON 1301	

P/N - 207877
K-1100

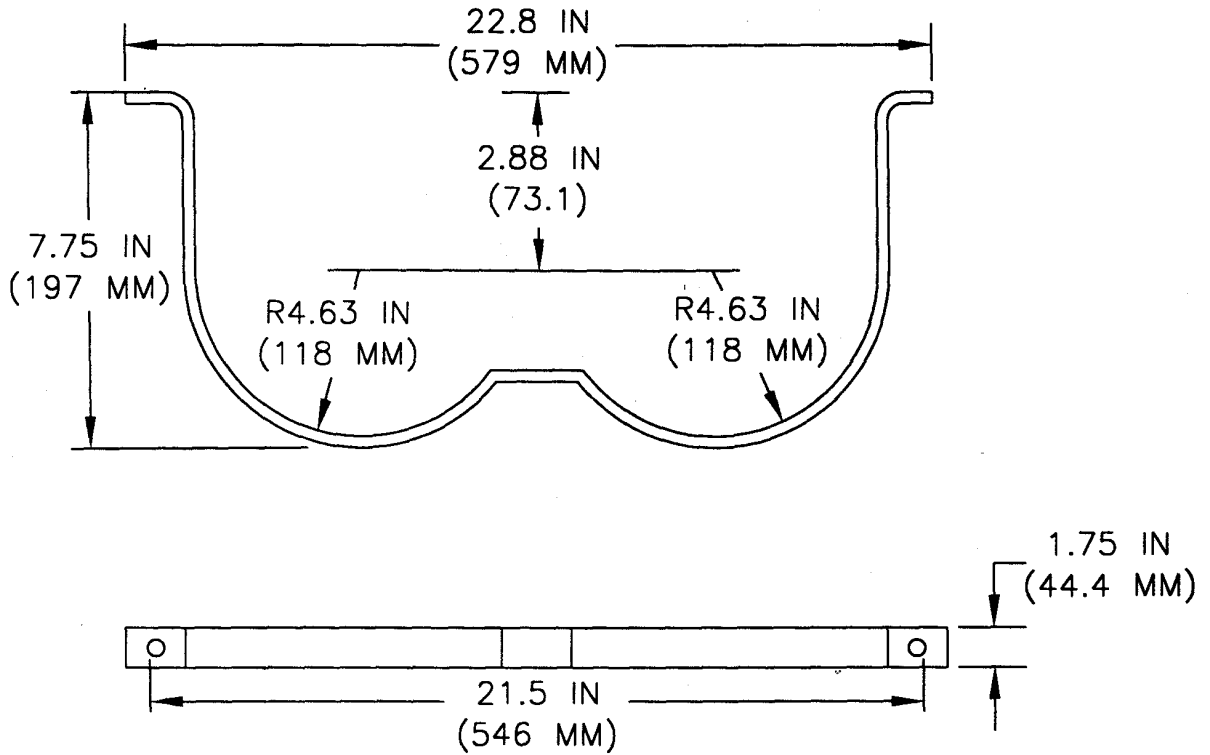
CARBON DIOXIDE SINGLE CYLINDER STRAP (50 LB)

MATERIAL: STEEL

P/N 270014
K-1230M

Change 1

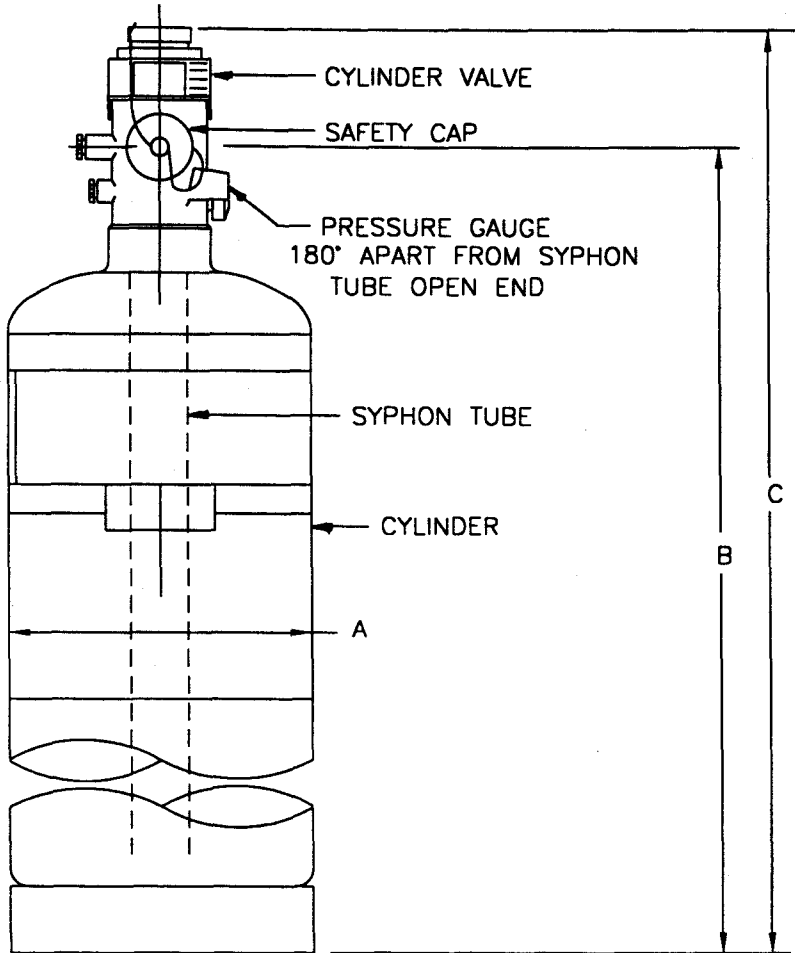
CARBON DIOXIDE TWO CYLINDER STRAP (50 LB)



MATERIAL: STEEL

P/N 241219
K-1240M

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 ₂	
FE-13	
FM-200	X
HALON 1301	

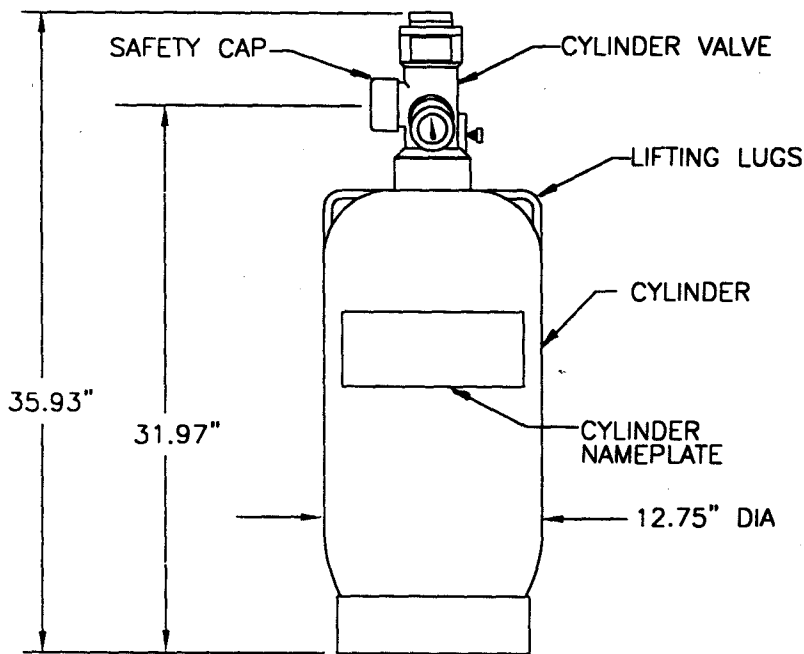
MATERIAL:
VALVE BODY: BRASS
CYLINDER: STEEL, PAINTED RED

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

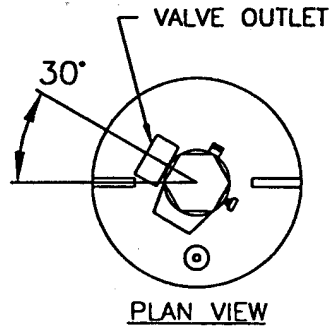
PRODUCT	USE
CO ₂	
FE-13	
FM-200	X
HALON 1301	

P/N - 90-100125-001
 K-2030

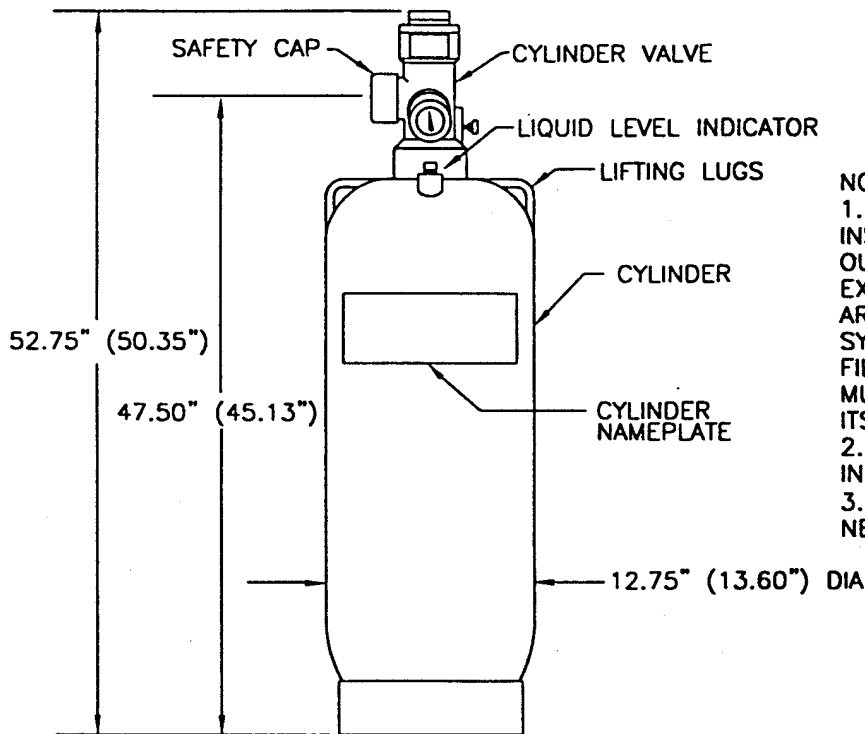


COMPONENT DESCRIPTION

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

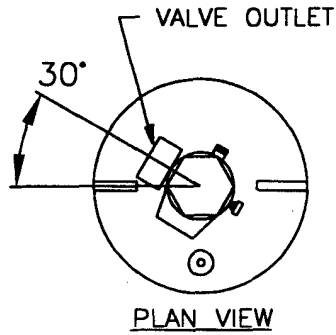


- NOTES-
1. THE SAFETY CAP MUST BE INSTALLED ON THE VALVE OUTLET AT ALL TIMES EXCEPT WHEN THE CYLINDERS ARE CONNECTED TO THE SYSTEM PIPING OR BEING FILLED. THE SAFETY CAP MUST NOT BE REMOVED FROM ITS CHAIN.
 2. SEE K-2070 FOR ADDITIONAL INFORMATION.
 3. OLD CYLINDER DIMENSIONS IN () NEW CYLINDER MFG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

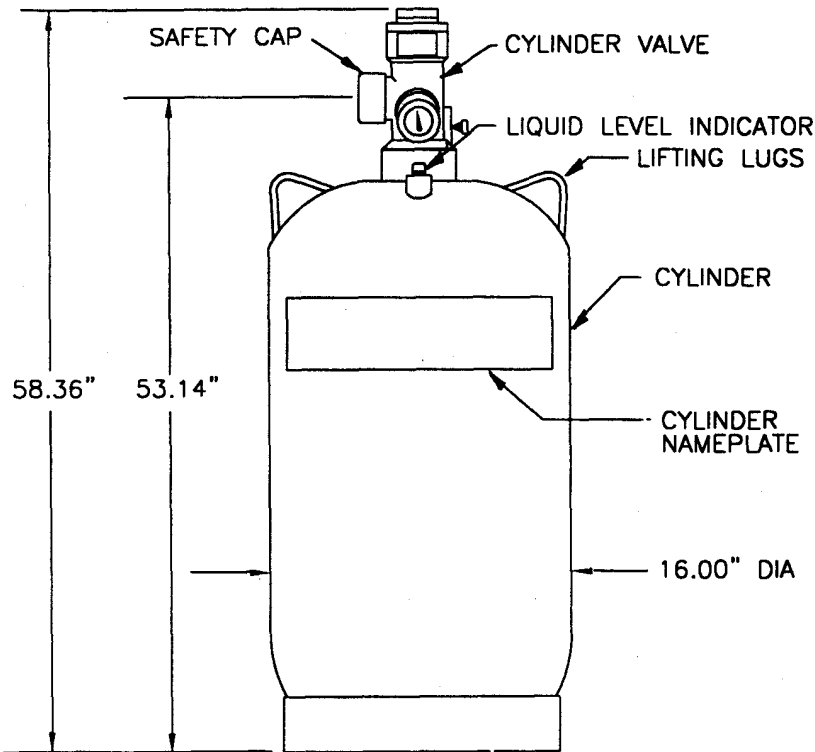
MATERIAL:
VALVE BODY: BRASS
CYLINDER: STEEL, PAINTED RED

P/N - SEE TABLE
K-8040

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

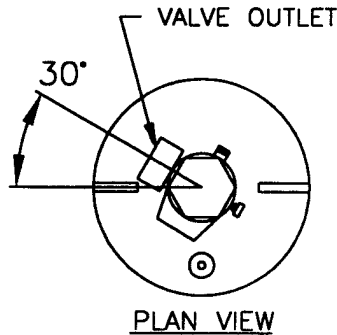
PRODUCT	USE
CO ₂	
FE-13	
FM-200	X
HALON 1301	

P/N - SEE TABLE
K-2050

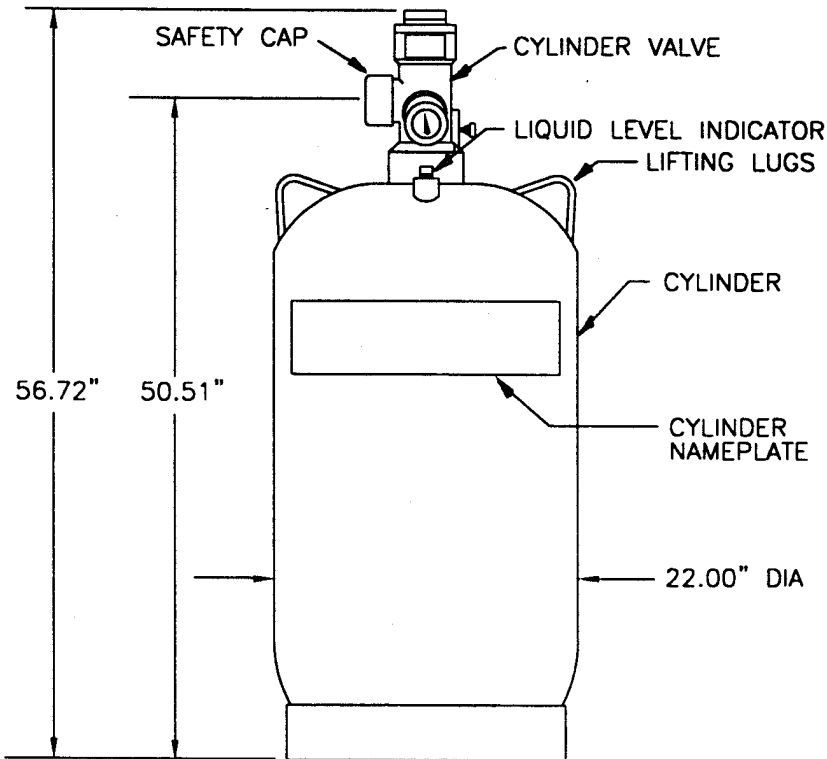


COMPONENT DESCRIPTION

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 ₂	
FE-13	
FM-200	X
HALON 1301	

P/N — SEE TABLE
 K-2060



GENERAL INFORMATION

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 ³	M ³
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.

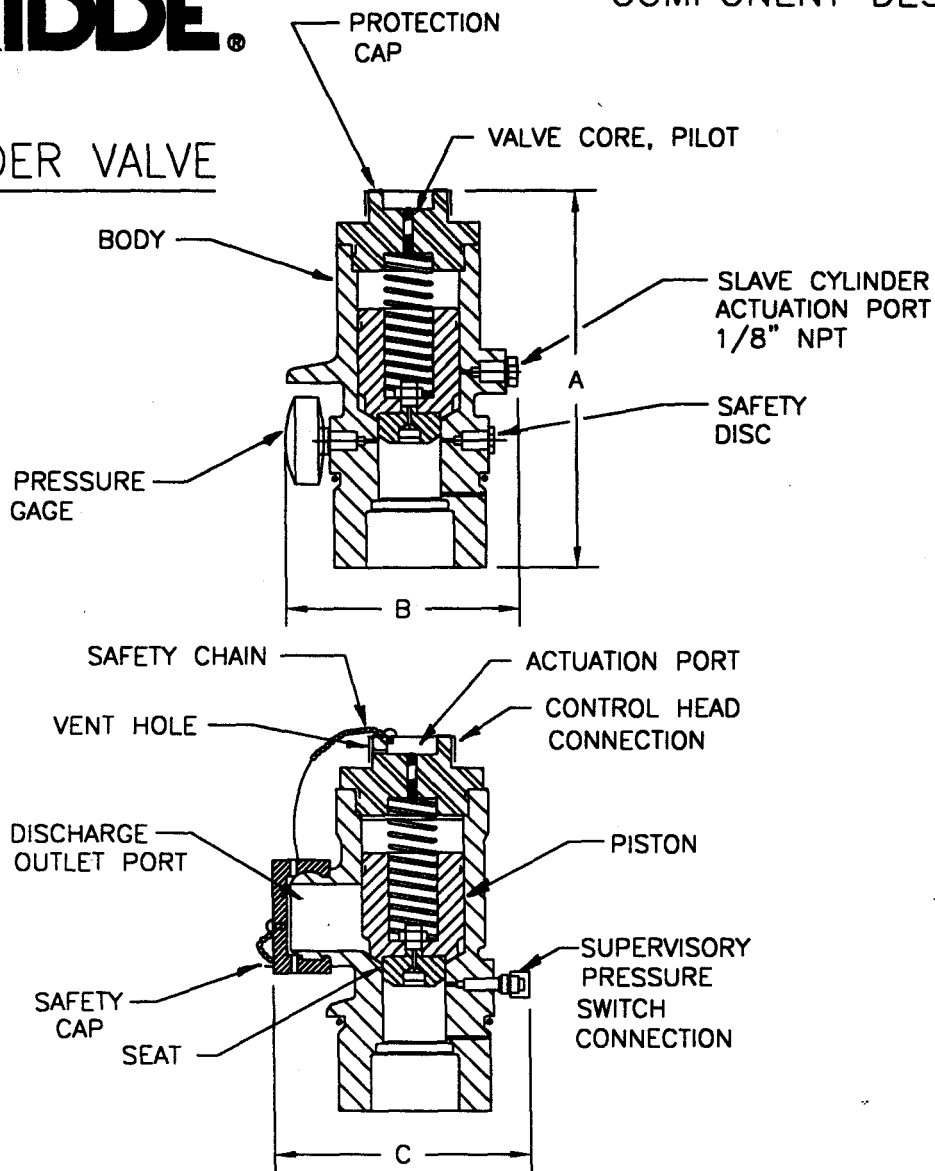
PRODUCT	USE
CO ₂	
FE-13	
FM-200	X
HALON 1301	

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

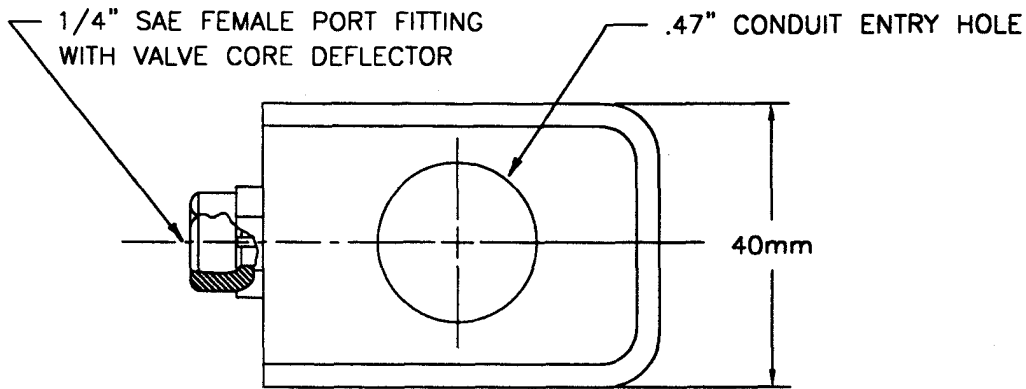
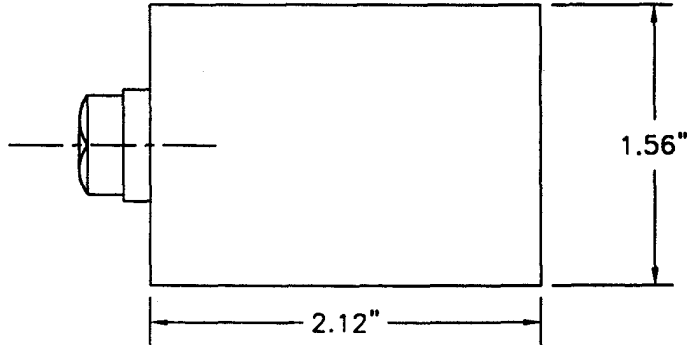
WORKING PRESSURE: 360-609 PSI
 PROOF PRESSURE: 1000 PSI
 BURST PRESSURE: 2000 PSI
 TEMPERATURE RANGE: 0 TO 130 F

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 ₂	
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

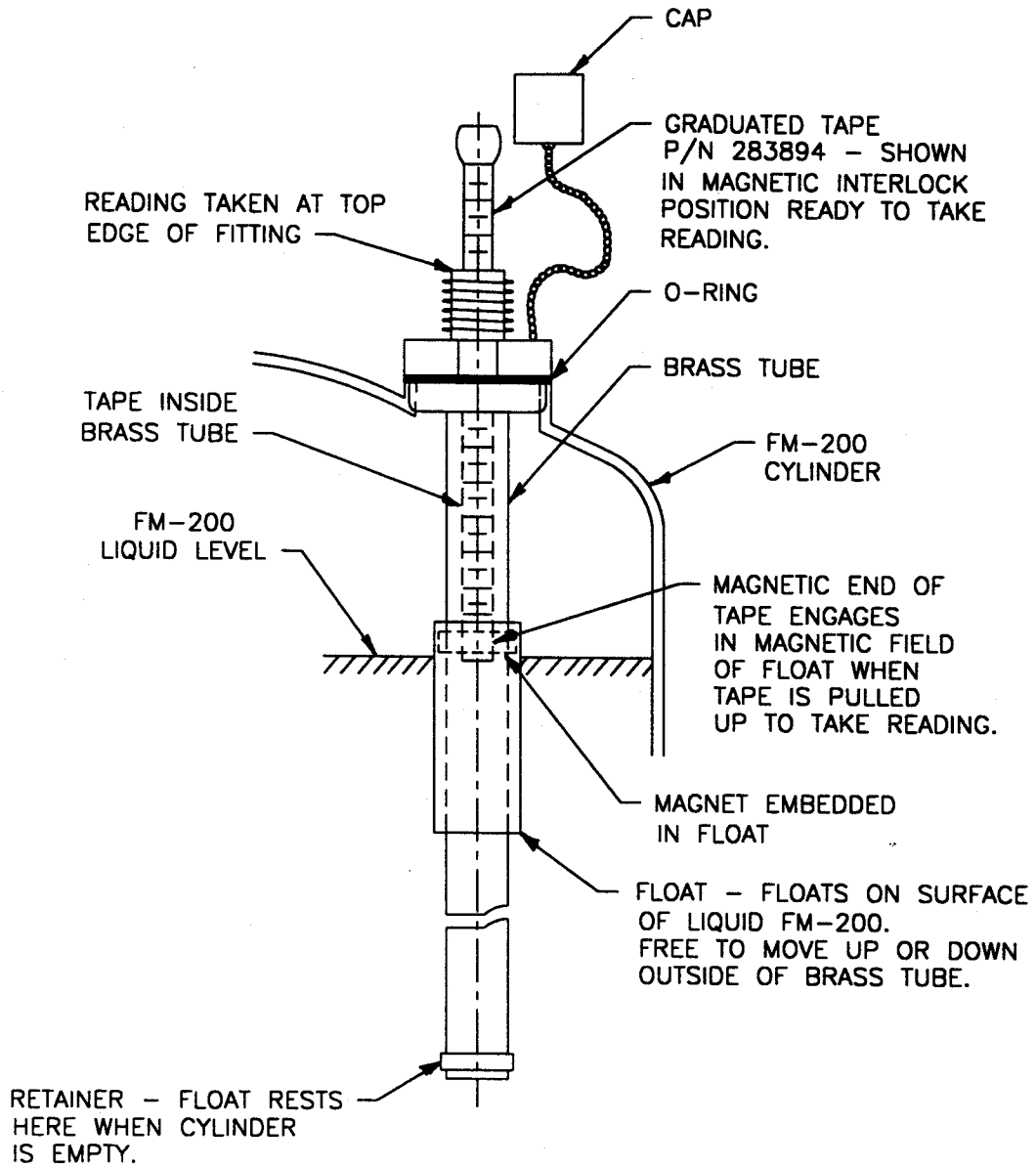
OPERATION: DEVICE "NORMALLY OPEN" "CLOSED UNDER PRESSURE"
PRESSURE LOSS GREATER THAN 40 PSI WILL CAUSE CONTACTS TO CLOSE

PRODUCT	USE
CO ₂	
FE-13	
FM-200	X
HALON 1301	X

P/N - 878709-0XX

K-2090

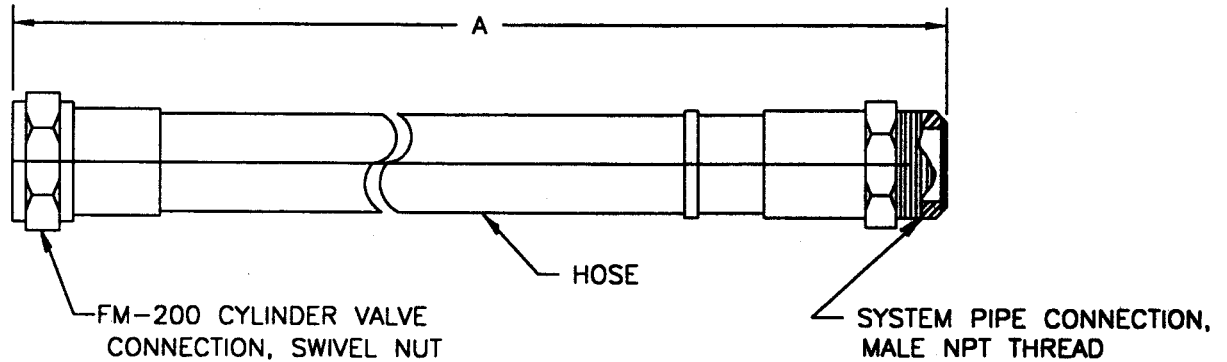
LIQUID LEVEL INDICATOR



PRODUCT	USE
CO ₂	
FE-13	
FM-200	X
HALON 1301	X

K-2110

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

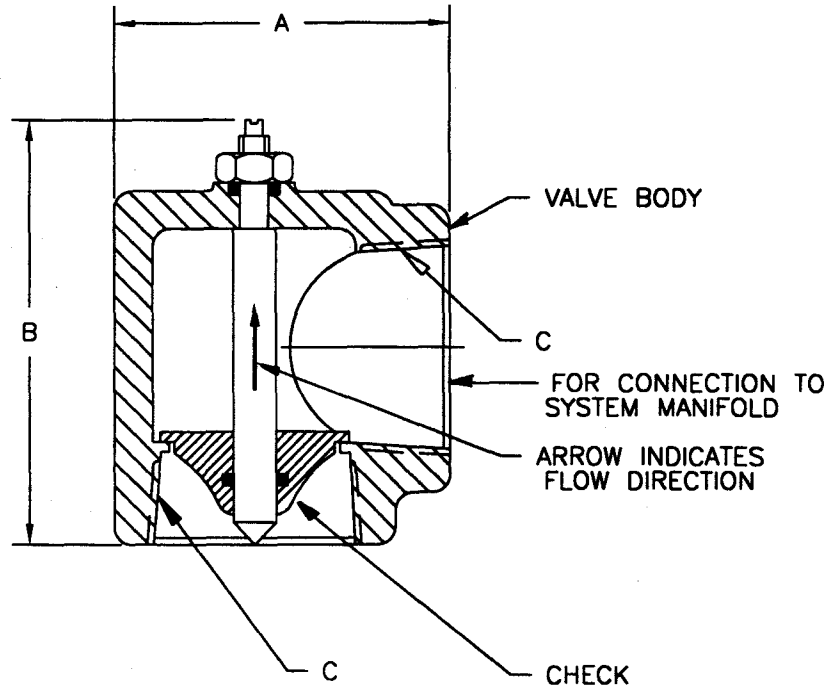
WORKING PRESSURE: 500 PSI

PROOF PRESSURE: 1000 PSI

PRODUCT	USE
CO ₂	
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

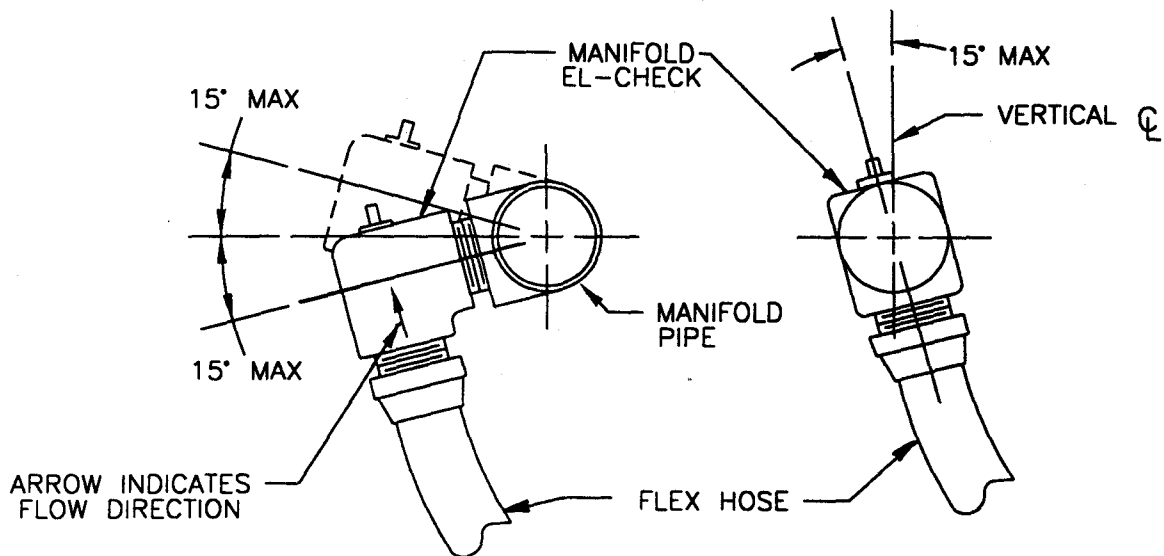
CHECK: STAINLESS STEEL

SEAT: NITRILE RUBBER

PRODUCT	USE
CO ₂	
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

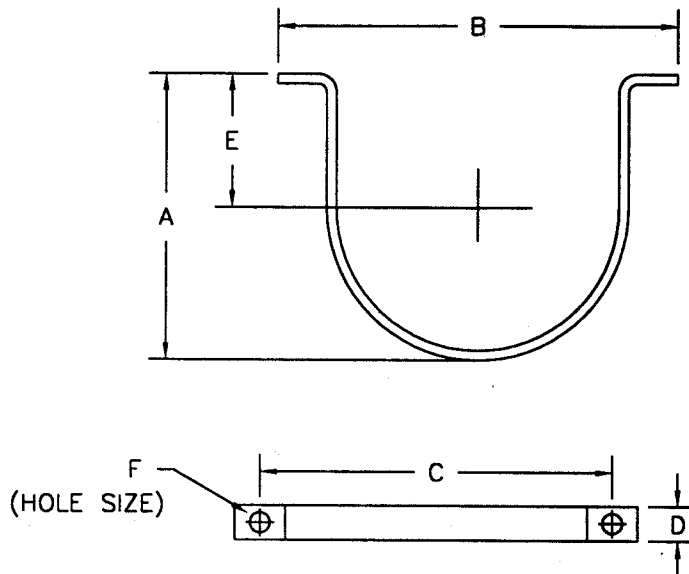
PRODUCT	USE
CO ₂	
FE-13	X
FM-200	X
HALON 1301	X

K-2131



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

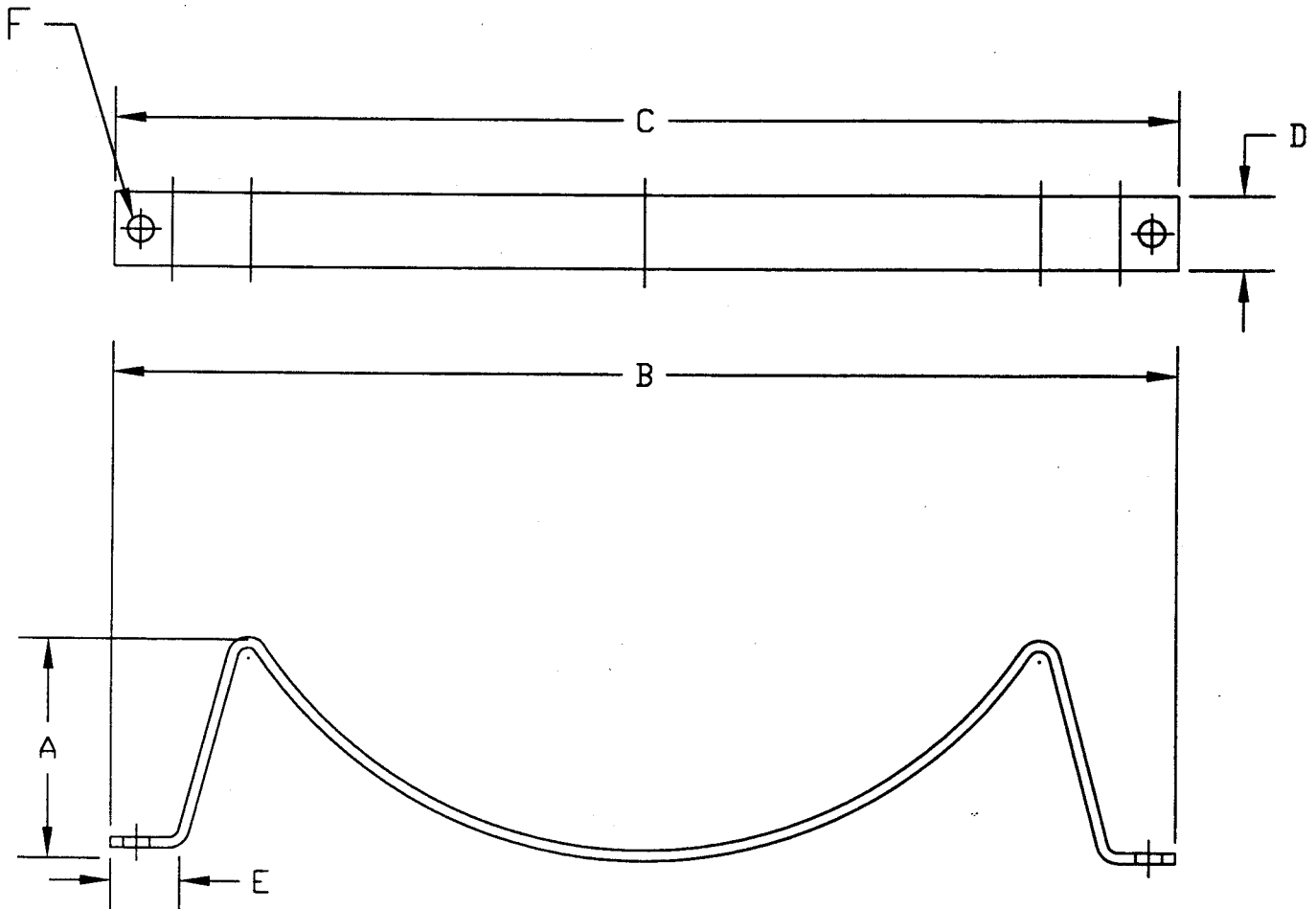
* DIMENSIONS ARE IN INCHES

MATERIAL: STEEL, PAINTED BLACK

P/N - SEE TABLE
K-8130M

Change 1

CYLINDER MOUNTING CRADLE



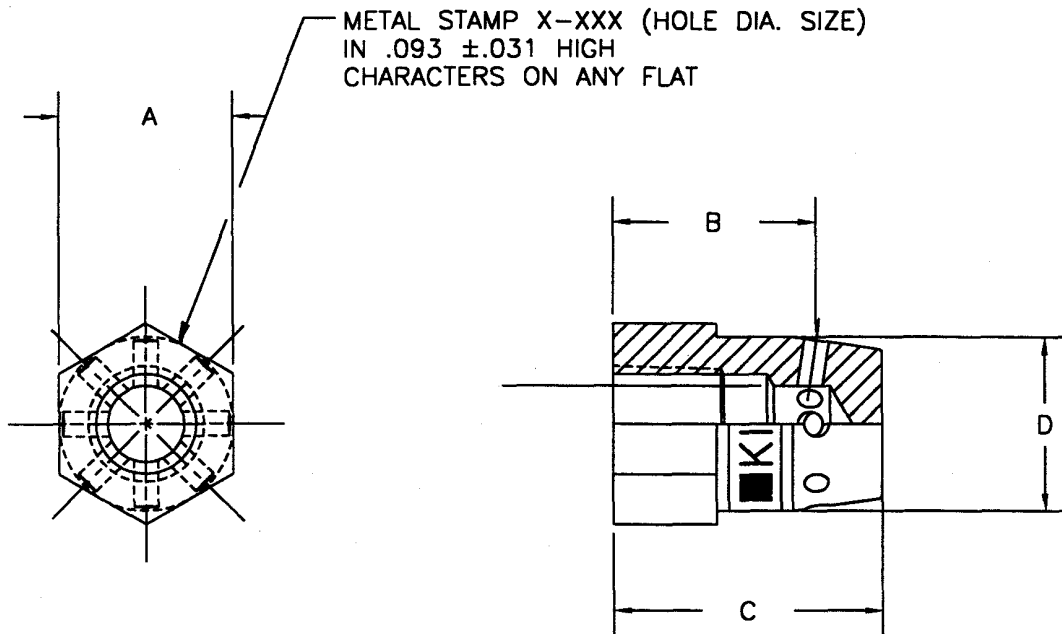
PART NO.	CYL SIZE	CYL O.D.*	A*	B*	C*	D*	E*	F*
235431	125,200	12.75	3.20	16.25	15.00	1.50	1.312	.562
281867	350	16.00	3.58	19.24	18.00	1.50	1.34	.562
294652	600	22.00	4.75	25.24	24.00	1.75	1.34	.562

* DIMENSIONS ARE IN INCHES

MATERIAL: STEEL, PAINTED GRAY

P/N - SEE TABLE
K-8150M

360 DEGREE PENDANT NOZZLE



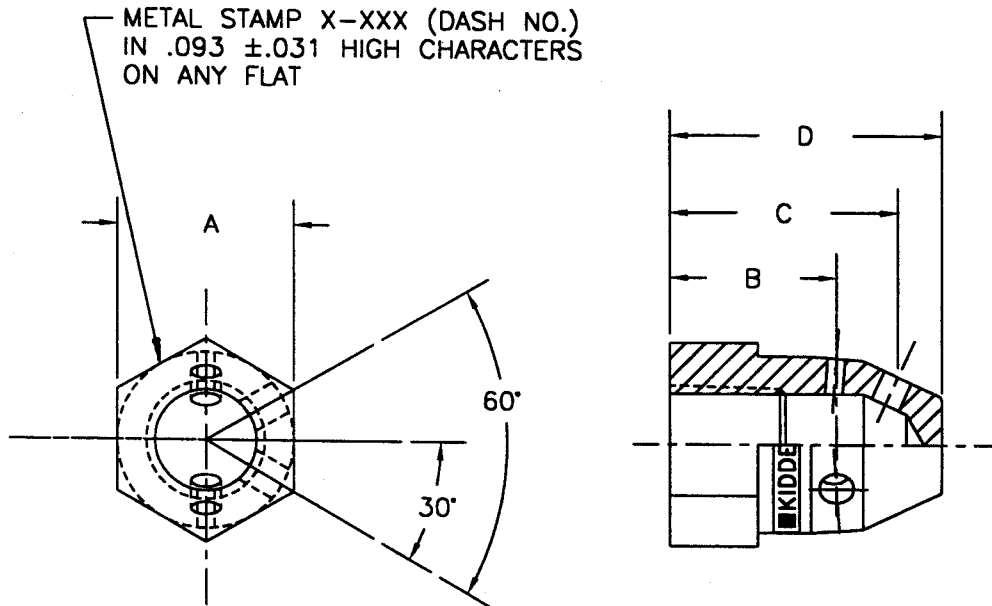
360 DEGREE NOZZLE					
Pipe Size	A	B	C	D	
1/2" (12.20mm)	1.250" (31.75mm)	1.468" (37.28mm)	1.937" (49.19mm)	1.250" (31.75mm)	
3/4" (19.05mm)	1.500" (38.10mm)	1.578" (40.08mm)	2.125" (53.97mm)	1.500" (38.10mm)	
1" (25.40mm)	1.750" (44.45mm)	1.718" (43.63mm)	2.375" (60.32mm)	1.750" (44.45mm)	
1-1/4" (31.75mm)	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 ₂	
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.

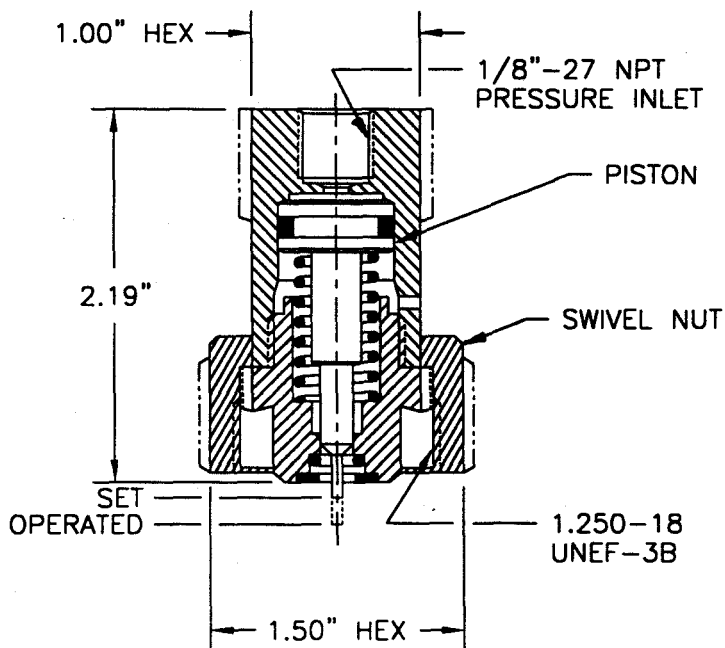
PRODUCT	USE
CO ₂	
FE-13	
FM-200	X
HALON 1301	

P/N - 90-19401X-XXX
K-2150



COMPONENT DESCRIPTION

PRESSURE OPERATED CONTROL HEAD

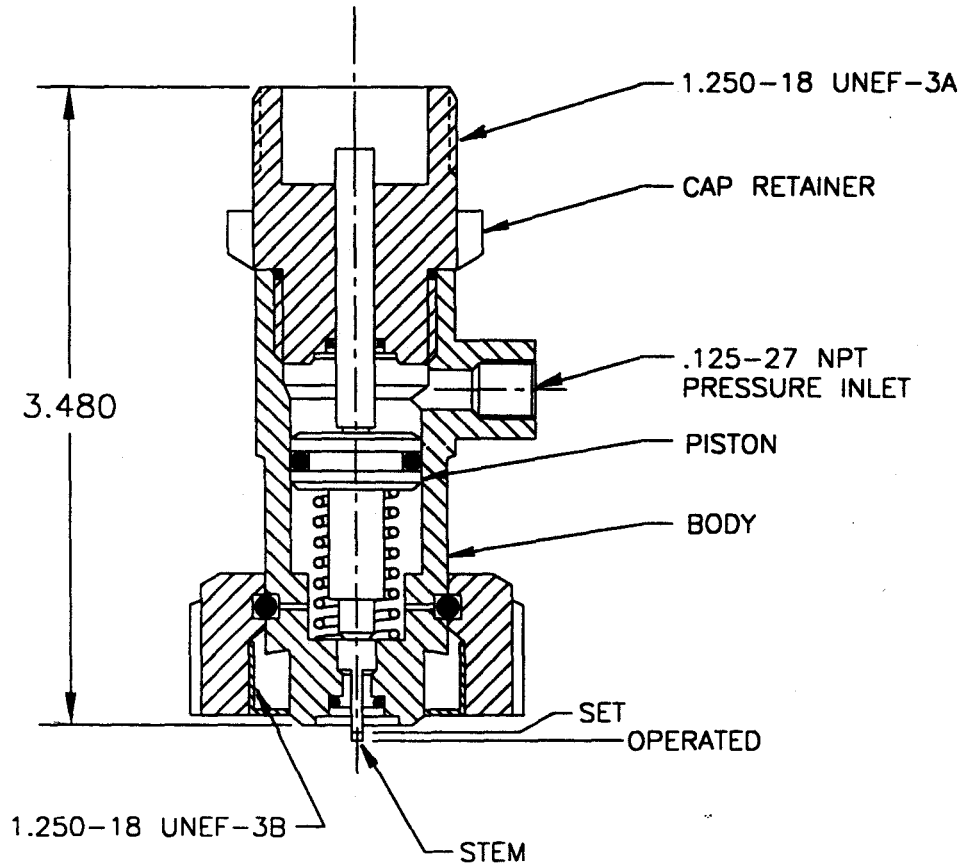


MATERIAL:
BODY, RETAINING NUT,
AND PISTON: BRASS

PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 878737
K-5010

PRESSURE OPERATED CONTROL HEAD, STACKABLE

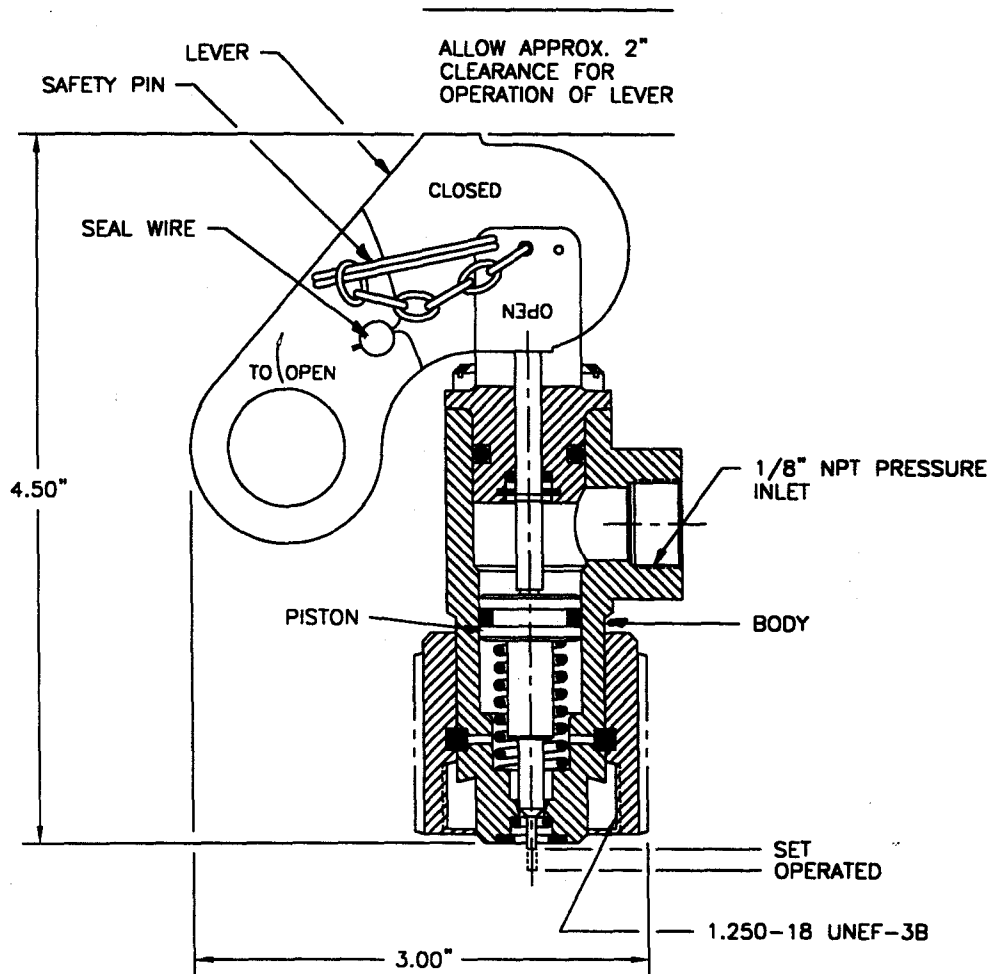


MATERIAL:
 BODY, RETAINER CAP,
 PISTON AND MTG. NUT: BRASS

PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 878750
 K-5020

LEVER OR PRESSURE OPERATED CONTROL HEAD

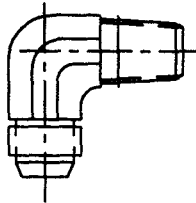


MATERIAL:
 LEVER: STAINLESS STEEL
 BODY AND PISTON: BRASS

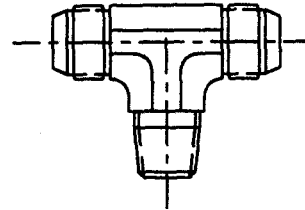
PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 878751
 K-5030

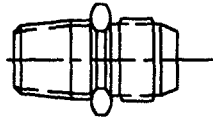
PILOT ACTUATION FITTINGS



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



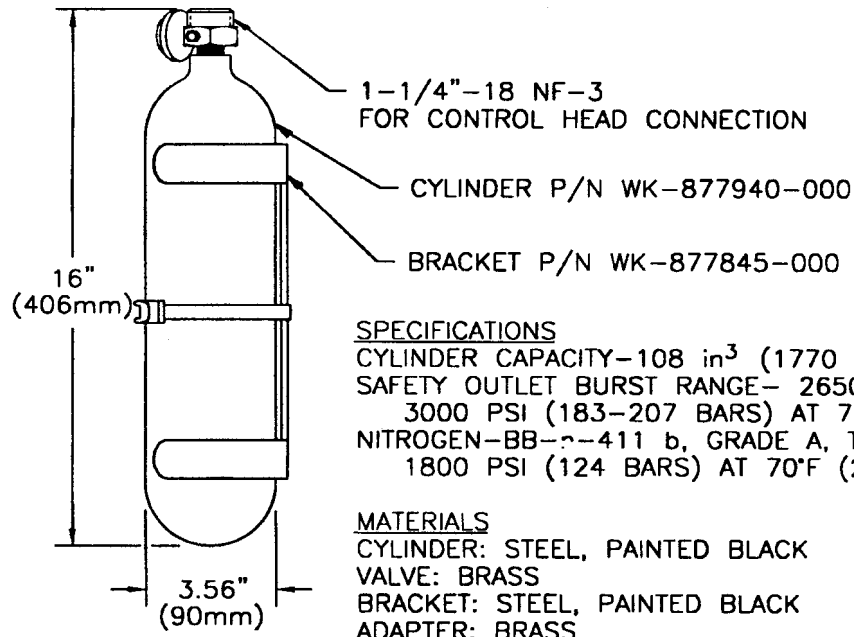
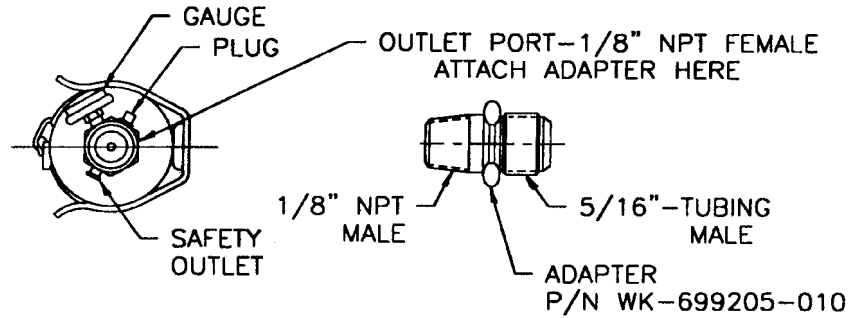
MALE CONNECTOR
1/8" NPT X 5/16" TUBING
P/N 6992-0501

MATERIAL: BRASS

PRODUCT	USE
CO ₂	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 in³ (1770 CM³)
 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

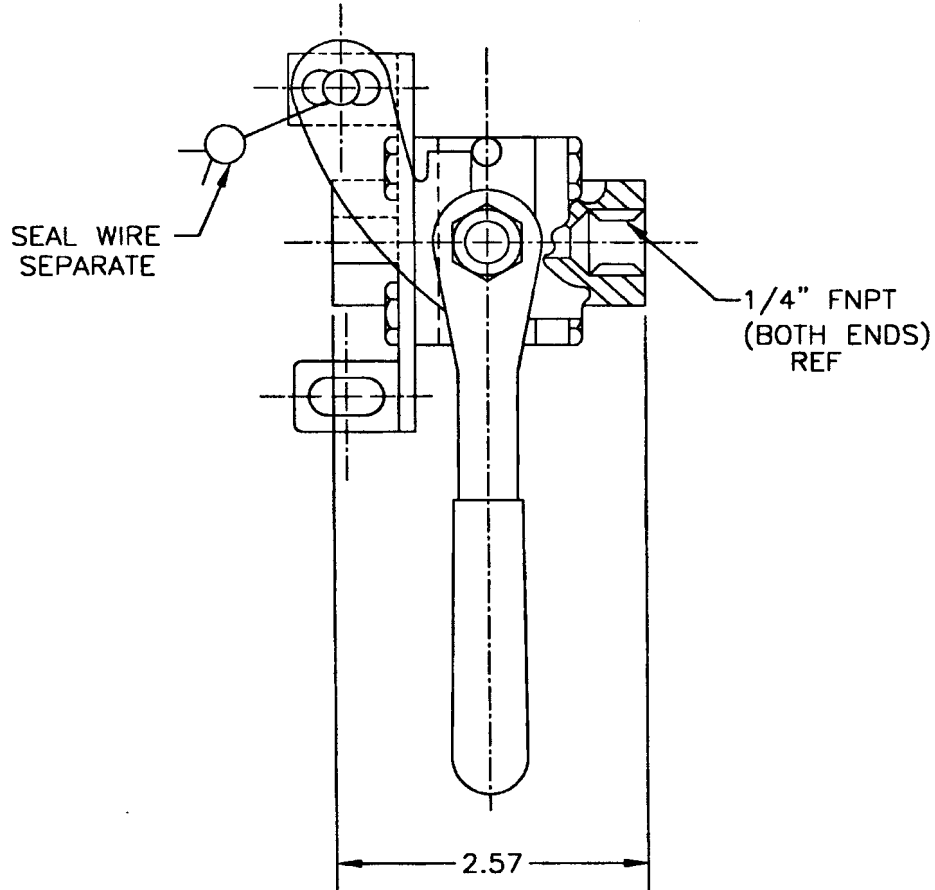
PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - SEE ABOVE
 K-5050



COMPONENT DESCRIPTION

BALL VALVE, 1/4"

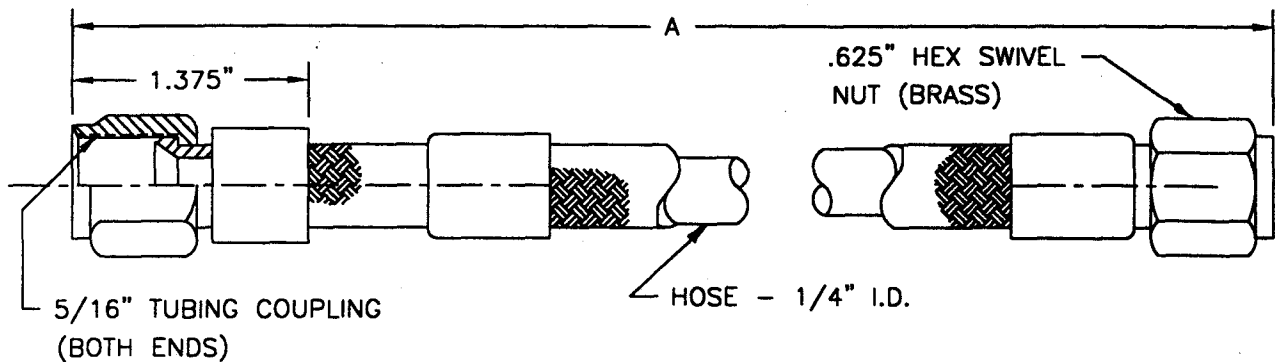


MATERIAL - STAINLESS STEEL, TYPE 316
OPERATING PRESSURE - 3000 PSIG @ 170°F
MINIMUM BURSTING PRESSURE 10000 PSI (680 BARS)

PRODUCT	USE
CO ₂	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"

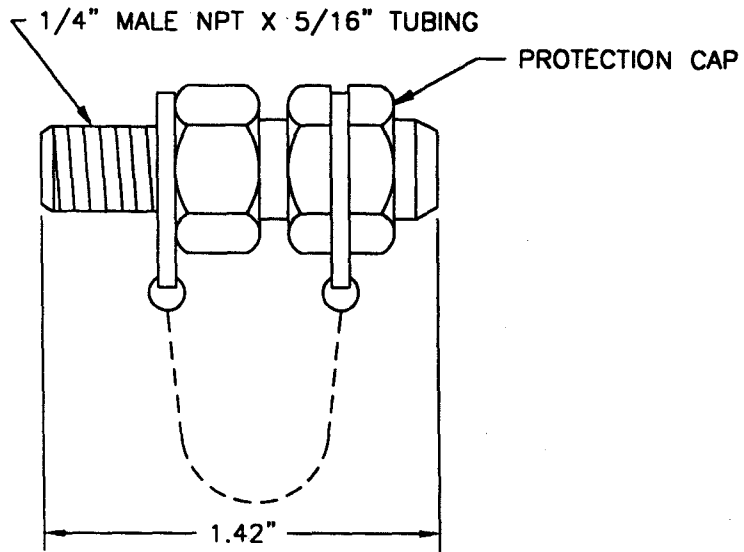
PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - SEE TABLE
K-5070

MASTER CYLINDER ADAPTER KIT

CAUTION
INSTALL CAP
WHEN
NOT IN
USE

LABEL

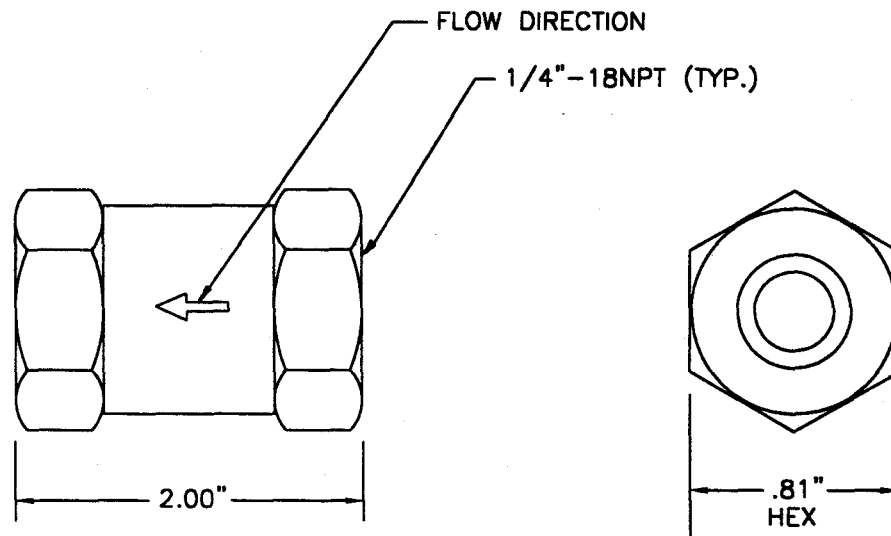


MATERIAL:
ADAPTER AND CAP: BRASS
CHAIN: STAINLESS STEEL
LABEL: MYLAR

PRODUCT	USE
CO ₂	
FE-13	X
FM-200	X
HALON 1301	X

P/N - 844895
K-5080

1/4" CHECK VALVE



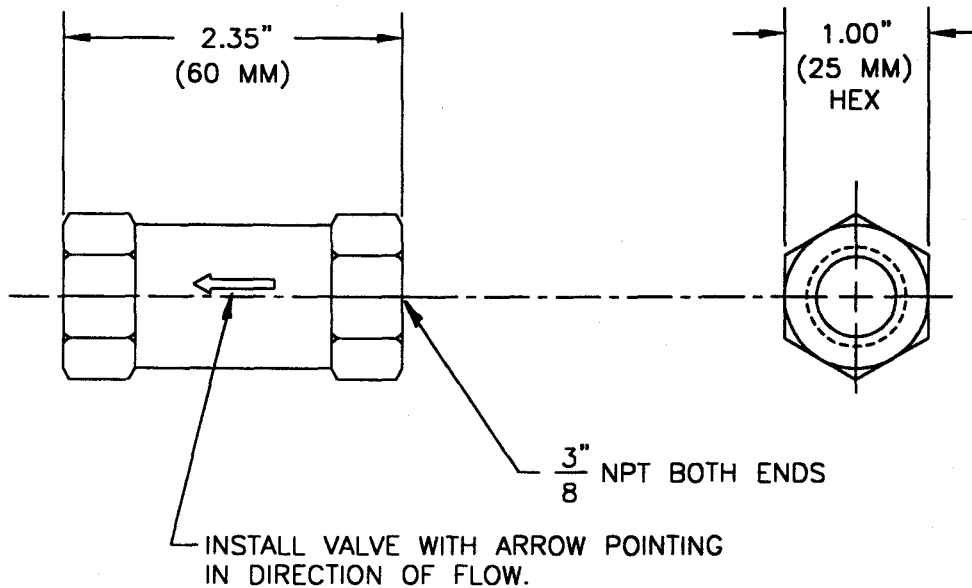
NOTE: INSTALL VALVE WITH ARROW POINTING IN DIRECTION OF FLOW.

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

PRODUCT	USE
CO ₂	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)

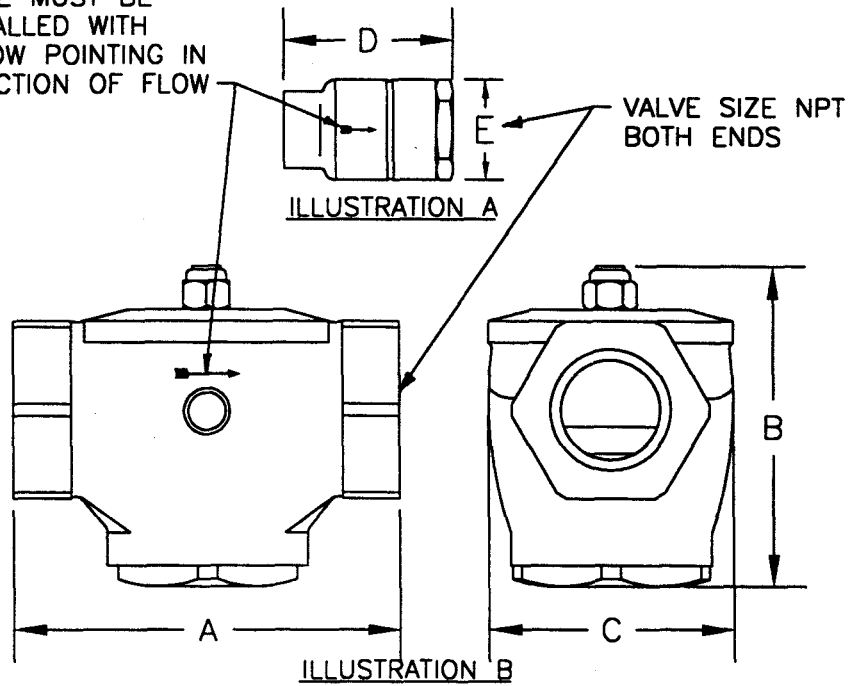
PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 261193

K-5100

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	-	-	-	-

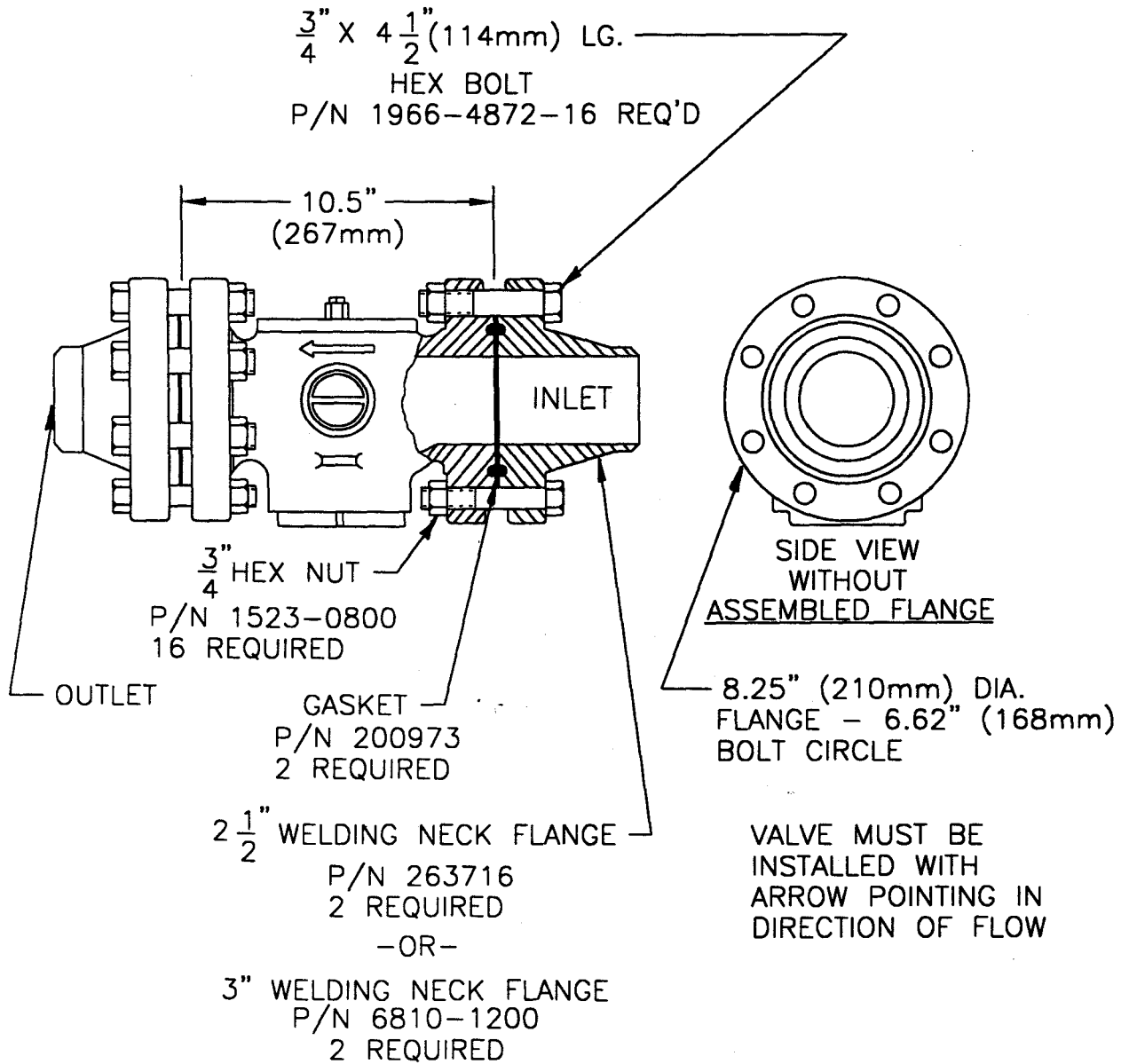
MATERIAL: BRASS

PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - SEE TABLE

K-5110

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

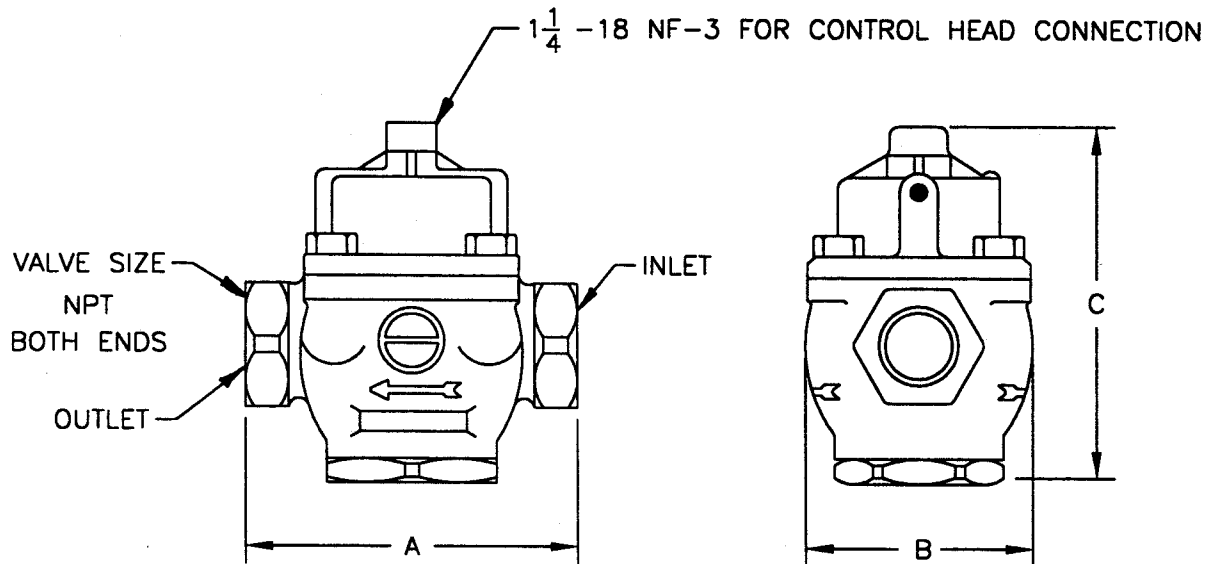


PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

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

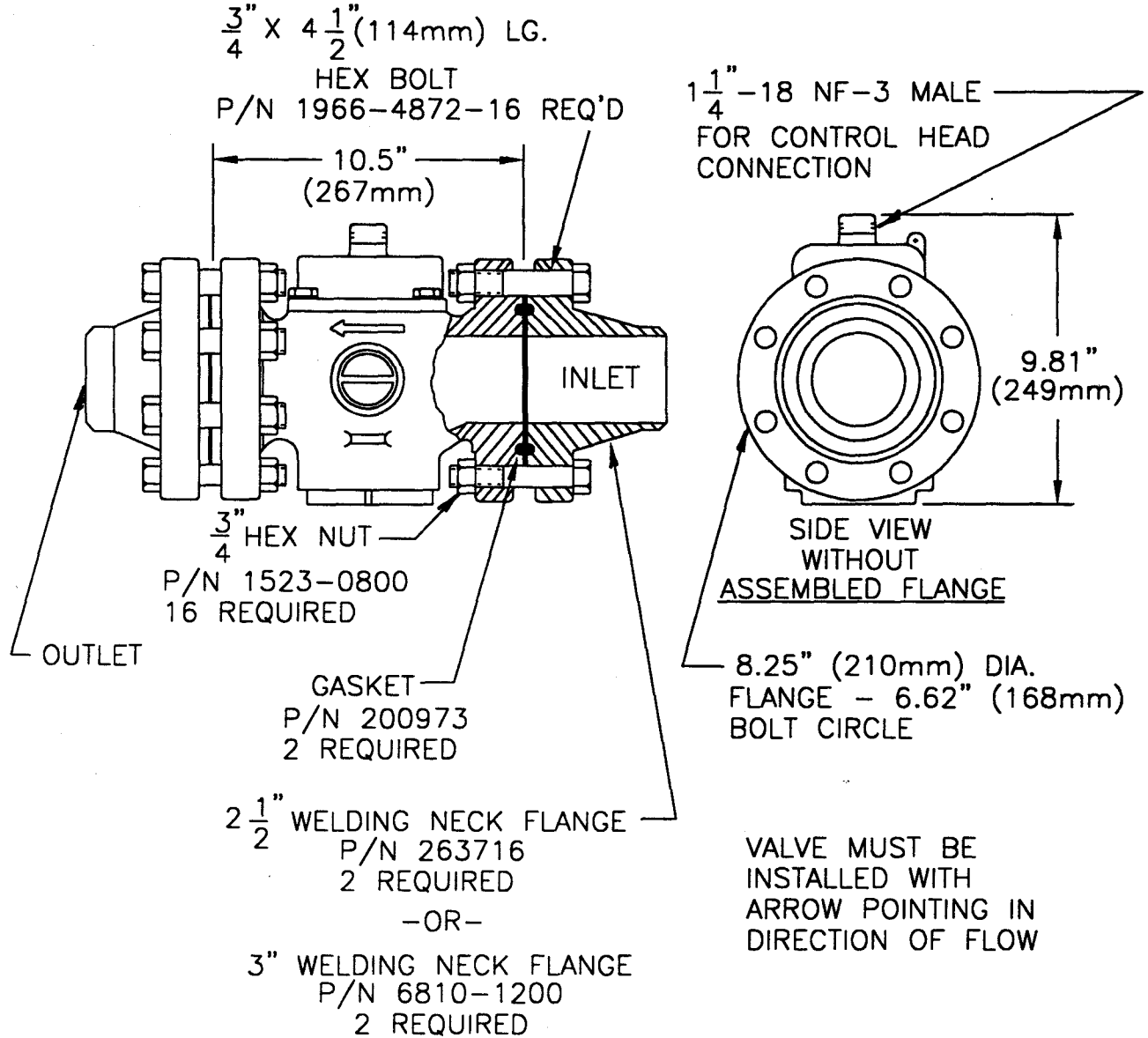
NOTES:

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 ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - SEE TABLE
K-5130

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



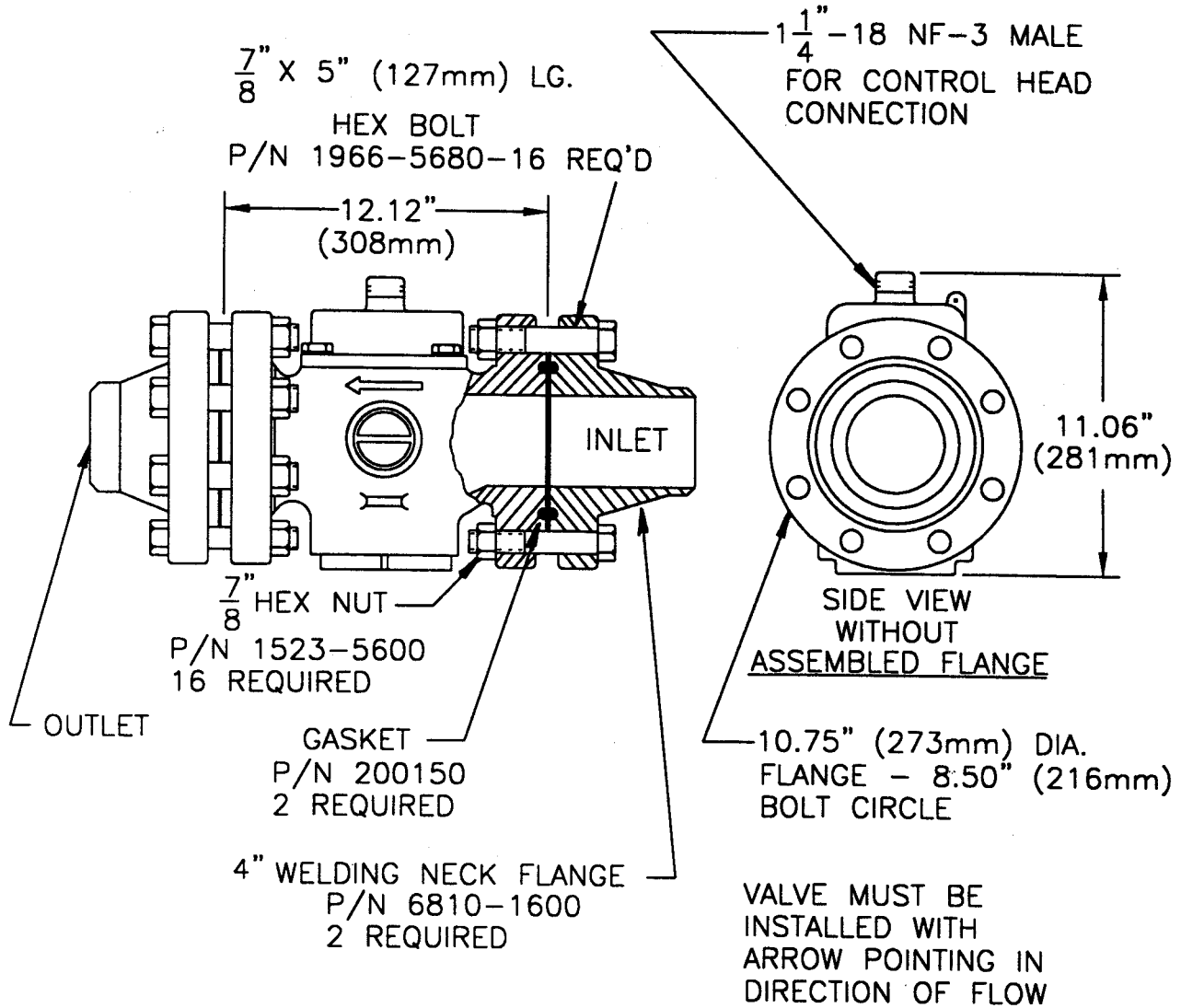
PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

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

P/N - 890010

K-5140

4" STOP (DIRECTIONAL) VALVE

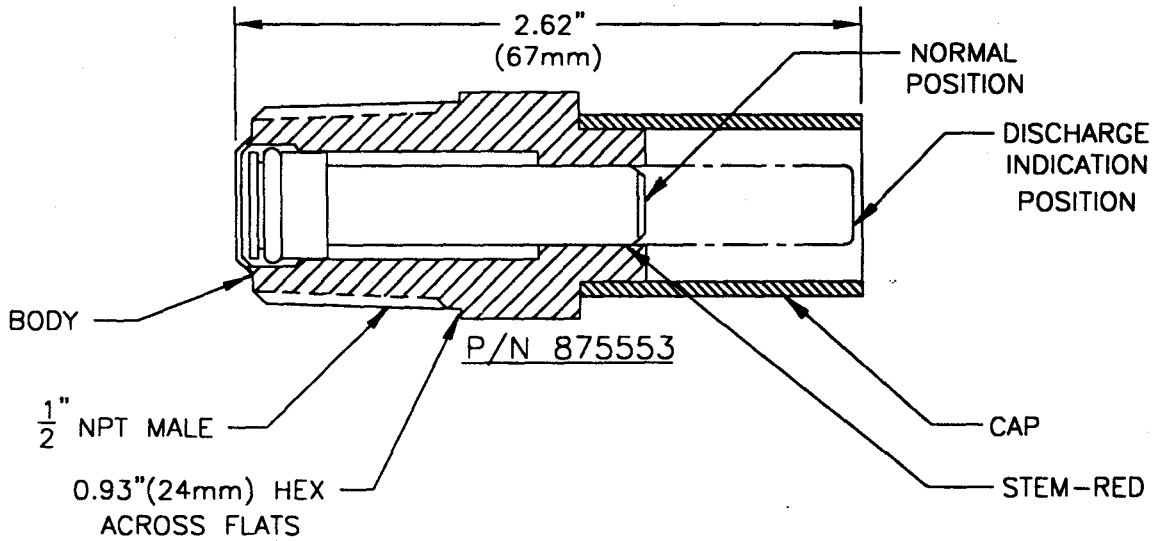
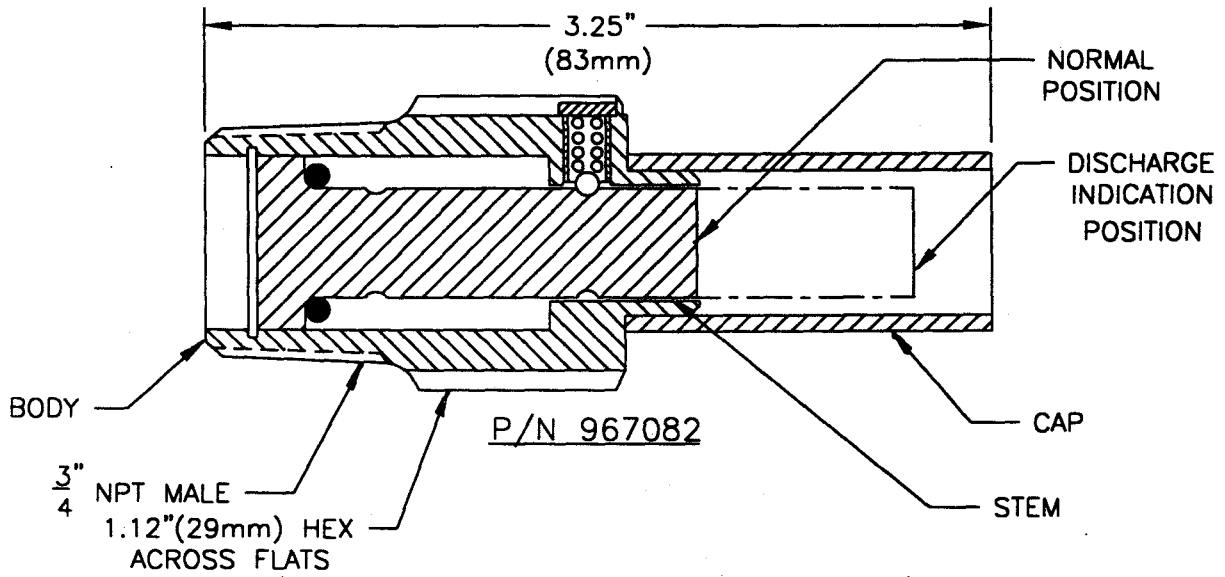


MATERIALS
 VALVE BODY: BRASS
 GASKET: IRON
 FLANGES, BOLTS, & NUTS: STEEL

PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 890208
 K-5150

DISCHARGE INDICATORS



MATERIALS

BODY-967082: BRASS

BODY-875553: ALUMINUM

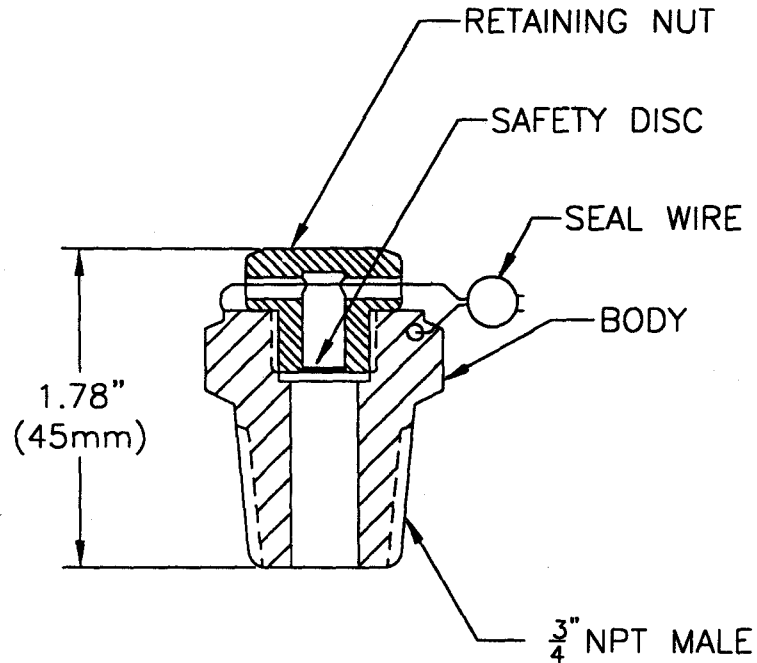
CAPS: CLEAR CELLULOSE ACETATE

PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - SEE ABOVE

K-5160

SAFETY OUTLETS



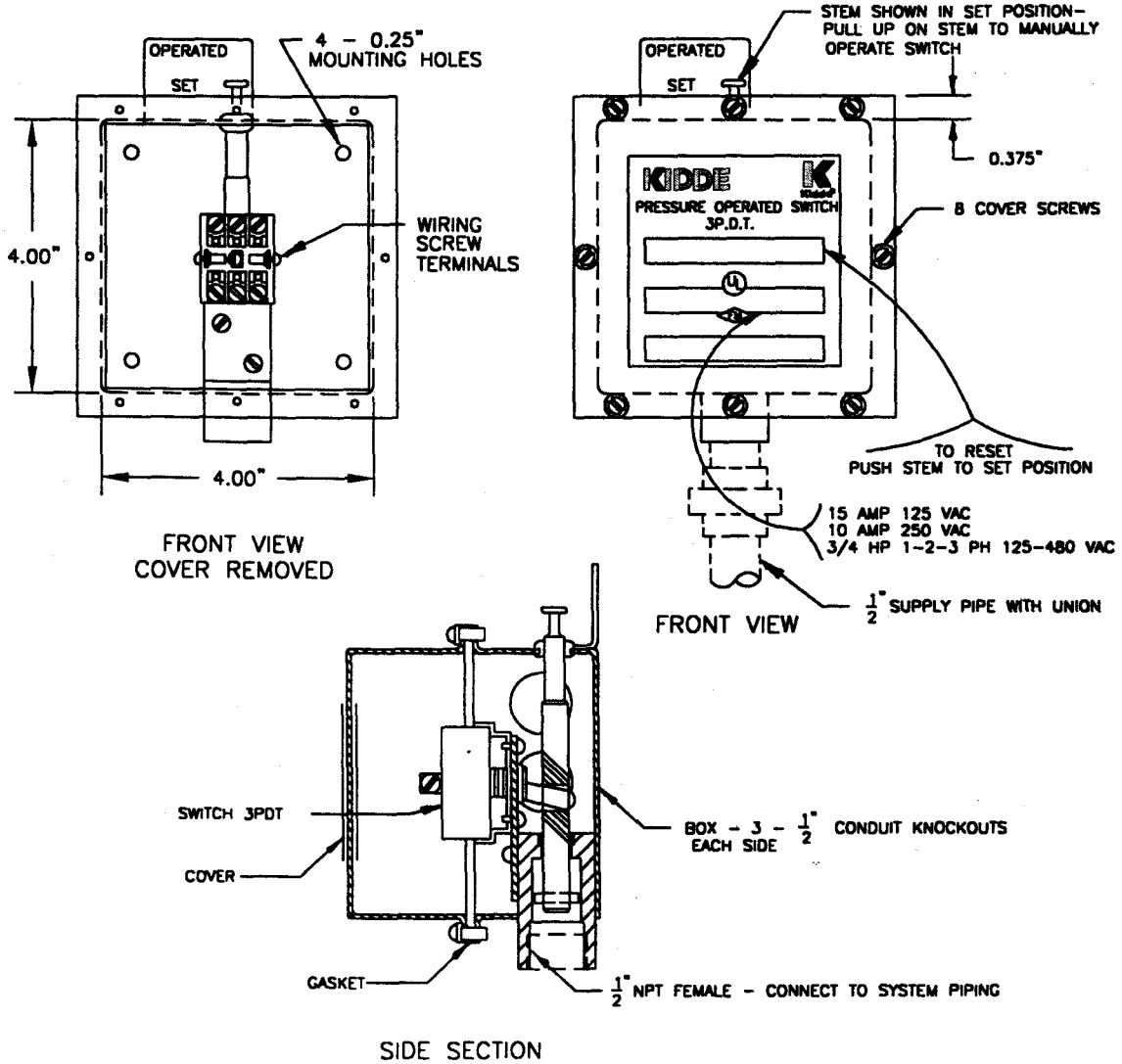
PART NUMBER	AGENT	PRESSURE RELIEF OPERATES AT	
		PSI	BARS
803242	N ₂ /CO ₂	2400-2800	166-193
844346	360 PSI HALON 1301	750-900	52-62

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

PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - SEE TABLE
 K-5170

PRESSURE OPERATED SWITCH



NOTES

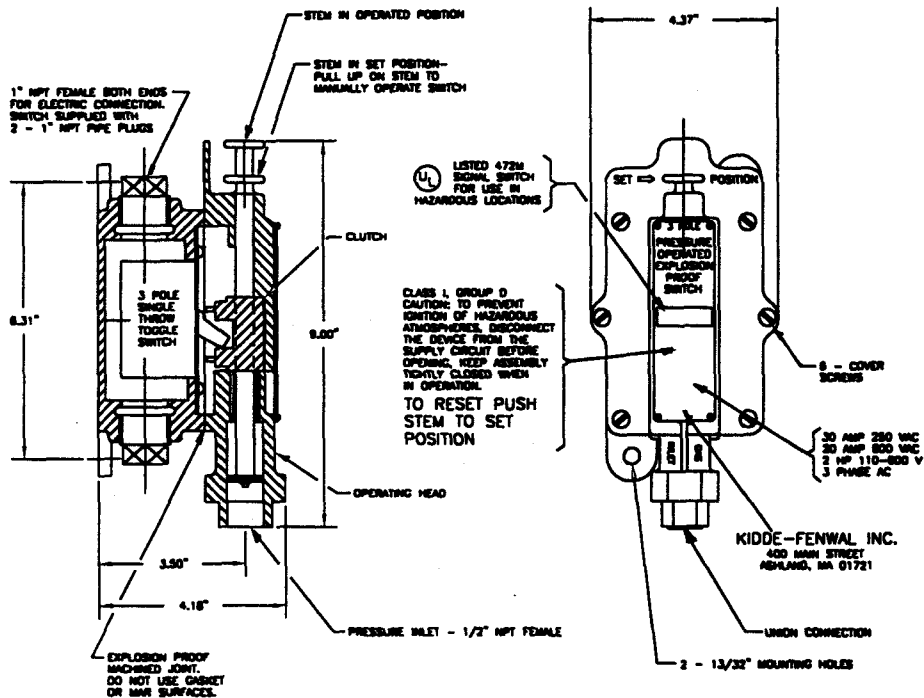
1. SWITCH MAY BE MOUNTED IN ANY POSITION BUT PREFERRED INSTALLATION IS UPRIGHT AS SHOWN.
2. ANY LOAD CONNECTED TO THE SWITCH MUST NOT EXCEED SWITCH RATING AND SHALL UTILIZE A SUITABLE PROTECTION DEVICE.(ie. CIRCUIT BREAKER, FUSE)

PRODUCT	USE
CO ₂	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:

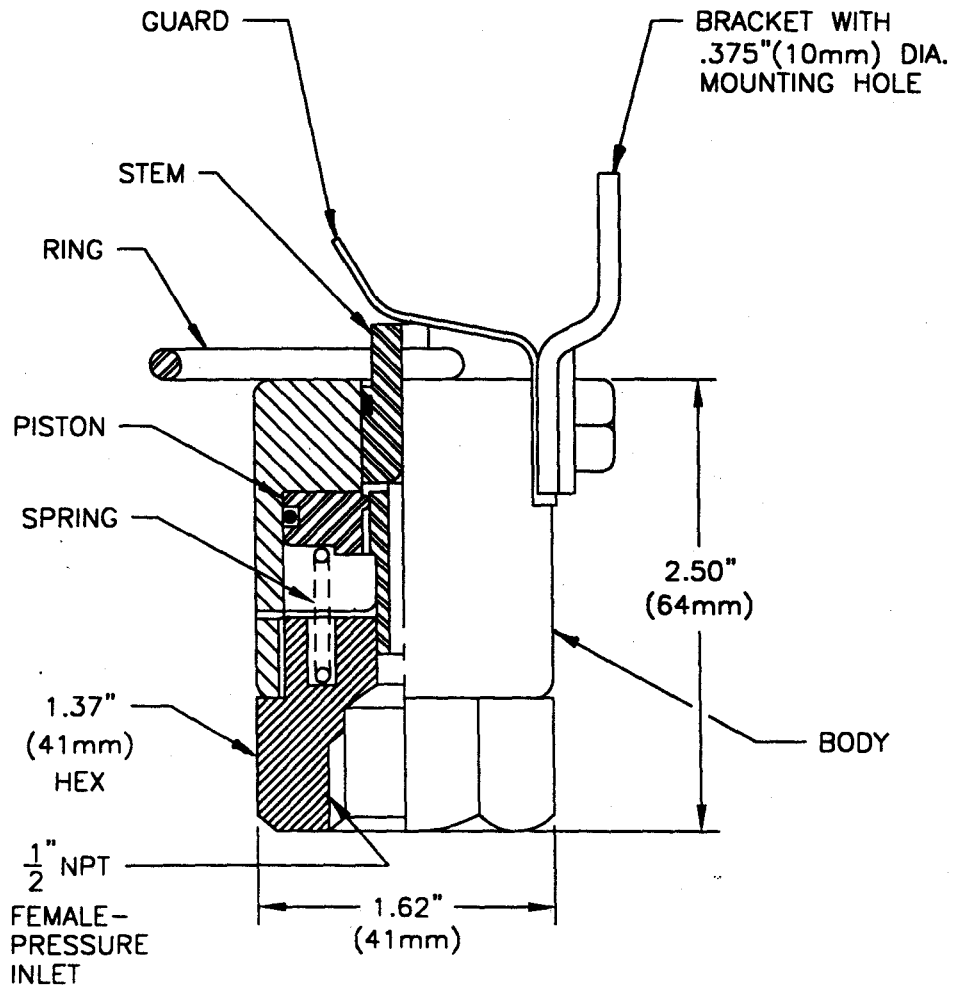
BASE: MALLEABLE IRON
OPERATING HEAD: CAST BRONZE

PRODUCT	USE
CO ₂	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)

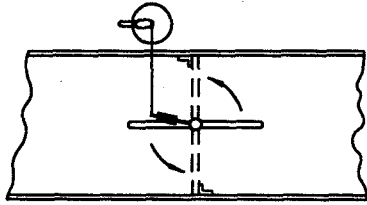
MATERIALS
 BODY, BRACKET, AND PISTON: BRASS
 GUARD, STEM, RING, AND SPRING: STAINLESS STEEL

PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

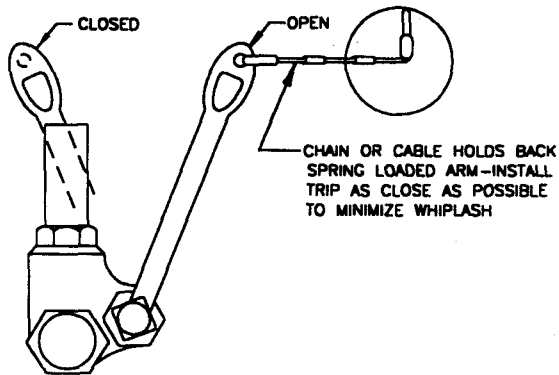
P/N - 874220
 K-5200



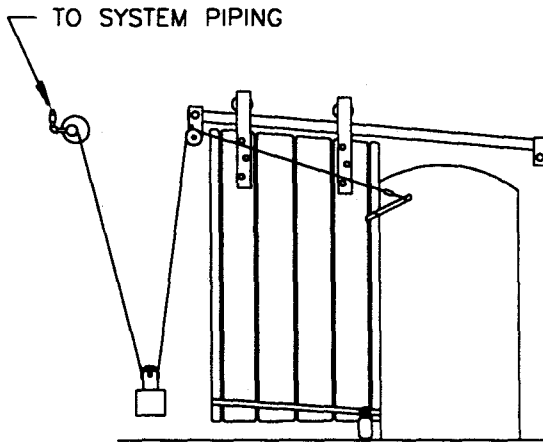
PRESSURE TRIP APPLICATIONS



HORIZONTAL DUCT DAMPER



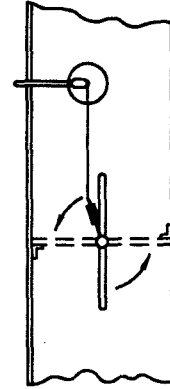
SPRING LOADED LIQUID OR GAS SHUTOFF VALVE



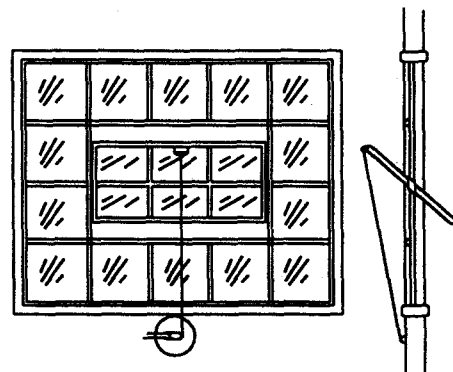
SLIDING DOOR

PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

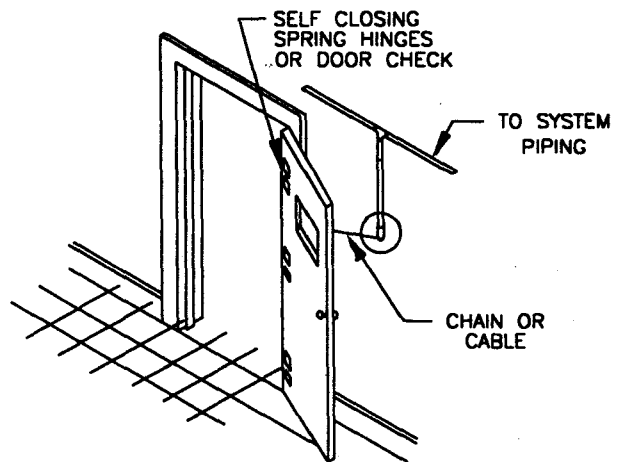
INSTALLATION DETAIL



VERTICAL DUCT DAMPER



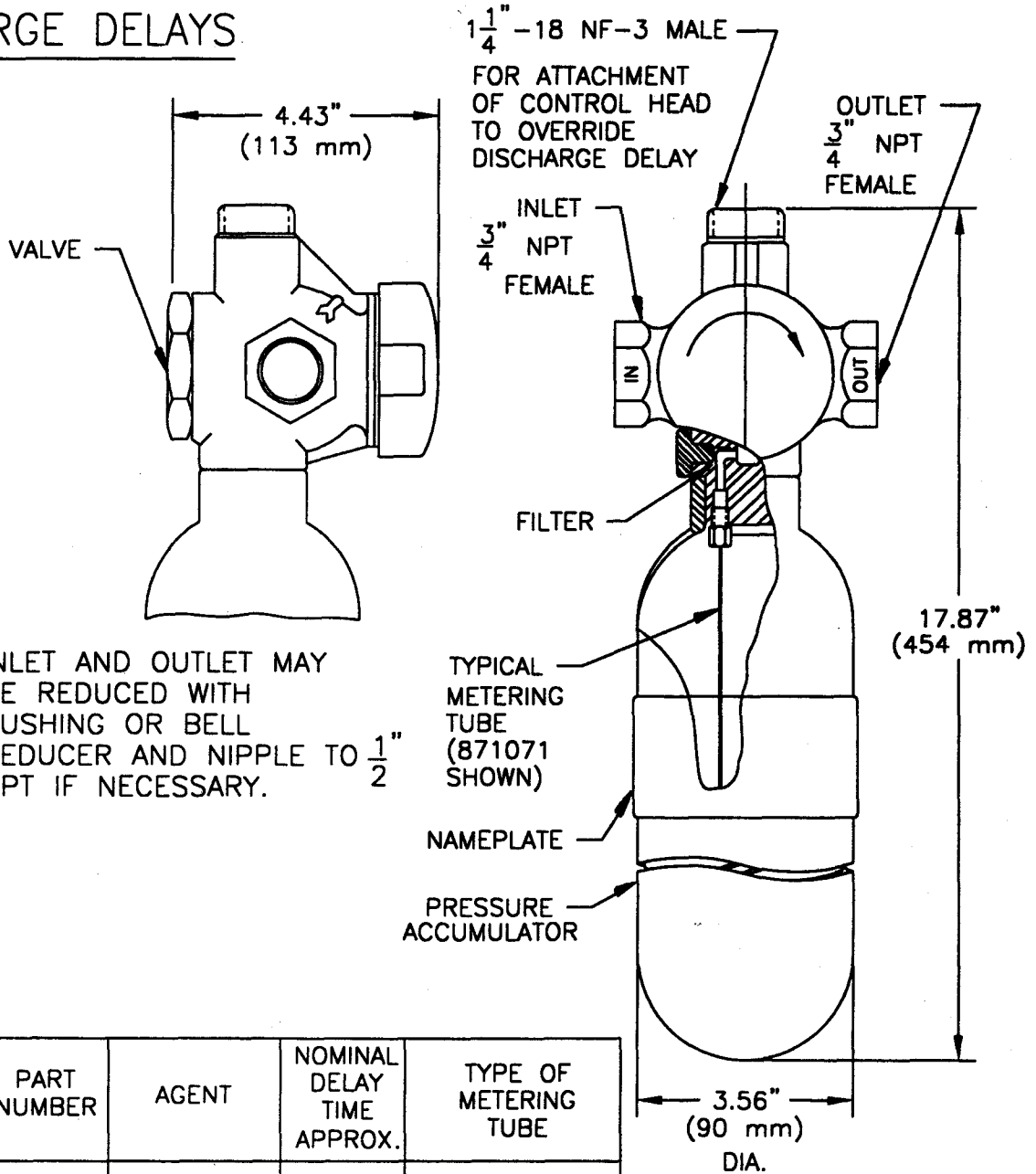
WINDOW—EITHER WEIGHTED OR OFF BALANCE



SWINGING DOOR—SELF CLOSING

K-5201

DISCHARGE DELAYS



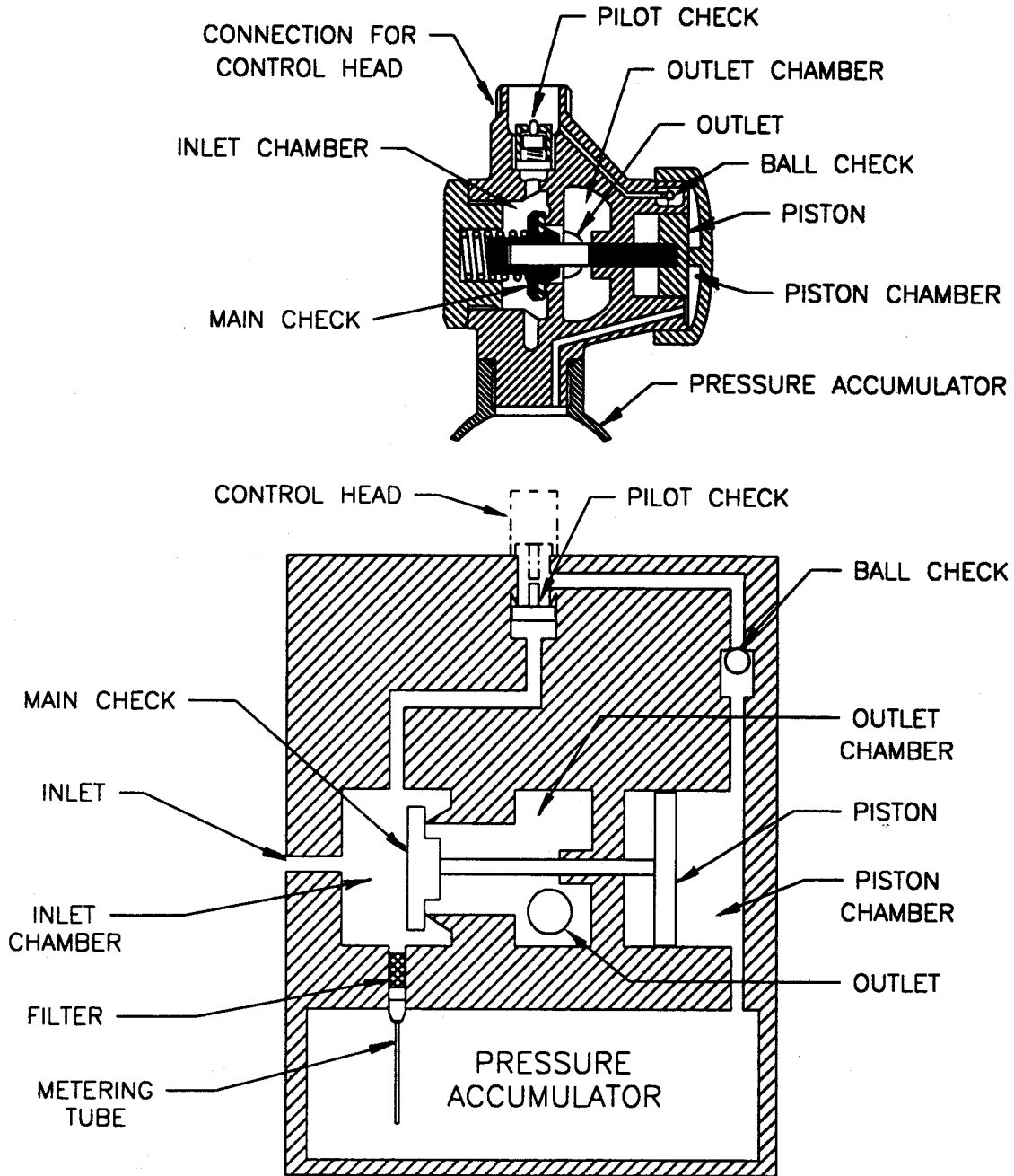
INLET AND OUTLET MAY BE REDUCED WITH BUSHING OR BELL REDUCER AND NIPPLE TO 1/2" NPT IF NECESSARY.

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

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

P/N - SEE TABLE
 K-5210M

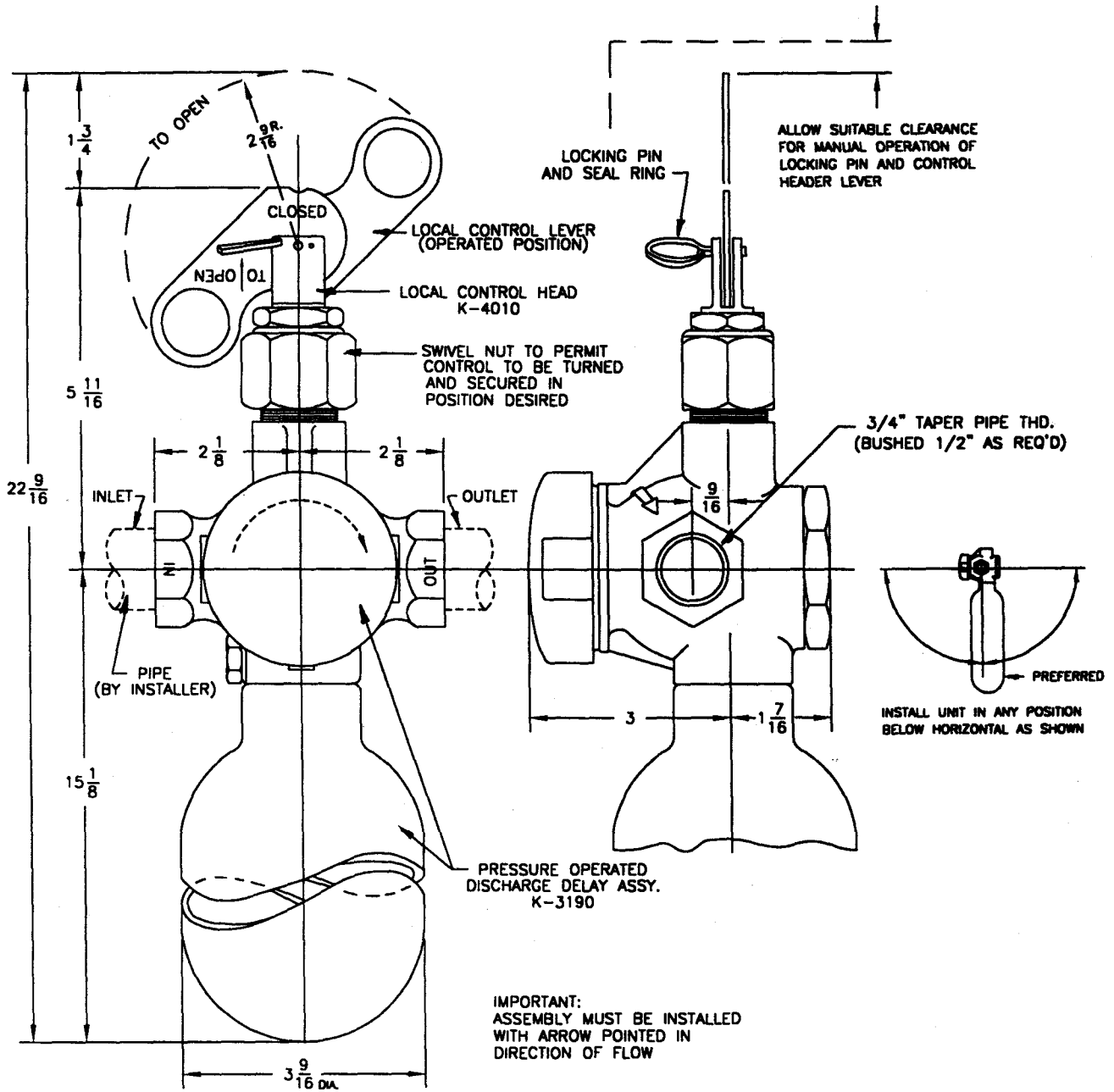
DISCHARGE DELAYS



K-5211M

Change 1

DISCHARGE DELAY WITH MANUAL OPERATED CONTROL HEAD



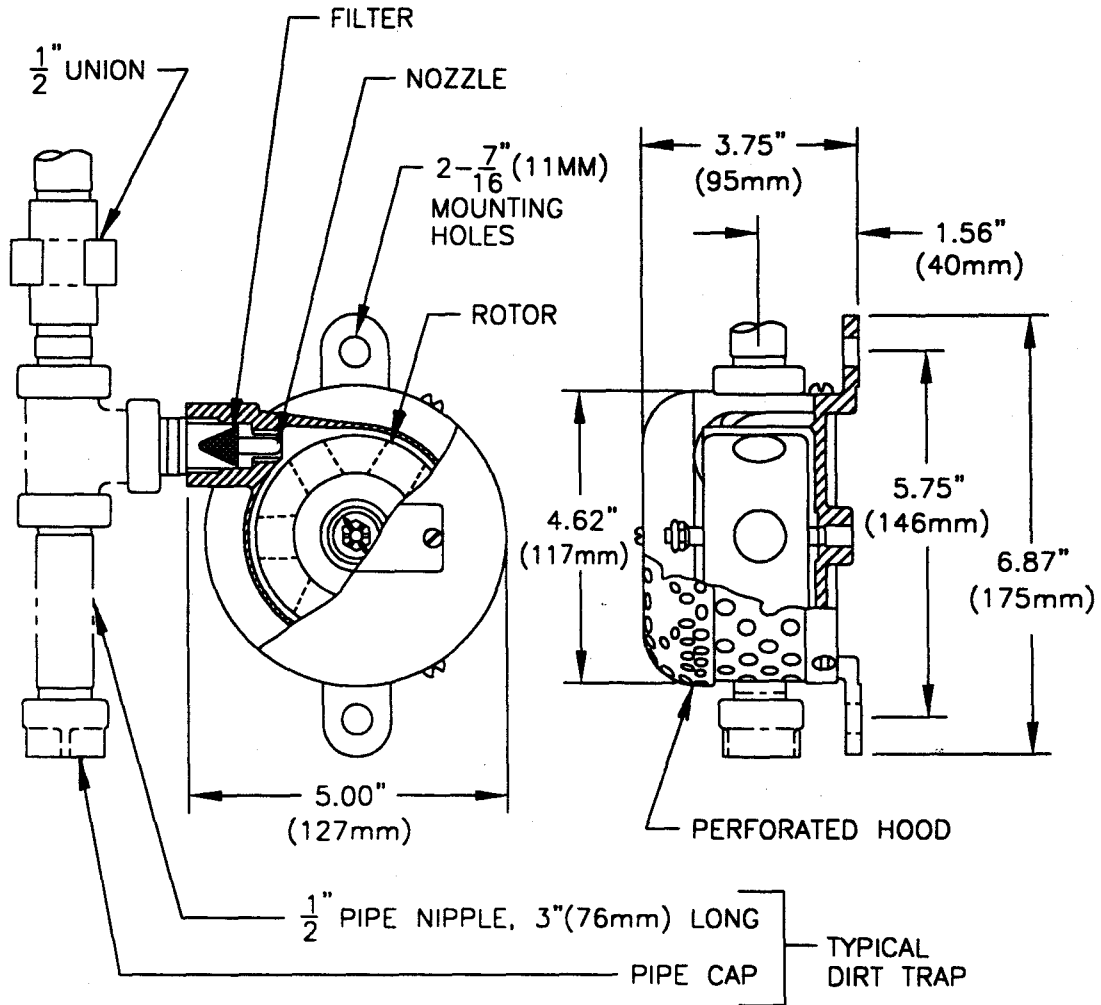
K-5212M



COMPONENT DESCRIPTION

PRESSURE OPERATED SIREN

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

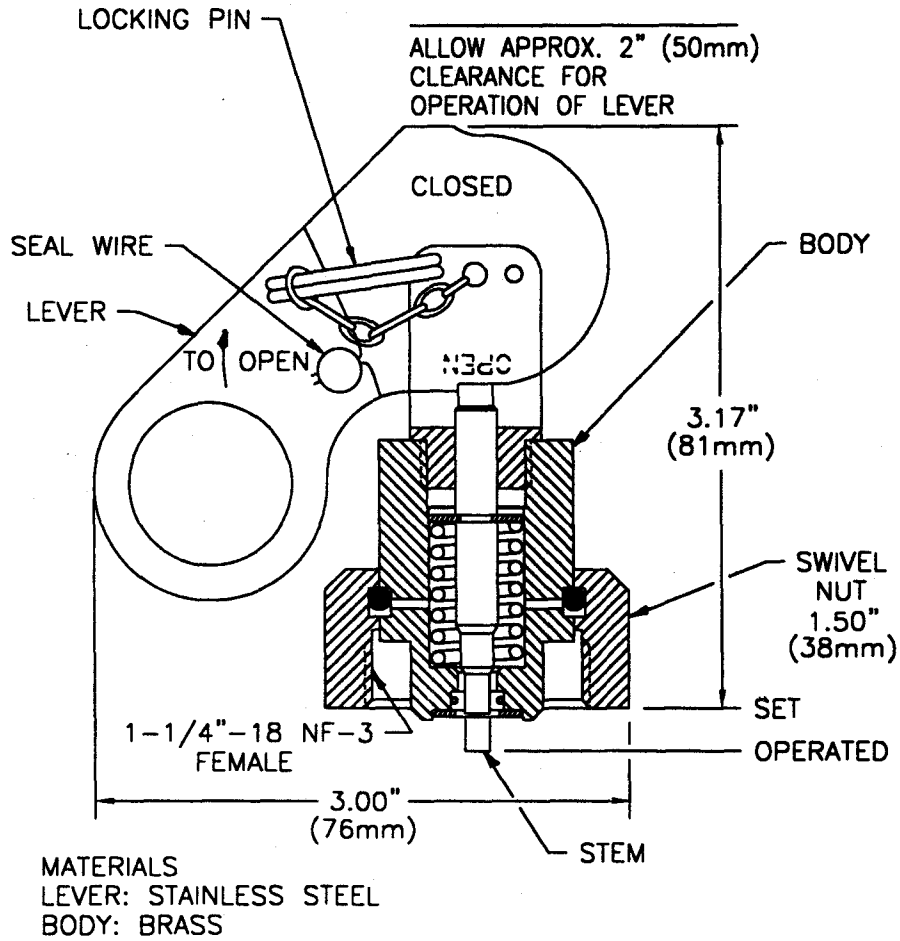


MATERIALS
 BODY: BRONZE
 ROTOR: BRASS
 NOZZLE AND FILTER: MONEL
 HOOD: STEEL
 FINISH: RED PAINT

PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 981574
 K-5220

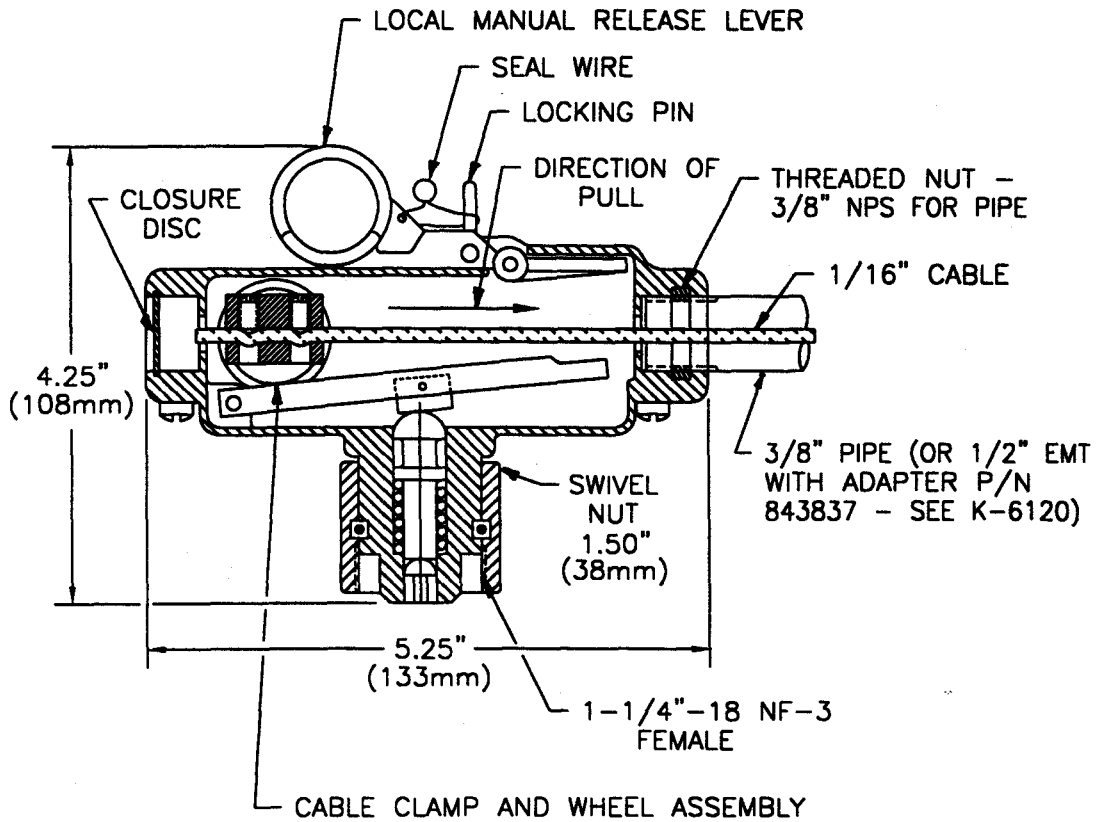
LEVER OPERATED CONTROL HEAD



PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 870652
K-6010

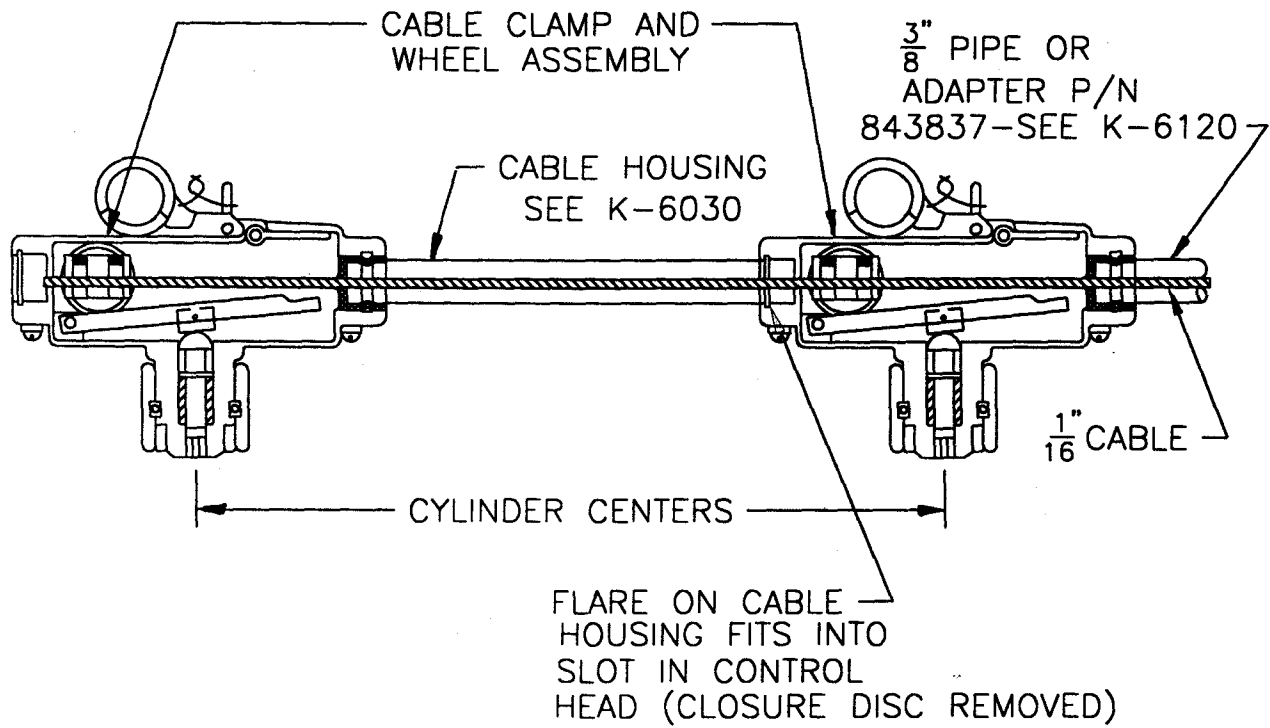
CABLE OPERATED CONTROL HEAD



PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 979469
K-6020

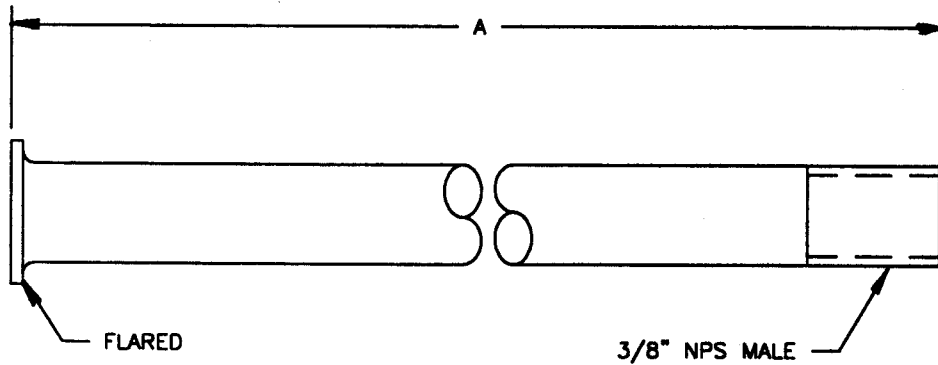
TANDEM CABLE OPERATED CONTROL HEADS



PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

K-6021

CABLE HOUSINGS FOR CABLE OPERATED CONTROL HEADS

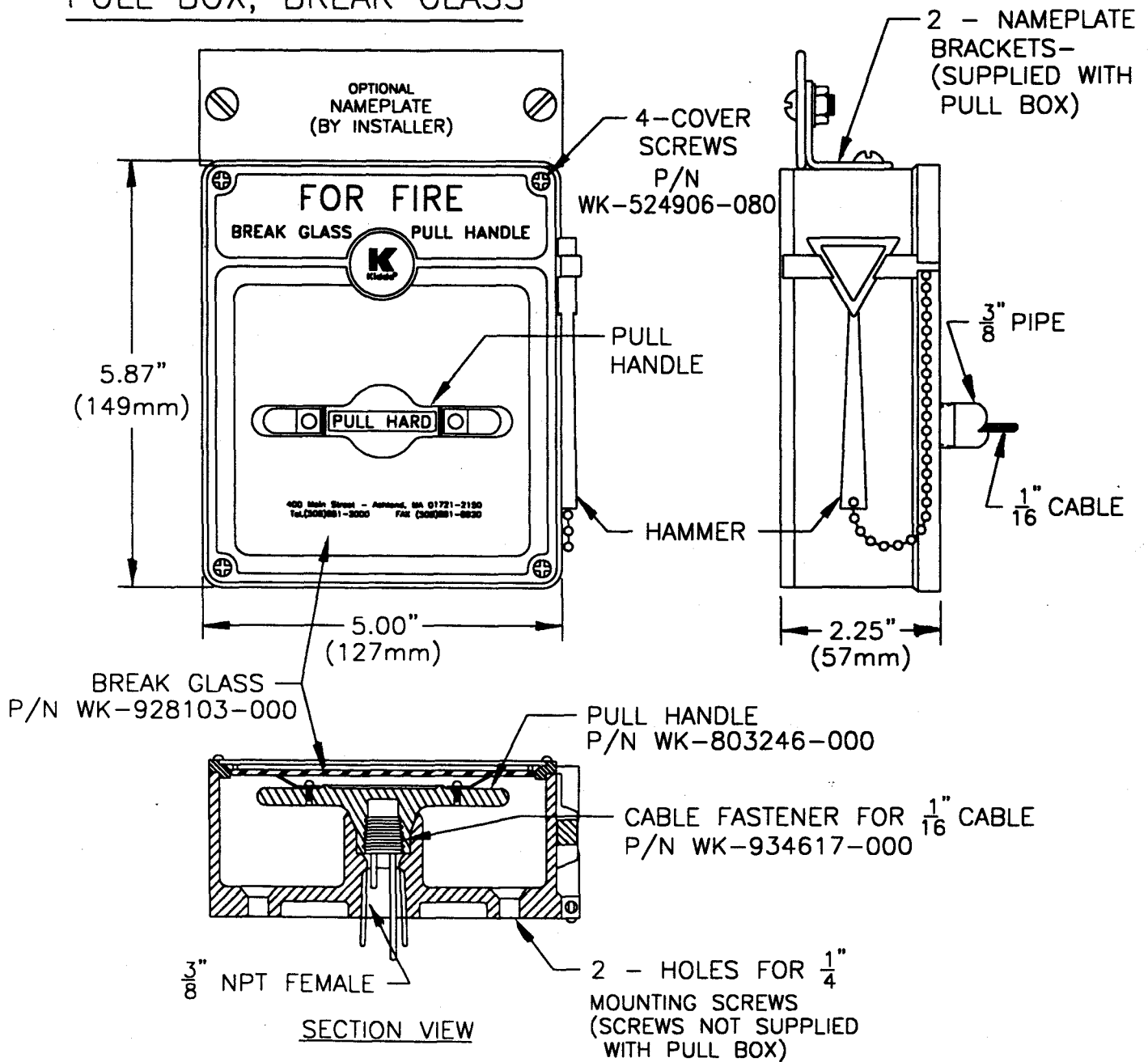


PART NUMBER	CYLINDERS USED WITH		CYLINDER CENTERS		"A" DIMENSION	
	LBS	KG	IN	mm	IN	mm
MARINE CO ₂						
33157	50	22.6	9.5	241	5.12	130
FM-200						
260702	125-200	56.7-90.7	15.0	381	10.6	270
260951	350	158.7	18.0	457	13.6	346
263602	600	272.1	24.0	610	19.6	498

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

P/N - SEE TABLE
K-6030M

PULL BOX, BREAK GLASS



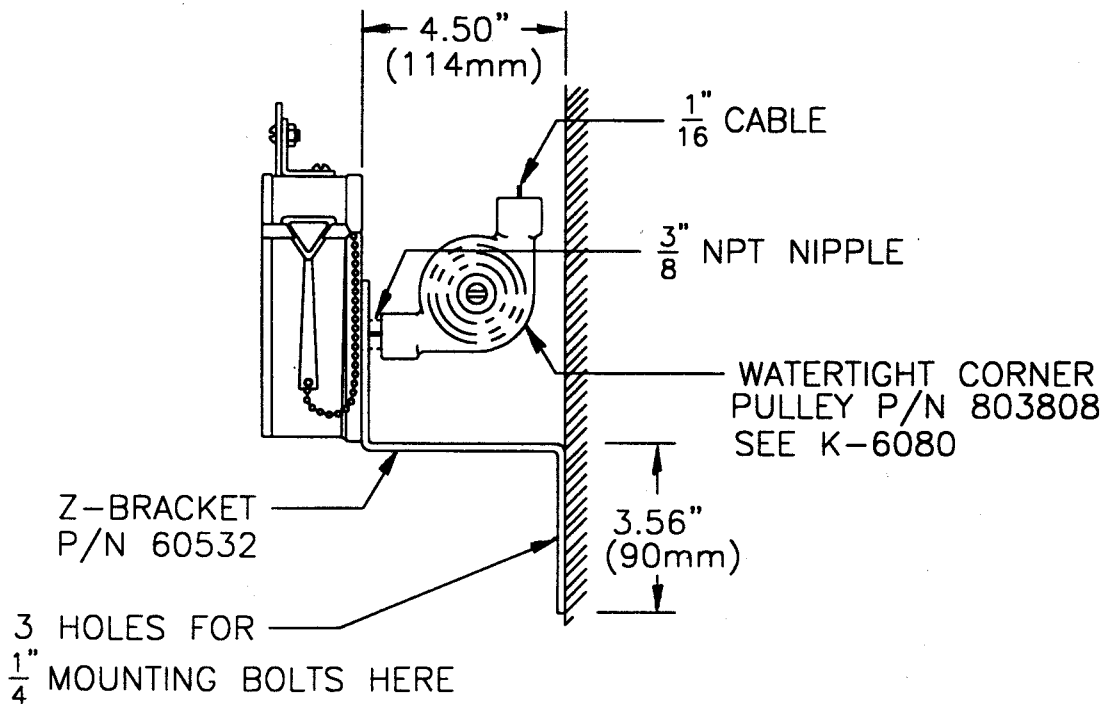
PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

MATERIALS
BODY: ALUMINUM
HANDLE: BRASS

P/N - 871403

K-6040

BREAK GLASS PULL BOX USED WITH Z-BRACKET

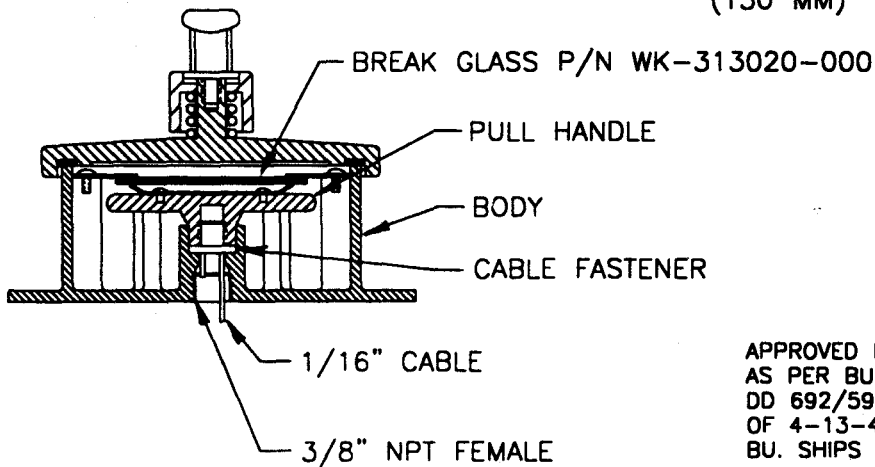
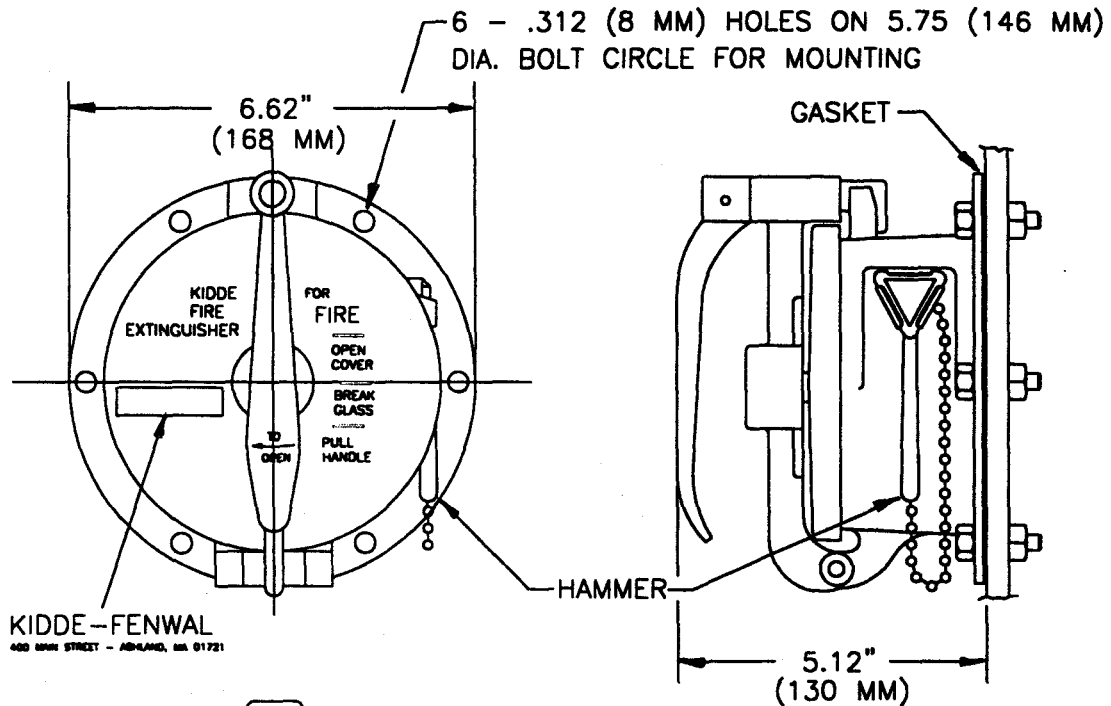


PRODUCT	USE
CO ₂	X
FE-13	X
M-200	X
HALON 1301	X

K-6041M

Change 1

WATERTIGHT PULL BOX

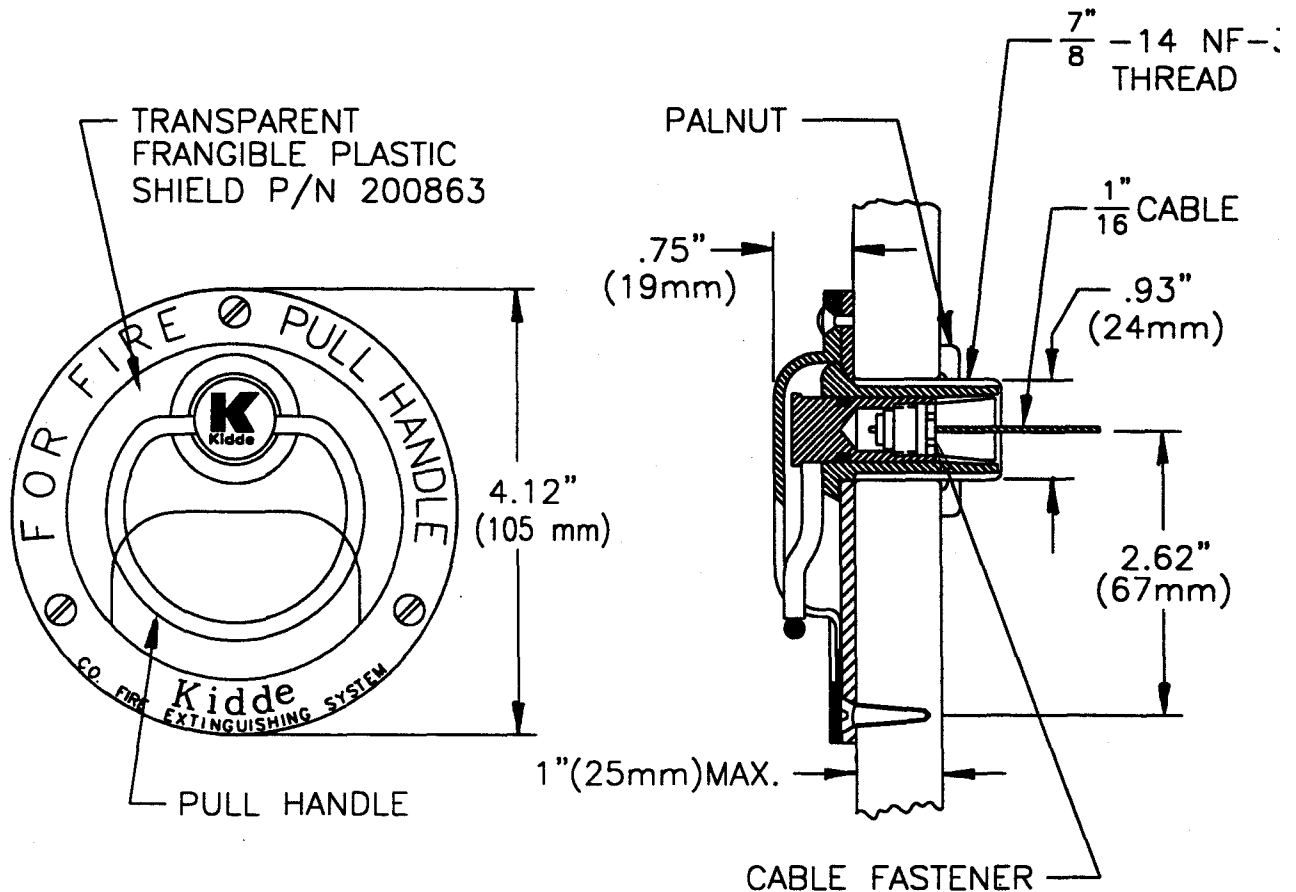


FINISH: RED PAINT WITH BLACK
RAISED LETTERS.

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

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

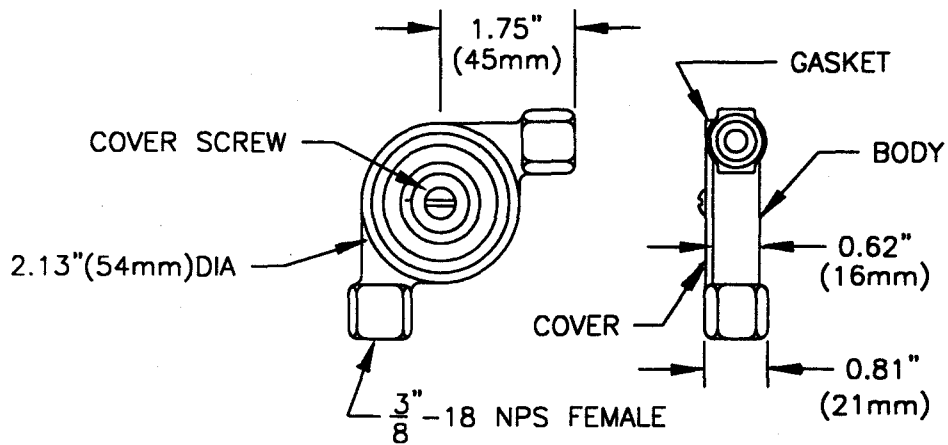
HANDLE: STAINLESS STEEL

PRODUCT	USE
CO ₂	X
FE-13	
FM-200	
HALON 1301	X

P/N - 840098

K-6070

WATERTIGHT CORNER PULLEY

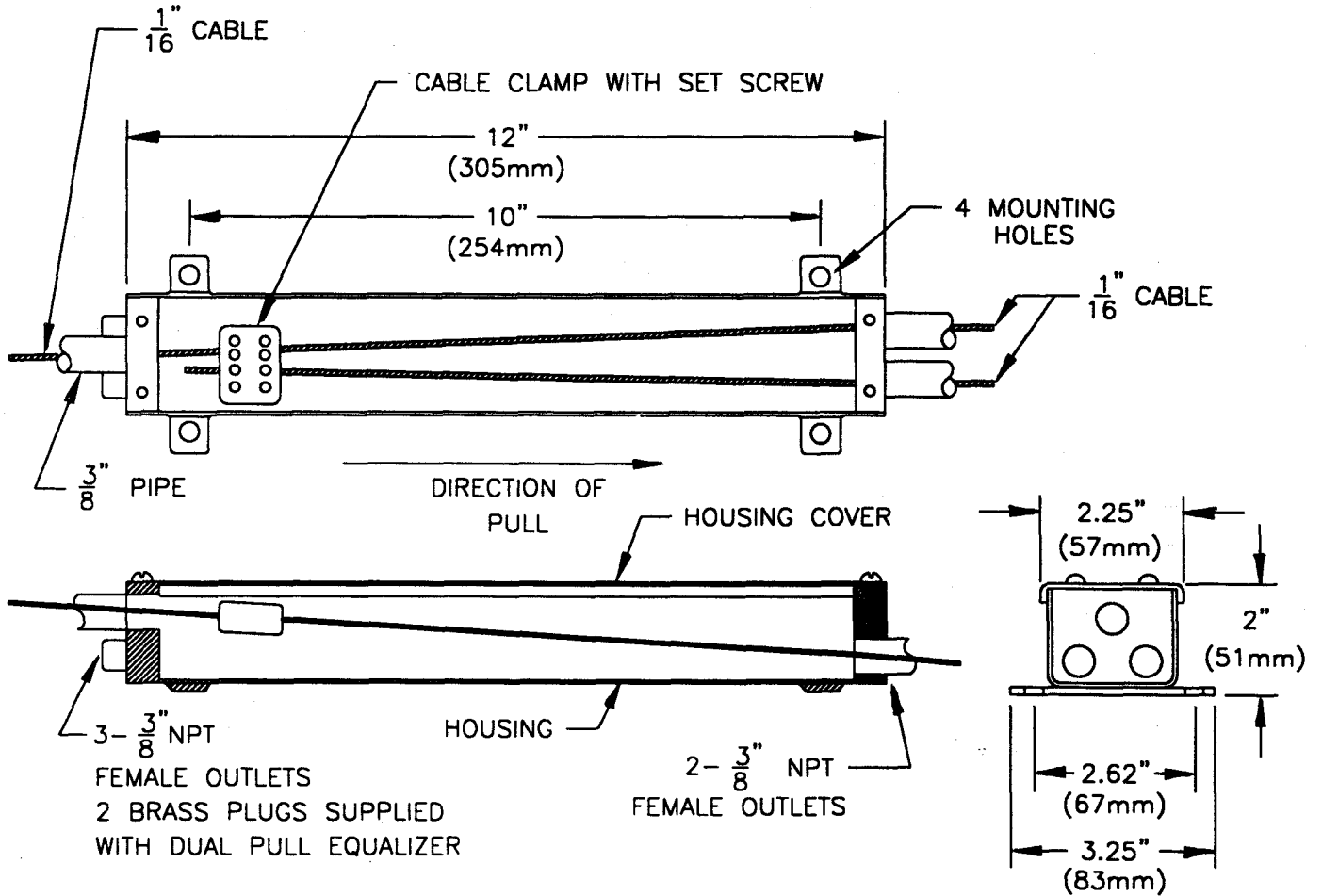


MATERIALS
 COVER AND BODY: BRASS
 GASKET: RUBBER

PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 803808
 K-6080M

DUAL PULL MECHANISM

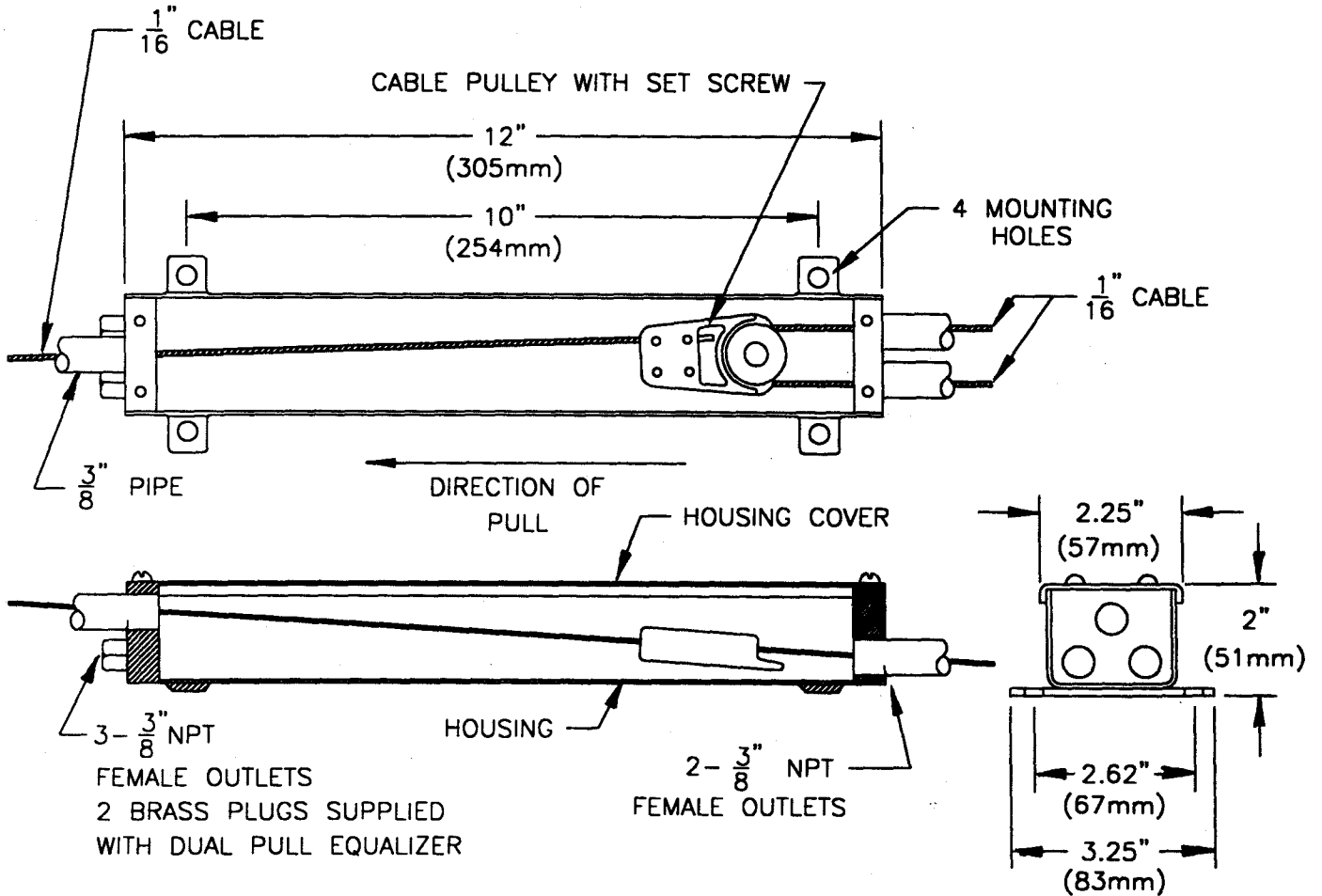


USE $\frac{3}{32}$ " HEX KEY FOR CABLE PULLEY SET SCREWS.

PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 840058
K-6100

DUAL PULL EQUALIZER

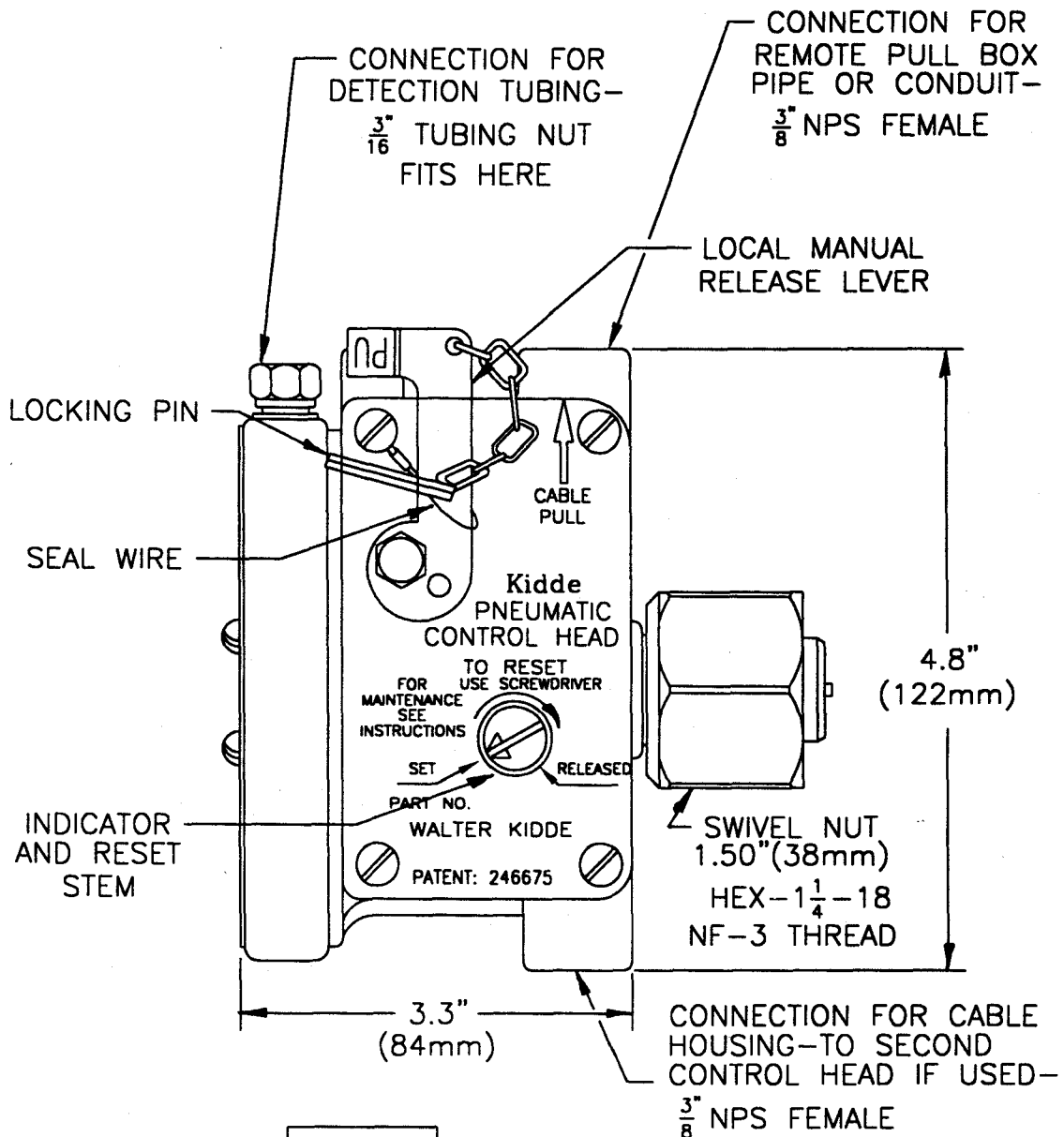


USE $\frac{3}{32}$ " HEX KEY FOR CABLE PULLEY SET SCREWS.

PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

P/N - 840051
K-6110

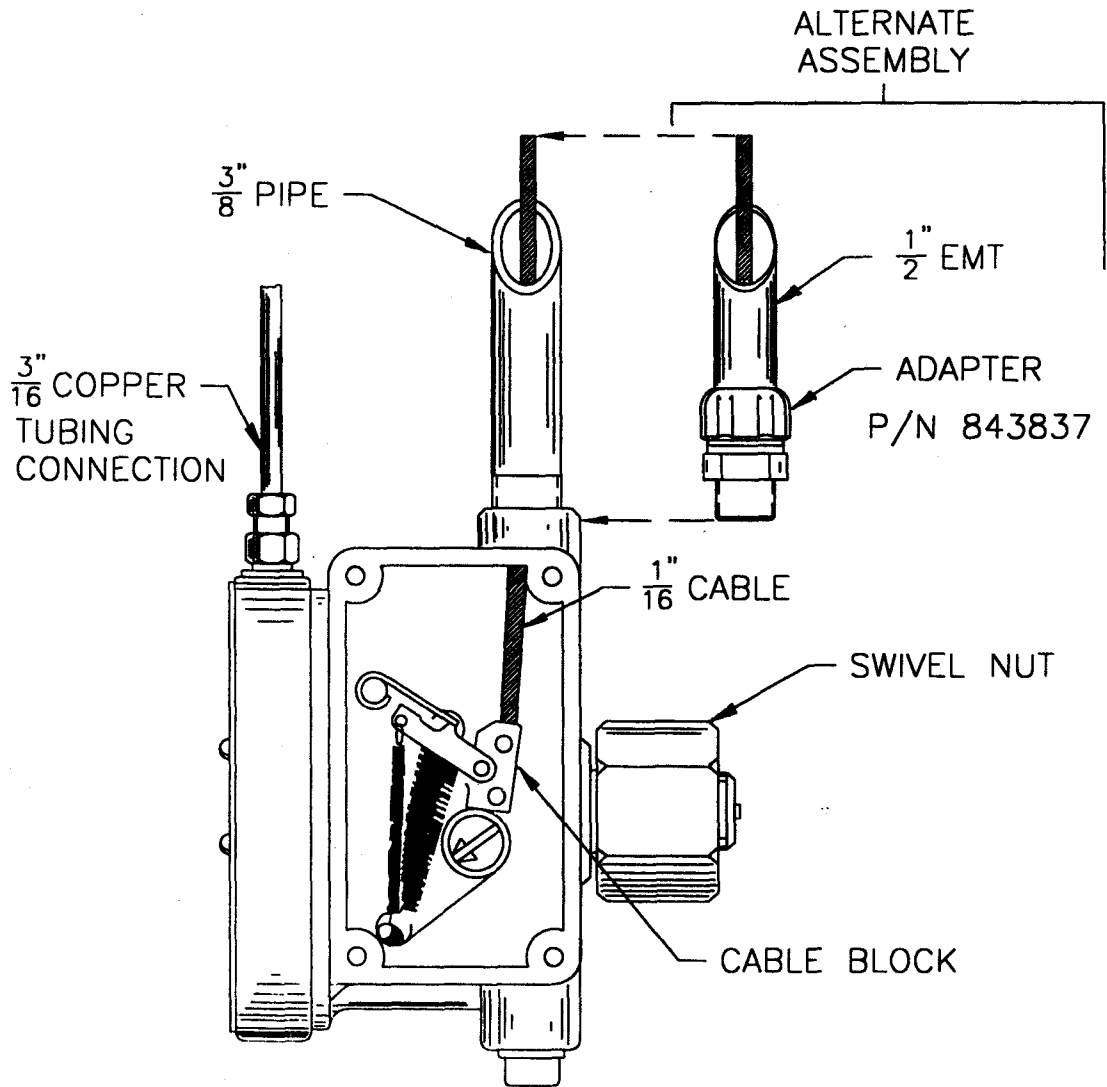
PNEUMATIC CONTROL HEAD



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

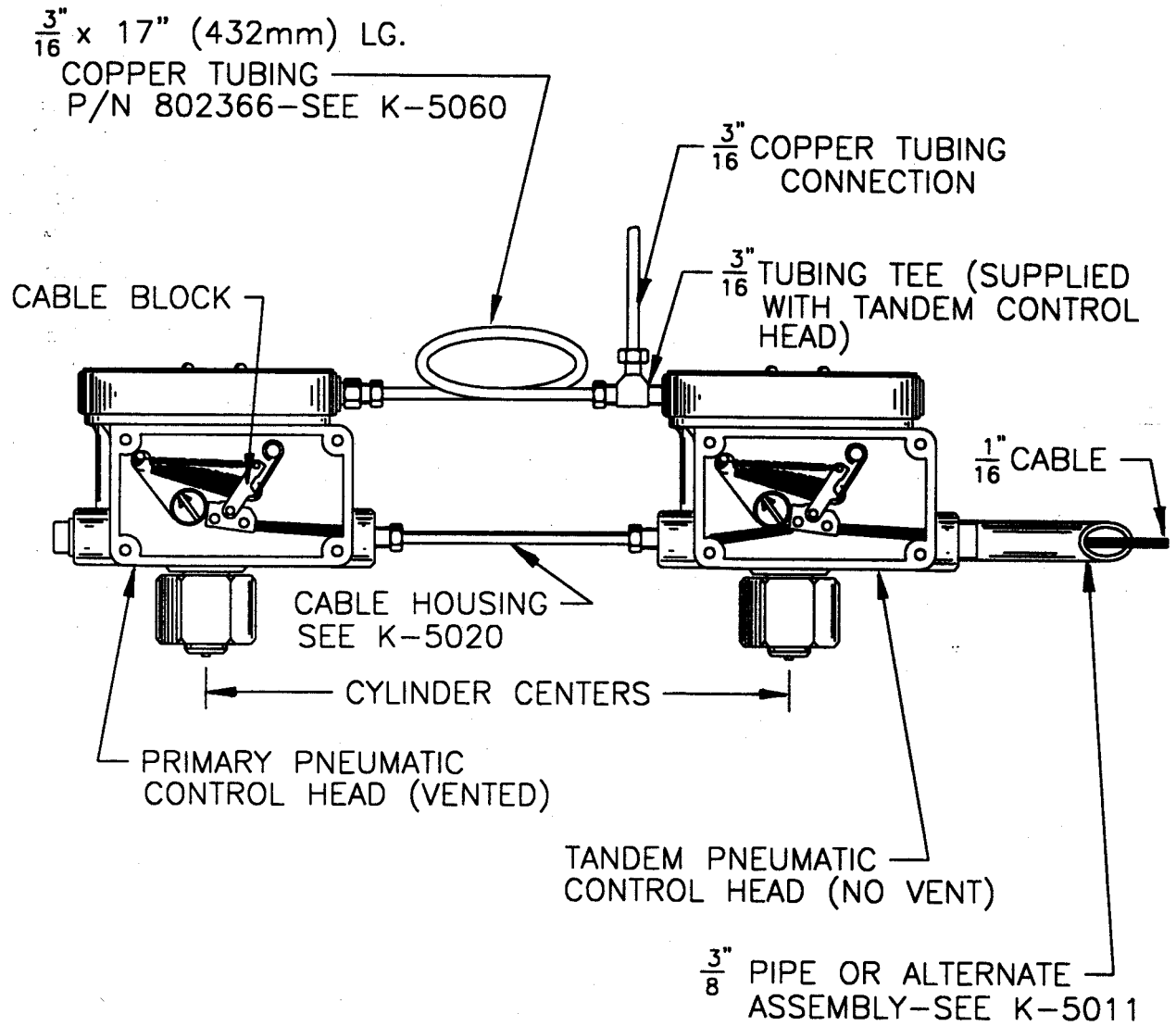
P/N — SEE TABLE
K-7010M

SINGLE PNEUMATIC CONTROL HEAD



K-7011M

TANDEM PNEUMATIC CONTROL HEADS



K-7012M

Change 1

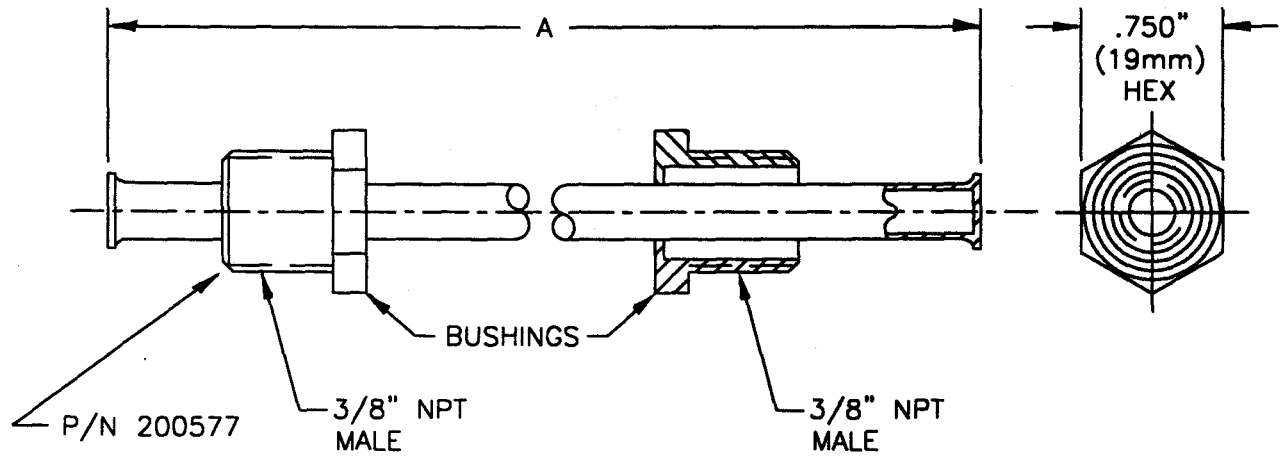


OPERATIONAL DETAIL

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 ₂						
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:

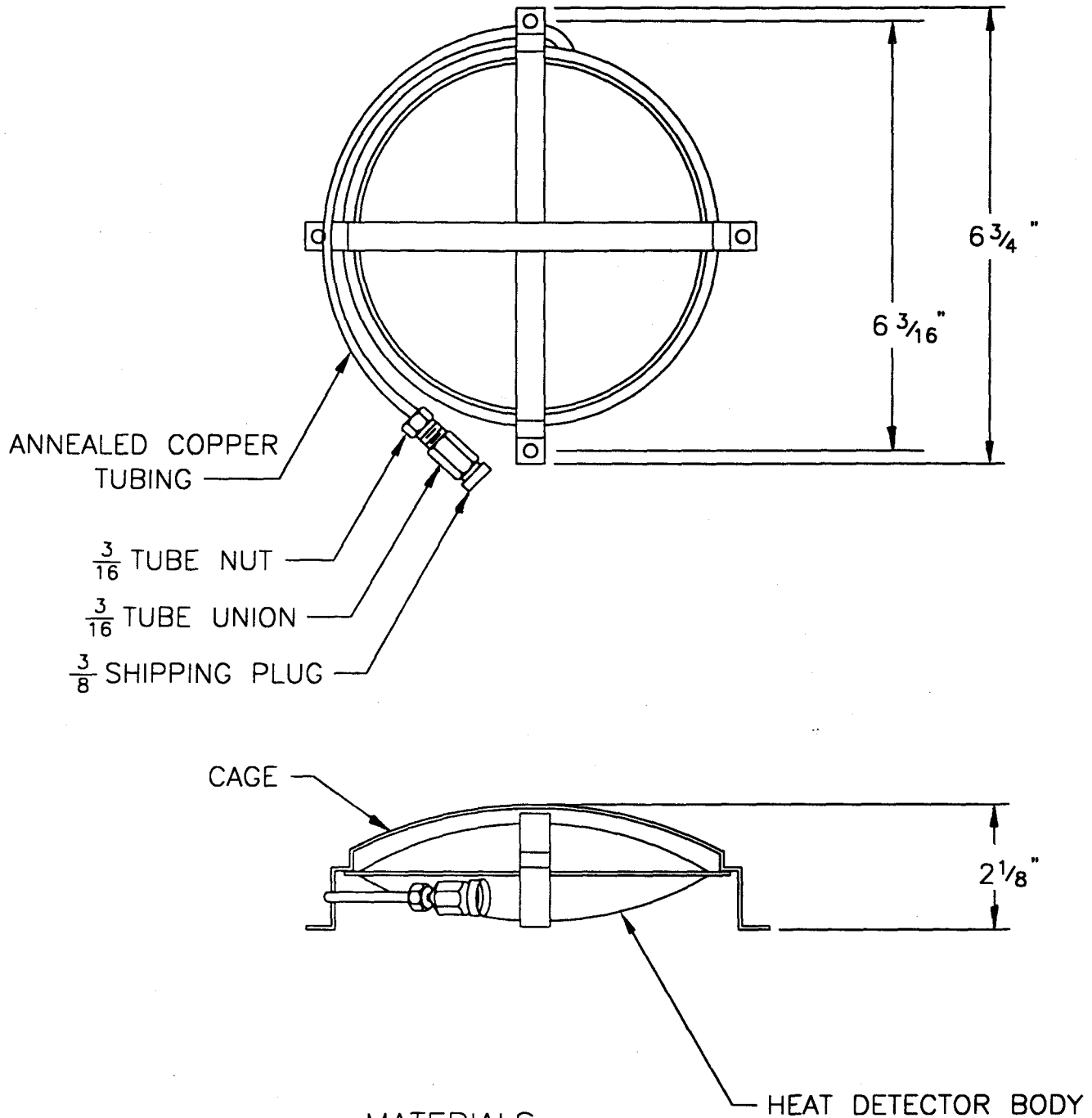
TUBING: BRASS, .312" (8mm) O.D.x

.025" (0.6mm) WALL, CADMIUM PLATED

BUSHING: BRASS, CADMIUM PLATED

SEE TABLE
K-7020M

PNEUMATIC HEAT DETECTOR, MARINE



MATERIALS—

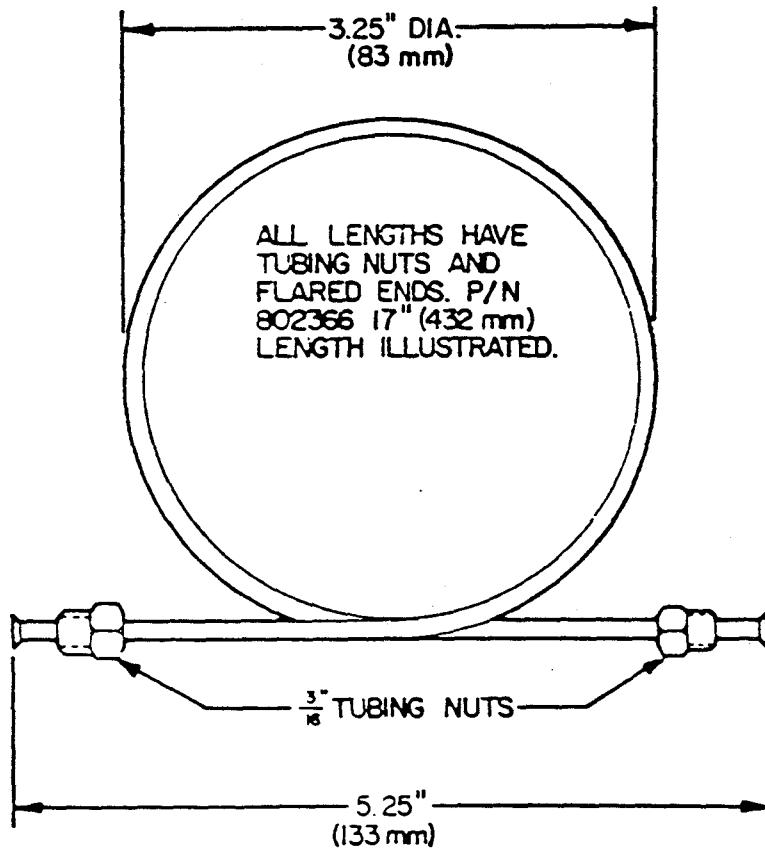
CAGE AND BODY: STEEL

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

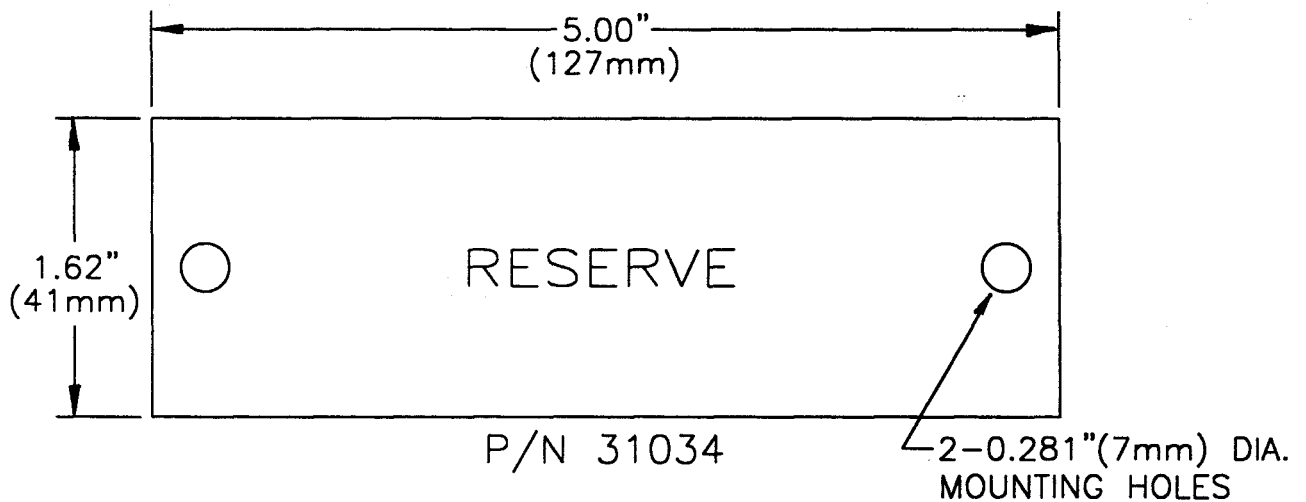
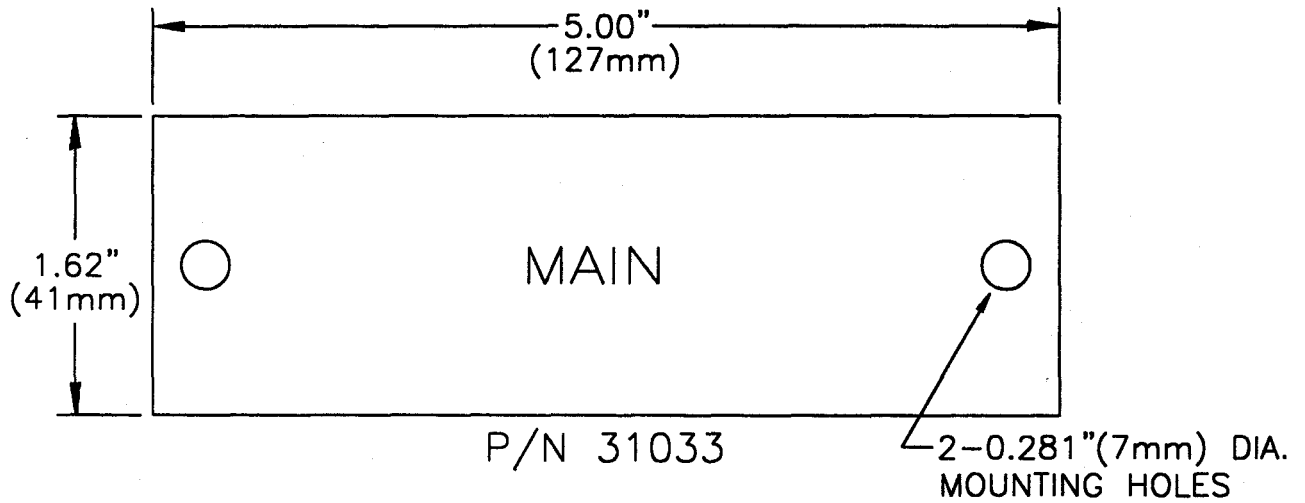


$\frac{3}{16}$ " TEE WITHOUT NUTS
P/N 5281-0370

MATERIAL: BRASS
ALL FITTINGS S. A. E. INVERTED FLARE

Pneumatic Detection System Tubing Fittings

MAIN AND RESERVE NAMEPLATES

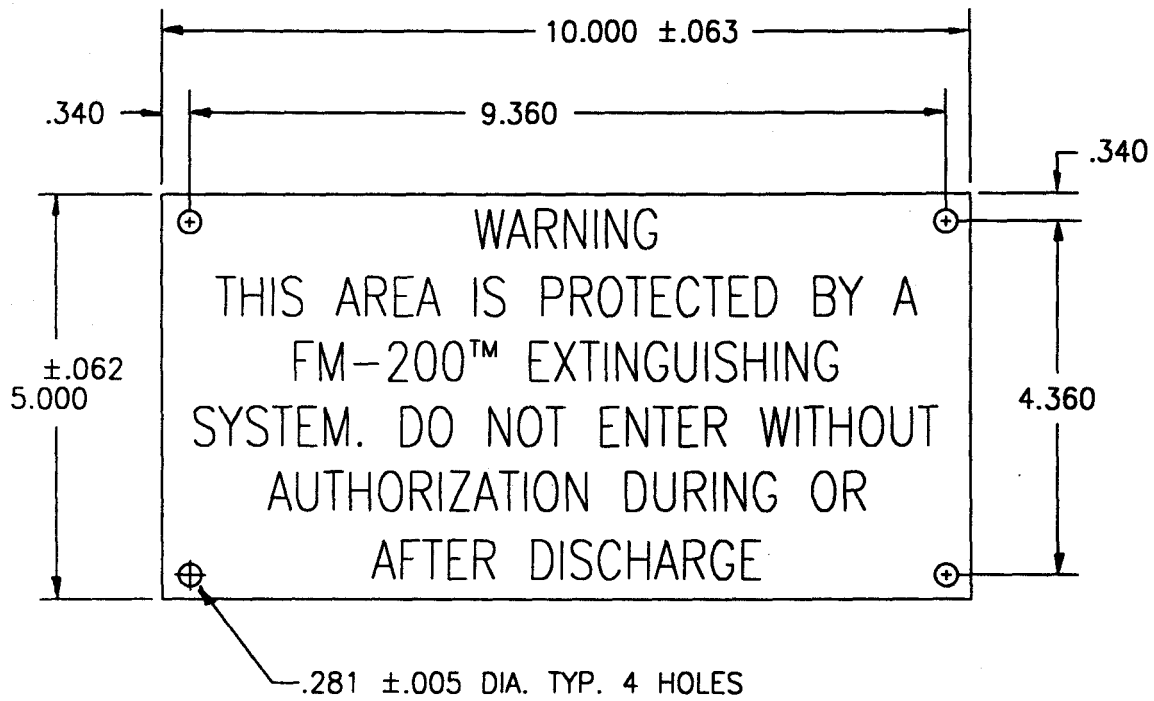


PRODUCT	USE
CO ₂	X
FE-13	X
FM-200	X
HALON 1301	X

MATERIAL: ALUMINUM WITH
RED PAINT LETTERS

P/N - SEE ABOVE
K-9010

WARNING NAMEPLATE (FM-200)



NOTES:

1. MATERIAL: ALUM. TYPE 1100-H14 OR 3003-H14, .032 ±.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.
2. FINISH: ONE COAT CLEAR LACQUER BOTH SIDES.

PRODUCT	USE
CO ₂	
FE-13	
FM-200	X
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.

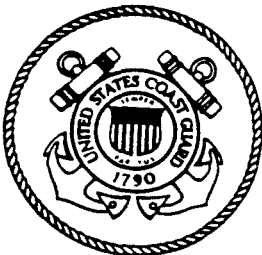
Identifying Data: Underwriters Laboratories File EX 4674
Kidde Manual 90-FM200-021 Ver 1.0 dated 5-98

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
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



Fuel	Design Concentration, %v/v (cup burner + 30%)	Fuel	Design Concentration, %v/v (cup burner + 30%)
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



CO₂ PILOT CYLINDER WITH DISCHARGE HEAD

2



NITROGEN PILOT CYLINDER



TIME DELAY (CO₂ 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

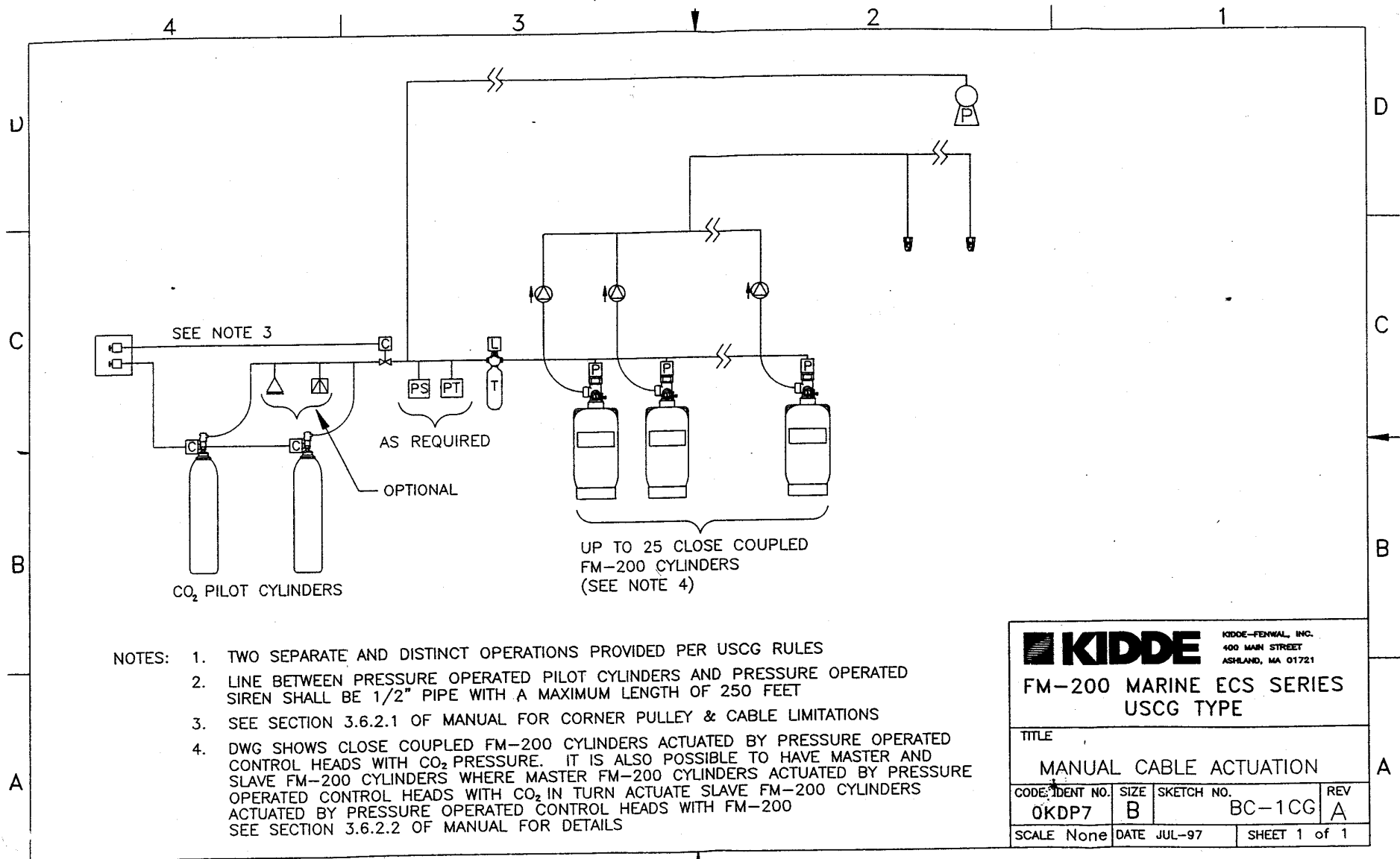
KIDDE		KIDDE-FORNAL, INC. 400 MAIN STREET BRAND, MA 01781	
FM-200 MARINE ECS SERIES USCG TYPE			
TITLE SYMBOL LEGEND			
CODE IDENT NO. OKDP7	SIZE A	SKETCH NO. LG-1CG	REV A
SCALE None	DATE APR-87	SHEET 1 of 1	

A

B

C

D



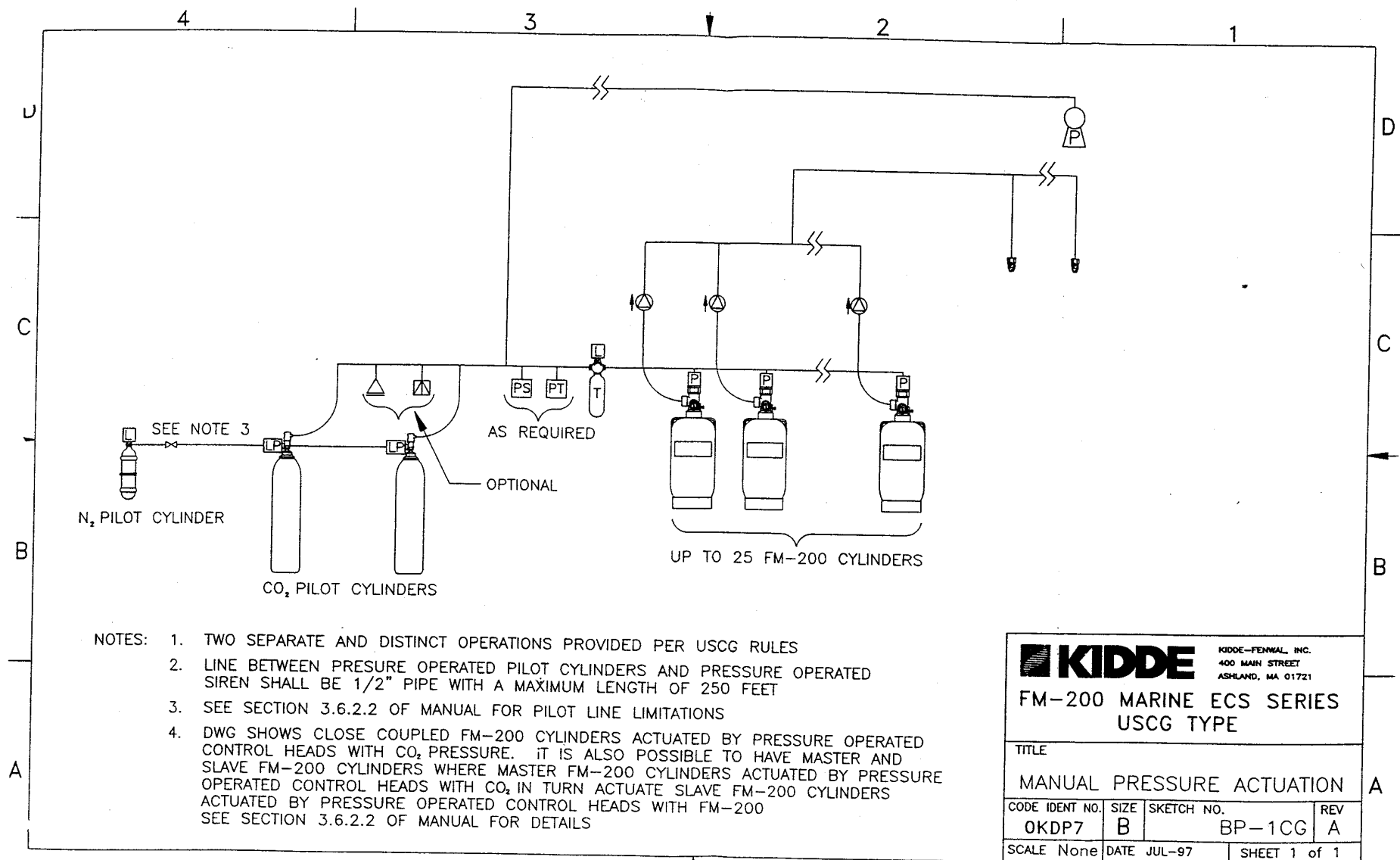
KIDDE KIDDE-FENVAL, INC.
400 MAIN STREET
ASHLAND, MA 01721

**FM-200 MARINE ECS SERIES
USCG TYPE**

TITLE
MANUAL CABLE ACTUATION

CODE IDENT NO.	SIZE	SKETCH NO.	REV
OKDP7	B	BC-1CG	A
SCALE None	DATE JUL-97	SHEET 1 of 1	

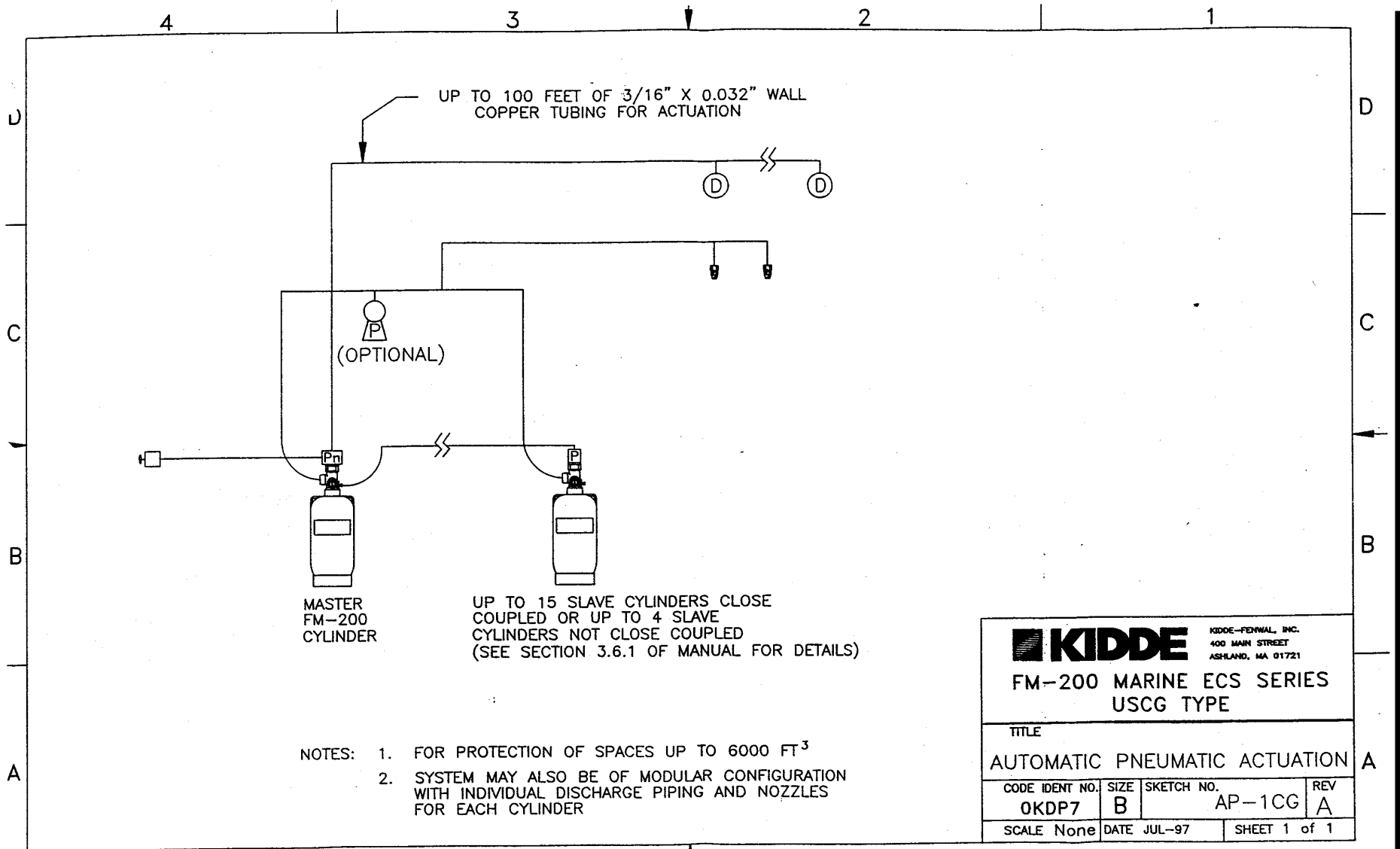
Change 1



- NOTES:
1. TWO SEPARATE AND DISTINCT OPERATIONS PROVIDED PER USCG RULES
 2. LINE BETWEEN PRESURE OPERATED PILOT CYLINDERS AND PRESSURE OPERATED SIREN SHALL BE 1/2" PIPE WITH A MAXIMUM LENGTH OF 250 FEET
 3. SEE SECTION 3.6.2.2 OF MANUAL FOR PILOT LINE LIMITATIONS
 4. DWG SHOWS CLOSE COUPLED FM-200 CYLINDERS ACTUATED BY PRESSURE OPERATED CONTROL HEADS WITH CO₂ 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 CO₂ 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		KIDDE-FENNAL, INC. 400 MAIN STREET ASHLAND, MA 01721	
FM-200 MARINE ECS SERIES USCG TYPE			
TITLE			
MANUAL PRESSURE ACTUATION			
CODE IDENT NO. OKDP7	SIZE B	SKETCH NO. BP-1CG	REV A
SCALE None	DATE JUL-97	SHEET 1 of 1	

Change 1



KIDDE		KIDDE-FENNAL, INC. 400 MAIN STREET ASHLAND, MA 01721	
FM-200 MARINE ECS SERIES USCG TYPE			
TITLE			
AUTOMATIC PNEUMATIC ACTUATION			
CODE IDENT NO. OKDP7	SIZE B	SKETCH NO. AP-1CG	REV A
SCALE None	DATE JUL-97	SHEET 1 of 1	

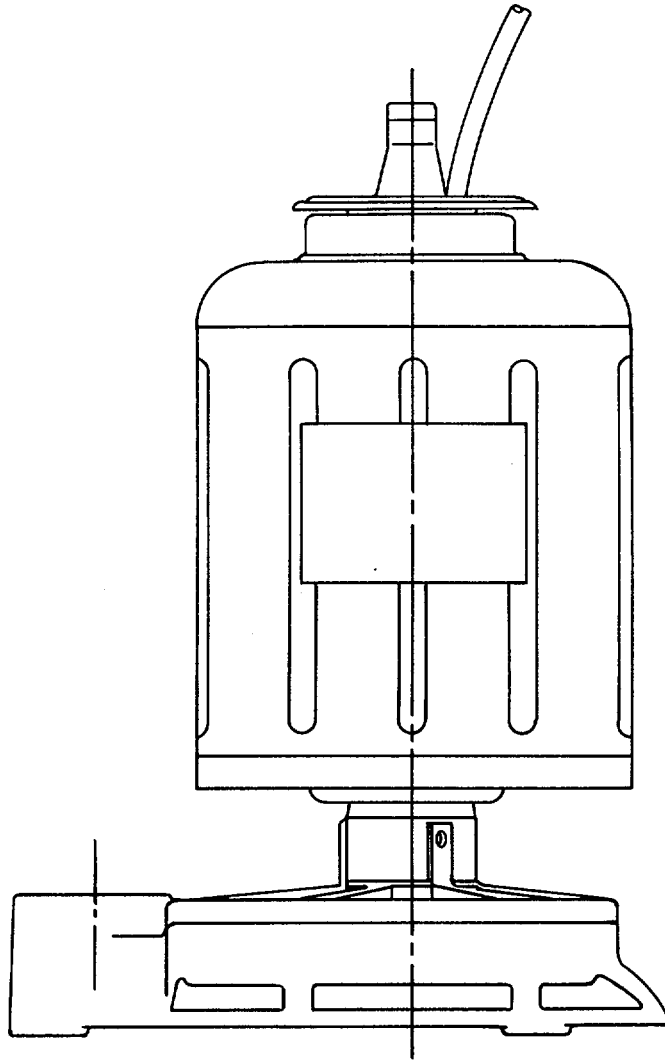
Change 1


SECTION IV

**Installation, and Maintenance Manual for
Prosser/ENPO Submersible Pump**



INSTALLATION & MAINTENANCE MANUAL
PROSSER/ENPO SUBMERSIBLE SUMP PUMPS
MODELS 65P, 85I, 75B, 75I & 43S



 **PROSSER/ENPO**
A Burks Pumps, Inc. Company
420 EAST THIRD ST. PIQUA, OH. 45356
PHONE (513) 773-2442 TELEX 288081
FAX: (513) 773-2238

Information Subject to Change Without Notice

9/89

625-03468 △ SUBM. INSTAL. FORM 38

PROSSER/ENPO SUBMERSIBLE SUMP PUMPS

MODEL	CONSTRUCTION	AUTOMATIC THERMAL OVERLOAD	DISCHARGE SIZE N.P.T. (FEMALE)	PRESSURE SWITCH
65P	Noryl™ motor housing, polypropylene impeller, volute and base.	YES	1.25"	YES
85I	Noryl™ motor housing, ABS impeller, cast iron volute and base.	YES	1.25"	YES
75B, 75I	Stainless steel motor enclosure; bronze impeller, volute and base.	YES	1.50"	YES
43S	Stainless steel motor enclosure, impeller, volute and base.	YES	1.50"	YES

SPECIFICATIONS				CAPACITY (GPM) HEAD (FEET)				
MODEL	HP	RPM	1 PH VOLTS	5	10	15	18	20
65P	1/3	1550	115	48	28	15	--	--
85T	1/3	1550	115	51	41	24	0	--
75B, 75I	1/3	1750	115	60	42	27	16	9
43S	1/3	1750	115	63	53	36	21	11

MODEL	"ON" LEVEL (IN.)	"OFF" LEVEL (IN.)
65P	11	6
85I	11	5
75B, 75I	10	6
43S	11 1/2	7

MODEL NUMBER (S), CONSTRUCTION, AND/OR SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

GENERAL INSTRUCTIONS

CAUTION: NEVER TOUCH PUMP OR DISCHARGE PIPING WHEN THE PUMP IS CONNECTED TO ELECTRICAL POWER AND WATER IS IN THE SUMP. ALWAYS DISCONNECT THE PUMP FROM THE POWER SOURCE BEFORE HANDLING.

1. The minimum recommended sump pit for Prosser/Enpo Submersible Sump Pumps 12" diameter and 18" deep. The bottom of the sump should be a level flat concrete slab. Never install pump directly on sand, gravel, or dirt. The sump pit shall have a removable cover of adequate strength to support anticipated loads, be sealed to prevent sewer gas from leaking out and prevent foreign matter from entering sump.
2. Do not cut, splice or damage the pump power cord. Do not carry or suspend pump by power cord.
3. It is recommended that a check valve and union be installed in pump discharge line. The check valve will prevent back flow of pumpage into the sump. When a check valve is used, drill a relief hole (.125 to .187 diameter) in the discharge pipe. This hole should be located below the sump cover and above pump volute. Unless such a relief hole is provided, the pump could "air lock" and will not pump water even though it will run. Discharge pipe and fitting must be the same size as, or larger than the pump discharge flange. Failure to adhere to these instructions will cause poor pump performance.
4. After completion of installation, test pump immediately to assure the installation is in proper working order.
5. These units are designed to pump effluent and/or waste water. Do not pump heavy, viscous or abrasive materials. Warranty will be voided if this occurs. Consult factory for special applications.
6. Installation must conform to all applicable national, state and/or local codes and ordinances.
7. If large quantities of grease are flowing into the sump or tank, a grease trap should be installed in the inlet line.
8. If vent fitting is supplied on top of sump or tank cover it must be connected to a vent stack.

ELECTRICAL CONNECTIONS

Single phase pumps are supplied with a 3-prong plug. The third prong is to ground the pump to prevent possible electrical shock. **DO NOT ALTER OR REMOVE THE GROUND PRONG.**

The receptacle must be a three pin polarized type with an internal ground. If receptacle is not as described, it must be changed to the proper type and grounded in accordance to the National Electric Code and any applicable local codes or ordinances.

The electrical circuit for the pump must be of adequate capacity and equipped with fuses or circuit breakers of proper size. A separate branch circuit is highly recommended.

Be sure that the electrical characteristics of the power circuit are identical to those shown on the pump nameplate. Check for full load amperage. The feeder circuit conductors from the power supply must be sized so voltage drop will not exceed 10% of the unit's rated voltage when pump is operating.

Receptacle should be located a minimum of 4' above floor level.

CAUTION: DO NOT USE AN EXTENSION CORD UNDER ANY CIRCUMSTANCES, AS LOW VOLTAGE AND ELECTRICAL HAZARDS MAY DEVELOP.

ELECTRICAL CONTROL AND SWITCHING

Single Phase Automatic Models

These units have internal switching and are plugged directly into an approved three pin polarized receptacle with an internal ground. Receptacle must be of appropriate voltage.

MAINTENANCE INSTRUCTIONS

CAUTION: NEVER TOUCH PUMP OR DISCHARGE PIPING WHEN THE PUMP IS CONNECTED TO ELECTRICITY AND WATER IS IN THE SUMP. ALWAYS DISCONNECT THE PUMP AND SWITCHES FROM THE POWER SOURCE BEFORE HANDLING AND/OR PERFORMING ANY MAINTENANCE.

The pump motor does not require internal maintenance. If there is any evidence of internal problems, the unit should be taken to an authorized Enpo service station. Warranty will be voided if pump, switching and/or other components are disassembled by unauthorized personnel.

The following should be performed up to four times a year depending on application:

- A. Pump sump or tank water level down.

B. Disconnect power (remove pump cord plug from receptacle, shut-off breaker, remove fuses or take any other applicable action to shut-off power) clean sump or tank walls, and other items where buildup of debris could be harmful to pump operations. Remove any foreign objects or solids from bottom of sump or tank.

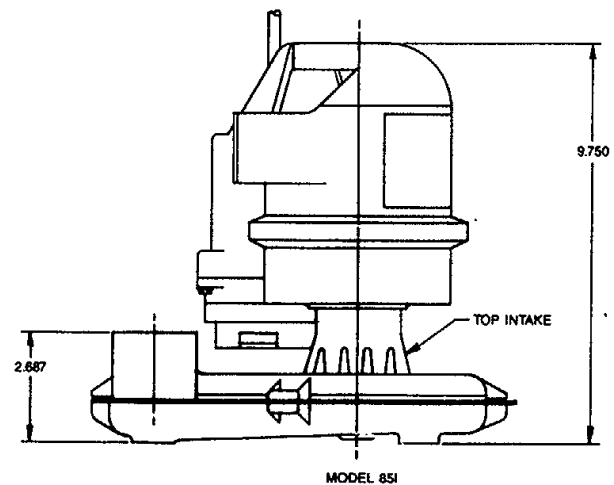
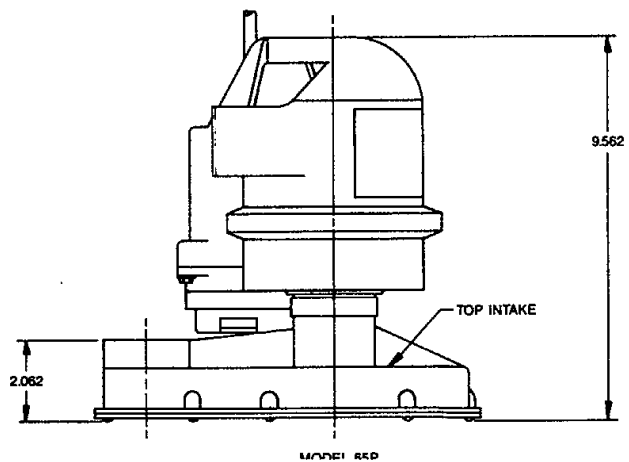
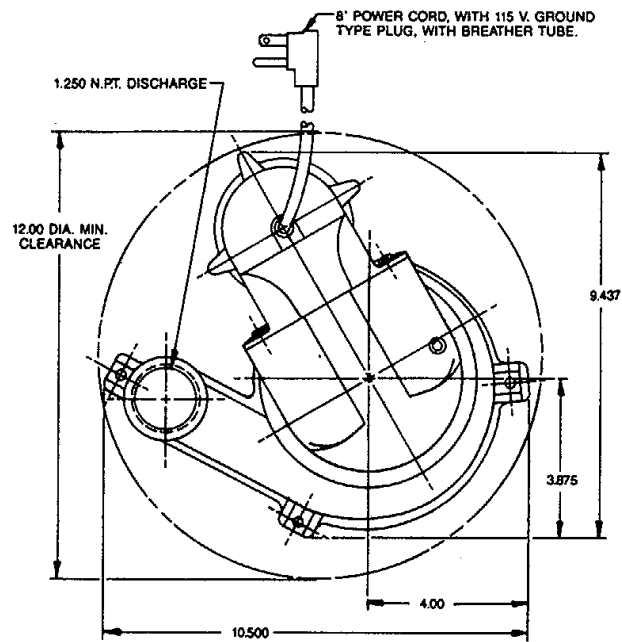
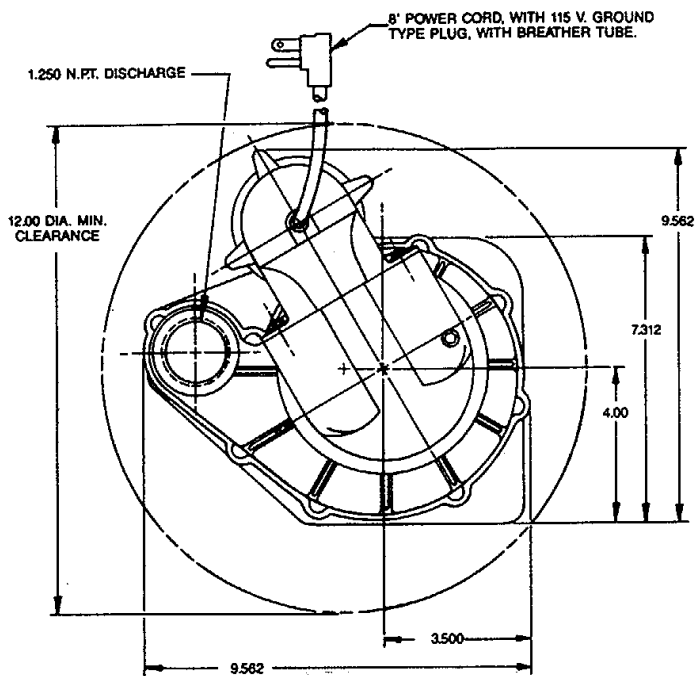
C. After cleaning sump or tank, refill with water. Observe pump for proper operation.

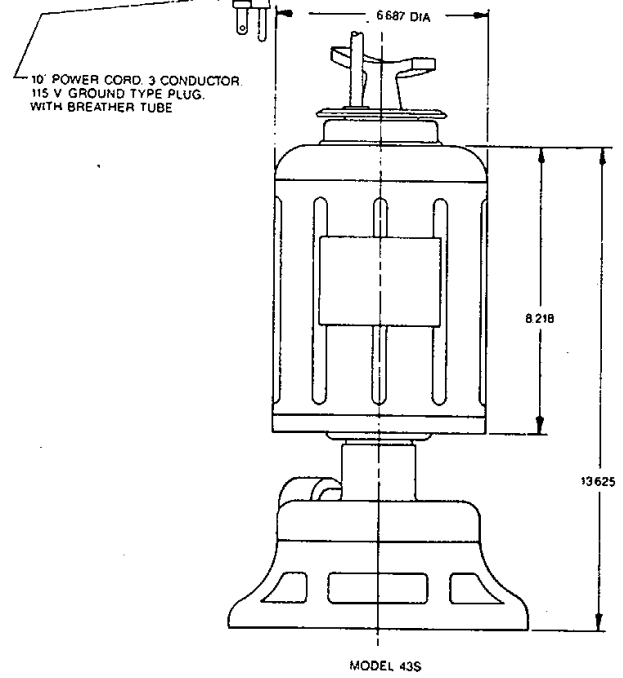
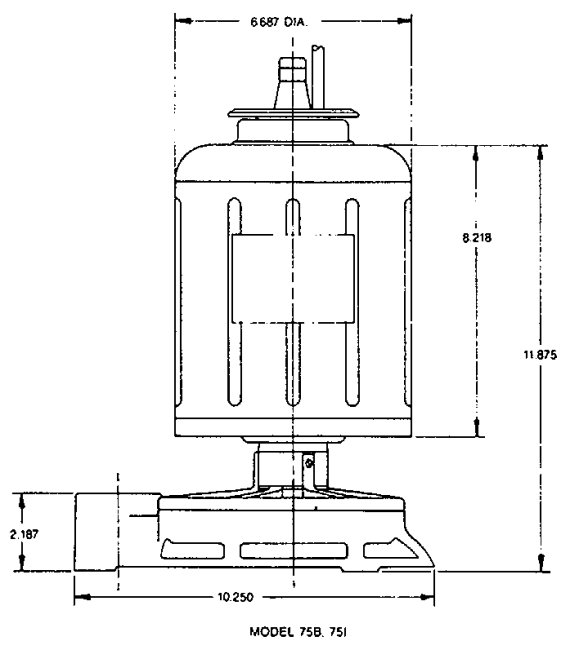
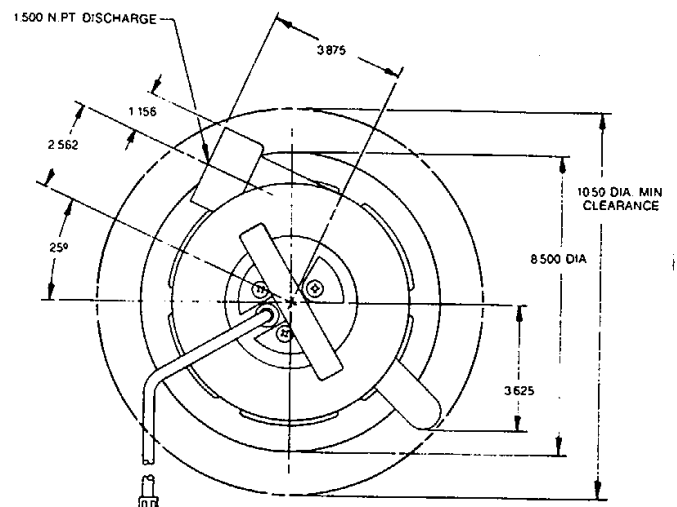
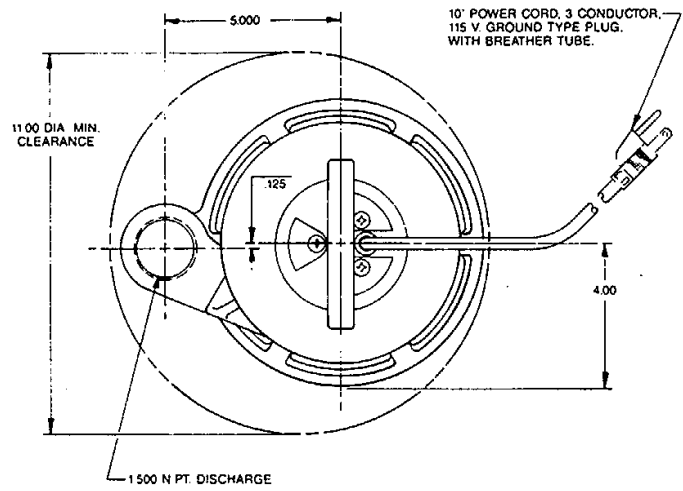
If the installation includes a check valve, the relief hole (drilled previously in the discharge pipe) should be cleaned at least four times a year. This will prevent air-locking problems.

The pump should be started manually at least four times a year to make sure that it is operational.

The power supply cord and electrical receptacle should be checked frequently to make certain that good corrosion free contact is maintained and that the plug is completely inserted into the receptacle.

Consult factory if any questions and/or problems arise that are not covered by manual.

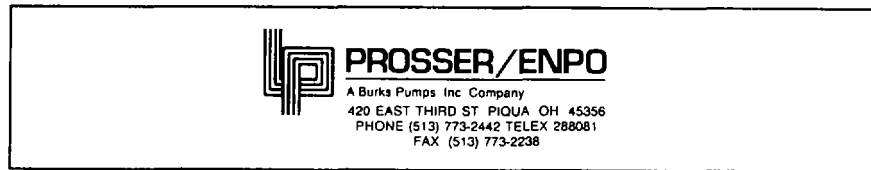




LIMITED WARRANTY

Each new unit is warranted to be free from defects in material and workmanship under normal use, service and application. We will repair or replace at our nearest authorized PROSSER/ENPO service outlet, without charge, any such unit or part which shall, within one year after date of installation, but within 18 months of manufacture date, be forwarded via prepaid transportation cheapest way and which our inspection shall disclose to our satisfaction to have been defective. This warranty is in lieu of all other warranties, expressed or implied, and all other obligations or liabilities on our part, and in no event shall we be liable for consequential damages, or for any charge or expenses incurred without our written consent.

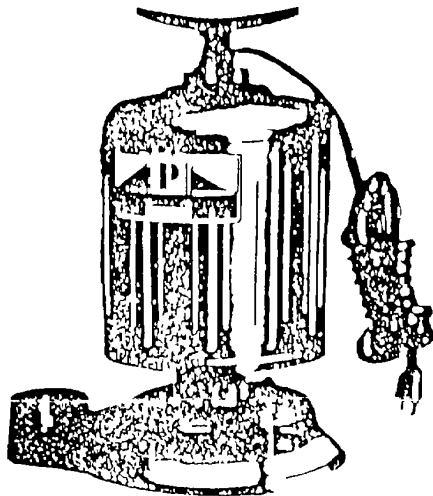
This warranty does not apply to any unit or part which shall have been repaired or altered outside our factory or authorized PROSSER/ENPO service agent in any way which, in our judgement, affects its quality, or which has been subject to careless handling, tampering, misuse, accident or faulty or improper installation or application. If service is required, do not use the unit or in any way disassemble. Forward the unit to the nearest authorized PROSSER/ENPO service outlet via prepaid transportation, cheapest way.





PROSSER/LETO™
 INDUSTRIES, INC
 420 EAST THIRD ST. PIQUA, OH. 45356
 PHONE (513) 773-2442 TELEX 288081

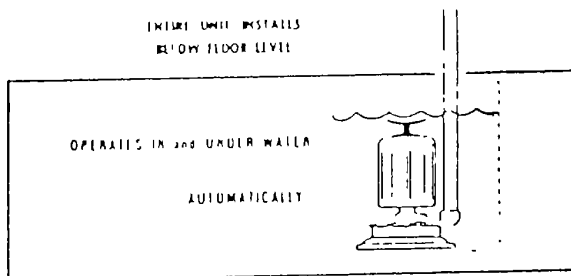
Series 75 submersible pumps



For complete safety
 and dependability . . .

Triangle's submersible 75's provide complete safety and dependability. ALL electrical mechanisms are sealed in bronze and stainless steel. NO exposed electrodes to corrode. NO elaborate switch seals and diaphragms to become fouled by water-borne debris. NO bearings in the pump. ALL bearings are permanently oiled and sealed in bronze and stainless steel. The only moving parts exposed to the water are the bronze impeller and rotary seal. A brass screen protects the pump intake. Available in 2 models: 75B is bronze and stainless steel; 75I is iron, bronze and stainless steel. Also can be equipped with 230V, single phase motor for special applications. Comes equipped with 10 water-proof power cord with 3 conductor grounded plug. 1½" discharge.

- Face-type shaft seal prevents moisture intrusion
- Automatic overload motor protector prevents winding burnouts
- Cord, handle and switch assembly is replaceable in the field
- Easy to install, plug-in appliance simplicity



Model	Spec No
75B	SB1551
75I	SC1551

DIMENSIONS AND CAPACITIES OF PUMPS

Series	Motor	Disch Pipe	Height Overall	Base to Motor	Dia of Base	Flow Capacity in GPM per Hour					Sump Size
						5'	10'	15'	20'	25'	
Submersible 75B & 75I	1/3 HP - 60 HZ 115V - Thermally Protected - Single Phase	1½"	14½"	3½"	10 ¼"	3600	2500	1600			30 lbs.

STANDARD TERMS AND CONDITIONS OF SALE

INTRODUCTION Maintenance of a satisfactory relationship between buyer and Seller demands a good understanding of the basis on which business is to be done.

Accordingly Prosser/Enpo Industries, Inc. (hereafter called the Seller) urges customers to read carefully these terms and conditions of sale which will govern distribution of Seller's commercial products.

ORDER ACCEPTANCE All orders are subject to review and acceptance in writing by an officer of Seller in Piqua, Ohio and subject to its terms and conditions. No order shall be binding upon Seller until so accepted. By submitting a written or telephone order, the Buyer will indicate his agreement to the Standard Terms and Conditions of Sale set forth herein. Any inconsistent or additional terms contained in a Buyer's order shall be considered as rejected by Seller within ten (10) days of its receipt of such order. Seller's failure to object to provisions in Buyer's order shall not be deemed a waiver of the provisions of Seller's Standard Terms and Conditions of Sale.

MODIFICATIONS No waiver or modification of any of the Seller's terms and conditions of sale shall be valid unless it is made in writing and signed by an officer of Seller.

The failure of Seller to enforce any right possessed under the foregoing terms and conditions of sale shall not constitute a waiver thereof or establish a custom.

PRICING All prices for products of Seller's standard design and constructed of standard material are subject to change without notice and all shipments will be invoiced at the price in effect at the time of shipment except that: (A) a purchaser's order for immediate shipment postmarked prior to a given change and not then being held for lack of credit approval will be invoiced at the price in effect at the time of postmark, and (B) prices may be negotiated on a firm basis with or without an appropriate escalation clause. Prices are for products of Seller's standard design and constructed of standard materials and there will be no reduction for the omission of any feature. Pricing of items not covered by the Price and Data Book must be referred to Seller's factory.

No price protection will be extended when shipment is held at customer's request for longer than six months, notwithstanding the fact that the order had been previously accepted. No price protection will be extended on orders held for lack of credit approval.

Minimum billing charges will be \$35.00 plus transportation charges. Price protection on purchased accessories will be in accordance with that given by the accessory manufacturer. Published prices, discounts, and specifications are subject to change without notice.

TAXES Customers shall reimburse the seller for any sales use occupation excise or similar tax arising out of the sale upon receipt of Seller's invoice for the amount of the tax or shall provide Seller at the time of order entry with a tax exemption certificate acceptable to the appropriate taxing authorities.

TERMS OF PAYMENT Net 30 days from invoice date with a prompt payment discount of 2% allowed for cash within 10 days of invoice date. All orders are subject to the approval of Seller's credit department and Seller may require full or partial payment in advance. Pro-rata payments shall become due as shipments are made. If the shipments are delayed by the customer for any cause, payments shall become due from the date on which Seller is prepared to make shipment and storage shall be at the customer's risk and expense. If manufacturer is delayed by the customer for any cause, a partial payment based upon the proportion of the order completed shall become due from the date on which Seller is notified of the delay. C.O.D. shipments do NOT qualify for prompt payment discount.

TITLE The right of possession of the products (or any part thereof) furnished by Seller shall remain in the Seller until paid for in full, and the customer shall do all acts necessary to protect and maintain such right in the Seller.

CANCELLATIONS AND CHANGE ORDERS While Seller has no desire to assess a penalty when it becomes necessary for a customer to change or cancel an order it will be done in certain instances.

When in Seller's opinion the change or cancellation will result in excess inventory of standard parts or material, a charge of 30% of the net value of the changed or cancelled portion of the order will be made. In the case of non-standard parts, material, engineering and/or labor, a charge will be made equal to Seller's cost plus 30% for that portion which Seller cannot immediately recover by sale or return to supplier.

QUOTATIONS Prices quoted for domestic shipment by Seller are valid for 30 days from date of quotation unless otherwise specified by Seller in writing. Clerical errors on quotations are subject to correction by the company and such errors will not be binding.

PENALTY CLAUSE No penalty clause of any description will be acceptable to the Seller.

PACKING Normal domestic packing for air or motor freight shipments at no additional charge. Packing for long term storage or for export will be quoted by factory.

SHIPMENT Seller's shipping terms are F.O.B. Shipping Point transportation charges collect unless otherwise agreed upon in writing.

Seller is not responsible for damage incurred during shipment or delivery. The customer should inspect shipments upon receipt from the carrier and in event of differences file a claim against the carrier. Seller will gladly provide assistance in securing claim adjustments upon request. The customer should immediately order replacement parts for those damaged. Such parts will be billed to the customer's regular account for payment. Reimbursement for damaged parts must be from the carrier to the customer on the basis of customer's claim.

DELAYS Seller will not be responsible for any delay or failure to meet a shipment date caused by circumstances beyond the reasonable control of Seller or others including but not limited to the following: Acts of God, the government or the public enemy, riots, embargoes, strikes or other concerted acts of workmen, casualties or accidents, deliveries in transportation and shortage of cars, fuel, power, labor or material.

RETURN OF EQUIPMENT No equipment shall be returned to Seller without written returned goods authorization and shipping instructions first having been obtained from Seller. In the event such authorization is granted by Seller, the customer must prepay the charges in full for transportation to Seller's factory.

Credit allowed for new, undamaged equipment of current standard design will be 70% of the invoiced price or current billing price, whichever is the lesser. Equipment which in Seller's opinion shows tool marks or efforts of use, however slight, will not be accepted for credit. Authorization will not be given for return of equipment which would, in the opinion of Seller, result in an excess in the amount of stock normally carried by Seller. For non standard equipment not manufactured by Seller, the only credit allowed will be such credit as may be allowed by the manufacturer of such equipment. Equipment must be returned within 30 days of the date of the returned equipment authorization.

The foregoing serves only to establish procedure in event Seller agrees to accept return of equipment. It shall in no way act to pre-obligate Seller to accept the return of equipment for any reason. Unauthorized returns may be refused and/or returned to sender freight collect.

DESIGN Prices cover current standard design which are subject to change or modification by Seller. When pumps or parts are ordered for use with an existing installation, Seller will furnish parts as nearly interchangeable as feasible. However, Seller reserves the right at any time to discontinue the manufacture of any model for to make changes in design to add improvements to products, without incurring any obligation to furnish or install the same on products previously manufactured.

DRAWINGS On request, Seller will furnish with shipment five (5) paper prints of parts list, performance curves and general outline prints covering the equipment or such other descriptive material as, in Seller's opinion, may be necessary. A charge will be made for reproduces, additional lists, curves, or prints required by the customer. Detailed pattern machine drawings, specifications and other unpublished material will not be supplied.

LIMITED WARRANTY Prosser/Enpo Industries, Inc. extends to the ultimate consumer that products of Seller's manufacturer are warranted by Seller against defects in material and workmanship under normal use and service for the following time periods:

Pump Products One (1) year from date of installation or eighteen (18) months from date of shipment, whichever occurs first.

Cleaning Products Six (6) months from date of installation or one (1) year from date of shipment, whichever occurs first.

This warranty extends to the ultimate consumer of the product. As used here, "ultimate consumer" is defined as the purchaser who first uses the product after its initial installation or in the case of the product designed for nonpermanent installations, the first owner to use the product. It is the purchaser's or any sub-vendor's obligation to make known to the ultimate consumer the terms and conditions of this warranty. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

In the event the product is one covered by the Federal Consumer Product Warranty Law (1) the duration of any implied warranties associated with the product and value of said law is limited to the same duration as stated hereinbefore, (2) this warranty is a LIMITED WARRANTY, and (3) no claim of any nature whatsoever shall be made against Prosser/Enpo Industries, Inc. until the ultimate consumer, his successor or assigns notifies Prosser/Enpo Industries, Inc. in writing of the defect and delivers the product and/or defective part(s) freight prepaid at the factory or nearest authorized service station. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

Products manufactured by Prosser/Enpo are warranted by Prosser/Enpo Industries, Inc. herein call the Seller, against defects in materials and workmanship under normal use and service and when installed and maintained in accordance with the manufacturer's instructions.

The sole and exclusive remedy for breach of any and all warranties with respect to any product shall be replacement or repair at Seller's cost at the F.O.B. factory or at the replacement station of such products and/or parts as proven defective. There shall be no further liability, whether based on warranty, negligence or otherwise, no claims for labor or consequential damages shall be payable.

Unless expressly stated otherwise, guarantees in the nature of performance specifications furnished in addition to the foregoing material and workmanship warranties on a product manufactured by Prosser/Enpo Industries, Inc. if any are subject to laboratory tests corrected for field performance. Any additional guarantees in the nature of performance specifications must be in writing and such writing must be signed by (an appropriate Prosser/Enpo representative). Due to inaccuracies of field testing, if a conflict arises between the results of field testing conducted by or for the user and laboratory tests corrected for field performance, the latter shall control.

Components or accessories supplied by Seller but manufactured by others are warranted only to the extent of, and by the terms and conditions of the original manufacturer's warranty.

Recommendations for special applications will be based on the best available experience of Seller and published industry information. Such recommendations do not constitute a warranty of satisfactory performance.

This warranty shall not apply when damage is caused by (a) improper installation, (b) improper voltage, (c) lightning, (d) sand or other abrasive material, (e) scale or corrosion build up due to excessive chemical content. Any modification of the original equipment will also void the warranty. Seller will not be responsible for any damage, labor costs due to interruption of service caused by defective parts. Neither will Seller accept charges incurred by others without Seller's prior written approval.

This warranty is void if Seller's inspection reveals the product was used in a manner inconsistent with normal industry practice and/or specific recommendation of Seller. The purchaser is responsible for communication of all necessary information regarding the application and use of the product.

UNDER NO CIRCUMSTANCES WILL THE COMPANY BE RESPONSIBLE FOR ANY OTHER DIRECT OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS PROFITS, LOST INCOME, LABOR CHARGES, DELAYS IN PRODUCTION, IDLE PRODUCTION, WHICH DAMAGES ARE CAUSED BY ANY DEFECTS IN MATERIAL AND/OR WORKMANSHIP IN ITS PRODUCTS AND/OR DAMAGE OR DELAYS IN SHIPMENT.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTY INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS AND OF OTHER OBLIGATION ON THE PART OF SELLER.

ASSIGNMENT None of the customer's rights under any order or agreement shall be assigned by the customer to any other person, whether by operation of law or otherwise without Seller's prior written approval.

COSTS OF ENFORCEMENT If any litigation is commenced between the parties herefor the enforcement of any rights hereunder, the successful party in such litigation shall be entitled to receive from the unsuccessful party all costs incurred in connection therewith, including a reasonable amount for attorney's fees.

Should any of the terms and provisions of Buyer's order be in any way inconsistent with the terms and conditions herein, the same shall not be binding on Seller and shall not be considered applicable to the sale.

OPERATING INSTRUCTIONS

1. **INSTALLATION**-Pump may be mounted in any position without loss of efficiency; however, it is suggested that the pump head be down if vertical mounting is desired. The rotation of the motor shaft determines the location of the pump's intake and discharge ports. Refer to Dimensional Drawing. Right hand port, looking at pump end cover, is inlet port.
2. **DRIVE-Direct.**
3. **SELF-PRIMING**-Pump will produce a suction lift approaching 10 feet (3m) when dry and a lift up to 22 feet (6,7m) when primed. BE SURE SUCTION LINES ARE AIRTIGHT or pump will not self-prime.
4. **RUNNING DRY**-Unit depends on liquid pumped for lubrication. DO NOT RUN DRY for more than 30 seconds. Lack of liquid will damage the impeller.
5. **PRESSURES**-For continuous operation, pressure should not exceed 20 p.s.i. (1,4 kg/sq cm).
6. **TEMPERATURES**-Neoprene impeller recommended for liquid temperatures of 45° to 180° F (7° to 82°C). Nitrile: 50° to 180°F (10° to 82°C).
7. **FREEZING WEATHER**-Drain unit by loosening the end cover.
8. **NOTICE** - Do not pump solvents, thinners, highly concentrated or organic acids. Damage to pump may result. If corrosive fluids must be handled, pump life will be prolonged if pump is flushed with water after each use or after each work day.
9. **GASKET**-Use standard pump part. A thicker gasket will reduce priming ability. A thinner gasket will cause impeller to bind. Standard thickness 0.010".
10. **SPARE PARTS** -A Jabsco Service Kit should be kept on hand to service all but the most badly worn 11810-Series pump.

SERVICE INSTRUCTIONS

DISASSEMBLY

1. Remove end cover screws, gasket and end cover.
 2. Grasp impeller hub with water pump pliers and withdraw from body.
 3. Loosen cam screw and remove cam. Clean off sealant. Remove wearplate with screwdriver or hooked wire.
 4. Loosen nut at body clamp. Remove body from motor shaft.
 5. Press out seal from motor mounting end of body towards impeller bore.
 6. Remove slinger from shaft.
- NOTE: Inspect all parts for wear or damage and replace if necessary.

ASSEMBLY

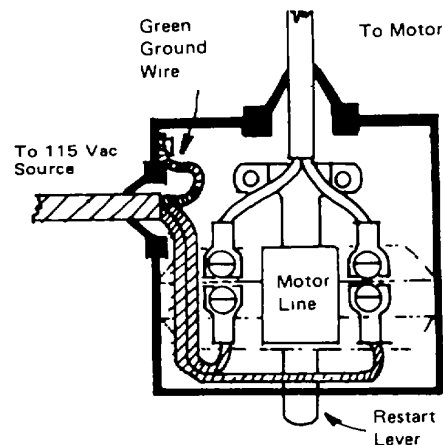
1. Install slinger and position 1/4" from motor boss.
2. Press seal into seal bore with lip facing toward the impeller bore. Apply grease to back of seal lip.
3. Install wearplate, aligning slot with dowel pin.
4. Apply sealant to top of cam and cam screw threads. Install cam with cam screw.
5. Install body on motor. Tighten nut at clamp. Do not overtighten or binding of shaft will result.
6. Lubricate impeller bore with water pump grease.
7. Lubricate shaft OD with grease, align drive ding in extended impeller insert with flat on shaft and install impeller.
8. Install gasket, end cover and end cover screws.

TO EQUIP WITH VACUUM SWITCH (4732-0000)

1. Install switch in tapped hole on top of inlet port. (Seal threads prior to assembly).
2. Connect switch to motor. See diagram.
3. Plug into 115 Vac outlet and hold down restart lever on switch until the pump primes.

SPECIAL ATTENTION

1. Constant vibration of the restart lever indicates:
(A) *An air leak.* This will usually show up when the pump is first started. All suction lines should be checked for loose connections.
(B) *A worn impeller.* Impeller should be replaced.
2. Intermittent stopping and starting indicates that the unit is operating against excessive discharge pressure.



VACUUM SWITCH WIRING DIAGRAM

VACUUM SWITCH WIRING DIAGRAM



Model 11810-SERIES

Model 11810-Series



SELF-PRIMING PUMPS

FEATURES

- Body: **Bronze Construction**
- Impeller: **Neoprene or Nitrile Compounds**
- Shaft: **Stainless Steel Sleeve over Motor Shaft**
- Wearplate: **Replaceable**
- Shaft Seal: **Lip Type**
- Ports: **3/4" Garden Hose External Thread and 1/2" NPT Internal**
- Motor: **1/3 Hp, 115 Vac, 60 Hz, 1725 rpm, Single Phase, Overload Protector, Capacitor Type, Open Drip Proof or Totally Enclosed Fan Cooled, Handle and 8 ft. cord with 3 prong grounded plug on ODP motor only**
- Weight: **20 lb (9.1 kg) with ODP Motor
25 lb (11.4 kg) with TEFC Motor**

⚠ MOTOR WARNING

MOTOR CAN SPARK
EXPLOSION & DEATH
CAN OCCUR

DO NOT USE WHERE
FLAMMABLE VAPORS
ARE PRESENT



STANDARD MODELS

MODEL	DESCRIPTION
11810-0001	Neoprene Impeller, ODP Motor
11810-0003	Nitrile Impeller, ODP Motor
11810-0011	Neoprene Impeller, TEFC Motor
11810-0013	Nitrile Impeller, TEFC Motor

TYPICAL APPLICATIONS

MARINE

Bait tank circulation • Transfer oil* • Wash down • Utility dock pumps

INDUSTRIAL

Circulate coolant on machine tools* • Industrial filling systems • Utility shop pump • Transfer gum arabic • Transfer distilled water • Recharge water softeners • Ice water recirculation • Hydrostatic pressure testing • As vacuum pump • Aspirating pump

FOOD, BEVERAGE & DAIRY

Circulate cooling water • Defrost refrigeration coils • Fill drums • Wash down equipment and floors • Utility pump

*Use nitrile impeller

HOME

Fill and empty tubs, pools • Empty basements • Cesspools • Water systems • Water lawns, gardens • Remove water from low areas • Recharge water softeners

PLUMBING

Empty clogged sumps, drains, sinks, tubs • Pump out water closets

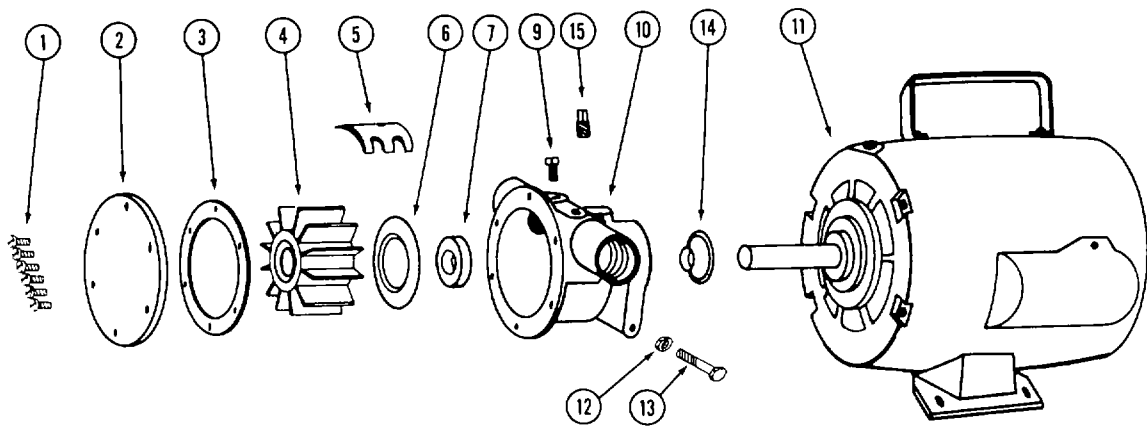
FARM

Fill tractor tires • Fill water tanks • Pump out silo pits, liquid manures • Transfer oil* • Flush and clean animal pens

CONTRACTORS

Remove water from excavations • Supply water to mortar boxes, cement mixing • Wash down equipment

EXPLODED VIEW



PARTS LIST

KEY	DESCRIPTION	PART NUMBER	QTY.
1	Screw (End Cover)	91002-0020	6
2	End Cover	11830-0000	1
3*	Gasket	11816-0000	1
4*	Neoprene Impeller	5929-0001	1
	Nitrile Impeller	5929-0003	
5	Cam	490-0001	1
6	Wearplate	2235-0000	1
7*	Seal (Shaft)	92700-0420	1
9	Screw (Cam)	91003-0010	1
10	Body	11814-0000	1
11	Motor (ODP)	18739-0000	1
	Motor (TEFC)	18753-0014	
12	Nut	91005-0030	1
13	Bolt	91095-0090	1
14	Slinger (O-Ring)	92000-0230	1
15	Plug (for vacuum switch hole)	92650-0070	1
4732-0000—VACUUM SWITCH KIT— automatic shut off for use when pump is left unattended			

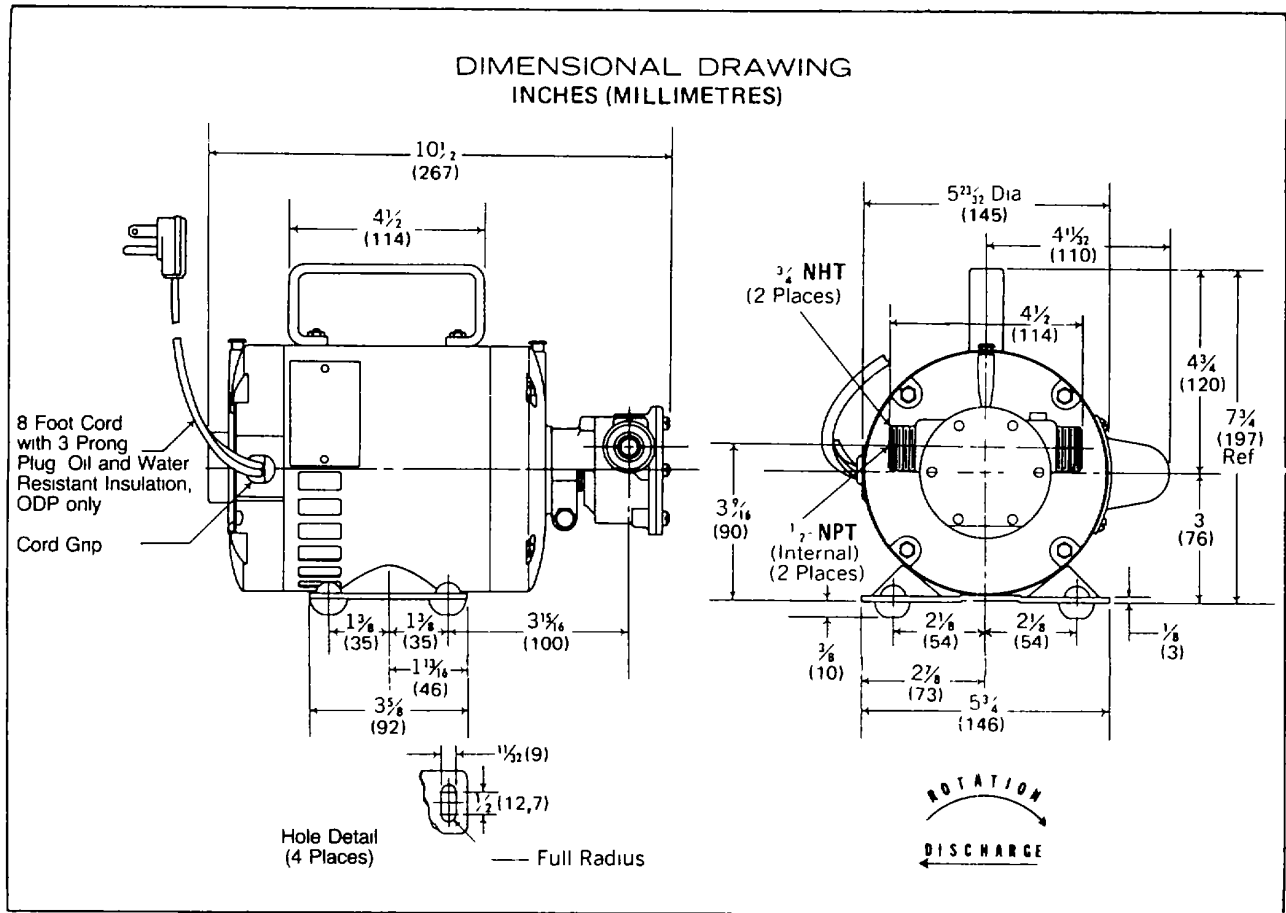
* Parts contained in service kit.

SERVICE KITS

PUMP MODEL NUMBER	SERVICE KIT NUMBER
11810-0001 11810-0011	90105-0001 Neoprene Impeller
11810-0003 11810-0013	90105-0003 Nitrile Impeller
Kits consist of: Impeller, seal and gasket	

REPLACEMENT PUMP HEADS COMPLETE

PUMP MODEL NUMBER	PUMP HEAD NUMBER
11810-0001 11810-0011	11818-0001 Neoprene Impeller
11810-0003 11810-0013	11818-0003 Nitrile Impeller



HEAD CAPACITY TABLE

p.s.i.	(kg/sq cm)	feet of water	(metres)	GPM	(l/min)
4.3	0.3	10	3	9.5	35.9
8.7	0.6	20	6	7.6	28.8
13.0	0.9	30	9	6.0	22.7
17.3	1.2	40	12	4.2	15.9

NOTE: Tables show approximate performance for new pump with neoprene impeller. For a nitrile impeller, reduce values by 10%.

THE PRODUCTS DESCRIBED HEREIN ARE SUBJECT TO THE JABSCO ONE YEAR LIMITED WARRANTY, WHICH IS AVAILABLE FOR YOUR INSPECTION UPON REQUEST.

ITT JABSCO
A Unit of ITT Corporation
1485 Dale Way, P O Box 2158
Costa Mesa, CA 92628-2158
Telephone (714) 545-8251

SECTION V

Portable Fire Fighting Pump Model P-250



NAVSEA S6225-EF-MMA-010/MODEL PE-250

TECHNICAL MANUAL

**INSTALLATION, OPERATION, MAINTENANCE AND REPAIR
INSTRUCTIONS WITH PARTS LIST**

**PORTABLE FIRE FIGHTING SERVICE GASOLINE
ENGINE DRIVEN CENTRIFUGAL PUMP
MODEL PE-250**

(Kawasaki Engine Model TA-440AP)

**PROSSER-EAST DIVISION OF PUREX
DEPARTMENT OF THE NAVY**

**PUBLISHED BY DIRECTION OF COMMANDER
NAVAL SEA SYSTEMS COMMAND**

NAVSEA S6225-EF-MMA-010/MODEL PE-250

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15 DECEMBER, 1981

NAVSEA

APPROVAL AND PROCUREMENT RECORD PAGE

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CERTIFICATION:

Technical Manual NAVSEA S6225-EF-MMA-O10 Model PE-250 provided under Contract
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CERTIFIED BY:

R. Van Zandt, Manager of
Engineering

Prosser-East Division
Purex Industries, Inc.

MANUFACTURER'S SIGNATURE

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CHAPTER 1 GENERAL INFORMATION AND SAFETY PRECAUTIONS

1-1. INTRODUCTION.

1-2. PURPOSE OF MANUAL.

1-3. The purpose of this technical manual is to provide information which will assist in the operation and maintenance of the Portable Fire Fighting Service Gasoline Engine Driven Centrifugal Pump, part number PE-250, hereinafter referred to as pump, manufactured by Prosser-East Division, Purex Industries, Inc., Horsham, Pennsylvania 19044. In addition, this technical manual includes a complete list of maintenance parts, though the maintenance philosophy is being directed toward "modular" in lieu of "piece part" support for forces afloat.

1-4. SCOPE OF MANUAL.

1-5. Chapters 2 through 7 of this technical manual provide operation instructions, functional descriptions, scheduled maintenance, troubleshooting, corrective maintenance, and parts list.

1-6. EQUIPMENT DESCRIPTION.

1-7. The pump is a self-contained, centrifugal, gasoline engine driven, portable fire pump. The pump is rated at 250 gpm with a discharge pressure of 100 psi and a suction lift of 16 feet (refer to figure 8-3). The pump is directly coupled to a 2 cycle gasoline engine, provided with a manual rope starter, supplemented with a battery powered electric starter. The pump is automatically primed by a vacuum pump driven by the engine. The pump can also be manually primed. Refer to Table 1-1 and Figure 1-1.

1-8. The pump has the throttle and choke controls, a start switch, a prime switch, and an ignition switch mounted on an engine control panel assembly. In addition, the pump has a gage panel assembly which consists of a 20 amp armner gage and a 0 to 30 Vac and 0 to 300 psi pressure compound gage.

1-9. EQUIPMENT AND ACCESSORIES SUPPLIED.

1-10. Refer to Table 1-2 for equipment and accessories supplied with the pump.

1-11. FUEL.

WARNING

Make sure fuel mixing is performed in a well ventilated area away from operating pump to prevent spilled fuel or fuel fumes from igniting on contact with hot engine parts, electrical or mechanical arc, spark, or flame.

CAUTION

Correct fuel mixture is extremely important because engine lubrication is dependent on the exact mixing of good quality oil and gasoline. Wrong or incorrect mixture ratio of oil and gasoline will cause engine overheating, piston and cylinder scoring with final engine stoppage or seizure. Correct fuel mixture is 2 cans of BIA-TC-W Oil, (NSN-9150-00-117-8791) and 6 gallons of 90 octane gasoline (5 ounces oil per gallon gasoline).

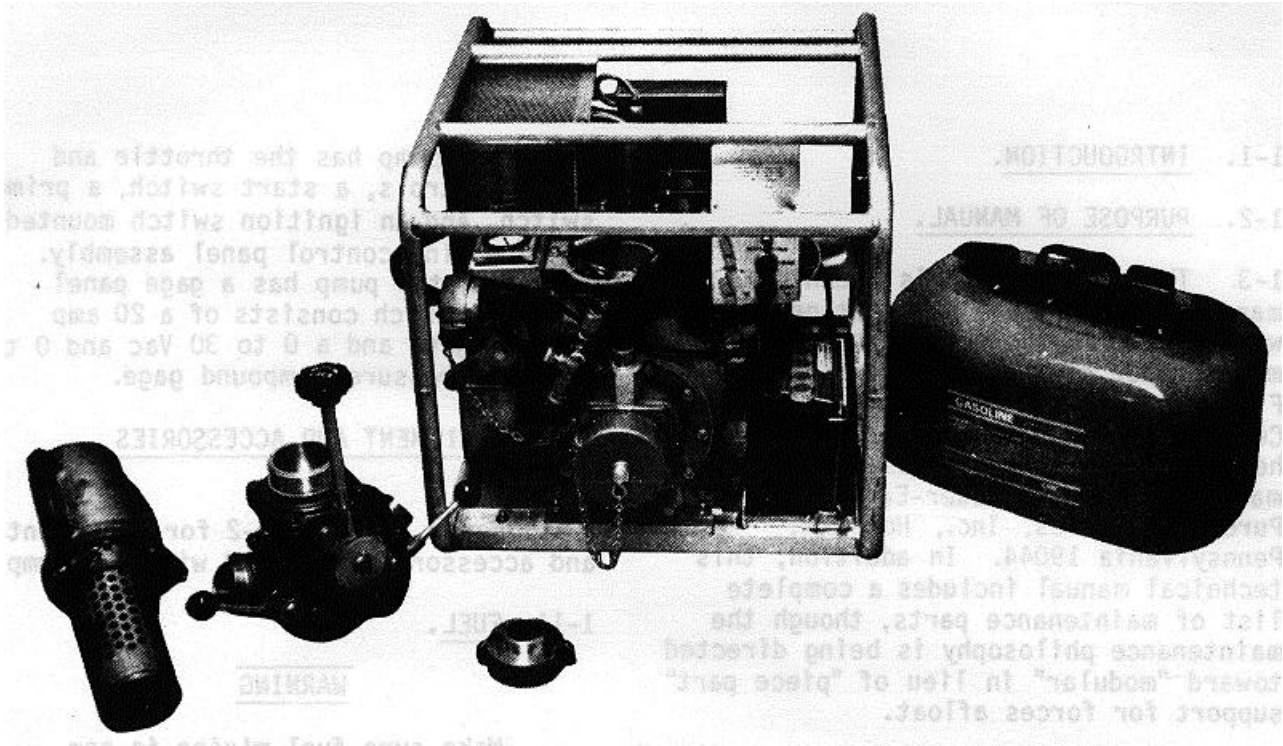


Figure 1-1. Portable Fire Fighting Service Gasoline Engine Driven Centrifugal Pump

1-12. EXHAUST.

WARNING

Do not operate pump in closed areas without exhaust hose connected and routed safely to outside fresh air. Make sure the exhaust hose connections are tight with no leaks, because engine gases contain carbon monoxide that is odorless, colorless and extremely hazardous to personnel when discharged in a closed area.

1-13. BATTERY.

WARNING

Danger - Battery contains sulfuric acid and may cause explosive gases when electrolyte has been added.

1-14. Make sure dry charged battery is activated strictly according to provided instructions. Because electrolyte is concentrated acid and must be handled with great care as it will blister the skin and damage the clothing, it is advisable to wear goggles, rubber gloves and a protective apron when working with it.

1-15. Neutralize acid electrolyte spilled on clothing, dilute ammonia water or a water solution of baking soda. If acid gets on clothes, dilute it with clean water first, then neutralize. If for any reason acid electrolyte should be spattered in the eyes, wash out immediately with large amounts of water cupped in the hands. Seek medical aid.

CAUTION

Make sure battery polarity is checked before connecting cables, red clamp to positive pole and black clamp to negative pole or ground. Reversed battery connections may damage components of the charging system.

Table 1-1. Leading Particulars

Manufacturer	Prosser-East Division Purex Industries, Inc.
Part Number	PE-250
Component Identification No	018740002
Pump Characteristics	
Capacity	250 gpm
Pressure	100 psi
Speed.....	5, 100 rpm
Suction Lift	
Manual with Eductor	50 feet
Maximum Pump Prime	20 feet
Rated Pump Prime	16 feet
Engine Characteristics, Kawasaki Model TA-440A	
Displacement.....	26.6 cubic inch
Cylinders	2
Cycle	2
Bore and Stroke.....	2.677 x 2.362 inches
Battery	12 volts, 24 amps, 5-1/8 x 7-3/4 x 7-3/3 high (includes terminals) Prestolite type 9943X or Autolite type LU7
Fuel Tank.....	6 U.S. gallons
Overall Dimensions	
Length	24 inches
Width.....	21 inches
Height.....	20 inches
Weight.....	159 pounds

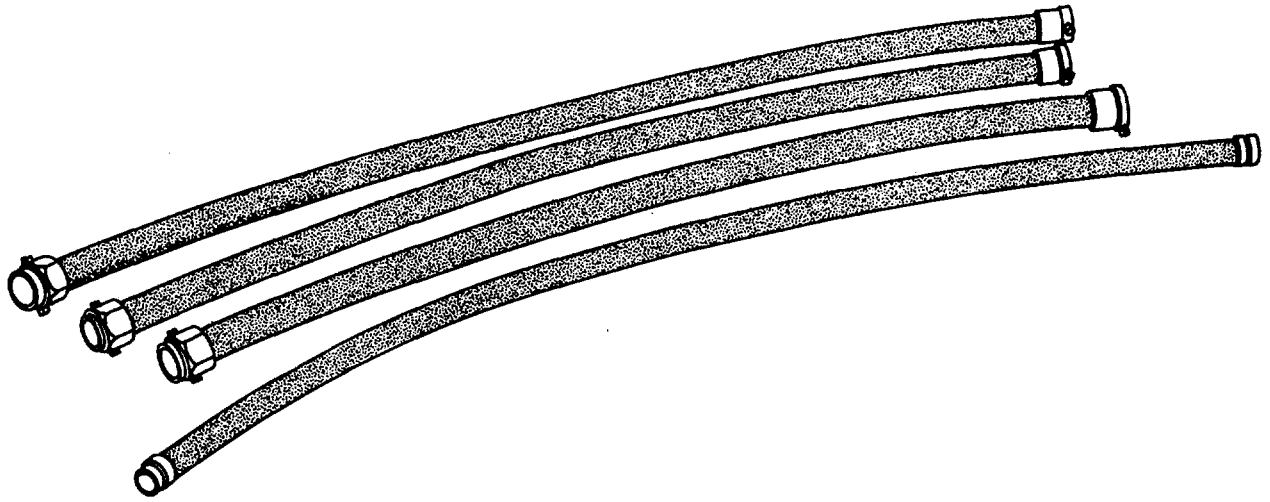


Figure 1-2. Hoses for PE-250 Portable fire Fighting Pump

Table 1-2. Equipment and Accessories Supplied

Qty	Item Name	Dimensions (inches)	Weight Pounds
3	Suction Hose, 10 feet length	3 ID	30/Length
1	Exhaust Hose, 20 feet length	2 ID	25/Length
1	Three-Way Gate Valve	2-1/2 x 1-1/2 x 2-1/2 x 1-1/2	25 each
1	Foot Valve and Strainer	3 ID	18 each
1	Adapter	2-1/2 x 1-1/2	1 each
1	Fuel Tank, 6 gallons capacity, complete	9-1/2 x 18 x 11-1/2	12 each
1	Battery	7-3/4 x 5-1/64 x 7-17/64	20 each

WARNING

Charge battery in ventilated area, because highly explosive gases, hydrogen and oxygen are given off during charging. Precautions must be taken to ensure that no arc, spark, or flame comes into contact with the generated gases particularly at the end of the charging period when it is most hazardous.

1-18. PRIMING PUMP.

CAUTION

Make sure discharge port of priming pump is clear. Blockage of discharge port will cause clogging and malfunction of automatic priming system.

1-16. PUMP.

CAUTION

Do not run pump more than 2 minutes without water flowing in main centrifugal pump. Lack of cooling water could cause severe impeller and exhaust system damage.

1-19. SAFETY PRECAUTIONS.

1-20. These safety precautions are provided to aid in the safe and reliable operation of the PE-250 pump. Read them and become thoroughly familiar with proper operating procedures before operating pump.

1-17. CARBURETOR.

CAUTION

Operating the pump with the carburetor main fuel power screw at too lean or too rich a setting (screwed in or out too far) could cause serious engine damage. Be careful when setting carburetor mixture screws. Do not force the screws into their seats. This could damage the screws and seats of the carburetor. Reference: Paragraph 4-17, Carburetor Adjustment.

1-21. SAFETY AWARENESS.

1-22. Whenever you see the symbol of WARNING or CAUTION, heed their instructions. Always follow safe operating and maintenance practices.

1-23. The warning symbol WARNING identifies special instructions or procedures which, if not correctly followed, could result in personal injury or loss of life.

1-24. The caution symbol CAUTION identifies special instructions or procedures which, if not strictly observed, could result in damage to, or destruction of equipment.

CHAPTER 2 OPERATION

2-1. INTRODUCTION.

2-2. The PE-250 model pump is portable and requires no fixed installation. It is a completely self-contained gasoline engine driven centrifugal fire fighting pump with an electric and manual start

2-3. The electric starting system requires an initial installation of a 12-volt lead-acid storage battery. This battery is shipped in a dry-charged condition, that must be activated with a liquid sulfuric acid electrolyte and booster charged to be operational as the conventional wet battery.

2-4. INITIAL INSTALLATION OF BATTERY

2-5. The dry charge activation instructions are as follows:

WARNING

Read safety precautions first, then carefully unpack battery shipping carton, place battery in vertical position, remove vent caps, remove or destroy any sealing device which may have been used to close or restrict the vent openings.

a. Fill each cell of the battery to the exact level with provided or approved battery electrolyte of recommended specific gravity.

NOTE

Temperature of battery and electrolyte at time of, filling should be above 60 F.

b. Fill with electrolyte until it becomes visible at the bottom of the filling tube.

CAUTION

Place on charge for 10 minutes at a 15 ampere rate. If a fast rate charger is not available, then charge for 1/2 hour at a 7 ampere rate. Adjust level with added electrolyte to top of split ring ledge of battery.

c. After charging, check acid electrolyte level in each cell and fill with acid electrolyte to proper level as required, then reinstall vent caps on all cells.

d. Install new battery in provided pump mounting support bracket. Check to make sure the battery base is seated properly in battery tray part of frame assembly with the (+) positive pole forward toward carburetor. Secure battery via hold down bar placed carefully across the top of battery and secure by tightening anchor bolts wing nuts.

2-6. INSTALLATION OF OPERATION HOSES.

2-7. When ready for use, place the pump in a suitable location for connection of required operating hoses as follows:

a. Suction Hose. Use spanner wrenches and connect suction hoses and foot valve strainer unit. Remove protective cap from suction inlet port of pump and attach 3 inch suction hose

Make sure all connections are clean and tight. Attach rope to the valve release mechanism of the foot valve strainer unit. Carefully lower hoses into water making sure foot valve and strainer are fully submerged and kept fully submerged throughout operating period.

CAUTION

For suction lift greater than 20 feet an eductor must be used. This unit is not supplied by manufacturer.

b. Discharge Hose. Connect discharge hose to meet fire fighting requirement, either 1-1/2 inch diameter or 2-1/2 inch diameter using the three-way gate valve or single adapter attached to discharge port of pump. Discharge hoses are not supplied by pump manufacturer.

c. Exhaust Hose.

WARNING

Do not operate pump in closed area without exhaust hose connected and routed safely to outside fresh air.

CAUTION

Read safety precautions. Make sure exhaust hose and gaskets are tight and sealed properly with no leaks. Exhaust gases are hazardous to personnel.

d. Fuel Line. Connect fuel line to carburetor fuel supply line coupler located below carburetor on mounting plate. Press gas tank priming button until fuel is pumped into the carburetor.

CAUTION

Read safety precautions, mix correct fuel mixture as described in start-up procedures; see paragraph 2-10.

2-8. CONTROLS AND INDICATORS.

2-9. The operator should become familiar with all pump controls and indicators before attempting initial operation. Figures 2-1 through 2-3 illustrate the location of all controls and Indicators used during operating of the pump. Tables 2-1 through 2-3 list these controls and indicators and describe their functions.

2-10. START-UP PROCEDURES.

2-11. AUTOMATIC PRIME.

2-12. Table 2-4 contains step-by-step procedures in tabular form for the automatic priming mode. If the suction lift is 20 feet or less, the automatic priming mode start-up procedures can be used.

CAUTION

For suction lifts greater than 20 feet an eductor must be used. This unit is not supplied by pump manufacturer.

2-13. MANUAL PRIME.

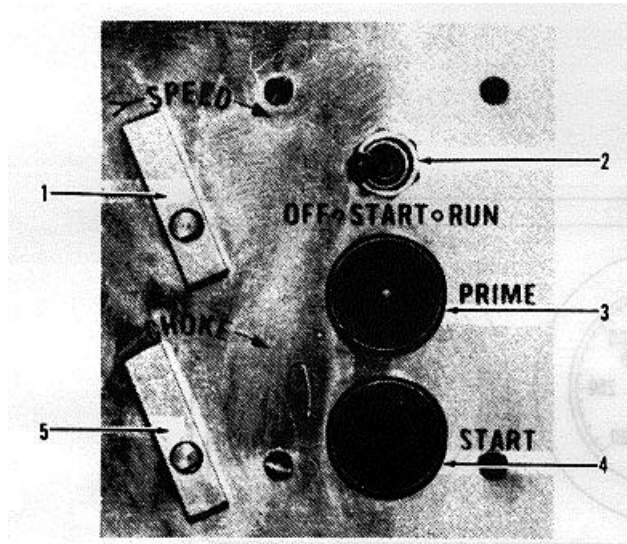
2-14. Table 2-5 contains step-by-step procedures in tabular form for the manual priming mode. If the suction lift is more than 20 feet, the manual priming mode start-up procedures must be used.

2-15. OPERATOR TURN OFF.

2-16. Table 2-6 contains step-by-step turn-off instructions in tabular form.

2-17. EMERGENCY START-UP.

2-18. If the battery fails to start the engine, perform the manual start-up procedures in table 2-7 or 2-8.

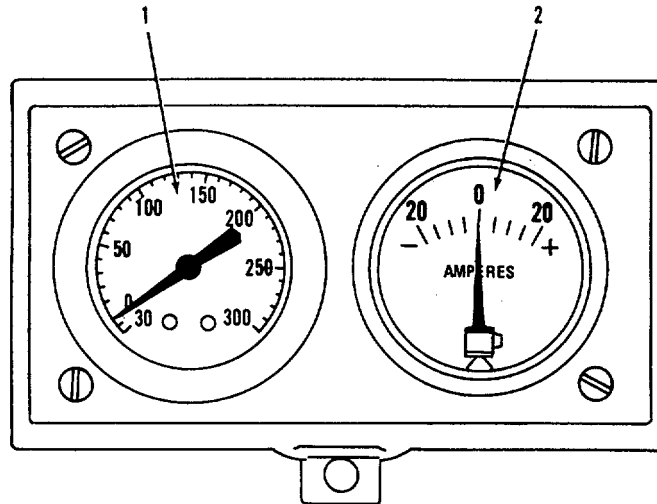


1. Speed Control
2. Off-Start-Run Switch
3. Priming Pushbutton
4. Start Pushbutton
5. Choke control

Figure 2-1. Engine Control Panel

Table 2-1. Engine Control Panel Controls

Figure & Index No.	Name	Type	Function
2-1-1	SPEED	Linkage from engine control panel to carburetor	Controls the speed of the engine
2-1-2	OFF-START-RUN	3-position spdt toggle switch	Switches engine off to OFF position, allows engine to start in START position and allows engine to run in RUN position which prevents over speed of the engine in the event the prime is lost.
2-1-3	PRIME	Pushbutton switch	When depressed, pump is in priming mode.
2-1-4	START	Pushbutton switch	With OFF-START-RUN switch in START position and START pushbutton depressed, engine is in starting mode.
2-1-5	CHOKE	Linkage from engine control panel to carburetor	Controls carburetor fuel mixture.



1. Pump Pressure Gage
2. Ampere Gage

Figure 2-2. Gage Panel Indicators

Table 2-2. Indicators

Figure & Index No	Name.	Type	Function
2-2-1	PUMP PRESSURE GAGE	0 to 30 vacuum and 0 to 300 psi pressure compound gage	Indicates pump pressure, or pump vacuum when priming.
2-2-2	AMPERE GAGE	20, 0, 20 ampere gage	Indicates whether alternator is charging or discharging.

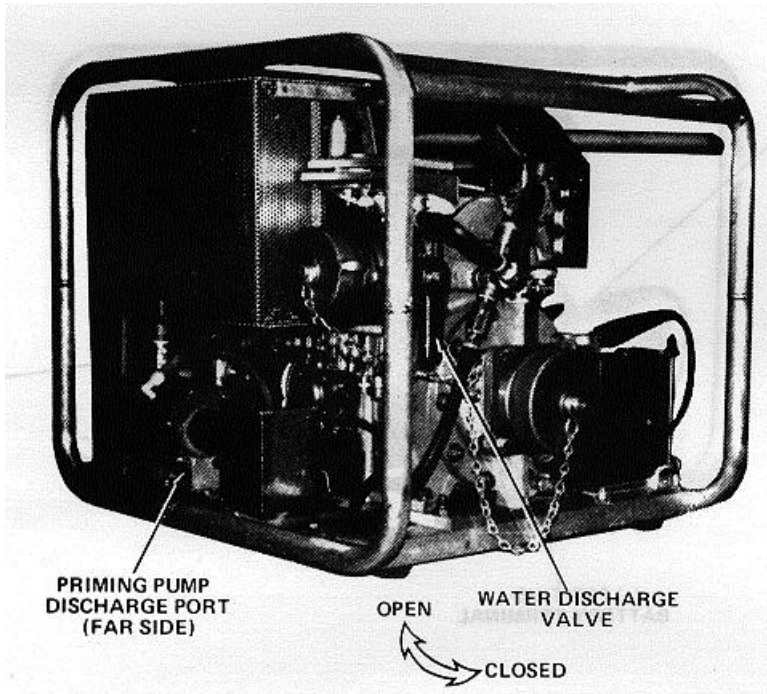


Figure 2-3. Fire Pump Controls (Sheet 1 of 3)

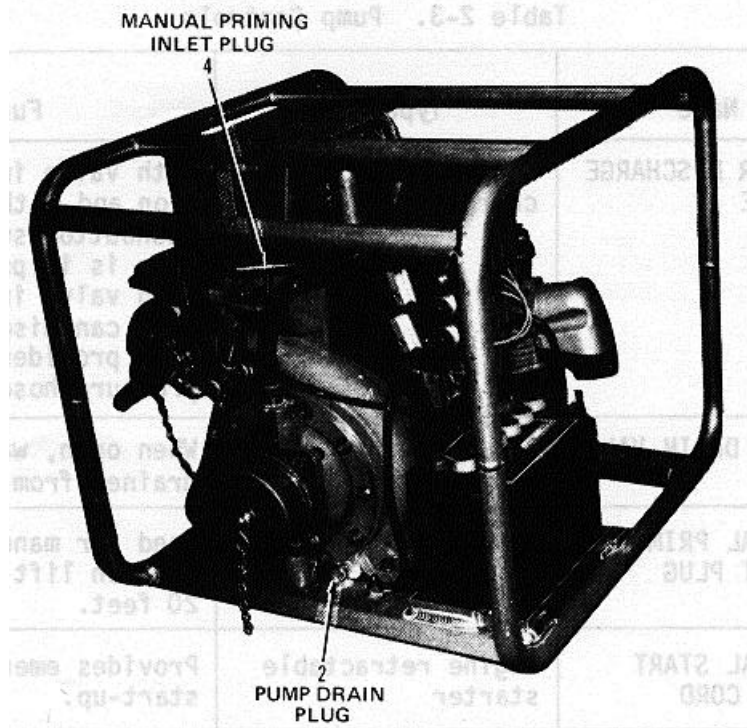


Figure 2-3. Fire Pump Controls (Sheet 2 of 3)

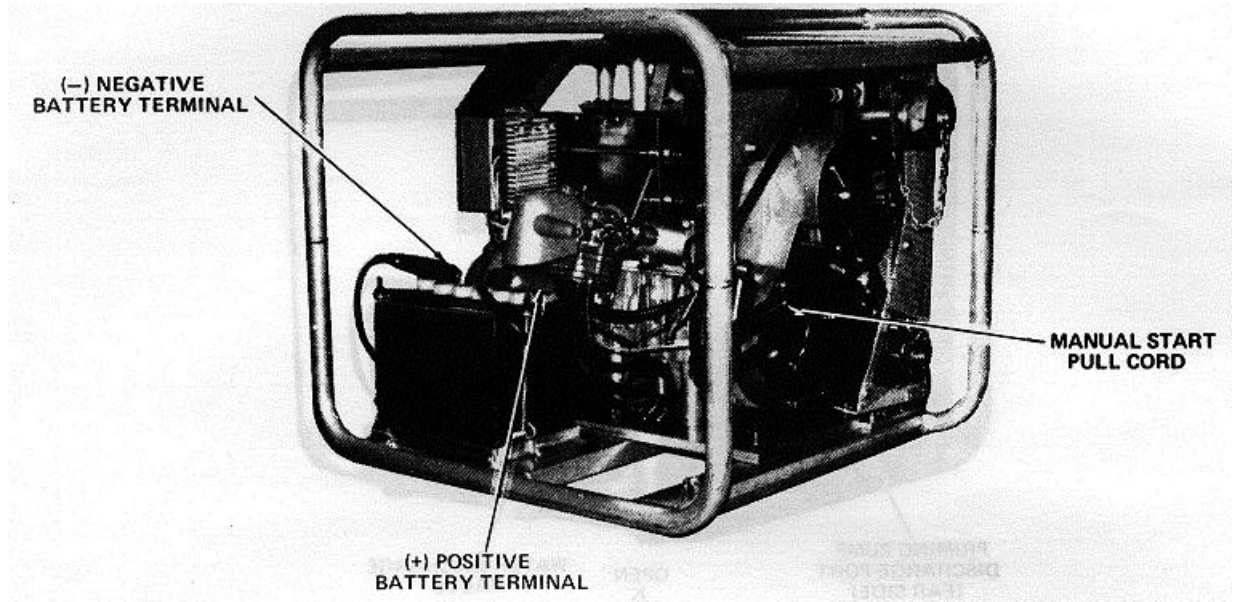


Figure 2-3. Fire Pump Controls (Sheet 3 of 3)

Table 2-3. Pump Controls

Figure & Index No.	Name	Type	Function
2-3-1	WATER DISCHARGE VALVE	2 x 2-112 inch discharge valve	With valve in CLOSED position and with PRIME pushbutton switch depressed, pump is in priming mode. With valve in OPEN position pump can discharge water. Also provides connection of pressure hoses.
2-3-2	PUMP DRAIN VALVE	1/8 NPT drain valve	When open, water can be drained from pump.
2-3-4	MANUAL PRIMING INLET PLUG	Manual priming inlet	Used for manual priming when suction lift is greater than 20 feet.
2-3-5	MANUAL START PULL CORD	Engine retractable starter	Provides emergency engine start-up.

Table 2-4. Automatic Priming. Start-Up Procedures

Step	Figure & Index No.	Observe
1. Clear discharge port of priming pump	2-3-2	
2. Fill gas tank with mixture of 2 cans of BIA-TC-W Oil (NSN 9150-00-117-8791) and 6 gallons of 90 octane gasoline.		Make sure gasoline and oil are mixed thoroughly into a blended fuel. Check that fuel line is clear of any obstruction from tank to pump by removing fuel line at carburetor and operating the priming device.
<p><u>CAUTION</u></p> <p>Before each start, shake or agitate the tank thoroughly, to mix the lubricating oil and gasoline. Press gas tank priming button until fuel is pumped into the carburetor.</p>		
3. Refer to paragraph 2-5 and make sure that strainer foot valve is installed to the bottom of the suction hose.		
4. Connect battery cables.	<p>2-3-6</p> <p>2-3-7</p> <p><u>CAUTION</u></p> <p>Read safety precautions. Reversed battery connections may damage components of the charging system.</p>	Make sure (+) positive red cable is clamped on (+) positive pole next to carburetor and (-) negative black cable is clamped on (-) negative pole next to main. pump suction inlet.
5. Place OFF-START-RUN switch in START position.	2-1-2	

Table 2-4. Automatic Priming Start-Up Procedures (Continued)

Step	Figure & Index No.	Observe
6. Advance SPEED control slightly to clockwise direction, 1/4 full throttle.	2-1-1 2-1-5 <p style="text-align: center;">NOTE If engine is cold it is necessary to advance CHOKE control in the clockwise direction, fully closed then 1/2 open as engine starts and fully open for running.</p>	
7. Depress and hold START pushbutton until engine starts. Adjust choke and speed controls as required.	2-1-4 <p style="text-align: center;">CAUTION Do not allow pump to run more than 2 minutes without water flowing. Lack of cooling water could cause severe impeller</p>	That engine is rotating when starter is energized.
8. Rotate water discharge valve counterclockwise to fully CLOSED position.		That valve is completely closed and seated properly.
9. If suction lift is 20 feet or less, push in and keep firm continuous pressure on prime pushbutton until pump is primed.	2-3-2	That water is discharged from priming pump and pressure is indicated on gage.
10. Open slowly by rotating water discharge valve clockwise until indicating pressure on gage and advance speed control as required.	2-3-1	That pressure gage indicates the desired pumping pressure.
11. Release PRIME pushbutton after priming pump.	2-3-1	Water is not being discharged from priming pump

Table 2-4. Automatic Priming Start-Up Procedures (Continued)

Step	Figure & Index No.	Observe
12. Place OFF-START-RUN switch in RUN position	2-1-2	Make sure pump engine continues to run Switch to START if engine stops, and check automatic shutdown pressure switch. Replace if pressure gage indicates 20 psi or greater when operating in START position when changing switch from START to RUN position.
13. Rotate CHOKE control to full counterclockwise OFF position	2-1-5	Choke is in OFF position.

Table 2-5. Manual Priming Start-Up Procedures

Step	Figure & Index No.	Observe
1. Fill gas tank with mixture of 2 cans of BIA-TC-W-Oil (NSN 9150-00-117-8791) and 6 gallons of 90 octane gasoline.		Make sure gasoline and oil are thoroughly into a blended fuel. Check that fuel line is clear of any obstructions from tank to pump.
<p>CAUTION</p> <p>Before each start, shake or agitate the tank thoroughly, to mix the lubricating oil and gasoline. Press gas tank priming button until fuel is pumped into the</p>		
2. Refer to paragraph 2-6, and make sure that strainer foot valve is installed to the bottom of the suction hose.		
3. Unscrew and remove manual prime inlet plug from manual priming inlet.	2-3-4	Inspect plug and seal for corrosion or dirty threads. Clean if required.

Table 2-5. Manual Priming Start-Up Procedures (Continued)

Step	Figure & Index No.	Observe
4. Fill pump with water until manual filler cup is full, then replace plug in manual priming inlet.		Make sure manual priming inlet plug is seated properly, sealed tight with no leaks.
5. Place OFF-START-RUN switch in START position.	2-1-2	
6. Advance SPEED control slightly in the clockwise direction, 1/4 full throttle.	2-1-1	
<p>NOTE</p> <p>If engine is cold, it is necessary to advance CHOKE control in the clockwise direction, fully closed, then 1/2 open as engine starts, and fully open for running.</p>		
7. Depress and hold START pushbutton until engine starts. Adjust choke and speed controls as required.	2-1-4	That engine is rotating when starter is energized.
<p>CAUTION</p> <p>Do not allow pump to run more than 2 minutes without water flowing.</p>		
8. Open water discharge valve slowly and advance engine speed control as required to attain desired pumping pressure.		That water is discharged from water discharge valve or discharge hose and that pressure gage indicates the desired pumping pressure.
9. Place OFF-START-RUN switch in RUN position.	2-1-2	Make sure pump engine continues to run. Switch to start if engine stops, and check automatic shutdown pressure switch. Replace if pressure gage indicates 20 psi or greater when operating in start position when changing from start to run position.
10. Rotate CHOKE control to full counterclockwise position.	2-1-5	

Table 2-6. Turn-Off Instructions

Step	Figure & Index No.	Observe
1. Rotate SPEED control to full counterclockwise OFF position.	2-1-1	That engine speed decreases, or engine stops
2. Place OFF-START-RUN switch in OFF position	2-1-2	That engine shuts off and stops completely.
3. Open pump drain valve fully counterclockwise. Keep open until drained.	2-3-3	That pump drains water from drain valve port at the base of main pump.
4. Flush the pump with fresh water in accordance with the procedure described in Chapter 4, paragraph 4-7.		
5. Disconnect hoses from pump.		Inspect condition of hoses, couplings and threads. Repair as required.

Table 2-7. Manual Start-Up Procedures for Automatic Priming Mode

Step		Observe
1. Perform steps 1, 2, 3, 5, and 6 of Table 2-4.		
2. Pull the retractable starting rope in a quick steady motion until the engine starts.		That engine is rotating when rope is pulled.
<p>CAUTION Do not allow pump to run more than 2 minutes without water flowing.</p>		
3. Perform steps 8, 9, 10, 11, 12, and 13 of Table 2-4.		

Table 2-8. Manual Start-Up Procedures for Manual Priming Mode

Step		Observe
1. Perform steps 1 through 6 of Table 2-5.		
2. Pull the retractable starting rope in a quick steady motion until the engine starts.		<p>That engine is running when rope is pulled.</p> <p style="text-align: center;">CAUTION Do not allow pump to run more than 2 minutes without water flowing.</p>
3. Perform steps 8 through 10 of Table 2-5.		

CHAPTER 3 FUNCTIONAL DESCRIPTION

3-1. DESCRIPTION. (See figure 3-1.)

3-2. The pump consists of a 2-cylinder, 2-cycle, 42 HP engine, single stage centrifugal pump, priming pump, 3-way gate valve, fuel tank, foot valve and strainer, suction hose, and exhaust hose. The purpose of the pump is to draw water from the sea (or other sources) and pump it through suitable hoses and nozzles under high pressure to combat fire. The pump can also be used for large volume pumping at low pressure as in the case of damage control work.

3-3. GASOLINE ENGINE.

3-4. The PE-250 pump, 2-cycle air-cooled gasoline engine, is an axial fan-cooled twin cylinder engine of the loop-scavenged third port type. It uses a mixture of gasoline, oil and air for combustion, lubrication and cooling. It fires on every stroke for every revolution of the crankshaft. See figure 3-3.

3-5. As the piston moves upward in the cylinder it draws the fuel/air mixture into the crankcase through the intake manifold while at the same time compressing fuel that has been forced into the combustion chamber. See figure 3-2, view A.

3-6. As the piston nears top dead center the spark plug is fired and the compressed fuel/air mixture burns and expands, thereby forcing the piston downward on a power stroke.

3-7. As the downward stroke of the piston turns the crankshaft, it also starts to compress the fuel/air mixture in the crankcase and simultaneously, opens the exhaust port and closes the intake port. See figure 3-2, view B and C.

3-8. After the exhaust port is fully closed, further piston travel starts to open the transfer ports. The compressed fuel/air mixture from the crankcase then travels up the transfer ports and into the combustion area. See figure 3-2, view D.

3-9. After most of the burned exhaust gases have left the cylinder, an incoming charge of fuel/air mixture scavenges the combustion area giving it a fresh charge and the cycle is then repeated.

3-10. Because lubrication is dependent on the mixing of oil and fuel, it is extremely important that good quality oil and gasoline are properly mixed. The proper ratio of oil to gasoline will prevent possible engine overheating, piston or cylinder scoring, or eventual engine seizure. Too much oil and not enough gasoline can lead to incomplete combustion, fouled plugs, carbon build-up, and muffler clogging.

3-11. ELECTRIC STARTER.

3-12. The engine has a Bendix type electric starting motor. Energy for cranking the starting motor is provided by a 12-volt battery. As the starter spins, a pinion engages on ring gear on the crankshaft assembly.

3-13. RETRACTABLE STARTER.

3-14. The retractable starter consists of a rope attached to a starter pulley which is, in turn, connected by spring-loaded dogs to a starter cup located on the crankshaft assembly. When the starter rope is pulled, the starter pulley rotates. This rotation increases the spring tension applied to the dogs and the dogs engage the starter cup.

While the dogs are engaged in the starter cup, the torque applied to the starter pulley is transmitted directly to the engine flywheel.

3-15. As soon as the engine starts, the starter rope is allowed to return into the starter housing, The starter pulley is also spring-loaded and rewinds the starter rope in preparation for the next start. At the same time, the pulley releases the tension applied to the dogs and allows them to disengage from the starter cup. After the engine has started, the starter pinion disengages from the ring gear.

3-16. IGNITION SYSTEM.

3-17. The capacitor discharge ignition (CDI) system consists of a flywheel with four magnets evenly spaced about the circumference and a stator. The stator serves as a mount for three coils. The exciter coil charges the capacitor in the CDI igniter; the pulser coil signals the CDI igniter to fire the spark plugs (both spark plugs fire simultaneously); and the lighting coil supplies current to the voltage regulator. See figure 7- 8.

3-18. As the flywheel rotates, an alternating current is Induced in the coils mounted on the stator. See figure 7-8.

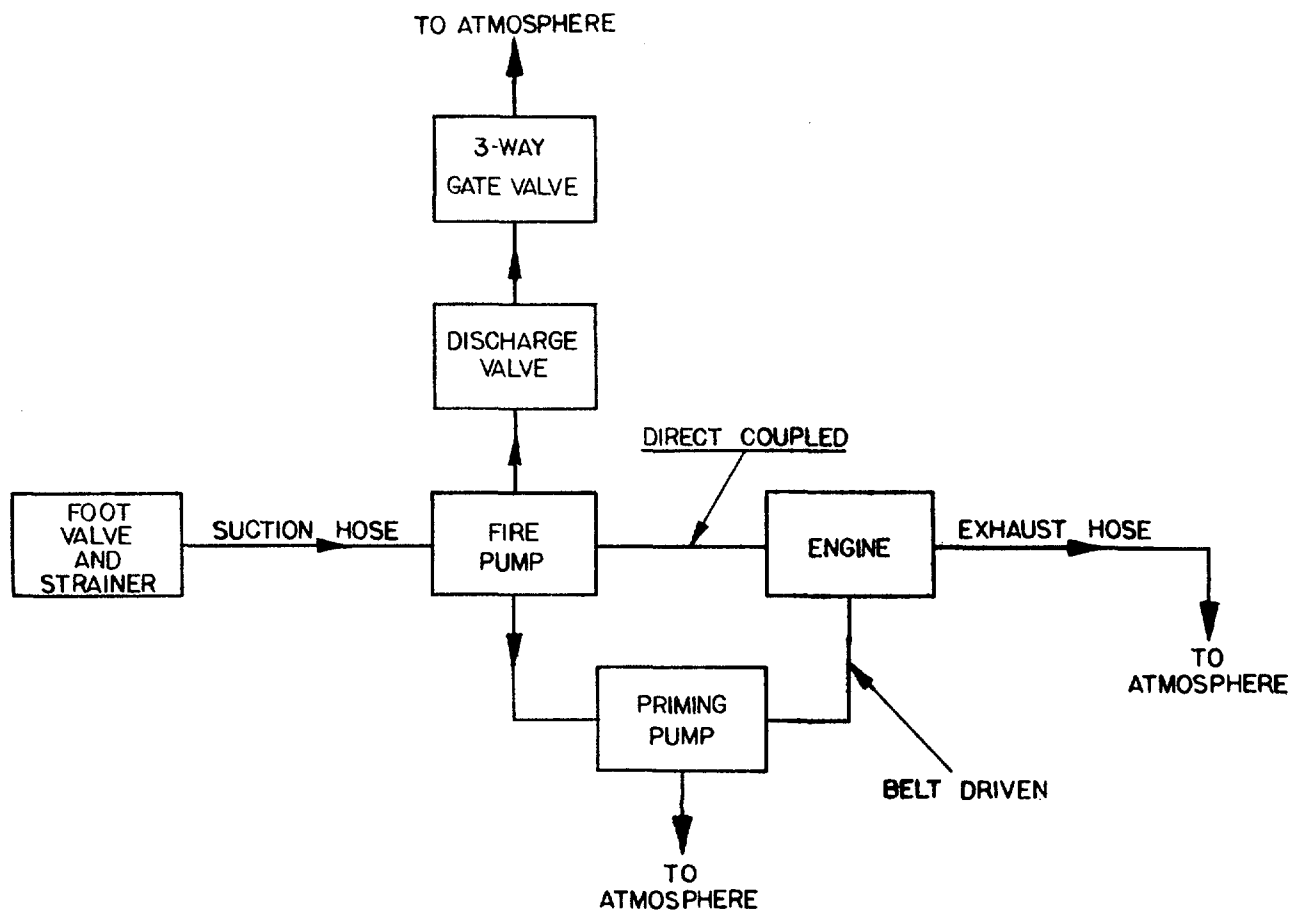


Figure 3-1. Block Diagram

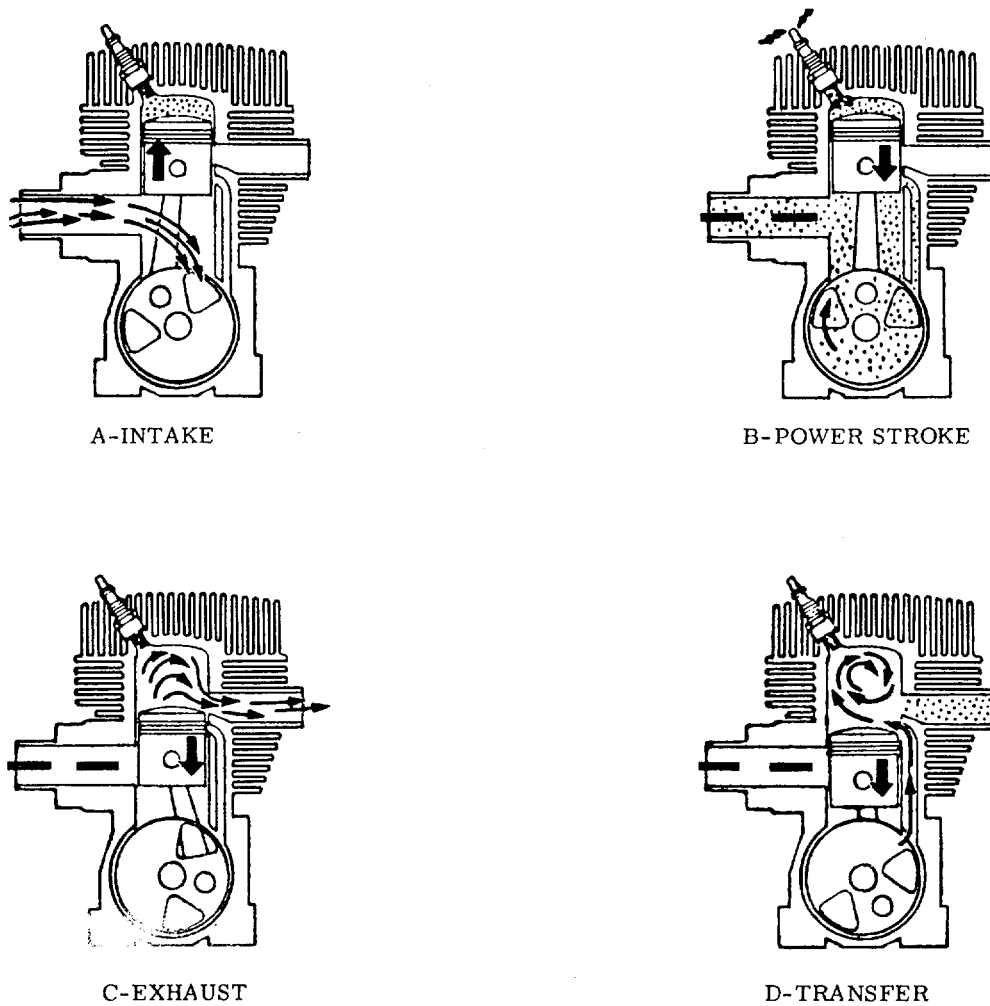


Figure 3-2. Functional Description Gasoline Engine

3-19. The CDI igniter capacitor stores the charge generated by the exciter coil. The amount of charge the exciter coil gives the capacitor effects the intensity of the spark. Current generated by the pulser coil causes the capacitor in the CDI igniter to release its stored charge to the ignition coil. The ignition coil primary induces a high

voltage in the secondary winding, and causes a spark to Jump across the spark plug electrodes. This sequence occurs twice every rotation of the flywheel. The pulser coil has no effect on the intensity of the spark. Its sole purpose is to signal the capacitor when to release its charge to the ignition coil. See figure 7-8.

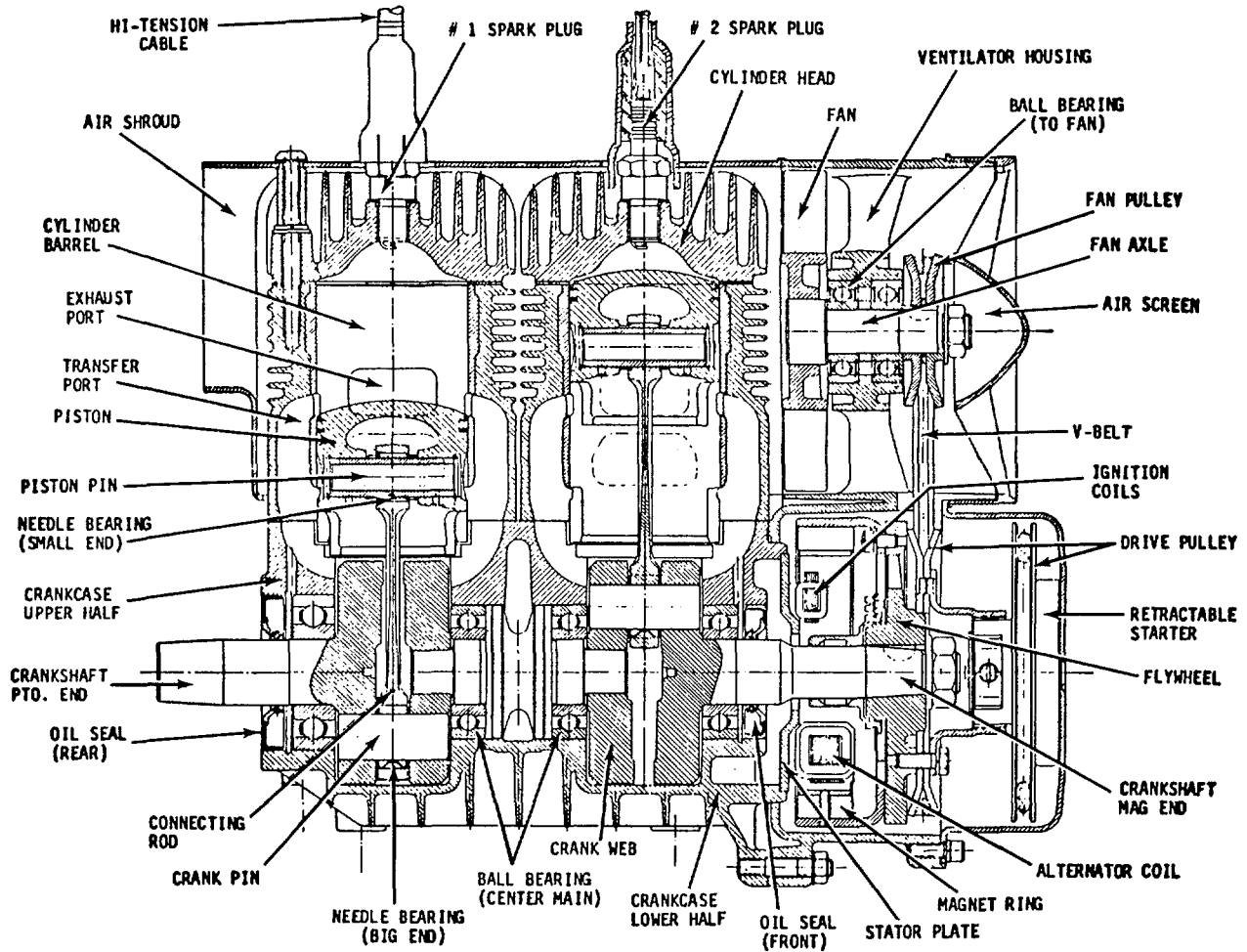
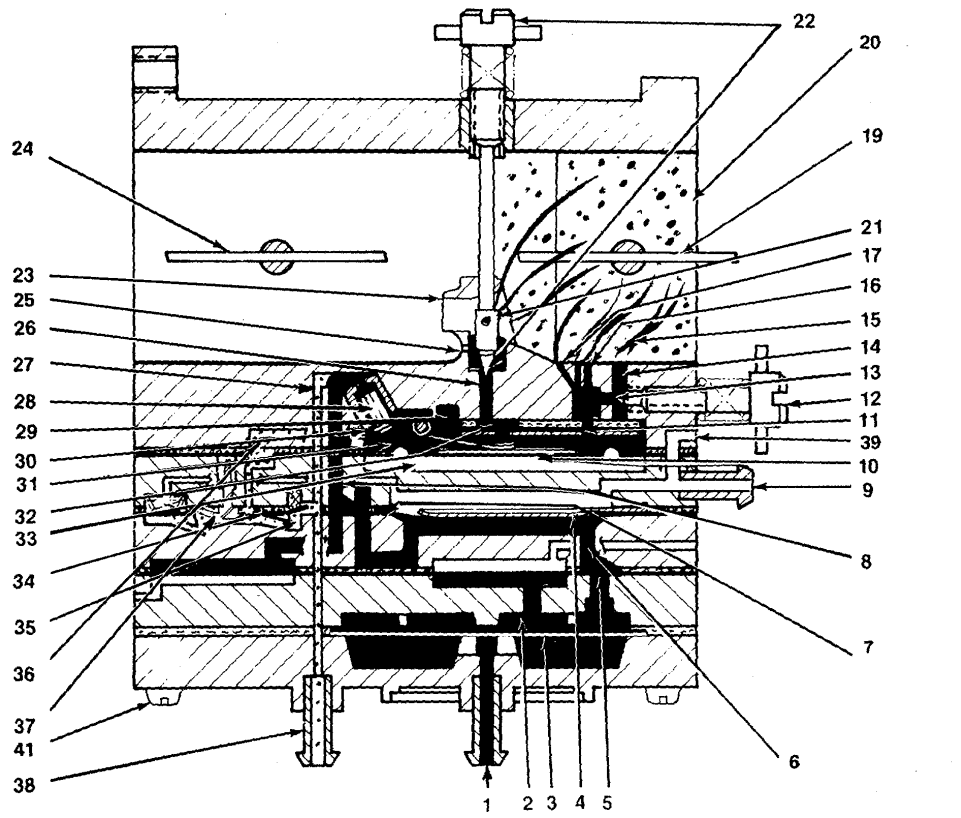


Figure 3-3. Engine Cross Section

3-20. CARBURETOR. (See figure 3-4.)

3-21. Fuel from the gas tank is drawn in the fuel inlet (1) into the surge chamber (2) through the filter screen (3) by pulsations of the fuel pump diaphragm (4). The engine crankcase pulsations transmitted through the external impulse fitting (9) or internal impulse hole (39) actuates the fuel pump diaphragm (4) which supplies pumping action for the fuel pump. The fuel is drawn from the surge chamber through the check valve (5) and the inlet channel (6). The fuel continues past the fuel pump outlet check valve (7) and into the

outlet channel (8). Fuel continues through outlet channel (8) and to the needle valve (28). The metering lever spring (29) transmits a force through the metering lever (30) and seats the inlet needle valve (28) against pressure. The metering diaphragm (10) is pulled upward by engine suction which is transmitted through the idle discharge port (14) secondary idle holes (16) and port throttle feed holes (17). The diaphragm action depresses the metering lever (30) and unseats the needle valve (28) and allows the fuel to enter the metering diaphragm chamber (31) and passes through the idle take



- | | |
|------------------------------|-----------------------------------|
| 1. Fuel Inlet | 21. Main Nozzle |
| 2. Surge Chamber | 22. Power Needle |
| 3. Filter Screen | 23. Venturi |
| 4. Fuel Pump Diaphragm | 24. Choke Valve |
| 5. Check Valve | 25. Air Bleed Nozzle |
| 6. Inlet Channel | 26. Passage |
| 7. Outlet Check Valve | 27. Vapor and Fuel Return Channel |
| 8. Outlet Channel | 28. Needle Valve |
| 9. Impulse Fitting | 29. Metering Lever Spring |
| 10. Metering Diaphragm | 30. Metering Lever |
| 11. Idle Take Off | 31. Metering Diaphragm Chamber |
| 12. Idle Needle | 32. Check Valve |
| 13. Idle Pocket | 33. Chamber |
| 14. Idle Discharge Port | 34. Chamber |
| 15. Point | 35. Outlet Valve |
| 16. Secondary Idle Holes | 36. Channel |
| 17. Port Throttle Feed Holes | 37. Check Valve |
| 18. Passage | 38. Vapor Return Line Fitting |
| 19. Throttle Valve | 39. Internal Impulse Hole |
| 20. Throttle Bore | 40. Secondary Fuel Pump |
| | 41. Cover Plate Screws |

Figure 3-4. Carburetor, Cross Section View

off (11). Check valve (32) is forced open passing fuel into the main nozzle (21) which also feeds the port throttle feed holes (17). Fuel is only fed through all discharge holes.

3-22. At high temperature fuel vaporizes and collects in outlet channel (8) and metering diaphragm chamber (31). As fuel is pumped past the fuel pump diaphragm (4) through outlet channel (8) to the needle valve (28) some fuel and vapor is pumped into channel (27) and out the fuel and vapor return line fitting (38). Vapor in the metering diaphragm chamber (31) is pumped by a secondary fuel pump (40), through channel (36) past check valve (37) into chamber (34) through the outlet valve (35) into the vapor and fuel return channel (27) and out the vapor return line fitting (38).

3-23. At port throttle, in addition to the fuel fed into the throttle bore by the idle system, more fuel enters past the check valve (32) through passage (26) around the power needle (22) and through the passage (18) and discharged into the throttle bore (20) through the port throttle holes (17). All ports except the main nozzle feed progressively as the throttle valve (19) opens for smooth acceleration. Air is intermixed through air bleed nozzle (25).

3-24. During full throttle operation fuel flows past the power needle (22) and into the primary (gunsight) venturi (23) at the main nozzle (21). The fuel 3-6 air mixture from the venturi (primary) picks up additional fuel as it flows past the secondary idle holes (16). The

carburetor provides immediate fuel response at wide open throttle.

3-25. CRANKCASE AND PISTONS.

3-26. Combustible vapor from the carburetor is inducted into the crankcase. As one piston reaches the bottom of its power stroke, the vapor is compressed and forced through the inlet ports into the cylinders. This action drives out the burned gases which were previously ignited during the last power stroke, and leaves the cylinder charged with a new supply of combustible vapor. The burned gases are driven through the exhaust ports into the exhaust system where they are cooled by a spray of water.

3-27. As the piston starts its upward stroke, the inlet and exhaust ports are closed, and the vapor trapped within the cylinder is compressed in preparation for the next power stroke. Engine cooling is accomplished by a fan which is coupled to a pulley that is driven by a sheave on the crankshaft.

3-28. FIRE PUMP AND PRIMING PUMP. (See figures 3-5 and 7-1.)

3-29. FIRE PUMP, DISCHARGE VALVE AND MANUAL PRIMING.

3-30. The fire pump impeller is enclosed within the pump housing and is mounted on the crankshaft. The impeller is

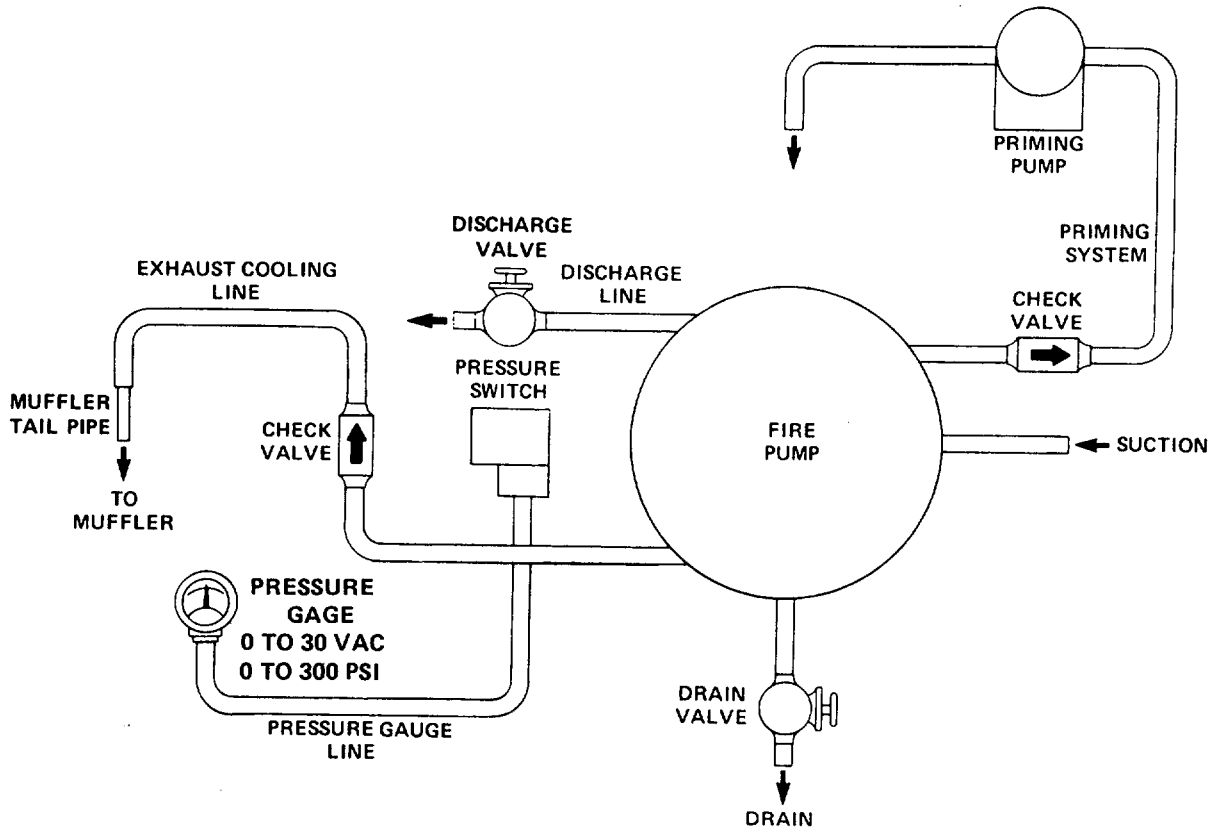


Figure 3-5. Water System, Schematic

secured by a bolt and behind the impeller is a water seal which prevents water from leaking out of pump housing. Water is drawn into the pump housing when air is evacuated from the housing and the suction hose by the action of the priming pump. As water is drawn into the pump housing the impeller throws the water outward, creating pressure within the impeller housing. A pressure gage is provided to measure the pump discharge pressure.

3-31. The water discharge valve is a ball type water outlet valve which is located in the discharge opening of the pump housing. The discharge valve consists of a ball with a hole through it. Pressing against the ball is a plastic sleeve, which helps channel water from the ball to the discharge line, when the ball is in the open position. When the ball is in the closed position, turned 90 degrees, the plastic sleeve presses against the ball sealing the discharge passage against the entry of air and preventing discharge of water.

3-32. The water discharge valve should always be closed when starting the pump to prevent air from entering the pump housing during priming and to permit pump pressure to build up properly. This ensures that the fire pump is completely primed. When water is discharged from the priming pump the water discharge valve should be opened slowly and water will be available in the discharge line. At this time the priming button can be released. The water discharge valve is used to regulate the flow through the pump and also the pressure at the pump. With the engine running at full throttle it may be necessary to close the valve slightly to restrict the flow to 250 gpm and maintain the pressure at 100 psi. The engine controls will not automatically regulate the flow and pressure.

3-33. The discharge hose (not supplied with pump) is screwed onto the discharge valve and the suction hose to the intake side of the pump housing.

3-34. The manual priming consists of priming bowl and

plug in the pump housing. Its function is to allow water to be poured into the pump housing to prime the fire pump when lifting water greater than 20 feet. While the pump is operating, the plug should be securely in place.

3-35. PRIMING PUMP AND CLUTCH.

3-36. The priming pump is a rotary vane type pump. The magnetic clutch is mounted on the priming pump shaft. The priming pump is driven by a sheave, part of the magnetic clutch, which is driven by the engine fan belt.

3-37. The intake side of the priming pump is connected to the intake side of the fire pump. There is a check valve in this line to prevent air from being sucked through the priming pump once the pump has been pressurized.

3-38. With the engine running, water discharge valve closed, and the prime pushbutton depressed, the magnetic clutch is engaged and the priming pump evacuates the air from the fire pump housing and the suction hose. If priming pressure is lost, a pressure switch located on the discharge side of the fire pump will automatically stop the engine. The pressure switch is preset for 10 to 15 psi.

3-39. FOOT VALVE AND STRAINER.

3-40. The foot valve and strainer is attached to the end of the suction hose. The foot valve consists of a strainer, a housing, and a flapper valve, which is spring loaded to the closed position. This allows water to enter the suction hose freely, but the closure of the foot valve prevents water from draining back, thus keeping the fire pump properly primed if it should be temporarily shut down. The strainer prevents large foreign matter from entering the intake and damaging the fire pump.

CHAPTER 4

SCHEDULED MAINTENANCE

4-1. INTRODUCTION.

maintenance and overhaul based upon a life cycle schedule. Scheduled maintenance also includes shorebased maintenance, performance testing and quality control over all maintenance actions performed.

4-2. This chapter provides scheduled maintenance procedures for shipboard and tender or shorebased

Section I. LIFE CYCLE SCHEDULE

4-3. Scheduled maintenance shall be performed according to the life cycle schedule given in table 4-1.

Table 4-1. Pump Life Cycle Schedule

Frequency	Title of Work Item	Applicable Paragraph
After each use with contaminated or salt water	Flush pump with fresh water	4-7
Monthly and after each use	Check water in battery	4-9
Monthly and after each use	Check specific gravity of battery and charge as necessary	4-9
Monthly and after each use	Clean battery terminals and cables	4-9
Annually or when starting is difficult	Inspect spark plugs	4-11
Monthly and after each use	Check fan belt tension	4-13
Monthly and after each use	Check priming pump oil level	4-15
Semi-annually	Adjust carburetor	4-17
Annually or when starting is difficult	Check ignition timing	4-19
Annually	Check water seal	4-21

Section II. OVERHAUL, MAINTENANCE AND REPAIR STANDARDS

4-4. Table 4-2 provides the overhaul, maintenance, and repair standards for all pump parts subject to continuing degradation in service.

Table 4-2. Pump Maintenance Standard

Standard	Component/Part	Part No.	Criteria
Water Pressure	Pump	PE-250	Operating: Capable of withstanding 200 psi without leakage of any kind. Test: Capable of withstanding 200 psi without leakage of any kind.
Water Pressure	Discharge Valve	PE-1244	Operating: Capable of withstanding 200 psi without leakage of any kind. Test: Capable of withstanding 200 psi without leakage of any kind.
Water Pressure	Check Valves	PE-1567 PE-2567 PE-3596	Operating: Capable of withstanding 10 psi without leakage of any kind.
Water Pressure	3-Way Gate Valve	PE-1600	Operating: Capable of withstanding 200 psi without leakage of any kind. Test: Capable of withstanding 200 psi without leakage of any kind.

Section III. SHIPBOARD MAINTENANCE AND OVERHAUL**4-5. SHIPBOARD MAINTENANCE**

4-6. Shipboard maintenance shall be performed as detailed in this section using the life cycle schedule in Section I as a basis. This section contains inspection and checking, cleaning, repair, and replacement of defective parts and reassembly of parts that can be accomplished at the shipboard level of maintenance.

CAUTION

If maintenance procedures or special instructions are not strictly observed, damage to or destruction of PE-250 pump could occur.

4-7. FRESH WATER FLUSH.

4-8. After each use with contaminated or salt water, wash down and flush out the pump with clean, non-contaminated, fresh water as follows:

- a. Mix 2 cans BIA-TC-W service oil (NSN 9150-00-117-8791) and 6 gallons of 90 octane gasoline in fuel tank.
- b. Connect fuel hose to engine.
- c. Connect fittings and hose to suction, discharge, and exhaust connections.
- d. Place suction hose with foot valve and strainer into Fresh Water supply.
- e. Prime pump until full, inspect for leaks.
- f. Shut discharge valve.

WARNING

Ensure exhaust gases discharge to outside atmosphere.

- g. Start engine. Switch to start, advance speed slightly, press start button, choke as needed.
- h. Prime pump; push priming button and hold, when water discharges from priming pump; ensure discharge hose is manned; open water discharge valve slowly.

Release priming button.

NOTE

Primer pump should evacuate air from impeller housing and suction hose in approximately 60 seconds.

CAUTION

Do not operate pump more than 2 minutes unless pressure shows on gage or priming pump discharges water.

- i. Operate pump; switch to run; adjust engine speed to obtain desired discharge pressure.
- j. Operate pump for 1 minute; inspect for leaks, unusual noises and vibrations.
- k. Slow engine speed to idle and push primer button; observe discharge at primer pump; allow primer pump to run for 30 to 45 seconds to flush out; release primer button.
- l. Shut discharge valve.
- m. Stop engine by disconnecting fuel hose and allowing engine to run until excess fuel is burned off.
- n. Depressurize and remove fuel tank.
- o. Check oil level in priming pump oiler; fill if necessary. Switch engine control to off position then push both starter and priming buttons to oil priming for storage. Hold both buttons for approximately 5 seconds. Release buttons.
- p. Disconnect hoses and fittings.
- q. Drain pump by opening pump drain valve fully counterclockwise.
- r. Dry unit, replace caps on all openings; close pump drain valve.
- s. Stow pump hoses and connectors.

4-9. BATTERY MAINTENANCE.

WARNING

Read safety precaution first. Contains sulfuric acid - avoid contact with skin, eyes, and clothing.

4-10. Monthly and after each use, check the water level in the battery and the cleanliness of battery terminals and cables as follows:

- a. Shut down pump in accordance with table 2-6.
- b. Remove vent caps and check individual cell specific gravity.
- c. Place hydrometer in each cell and take reading and recharge if required. The following table provides ranges of specific gravity for a cell of 80 °F (26.70C).

Cold and Temperate Climates

1.265 S.P. Gr.	100 percent charged
1.225 S.P. Gr.	75 percent charged
1.190 S.P. Gr.	50 percent charged
1.155 S.P. Gr.	25 percent charged
1.120 S.P. Gr.	Discharged

Tropical Climates

1.225 S.P. Gr.	100 percent charged
1.185 S.P. Gr.	75 percent charged
1.150 S.P. Gr.	50 percent charged
1.115 S.P. Gr.	25 percent charged
1.080 S.P. Gr.	Discharged

- d. Remove battery from pump if charging is required.
- e. Connect battery to 12V battery charger at 10 ampere hour charging rate or equivalent.
- f. Replace hydrometer in each cell and take reading; continue charge if required.
- g. Check water level in each cell and fill with distilled water, if available, or ordinary tap water as required (see figure 4-1).
- h. Reinstall battery in pump.
- i. Check battery terminals and cables for

cleanliness. If corrosion is indicated, proceed as follows:

- (1) Remove battery cables from terminals.
- (2) Using a wire brush, clean cable terminals and battery terminals.
- (3) Coat battery terminals with grease.

CAUTION

Connect positive battery cable to positive (+) terminal on battery and negative battery cable to negative (-) terminal on battery.

- (4) Reconnect battery cables.

4-11. SPARK PLUGS.

4-12. Annually or when starting is difficult, remove each spark plug (see figure 4-1) and inspect as follows:

- a. Shut down pump in accordance with table 2-6.
- b. Tag pump OUT OF SERVICE.
- c. Remove spark plug cables from spark plugs.
- d. Unscrew and remove spark plugs.
- e. Spark plugs should be replaced if the electrodes are black or white or if porcelain is cracked.

NOTE

Spark plugs whose electrodes are tan in color need not be replaced.

- f. If new spark plugs are required, use Champion RN-3 spark plugs.
- g. Install spark plugs and torque tighten to 20 foot-pounds.
- h. Reinstall spark plug cables.
- i. If the spark plugs were replaced because their electrodes were either black or white, refer to paragraph 4-17 and adjust the carburetor.

4-13. FAN BELT TENSION CHECK AND REPLACEMENT.

4-14. Monthly and after each use, check fan belt tension as follows:

- a. Shut down pump in accordance with table 2-6.
- b. Tag pump OUT OF SERVICE.
- c. Remove fan belt guard by removing the two attaching screws, then remove fan cover (see figure 4-1).
- d. Check fan belt tension by pushing fan belt in at point shown in figure 4-2. Verify that fan belt deflection is 5/32 inch.
- e. Adjust fan belt as follows:

- (1) Loosen the four bolts on the priming pump mounting bracket and the two bolts on the priming pump stabilizer bracket.

- (2) Slide the priming pump out to tighten fan belt.

- (3) When fan belt deflection is 5/32 inch, tighten the four bolts on the priming pump mounting bracket and the two bolts on the priming pump stabilizer bracket (see table 4-3).

- f. If fan belt shows sign of wear or proper tension cannot be obtained, replace fan belt as follows:

- (1) Remove retractable starter by removing three hex head bolts (see figure 4-1).

- (2) Using a spanner wrench, hold fan pulley while removing nut and washer (see figure 4-2).

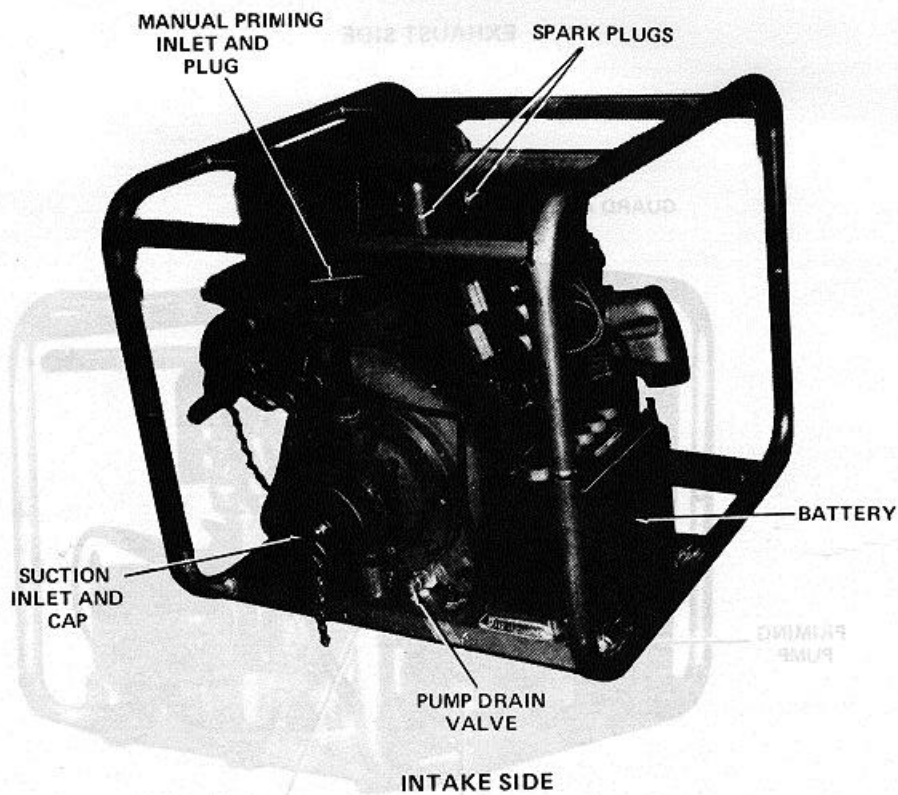
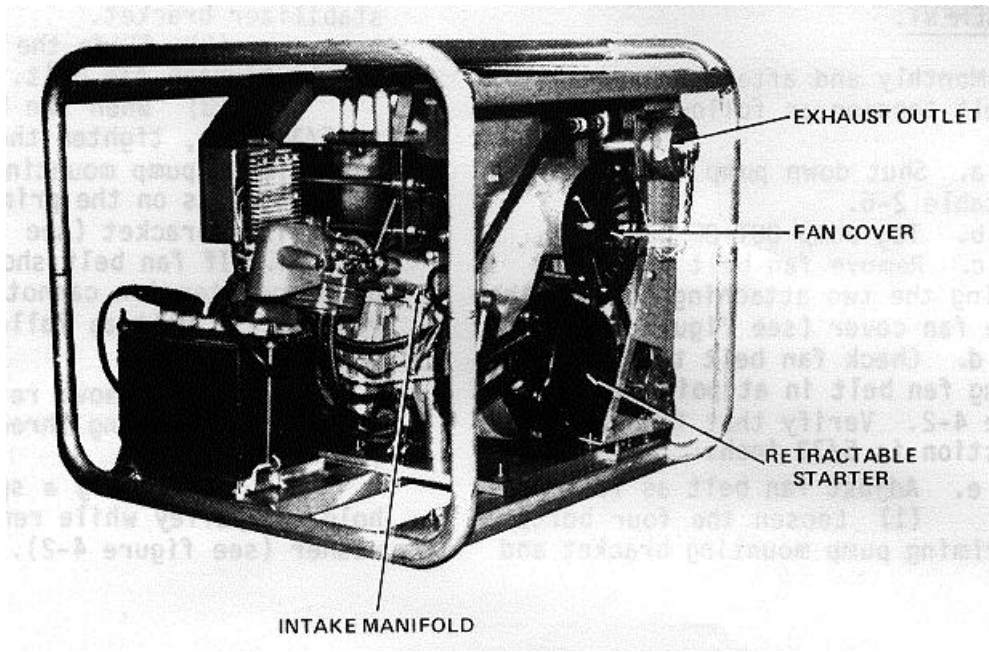


Figure 4-1. Pump (Sheet 1 of 2)



EXHAUST SIDE

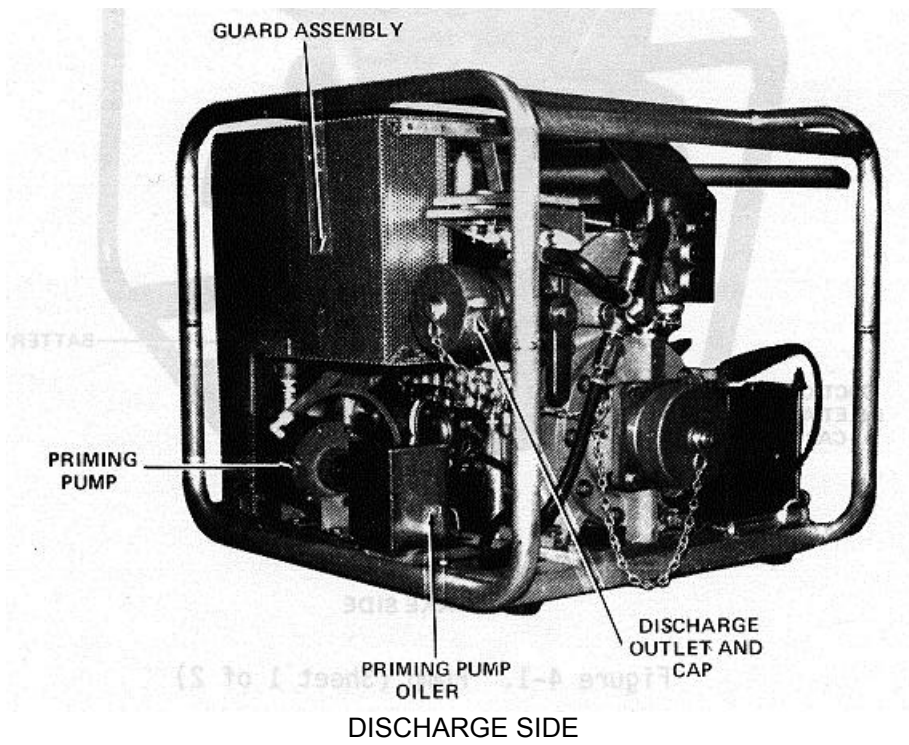


Figure 4-1. Pump (Sheet 2 of 2)

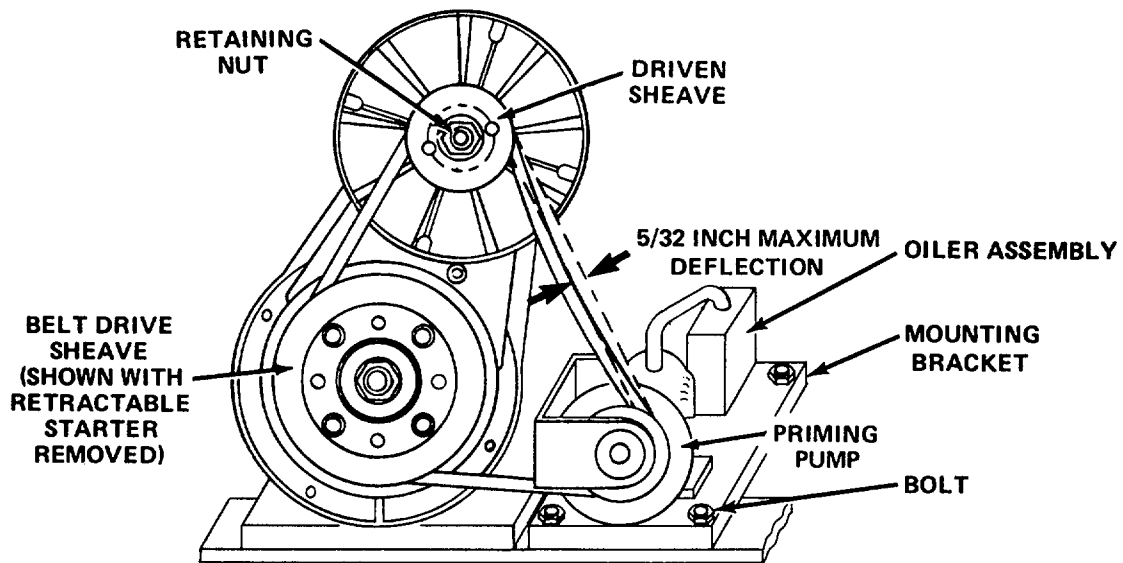


Figure 4-2. Belt Tension and Replacement

(3) Unscrew and remove three hex head bolts and remove starter pulley.

(4) Remove old fan belt and install a new one.

(5) Install starter pulley and secure with three hex head bolts.

(6) Install washer and nut. Torque tighten nut to 35 foot-pounds.

(7) Check belt tension and adjust in accordance with steps d and e, above.

4-15. PRIMING PUMP OIL LEVEL CHECK.

4-16. Monthly and after each use, check the oil level in the priming pump oiler as follows:

- a. Shut down pump in accordance with table 2-6.
- b. Tag pump OUT OF SERVICE.
- c. Check oil level in priming pump oiler (see figure 4-1).

NOTE

The priming pump oiler should be filled full to provide oil for priming operation.

d. If oil level is below full, add oil per Military Specification MIL-L-46152 until oil level reaches full .

4-17. CARBURETOR ADJUSTMENT.

4-18. Twice a year, adjust the carburetor as follows:

- a. Shut down pump in accordance with table 2-6.
- b. Tag pump OUT OF SERVICE.

CAUTION

Fuel adjustment screws must be bottomed lightly. Do not force.

c. Turn idle fuel and main fuel adjustment screws clockwise until they bottom (see figure 7-7).

d. Turn idle fuel and main fuel adjustment screws counterclockwise 1-1/4 turns.

NOTE

The carburetor is now adjusted slightly to the rich side. If a leaner adjustment is required, turn adjustment screws clockwise 1/8 of a turn.

4-19. IGNITION TIMING.

4-20. Annually or when starting is difficult, perform the ignition timing procedure as follows:

- a. Shut down pump in accordance with table 2-6.
- b. Tag pump OUT OF SERVICE.
- c. Remove spark plug wires from spark plugs (see figure 4-1).
- d. Remove retractable starter by removing three hex head bolts (see figure 4-1).
- e. Unscrew and remove three hex head bolts and remove starter pulley.
- f. Twist fan belt out of the way.

CAUTION

When adjusting the stator assembly, take care not to damage the coil windings.

g. Loosen the stator assembly mounting screws through the holes in the flywheel. To correct timing, rotate the stator assembly as required (clockwise to retard the timing; counterclockwise to advance the timing) (see figure 4-3).

h. Tighten the stator assembly mounting screws (see table 4-3).

i. Install lower fan pulley, fan belt, and secure with three hex head bolts.

j. Install retractable starter and secure with three hex head bolts.

4-21. WATER SEAL CHECK. Annually, or when water seal is leaking.

4-22. See figure 7-1, and check water seal as follows:

- a. Shut down pump in accordance with table 2-6.
- b. Tag pump OUT OF SERVICE.

WARNING

Water seal spring loaded.

c. Remove suction head (16) and hose adapter assembly by removing ten nuts (19) and washers (20), screw (17), and washer (18).

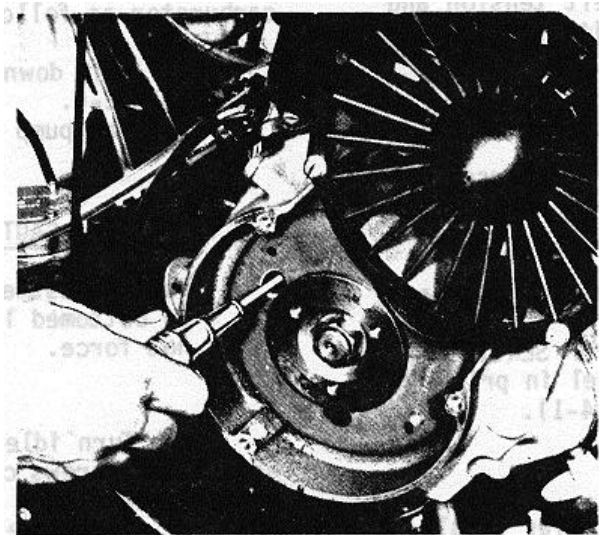


Figure 4-3. Ignition Timing Adjustment

Table 4-3. Torque Table

<p><u>ENGINE</u></p> <p>Mounting Bolts Flywheel Nut Cylinder Head Nuts Spark Plugs Crankcase Bolts</p>	<p>30 foot-pounds 60 foot-pounds 16 foot-pounds 20 foot-pounds 16 foot-pounds</p>
<p>Carburetor Mounting Nuts Intake Manifold Bolts Exhaust Manifold Nuts Fan Shaft Nut Fan Case Mounting Screws</p>	<p>3.5 foot-pounds 5 to 6 foot-pounds 12 foot-pounds 47 foot-pounds 5 foot-pounds</p>
<p>Starter Mounting Bolts Fan Case to Crankcase Mounting Bolts Duct to Engine Screws Stator Assembly Mounting Screws Recoil Starter Drive Plate Nut</p>	<p>16 to 18 foot-pounds 10 to 12 foot- pounds 3 foot-pounds 5 to 6 foot-pounds 8 to 10 foot-pounds</p>
<p>Recoil Starter Pulley Mounting Bolts Recoil Starter Mounting Bolts Carburetor Ram Tube Screws Exhaust Assembly</p>	<p>5 foot-pounds 5 foot-pounds 8 foot-pounds 12 foot-pounds</p>
<p><u>PRIMING PUMP</u></p> <p>Priming Pump Mounting (Belt Tension Adjustment) Priming Pump Assembly Capscrews</p>	<p>7 foot-pounds 7 foot-pounds</p>
<p><u>PUMP</u></p> <p>Cover Nuts Impeller Screw Pump Mounting Bolts</p>	<p>14 foot-pounds 70 foot-pounds 24 foot-pounds</p>

- d. Remove and discard gasket (21).
- e. Remove impeller screw (26), washer (27), and impeller seal (28).
- f. Screw a 5/8-11 x 2-1/2 inches long hex head bolt into impeller (25) until snug, then continue screwing in bolt until impeller comes free.
- g. Remove water seal (29) and inspect for wear and/or defects.
- h. If damage is indicated, install new water seal (29).

i. Reassemble parts in reverse order of disassembly using new gasket (21) and impeller seal (28). Tighten impeller screw (26) to 70 foot-pounds torque, mounting screw (17) to 24 foot-pounds, and cover nuts (19) to 14 foot-pounds.

j. Remove pump OUT OF SERVICE tag upon completion.

4-23. PUMP OVERHAUL.

4-24. Overhaul of the pump should be accomplished on an as required basis. For overhaul instructions, refer to Chapter 6.

Section IV. TENDER OR SHORE-BASED MAINTENANCE AND OVERHAUL

4-25. Not applicable.

Section V. PERFORMANCE TESTING

4-26. The pump shall be performance and leakage tested after overhaul or repair. This section provides the test procedures for the pump.

4-27. EQUIPMENT REQUIRED FOR TESTING.

4-28. Not applicable.

4-29. PERFORMANCE TEST.

4-30. To perform the performance test, proceed as follows:

- a. Operate the pump (refer to paragraph 2-10) at a suction lift of 16 feet.
- b. Verify that the pump pumps 250 gpm at a discharge pressure of 100 psi.
- c. Check piping, valves, and fittings for any indication of leakage.
- d. Replace any leaking component and retest the pump.
- e. Shut down pump in accordance with table 2-6.

4-31. HYDROSTATIC LEAKAGE TEST.

4-32. To perform the hydrostatic leakage test, proceed as follows:

- a. Remove check valve (7) in exhaust cooling line and reinstall it in the opposite direction (see figure 7-4).
- b. Remove check valve (10) in priming system line and reinstall it in the opposite direction (see figure 7-4).
- c. Connect pump to a water pressure source not to exceed 150 psi.
- d. With water pressure applied, open discharge valve until water comes out of discharge valve.
- e. Close discharge valve and allow pressure to rise in pump.
- f. Inspect pump for leakage.
- g. Shut down water pressure to pump.
- h. Replace any leaking component and retest pump.

4-33. TEST SHUT DOWN.

reversing exhaust cooling line and priming system check valves. Upon completion of shut down the pump is operable and ready for service.

4-34. Test shut down after hydrostatic leakage test consists of removing water pressure source and

Section VI. DIAGRAMS

4-35. The diagrams required for scheduled and corrective maintenance, troubleshooting, and for

location of parts are found in Chapter 5 and 6.

CHAPTER 5 TROUBLESHOOTING

5-1. GENERAL.

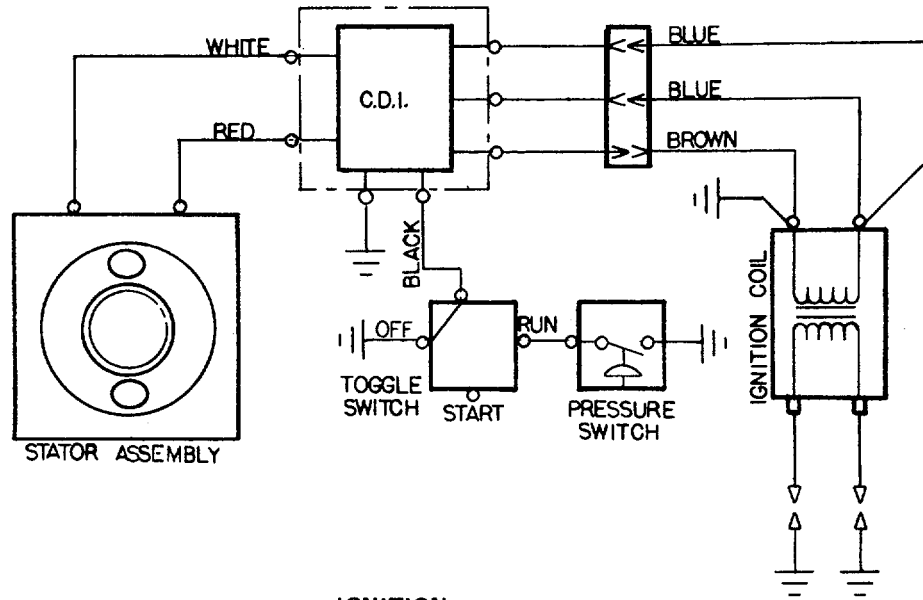
5-2. Table 5-1 lists the troubles that may occur during operation. In tracing faults, an orderly systematic procedure should be followed. The troubleshooting table gives the symptoms of troubles commonly encountered in the left-hand column, the possible causes of these symptoms in the center column and suggested corrective measures in the right-hand column. An electrical schematic and a wiring diagram (figure 5-1) are included in this chapter to assist in tracing faults.

5-3. TROUBLESHOOTING THE IGNITION SYSTEM.

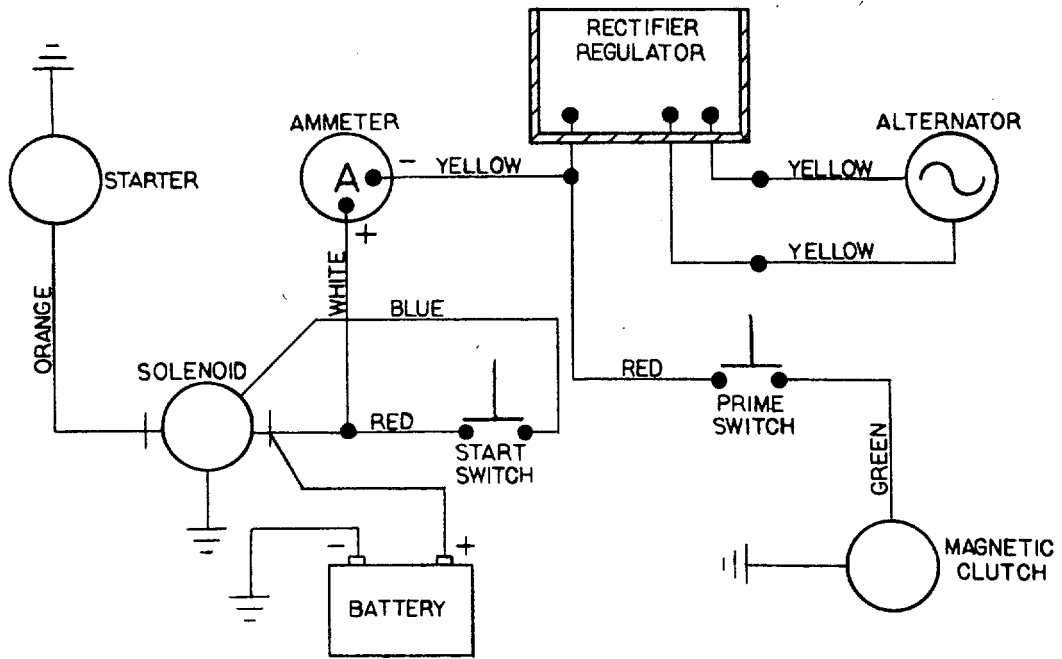
5-4. Remove the spark plug from one cylinder and ground to engine firmly. Reconnect the spark plug wire to the spark plug. Turn the switch to the start position,

then pull the manual starter and check for a spark at the test plug. Test both cylinders in the same manner. If sparks are observed at the plug, for both cylinders, the problem lies elsewhere in the engine (carburetion, timing, or mechanical failure). If a spark discharge is observed at one cylinder but not the other, replace spark plug that does not spark; if results remain the same-the problem lies in the enclosure coil (56), the exciter coil (68), or the pulser coil (69, figure 7-8).

5-5. If spark discharges are not observed at either cylinder, the system will have to be tested with an ohmmeter or checked by replacing components. However, before testing the system, make certain the on-off switch is not the problem. Disconnect the black lead from the switch, position the lead so the terminal cannot contact ground and again check for spark discharges at the test plug. The switch is faulty if a spark is obtained at both spark plugs.



IGNITION



ELECTRICAL

Figure 5-1. Wiring Diagram

Table 5-1. Troubleshooting

Symptom	Probable Cause	Remedy
HARD STARTING OR WILL NO START		
Lack of fuel	<p>Empty fuel tank.</p> <p>Fuel line pinched or disconnected.</p> <p>Plugged vent hole in fuel tank filler cap.</p> <p>Fuel line connector plugged.</p> <p>Impulse tube loose or pinched.</p>	<p>Refill fuel tank. (Refer to table 2-4, step 2.)</p> <p>Check fuel lines and repair or replace as required.</p> <p>Remove filler cap and clean vent hole.</p> <p>Remove connector and clean.</p> <p>Check impulse tube and repair or replace as required.</p>
<p>Poor or no ignition spark</p> <p>Spark plug electrodes broken.</p>	<p>Ignition not turned on.</p> <p>Spark plugs wet or carbon fouled.</p> <p>Check spark plugs. (Refer to figure 4-1.)</p> <p>Spark plug cables loose or broken.</p> <p>Faulty ignition system.</p>	<p>Turn ignition on. (Refer to table 2-4, step 5.)</p> <p>Check spark plugs. (Refer to figure 4-1.)</p> <p>Tighten cable connections or replace as necessary.</p> <p>Troubleshoot ignition system in accordance with paragraph 5-3.</p>
Engine flooded	<p>Metering diaphragm lever set too high.</p> <p>Dirt under inlet needle valve.</p> <p>Metering lever spring not seated on the dimple in the metering lever.</p> <p>Fuel pump diaphragm leaking.</p>	<p>Adjust metering diaphragm lever (30, figure 3-4). (Refer to paragraph 6-93 and figure 6-1.)</p> <p>Replace carburetor.</p> <p>Remove metering diaphragm lever spring (29, figure 3-4) and reinstall. (Refer to paragraph 6-93.)</p> <p>Replace carburetor.</p>

Table 5-1. Troubleshooting (Continued)

Symptom	Probable Cause	Remedy
Engine flooded (continued)	Dirt under check valve (37, figure 3-4).	Replace carburetor.
Carburetor lean, too much air	Dirt in idle fuel channels.	Replace carburetor.
	Metering lever set too low.	Adjust metering diaphragm lever (30, figure 3-4). (Refer to paragraph 6-93.)
	Leaky nozzle check valve diaphragm (32, figure 3-4).	Replace carburetor.
	Hole in metering diaphragm (10, figure 3-4).	Replace carburetor.
	Impulse line plugged.	Remove impulse line and clean.
	Leaky manifold gaskets (figure 4-1).	Replace gaskets.
	Leaky diaphragm check valve (5 and 32, figure 3-5).	Replace carburetor.
	Dirty fuel inlet screen (3, figure 3-5).	Replace carburetor.
	Faulty fuel delivery system to carburetor.	Check fuel tank, lines, and connector.
Poor compression	Loose spark plug.	Torque tighten spark plug to 20 foot-pounds.
	Cylinder head loose.	Torque tighten cylinder head nuts to 16 foot- pounds.
	Blown cylinder head gasket.	Replace engine.
	Piston rings broken.	Replace engine.
Piston and cylinder badly worn.		Replace engine.
RUNNING TROUBLES		
Lacks power	Poor quality or improperly mixed fuel .	Empty fuel tank and re- fill. (Refer to table 2-4, step 2.)

Table 5-1. Troubleshooting (Continued)

Symptom	Probable Cause	Remedy
Lacks power (continued)	Water in fuel. Exhaust port and/or muffler plugged. Improperly adjusted carburetor. Ignition timing wrong. Poor compression.	Empty fuel tank and re-fill. (Refer to table 2-4, step 2.) Remove blockage from exhaust port and/or muffler. Adjust carburetor. (Refer to paragraph 4-17.) Check ignition timing. (Refer to paragraph 4-19.) Replace engine.
Runs unevenly	Bad spark plug. Wrong spark plug. Spark plug cable loose. Faulty ignition system.	Check spark plugs. (Refer to paragraph 4-11.) Check spark plugs. (Refer to paragraph 4-11.) Tighten spark plug cable connection. Troubleshoot ignition system in accordance with paragraph 5-3.
Poor acceleration Dirt under carburetor inlet	Choke closed (24, figure 3-4). Carburetor improperly adjusted. Replace carburetor needle valve (28, figure 3-4). Exhaust port heavily coated with carbon. (Refer to figure 3-3.)	Open choke. Adjust carburetor. (Refer to paragraph 4-17.) Remove carbon.
No acceleration	Carburetor idle mixture too lean. Carburetor diaphragm coverplate loose (41, figure 3-4). Carburetor diaphragm gasket (10, figure 3-4) leaking.	Adjust carburetor. (Refer to paragraph 4-17.) Tighten screws securing coverplate. Replace carburetor.

Table 5-1. Troubleshooting (Continued)

Symptom	Probable Cause	Remedy
No acceleration (continued)	Intake manifold loose and leaking. (Refer to figure 4-1.)	Replace gasket.
	Carburetor leaking or malfunctioning.	Replace carburetor.
Engine backfires through carburetor	Insufficient fuel.	Check fuel tank and fuel lines.
	Wrong spark plug.	Check spark plug. (Refer to paragraph 4-11.)
	Air leakage from faulty gaskets or oil seals.	Check gaskets and seals and replace as necessary.
Pings under heavy load, full throttle	Ignition timing too early.	Check ignition timing. (Refer to paragraph 4-19.)
	Wrong spark plug.	Check spark plug. (Refer to paragraph 4-11.)
	Carburetor main fuel.	Adjust carburetor. (Refer to paragraph 4-17.)
	Adjustment too lean.	
Engine stops	Fuel tank empty.	Refill fuel tank. (Refer to table 2-4, step 2.)
	Ignition inadvertently turned off.	Restart pump. (Refer to paragraph 2-5.)
	Exhaust port and/or muffler plugged. (See figure 3-3.)	Remove blockage from exhaust port and/or muffler.
	Insufficient oil content in fuel.	Empty fuel tank and refill. (Refer to table 2-4, step 2.)
	Plugged fuel line.	Check fuel lines and clean as required.
	Impulse tube plugged, loose or pinched (89, figure 7-1).	Clean, tighten, or repair as required.
	Carburetor inlet screen or passages clogged (6,8,18,26, and 36, figure 3-4).	Replace carburetor.

Table 5-1. Troubleshooting (Continued)

Symptom	Probable Cause	Remedy
Engine stops (continued)	Faulty pressure switch (11, figure 7-4).	Replace pressure switch.
PUMP TROUBLES		
Pump primes slowly or not at all	Air leaking into the priming system or suction hose. Defective check valve (4, figure 7-4) in exhaust cooling line. Defective priming switch (21, figure 7-2).	If the location of air leakage cannot be determined, refer to paragraph 4-34 and perform hydrostatic leakage test. Remove and replace check valve. Remove and replace priming switch.
Magnetic clutch slipping	Clutch slipping (56, figure 7-1) Defective magnetic clutch. Defective priming pump pulley. Improper fan belt tension. Defective priming pump.	Remove magnetic clutch and key. See paragraphs 6-55 and 6-63. Inspect magnetic clutch key and priming pump shaft for damage. Remove and replace magnetic clutch. Replace magnetic clutch. Check fan belt tension. Repair or replace priming pump.
Pump will not pump water or is not pumping enough	Clogged strainer-foot valve. (Refer to figure 1-1.) Foreign matter in suction hose. Clogged discharge valve (12, figure 7-1). Foreign matter in discharge hose. Clogged pump impeller waterways. Engine lacks power.	Clean strainer-foot valve. Remove foreign matter from suction hose. Clean discharge valve. Remove foreign matter from discharge hose. Clean impeller waterways. Refer to paragraph 5-2.

5-6. OHMMETER TEST PROCEDURE. Make certain the ohmmeter being used is accurate and the batteries are fresh. Periodically zero the meter during the tests.

CAUTION

Do not use an improper tester (insulation resistance testers, or other testers with a battery of large capacity). The use of a large capacity tester may ruin components during test.

a. Wire Connection Test.

(1) Check all wiring connectors to ensure connections are clean, secure, and correct. (Refer to figure 5-1.)

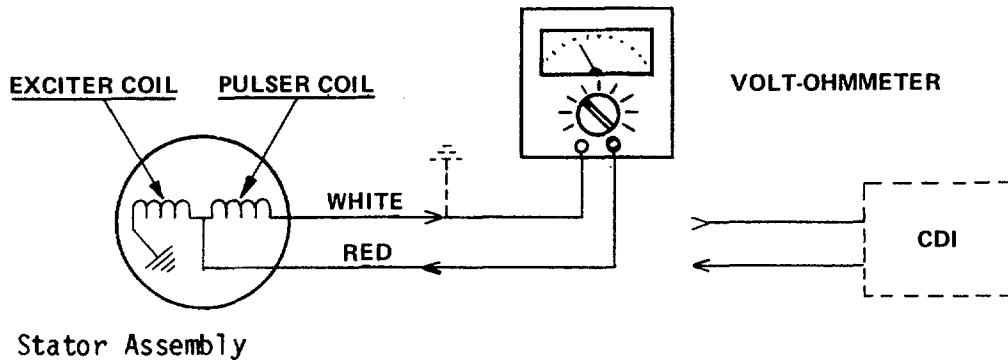
(2) Check wires for breaks, shorts, grounds, and defective insulation.

c. Ignition Coil Test. Measure resistance of ignition coil primary and secondary windings as specified in figure 5-3. Repair defective wire or replace coil not within specifications. (Refer to figure 5-3.)

CAUTION

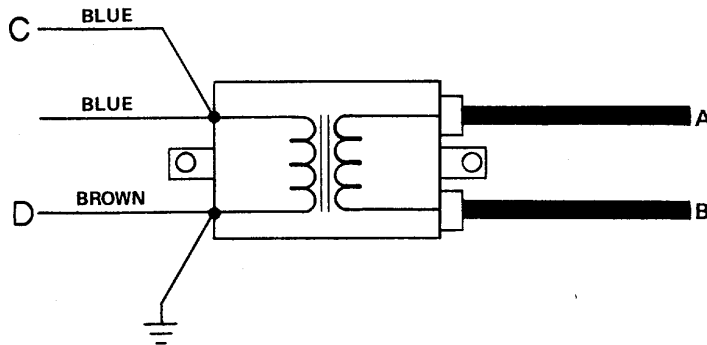
Do not use an improper tester (insulation resistance testers or other testers with a battery of large capacity). The use of a large capacity tester may ruin components during test.

b. Exciter and Pulser Coil Test. To locate the cause of trouble (broken wire, short circuit, etc.) measure the resistance of each coil winding and check AC voltage output as specified in figure 5-2. Repair defective wire or replace coil not within specifications.



Coil to be measured	Exciter	Pulser
Meter Lead Connections	Red- Ground	Red - White
Resistance, Ohms +/-20 percent	128	23
Ac Voltage *	40	4
* Engine cranking, spark plugs installed.		

Figure 5-2. Exciter and Pulser Test Setup



Ohmmeter Leads Connection	Primary Winding Blue (C) to Ground (D)	Secondary Winding A to B
Resistance, Ohms +/-20 percent	0.37	10,200

NOTE: Defective coils can not always be detected in this manner. Use of a coil tester is more reliable.

Figure 5-3. Ignition Coil Test Setup

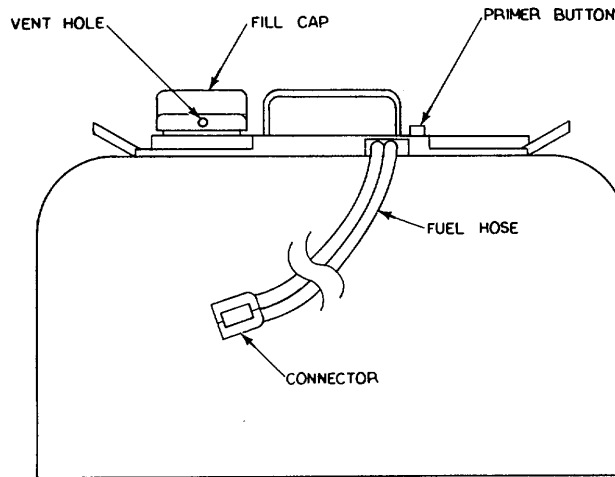


Figure 5-4. Fuel Feed System

CHAPTER 6 CORRECTIVE MAINTENANCE

6-1. INTRODUCTION.

6-2. This chapter provides instructions for adjusting, removing, disassembly, inspection, cleaning, repair, or replacement, reassembly and installation of the components of the pump. Several engine parts have been modified by the pump manufacturer. These parts include the ignition and electrical systems, as well as the crankcase and fan housing. The interval rotor parts of the engine are not modified. All other parts must be obtained from the pump manufacturer.

Section I. ADJUSTMENT AND ALIGNMENT

6-3. FAN BELT TENSION ADJUSTMENT.

6-4. Refer to paragraph 4-13 for fan belt tension adjustment procedures.

6-5. CARBURETOR ADJUSTMENT.

6-6. Refer to paragraph 4-17 for carburetor adjustment procedures.

6-7. IGNITION TIMING.

6-8. Refer to paragraph 4-19 for ignition timing instructions.

Section II. REPAIR

6-9. GENERAL.

6-10. This section includes Instructions for removal, disassembly, inspection, cleaning, repair, and replacement of components of the pump. Prior to removal of any component, proceed as follows:

- a. Shut down pump. (Refer to table 2-6.)
- b. Tag pump OUT OF SERVICE
- c. Before removing any electrical part, tag electrical leads to facilitate rewiring during reassembly.

6-11. ENGINE CONTROL PANEL REPAIR.

6-12. ENGINE CONTROL PANEL DISASSEMBLY.

6-13. To disassemble engine control panel, see figure 7-2 and proceed as follows:

- a. Remove two cotter pins (5).
- b. Unscrew and remove throttle and choke rods (9) from carburetor.
- c. Unscrew and remove two nuts (2) from two control spindles (6).
- d. Remove two springs (1).
- e. Remove throttle and choke knobs (11) by removing two setscrews (12).
- f. Unscrew and remove two control spindles (6) and two washers (4) from throttle and choke shafts (13).

- g. Remove two control arms (7) from two control spindles (6) by removing two screws (8).
- h. Remove throttle and choke shafts (13) and two nuts (10).
- i. Unscrew and remove connector (17) from control box (18).
- j. Remove control box (18) and gasket (20) from engine control panel by removing four screws (19).
- k. Tag and remove electrical leads from engine control panel.
- l. Remove voltage regulator (14) from control box (18) by removing two screws (15) and nuts (16).
- m. Remove two pushbutton switches (21) from control panel (27) by unscrewing and removing nut.
- n. Remove toggle switch (22) from control panel (27) by unscrewing and removing nut.
- o. Remove information plate (23) from control panel (27) by removing four screws (24), nuts (25), and lockwashers (26).
- p. Remove control panel (27) from bracket (3) by removing two screws (28), nuts (29), and lockwashers (30).
- q. Remove bracket (3) by removing four screws (2 and 5, figure 7-1), lockwashers (4 and 7, figure 7-1), two washers (6, figure 7-1), and two nuts (3, figure 7-1).

6-14. ENGINE CONTROL PANEL CLEANING.

6-15. Clean parts of disassembled engine control panel as follows:

- a. Wash throttle and choke control parts with general purpose cleaner, P-D-680, Type II.
- b. Dry parts with compressed air and wipe with clean cloth.
- c. Clean switches outer surfaces with mild solvent that will not affect rubber.
- d. Wipe switches dry with clean cloth.
- e. Clean control panel information plate and voltage regulator and attached wires with mild cleaning solution that will not affect plastic.

6-16. ENGINE CONTROL PANEL INSPECTION, REPAIR, AND REPLACEMENT.

6-17. Inspect, repair, and replace parts of engine control panel as follows:

- a. Inspect switches, connectors, linkage, and wiring for abrasions, looseness, and accumulation of dirt.
- b. Replace all parts that show signs of wear or damage.
- c. Apply a thin coat of silicone compound, MIL-S-8660, to throttle and choke linkage.
- d. Inspect gasket of control electrical box for deterioration.
- e. Replace gasket that shows signs of wear or damage.

6-18. ENGINE CONTROL PANEL REASSEMBLY.

6-19. Reassemble engine control panel In reverse order of disassembly.

6-20. GAGE PANEL REPAIR.

6-21. GAGE PANEL REMOVAL.

6-22. Remove gage panel as follows:

- a. Tag and remove electrical leads from ammeter (6, figure 7-3).
- b. See figure 7-4 and unscrew gage hose (3) from pipe elbow (9).
- c. Unscrew and remove gage hose (3) from pipe elbow (10).
- d. Remove gage panel assembly (8, figure 7-1) by removing three cap screws (9).

6-23. GAGE PANEL DISASSEMBLY.

6-24. To disassemble gage panel, see figure 7-3 and proceed as follows:

- a. Unscrew and remove pipe elbow (2, figure 7-4) from compound gage (5).
- b. Remove bracket (7) from gage plate (1) by removing four nuts (4).
- c. Remove four vibration isolators (3) from gage plate (1) by removing four screws (2).

d. Remove compound gage (5) from gage plate (1) by removing two nuts, lockwashers, and brackets.

e. Remove ammeter (6) from gage plate (1) by removing four nuts, two lockwashers, and bracket.

6-25. GAGE PANEL CLEANING.

6-26. Clean parts of disassembled gage panel as follows:

a. Wipe all parts carefully with clean cloth dampened with general purpose cleaner, P-D-680, Type II.

b. Dry parts with compressed air and wipe dry with clean cloth.

6-27. GAGE PANEL INSPECTION, REPAIR AND REPLACEMENT.

6-28. Inspect, repair and replace parts of gage panel as follows:

a. Inspect gages, shock mounts, and wiring for abrasions, looseness, and accumulation of dirt.

b. Replace all parts that show signs of wear or damage.

6-29. GAGE PANEL REASSEMBLY.

6-30. Reassemble gage panel in reverse order of disassembly.

6-31. GAGE PANEL INSTALLATION.

6-32. Install gage panel in reverse order of removal.

6-33. DISCHARGE VALVE REPAIR.

6-34. DISCHARGE VALVE REMOVAL.

6-35. Remove discharge valve as follows:

a. Unscrew discharge cap and chain (11, figure 7-1) from discharge valve (12).

b. Unscrew and remove four cap screws (13, figure 7-1) and remove discharge valve (12).

6-36. DISCHARGE VALVE CLEANING (12, figure 7-1).

6-37. Clean discharge valve as follows:

WARNING

Observe no smoking regulation and avoid prolonged contact with, or inhalation of, cleaning solvents. Avoid use near heat or open flame and provide adequate ventilation.

a. Wash discharge valve carefully with general purpose cleaner, P-D-680, Type II. Salt or scale deposits on surfaces may be removed by using scale removing compound (sulfamic acid, PS-120).

b. Blow out and dry internal passage and hose fitting of discharge valve with filtered compressed air.

c. Wipe external surfaces of discharge valve dry with clean cloth.

6-38. DISCHARGE VALVE INSPECTION, REPAIR, AND REPLACEMENT.

6-39. Inspect, repair, and replace discharge valve as follows:

a. Inspect discharge valve for damaged threads, looseness, and leaking.

b. Replace discharge valve if it shows signs of wear or damage.

c. Apply a thin coat of silicone compound, MIL-S-8660, to the handle.

6-40. DISCHARGE VALVE INSTALLATION.

6-41. Install discharge valve in reverse order of removal.

6-42. PUMP REPAIR.

NOTE

The pump body does not have to be removed so that repair can be accomplished on pump. If damage to pump body is indicated, first disassemble pump in accordance with paragraph 6-43.

6-43. PUMP DISASSEMBLY.

WARNING

Exercise care when removing water seal from impeller assembly. All spring tension should be released to prevent spring from accidentally disengaging and causing injury. Wear safety glasses when repairing water seal assembly components.

- a. Remove priming pump hose (8, figure 7-4) from priming pump suction port.
- b. Unscrew suction cap and chain (15, figure 7-1).
- c. Remove suction head and hose adapter assembly (16, figure 7-1) by removing one screw (17), one lockwasher (18), ten nuts (19) and ten washers (20).
- d. Remove and discard gasket (21).
- e. Remove impeller screw (26), washer (27), and impeller seal (28).
- f. Screw a 5/8 x 2-1/2 inch long hex head bolt into impeller (25) until snug, then continue screwing in bolt until impeller comes free.

WARNING

Exercise care when removing water seal from impeller assembly. All spring tension should be released to prevent spring from accidentally disengaging and causing injury. Wear safety glasses when repairing water seal assembly components.

- g. Carefully remove impeller assembly (25).
- h. Remove water seal (29) from impeller.

6-44. PUMP BODY REMOVAL.

6-45. To remove pump body, proceed as follows:

- a. Disconnect electrical lead from pressure switch (11, figure 7-4).
- b. Unscrew gage hose (3) and exhaust cooling hose (2) at pump outlet (figure 7-4). It may be necessary to hold hose with pliers while turning the hose fitting. The fitting will turn inside the hose.
- c. Unscrew and remove pipe elbow (9), check valve (7), pressure switch (11), pipe cross (5), and pipe nipple (6) at pump outlet. (Refer to figure 7-4.)
- d. Unscrew body plug and chain (30, figure 7-1) and drain valve (12, figure 7-4).

CAUTION

Check shims between pump body base and mounting support plate, accurately record each shim location.

NOTE

Shims are required for alignment of pump body. Keep for reassembly.

- e. Remove pump body (31, figure 7-1) by removing four cap screws (32) and lockwashers (33).

6-46. PUMP CLEANING.

6-47. Clean the disassembled components of the pump as follows:

WARNING

Observe no smoking regulation and avoid prolonged contact with, or inhalation of, cleaning solvents. Avoid use near heat or open flame and provide adequate ventilation.

- a. Wash all parts carefully with general purpose cleaner, P-D-680, Type II. Salt or scale deposits on surfaces may be removed by using scale removing compound (sulphamic acid, PS-120).

- b. Dry all internal parts with filtered compressed air and wipe dry with clean cloth external surfaces.
- c. Blow out all passages, hoses, pipe fittings, and impeller with filtered compressed air.

6-48. PUMP INSPECTION, REPAIR, AND REPLACEMENT.

- 6-49. Inspect, repair, and replace pump as follows:
- a. Inspect hoses for abrasions, cuts, chafing, and permanent set.
 - b. Replace hose if damaged to cause leaking in priming or exhaust systems.
 - c. Inspect threads for nicks, burrs, and distortion.
 - d. Replace all parts that show signs of wear or damage.
 - e. Apply a thin coat of silicone compound, MIL-S-8660, to bolt threads and pump housing surface.
 - f. Apply a thin coat of pipe thread sealant to pipe threads, check valve, elbow, nipple, cross, and pressure switch.
 - g. Inspect gasket surfaces for nicks, burrs, laserioration.
 - h. Smooth out minor nicks, scratches with fine emery cloth.
 - i. Replace all gaskets and seals with new gaskets and seals.
 - j. Inspect water seal wear surfaces.

CAUTION

Surfaces are polished finish. Wipe with soft clean cloth. Inspect for nicks, scoring, chipping, and distortion.

- k. Replace all parts that have nicks, scoring, chipping or distortion.
- l. Inspect impeller for ridges, scoring, or nicks.
- m. Repair impeller wear ring surfaces.

CAUTION

Carefully smooth out ridges, scoring, or minor nicks with fine emery cloth. Excessive machining of impeller suction rings can cause damage to impeller capacity for pumping.

- n. Replace impeller that cannot be repaired.
- o. Inspect pump housing wear ring for accumulation of deposits of foreign material.
- p. Repair rings by removing material deposits with fine emery cloth.
- q. Replace rings that show signs of rubbings, damage, or distortion and impair the rotation of the impeller.
- r. The difference in the diameters of the wear rings and the impeller should not exceed 0.040 inch.

6-50. PUMP BODY INSTALLATION.

- 6-51. Install pump body on frame as follows:
- a. Place pump body on frame and secure with four cap screws (32), lockwashers (33), and replace alignment shims, if used. Refer to paragraph 6-45, step e. Torque to 24 foot-pounds.

CAUTION

Accurately install shims as recorded during disassembly. b. Screw body plug and chain (30, figure 7-1) and drain valve (12, figure 7-4) into pump body (31, figure 7-1).

- c. Install pipe nipple (6, figure 7-4), pipe cross (5), pressure switch (11), check valve (4), and pipe elbow (9) at pump outlet. All pipe threads should engage 3/8 inch.
- d. Screw gage hose (3) to pipe elbow (9). Thread engagement 3/8 inch.

- e. Screw exhaust cooling hose (2) to check valve (4). Thread engagement 3/8 inch.
- f. Connect electrical lead to pressure switch (11).

6-52. PUMP REASSEMBLY.

6-53. To reassemble the pump, proceed as follows:

CAUTION

Water seal assembly spring loaded.

- a. Install water seal (29, figure 7-1) on impeller (25).
- b. Install washer (27) and impeller seal (28) on impeller screw (26).
- c. Install impeller (25) in pump body (31) and secure with impeller screw (26), torque 51 foot-pounds.
- d. Install suction head and hose adapter assembly (16).
 - (1) Align holes in new gasket (21) with pump body studs (22) and position gasket on pump body (31).
 - (2) Align suction head and hose adapter assembly (16) with pump body studs (22) and assemble suction head and hose adapter assembly to pump body (31). Secure suction head and hose adapter assembly using one cap screw (17), one lockwasher (18), ten nuts (19), and washers (20), torque 170 pound-inches.
 - (3) To check alignment, remove spark plugs and rotate engine by pulling on retractable starter rope. Engine and pump should rotate freely without binding. If impeller is rubbing, check for proper shimming.

6-54. PRIMING PUMP REPAIR.

6-55. PRIMING PUMP ASSEMBLY REMOVAL.

6-56. To remove priming pump assembly, proceed as follows:

- a. Remove three cap screws, washers, and nuts that secure guard assembly (34, figure 7-1) to support bracket.

- b. Carefully remove guard assembly (34) from support bracket.

- c. Remove priming pump hose (8, figure 7-4) via unscrewing hose from the fire pump suction cover.

- d. Loosen magnetic clutch (56, figure 7-1) locking setscrews and slide clutch on drive shaft towards priming pump (54). Remove hook end of clutch stabilizer (55) from magnetic clutch (56) stabilizer hole. Unscrew clutch stabilizer (55) from priming pump (54). Then carefully unwrap magnetic clutch (56) power 12V lead and remove clutch stabilizer (55).

- e. Remove priming pump stabilizer bracket (50) by removing one cap screw (49) and nut (48) from fan housing and one cap screw (49) from priming pump (54, figure 7-1).

- f. Remove magnetic clutch (56) ground wire by removing one cap screw (46), washer (47), and nut (48).

- g. Remove oiler assembly (42) by removing two cap screws (43), washers (44), and nuts (45).

- h. Remove other cap screw (46), two washers (47), and nut (48) that secure priming pump base plate (58) to frame.

- i. Carefully remove priming pump and clutch assembly by sliding it toward engine, releasing fan belt tension. Then remove fan belt from magnetic clutch (56) drive pulley.

CAUTION

Protect magnetic clutch wiring harness during removal, because clutch 12V power lead remains attached to primary electrical harness.

- j. Unscrew and remove two cap screws (49) which secure priming pump (54, figure 7-1) to mounting brackets (53). Then carefully remove priming pump and clutch assembly from mounting brackets (53). Keep adjacent to engine until magnetic clutch (56) is removed from priming pump drive shaft.

k. Carefully slide magnetic clutch (56) off priming pump drive shaft. Place magnetic clutch (56) near engine with 12V power lead attached.

l. Remove woodruff key (57) from priming pump drive shaft. m. Remove priming pump hose (8, figure 7-4) from priming pump (54, figure 7-1) by unscrewing hose from priming pump inlet part.

6-57. PRIMING PUMP DISASSEMBLY.

6-58. See figure 7-6 and disassemble priming pump as follows:

a. Remove two end plates (2) by unscrewing and removing nine cap screws (9). Remove and discard gaskets (8).

b. Remove outer seal (4), bearing (6), and inner seal (5) from both end plates (2).

c. Remove four vanes (7) from rotor and shaft (3).

6-59. PRIMING PUMP CLEANING.

6-60. Clean disassembled parts of priming pump as follows:

WARNING

Observe no smoking regulation. Avoid prolonged contact with, or inhalation of cleaning solvents. Avoid use near heat or open flame and provide adequate ventilation.

a. Clean all parts with general purpose cleaner, P-D-680, Type II. Salt or scale deposits may be removed by using scale removing compound (sulphamic acid, PS-120).

b. Dry all internal parts with filtered compressed air and wipe dry external surfaces with clean cloth.

c. Blow out all passages, hoses, and pipe fittings with filtered compressed air.

6-61. PRIMING PUMP INSPECTION, REPAIR, AND REPLACEMENT.

6-62. Inspect, repair, and replace priming pump as follows:

a. Inspect hose for abrasions, cuts, chafing, and permanent set.

b. Replace hose if damaged or shows wear to cause leaking in priming systems.

c. Inspect threads for nicks, burrs, and distortion.

d. Replace all parts that show signs of wear or damage.

e. Apply a thin coat of silicone compound, MIL-S-8660, to screw threads and pump housing surface.

f. Apply a thin coat of pipe sealant to pipe threads.

g. Inspect gasket surface for nicks, burrs, and deterioration.

h. Smooth out minor nicks, scratches, and burrs with fine emery cloth.

i. Replace gaskets with new gaskets.

J. Replace shaft seals if leaking or shows sign of excessive wear.

k. Replace bearings if it has a rough feel when you rotate it.

l. Replace the vanes if they show signs of excessive wear. If height is less than 1/2 inch replace vanes.

6-63. PRIMING PUMP REASSEMBLY.

6-64. To reassemble the priming pump, see figure 7-6 and proceed as follows:

a. Place end plate (2) in press fixture with counterbore up.

b. Place inner seal (5) with lip of seal face down in end plate (2) bore.

c. Slowly press inner seal (5) into end plate (2) bore and press in until seated.

d. Place bearing (6) on top of end plate (2) bore and slowly press bearing (6) down into end plate (2) bore, until seated on inner seal (5).

- e. Place outer seal (4) on top of end plate (2) with lip side facing up and then slowly press outer seal (4) into end plate (2) bore until seated.
- f. Do same for the other end plate (2).
- g. Now press rotor and shaft (3) into one of the end plates (2) making sure that shaft is pressed in until seated.
- h. Place one gasket (8) on the face of the end plate (2), then place body (1) on top of gasket (8) and align screw holes at same time.
- i. Start screws (9) in holes.
- j. Place vanes (7) in grooves of rotor.
- k. Place one gasket (8) on top of face of body (1).
- 1. Press on other end plate (2) on shaft and press until seated on body (1).
- m. With holes aligned start screws (9).
- n. As you tighten up on the screws (9) rotate shaft back and forth.
- o. If you are unable to rotate shaft back and forth, tap body (1) with lead hammer lightly. p. If step o, above, does not free up shaft, a second gasket (8) will be required. Repeat steps h through o, above. A side clearance of 0.005 inch to 0.010 inch is standard.
- q. Torque screws to 7 footpounds.

NOTE

Shaft must rotate freely to meet required performance.

6-65. PRIMING PUMP INSTALLATION.

6-66. Install priming pump in reverse order of removal.

6-67. MUFFLER EXHAUST ASSEMBLY REPAIR.

WARNING

Exhaust system when hot can cause personal injury.

6-68. MUFFLER EXHAUST ASSEMBLY REMOVAL.

6-69. To remove the muffler exhaust assembly, see figure 7-1, and proceed as follows:

- a. Remove guard assembly (34) by removing three-c s crews, washers, and nuts.
- b. Unscrew and remove exhaust cap and chain (35).
- c. Remove muffler exhaust assembly (36) by removing one tapping screw (37), one lockwasher (38), two cap screws (39), two washers (40), and two lockwashers (41).

6-70. MUFFLER EXHAUST DISASSEMBLY.

6-71. See figure 7-5 and disassemble the muffler exhaust assembly as follows:

- a. Remove outlet cap (2) by removing four cap screws (4) and nuts (5).
- b. Remove and discard gasket (3).
- c. Unscrew and remove long nipple (6), coupling (7), and check valve (8).

6-72. MUFFLER EXHAUST ASSEMBLY CLEANING.

6-73. Clean disassembled parts as follows:

WARNING

Observe no smoking regulations. Avoid prolonged contact with or inhalation of cleaning solvents. Avoid use near heat or open flame and provide adequate ventilation.

- a. Clean muffler tailpipe, outlet cap, long nipple, and coupling with general purpose cleaner, P-D-680, Type II.
- b. Remove any accumulated scale, carbon deposits, or dirt.
- c. Blow compressed air through the passages and wipe external surfaces dry with clean cloth.
- d. Clean threads and gasket surfaces.

- e. Clean external surface of check valve with general purpose cleaner, P-D-680, Type II.
- f. Air dry and wipe with clean cloth.

6-74. MUFFLER EXHAUST ASSEMBLY INSPECTION, REPAIR, AND REPLACEMENT.

6-75. Inspect, repair, and replace parts of muffler exhaust assembly as follows:

- a. Inspect gasket surfaces for nicks, burrs, and deterioration.
- b. Smooth out minor nicks, scratches, and burrs with fine emery cloth.
- c. Inspect threads for nicks, burrs, and distortion.
- d. Replace all parts that show signs of wear or damage.
- e. apply a thin coat of silicone compound, MIL-S-8860, to screw threads and outlet cap threads.
- f. Replace check valve that shows signs of excessive wear or leaking.
- g. Replace gasket with new gasket.

6-76. MUFFLER EXHAUST REASSEMBLY.

6-77. Reassemble muffler exhaust assembly in reverse order of disassembly (see table 4-3).

6-78. MUFFLER EXHAUST INSTALLATION.

6-79. muffle exhaust assembly in reverse order of removal.

6-80. CARBURETOR ASSEMBLY REPAIR.

6-81. CARBURETOR ASSEMBLY REMOVAL.

6-82. To remove the carburetor assembly, proceed as follows:

WARNING

Observe no smoking regulations.

- a. See figure 7-2 and remove two cotter pins (5).
- b. Unscrew and remove throttle and choke rods (9, figure 7-2) from carburetor assembly (75, figure 7-1).
- c. Remove two fuel hoses (7) by loosening two hose clamps (71).
- d. Remove carburetor assembly (75, figure 7-1) by unscrewing and removing two washers (76), lockwashers (77), and nuts (78).

6-83. CARBURETOR DISASSEMBLY.

6-84. To disassemble carburetor assembly, see figure 7-7, remove ram tube (2) from carburetor (1) by removing two screws (3) and lockwashers (4).

6-85. CARBURETOR ASSEMBLY CLEANING.

6-86. Clean the parts of the disassembled carburetor assembly as follows:

WARNING

Observe no smoking regulations. Avoid prolonged contact with, or inhalation of cleaning solvent. Avoid use near heat or open flame and provide adequate ventilation.

- a. Clean carburetor parts with carbon removing compound, MIL-C-19853, FSN 6850-00-702-8451.
- b. Dry all parts with filtered compressed air (20 psi).
- c. Blow out all passages in carburetor and ram tube with filtered compressed air.

6-87. CARBURETOR ASSEMBLY INSPECTION, REPAIR, AND REPLACEMENT.

6-88. Inspect, repair, and replace parts of the carburetor assembly as follows:

- a. Inspect carburetor and ram tube for wear and damage.
- b. Replace carburetor and ram tube if it shows signs of wear or damage.

6-89. CARBURETOR REASSEMBLY.

6-90. Reassemble carburetor assembly in reverse order of disassembly. Torque to 85 foot-pounds.

6-91. CARBURETOR INSTALLATION.

6-92. Install carburetor assembly in reverse order of removal. Torque to 40 pound-inches.

6-93. METERING LEVER ADJUSTMENT.

6-94. See figure 6-1 and adjust the metering lever as follows:

- a. Slide a straight edge across the face of the casting.
- b. Check to see that the bumper end of the metering lever extends from 0.005 to 0.020 inch above the casting.

CAUTION

Do not press down on the needle.

- c. If adjustment is necessary, hold down the bumper end of the metering lever and bend the needle end.

6-95. BATTERY REMOVAL.

WARNING

Danger! Contains sulfuric acid. Avoid contact with skin, eyes, or clothing. Read safety precautions.

6-96. See figure 7-1, and remove battery as follows:

- a. Unclamp positive battery cable (60) from battery (88).
- b. Unclamp negative battery cable (61) from battery (88).
- c. Loosen wing nut and swing cup hook out of the way.
- d. Remove battery (88) from tray.

6-97. SOLENOID AND ELECTRIC STARTER REPAIR.

6-98. SOLENOID AND ELECTRIC STARTER REMOVAL.

6-99. To remove solenoid (63) and electric starter (67), see figure 7-1 and proceed as follows:

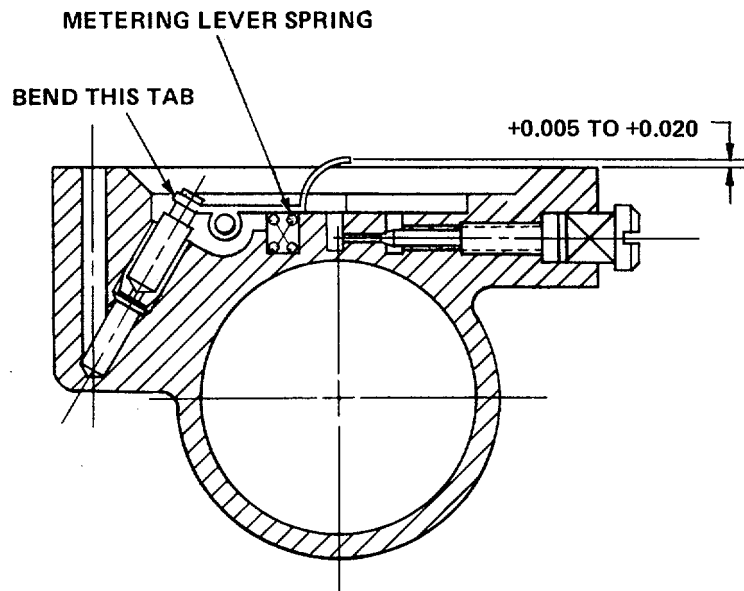


Figure 6-1. Metering Lever Adjustment

- a. Remove three cap screws, washers, and nuts that secure guard assembly (34) to support bracket.
- b. Carefully remove guard assembly (34) from support bracket.
- c. Remove priming pump assembly. (Refer to paragraph 6-56.)
- d. Tag and remove solenoid to starter wire (62) from solenoid (63) and electric starter (67).
- e. Tag and remove positive battery cable (60, figure 7-1) from solenoid (63, figure 7-1).
- f. Tag and remove the two remaining electrical leads from solenoid (63).
- g. Remove solenoid (63) from bracket (66) by removing two cap screws (64) and nuts (65).
- h. Remove bracket (66) from electric starter (67) by removing two lockwashers and nuts.
- i. Remove electric starter (67) by removing one cap screw, three washers, two lockwashers, and two nuts.

6-100. SOLENOID AND ELECTRIC STARTER REPLACEMENT.

6-101. Replace solenoid and electric starter that shows signs of obvious damage.

6-102. ENGINE GENERAL MAINTENANCE.
(See figure 3-3.)

CAUTION

Certain parts of engine have been modified by pump manufacturer. To ensure replacement parts order them from pump manufacturer.

a. Carbon Removal.

(1) If excessive carbon is noted on the spark plug, check the condition of the combustion chamber and top of the piston as these, too, may be carbon fouled.

(2) Remove the cylinder heads and remove the carbon deposits with a wood or plastic scraper to avoid cutting or scratching the aluminum heads and pistons.

(3) If carbon build-up is heavy on top of the piston, the rings are often stuck or about ready to stick in the grooves.

(4) Use carbon removing compound, MIL-C-19853, (FSN 6850-00-702- 8451) to clean carbon build-up on rings and other engine components.

(5) Clean off the carbon removing compound before reinstalling barrels.

(6) Apply lubrication to cylinder wall, then use the ring compressor (for 2-cycle engines) and install the barrels over the piston (figure 6-12).

(7) Tighten barrel nuts and cylinder heads to torque value specified. Always use a new cylinder head gasket.

b. Cooling System. Engines are cooled by a belt driven blower. Never operate your engine with missing or loose air shroud covers. Keep air intake openings on pump and engine clean and unobstructed at all times to prevent overheating. Proper belt tension (see paragraph 4-14) must be maintained for proper cooling. Do not operate Axial Flow engines with broken or badly frayed belts.

6-103. ENGINE OVERHAUL. (See figure 3-3.)

WARNING

Before starting to disassemble an engine, make sure that the work area is clean and well lighted. Observe all rules or safety when working on an engine - for instance, wear safety glasses and do not smoke or use an open flame around the cleaning solvents or other flammable materials found in many shops.

6-104. Start looking for causes of engine problems before you remove it from the pump. If cracked or broken parts are evident, check for loose engine mounts. Some other types of damage and probable causes follow.

a. Piston Burn-thru. If a hole is burned right through the piston, look for an improperly adjusted carburetor or incorrect timing. If these items check out OK, check use of wrong oil or improperly mixed fuel. The wrong type of spark plug for conditions involved may also be the cause of abnormally high combustion temperatures which cause burn-thru. Use Champion RN-3 spark plugs.

b. Foreign Material.

CAUTION

When inspecting spark plugs, clean out around spark plug openings before removing plugs. Otherwise, damage can result from foreign objects dropping into the engine. If the damage is on the piston crown, something probably fell into the opening when the plug was removed. Damage on the sides of piston may indicate that an object was drawn into the intake.

c. Loose Needle, Retainers, Pins. Piston and cylinder damage caused by loose needle bearings, pin retainers, or piston pins is usually quite easy to diagnose. A needle bearing is hard enough to cut right through piston rings without leaving jagged edges - a loose retainer will not cut but will break the ring. If retainer falls out or is not installed in the first place, the pin may rub a regular groove in the cylinder wall. Often damage such as this goes by unnoticed until power becomes extremely poor due to lack of compression.

d. Ring Breakage. If a ring breaks, the engine may continue running; however, it will probably backfire badly and it cannot be restarted after it is shut down. Ring breakage occurs from overheating due to lack of proper lubrication. A poor quality or wrong type of oil may have been used or the oil may have been poorly mixed or mixed

in incorrect proportion with the gasoline. A ring that has been subjected to overheating often becomes soft and is easily bent.

e. Rings Sticking. If there has been repeated occurrence of spark plug fouling, the rings might be stuck in the grooves due to carbon fouling. This usually occurs from an "over-rich" fuel mixture. If the build-up is varnish rather than carbon, this probably indicates use of an unauthorized lubricating oil.

f. Broken, Damaged Rods. Pounding on the end of the crankshaft to remove the flywheel can play havoc with connecting rods and rod bearings. This practice can push the counterweights together squeezing the rod small end bearing, indicated by the metal lapped over edges. This, of course, freezes the needle bearing and snaps the connecting rod. Always use a puller to remove the flywheel and also to get the impeller off the taper of the crankshaft.

6-105. ENGINE RECONDITIONING.

a. Crankshaft - Connecting Rod.

NOTE

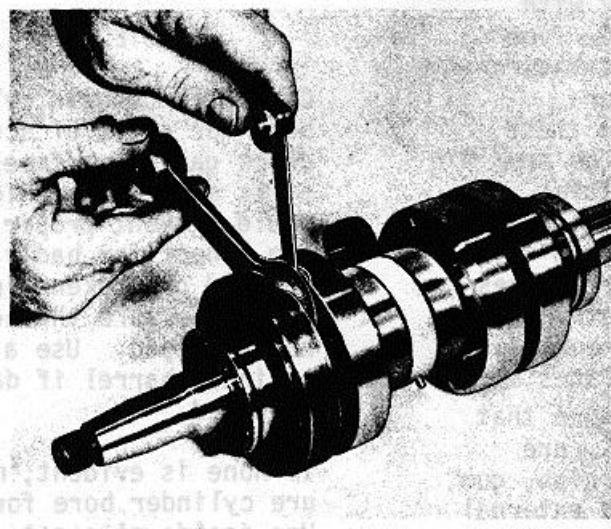
If a visual check fails to uncover any damage, install crankshaft-rod assembly in vise - use protective caps on Jaws. Make following tests to determine if the crankshaft-rod assembly can be reused. Do not attempt to disassemble crankshaft for reconditioning - special tools and equipment are required for this. If center main or rod bearings or crankshaft are damaged, or connecting rods have any noticeable radial play replace assembly as a unit. Do not reinstall outer main bearing until after end play is established.

(1) Outer Main Bearing. First check crankshaft outer main bearings for evidence of binding or roughness. Turn bearings by hand - if bearings are in good condition, rotation will be smooth. The outer main bearing may be removed and replaced if necessary. To install new bearings, heat inside bearing race with a heat gun or set bearing on light bulb, then press them onto the crankshaft.

(2) Inner Main Bearing and Labyrinth Seal. These bearings cannot be removed - if these are damaged, replace crankshaft assembly.

(3) Rod Side Play. Check lateral movement of connecting rod as shown in figure 6-2. If side play stays within the 0.016 to 0.020 inch range, end play is within allowable limits.

(4) Shaft Alignment. Install crankshaft in V blocks with outer mains resting in blocks and check concentricity with dial indicator riding on shaft as shown in figure 6-3. If run-out exceeds 0.002 inch TIR, remove shaft and try to bring back into alignment by either pinching weights closer together in a vise or by spreading them further apart with a metal wedge. Repeat alignment check after repositioning weights. If this fails to bring shafts back into alignment, a new assembly must be used.



**SIDE PLAY
0.016 TO 0.02 INCH**

Figure 6-2. Connecting Rod Side Play

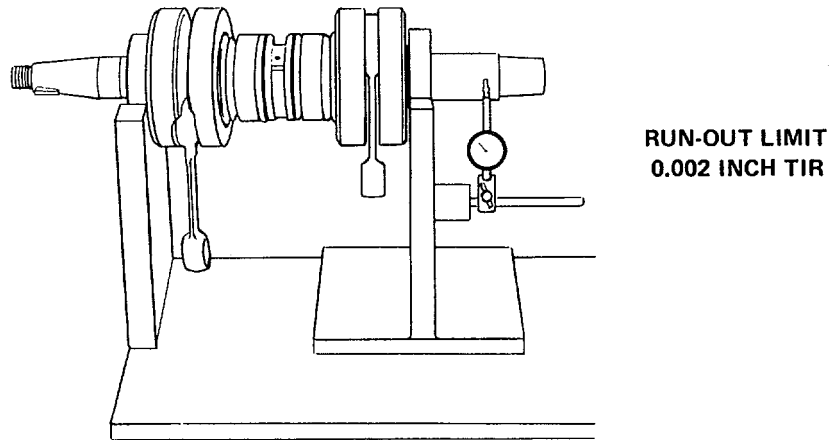


Figure 6-3. Crankshaft Run-Out

(5) **Cleaning.** After checking shaft, thoroughly clean assembly with general purpose cleaner, P-D-680, Type II. DO NOT use kerosene as this leaves an oily film. Alcohol or lacquer thinner also must not be used as these, on the other hand, leave parts too dry and may cause seizure during initial start up after reconditioning.

b. **Crankcase.** (See figure 3-3.) Carefully inspect upper and lower halves of crankcase assembly. Check mating surfaces. Replacement of the crankcase assembly may be required if surfaces are badly nicked or grooved. Make sure that all screws, threads, studs, etc., are clean and undamaged. Remove varnish, gum, etc., deposits from internal and external surfaces by using carbon removing compound, MIL-C-19853, FSN 6850-00-702-8451.

c. **Cylinder Head.** (See figure 3-3.) Make certain that cooling fins are unbroken and that threads for spark plug are clean and undamaged. Also check gasket surface of head. Replace head if internal surface is scratched, nicked or distorted. Clean out any carbon deposits from inside the combustion dome by using carbon removing compound, MIL-C-19853, (FSN 6850-00-702- 8451) if badly varnished or if carbon deposits cannot be removed, use a new cylinder head.

d. **Cylinders.** (See figure 3-3.)

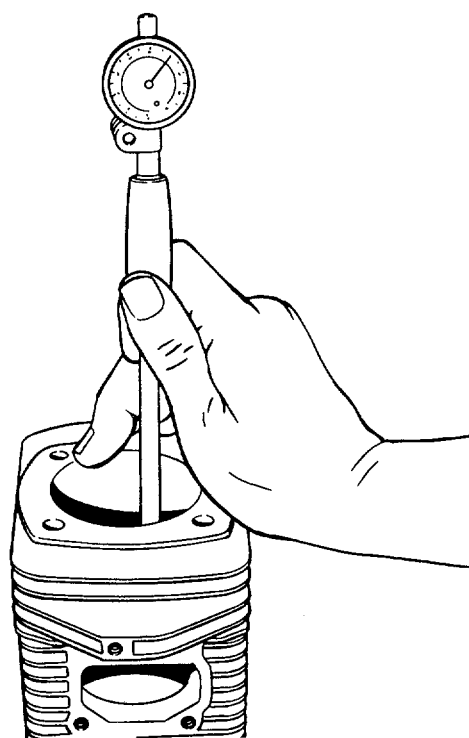
NOTE

Carefully observe cylinder bore for signs of scuffing, check gasket surfaces for nicks or grooves which could prevent proper seal- ing, check for badly chipped or broken fins. Also make sure threads are not stripped. Use a new cylinder barrel if damage is noted.

If none is evident, measure cylinder bore for wear. Use inside micrometer or bore gage and check area Just below top of bore. Wear will be indicated by a "step" worn into wall. Move the micrometer in a circular direction, 90 degrees at a time. If worn more than 0.002 inch cylinder will have to be replaced (see figure 6-4).

e. **Piston - Piston Rings.** (See figure 3-3.)

(1) To check wear, measure piston at the top level of the piston



**BORE WEAR LIMIT
0.002 INCH**

STANDARD (NEW)	SERVICE LIMIT (USED)
2.6774 to 2.6781 INCH	2.681 INCH

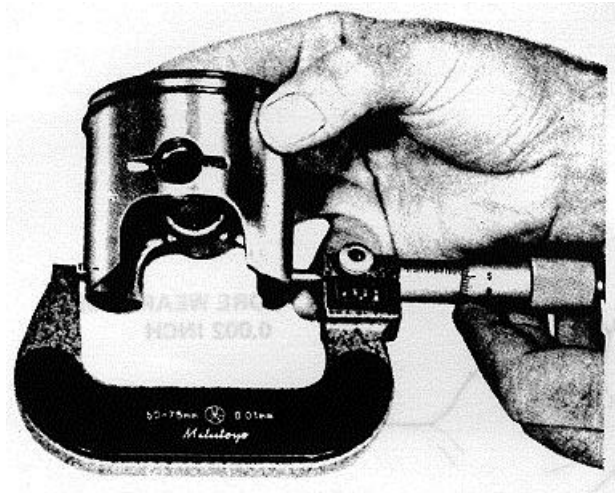
Figure 6-4. Cylinder Bore Wear

skirt (Just below bottom ring) and at right angle to the piston pin. If wear exceeds between 0.002 to 0.004 inch, the piston must be replaced. Also replace if there is any evidence of pitting on top of the piston. (See figure 6-5.)

(2) If piston is undamaged and can be reused, remove used rings and fit new rings; never reuse rings. After removing old rings, break one of the old rings in half and use this to clean carbon deposits from the ring grooves - be careful not to scratch or enlarge grooves when doing this. Carbon removing compound, MIL-C-19853, (FSN 6850-00-702-8451) may also be used.

(3) Before installing new rings, insert each ring into the bottom of the cylinder bore, square with piston then check ring end gap with feeler gage. (See figures 6-6 and 6-7.)

**WEAR LIMIT
0.002 TO 0.004 INCH**



STANDARD (NEW)	SERVICE LIMIT (USED)
2.6744 TO 2.6752 INCH	2.670 INCH

Figure 6-5. Piston Wear

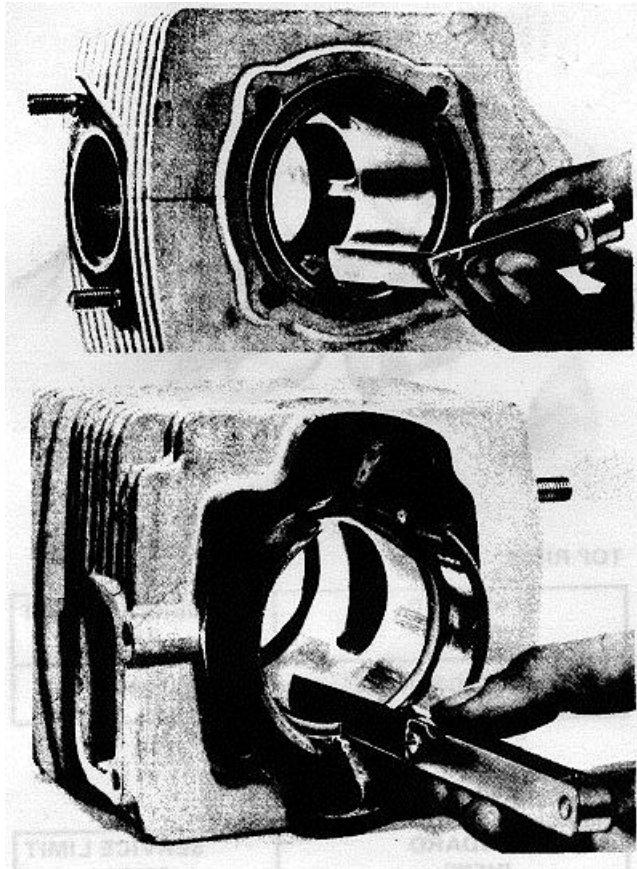
(4) Ring side clearance must also be checked before installation. To do this, place in its proper groove and check side clearance with feeler gage as shown in the accompanying illustration. Side clearance must not be more than that specified in figure 6-6. If more than this, groove is worn beyond limits and piston must be replaced.

(5) The Axial Flow engines use "L" shaped ring in the top groove. Use ring expander to install ring. On all models, turn rings so that the ring gap is over the small locating pins in the piston grooves.

6-106. ENGINE REASSEMBLY.

NOTE

The following is sequence for reassembly of a typical two cylinder engine. The procedure does not, in most cases, cover reassembly of the various sub-assemblies. This has been covered elsewhere in this chapter. Make sure work area and all parts are kept clean during final assembly of the engine.



STANDARD (NEW)	SERVICE LIMIT (USED)
0.008 TO 0.016 INCH	0.028 INCH

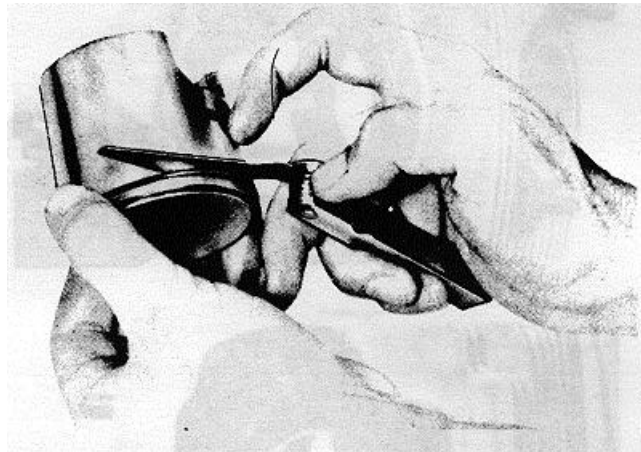
Figure 6-6. Piston Ring Clearance

a. Crankshaft End Play Adjustment. If bearings are replaced you must measure crankshaft and shim as required to assure correct end play exists when crankshaft is installed in crankcase. Proper end play is to be established by the following procedure:

(1) With a suitable micrometer, measure distance B. (The distance across the outer surfaces of each pair of crankshaft flyweights as shown in figure 6-8.)

(2) Refer to Shim Chart (distance B) for the appropriate shim to be placed between the bearings and outer flyweights. (See figure 6-8.)

(3) After installing the first two bearings, and shims B, distance A is to be computed by measuring the total distance between the outer-most race surfaces of the two bearings already installed, and adding to that measurement, the thickness dimension of the bearing yet to be installed. The arrived-at sum of these dimensions will constitute distance A. (See figure 6-8.)



TOP RING

STANDARD (NEW)	SERVICE LIMIT (USED)
0.0020 TO 0.0047 INCH	0.009 INCH

BOTTOM RING

STANDARD (NEW)	SERVICE LIMIT (USED)
0.020 TO 0.0035 INCH	0.008 INCH

Figure 6-7. Piston Ring Side Gap

(4) Refer to Shim Chart (distance A) and select the appropriate shim(s) required between the two left hand main bearings.

b. Crankcase, Crankshaft. (1) Lubricate all bearings with SAE 10 weight oil.

(2) Align crankshaft labyrinth seal aligning pin with recess in upper crankcase half and carefully insert crankshaft into crankcase. (See figure 6-9.)

(3) Install washers in crankcase grooves. Apply a thin coat of multipurpose, DOD-G-24508, grease to inner section of oil seals and install oil seals to crankshaft.

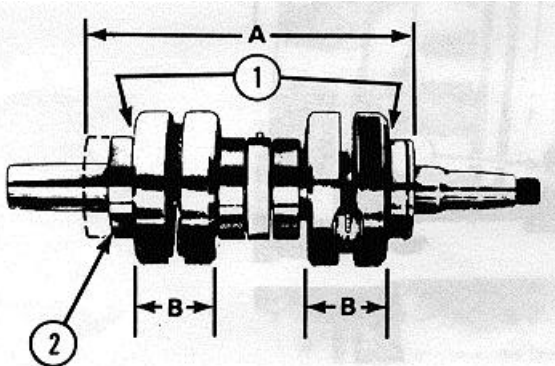
CAUTION

When replacing bearings, crankshaft surface that oil seal contacts may be scratched which will cause excessive seal wear. Always remove any irregularities on the shaft surface using No. 400 emery cloth before installing new oil seals.

(4) Apply crankcase sealer 3M EC847 or equivalent to lower crankcase half and carefully attach crankcase halves. (See figure 6-10).

Shim(s) Required for Distance A

Distance A	Required Shim Reference Number(s)
8.0158 to 8.0256 inch (203.61 to 203.84 mm)	None
8.0119 to 8.0157 inch (203.51 to 203.60 mm)	1
8.0080 to 8.0118 inch (203.41 to 203.50 mm)	2
8.0040 to 8.0079 inch (203.31 to 203.40 mm)	3
8.0001 to 8.0039 inch (2-3/21 to 203.30 mm)	4
7.9962 to 8.0000 inch (203.11 to 203.20 mm)	5
7.9922 to 7.9961 inch (203.01 to 203.10 mm)	6
7.9898 to 7.9921 inch (202.93 to 203.00 mm)	6+1, or 5+2, or 4+4



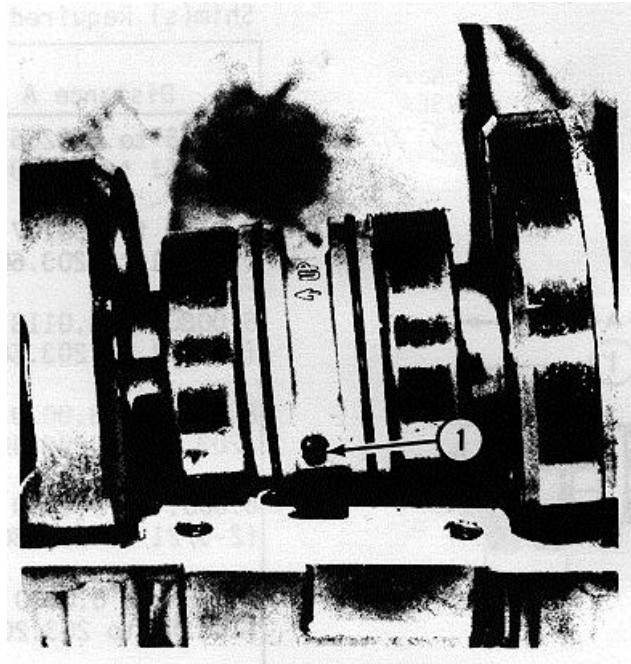
Shim(s) Required for Distance B

Distance B	Required Shim Reference Number(s)
1.9551 to 1-9634 inch (49.66 to 49.87 mm)	None
1.9469 to 1.9547 inch (49.45 to 49.65 mm)	2
1.9378 to 1.9465 inch (49.22 to 49.44 mm)	4

Shim Description Chart

Shim Reference Number	Part Number	Thickness
1 (0.1 mm)	92025-513	0.0039 in.
2 (0.2 mm)	92025-518	0.0078 in.
3 (0.3 mm)	92025-523	0.0118 in.
4 (0.4 mm)	92025-527	0.0157 in.
5 (0.5 mm)	92025-530	0.0197 in.
6 (0.6 mm)	92025-533	0.0236 in.

Figure 6-8. Crankshaft 2nd Play



1. Aligning Pin

Figure 6-9. Aligning Labyrinth Seal Aligning Pin

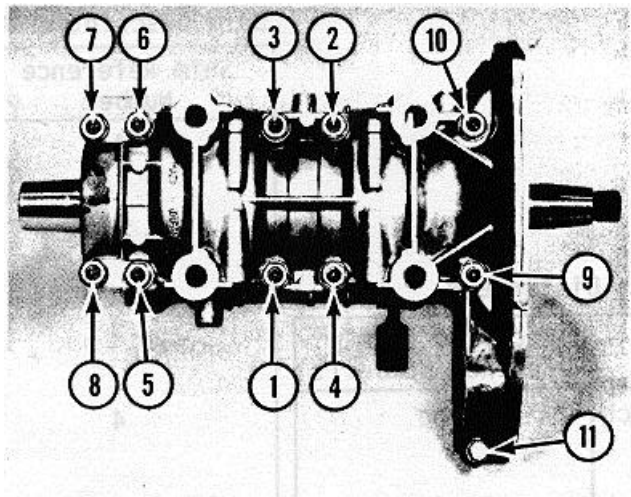


Figure 6-10. Sequence for Securing Crankcase Halves

WARNING

The safety precautions of Naval Ships Technical Manual NAVSEA 0901-LP-190-0002, Chapter 9190, should be exercised. The solvents in these sealers are toxic and highly flammable while drying. Ensure adequate ventilation and the absence of all sources of ignition while using these sealers.

NOTE

Apply torque in one third increments to prevent distortion of crankcase halves.

c. Piston - Ring Assembly.

(1) Apply light coat of BIA-TC-W oil (NSN-9150-00-117-8791) to piston pin needle bearings and insert needle bearing into upper connecting rod.

(2) Install piston to connecting rod with arrow pointing toward exhaust side. Insert piston pin and secure piston pin using new circlips, snap rings, or equivalent. Use the piston pin tool when installing pin. (See figure 6-11.)

CAUTION

New circlips must be used to prevent serious engine damage.

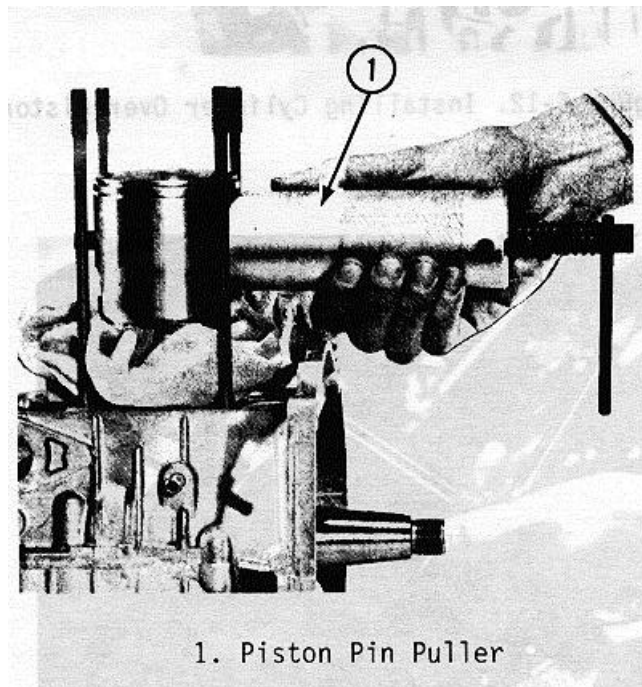


Figure 6-11. Piston Pin Installation

d. Cylinders.

(1) Install new base gaskets on crankcase.

(2) Apply a light coat of BIA-TC-W oil (NSN-9150-00-117-8791) to bearing on each end of rod, inside of

cylinders and outside of pistons. Align piston rings with locating pins on piston and using ring compressor tool, compress the rings and install cylinders over pistons. (See figure 6-12.)

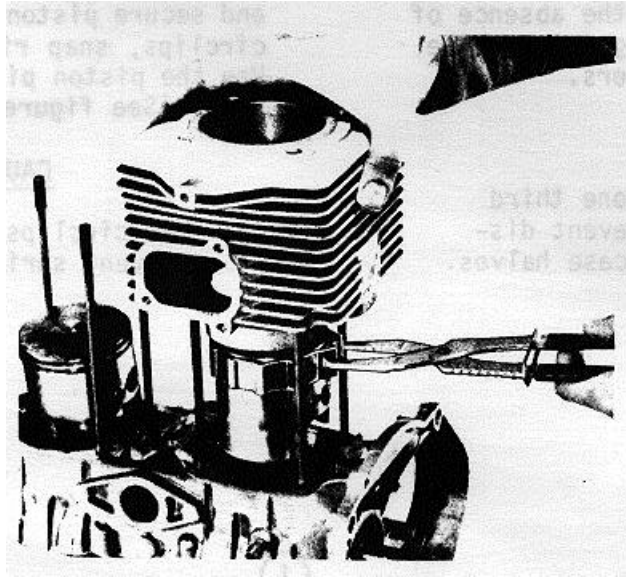
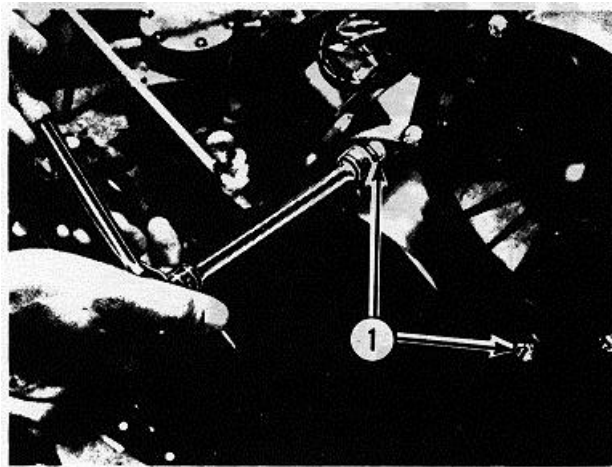
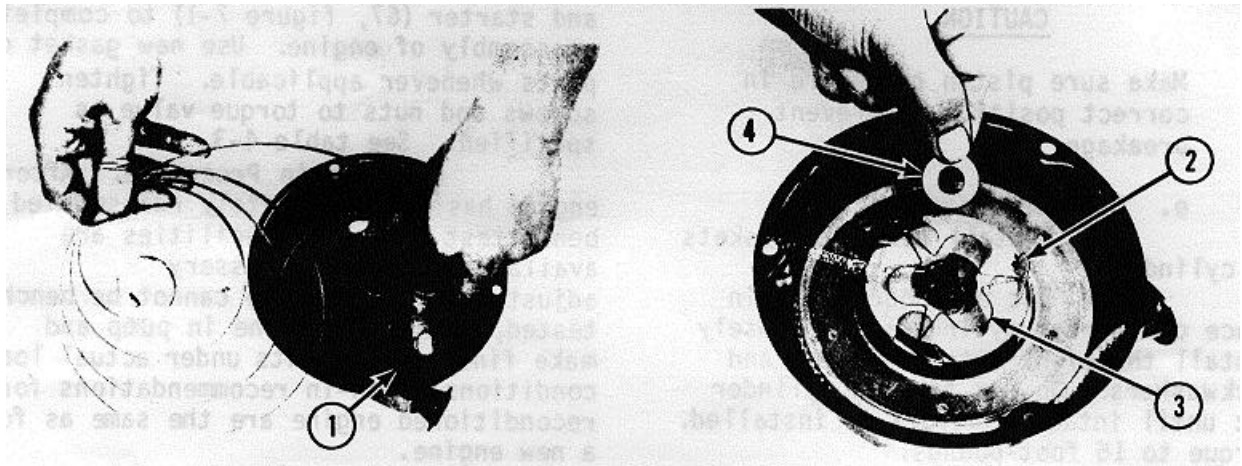


Figure 6-12. Installing Cylinder Over Piston



1. Slotted Hex Head Bolts

Figure 6-13. Removing Starter Assembly



1. Spring Hook in Slot
2. Pawl
3. Pawl Return Spring
4. Thrust Washer

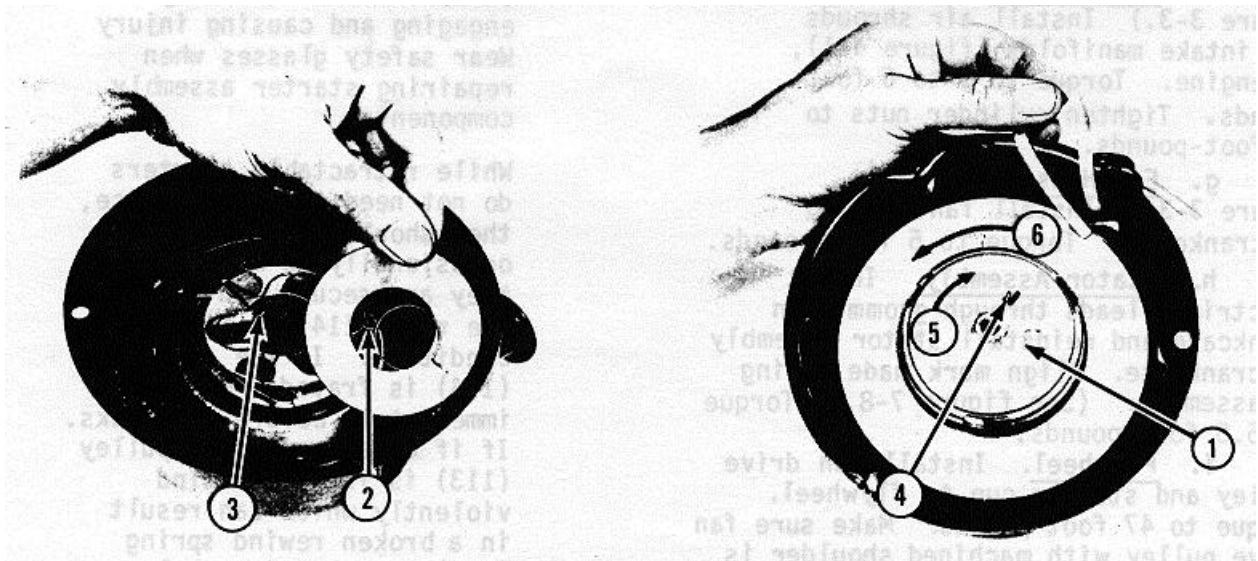


Figure 6-14. Installing Return Spring

1. Friction Plate
2. Straight End of Spring
3. Hole in Reel
4. End of Spring through Slot
5. Rotate-1/3 Turn (clockwise)
6. Rotate until Handle Meets Housing (counterclockwise)

Figure 6-15. Starter Reassembly

CAUTION

Make sure piston rings are in correct position to prevent breakage.

e. Cylinder Heads.

(1) Install new head gaskets to cylinders.

(2) Set cylinder heads in place on correct cylinders and loosely install the eight nuts, washers, and lockwashers. Do not tighten cylinder nut until intake manifold is installed. Torque to 16 foot-pounds.

NOTE

The long nuts are installed on the outside studs of the PTO side cylinder head.

f. Air Shrouds. (See figure 3-3.) Install air shrouds and intake manifolds (figure 4-1), to engine. Torque to 5 to 6 foot-pounds. Tighten cylinder nuts to 16 foot-pounds.

g. Fan Housing. (See figure 3-3.) Install fan housing to crankcase. Torque to 5 foot-pounds.

h. Stator Assembly. Insert electrical leads through grommet in crankcase and reinstall stator assembly to crankcase. Align mark made during disassembly. (See figure 7-8.) Torque to 5.5 foot-pounds.

i. Flywheel. Install fan drive pulley and starter cup to flywheel. Torque to 47 foot-pounds. Make sure fan drive pulley with machined shoulder is towards the flywheel. Install flywheel on crankshaft. (See figure 3-3.) Torque to 60 foot-pounds.

j. Fan Belt. Install fan belt and check belt tension. (Refer to paragraph 4-13.)

k. Engine System, Accessories. Reinstall carburetor

(75, Figure 7-1), exhaust system (36 and 68, figure 7-1), and starter (67, figure 7-1) to complete reassembly of engine. Use new gasket or parts whenever applicable. Tighten screws and nuts to torque value as specified. See table 4-3.

(1) Run-in Procedure. After engine has been completely reassembled, bench test engine if facilities are available and make necessary adjustments. If engine cannot be bench tested, reinstall engine in pump and make final adjustments under actual load conditions. Run-in recommendations for a reconditioned engine are the same as for a new engine.

6-107. RETRACTABLE STARTER MAINTENANCE.WARNING

Exercise care when removing recoil reel (103, Figure 7-8) from starter assembly. All spring tension should be released to prevent spring (102) from accidentally disengaging and causing injury. Wear safety glasses when repairing starter assembly components.

While retractable starters do not need regular service, they should be checked occasionally to make sure they are secure and that the rope (114) is in good condition. If the rope (114) is frayed, replace it immediately before it breaks. If it does break, the pulley (113) is free to rewind violently which can result in a broken rewind spring (102) or other internal damage.

a. Removal.

(1) Unscrew three slotted hex head bolts (1, figure 6-13) securing starter assembly to engine and remove starter assembly.

(2) Remove starter handle (115, figure 7-8) and tie knot in

starter rope (114) to prevent rope from suddenly retracting into the recoil case.

b. Disassembly.

(1) Release return spring tension by removing handle (115) from starter rope and allow rope to retract slowly by applying thumb pressure on recoil reel (103).

(2) Exert slight downward pressure on friction plate (109) then remove securing nut (112) and washers (111 and 110) while slowly removing friction plate (109)

(3) Remove the plate return spring (106), friction spring (105), pawl springs (108), pawls (107), and thrust washer (104) from starter assembly (see figure 7-8). Check the return spring (106) and friction spring (105) for breaks, rust, distorted, or weakened condition.

(4) To replace starter rope (114), remove recoil reel (103) from starter assembly. Untie knot and remove starter rope (114). Install new starter rope (114) and tie a securing knot.

(5) With recoil reel (103) removed, examine return spring (102) for cracks, crystallization, or abnormal bends. Exercise care when handling recoil case (119) to prevent return spring (102) from accidentally disengaging. Spring should remain in the recoil case (119).

(6) To remove return spring (102), hold recoil case (119) approximately 2 inches above work bench with flat surface of housing towards palm of hand. Slap mounting surface of recoil case (119) against bench to release spring (102) from housing.

c. Reassembly.

(1) Thoroughly clean all parts removed prior to reassembling starter. Reassemble components in sequence shown in figure 7-8.

(2) To install return spring, insert outside spring hook into slot, and carefully wind spring in direction shown, while applying pressure with fingers to prevent

spring from jumping out of case (see figure 6-14).

(3) Apply light coat of multipurpose grease, DOD-G-24508, to spring and housing.

(4) With the rope installed on reel, (103, figure 7-8), insert reel assembly into case (119) Be sure to engage reel (103) with spring hook near center of case (119).

(5) Assemble starter pawls (2), pawl return springs (3). and thrust washer (4). (See figure 6-14.) (6) Insert straight end of plate return spring into hole (3) of reel. (See figure 6-15.)

NOTE

Apply multipurpose grease, DOD-G-24508, to dimples in friction plate side of thrust washer prior to performing next step.

(7) Install friction spring (105, figure 7-8) onto stub in recoil case (119), then carefully position friction plate (109) onto reel (103) assembly as follows:

(a) Lower friction plate (1, figure 6-15) only until bent end of plate return spring (4) enters slot shown in figure 6-15.

(b) Prelude friction plate (1) by turning plate 1/3 turn clockwise. (See figure 6-15.)

(c) With prelude applied to friction plate (1) lower plate completely into position (guide cutouts in plate over end of pawls) and secure.

NOTE

After assembly check to be sure pawl return springs remained properly positioned by moving tip of pawl outward and release. If pawl does not return to disengaged position remove friction plate and repeat steps (5) through (8), above.

(8) Fasten handle (115, figure 7-8) to rope with knot, then apply prelude to return spring by placing rope (114) in notch of recoil reel and rotate reel counterclockwise until handle retracts into housing. (See figure 6-15.)

(9) Pull starter handle and check starter assembly for proper operation.

d. Installation.

NOTE

Before bolts are tightened pull slightly on starter rope to engage pawls, then tighten bolts securely.

(1) Secure starter assembly to engine using three hex head bolts. Torque to 60 pound-inches.

(2) Pull starter a few times and observe starter operation.

**CHAPTER 7
MAINTENANCE PARTS LIST**

7-1. GENERAL.

7-2. This maintenance parts list lists, describes and illustrates replaceable parts for the PE-250 Fire Fighting Pump manufactured by the Prosser-East Division of Purex Industries, Horsham, PA. The following paragraphs explain the presentation of the material in this chapter.

7-3. MAINTENANCE PARTS LIST.

7-4. CONTENTS.

7-5. The Maintenance Parts List is systematically broken down into installation, assemblies, and detail parts which fall into the following categories: those considered impractical to fabricate with average field equipment and those which are subject to frequent removal and replacement.

7-6. The following items, unless specifically ordered as spares, are not included in this Maintenance Parts List: details of welded assemblies and similar parts which have lost their individual identity by being fabricated into permanent assemblies. Excluded also are those parts which are normally carried as standard stock, such as rivets, locker, cement, etc.

7-7. INDENTION AND NOMENCLATURE.

7-8. Each of the major groups is broken down into assemblies, subassemblies, sub-subassemblies, detail parts and attaching parts. Parts are listed in their proper sequence of disassembly, except that attaching parts follow immediately after items to be attached and preceding any components of the item. The nomenclature for the component parts of each assembly or installation is listed immediately following the assembly

and indented one column to the right of the next higher assembly (NHA). The attaching parts are listed in the same column as the parts they attach and are captioned "(AP)", which follows the name of the item. The following outline shows the indentation procedure:

1 2 3 4 5 6 7

Assembly (See figurefor NHA)

- Subassemblies
- Attaching parts for subassemblies (AP)
- Detail parts for subassemblies
- Sub-subassemblies
- Attaching parts for sub-subassemblies
- Detail parts for sub-subassemblies

7-9. FIGURE AND INDEX NUMBER.

7-10. The figure and index number listed immediately preceding the part number indicates the location of the part on the illustration.

7-11. PART NUMBER.

7-12. The numbers in the part number column are contractor part numbers.

7-13. CONTRACTOR'S PART NUMBERS.

7-14. The contractor's part numbering system is an alphanumeric sequence of drawing numbers.

7-15. Where an assembly has required a detail breakdown on a separate figure, the nomenclature of the assembly listed

under its proper next higher assembly is followed by "(See figure for detail breakdown)".

7-16. Where an assembly has been broken down on one figure and reference to its next higher assembly on another figure, the nomenclature is followed by "(See

figure for NHA)".

7-17. When several identical parts, such as nuts, bolts, washers, etc. Are used in the same location, only one part is shown on the illustration.

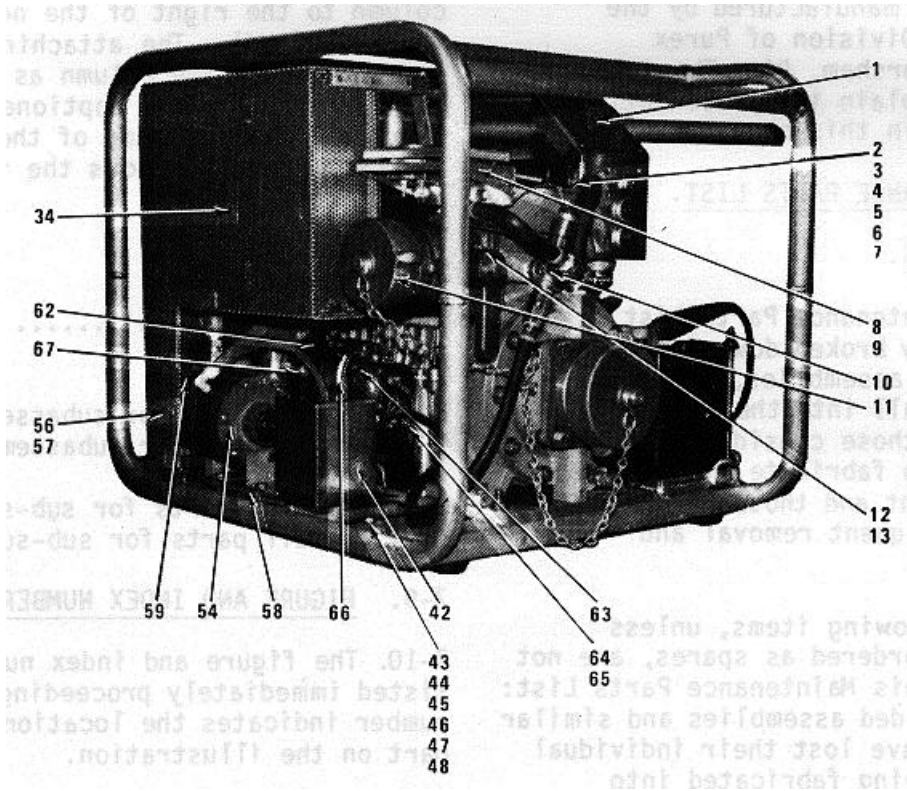


Figure 7-1. Fire Pump (Sheet 1 of 3)

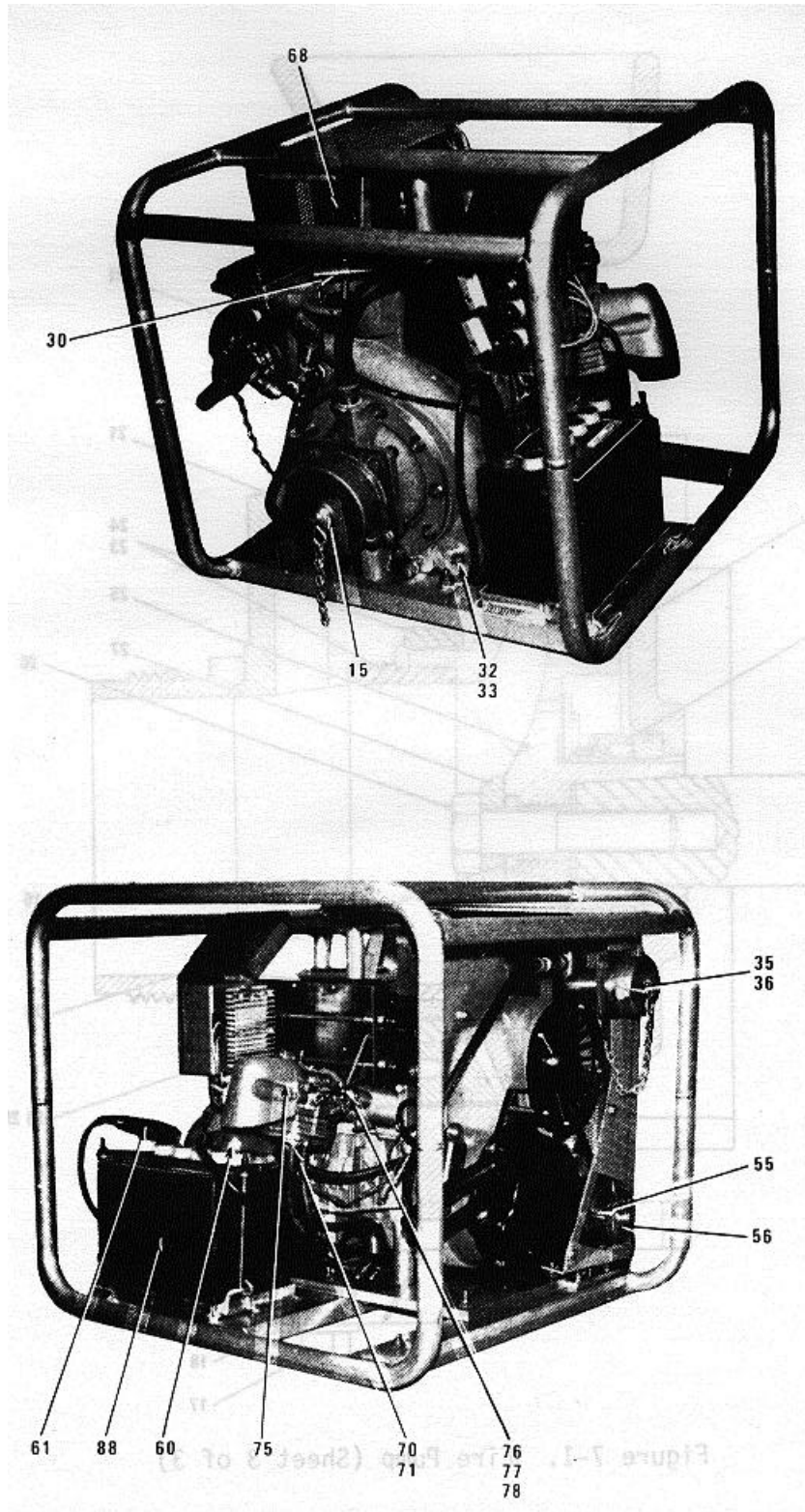


Figure 7-1. Fire Pump (Sheet 2 of 3)

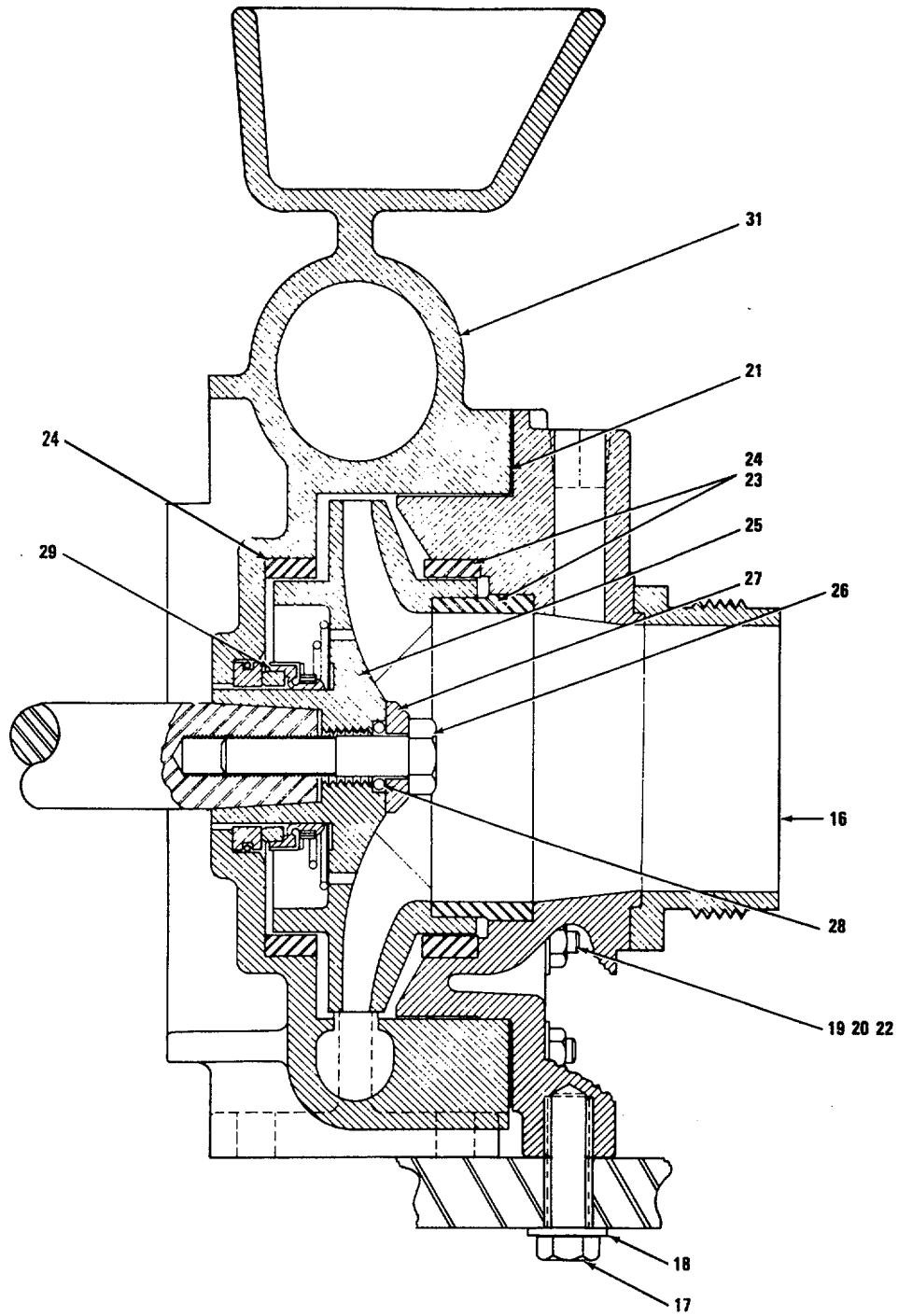


Figure 7-1. Fire Pump (Sheet 3 of 3)

Fig. & Index No.	Part Number	Description	1 2 3 4 5 6 7							Qty Per Assy
			1	2	3	4	5	6	7	
7-1-	PE-250	PUMP, Centrifugal, gasoline engine driven								1
-1	PE-2325	portable fire fighting service ENGINE CONTROL PANEL ASSEMBLY.....								1
		(See figure 7-2 for breakdown)								
-2	PE-2451	SCREW, Machine, RDH, 10-32 x 2-1/2, SS (AP)								2
-3	PE-1489	NUT, Plain hexagon, 10-32, SS (AP).....								2
-4	PE-1502	WASHER, Lock, IT, No. 10, SS (AP).....								2
-5	PE-2450	SCREW, Cap hex head, 6 mm x 16 mm, SS (AP)								2
-6	PE-2490	WASHER, Flat, 6 mm, SS (AP).....								2
-7	PE-2496	WASHER, Lock, split, 6 mm, SS (AP).....								2
-8	PE-1340	GAGE PANEL ASSEMBLY (See figure 7-3								1
		for breakdown)								
-9	PE-1454	SCREW, Cap hex head, 1/4-20 x 3/8, SS (AP)								3
-10	PE-2399	PIPING ASSEMBLY (See figure 7-4 for breakdown)								1
-11	PE-1246	CAP AND CHAIN, Discharge								1
-12	PE-1244	VALVE, Discharge								1
-13	PE-1566	SCREW, Cap hex head, 5/16-18 x 1, SS (AP).....								4
-14	PE-2120	ENCLOSURE COIL ASSEMBLY.....								1
-15	PE-1245	CAP AND CHAIN, Suction								1
-16	PE-2235-1	SUCTION HEAD AND HOSE ADAPTER ASSEMBLY .								1
-17	PE-1553	SCREW, Cap hex head, 3/8-16 x 2, SS (AP).....								1
-18	PE-1498	WASHER, Lock, split, 3/8, SS (AP)								1
-19	PE-1483	NUT, Plain hexagon, 5/16-18, SS (AP).....								10
-20	PE-1492	WASHER, Flat, 5/16, SS (AP).....								10
-21	PE-1536	GASKET.....								1
-22	PE-1515	STUD, 5/16-18 x 1-1/2, SS.....								10
-23	PE-1236	RING, Clearance, front inner								1
-24	PE-1234	RING, Clearance, outer and inner								2
-25	PE-1233	IMPELLER								1
-26	PE-1240	SCREW, Impeller.....								1
-27	PE-1238	WASHER, Impeller.....								1
-28	PE-1239	SEAL, Impeller.....								1
-29	PE-1237	SEAL, Water.....								1
-30	PE-1535	PLUG AND CHAIN, Body.....								1
-31	PE-2231	BODY, Pump.....								1
-32	PE-1528	SCREW, Cap hex head, 3/8-16 x 1, SS (AP).....								4
-33	PE-1498	WASHER, Lock, split, 3/8, SS (AP).....								4
-34	PE-2193	GUARD ASSEMBLY.....								1
-35	PE-1320	CAP AND CHAIN, Exhaust.....								1
-36	PE-3300	MUFFLER EXHAUST ASSEMBLY (See figure 7-5								1
		for breakdown)								
-37	PE-1474	SCREW, Tapping, filibuster head, No. 10 x 3/8,								1
		SS (AP)								
-38	PE-1502	WASHER, Lock, IT, No. 10, SS (AP).....								1
-39	PE-2450	SCREW, Cap hex head, 6 mm x 16 mm, SS (AP)								1
-40	PE-2490	WASHER, Flat, 6 mm, SS (AP)								2
-41	PE-2496	WASHER, Lock, split, 6 mm, SS (AP)								2
-42	PE-2260	OILER ASSEMBLY.....								1
-43	PE-1453	SCREW, Cap hex head, 1/4-20 x 1-3/4, SS (AP)....								2
-44	PE-1444	WASHER, Flat, 1/4, SS (AP).....								2
-45	PE-1485	NUT, Self locking, hexagon, 1/4-20, SS (AP)								2

Fig. & Index No.	Part Number	Description							Qty Per Assy
		1	2	3	4	5	6	7	
7-1-	PE-2570	.	.	.	.	.	.	.	1
-46	PE-1453	.	.	.	.	.	.	.	2
-47	PE-1994	.	.	.	.	.	.	.	3
-48	PE-1485	.	.	.	.	.	.	.	3
-49	PE-1593	.	.	.	.	.	.	.	4
-50	PE-1582	.	.	.	.	.	.	.	1
-51	PE-1451	.	.	.	.	.	.	.	4
-52	PE-1485	.	.	.	.	.	.	.	4
-53	PE-2581	.	.	.	.	.	.	.	2
-54	PE-1590	.	.	.	.	.	.	.	1
-55	PE-1580	.	.	.	.	.	.	.	1
-56	PE-1254	.	.	.	.	.	.	.	1
-57	PE-1558	.	.	.	.	.	.	.	1
-58	PE-2583	.	.	.	.	.	.	.	1
-59	PE-2151	.	.	.	.	.	.	.	1
-60	PE-1367	.	.	.	.	.	.	.	1
-61	PE-1368	.	.	.	.	.	.	.	1
-62	PE-1390	.	.	.	.	.	.	.	1
-63	PE-1350	.	.	.	.	.	.	.	1
-64	PE-1450	.	.	.	.	.	.	.	2
-65	PE-1485	.	.	.	.	.	.	.	2
-66	PE-2015	.	.	.	.	.	.	.	1
-67	PE-2395	.	.	.	.	.	.	.	1
-68	PE-2276	.	.	.	.	.	.	.	1
-69	PE-1374	.	.	.	.	.	.	.	1
-70	PE-1921	.	.	.	.	.	.	.	2
-71	PE-1549	.	.	.	.	.	.	.	4
-72	PE-1530	.	.	.	.	.	.	.	1
-73	PE-1550	.	.	.	.	.	.	.	1
-74	PE-1496	.	.	.	.	.	.	.	1
-75	PE-1017	.	.	.	.	.	.	.	1
-76	PE-1492	.	.	.	.	.	.	.	2
-77	PE-1497	.	.	.	.	.	.	.	2
-78	PE-2021	.	.	.	.	.	.	.	2
-79	PE-2020	.	.	.	.	.	.	.	2
-80	PE-2011	.	.	.	.	.	.	.	1
-81	PE-2225	.	.	.	.	.	.	.	4
-82	PE-2551	.	.	.	.	.	.	.	4
-83	741190	.	.	.	.	.	.	.	4
-84	PE-2220	.	.	.	.	.	.	.	1
-85	PE-1565	.	.	.	.	.	.	.	6
-86	PE-1443	.	.	.	.	.	.	.	6
-87	PE-1487	.	.	.	.	.	.	.	6
-88	PE-1364	.	.	.	.	.	.	.	1
-89	PE-2425	.	.	.	.	.	.	.	1

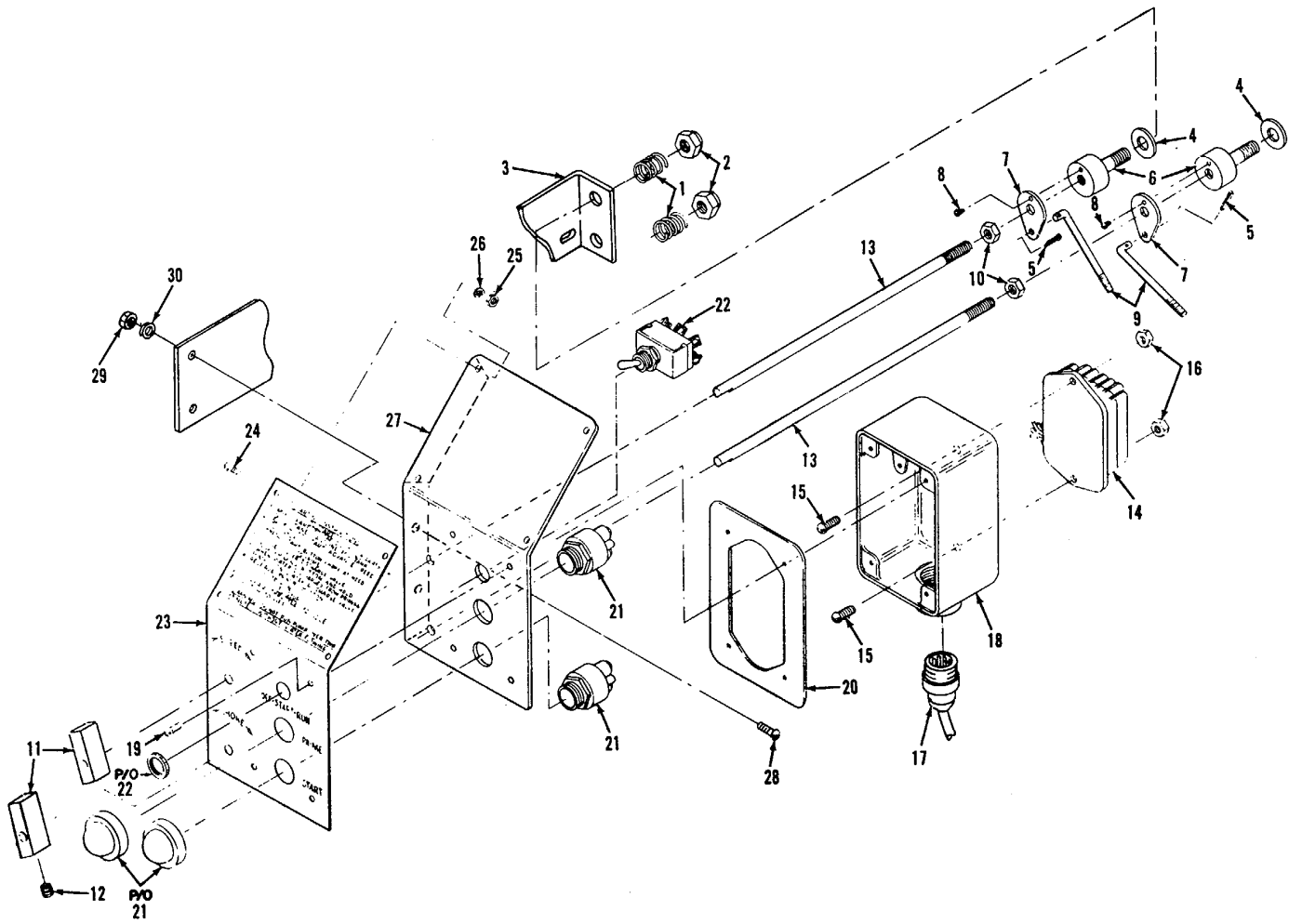


Figure 7-2. Engine Control Panel Assembly, Exploded View

Fig. & Index No.	Part Number	Description							Qty Per Assy
		1	2	3	4	5	6	7	
7-2-	PE-2325	ENGINE CONTROL PANEL ASSEMBLY.....							REF
		(See figure 7-1 for NHA)							
-1	PE-1330	. SPRING, Helical, compression							2
-2	PE-1486	NUT, Self-locking hexagon, 5/16-18, SS (AP)							2
-3	PE-2336	..BRACKET, Control, mounting							1
-4	PE-1501	. WASHER, Flat, 5/16 ID x 3/4 OD x 1/16 the,							2
		NIL							
-5	PE-1505	. PIN, Cotter, extended prong, 1/16 x 1/2, SS.....							2
-6	PE-1328	SPINDLE, Control							2
-7	PE-1329	ARM, Control							2
-8	PE-1473	. SCREW, Drive, type "U", No. 2 x 3/16 SS (AP).....							2
-9	PE-1331	.ROD, Throttle and Choke.....							2
-10	PE-1482	. NUT, Plain hexagon, 1/4-20, SS							2
-11	PE-1334	. KNOB, Throttle and Choke							2
-12	PE-1477	. SETSCREW, Knurled cup point, 8-32 x 3/8, SS							2
-13	PE-1333	. SHAFT, Throttle and Choke							2
-14	PE-1353	. VOLTAGE REGULATOR							1
-15	PE-1451	. SCREW, Cap hex head, 1/4-20 x 3/4, SS (AP)							2
-16	PE-1485	. NUT, Self-locking hexagon, 1/4-20, SS (AP)							2
-17	PE-1392	. CONNECTOR							1
-18	PE-1542	. BOX, Control							1
-19	PE-1472	. SCREW, Machine, RDH, 6-32 x 1/2, SS (AP)							5
-20	PE-1541	. GASKET, Control box							1
-21	PE-1360	. SWITCH, Pushbutton							2
-22	PE-1359	. SWITCH, Toggle, SPDT, 3-position							1
-23	PE-1533	PLATE, Information.....							1
-24	PE-1479	. SCREW, Machine, RDH, 6-32 x 5/16, SS (AP)							4
-25	PE-1488	. NUT, Plain hexagon, 6-32, SS (AP)							4
-26	PE-1500	. WASHER, Lock, IT, No. 6, SS (AP)							4
-27	PE-1326	. PANEL, Control							1
-28	751411	. SCREW, Machine, RDH, 8-32 x 3/8, SS (AP)							2
-29	PE-1480	. NUT, Plain hexagon, 8-32 x 3/8, SS (AP).....							2
-30	PE-1499	. WASHER, Lock, IT, No. 8, SS (AP)							2

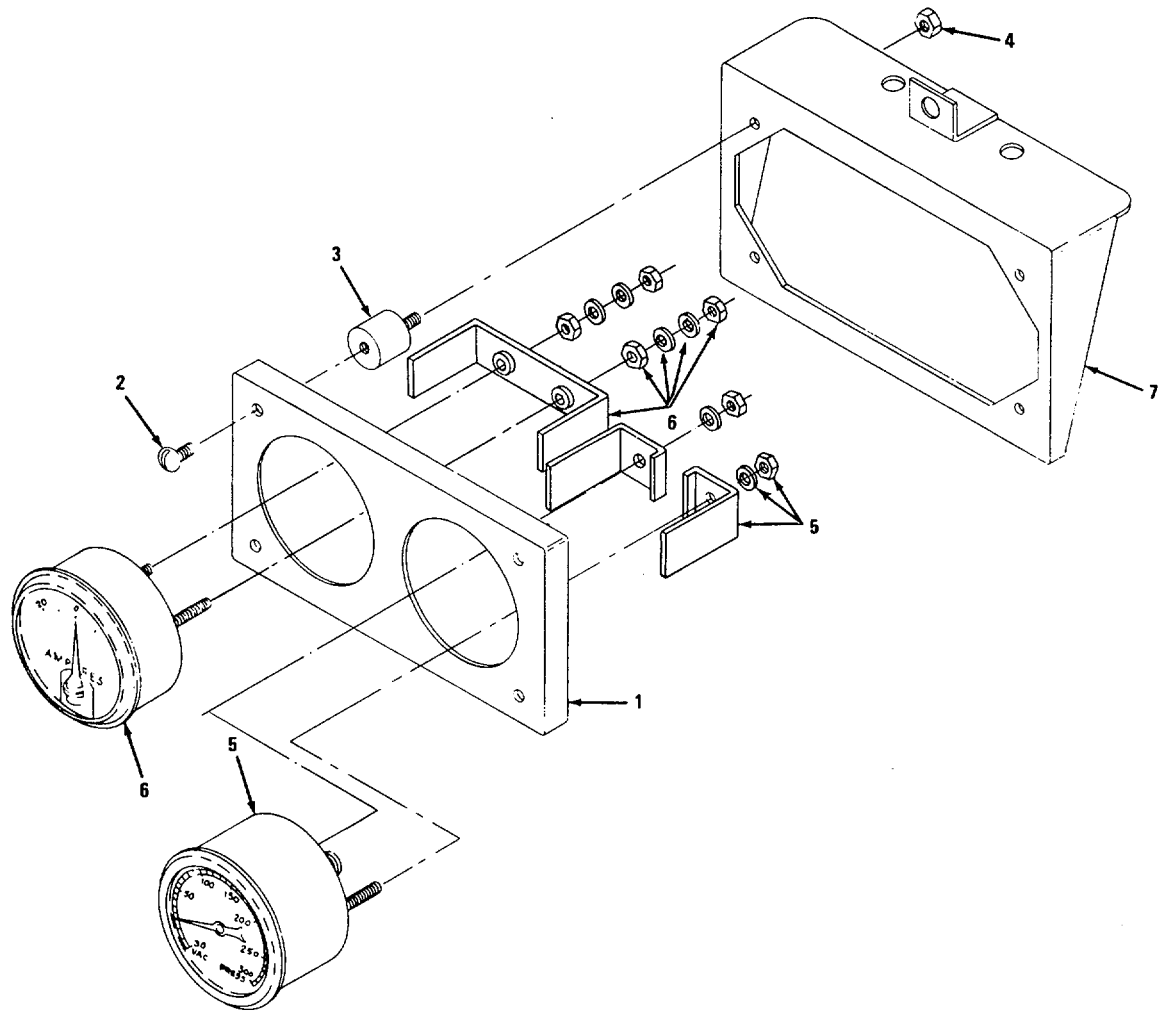


Figure 7-3. Gage Panel Assembly, Exploded View

Fig. & Index No.	Part Number	Description							Qty Per Assy
		1	2	3	4	5	6	7	
7-3-	PE-1340	GAGE PANEL ASSEMBLY (See figure 7-1 for HA).....							REF
-1	PE-1342	. PLATE, Gage							1
-2	PE-1476	. SCREW, Machine, RDH, 8-32 x 5/16, SS (AP)							4
-3	PE-1529	. VIBRATION ISOLATOR							4
-4	PE-1480	. NUT, Plain hexagon, 8-32, SS (AP)							4
-5	PE-1343	. GAGE, Compound, 0 to 30 V ac, 0 to 300 psi-.....							1
-6	PE-1356	. AMMETER, 20 Amps							1
-7	PE-1341	. BRACKET, Gage mounting							1

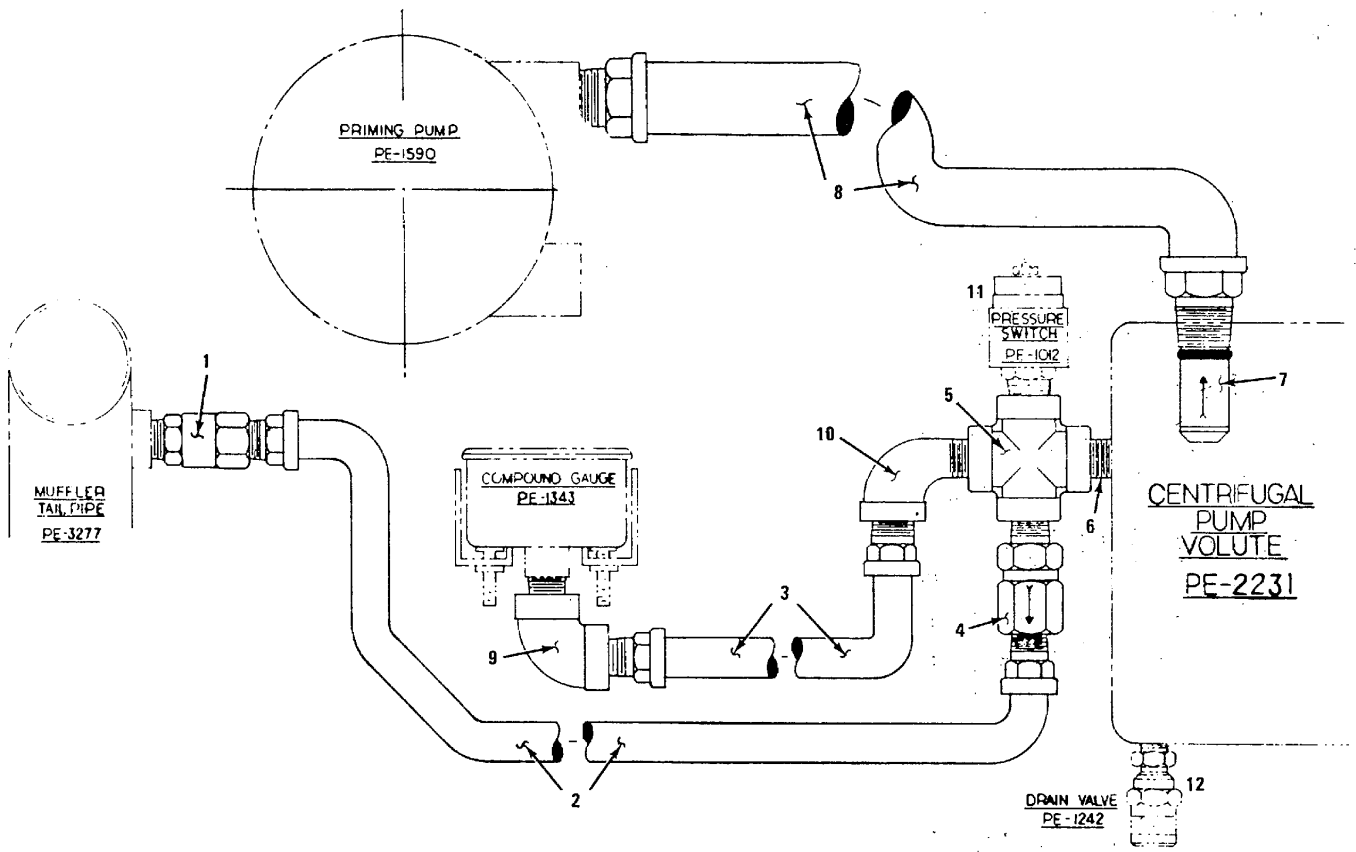


Figure 7-4. Piping Assembly

Fig. & Index No.	Part Number	Description							Qty Per Assy
		1	2	3	4	5	6	7	
7-4-	PE-2399	PIPING ASSEMBLY (See figure 7-1 for HA)							REF
-1	PE-1568	NOZZLE, Spray, 1/4 NPT, SS							1
-2	PE-2420	HOSE, Exhaust cooling.....							1
-3	PE-2410	HOSE, Gage.....							1
-4	PE-1567	VALVE, Check, 1/4 NPT, SS							1
-5	PE-1538	CROSS, Pipe, 1/4 NPT, SS							1
-6	PE-1417.	NIPPLE, Pipe, close, 1/4 NPT, SS							1
-7	PE-2567	VALVE, Check, cartridge type							1
-8	PE-2422	HOSE, Priming Pump							1
-9	PE-1404	ELBOW, Pipe, 90 degree, 1/4 NPT, SS							1
-10	PE-1402	ELBOW, Pipe, street 90 degree, 1/4 NPT, SS							1
-11	PE-1012	SWITCH, Pressure							1
-12	PE-1242	VALVE, Drain, 1/8 NPT							1

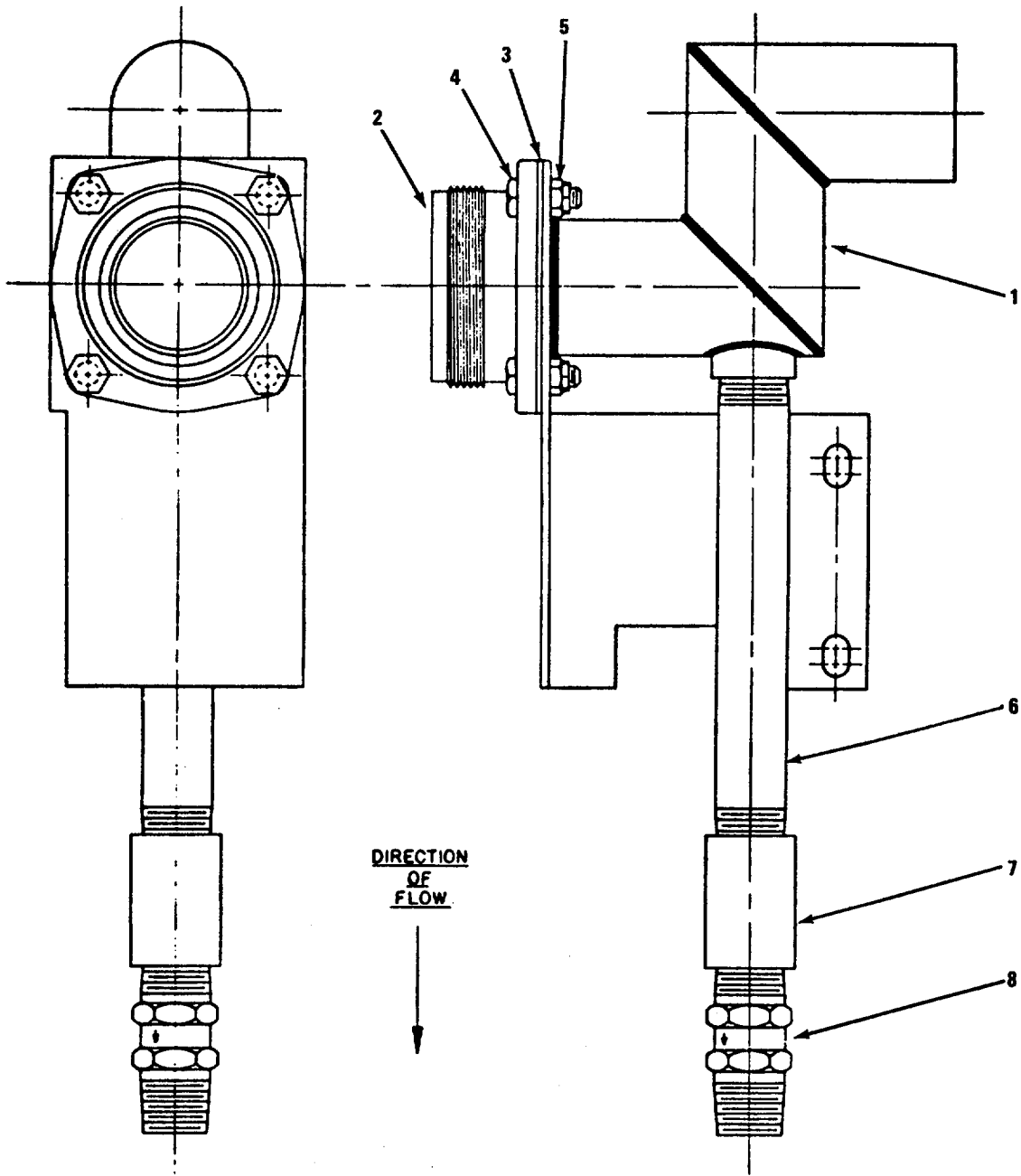


Figure 7-5. Muffler Exhaust Assembly

Fig. & Index No.	Part Number	Description							Qty Per Assy
		1	2	3	4	5	6	7	
7-5-	PE-3300	MUFFLER EXHAUST ASSEMBLY (See figure 7-1 for . HA)							REF
-1	PE-3277	TAILPIPE, Muffler							1
-2	PE-1309	CAP, Outlet.....							1
-3	PE-1310	GASKET.....							1
-4	PE-1451	SCREW, Cap hex head, 1/4-20 x 3/4, SS (AP) ..							4
-5	PE-1485	NUT, Self-locking hexagon, 1/4-20, SS (AP)							4
-6	PE-3594	NIPPLE, Long, 1/2 x 6, BRS							1
-7	PE-3595	COUPLING, 1/2 BRAS							1
-8	PE-3596	VALVE, Check, 1/2 NPT, BRS ...							1

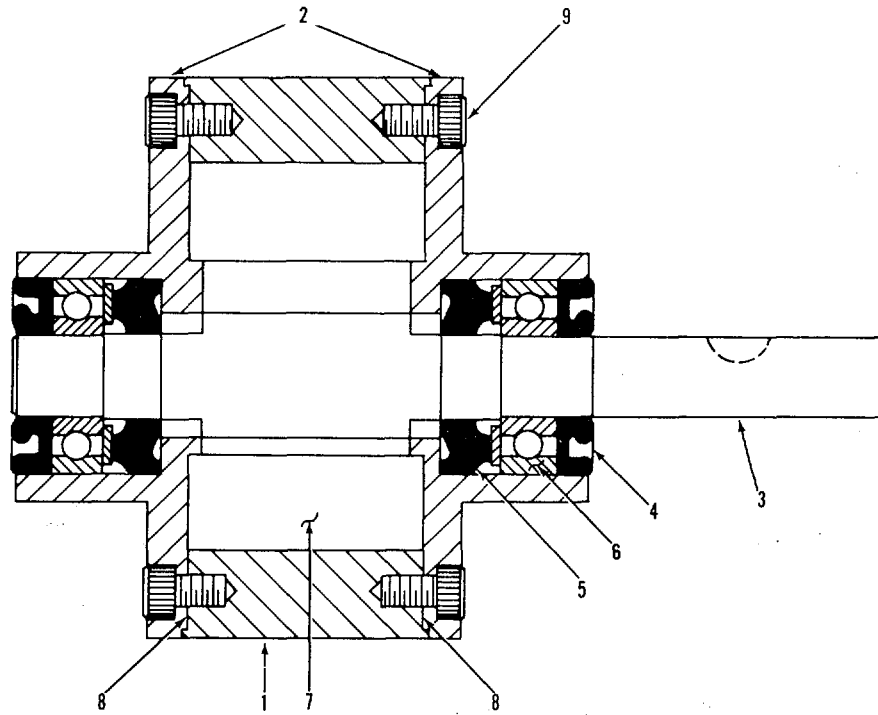


Figure 7-6. Priming Pump Assembly

Fig. & Index No.	Part Number	Description							Qty Per Assy
		1	2	3	4	5	6	7	
7-6-	PE-1590	PRIMING PUMP (See figure 7-1 for HA).....							REF
-1	PE-2571	. BODY							1
-2	PE-1572	. PLATE, End.							2
-3	PE-1751	. ROTOR AND SHAFT.....							1
-4	PE-1578	. SEAL, Outer.....							2
-5	PE-1588	. SEAL, Inner							2
-6	PE-1579	. BEARING							2
-7	PE-1585	. VANE							4
-8	PE-1591	. GASKET							2
-9	PE-1592	. SCREW, Cap socket head, 1/4-20 x 5/8, SS (AP).....							9

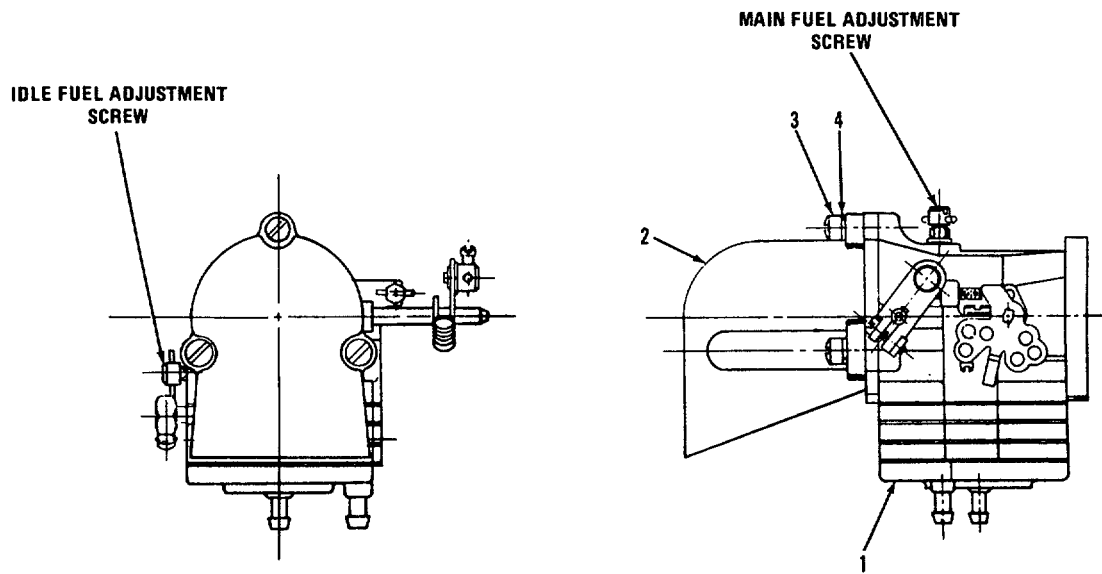


Figure 7-7. Carburetor Assembly

Fig. & Index No.	Part Number	Description							Qty Per Assy
		1	2	3	4	5	6	7	
7-7-	PE-1017	CARBURETOR ASSEMBLY (See figure 7-1 for HA) ...							REF
-1	PE-1018	. CARBURETOR.....							1
-2	PE-1019	. RAM TUBE							1
-3	PE-3597	. SCREW, Machine, filibuster head, 1/4-20 x 3/4,							3
		SS (AP)							
-4	PE-1496	WASHER, Lock, split, 1/4, SS (AP)							3

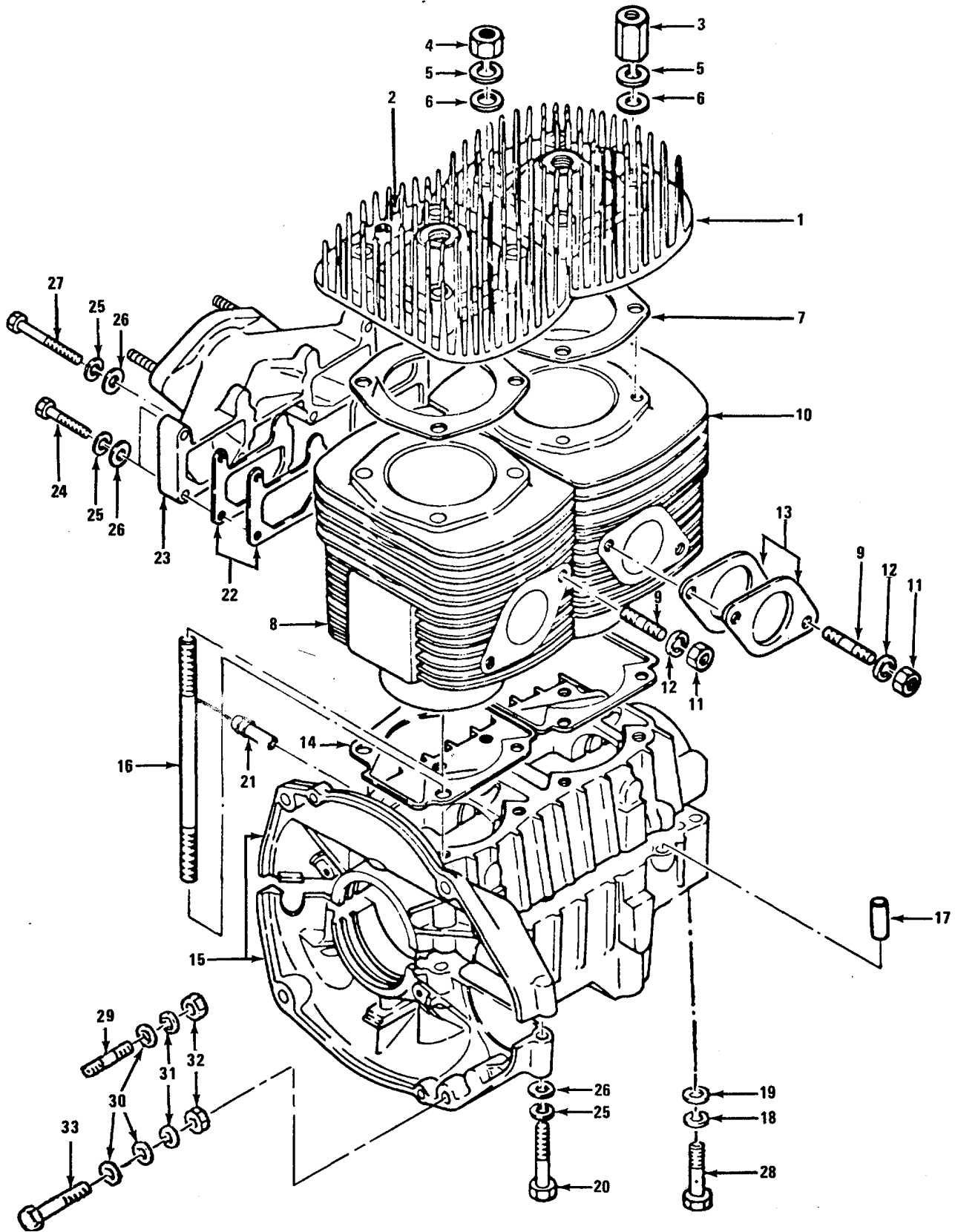


Figure 7-8. Crankcase and Cylinder Assembly (Sheet 1 of 6)

Fig. & Index No.	Part Number	Description							Qty Per Assy
		1	2	3	4	5	6	7	
7-8-	*PE-2011	ENGINE.....							1
-1	11001-510	HEAD, Cylinder, No. 1							1
-2	11001-3007	HEAD, Cylinder, No. 2							1
-3	92015-502	NUT, 8 mm long.....							2
-4	311B0800	NUT, 8 mm							6
-5	461F0800	WASHER, Spring, 8 mm							8
-6	92022-503	WASHER, Plain, 8 mm							8
-7	11004-505	GASKET, Head.....							2
-8	11005-3002	CYLINDER, No. 2							1
-9	172G0820	STUD, 8 x 20							4
-10	11005-3001	CYLINDER, No. 1							1
-11	310R0800A	NUT, 8 mm							4
-12	461S0800	WASHER, Spring, 8 mm							4
-13	18067-501	GASKET, Exhaust							4
-14	11009-505	GASKET, Cylinder Base							2
-15	*PE-2011-3	CRANKCASE SET							1
-16	92004-504	STUD.....							8
-17	551A0816	PIN, Dowl, 8 x 16							2
-18	461F0800	WASHER, Spring, 8 mm							10
-19	410B0800	WASHER, Plain, 8 mm							10
-20	110B0640	BOLT, Hex head, 6 x 40.....							1
-21	32032-3001	PIPE, Pulse.....							1
-22	16062-510	GASKET, Intake.....							4
-23	*PE-2011-6	MANIFOLD, Intake.....							1
-24	110B0635	BOLT, Hex head, 6 x 35.....							4
-25	461F0600	WASHER, Spring, 6 mm							7
-26	411B0600	WASHER, Plain							7
-27	110B0655	BOLT, Hex head, 6 x 55.....							2
-28	110G0863	BOLT, Hex head, 8 x 63.....							10
-29	172G0820	STUD, 8 x 20							1
-30	410B0800	WASHER, Plain 8 mm							3
-31	461F0800	WASHER, Spring, 8 mm.....							2
-32	311B0800	NUT, 8 mm							2
-33	110B0868A	BOLT, Hex head, 8 x 68.....							1

*Items are modified and must be ordered from the pump contractor.

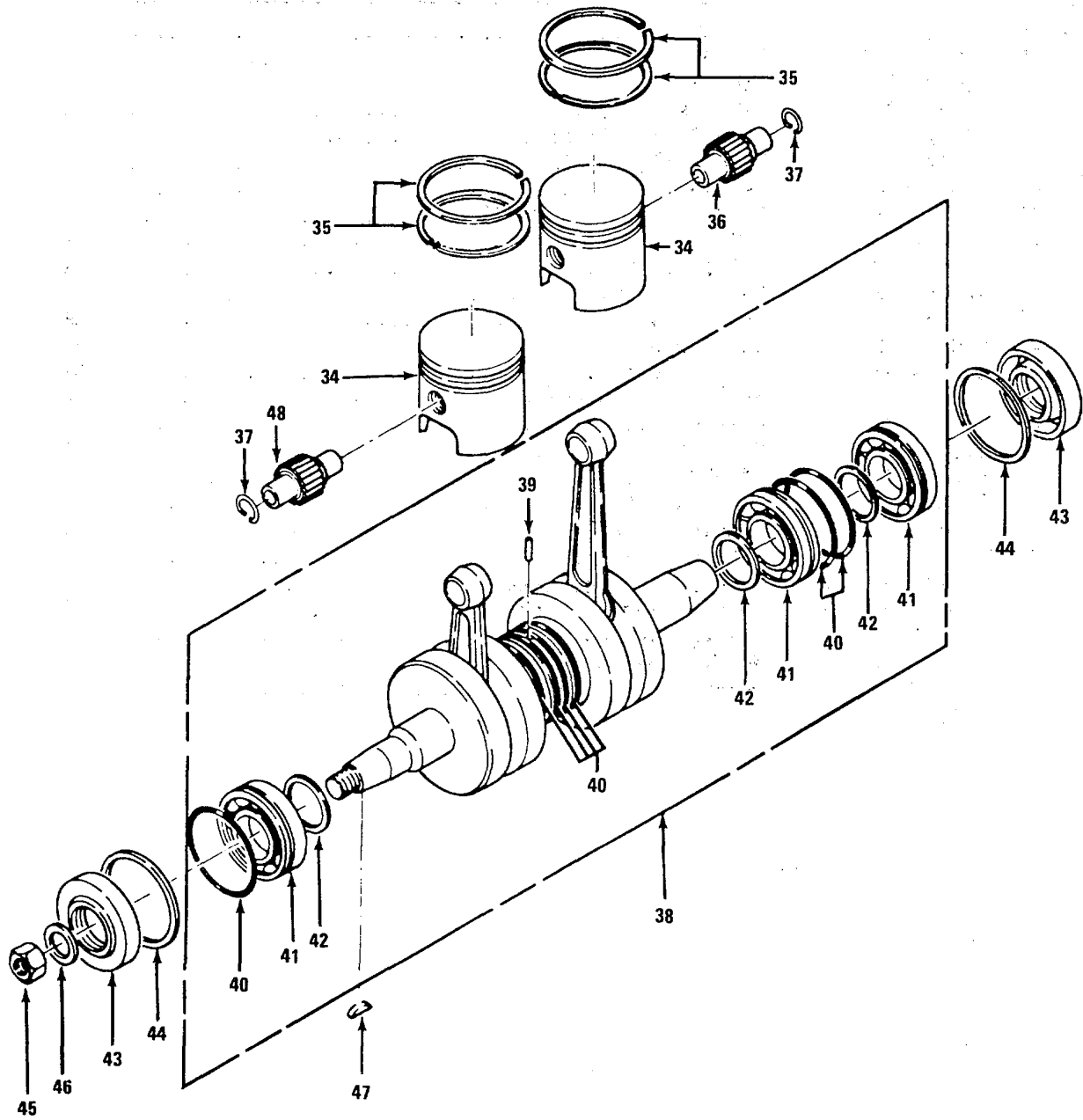


Figure 7-8. Crankcase and Cylinder Assembly (Sheet 2 of 6)

Fig. & Index No.	Part Number	Description							Qty Per Assy
		1	2	3	4	5	6	7	
7-8-34	13001-3009	PISTON							2
-35	13008-3006	PISTON RING SET							2
-36	13002-504	PIN, Piston							2
-37	92036-507	CIRCLIP							4
-38	13031-3001	CRANKSHAFT ASSEMBLY							1
-39	551A410	PIN, Dowl, 4 x 10							1
-40	92055-504	O-RING							7
-41	92045-505	BEARING, Ball, 6206NC3							3
-42	92025-513	SHIM, 0.1 t							AR
-42	92025-518	SHIM, 0.2 t							AR
-42	92025-523	SHIM, 0.3 t							AR
-42	92025-527	SHIM, 0.4 t							AR
-42	92025-530	SHIM, 0.5 t							AR
-42	92025-533	SHIM, 0.6 t							AR
-43	92050-507	SEAL, Oil, TCY06210							2
-44	92022-531	WASHER							2
-45	315B1800A	NUT, 18 mm							1
-46	92022-3019	WASHER							1
-47	510A5200	KEY, Woodruff							1
-48	13033-3002	BEARING, Small end							2
-49	49089-3001-9H	SHROUD, Engine, main							1
-50	49089-3002-9H	SHROUD, Engine, exhaust							1
-51	49089-3003-9H	SHROUD, Engine, intake							1
-52	220B0812	SCREW, Pan head, 8 x 12							2
-53	461F0800	WASHER, Spring, 8 mm							2
-54	410B0800	WASHER, Plain, 8 MM							2
-55	DELETED								

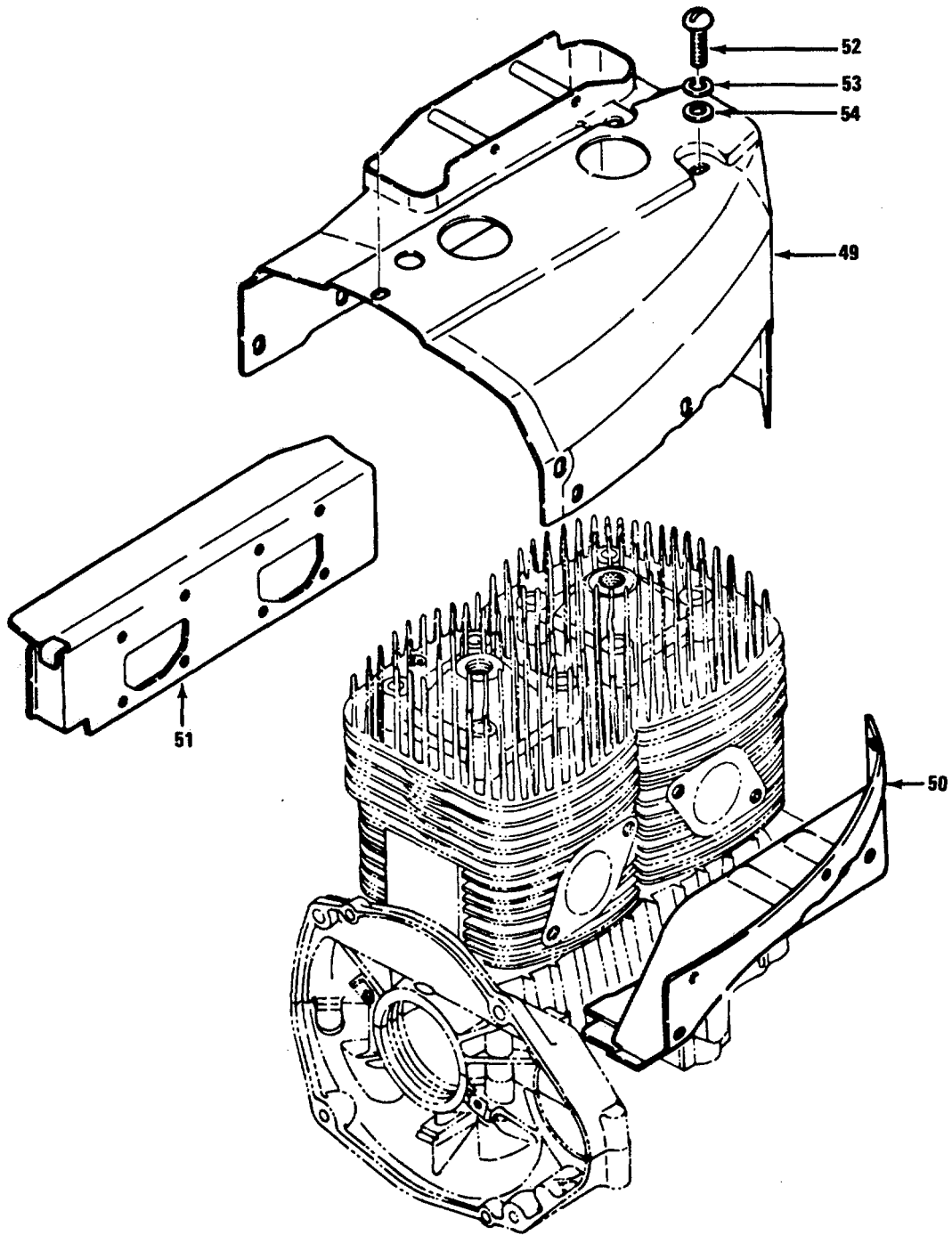


Figure 7-8. Crankcase and Cylinder Assembly (Sheet 3 of 6)

Fig. & Index No.	Part Number	Description							Qty Per Assy
		1	2	3	4	5	6	7	
7-8-56	*PE-2120								1
-57	461F0600								3
-58	21119-3001								1
-59	92022-554								3
-60	92027-291								1
-61	92037-3003								1
-62	411B0600								1
-63	220B0520A								2
-64	461F0500								2
-65	411B0500								2
-66	21050-3006								1
-67	21003-3004								1
-68	21049-3001								1
-69	59026-3002								1
-70	21047-3002								1
-71	92027-521								2
-72	92037-517								1
-73	92037-518								1
-74	92009-3002								2
-75	92011-532								2
-76	220B0408A								2
-77	461F0400								2
-78	220B0625								3

*Items available only from pump contractor.

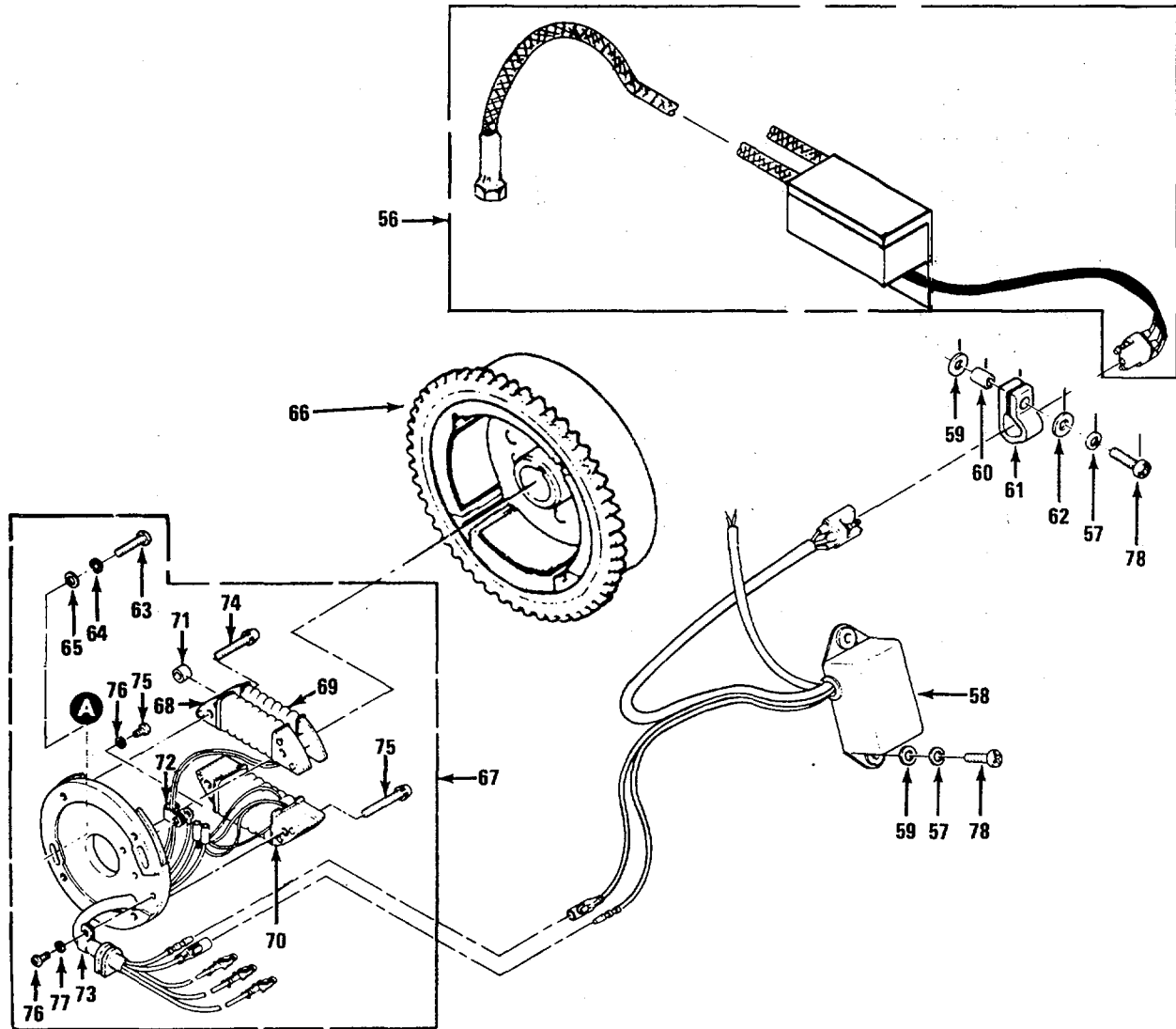


Figure 7-8. Crankcase and Cylinder Assembly (Sheet 4 of 6)

Fig. & Index No.	Part Number	Description							Qty Per Assy
		1	2	3	4	5	6	7	
7-8-79	*PE-2011-4/5								1
-80	551A0612								2
-81	172G0820								4
-82	410B0800								4
-83	461F0800								4
-84	311B0800								4
-85	59041-501								1
-86	92045-501								2
-87	92025-529								2
-88	92033-3001								1
-89	510A3200								1
-90	59051-3001								2
-91	92025-501								AR
-92	461F1400								1
-93	315B1400								1
-94	14037-503								1
-95	234B0420A								5
-96	13190-502								1
-97	220B0410A								3
-98	461F0400								3
-99	92022-545								3
-100	59091-515								2

*Items are modified and must be ordered from pump contractors.

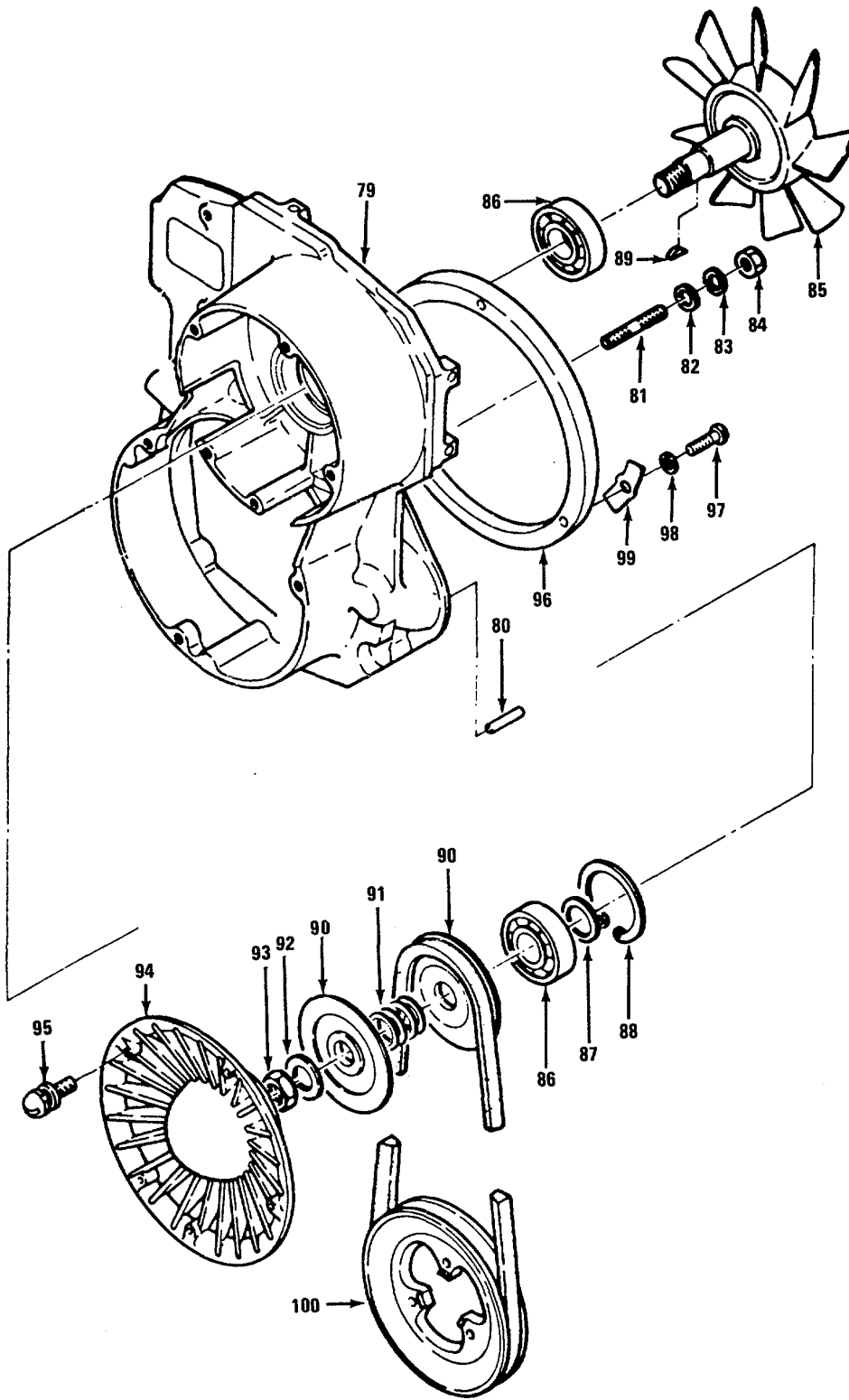


Figure 7-8. Crankcase and Cylinder Assembly (Sheet 5 of 6)

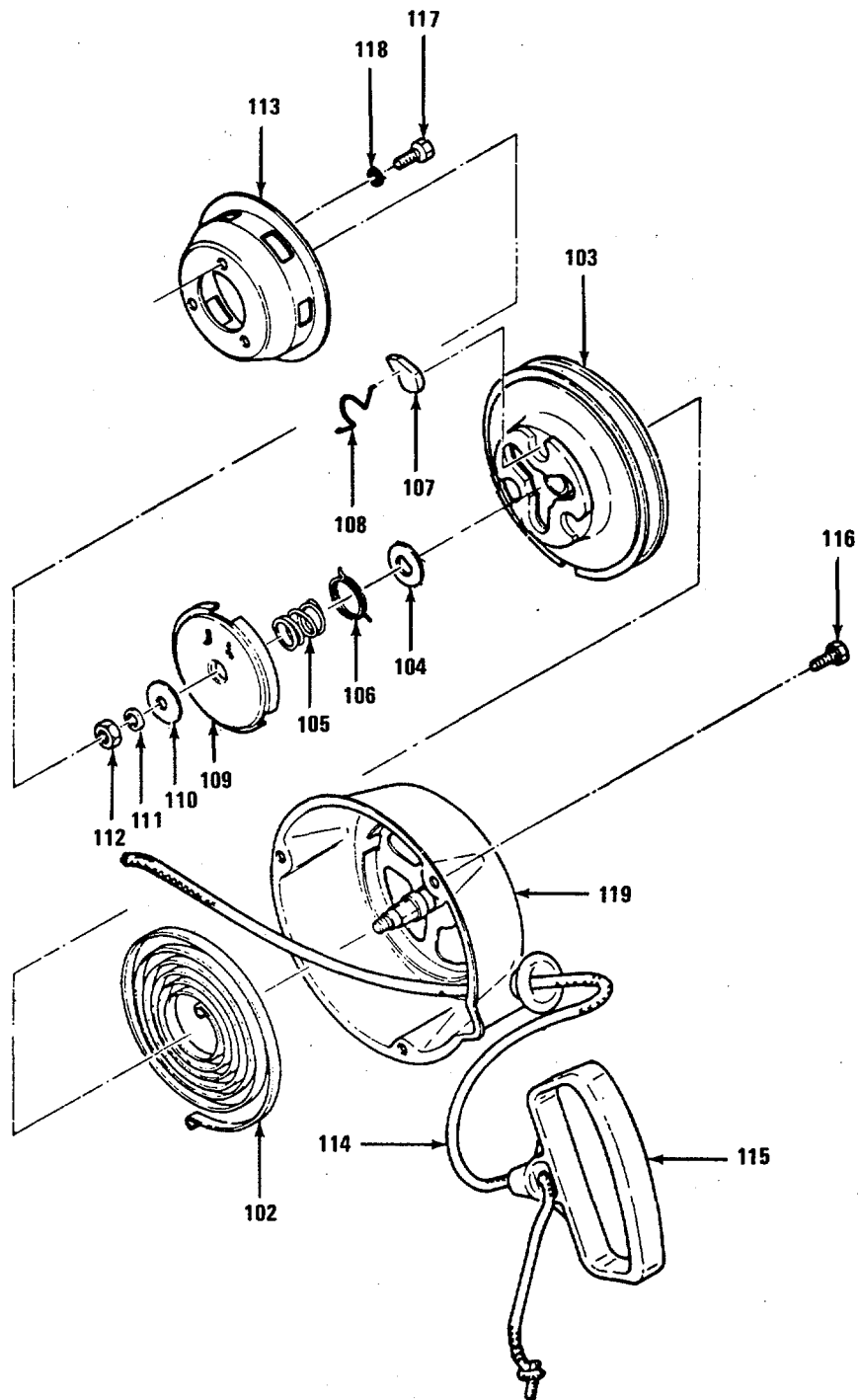


Figure 7-8. Crankcase and Cylinder Assembly (Sheet 6 of 6)

Fig. & Index No.	Part Number	Description							Qty Per Assy	
		1	2	3	4	5	6	7		
7-8-101	49088-3004-9H								1	RECOIL STARTER ASSEMBLY
-102	92081-517								1	SPRING, Recoil
-103	59101-506								1	REEL, Recoil
-104	92095-503								1	WASHER, 1.2 t
-105	92081-508								1	SPRING
-106	92081-512								1	SPRING, Return
-107	13069-504								3	PAWL
-108	92081-503								3	SPRING, Pawl
-109	23072-506								1	RETAINER, Cover
-110	92022-564								1	WASHER, 1.6 t
-111	92029-503								1	WASHER, Spring, 8 mm
-112	92015-513								1	NUT, 8 mm
-113	59091-510								1	PULLEY
-114	59106-506								1	ROPE
-115	46075-3002								1	HANDLE
-116	92003-510								3	BOLT, Hex head, 6 x 16.....
-117	110B0618								3	BOLT, Hex head, 6 x 18.....
-118	461F0600								3	WASHER, Spring, 6 mm
-119	59021-508-9H								1	CASE

CHAPTER 8
DIAGRAMS

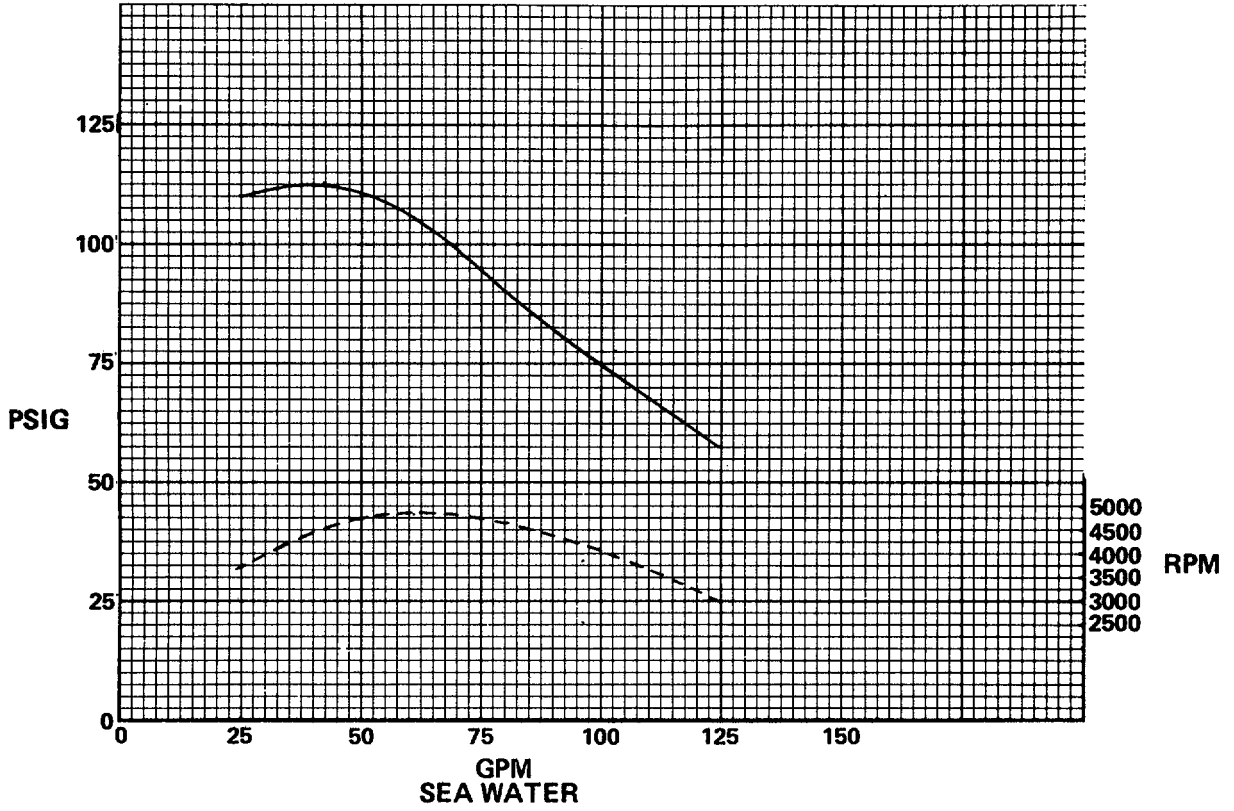


Figure 8-1. 50 Feet Eductor Test

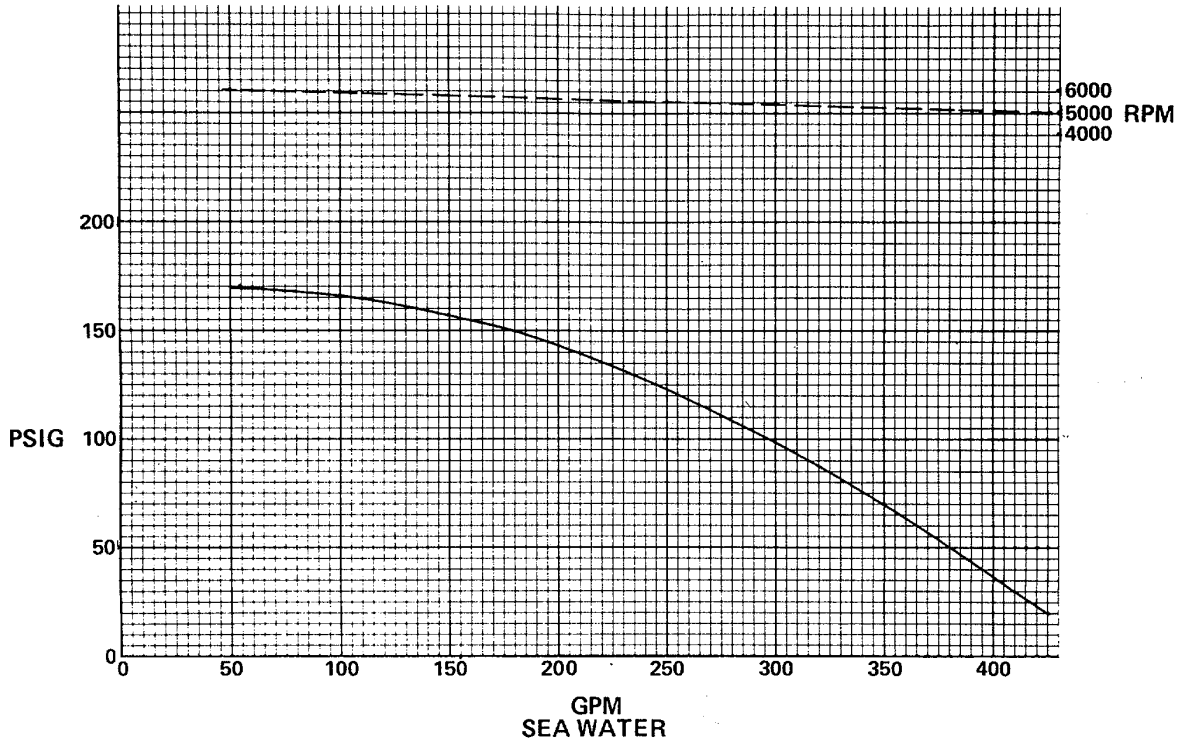


Figure 8-2. Performance Curve - 3 Feet Lift

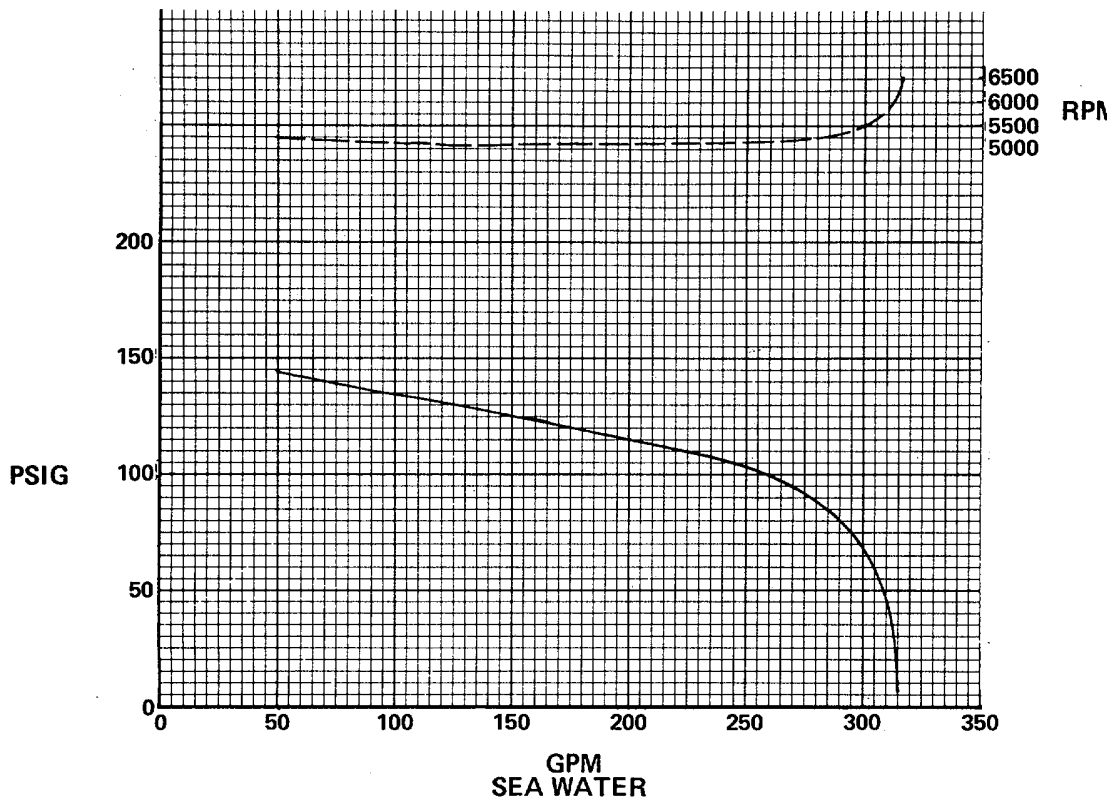


Figure 8-3. Performance Curve - Feet Lift

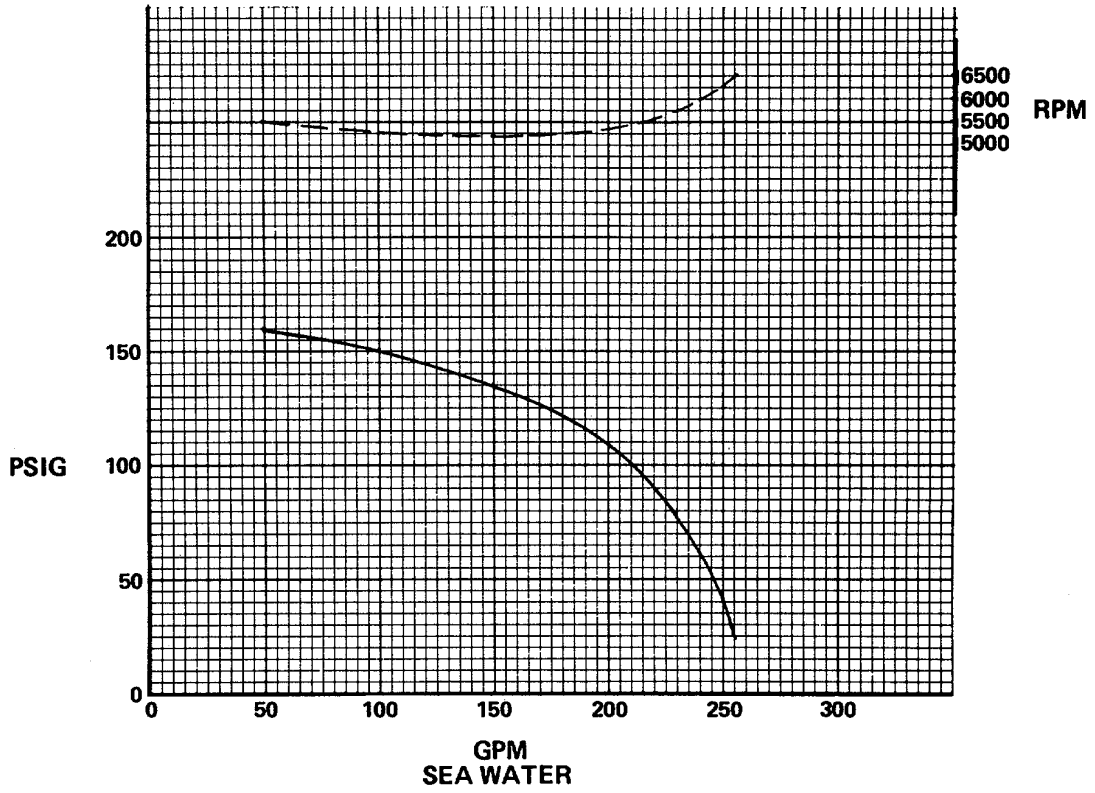


Figure 8-4. Performance Curve - 22 Feet Lift

SECTION VI

Foam Turret

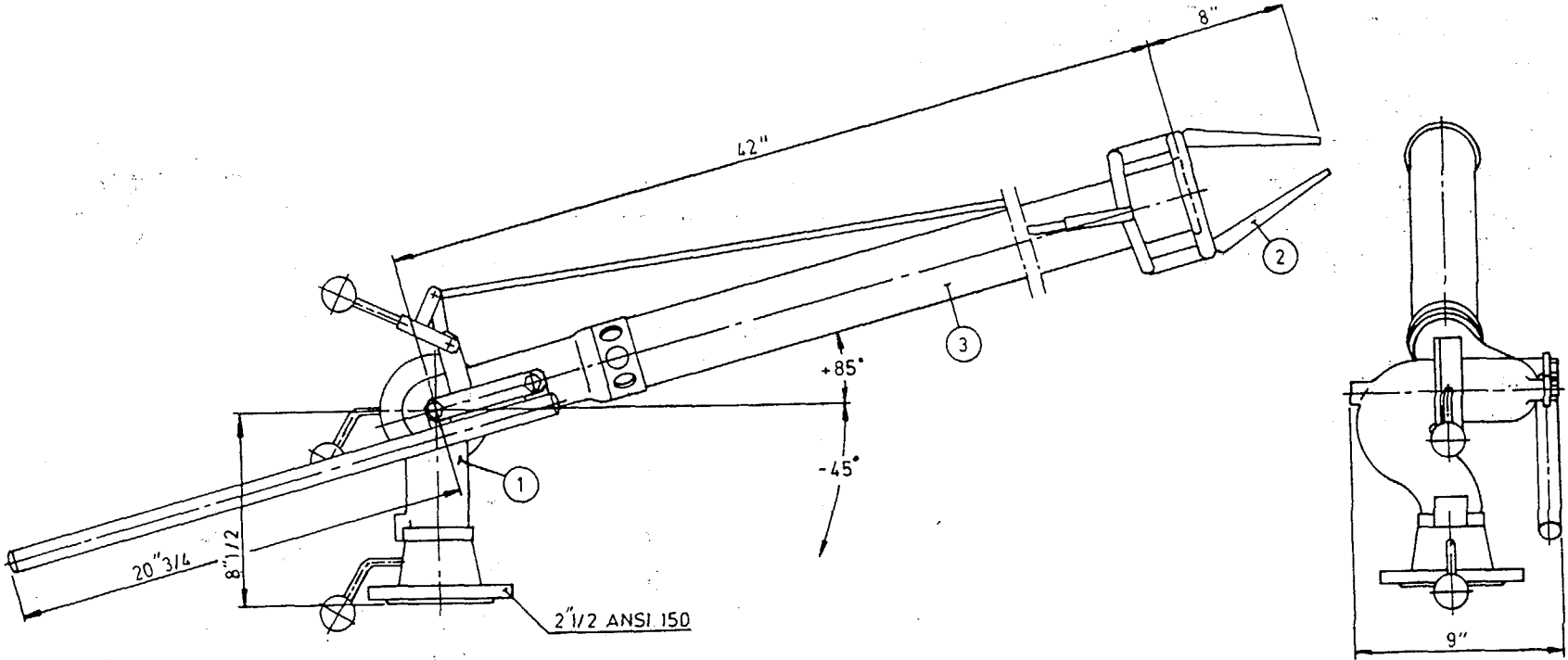




Design change

Datum

Sign.

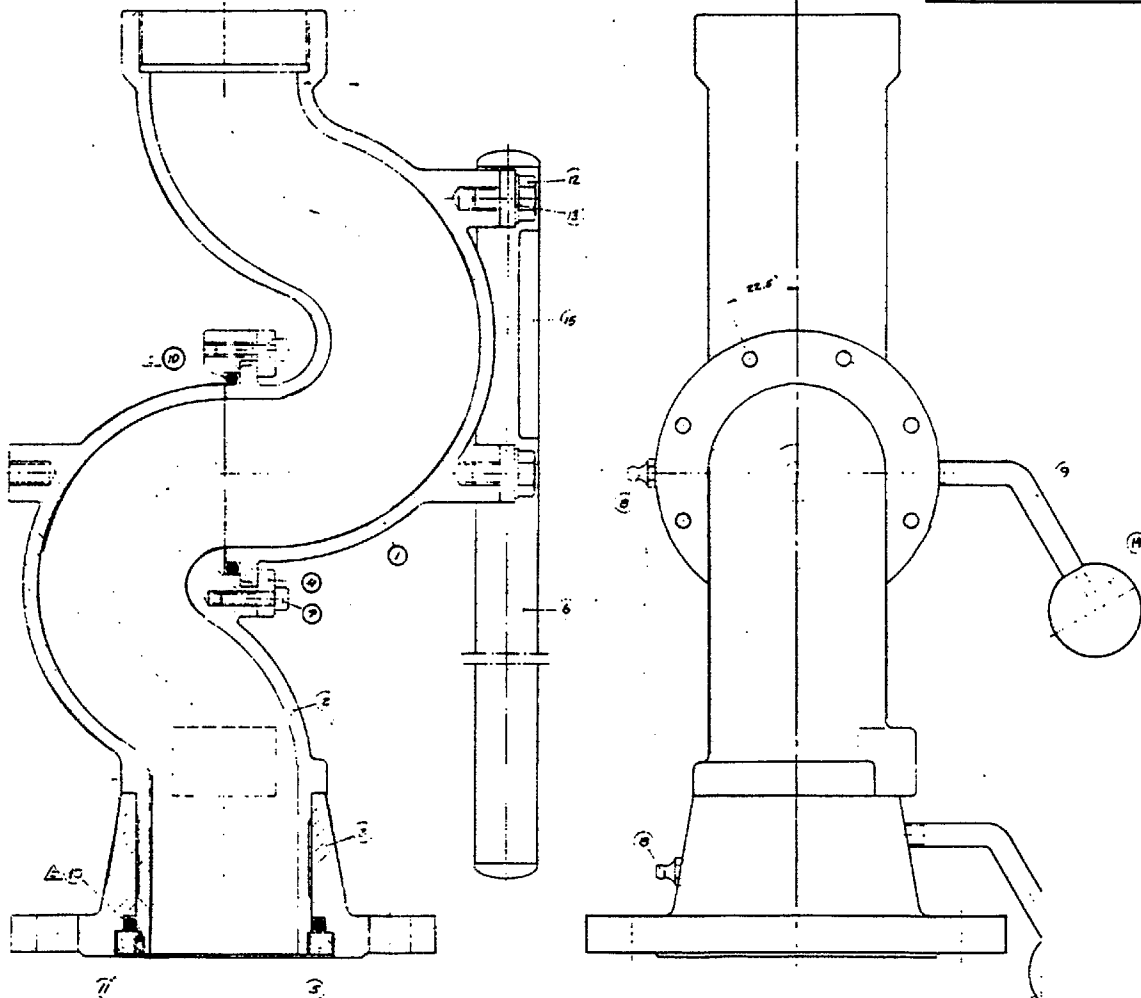


U.S. AGENT/DISTRIBUTOR
In-Mar Systems, Inc.
 Box 640268 • Kenner, LA 70064
 (504) 469-8062 • Telex 753946 • Fax (504) 469-0908

PURCHASE ORDER NO:130-0096
PROJECT: (4) EA. U.S. ARMY TUGS
SHIPYARD: ROBERT E. DIRECTOR OF R.I., INC.

	3	1	20813	Foam branch pipe	MJ-65	7.7 lb
	2	1	20342	Deflector-foam		8.8 lb
	1	1	1458	Turret	VK-65	39.7 lb
	No.	Qty	Drawing	Description	Dimension or type	Weight
Items included	SVENSKA SKUMSLACKNING AB					
	VK-65/MJ-65 Dimension print					
	ART. NO.	DATE	CHECKED	SCALE	DRAWING NO.	REV.
		88 10 11	ELE	1:5	31563-S	1
		DRAWN				
		HE				

Δ	Design change	Datum	Sign.



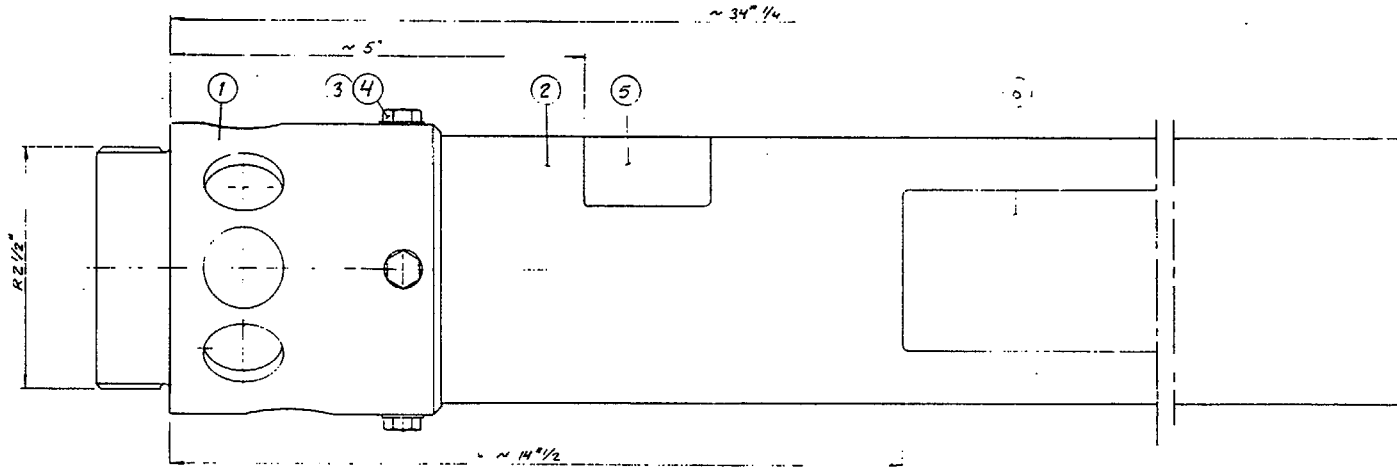
U.S. AGENT/DISTRIBUTOR
In-Mar Systems, Inc.
 Box 640268 • Kenner, LA 70064
 (504) 469-8062 • Telex 753946 • Fax (504) 469-0908

Sign	1	15	41555	Sjvst			
Ball	2	14		Kulle	040-4110	Bakelit	
Washer	2	13		Bricka	R8 10.5 - 22	522543	
Screw	2	12		Skruv	M8x100Z0		
Screw	1	11		Ljsskruv	M8x83.5x10		
O-ring	2	10		O-ring	74.2 - 5.7	Nitril	
Lock arm	2	8	41700	Ljssarm			
Grease cup	2	6		Smor/Bopp	R1/8	Form	
Screw	8	7		Skruv	M8x8 - 20	SproL	
Lever	1	6	31581	Havarm			
Clamp ring	1	5	4819	Ljssring		Fotgods	
Lock washer	1	4	4817	Ljssbricka			
Flange	1	3	5058	Fl.klona			
Inlet port	1	2	2813	InLgat			
Outlet port	1	1	2814	OutLgat			

PURCHASE ORDER NO:130-0096
 PROJECT: (4) EA. U.S. ARMY TUGS
 SHIPYARD: ROBERT E. DIRECTOR OF R.I., INC.

SVENSKA SKUMSLACKNINGARS AB			
VK-65			
Assembly drawing			
Order no. 8800876/449940			
???	???	???	???
			2 1458-S

Δ	Design change	Datum	Sign.
1	Pos 1 Hus Bridrad	870508	HE



U.S. AGENT/DISTRIBUTOR

In-Mar Systems, Inc.

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(504) 469-8062 • Telex 753946 • Fax (504) 469-0908

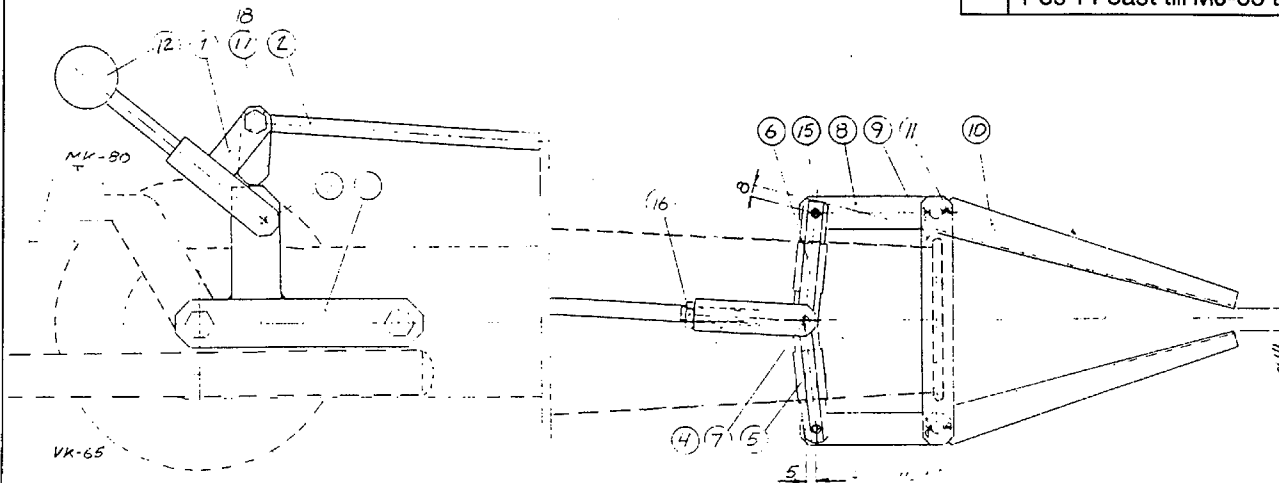
Sticker	6	2	31537	Dekal		
Sign	5	1		Skytt	MJ-65 41532, MJ 5541533	
Washer	4	4		Bricka	FBB6,1	SS2343
Screw	3	4		Skruv	M65 6 = 10	
Pipe	2	1	31551	Ror		
House	1	1	31621	Hus		

PURCHASE ORDER NO: 130-0096
PROJECT: (4) EA. U.S. ARMY TUGS
SHIPYARD: ROBERT E. DIRECTOR OF R.I., INC.

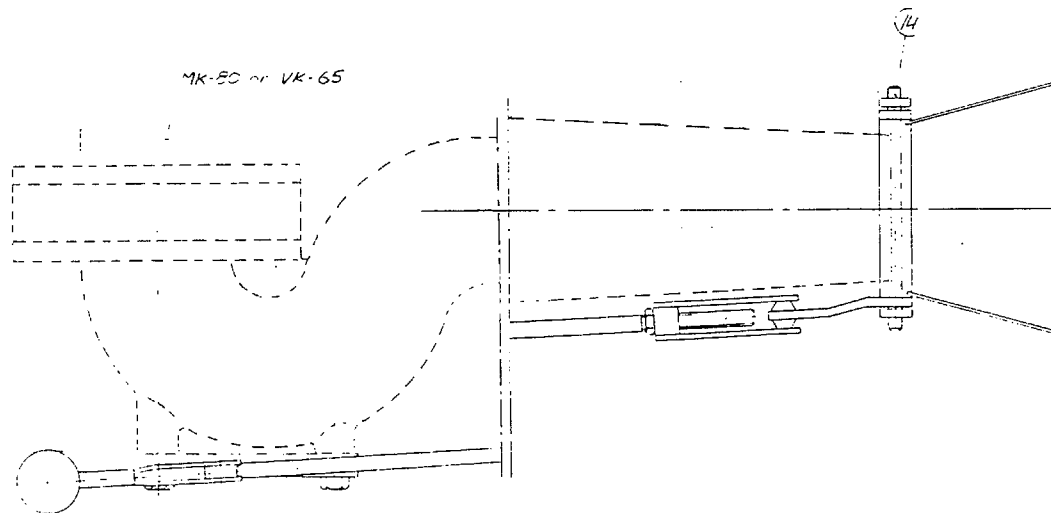
No.	Qty	Drawing	Description	Dimension or Type	Material
SVENSKA SKUMSLACKNING AB					
MJ-65 Assembly drawing Order no 8800878/449940					
ART NO.	DATE 850719	CHECKED ELE	SCALE 1:1	DRAWING NO. 20813-S	REV. 1
	DRAWN HE				

Δ	Design change	Datum	Sign.
	Pos 1 Foast till MJ-65 tillkammer	850923	HE

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In-Mar Systems, Inc.
 Box 640268 • Kenner, LA 70064
 (534) 469-8062 • Telex 753946 • Fax (504) 469-0908



Rör	Faste ritn
MJ-80	30841
MJ-65	31553
MR	30841
MLR	31240



Nut	18	2		Muller	M6M6	2343
Screw	17	1		Skruv	M6S 6 X 30	
Nut	16	1		Mutter	M6M10	
Spring pin	15	2		Rörpinne	FRP 6 X 18	2331
Bar	14	2	40853	Axe		
Spring pin	13	1		Rörpinne	FRP DF 6 X 20	2331
Ball	12	1		Bakelitkula	040/M10	
Split pin	11	4		Saxpinne	04 X 20	2343
Flap	10	2	30665	Spridarblad		
Attachment	9	2	Setabell	Faste		
Flap support	8	2	40636	Bladfaste		
Spring pin	7	1		Rörpinne	FRP DF 6 X 25	2331
Arm	6	1	40639	Ledarm		
Arm	5	1	40640	"		
Fork	4	1	40636	Gaffe		
Support	3	1	40641	Ledfaste		
Bar	2	1	40637	Stang		
Handle	1	1	30666	Manoverspak		

PURCHASE ORDER NO:130-0096
 PROJECT: (4) EA. U.S. ARMY TUGS
 SHIPYARD: ROBERT E. DIRECTOR OF R.I., INC.

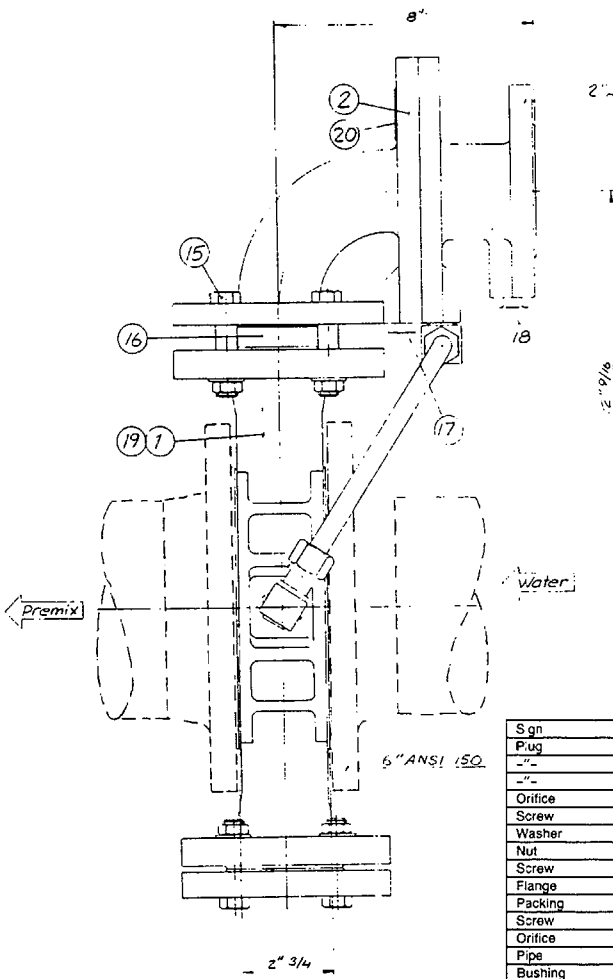
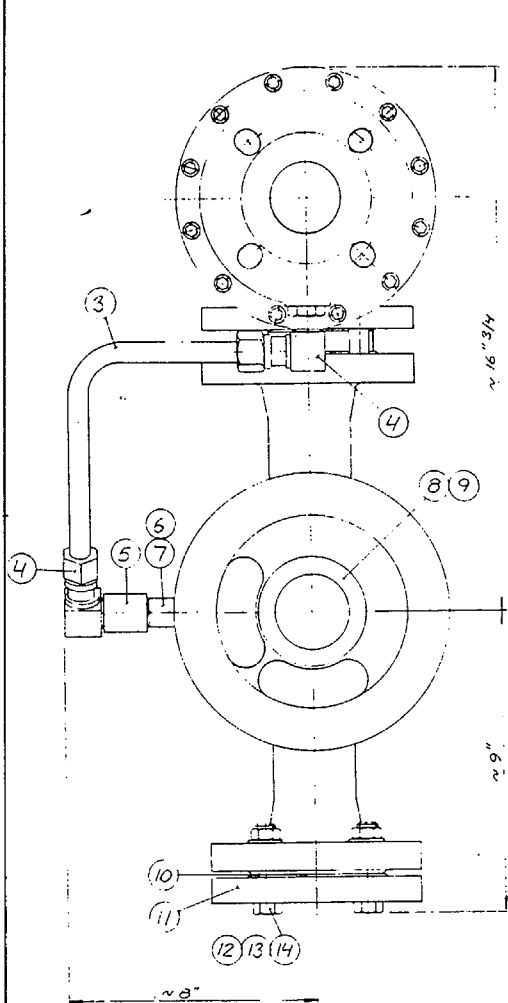
Nr	A:1	Ritning	Benämning	Dimensioner/teckn.	Material
SVENSKA SKUMSLÄCKNINGSS AB					
Deflector MJ-2500/MR-1250 Assembly drawing Order no 8800878/449940					
REVISION 1	RITAD 0790315	KONTR. HE	SKALA 1:2	RITN NR 20342-S	



Design change

Datum

Sign.



DESIGN PRESSURE 227 PSI
 HYDROSTATIC TEST PRESSURE 340 PSI

PURCHASE ORDER NO:130-0096
 PROJECT: (4) EA. U.S. ARMY TUGS
 SHIPYARD: ROBERT E. DIRECTOR OF R.I., INC.

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In-Mar Systems, Inc.
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Sign	20	1	41534	Sign		
Plug	19	1		Propp	20 RSK8070047	Moss.
"-	18	1		"-	20 R-235	SS2343
"-	17	1		"-	15 -"	"-
Orifice	16	1	41269	Munstycke		
Screw	15	4		Skruv	M6S 18 X 80	???
Washer	14	8		Bricka	BRB 17 X 30	"-
Nut	13	8		Mutter	M6M 16	"-
Screw	12	4	Skruv	M6S 16 X 60	"-	
Flange	11	1	31270	Plattflang		
Packing	10	1		Packning	50	???
Screw	9	2		Skruv	MCS 6 X 12	???
Orifice	8	1	31236	Valkenmunstycke	15 R-210	???
Pipe	7	1		Nippellor	20-15 R-211	"-
Bushing	6	1		Bussning	15 R-201	"-
Muff	5	1		Muff	014-1/2" R-1325	"-
Coupling	4	2		Skarringskoppling	014-1	"-
Pipe	3	1	41452	Ror	SDA-50	
SDA-50	2	1	20723	SDA-50	MP-150	
MP-150	1	1	1763	MP-150		

No.	Qty	Drawing	Description	Dimension or type	Material
SVENSKA SKUMSLACKNING AB					
SDA-50/MP-150 Assembly drawing Order no 8800878/449940					
ART NO.	DATE 831019 DRAWN HE	CHECKED	SCALE 1:2,5	DRAWING NO. 20727-S	REV.

SECTION VII

Roper Pumps Model 2F75-17



I-84



Installation and Operating Instructions

WARNING! DANGER!

READ BELOW BEFORE STARTING PUMP! FAILURE TO HEED THESE WARNINGS MAY RESULT IN AN ACCIDENT CAUSING PHYSICAL DAMAGE, SERIOUS PERSONAL INJURY OR DEATH!

1. Read and understand tags and installation and operating instructions.
2. Know operating conditions.
3. Open all lines before starting pump.
4. Install and properly set relief valve.
5. Install proper guard(s), never operate pump without guard(s) in place.
6. Always use caution near rotating parts.
7. Do not operate this equipment in excess of its rated capacity, pressure, speed, and temperature, or other than in accordance with instructions contained in the installation and operating instructions.

Every Roper pump is performance tested before being shipped from our factory. Correctly installed, operated and maintained, it will give long, dependable service. Remember...faulty selection and installation form the basis of more pump troubles than all other causes combined...no amount of maintenance can compensate for selection and installation mistakes. Read these instructions carefully before installing and operating this pump.

This pump is satisfactory for the conditions for which it is rated, but its operation in excess of these conditions may subject it to stresses and strains which it is not designed to withstand.

On all pumps it is recommended that a relief valve (either a built in valve or an external valve in the line) be used to protect the equipment and personnel from accident due to overpressure. FOR A PUMP EQUIPPED WITH A BUILT IN RELIEF VALVE, SEE SECTION(S) ON RELIEF VALVES BEFORE OPERATING PUMP. READ SECTION ON PRE-OPERATION CHECKS, ESPECIALLY FOR A PUMP WITH NO BUILT IN RELIEF VALVE.

It is also recommended that appropriate coupling or belt guards be installed for the protection of personnel.

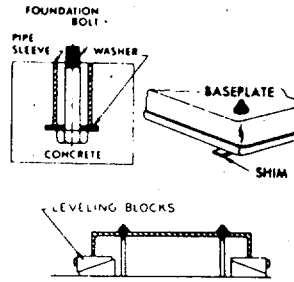
These instructions will cover standard pumps and most spec. no. pumps. Appearance may vary among pumps and construction may vary on spec. no. pumps.

If there is any question concerning the ratings or instructions, please consult a distributor, district representative, or the home office of the:

ROPER PUMP COMPANY
COMMERCE, GEORGIA 30529

PREPARATION OF FOUNDATION-BASEPLATE MOUNTED PUMPS

A good foundation is of major importance. Concrete is best, since it is heavy enough to support the baseplate rigidly and absorb strain and shock. Baseplate units must be securely bolted in position, with shims or leveling wedges to correct any angular and-or parallel misalignment. Such misalignment will cause the pump or driver to be out of alignment, thus resulting in heavy stresses on the pump. Accelerated wear or vibration can be caused by a very slight misalignment.



PLACE STRAIGHT EDGE AT TOP BOTTOM AND BOTH SIDES TO CHECK ALIGNMENT OF COUPLING MEMBERS	
Correct	
Parallel Misalignment	
Angular Misalignment	

ALIGNING DRIVER AND PUMP

Driver and pump units are factory aligned before shipment, but they must be accurately realigned during and after installation.

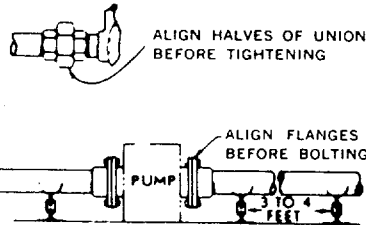
To align coupling, use a straight edge and feeler gauges to check for parallel and angular alignment as shown in illustration at left.

Check the alignment at every step during installation: after the unit is mounted on foundation, after piping has been secured, and after pump has run with the liquid at operating temperature. **DO NOT DEPEND ON FLEXIBLE COUPLINGS TO COMPENSATE FOR MISALIGNMENT.**

INSTALLATION OF PIPES

Use of teflon tape for installing pipes may cause damage to pump. PIPING MUST BE CHECKED CAREFULLY, ALLOWING FOR EXPANSION OR CONTRACTION. Pipe strain can distort the pump components, thus increasing wear, causing bearing misalignment, or breaking parts. Pipe supports and expansion joints should be used to avoid weight and stresses on the pump. See that flanges or unions fit without forcing.

Pump port size does not necessarily establish correct pipe size. If in doubt as to pipe size to use, check with a Roper Distributor or District Representative. It is recommended that the pump be installed below the liquid level, with a short, large diameter supply line to assure a flooded inlet. Roper pumps, however are self-priming, positive displacement pumps and will prime under the most difficult conditions. Roper pumps are recommended for clean liquid only. A strainer, of ample size and regularly cleaned, should be used in the inlet piping to prevent foreign material from entering the pump.

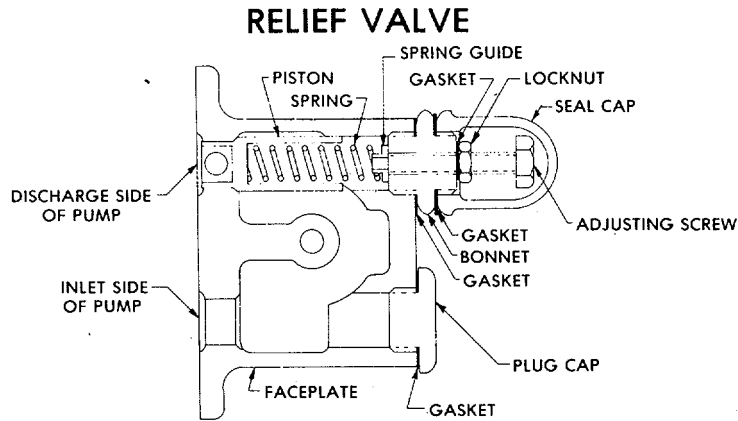


Prior To Starting The Pump See: PRE-OPERATION CHECKS

RELIEF VALVE

The relief valve must be positioned as shown in instructions for direction of rotation —otherwise the valve is inoperable and will not give protection.

It is mandatory that the relief valve be set BY THE USER since the maximum relief valve pressure depends upon the viscosity and specific gravity of the liquid, the flow rate (pump RPM), and also the initial relief valve setting. If not specified otherwise, the relief valve on this pump is factory set for full by-pass at a differential pressure of 300 PSIG, at a pump speed of 900 to 1800 RPM on liquid with viscosity of approximately 150 to 300 SSU. This setting would only apply if all these conditions are duplicated. Built-in relief valves sense differential pressure only (difference between inlet and outlet pressures.)



To adjust the relief valve, remove the seal cap and loosen locknut. Turn adjusting screw clockwise to increase pressure and countercheck- wise to decrease pressure. Make adjustments in 1/2 turn increments until desired pressure is obtained. Tighten locknut and replace seal cap.

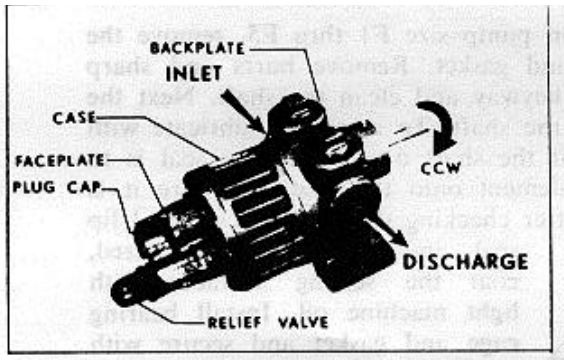
To replace spring and/or piston or to change direction of rotation, remove seal cap and gasket. Loosen locknut and adjust relief valve pressure to minimum. Remove bonnet and gasket making sure that the spring pressure does not force bonnet out too rapidly. Remove spring, spring guide, and piston. Remove plug cap and gasket from faceplate. Check all parts and internal passages to make sure that they are clean and free from rust or damage. To assemble, determine direction of rotation and replace plug cap and gasket as shown in direction of rotation. Place piston and spring in correct position according to direction of rotation.

Turn adjusting screw to have shoulder flush with bonnet, place spring guide on adjusting screw; install gasket and assemble into faceplate making sure spring engages over spring guide. Tighten bonnet. Rein- stall gasket and plug cap, if removed. Adjust relief valve pressure as described.

A built-in relief valve should not be used on applications where the discharge must be closed for more than a few minutes. Prolonged operation with the relief valve fully by-passing will cause heating of the liquid circulating thru the valve, thus resulting in possible damage.

CHECK PISTON PERIODICALLY TO MAKE SURE THAT IT WILL SLIDE FREELY IN PUMP FACEPLATE. FAILURE TO SLIDE DUE TO BINDING OR FOREIGN MATERIAL WILL CAUSE EXCESSIVE PRESSURE BUILDUP IN PUMP.

DIRECTION OF ROTATION

COUNTERCLOCKWISE

PRIOR TO OPERATING THE PUMP, MAKE SURE THAT THE SHAFT ROTATION, PIPE CONNECTIONS, AND THE RELIEF VALVE POSITION IS IN ACCORDANCE WITH THE ABOVE ILLUSTRATION.

To reverse rotation, the relief valve must be positioned as shown for desired direction of rotation. See appropriate instructions to change relief valve position if required.

For inlet pressures over 25 PSIG, consult a distributor, district representative, or the home office of the **ROPER PUMP COMPANY, COMMERCE, GEORGIA.**

LUBRICATION

All lubrication fittings have been greased at the factory. The internal parts of the pump are lubricated by the liquid being pumped. Outboard bearing or bearing cage should be greased with ball bearing grease once a month in daily service or equivalent in intermediate service.

MECHANICAL SEAL

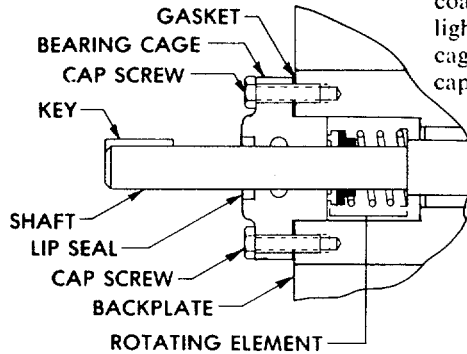
Mechanical seals do not require adjustments. Leakage developed at the seal may be due to one of the following conditions; worn, marred, or cracked rotating or stationary lapped seal faces, or bellows that has become hard, soft, cracked, expanded or extruded.

When replacing or servicing a mechanical seal, take particular care not to mar or scratch the sealing surfaces or damage the bellows. If the seal has been used, do not put it back into service unless both sealing surfaces are perfectly flat and smooth or else replaced.

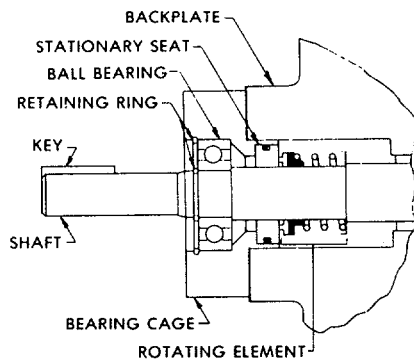
MECHANICAL SEAL, CONTINUED

To replace the mechanical seal on pump size F1 thru F5, remove the key, cap screws, bearing cage, and gasket. Remove burrs and sharp edges from the end of shaft and keyway and clean the shaft. Next the seal parts may be removed from the shaft. To assemble, lubricate with a light machine oil the section of the shaft over which the seal is to be mounted. Slide the rotating element onto the shaft. Be sure it is properly centered on the shaft. After checking the bearing cage and lip seal and replacing if required,

coat the sealing surfaces with light machine oil. Install bearing cage and gasket and secure with cap screws.



To remove the mechanical seal on pump sizes F10 thru F300, remove the retaining ring on the shaft of the F10, or loosen the set screws in the bearing of F15 thru F300. Remove the retaining ring from the bearing cage. Remove the cap screws and bearing cage. (Bearing and stationary seat will be removed along with bearing cage.) Remove burrs and sharp edges from end of shaft and keyway and clean the shaft. Next the seal parts may be removed from the shaft. To assemble, lubricate with a light machine oil the section of the shaft over which the seal is to be mounted. Slide the rotating element onto the shaft. Be sure it is properly centered on the shaft. After checking the stationary seat and "O" ring and replacing if required, coat the sealing surfaces with light machine oil. Install gasket and bearing cage and secure with cap screws. Install retaining ring on shaft for F10, or tighten set screws in bearing for F15 thru F300.



CHECKING PUMP PERFORMANCE

A summary of the causes of common malfunctions.

NO LIQUID DELIVERED

1. Pump not primed. If pump fails to deliver liquid after a minute, stop the pump and prime it by pouring some liquid into the discharge side of the pump.
2. Rotating in wrong direction.
3. Inlet lift too high. Check this with gauge at pump inlet.
4. Clogged inlet line.
5. Air pockets or vapor lock.
6. Air leaks in inlet line.
7. Foreign matter under valve seat or poppet. Remove and clean poppet and valve seat. Caution: if poppet or seat is damaged it must be remachined or replaced.

RAPID WEAR

1. Abrasives in liquid.
2. Compatibility of liquid and pump material.
3. Excessive pressure.
4. Non-lubricating liquid.

EXCESSIVE NOISE

1. Starved pump.
2. Air leaks in inlet line.
3. Air or gases in liquid.
4. Pump speed too high.
5. Relief valve chatter. Check pressure setting.
6. Improper mounting. Check alignment thoroughly. See instructions for aligning driver and pump and preparation of foundation for baseplate mounted pumps.

INSUFFICIENT LIQUID DELIVERED

1. Air leaks in inlet line.
2. Air leaks through packing or mechanical seal.
3. Speed too slow.
4. Excessive lift at inlet. Check this with gauge at the pump inlet.
5. Viscosity of liquid too high for size and length of inlet pipe.
6. Foot valve or end of inlet pipe not immersed deeply enough in liquid.
7. Foot valve, if used, too small, stuck, or not working properly.
8. Partial air pockets or vapor lock.
9. Pump damaged by foreign matter or misalignment.
10. Excessive clearance in pump caused by wear or corrosion.
11. Relief valve set too low, or stuck partially open.

PUMP TAKES TOO MUCH POWER

1. Speed too high.
2. Liquid more viscous than previously anticipated.
3. Operating pressure higher than specified. Check this with gauge at the pump outlet.
4. Outlet line obstructed.
5. Mechanical defect, such as bent shaft, packing gland too tight, or misalignment of piping.
6. Relief valve not operating properly.

SERIES F **TYPE 27**
SAFETY PRECAUTIONS

Safe installation, operation and maintenance must be performed by qualified personnel. Do not work on a pump while it is running, except for minor necessary adjustments such as packing and relief valve. Be careful when working on or near a running pump, contacting or being caught in rotating parts could cause serious or fatal injury. Guards should be provided for all exposed rotating parts. WHEN LIQUID BEING PUMPED IS HAZARDOUS OR VOLATILE, PRECAUTIONS SHOULD BE TAKEN AT ALL TIMES INCLUDING THE RUN IN PERIOD AND DURING DISASSEMBLY AND ASSEMBLY OF PUMP.

PRE-OPERATION CHECKS

See instructions on Preparation of Foundation for Base Mounted Pumps, Aligning Driver and Pump, and Pipe Installation.

Determine the proper direction of rotation by using the appropriate instructions and illustrations. When a relief valve is used, make sure it is positioned and adjusted properly. Check the rotation of the driver to make sure it will operate the pump in the desired direction of rotation. After the unit is mounted and the piping is connected, the pump should be checked to be sure it operates freely, without binding. After operation is proved satisfactory, both pump and driver should be tightly secured and the alignment rechecked before operation.

Before starting, make sure the inlet and discharge valves are open and there is liquid in the pump.

After starting the unit, check to see that the pump is delivering liquid. If not, stop the driver immediately and refer to the section on Checking Pump Performance. If the pump is delivering liquid, check the unit for quiet operation, vibration, localized heating, and excessive seal or packing leakage. It is recommended the pressure and-or vacuum be checked by installing gages at both sides of the pump to make sure the pressure and-or vacuum conform to specifications.

IF THERE IS NO RELIEF VALVE IN THE SYSTEM NEVER BLOCK THE OUTLET LINE. HIGH PRESSURE WILL OCCUR, RESULTING IN POSSIBLE DAMAGE OR BREAKAGE TO THE PUMP OR SYSTEM PARTS AND POSSIBLE INJURY TO PERSONNEL. EVEN WITH A RELIEF VALVE IN THE SYSTEM, DO NOT OPERATE THE PUMP FOR MORE THAN A FEW MINUTES WITH THE OUTLET LINE BLOCKED. RAPID HEATING AND POSSIBLE DAMAGE WILL OCCUR.

REPAIR PARTS

Use only Roper repair parts. Roper Pump Company takes no responsibility for the use of parts other than those manufactured and supplied by Roper Pump Company. The use of substitutes may result in poor pump performance or in an accident causing physical damage or injury to personnel.

P. O. BOX 1252

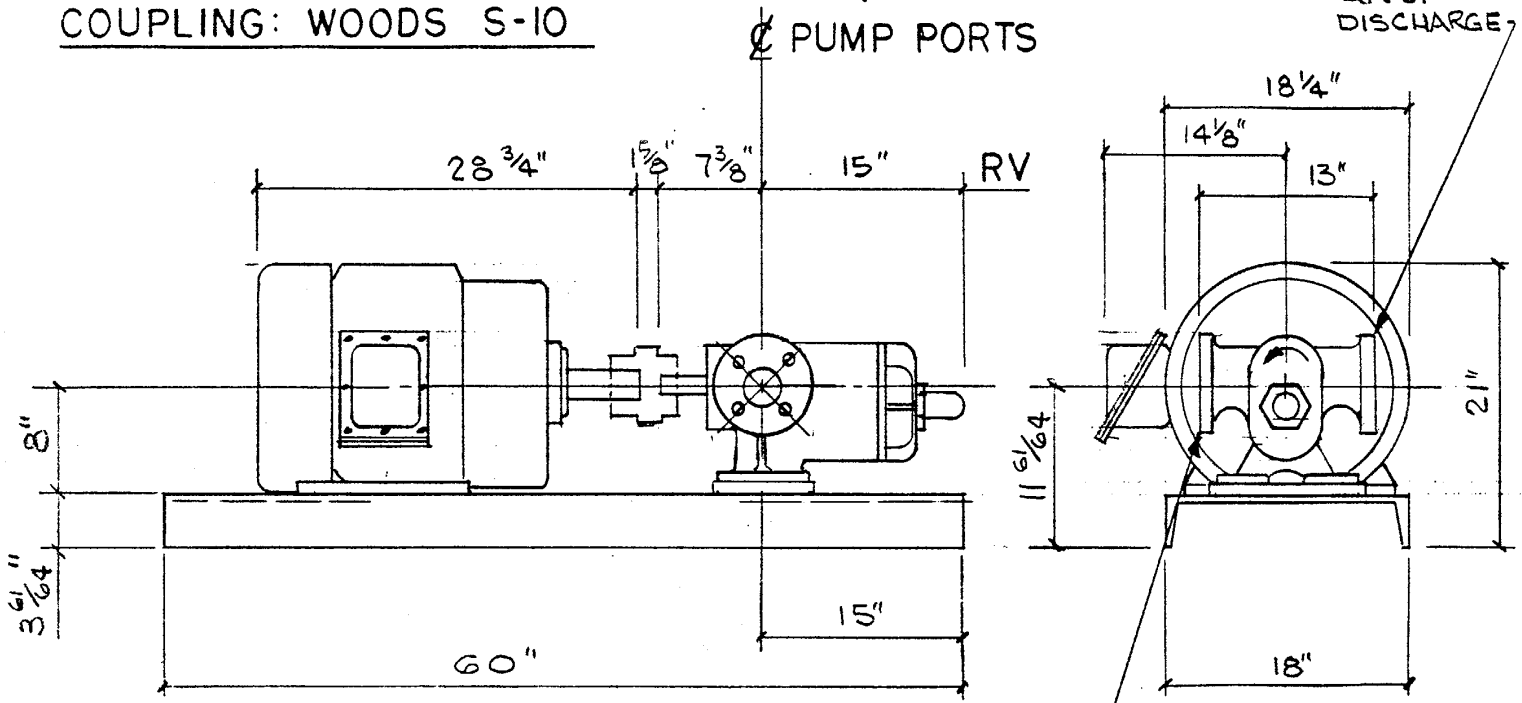
METAIRIE, LA. 70004



PUMP: ROPER 2F75

MOTOR: 20 HP 880 RPM

COUPLING: WOODS S-10



WEIGHTS (LBS)	
PUMP	188
MOTOR	632
BASE & CPLG	238

DRAWING TITLE: **FOAM PUMP**

SCALE: NONE

DRAWN BY: RAG

DATE: 9/77/82

DWG. NO.:

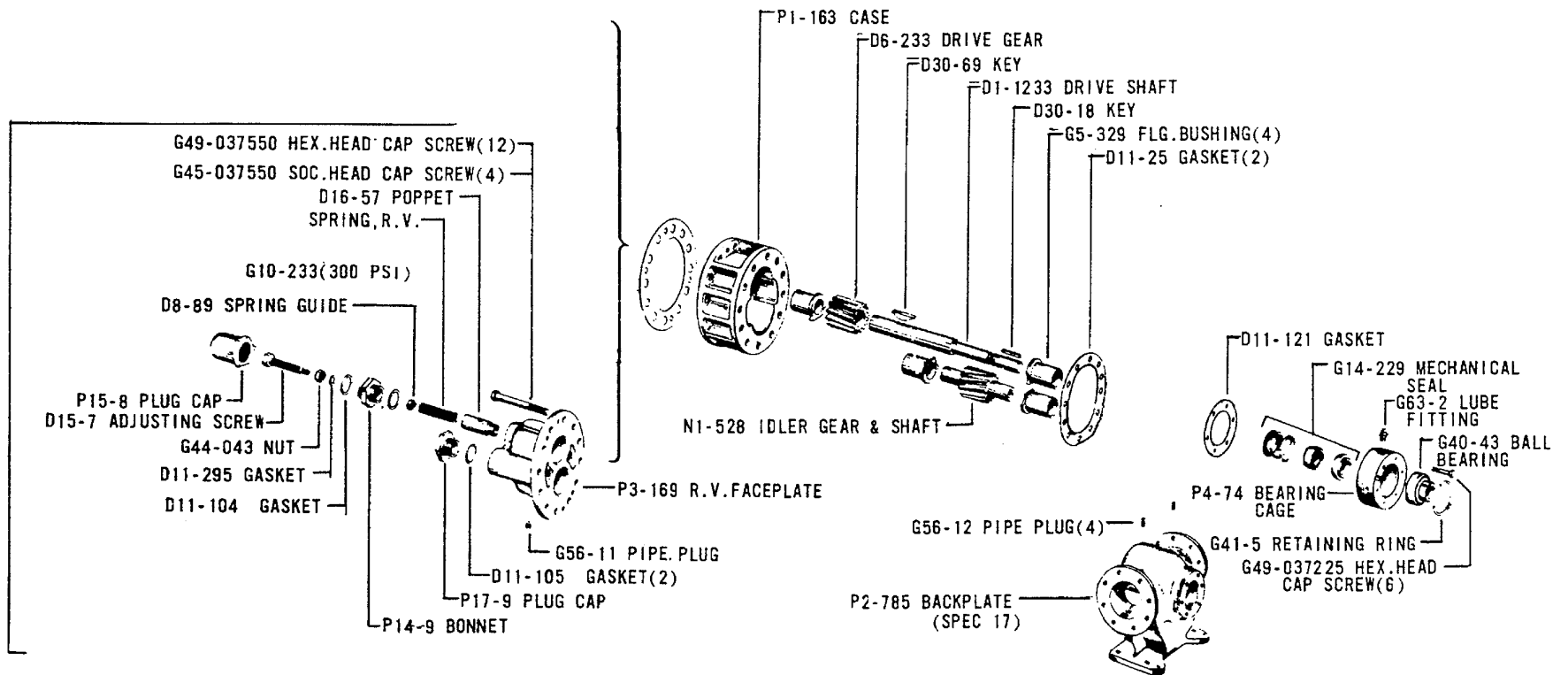


FIGURE 2 F75 FOOT-MOUNTED
 SPECS 17 TYPE 27 MECHANICAL SEAL

ROPER PUMP COMPANY
COMMERCE, GEORGIA

ROPER MODEL - 2F75 - 17

<u>DESCRIPTION</u>	<u>PART NO.</u>	<u>QTY.</u>	<u>MATERIAL</u>
HEAX. HD. CAP SCREW	G49-037550	12	STEEL
SOCK. HD. CAP SCREW	G45-037550	4	STEEL
POPPET	D16-57	1	STEEL
SPRING R.V.	G10-233(300PSI)	1	STEEL
SPRING GUIDE	D8-89	1	STEEL
BONNET	P14-9	1	CAST IRON
GASKET	D11-104	1	BRASS
GASKET	D11-295	1	BRASS
NUT	G44-043	1	STEEL
ADJUSTING SCREW	D15-7	1	STEEL
PLUG CAP	P15-8	1	CAST IRON
CASE	P1-163	1	CAST IRON
DRIVE GEAR	D6-233	1	STEEL
KEY	D30-69	1	STEEL
DRIVE SHAFT	D1-1233	1	STEEL
KEY	D30-18	1	STEEL
FLG. BUSHING	G5-329	4	HI LEAD BRZ
GASKET	D11-25	2	VELUM
IDLER GEAR & SHAFT	N1-528	1	STEEL
R.V. FACE PLATE	P3-169	1	CAST IRON
PIPE PLUG	G56-11	1	STEEL
GASKET	D11-105	2	VELUM
PLUG CAP	P17-79	1	STEEL
PIPE PLUG	G56-12	4	STEEL
BACK PLATE	P2-785	1	CAST IRON
GASKET	D11-121	1	VELUM
MECHANICAL SEAL	G14-229		
LUBE FITTING	G63-2	1	STEEL
BALL BEARING	G40-43	1	STEEL
BEARING CARTRIDGE	P4-74	1	CAST IRON
RETAINING RING	G41-5	1	STEEL
HEX. HD. CAP SCREW	G49-037225	6	STEEL

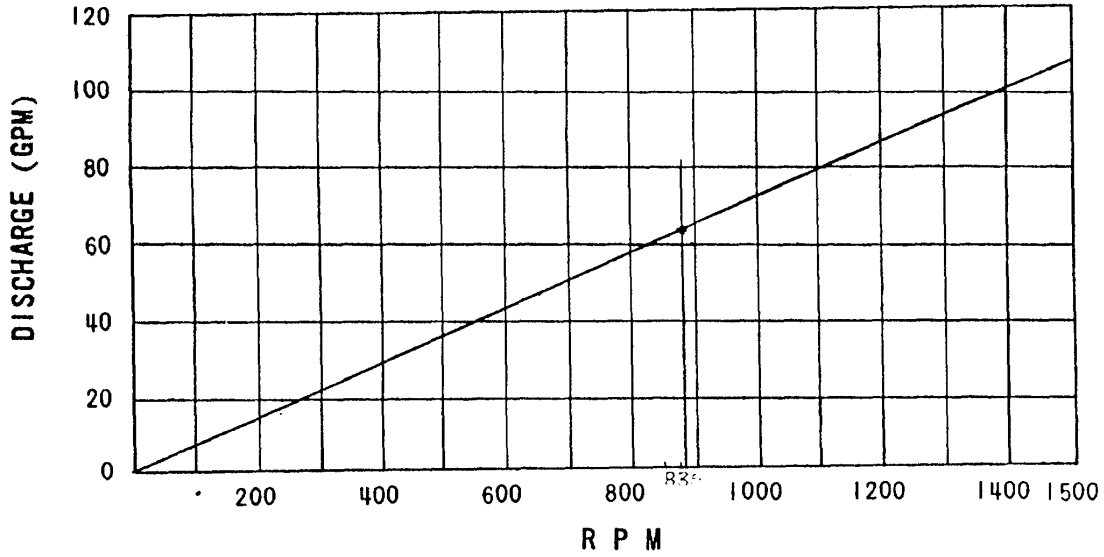
DELIVERY

F75

TOTAL OUTPUT IN GPM:

GRAPH I -- GRAPH II

GRAPH I



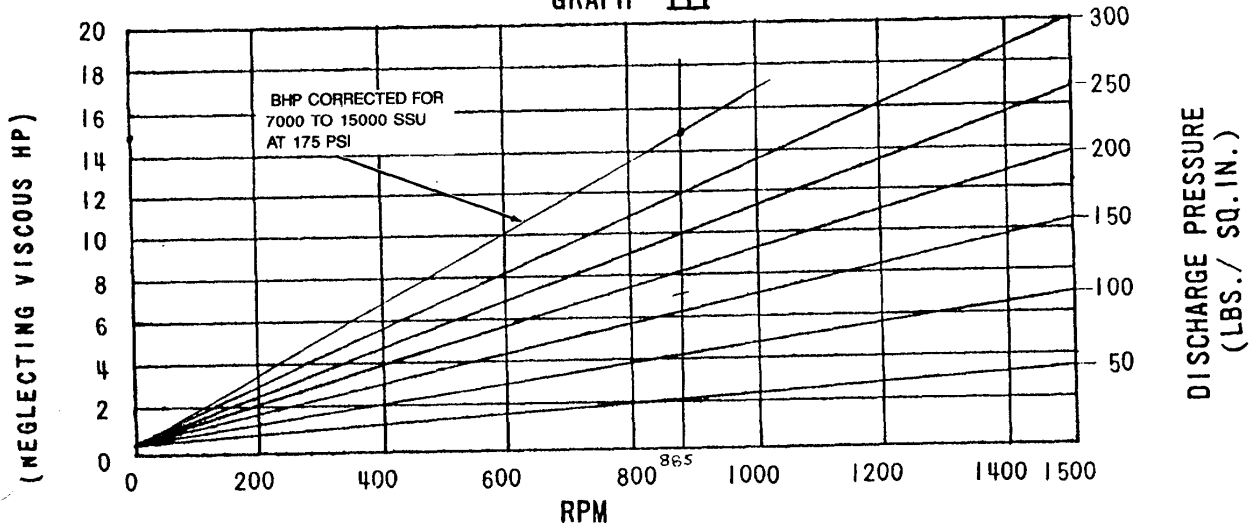
INPUT HORSEPOWER

F75

TOTAL INPUT HORSEPOWER:

GRAPH III + GRAPH IV

GRAPH III



SECTION VIII

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

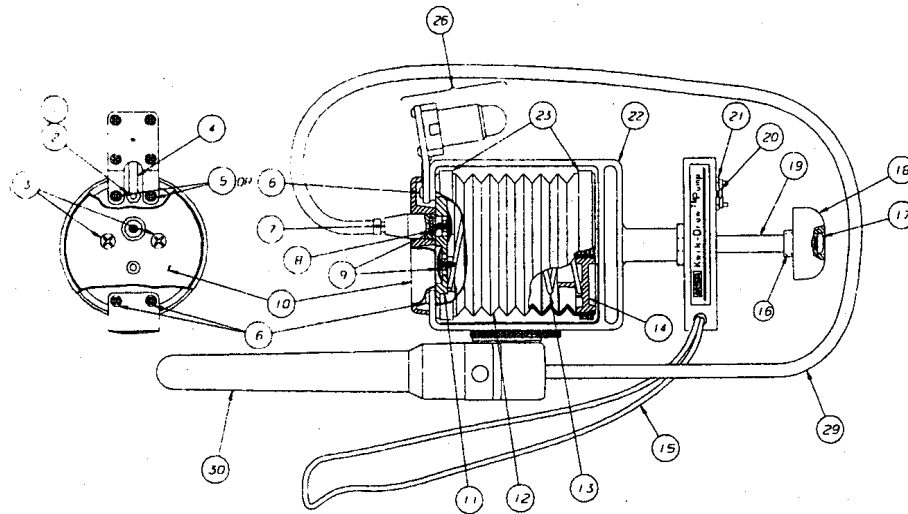
1. Plug the Pump inlet by inserting an unbroken Detector Tube into the Tube Holder.
2. Deflate the Pump fully, release, and wait 10 minutes. The Pump is leak-free if the distance from the bellows to the frame is 1/2-inch or greater after 10 minutes. If the Pump leaks, check the Tube Holder and, if necessary, the valves (see "Maintenance"). After repair, re-test for leakage.

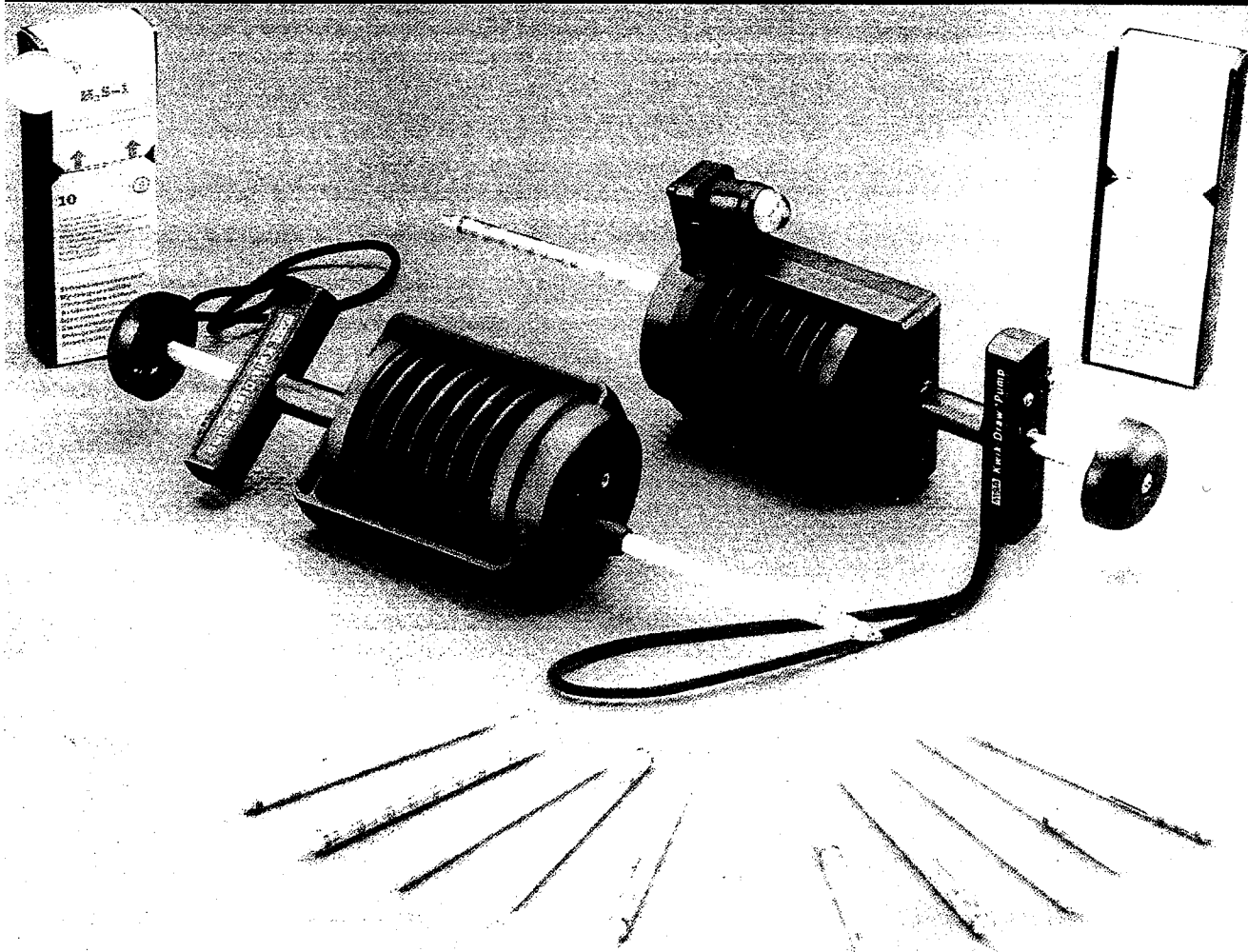
⚠ WARNING

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.

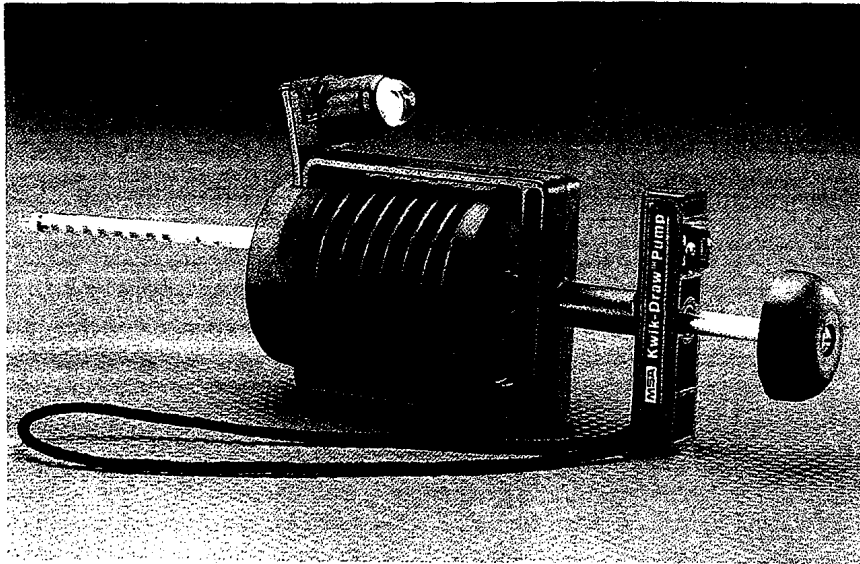
DESCRIPTION

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

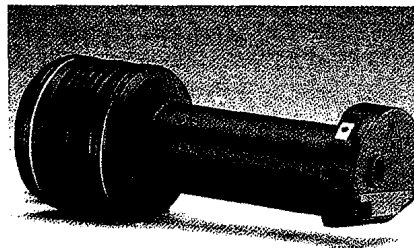
Kwik-Draw Pumps allow detection of gases and vapors with the squeeze of a handle. To obtain a precise (100 ml) sample volume, the user simply grasps the hand grip and pushes the knob. The pump's compression system provides the guiding action to drive a spring-loaded bellows pump.

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

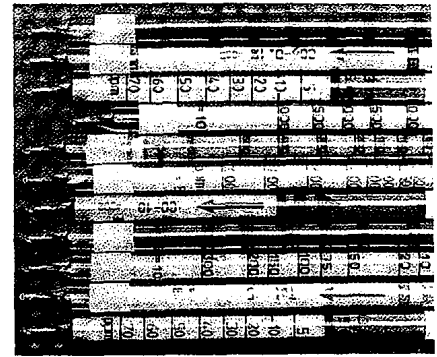
The Gas-Tester II H Pump is set for action by compressing the bellows. A pump stroke is started by pressing the release button. When the sample (100ml) is drawn through the tube, the end-of-stroke indicator changes color. An accurate measurement is obtained because the sample draw procedure itself is 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 ₃ - 2	804405	2 - 500 ppm	25
	NH ₃ - 20	800300	20 - 1000 ppm	
	NH ₃ - 0.1%	804406	0.1 - 10 Vol.-%	
n-Amyl chloride (1-Chloropentane)	Trichloroethane-5	487343	5 - 550 ppm	—
Benzene	C ₆ H ₆ -1	807024	0.5 - 25 ppm	
	C ₆ H ₆ -5	804411	5 - 100 ppm	
	Aromatic HC	804132	5 - 500 ppm	10
	Qualitest QL	497665	n/a	
Bromine	Cl ₂ -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 ₂ -100 CO ₂ -0.1% CO ₂ -1%	497606 487333 804419	100 - 3000 ppm 0.1 - 7.0 Vol.-% 1 - 20 Vol.-%	5000
Carbon Disulfide	CS ₂ -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 ₂ -0.2 Cl ₂ -0.5	803944 804133	0.2 - 30 ppm 1 - 46 ppm	0.5
Chlorine dioxide	ClO ₂ -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 ₂ Cl ₂ -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 ₂ Cl ₂ -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

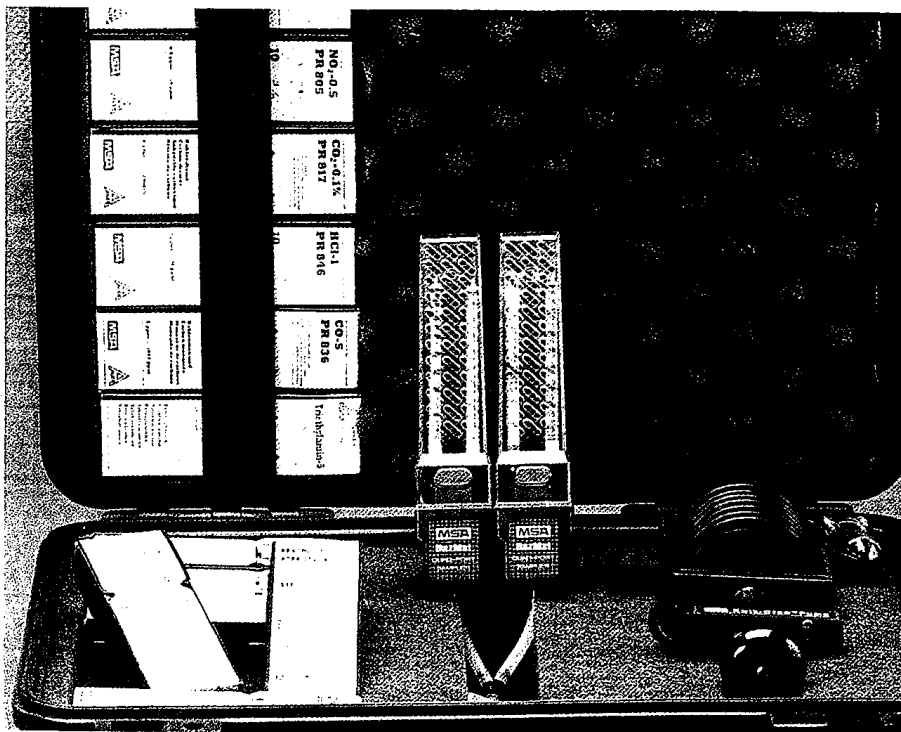
Substance measured	Detector Tube applicable	Part No. (one package of 10 tubes)	Measuring range	Threshold Limit value 1995-1996 ACGIH (ppm)
Ethyl chloride (Chloroethane)	Trichloroethane-5	487343	50 – 8000 ppm	100
Ethylene (Ethene)	Ethylene-50 Qualitest QL	804428 497665	25 – 5000 ppm n/a	—
Ethylenediamine	Triethylamine-5	804134	5 – 27 ppm	10
Ethylene dibromide (1,2-Dibromoethane)	Trichloroethane-5	487343	25 – 700 ppm	—
Ethylene dichloride (1,2-Dichloroethane)	CH ₂ Cl ₂ -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 ₂ S-1 H ₂ 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 ³ (0.01 - 0.08 ppm)	0.025 mg/m ³ (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 ₂ Cl ₂ -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 ₂ -0.5 NO ₂ -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 ₃ -0.05	497101	0.05 – 3 ppm	0.3
	PH ₃ -0.1	485680	0.1 – 100 ppm	
	PH ₃ -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 ₂ -1	487338	0.5 – 25 ppm	2
	SO ₂ -5	497662	5 – 120 ppm	
	SO ₂ -100	497661	100 – 4000 ppm	
Sulfur hexafluoride decomposition products	SF ₆ 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
	Tri-5	487342	5 - 250 ppm	
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.

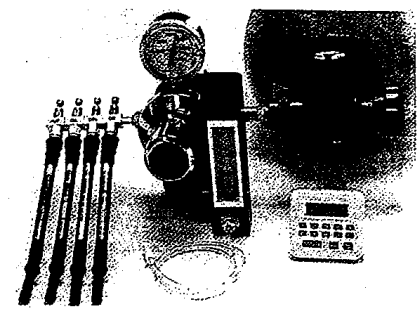
An easy-to-follow interpretation chart helps identify these classes of chemicals: oxidizing gases, carbon monoxide, aromatic hydrocarbons, organic gases, mercaptans, unsaturated hydrocarbons, acidic gases, hydrogen cyanide, amines, halogenated hydrocarbons, alcohols, and carbon dioxide.

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, CO₂, 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.

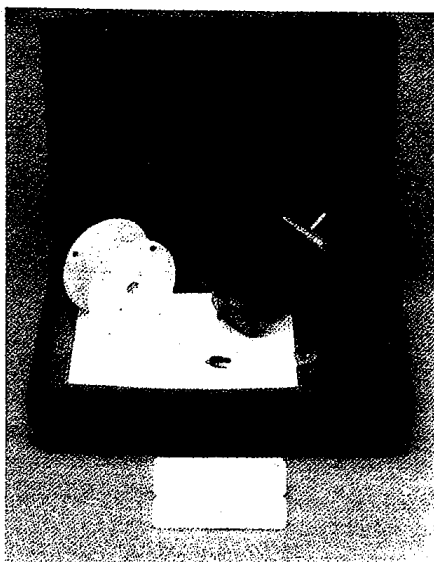
In operation, an air sample is released from the test kit regulator into the manifold and then simultaneously into the four detector tubes. Complete easy-to-follow instructions are included, and an NFPA test for all four gases can be completed in about five minutes.

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 ³
488908	Water Vapor Tube, 5 to 70 mg/m ³ (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.

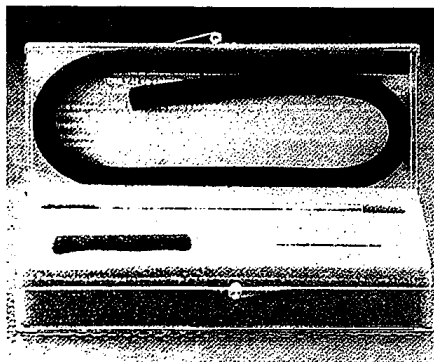
Part No.	Description
488690	Basic Tank-Check Leak Detection Kit, less tubes
493571	Deluxe Tank-Check Leak Detection Kit, complete with 492870 and 804132 Gasoline detector tubes

ACCESSORIES



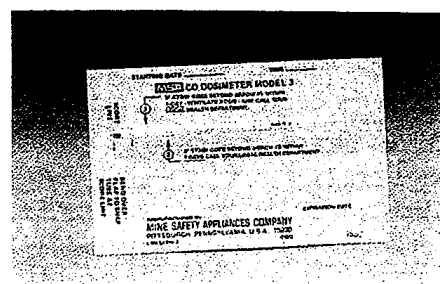
Remote Sampling
 Various length sampling lines are available for use with the Kwik-Draw Pump to make it easier to test for the presence of toxic gases or vapors in hard-to-reach areas. A remote sampling adapter should be used to attach line to pump.

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
	487338	SO2-1
SDO	497662	SO2-5
	497661	SO2-100
	487339	H2S-1
SWS	487340	H2S-100
	485680	PH3-0.1
	489119	PH3-50
	497665	Qualitest
	487337	Per-10
TCE	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 IX

Appendix A Maintenance Allocation Chart (MAC)



APPENDIX A

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

A-1. General.

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance categories (levels).

b. The Maintenance Allocation Chart (MAC) in Section II 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 will be consistent with the capacities and capabilities of the designated maintenance categories.

c. Section III lists the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function. .

A-2. Maintenance Functions. Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (for example, by sight, sound, or feel).

b. Test. To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, that is, to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

d. Adjust. To maintain or regulate, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test, measuring, and diagnostic equipments used in precision measurements. 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.

g. 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 an equipment or system.

h. Replace. To remove an unserviceable item and install a serviceable counter-part in its place. "Replace" is authorized by the MAC and is shown as the third position code of the SMR code.

i. Repair. The application of maintenance services¹, including fault location/ troubleshooting², removal/installation, and disassembly/assembly' procedures, and maintenance actions⁴ 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.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications [i.e., Depot Maintenance Work Requirements (DMWR)]. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

k. 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 materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipments/components.

A-3. Explanation of Columns in the MAC, Section II.

a. Column 1. Group Number. Column 1 lists functional group code numbers, the purpose of which is to identify maintenance-significant components, assemblies, subassemblies, and modules with the next higher assembly. End item group number shall be "00."

b. Column 2. Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3. Maintenance Function. Column 3 lists the functions to be performed on the item listed in Column 2. (For detailed explanation of these functions, see paragraph A-2.)

¹Services - inspect, test, service, adjust, align, calibrate, and/or replace.

²Fault locate/troubleshoot - 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).

³Disassemble/assemble - encompasses the step-by-step taking apart (or breakdown) of a spare/functional group coded item to the level of its lowest component identified as maintenance significant (that is, assigned an SMR code) for the category of maintenance under consideration.

⁴Actions - welding, grinding, riveting, straightening, facing, remachinery, and/or resurfacing.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the category of maintenance authorized to perform the function listed in Column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate work time figures will be shown for each category. 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/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various maintenance categories are as follows:

- | | |
|---------------------|---|
| <u>UNIT</u> | C - Operator or Crew
O - Organizational Maintenance |
| <u>INTERMEDIATE</u> | F - Direct Support Maintenance
H - General Support Maintenance |
| <u>DEPOT</u> | D - Depot |

e. Column 5, Tools and Equipment. Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, TMDE, and support equipment required to perform the designated function.

f. Column 6, Remarks. This column shall, when applicable, contain a letter code, in alphabetic order, which shall be keyed to the remarks contained in Section IV.

A-4. Explanation of Columns in Tool and Test Equipment Requirements, Section II.

a. Column 1, Reference Code. The tool and test equipment reference code correlates with a code used in the MAC, Section II, Column 5.

b. Column 2, Maintenance Category. The lowest category of maintenance authorized to use the tool or test equipment.

c. Column 3, Nomenclature. Name or identification of the tool or test equipment.

d. Column 4, National Stock Number. The National stock number of the tool or test equipment.

e. Column 5, Tool Number. The manufacturer's part number.

A-5. Explanation of Columns in Remarks, Section IV.

a. Column 1, Reference Code. This code recorded in Column 6, Section II.

b. Column 2, Remarks. This column lists information pertinent to the maintenance function being performed as indicated in the MAC, Section II.

Section II Maintenance Allocation Chart for Fire Fighting Systems

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS & EQUIPMENT REF CODE	(6) REMARKS CODE
			UNIT		DIRECT SUPPORT	GENERAL SUPPORT	DEPOT		
			C	O	F	H	D		
20	FIRE FIGHTING SYSTEMS	Inspect	.08						
		Test	.05						
		Repair			1.0				
2001	Fire Detection System	Inspect	3.0					3	
		Test			3.0				
2002	Halon 1301 Fire Extinguishing System Note Not applicable to vessel hull numbers LT-801, LT-804, and LT-805	Inspect	1.0						
		Service			1.0			2	
2003	Foam Pump	Adjust	1.0					1	
		Service	1.0					1	
		Repair	3.0					1	
2004	FM-200 System	Inspect	1.0						
		Service			1.0			4, 5, 6	
		Repair			1.0				
2005	Water Wash-down System (WWS)	Inspect	1.0						
		Service			1.0				

Section III Tools and Test Equipment for Fire Fighting Systems

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER	TOOL NUMBER
1	C	Tool Kit, General Mechanics	5180-00-629-7963	(50908) SC5180-90-CL-N55
2	F	Scale, Weighing (0-350 lbs)	6670-01-184-0726	(06370) 53711
3	C	Multi-Meter, AN/PSM-45A	6625-01-265-6001	(89536) Model 27FM
4	F	Kwik-Draw Deluxe Detector Tube Pump w/ End of Stroke Indicator, Remote Sampling Adapter, and Carrying Pouch		(7L021) 487500
5	F	Detector Tube, Hydrogen Fluoride Gas (HF-1), 125 ppm Range, 3 ppm Threshold Limit Value (TLV)		(7L021) 804142
6	F	Sampling Line, 10 feet long		(7L021) 73076

SECTION X

**Appendix B Repair Parts and Special Tools List,
Material Safety Data Sheets for Hydrogen
Fluoride (HF) Gas, FM-200, Nitrogen and
Carbon Dioxide (CO₂)**

**UNIT, INTERMEDIATE DIRECT SUPPORT
AND INTERMEDIATE GENERAL SUPPORT
MAINTENANCE REPAIR PARTS AND SPECIAL TOOLS LIST**

SECTION I. INTRODUCTION

1. SCOPE. This RPSTL lists and authorizes spares and repair parts; special tools; special test, measurement, and diagnostic equipment (TMDE); and other special support equipment required for performance of unit, intermediate direct support, and intermediate general support maintenance of the LARGE TUG (LT). It authorizes the requisitioning, issue, and disposition of spares, repair parts and special tools as indicated by the source, maintenance and recoverability (SMR) codes.

2. GENERAL.. In addition to this section, Introduction, this Repair Parts and Special Tools List is divided into the following sections:

a. Section II. Repair Parts List. A list of spares and repair parts authorized by this RPSTL for use in the performance of maintenance. The list also includes parts which must be removed for replacement of the authorized parts. Parts lists are composed of functional groups in ascending alphanumeric sequence, with the parts in each group listed in ascending figure and item number sequence. Bulk materials are listed in item name sequence. Repair parts kits are listed separately in their own functional group within Section II. Repair parts for repairable special tools are also listed in this section. Items listed are shown on the associated illustration(s)/figure(s).

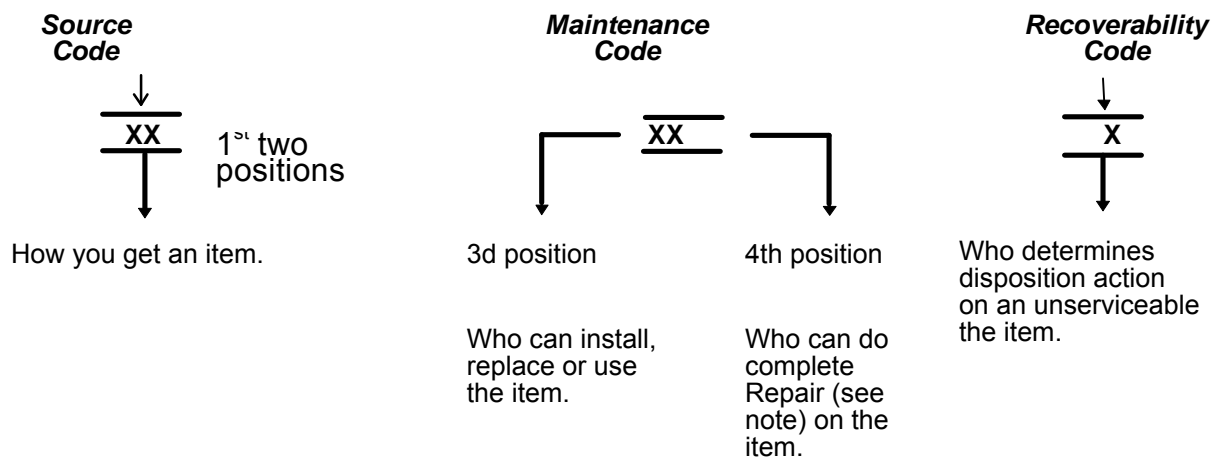
b. Section III. Special Tools List. A list of special tools, special TMDE, and other special support equipment authorized by this RPSTL (as indicated by Basis of Issue (BOI) information in DESCRIPTION AND USABLE ON CODE column) for the performance of maintenance.

c. Section IV. Cross-references Indexes. A list, in National Item Identification Number (NIIN) sequence, of all National stock numbered items appearing in the listing, followed by a list in alphanumeric sequence of all part numbers appearing in the listings. National stock numbers and part numbers are cross referenced to each illustration figure and item number appearance. The figure and item number index lists figure and item number in alphanumeric sequence and cross references NSN, CAGEC and part number.

3. EXPLANATION OF COLUMNS (SECTIONS II AND E).

a. PAGE NO. (Column (1)). Indicates the page number used to identify items called out in the illustration.

b. SMR Code (Column (2)). The Source, Maintenance, and Recoverability (SMR) code is a 5-position code containing supply/requisitioning information, maintenance category authorization criteria, and disposition instruction, as shown in the following breakout:



*Complete Repair: Maintenance capacity, capability, and authority to perform all corrective maintenance tasks of the "Repair" function in a use/user environment in order to restore serviceability to a failed item.

(1) Source Code. The source code tells you how to get an item needed for maintenance, repair, or overhaul of an end item/equipment. Explanations of source codes follows:

Code	Explanation
PA PB PC** PD PE PF PG	<p>Stocked items; use the applicable NSN to request/requisition items with these source codes. They are authorized to the category indicated by the code entered in the 3^d position of the SMR code.</p> <p>**NOTE: Items coded PC are subject to deterioration.</p>
KD KF KB	<p>Items with these codes are not to be requested/requisitioned individually. They are part of a kit which is authorized to the maintenance category indicated in the 3rd position of the SMR code. The complete kit must be requisitioned and applied.</p>
MO - (Made at org AVUM Level) MF - (Made at DS/AVUM Level) MH - (Made at GS Level) ML - (Made at Specialized Repair Activity (SRA)) MD - (Made at Depot)	<p>Items with these codes are not to be requested/requisitioned individually. They must be made from bulk material which is identified by the part number in the DESCRIPTION and USABLE ON CODE (UOC) column and listed in the Bulk Material group of the repair parts list in this RPSTL. If the item is authorized to you by the 3rd position code of the SMR code, but the source code indicates it is made at a higher level, order the item from the higher level of maintenance.</p>
AO - (Assembled by org/AVUM Level) AF - (Assembled by DS/AVIM Level) AH - (Assembled by GS Category) AL - (Assembled by SRA) AD - (Assembled by Depot)	<p>Items with these codes are not to be requested/requisitioned individually. The parts that make up the assembled item must be requisitioned or fabricated and assembled at the level of maintenance indicated by the source code. If the 3rd position code of the SMR code authorizes you to replace the item, but the source code indicates the items are assembled at a higher level, order the item from the higher level of maintenance.</p>
XA - XB - XC - XD -	<p>Do not requisition "XA" -coded item. Order its next higher assembly. (Also, refer to the NOTE below.)</p> <p>If an "XB" item is not available from salvage, order it using the CAGEC and part number given.</p> <p>Installation drawing, diagram, instruction sheet, field service drawing, that is identified by Reciprocating Compressor manufacturer's part number.</p> <p>Item is not stocked. Order an "XD" -coded item through normal supply channels using the CAGEC and part number given if no NSN is available.</p>

NOTE

Cannibalization or controlled exchange, when authorized, may be used as a source of supply for items with the above source codes, except for those source

coded "XA" or those aircraft support items restricted by requirements of AR 750-1.

(2) Maintenance Code. Maintenance codes tells you the level(s) of maintenance authorized to USE and REPAIR support items. The maintenance codes are entered in the third and fourth positions of the SMR code as follows:

(a) The maintenance code entered in the third position tells you the lowest maintenance level authorized to remove, replace, and use an item. The maintenance code entered in the third position will indicate authorization to one of the following levels of maintenance.

Code	Application/Explanation
C --	Crew or operator maintenance done within unit or aviation unit maintenance.
O --	Unit or aviation unit category can remove, replace, and use the item.
F --	Intermediate direct support or aviation intermediate level can remove, replace, and use the item.
H --	Intermediate general support level can remove, replace, and use the item.
L --	Specialized repair activity can remove, replace, and use the item.
D --	Depot level can remove, replace, and use the item.

(b) The maintenance code entered in the fourth position tells whether or not the item is to be repaired and identifies the lowest maintenance level with the capability to do complete repair (i.e. , perform all authorized repair functions.) NOTE: Some limited repair may be done on the item at a lower level of maintenance, if authorized by the Maintenance Allocation Chart (MAC) and SMR codes. This position will contain one of the following maintenance codes.

Code	Application/Explanation
O --	Unit or (aviation unit) is the lowest level that can do complete repair of the item.
F --	Intermediate direct support or aviation intermediate is the lowest level that can do complete repair of the item.
H --	Intermediate general support is the lowest level that can do complete repair of the item.
L --	Specialized repair activity is the lowest level that can do complete repair of the item.
D --	Depot is the lowest level that can do complete repair of the item.
Z --	Nonreparable. No repair is authorized.
B --	No repair is authorized. (No parts or special tools are authorized for the maintenance of a "B" coded item). However, the item may be reconditioned by adjusting, lubricating, etc., at the user level.

(3) Recoverability Code. Recoverability codes are assigned to items to indicate the disposition action on unserviceable items. The recoverability code is entered in the fifth position of the SMR Code as follows: Recoverability

Recoverability Codes	Application/Explanation
Z --	Nonreparable item. When unserviceable, condemn and dispose of the item at the level of maintenance shown in third position of SMR Code.

- O -- Reparable item. When not economically reparable, condemn and dispose of the item at organizational or aviation unit level
- F -- Reparable item. When uneconomically reparable, condemn and dispose of the item at the direct support or aviation intermediate level
- H -- Reparable item. When uneconomically reparable, condemn and dispose of the item at the general support level.
- D -- Reparable item. When beyond lower level repair capability, return to depot. Condemnation and disposal of item not authorized below depot level.
- L -- Reparable item. Condemnation and disposal not authorized below specialized repair activity (SRA).
- A -- Item requires special handling or condemnation procedures because of specific reasons (e.g., precious metal content, high dollar value, critical material, or hazardous material). Refer to appropriate manuals/directives for specific instructions.

d. PART NUMBER (Column (3)). Indicates the primary number used by the manufacturer, (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements to identify an item or range of items.

NOTE

When you use an NSN to requisition an item, the item you receive may have a different part number from the part ordered.

e. NATIONAL STOCK NUMBER (NSN) INDEX.

(1) STOCK NUMBER (Column(4)). This column lists the NSN by National item identification number (NIIN) sequence. The NIIN consists of the last nine digits of the NSN, i.e.

NSN
<hr style="width: 100%;"/>
5305-01-5741467
NIIN

When using this column to locate an item, ignore the first 4 digits of the NSN. However, the complete NSN should be used when ordering items by stock number.

**APPENDIX B
REFERENCE NUMBER/PART NUMBER TO NATIONAL
STOCK NUMBER CROSS REFERENCE**

20 FIRE FIGHTING SYSTEM

Page Number	SMR Code	Part Number	Stock Number
1	PACCH	2F75-17	
	PACCH	324TTFS7114AP	
3	PACZZ	D11-104	
3	PACZZ	D11-105	
3	PACZZ	D11-121	
3	PACZZ	D11-25	
3	PACZZ	D11-295	
3	PACZZ	D16-57	
3	PACZZ	G1 0-233	
3	PACZZ	G1 4-229	4320-00-704-3552
3	PACZZ	G40-43	
3	PACZZ	G41-5	
3	PACZZ	G63-2	
3	PACZZ	P14-9	
3	PACZZ	P4-74	

SPECIAL TOOLS

53711	6670-01-184-0726
MODEL 27FM	6625-01-265-6001
SC5180-90-CL-N55	5180-00-629-9783

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 ¹	TLV-ACGIH ²	LD ₅₀ or LC ₅₀ 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)

¹ As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993).

² 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

MSDS: G-91

Revised: 6/7/96

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 LIMITS¹:

INGREDIENT	% VOLUME	PEL-OSHA ²	TLV-ACGIH ³	LD ₅₀ or LC ₅₀ Route/Species
Carbon Dioxide FORMULA: CO ₂ CAS: 124-38-9 RTECS #: FF6400000	99.8 TO 99.999	5000 ppm TWA	5000 ppm TWA 30,000 ppm STEL	Not Available

¹ Refer to individual state of provincial regulations, as applicable, for limits which may be more stringent than those listed here.

² As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)

³ 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

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Change 1

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 (H2O)	: 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 InformationLC₅₀ (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.

MSDS: G-91

Revised: 6/7/96

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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Product Name: FM-200

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SECTION I - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name:	FM-200		
Manufacturer:	Great Lakes Chemical Corporation		
Address:	P.O. Box 2200		
City:	West Lafayette		
State:	Indiana		
Zip:	47906-0200		
Emergency Telephone Number:	1-800-949-5167		
Information			
Telephone Number:	1-765-497-6100	Fax:	1-765-497-6123
Chemtrec Phone:	1-800-424-9300		
Effective Date:	8/11/97		
Supercede Date:	2/96		
MSDS Prepared By:	Regulatory Affairs Department/Great Lakes Chemical Corporation		
Synonyms:	1,1,1,2,3,3,3-Heptafluoropropane, 2H-Heptafluoropropane		
Product Use:	Fire extinguishing, fire suppression, explosion suppression and inerting agent		
Chemical Name:	1,1,1,2,3,3,3-Heptafluoropropane		
Chemical Family:	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

MATERIAL SAFETY DATA SHEET

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SECTION III - HAZARDS IDENTIFICATION

Emergency Overview: 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.

Relevant Routes of Exposure: Inhalation

Signs and Symptoms of Overexposure: 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.

Medical Conditions Generally Aggravated By Exposure: 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.

Potential Health Effects: See Section XI for additional information.

Eyes: Direct eye contact with the liquid or cold gas can cause chilling or possibly frostbite of exposed tissues.
Skin: Direct skin contact with the liquid or cold gas can cause chilling or possibly frostbite of exposed tissues.
Ingestion: Not expected to be a hazard in normal industrial use.
Inhalation: 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.

Carcinogenicity:
NTP: No
IARC: No
OSHA: No
ACGIH: No
OTHER: No

Additional Information

No information available

SECTION IV - FIRST AID MEASURES

Eyes: Flush with water. Get medical attention.
Skin: Flush with water; if frostbite occurs get medical attention.
Ingestion: No information available
Inhalation: 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

Appearance:	Colorless gas
Boiling Point:	-16.4 degrees C (3 degrees F)
Bulk Density:	Not available
Color:	Colorless
Decomposition Temperature:	Not available
Evaporation Rate:	Not available
Evaporation Rate Basis:	Not available
Freezing Point:	Not available
Heat Value:	Not available
Melting Point:	-131 degrees C (-204 degrees F)
Molecular/Chemical Formula:	C3HF7
Molecular Weight:	170
Octanol/Water Partition Coefficient:	Not available
Odor:	Odorless
Odor Threshold:	Not available
Particle Size:	Not available
Percent Volatile:	Not available
pH Value:	Not available
pH Concentration:	Not available
Physical State:	Gas
Reactivity in Water:	Not water reactive
Saturated Vapor Concentration:	Not available
Softening Point:	Not available
Solubility in Water:	260 mg/L
Specific Gravity or Density (Water=1):	1.46
Vapor Density:	6.04
Vapor Pressure:	58.8 psia at 70 degrees F (21 degrees C)
Viscosity:	Not available
Volatile Organic Compounds:	Not available
Water/Oil Distribution Coefficient:	Not available
Weight Per Gallon:	Not available

Additional Information

No information available

SECTION X - STABILITY AND REACTIVITY

Stability:	Stable under normal conditions of handling and use.
Conditions to Avoid:	None
Incompatibility With Other Materials:	Powdered metals (ex. Al, Mg, or Zn) and strong alkalis, oxidizers or reducing agents are not compatible with this and most other halogenated

MATERIAL SAFETY DATA SHEET

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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 N₂, CO₂, 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 LC₅₀ 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

MATERIAL SAFETY DATA SHEET

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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

MSDS Number: 00057
Product Name: FM-200

Effective Date: 8/11/97
Page: 9 of 9

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

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 ¹	TLV-ACGIH ²	LD ₅₀ or LC ₅₀ Route/Species
Nitrogen FORMULA: N ₂ CAS: 7727-37-9 RTECS #: QW9700000	99.995 to 99.999	Simple Asphyxiant	Simple Asphyxiant	Not Available

¹ As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)

² 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
---------------------	-----------------------	--------------------	-------------------	-----------------

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.

MSDS: G-7
Revised: 6/7/96

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

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.

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 LIMITS¹:

INGREDIENT	% VOLUME	PEL-OSHA ²	TLV-ACGIH ³	LD ₅₀ or LC ₅₀ Route/Species
Nitrogen FORMULA: N ₂ CAS: 7727-37-9 RTECS #: QW9700000	99.995 to 99.999	Simple Asphyxiant	Simple Asphyxiant	Not Available

¹ Refer to individual state of provincial regulations, as applicable, for limits which may be more stringent than those listed here.

² As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)

³ 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

PARAMETER	VALUE	UNITS
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 ₂ 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.

MSDS: G-7
Revised: 6/7/96

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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).

MSDS: G-7
Revised: 6/7/96

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Change 1

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 ¹	TLV-ACGIH ²	LD ₅₀ or LC ₅₀ Route/Species
Carbon Dioxide FORMULA: CO ₂ CAS: 124-38-9 RTECS #: FF6400000	99.8 TO 99.999	5000 ppm TWA	5000 ppm TWA 30,000 ppm STEL	Not Available

¹ As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)

² 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.

MSDS: G-8
Revised: 6/7/96

Page 1 of 7

Change 1

PRODUCT NAME: HYDROGEN FLUORIDE**ROUTE OF ENTRY:**

Skin Contact Yes	Skin Absorption No	Eye Contact Yes	Inhalation Yes	Ingestion Yes
---------------------	-----------------------	--------------------	-------------------	------------------

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.

MSDS: G-91
Revised: 6/7/96

Page 2 of 7

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 LIMITS¹:

INGREDIENT	% VOLUME	PEL/OSHA	TLV/ACGIH ³	LD ₅₀ or LC ₅₀ 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)

¹ Refer to individual state or provincial regulations, as applicable, for limits which may be more stringent than those listed here.

² As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993).

³ 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.

MSDS: G-91
Revised: 6/7/96

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 XI

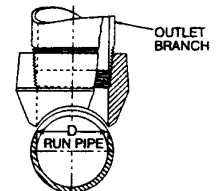
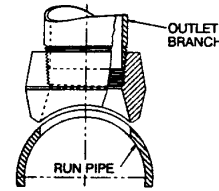
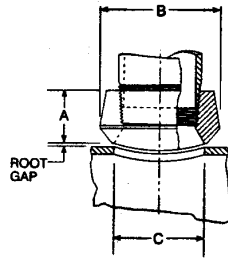
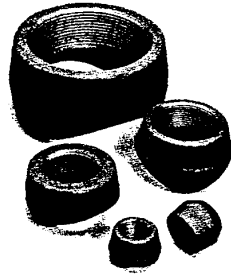
**Appendix C Component Manufacturer's Data Sheets for
FM-200 and Water Washdown System**

B THREDOLET® REDUCING, SIZE ON SIZE AND FLAT

BONNEY FORGE

CL 3000

CL 6000



REDUCING SIZES

	Outlet Size Inches	Dimensions			Appx. Weight Pounds
		A	B	C	
CL 3000	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
CL 6000	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	
CL 3000	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.

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"

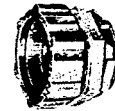
Third Party Certification:



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 13/16	9/16	40
31-125	1 1/4	1 3/8	2 5/16	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 7/16	4 13/16	1	402
*31-350	3 1/2	2 5/8	5 1/2	1 3/16	600
*31-400	4	2 9/16	6 1/8	1 1/4	673
*31-500	5	2 3/8	7 3/8	1 1/8	760
*31-600	6	2 3/8	8 9/16	1 3/8	1100

Insulated Throat

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 13/16	9/16	41
31-125T	1 1/4	1 3/8	2 5/16	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 7/16	4 13/16	1	383
*31-350T	3 1/2	2 5/8	5 1/2	1 3/16	610
*31-400T	4	2 9/16	6 1/8	1 1/4	640
*31-500T	5	2 3/8	7 3/8	1 1/8	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"

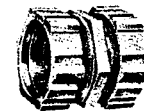
Third Party Certification:



File No. E-11853



30-050 thru 30-200



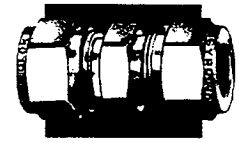
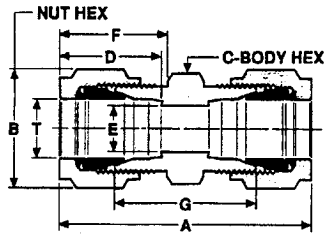
30-250 thru 30-600

Catalog Number	Trade Size Inches	Dim. in Inches		Wt. Per 100
		Length	Max. Dia.	
30-050	1/2	1 11/16	1 3/8	28
30-075	3/4	1 3/4	1 9/16	32
30-100	1	1 13/16	1 13/16	48
30-125	1 1/4	2 1/2	2 5/16	92
30-150	1 1/2	2 9/16	2 5/8	146
30-200	2	2 1/2	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 3/4	8 9/16	1300

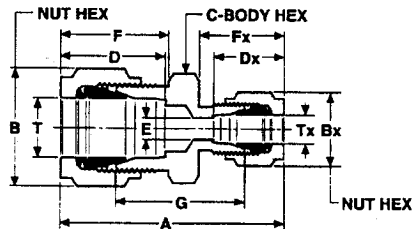
*Not UL Listed



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	4 1/64	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 9/32	1 1/8	1 1/16	1	21/32	31/32	1 19/32	
14U - □	7/8	2 9/32	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	

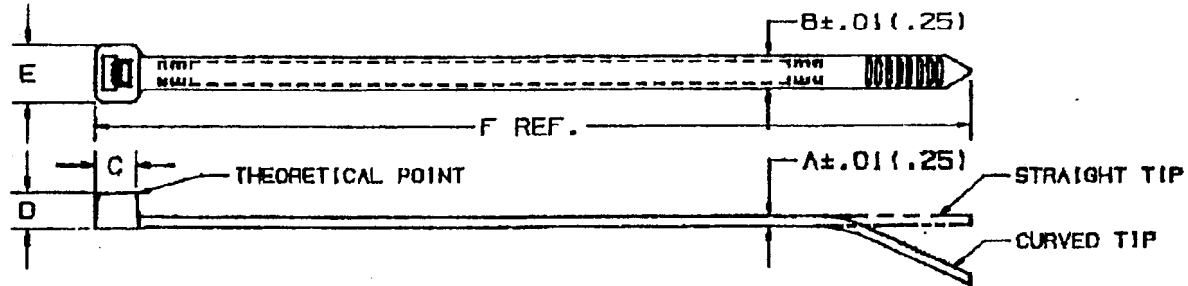


Reducing Union: RU



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	4 1/64	13/32	3/64	49/64	31/64	1 5/16
4RU2 - □	1/4	1/8	1 21/32	9/16	7/16	1/2	4 1/64	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	4 1/64	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	1 5/16
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	4 1/64	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	4 1/64	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	4 1/64	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

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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 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)	2.6 (71)	8 (36)	SUB-MINIATURE	CURVED	.02 (9.0)
PLT.7M	.03 (.8)	.68 (17.3)	.032 (.8)	.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)	.206 (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	3-4-97	JND	CC	ADDED THEORETICAL POINT	5540	23	IMP					
22	4-18-97	JND	VDP	PLT.6SM-CATALOG TOOL APPLIED STRENGTH B WAS 12 LBS	5540	22	VDP					
21	4-4-96	FKS	HVP	SHEET 1 OF 4 WAS SHEET 1 OF 3	5540	21	HVP					
20	3-9-92	RAM	HVP	PLT.6SM MIN. LOOP TENSILE WAS 8 (36)	5540	20	IMP					

UNLESS OTHERWISE SPECIFIED, DIMENSIONAL TOLERANCES ARE: 1.XI ± .0001 1.XX ± .0015		UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE OTHER TO TOLERANCE, UNLESS SHOWN OTHERWISE.
GRADE OF CEW	MAT'L	GRADE NONE
DATE 12-27-84	NYLON 6/6	GRADE NO. SS-5540
REV'S		REV A

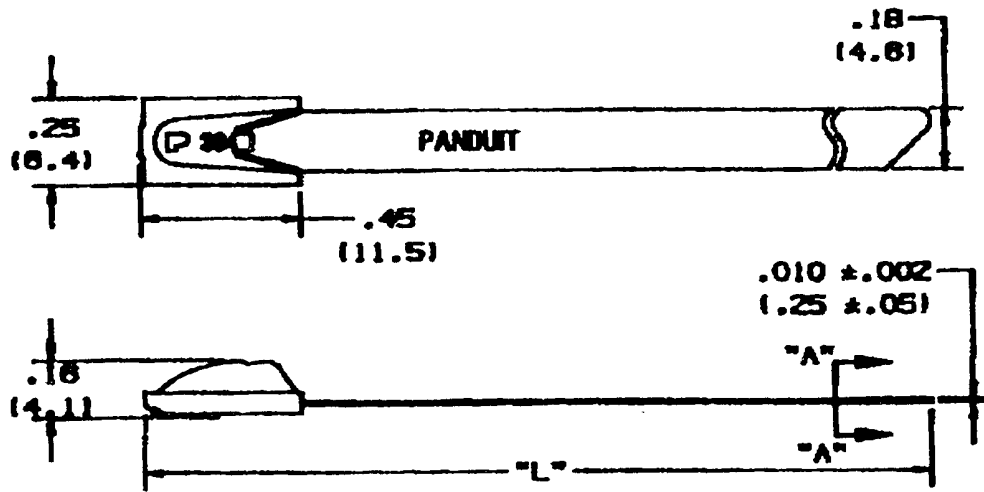
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PANDUIT PART NO.	BUNDLE DIA.		A		B		C		D		E		F		MIN. LOOP TENSILE (lbs.)	CROSS SECTION	TIP STYLE	WEIGHT (lbs./1000 pwr.) (oz.)
	MM. (in.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)	IN. (mm.)					
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	4.58 (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.												
PANDUIT CORP. 12-27-84 YINLEY PARK, ILLINOIS												
PAN-TY CABLE TIES PLT SERIES												
UNLESS OTHERWISE SPECIFIED, DIMENSIONAL TOLERANCES ARE: [K] ± .0005 [MM] ± .00125 [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 FOR SEE SHEET 1 OF 4	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	CKD	DESCRIPTION	LEN	R	COST	SUP	CHILD.	PART # OF 4	REV	A



PANDUIT PART NO.	MAX BUNDLE DIA.	PACKAGE QTY	LENGTH L ±.2 (5)
MLT1S-CP	1" (25)	100	5.0" (127)
MLT2S-CP	2" (50)	100	7.9" (201)
MLT2.7S-CP	2.7" (70)	100	10.2" (259)
MLT4S-CP	4" (100)	100	14.2" (361)
MLT5S-CP	5" (125)	100	17.0" (432)
MLT6S-CP	6" (150)	100	20.5" (521)
MLT8S-CP	8" (200)	100	26.8" (681)
MLT10S-CP	10" (250)	100	33.0" (838)
MLT12S-Q	12" (300)	25	39.3" (998)
MLT14S-Q	14" (350)	25	45.5" (1158)
MLT15S-Q	15" (380)	25	49.2" (1250)
MLT16S-Q	16" (400)	25	51.8" (1318)
MLT30S-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	PK	REV	BY	CHK	REV	BY	CHK	REV	BY	CHK	REV	BY	CHK
12/97	TM	JD	ADDED MLT16S-Q	06507														
6/98	JKD	JD	REVISED TO REFLECT CURRENT PART	04784	LA	DH												
2/98	MS	JD	ADDED MLT5S-CP PART	02888	LA	MLSE												

PANDUIT

CORP.

TRILBY PARK, ILLINOIS

METAL LOCKING TIE
STANDARD SERIES - 304 STAINLESS STEEL

REVISED BY SAM REVISED BY BJO REVISED BY 2x REVISED BY 541005



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	1/2"	Box only 5 outlets, 4 closure plugs, mounting lugs
S-48	3/4"	
 S-49	1/2"	Box with Cover 5 outlets, 4 closure plugs, mounting lugs, gasket, screws, and cover with one 1/2" hole
S-50	3/4"	
 S-51	1/2"	Box with Cover 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"	Box only 7 outlets, 4 closure plugs with mounting lugs
 S-73	1/2"	Box with Cover 7 outlets, 4 closure plugs, mounting lugs, gasket, screws, and cover with one 1/2" hole

Extensions



Cat. No.	Hub Size	Description
 SE-47	1/2"	Round Extension Ring 4 outlets, 4 closure plugs, gasket and screws
SE-48	3/4"	

Covers For Standard Boxes *Raintight


Catalog No.	Description
Standard Cover 4" Diameter with Gasket and Screws	
 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
Jumbo Covers 4 1/2" Diameter with Gasket and Screws	
 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	1/2"	5 outlets, 2 closure plugs with mounting lugs
•JBU-2	3/4"	
 JBX-1	1/2"	4 outlets, 2 closure plugs with mounting lugs
JBX-2	3/4"	

Vaportight Boxes for use with V Series Fixtures

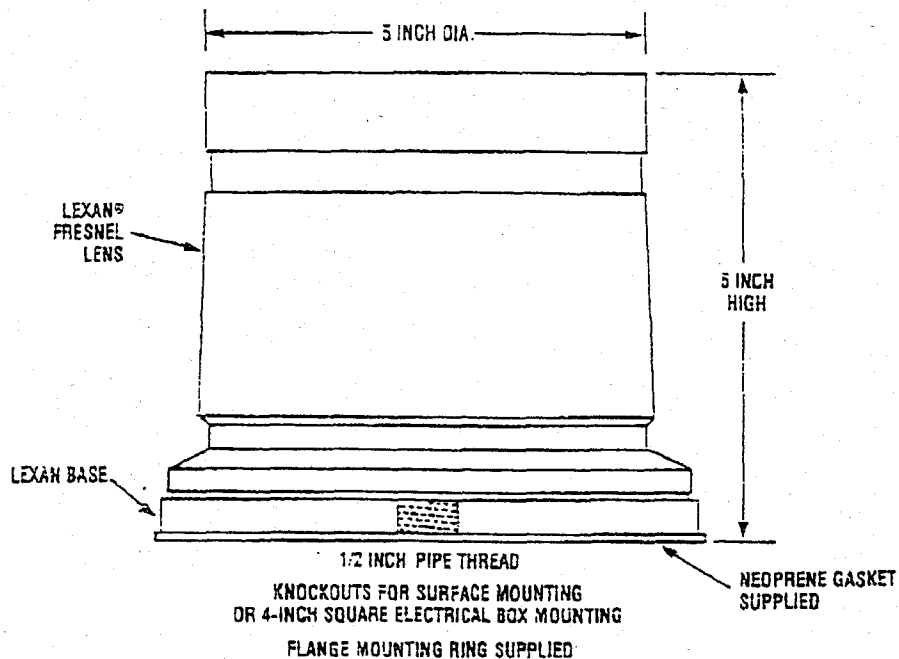
Catalog No.	Hub Size	Description
 LVX-1	1/2"	5 outlets, 4 close-up plugs with mounting lugs
LVX-2	3/4"	

Covers for Vaportight & Deep Boxes *Raintight

Vaportight LVX Boxes	Deep J. Boxes	Hub Size
 V-B	JBK-B	None
Blank		

• Denotes items made to order. Consult factory for minimum quantities and lead time.

SERIES MAX
**INDUSTRIAL
 STROBES**



SPECIFICATIONS

Model Number	Lens Color	Rated Voltage	Current Draw	Flash Energy	Flash Rate	Effective Candela	Temperature Range	Ship Weight
MAX-DC-A	Amber	12 VDC to 90 VDC	1.00A @ 12 VDC	7.5 joules per double flash	60 per minute	100 cd	-35C (-31F) to +66C (+151F)	2 Lb
MAX-DC-R	Red		0.50A @ 24 VDC					
MAX-DC-B	Blue		0.25A @ 48 VDC					
MAX-DC-C	Clear		0.17A @ 72 VDC					
MAX-AC-A	Amber	110 VAC to 120 VAC	0.20A @ 120 VAC	7.5 joules per double flash	60 per minute	100 cd	-35C (-31F) to +66C (+151F)	2 Lb
MAX-AC-R	Red							
MAX-AC-B	Blue							
MAX-AC-C	Clear							

NOTES:

- All models are UL listed per JL standard 1638.
- Minimum effective candela is measured per UL and IES standards (Clear Lens).
- All lenses are interchangeable. Order MAX-A, B, C or extra lenses.
- All flashtubes are replaceable. Order MAX-FT for extra flashtubes.
- Lexan® is a Registered TM of General Electric.

Wheelock Inc. was specialized in the design and manufacture of Signaling and Communication Products since 1922.

wheelock
 INC.

273 Branchport Avenue
 Long Branch, NJ 07741
 908-222-6880
 FAX: 908-222-8707

IND REVISED 3

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

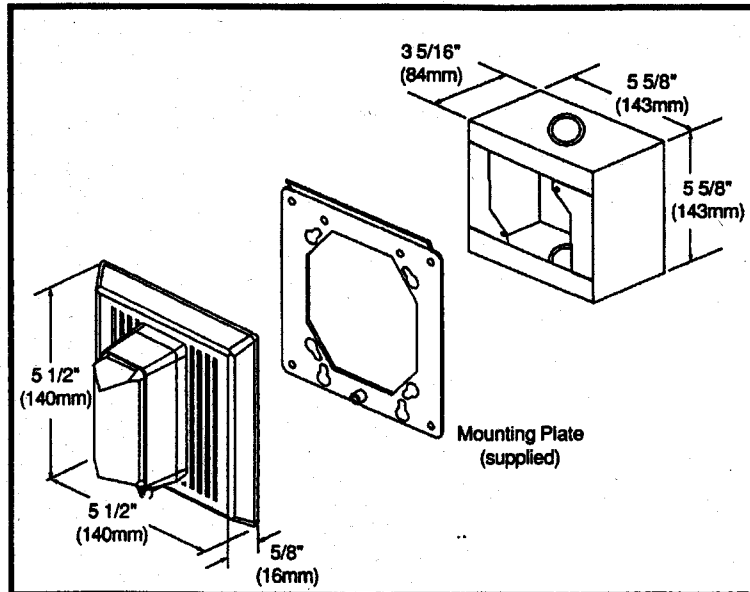
- Operating voltage: -20% to +10% of nominal voltage
- Outdoor Operating Environment: 85% relative humidity at 86°F (30°C); 32°F to 120°F (0° to 49°C) variable ambient

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	
	120V AC	24V AC	24V AC	24V DC
Operating Voltage	120V AC	24V AC	24V AC	24V DC
Operating Current - Horn**	21 mA	60 mA	20 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)	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.

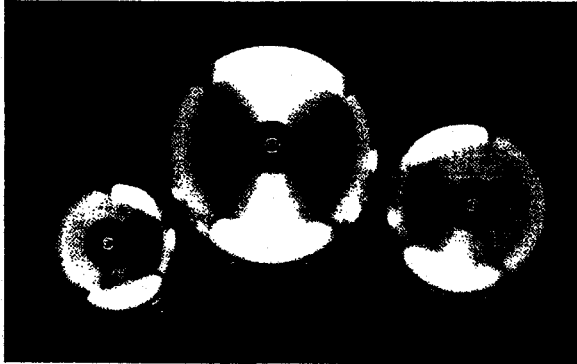
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© 1997 EDWARDS
CHESHIRE, CT 06410
Fax-on-Demand # 1274

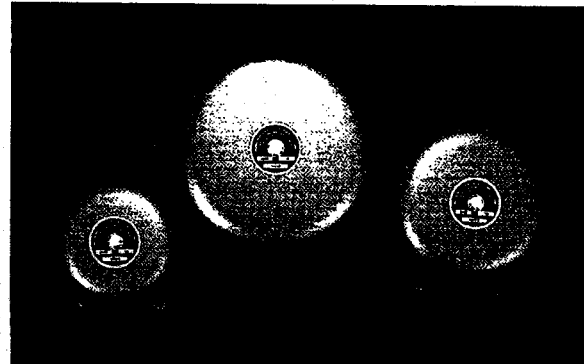
Change 1

Bells/Horns & Sirens



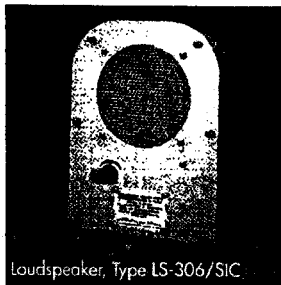
New Explosion Proof/Low Drain Alarm Bells

- 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

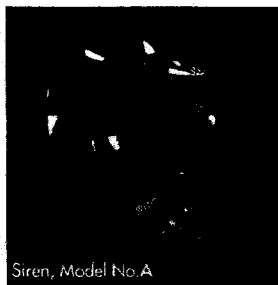


General Alarm Bells/Watertight

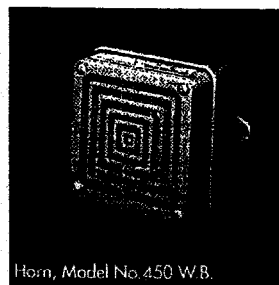
- The Hose-McCann watertight, vibrating, underdome bell has been designed primarily for use in the general alarm system.
- The standard bell comes with an 8-inch steel gong, finished in grey enamel. Gongs are also available in 6, 10, or 12-inch steel or brass. The bell enclosure is manufactured with 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



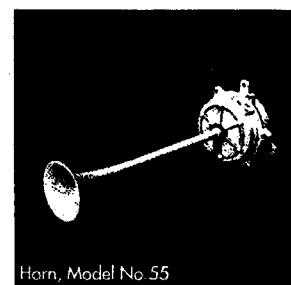
Loudspeaker, Type LS-306/SIC.



Siren, Model No. A



Horn, Model No. 450 W.B.



Horn, Model No. 55

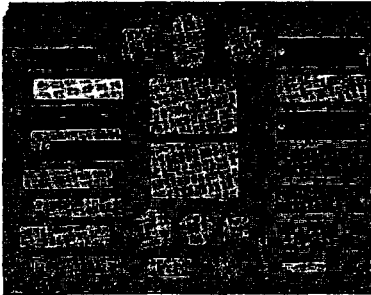
Additional Audible Signaling Devices



For more information on Hose-McCann's Audible Signaling Devices contact our sales department.

PANDUIT® Stainless Steel, Brass, & Aluminum Markers

Stainless Steel, Brass, and Aluminum Marker Plates and Tags



Most tags are provided with one 1/4" (6.35mm) hole.

- 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.

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.

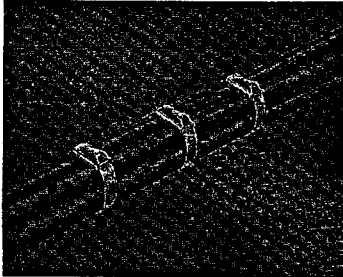
PANDUIT® PAN-STEEL™ Stainless Steel Ties - MLT Series

Part Number System Example

(Stock Size Tie)

MLT	6	S	—	CP	
Part Description	Maximum Bundle Diameter	Cross-Section		Package Qty.	Material
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)			100	500
			2.00 (50)	7.9 (201)			50	500
			2.70 (69)	10.2 (259)			100	500
			4.00 (102)	14.3 (362)			100	500
			4.00 (102)	14.3 (362)			50	500
			6.00 (152)	20.5 (521)			100	500
			8.00 (203)	26.8 (679)			100	500
			10.00 (254)	33.0 (838)			100	500
			12.00 (305)	42.0 (1067)			25	125
14.00 (356)	47.0 (1194)	25	125					
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)			25	250
			2.70 (69)	10.2 (259)			50	250
			4.00 (102)	14.3 (362)			50	250
			6.00 (152)	20.5 (521)			50	250
			8.00 (203)	26.8 (679)			50	250
			10.00 (254)	33.0 (838)			50	250
			12.00 (305)	42.0 (1067)			25	125
			14.00 (356)	47.0 (1194)			25	125

Type AISI 316

MLT-S-CP MLT-S-CP316 MLT-S-CP MLT-S-CP316 MLT-S-CP	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)			100	500
			4.00 (102)	14.3 (362)			100	500
			6.00 (152)	20.5 (521)			100	500
			8.00 (203)	26.8 (679)			100	500
10.00 (254)	33.0 (838)	100	500					
MLT-H-CP MLT-H-CP316 MLT-H-CP MLT-H-CP316 MLT-H-CP	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)			50	250
			6.00 (152)	20.5 (521)			50	250
			8.00 (203)	26.8 (679)			50	250
			10.00 (254)	33.0 (838)			50	250

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)			100	500
			6.00 (152)	20.4 (521)			100	500
			8.00 (203)	26.8 (679)			100	500
			10.00 (254)	33.0 (838)			100	500
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)			50	250
			6.00 (152)	20.4 (521)			50	250
			8.00 (203)	26.8 (679)			50	250
			10.00 (254)	33.0 (838)			50	250

*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.



TF

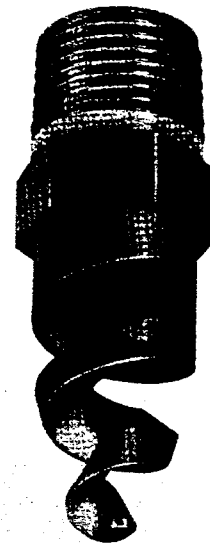
Wide Range of Flows and Angles

DESIGN FEATURES

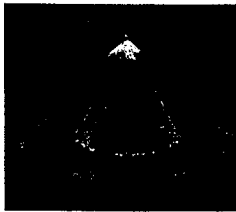
- The original spiral nozzle
- High energy efficiency
- One piece/no internal parts
- Clog-resistant performance
- High discharge velocity
- Male connection standard; female connection available by special order

SPRAY CHARACTERISTICS

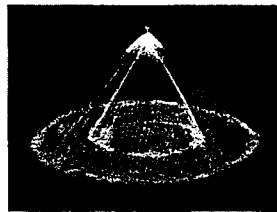
- Wide range of flow rates and spray angles
- Fine atomization
- Spray patterns: Full and Hollow Cone
- Spray angles: 50° to 180°
- Flow rates: 0.7 to 3320 gpm (Higher flow rates available)



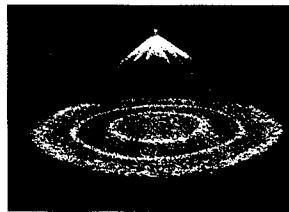
60°, 90°, 120° Metal



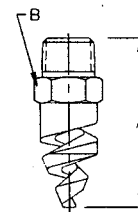
Full Cone 60° (NN)



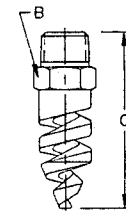
Full Cone 90° (FCN)



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	Free Orif. Dia.	Pass. Dia.	A	B	C	60° 90° Metal	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	3.13	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							
	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							
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							
3/8	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	1.88	0.69	2.38	1.63	0.25		
	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							
	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							
	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	25.8	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							
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	
1	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	3.63	1.38	4.38	8.50	2.50	
	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						
1 1/2	TF56	60° 90° 120° 150° 170°	20.4	45.6	64.5	91.2	112	129	144	158	182	204	288	408	0.88	0.31	4.38	2.00	5.38	22.0	4.25	
	TF64	60° 90° 120° 150° 170°	26.7	59.7	84.5	120	146	169	189	207	239	267	378	524	1.00	0.31						
	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	6.83	2.50	6.88	46.0	8.00	
	TF96 ¹	90° 120° 150° 170°	55.9	125	177	250	306	354	395	433	500	559	791	1120	1.50	0.44						
3	TF112 ¹	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 ¹	90° 120°	107	239	339	480	588	679	759	831	960	1070	1510	2150	2.00	0.56						
4	TF160 ¹	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) = $K \sqrt{\text{PSI}}$ *Dimensions are for bar stock, cast sizes may vary. ¹ 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.

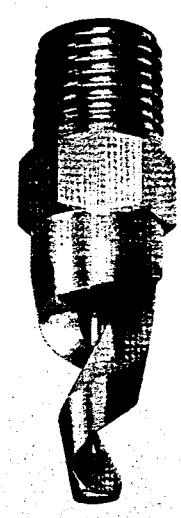




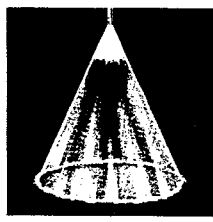
150°, 170° Metal



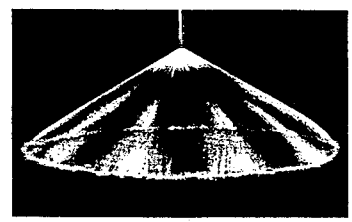
180° Metal



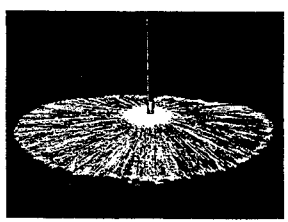
50° Metal



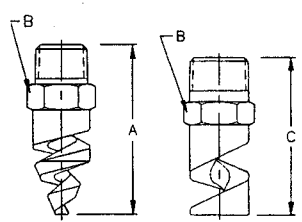
Hollow Cone 50° (N)



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

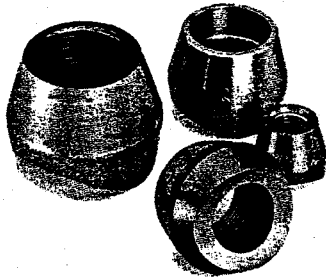
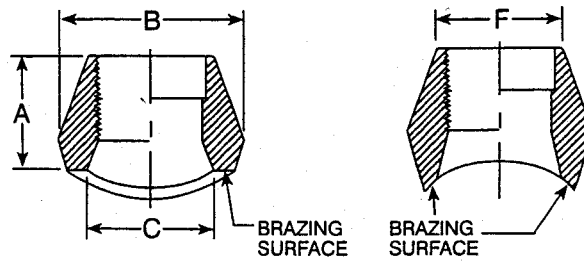
Male Pipe Size	Nozzle Number	Available Spray Angles			K Factor	GALLONS PER MINUTE @ PSI										Approx. (in.)		Wt. (oz.) 180° Metal Plas.		
		50°	120°	180°		5	10	20	30	40	50	60	80	100	200	400	Orif. Dia.		Pass. Dia.	Dim. (in.) for Metal Only* A B C
1/4	TF6	50°	120°		0.221	0.70	0.99	1.21	1.40	1.57	1.71	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 ² 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 ² 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. ¹ 1.00 for 180° ² 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





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

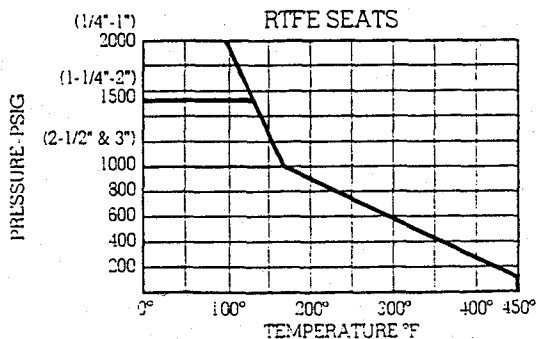
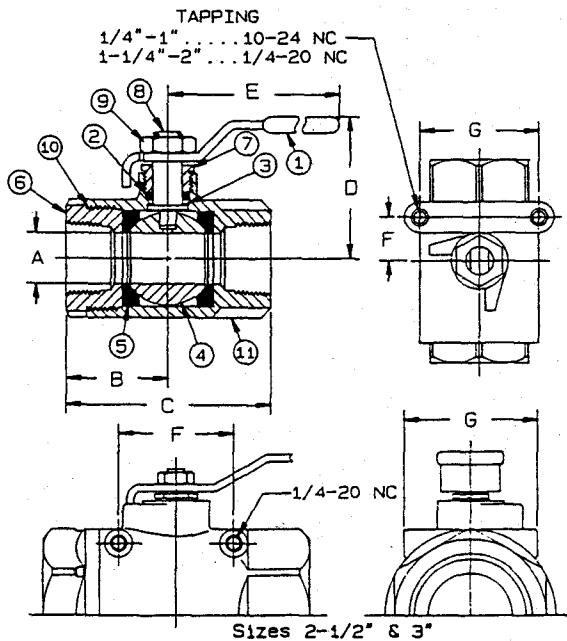
- Investment cast components
- Reinforced TFE seats and stuffing box ring
- Mounting pad for easy Actuator Mounting
- Blow-out-proof stem design
- Adjustable packing gland
- Meets NACE MR-01-75
- Stainless steel lever and nut
- (-24) 1/4" to 2" Certified to API 607, 4th Edition, Class 600 burn

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:

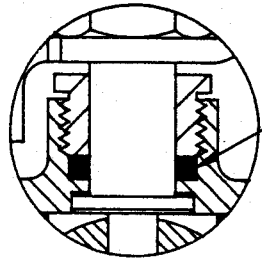
(SUFFIX NUMBER)	OPTION	SIZES
-02-	Static Grounded	1/4" to 3"
-03-	1-1/4" Stem Extension	1/4" to 3"
-04-	2-1/4" Stem Extension	1/4" to 3"
-07-	Tee Handle	1/4" to 2"
-08-	90° Reversed Stem	1/4" to 3"
-14-	Vented Ball	1/4" to 2"
-15-	Round Handle	1/4" to 2"
-16-	Vertical Chain Lever	3/4" to 2"
-19-	Lock 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

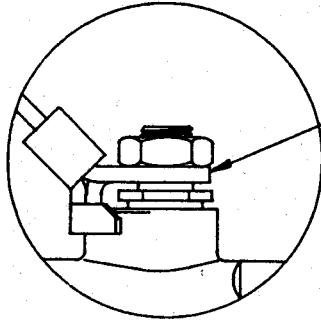
NUMBER	SIZE	A	B	C	D	E	F	G
76-101-01	1/4"	.37	1.03	2.06	1.75	3.87	.50	1.12
76-102-01	3/8"	.37	1.03	2.06	1.75	3.87	.50	1.12
76-103-01	1/2"	.50	1.12	2.25	1.81	3.87	.50	1.12
76-104-01	3/4"	.68	1.50	3.00	2.12	4.87	.87	1.37
76-105-01	1"	.87	1.68	3.37	2.25	4.87	.87	1.37
76-106-01	1-1/4"	1.00	2.00	4.00	2.62	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

Options



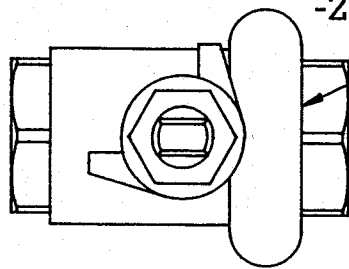
-24

Graphite Stem Packing - Necessary for Firesafe Design



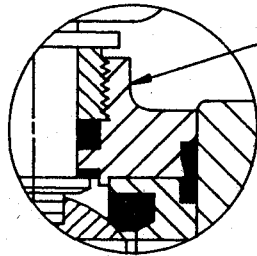
-27

S.S. Latch-Lock Handle and S.S. nut



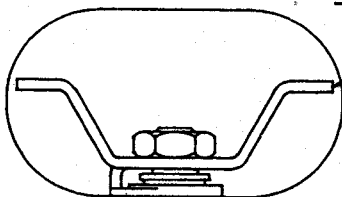
-28

Mounting Pads Not Threaded



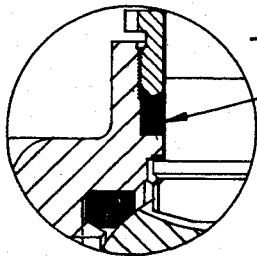
-29

1500 P.S.I. 3-Piece Firesafe Design
Graphite packing and gaskets



-32

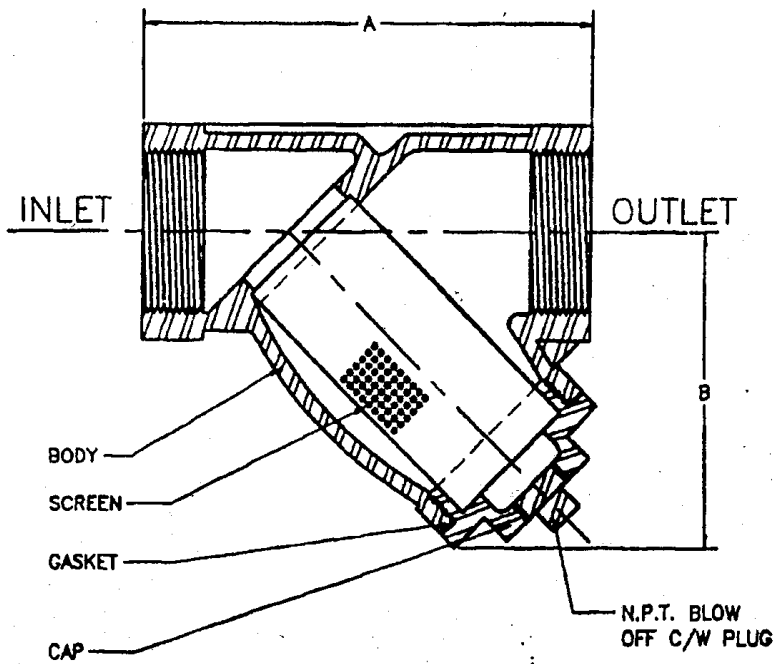
S.S. Tee Handle And Nut



-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	SIZE
		MODEL	300YTSS	AS SHOWN
DESCRIPTION			DRAWING NO.	
CAST STEEL SCREWED Y-STRAINER			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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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)

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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)

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Stuart L White Company 543 Boston Post Road Milford, CT 06460	203-878-6311	203-877-3945

FLORIDA

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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)

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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)

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
University Rubber Co. DBA Eastern Fire & Safety 511 Riverside Industrial Pky Portland, ME 04103	207-797-5067	207-797-7370

MARYLAND

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
BFPE International 7512 Connelley Drive Hanover, MD 21076	410-768-2200	410-768-3105

MASSACHUSETTS

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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)

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Fisher Fire 236 Oakdale Jackson, MS 39201	601 -354-5551	601-352-9133

MISSISSIPPI (CONTD)

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
International Fire & Safety 405 West Drive Laurel, MS 39440	601-649-0888	601-649-0897

MISSOURI

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Fire-Safety Sales & Service (Branch) 1801 Vandiver Columbia, MO 65201	573-474-1544	573-474-4569
Firemaster 1113 East 13 th 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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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)

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Protection Specialties 4315 So. 79th Circle Omaha, NE 68127	402-592-1999	402-592-1599

NEVADA

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Nevada Fire Control P.O Box 247 Winnemucca, NV 89446	702 625-1166	702-625-3473

NEW HAMPSHIRE

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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)

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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)

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Nardini Fire Equipment Co. 3313 Fiechtner Fargo, ND 58109	701-235-4224	701-235-5089

OHIO

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Sigler Fire Equipment Co. 710 N. Western Ave. Sioux Falls, SD 57104	605-332-7181	605-332-6981

TENNESSEE

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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)

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Creech Fire 101 Willson St. Hwy 11 Niota, TN 37826	423-745-7731	423-568-3064

TEXAS

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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)

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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)

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Firetron 10129 Greenridge Stafford, TX 77497	281-499-1500	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 th Street Waco, TX 76708	817-753-0336	817-752-1366

UTAH

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Advanced Fire & Safety Branch of New England Fire 128 Bridge St. Springfield, VT 05256	802-885-5599	802-885-5505

VIRGINIA

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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)

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

WASHINGTON

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Alexander Gow Fire Equipment 456 North 35th Street Seattle, WA 98103-8688	206432-2810	206-633-0434
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Jefferson Fire & Safety 7617 Donna Drive Middleton, WI 53562	608-836-0068	608-836-4927

INTERNATIONAL

CANADA

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
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

CHINA

Company

Acorp M & B Engineering Co. Ltd.
No. A20-27 Fuxing Road
Beijing, China 100840

Telephone

861-068-22465

Facsimile

861-068-288347

NETHERLANDS

Company

AJax de Boer B.V.
P.O. Box 4105
Cruquisweg 18
1009 AC Amsterdam, Netherlands

Telephone

312-059-09500

Facsimile

312-059-09655

COLOMBIA

Company

Ascom Autophon S.A.
Calle 37 No. 20-51
Apartado 8539
Santafe de Bogata, Colombia

Telephone

571-288-2588

Facsimile

571-288-6251

General Fire Control Ltda.
Carrera 64 No. 24-81 Sur
Apartado Aereo, Bogota, Columbia

571-290-0975

571-420-3100

FRANCE

Company

Automatismes SICLI
Z1 La Sauniere
89600, Saint Florentin FRANCE

Telephone

333-864-37930

Facsimile

333-864-34072

Automatismes SICLI
1 Rue Ivan Paviov
93152 Le Blanc Mesnil
Cedex, France

331-493-94600

331-493-94130

Kidde Dexaero
4 Rue Poincare
92167 Antony Cedex
Paris, France

331-466-60808

331-466-62324

TURKEY

Company

Basel
Elektronik San. ve Tic. Ltd. Sti
Osmani Yokusi Muhtar Kamil Sk.
80090 Taksim, Istanbul, Turkey

Telephone

902-122-499086

Facsimile

902-122-513924

MEXICO

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Kencher Instrumentacion S.A. de C.V. Calle Primavera #26 Naucalpan Centro Mexico State, Mexico CP53000	525-576-4639	525-576-6533
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

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Beydoun Fire Equipment Co. 22nd November Avenue Kaskas Area Beirut, Lebanon	961-164-7147	961-164-5043

THAILAND

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Buildings Automated Co. 1176-8 Soi Thanurat 8 Worarat Trade Center Bangkok 10120, Thailand	662-286-7840	662-287-1660

AUSTRALIA

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Chubb - Australia 314 Boundary Rd. Dingley, Victoria 3172 AUSTRALIA	613-926-49700	613-926-49751

NEW ZEALAND

Company

Chubb - New Zealand
5 Howe St.
Newton Auckland, New Zealand

Telephone

649-359-5505

Facsimile

649-359-5532

EQUADOR

Company

Decision Cia Ltda.
Reina Victoria 562 C
P.O. Box 17-07-8899
Quite, Ecuador

Telephone

593-254-6907

Facsimile

593-256-9948

PHILLIPPINES

Company

EEl Corporation
186 E. Rodriguez Jr. Ave.
Ortigas Industrial Estate
Manila 1110, Philippines

Telephone

632-722-1363

Facsimile

632-635-0861

CHILE

Company

Elevair S.A.
Condell #511
Providencia, Santiago, Chile

Telephone

562-225-8446

Facsimile

562-225-2458

WEST MALAYSIA

Company

Erif Electronics Sdn. Bhd.
Unit 10-1, 1st Floor, Jalan 3/114
Kuchai Business Centre
58200, Kuala Lumpur, West Malaysia

Telephone

603-783-2313

Facsimile

603-782-8313

GUATEMLA

Company

Fabrigas
41 Calle 6-31
Zone 8, Guatemala

Telephone

502-471-6533

Facsimile

502-440-9666

JAPAN

Company

Fenwal Controls of Japan
Kyohan Kudan Bldg. 2nd Floor
5-10, 1-Chome Iidabashi
Chiyoda-Ku, Tokyo 102, Japan

Telephone

813-323-73561

Facsimile

813-323-73569

JAPAN (CONTD)

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Fukada Kidde N. 1-5, 3-Chome, Mita Minato-Ku Tokyo 108, Japan	813-345-15451	813-345-15444

ITALY

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Fenwal Italia V. Le De Gasperi, 44 Bareggio, Milan 20010, Italy	392-903-61620	392-903-61627
Nova Anticendi SRL Via Dell Artigianco 11 20082 Binasco Milano, Italy	392-900-92505	392-900-92501

PUERTO RICO

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Fire Control Corp. P.O. Box 192076 San Juan, Puerto Rico 00919-2076	787-793-6060	787-793-4905

ARUBA

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Fire Stop N.V. Dakota Shopping Paradise Fergusonstraat #51 Aruba	297-836-239	297-836-248

SINGAPORE

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Firematic Engineering PTE 11 Tuas Avenue 1 639496, Singapore	658-625-180	658-624-714

WEST INDIES

<u>Company</u>	<u>Telephone</u>	<u>Facsimile</u>
Frank Mouttet, Ltd. 9 Stanmore Ave. Port of Spain Trinidad, West Indies	809-623-7191	809-623-4996

HAITI**Company**

Gaz Industriel de Haiti
Box 426
Port Au Prince, Haiti

Telephone

509-232-169

Facsimile

509-234-640

ISRAEL**Company**

Hashmira Security Tech.
98 Jabotinsky Street
Petah Tikva 49517, Israel

Telephone

972-393-74545

Facsimile

972-393-74572

EGYPT**Company**

Henor/Arab Industrial Security
3 Road 79 Apt. 101
Maadi, Cairo, Egypt

Telephone

202-375-9715

Facsimile

202-378-5669

HONG KONG**Company**

HLK Services Ltd.
Unit 11, 11th Floor, Tower B
Hungohm Commercial Centre
Hungohm, Kowloon, Hong Kong

Telephone

852-233-03083

Facsimile

852-236-56128

AUSTRALIA**Company**

James Hardie Bldg. Services
6 Hope Street
P.O. Box 2
Ermington MSW 2115, Australia

Telephone

612-992-87127

Facsimile

612-992-87133

GERMANY**Company**

Kidde Deugra GMBH
Halkestrasse 30
D40832 Ratingen
Republic of Germany

Telephone

492-102-4050

Facsimile

492-102-4051

UNITED KINGDOM**Company**

Kidde Fire Protection
Belvue Road
Northolt
Middlesex, United Kingdom UB5 5QW

Telephone

441-818-457711

Facsimile

441-818-454304

ARGENTINA

Company

Laher Mercantil S A.
Intendente Neyer 924
1643 Beccar, PCIA
Buenos Aires, Argentina

Telephone

541-747-8000

Facsimile

541-747-5031

SPAIN

Company

LPG Tecnicas en Extincion de Incend.
Calle Mestre Joan Corrales 107-109
08950 Esplugues De Liobregat
Barcelona, Spain

Telephone

343-473-5252

Facsimile

343-473-7492

JAMAICA

Company

National Safety Ltd.
24 Belmont Road
Kingston 5' Jamaica

Telephone

809-926-5651

Facsimile

809-929-3015

MALAYSIA

Company

Orbtech Systems SDN BHD
Lot No. 19-7, Jalan Satu
Bersatu Ind. Complex
43200 Balakong, Selangor
Darul Ehsan MALAYSIA

Telephone

603-906-3081

Facsimile

603-906-2624

TAIWAN

Company

Paul & Kirk Enterprises Co., Ltd.
4F-1, #3, Lane 250, Sec. 5
Nanking E. Road
Taipei, Taiwan R.O.C.

Telephone

886-276-77901

Facsimile

886-276-35387

INDONESIA

Company

PT Chubb Lips Indonesia
Plaza 89 Bldg, Suite 301
Jl H.R. Rasuna Said Kav
Jakarta 12940, Indonesia

Telephone

622-152-25566

Facsimile

622-152-22688

P.T. Landis & Staefa Indonesia
J1. Griya Agung No. 23
Komp. Griya Inti Sentosa
Sunter, Jakarta 14350, Indonesia

622-164-01651

622-164-01647

BRAZIL

Company

Resmat Parsch Ltda.
Rua Antonio de Mariz
147 LAPA
05060,010 Sao Paulo, Brazil

Telephone

551-126-08988

Facsimile

551-126-18810

GUAM

Company

Safety First Systems
114 E. Harmon Industrial Park Rd.
Suite A
Tamuning, Guam 96911

Telephone

671-649-6440

Facsimile

671-649-4997

KUWAIT

Company

Saleh Jamal & Co. W.L.L.
P.O. Box 179
Safat 13002, Kuwait

Telephone

965-481-5077

Facsimile

965-483-9725

SAUDI ARABIA

Company

Salem Agencies & Services
P. O. Box 9270
Jeddah 21413, Saudi Arabia

Telephone

966-266-54616

Facsimile

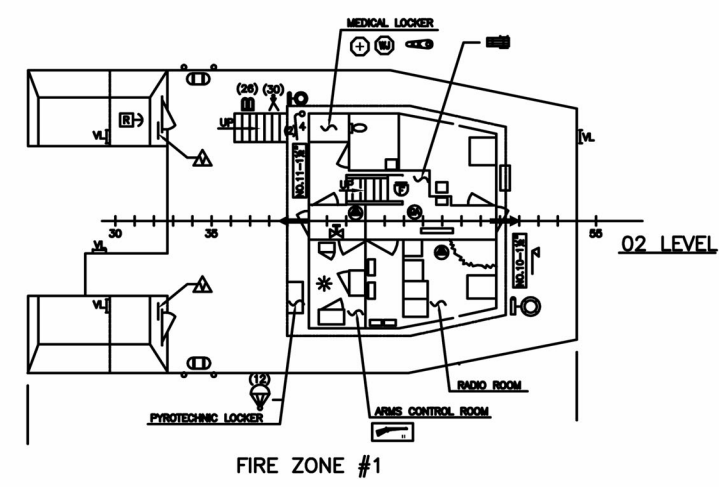
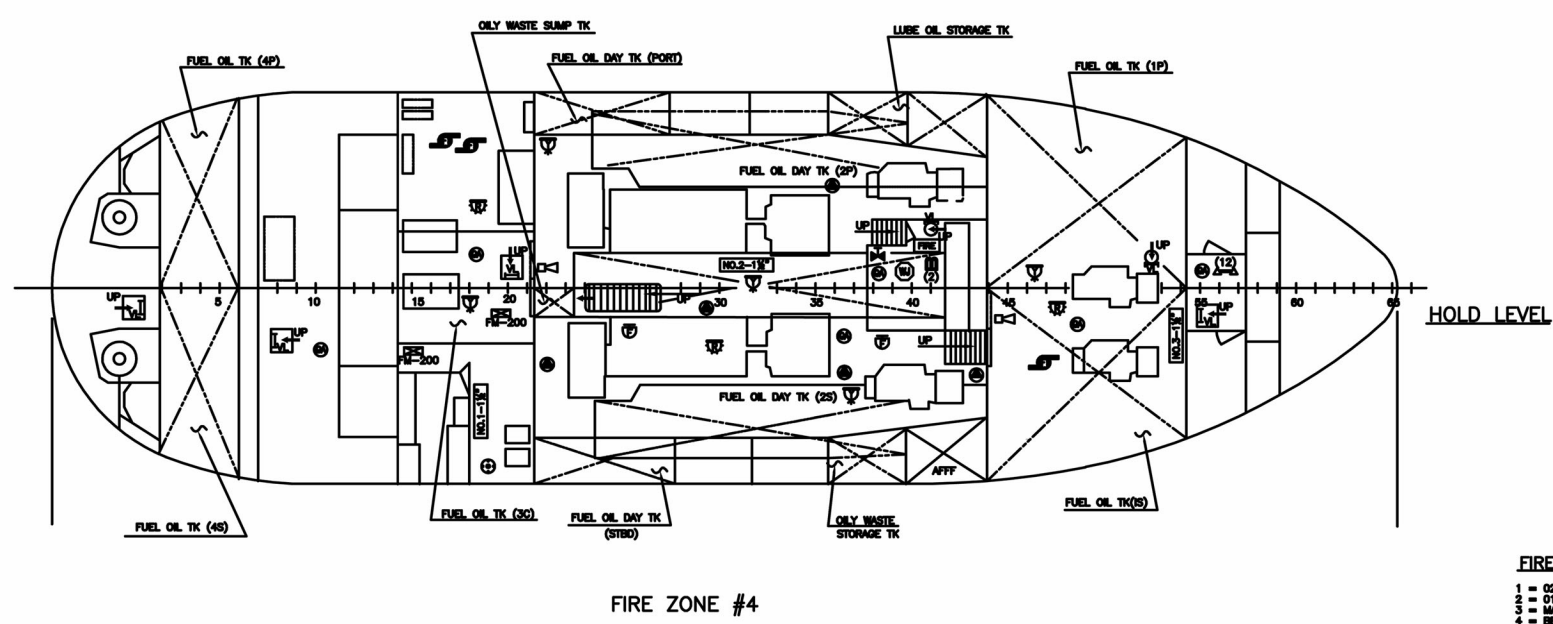
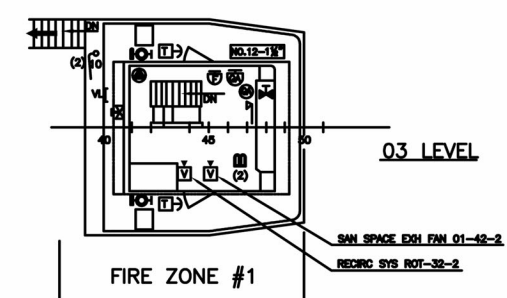
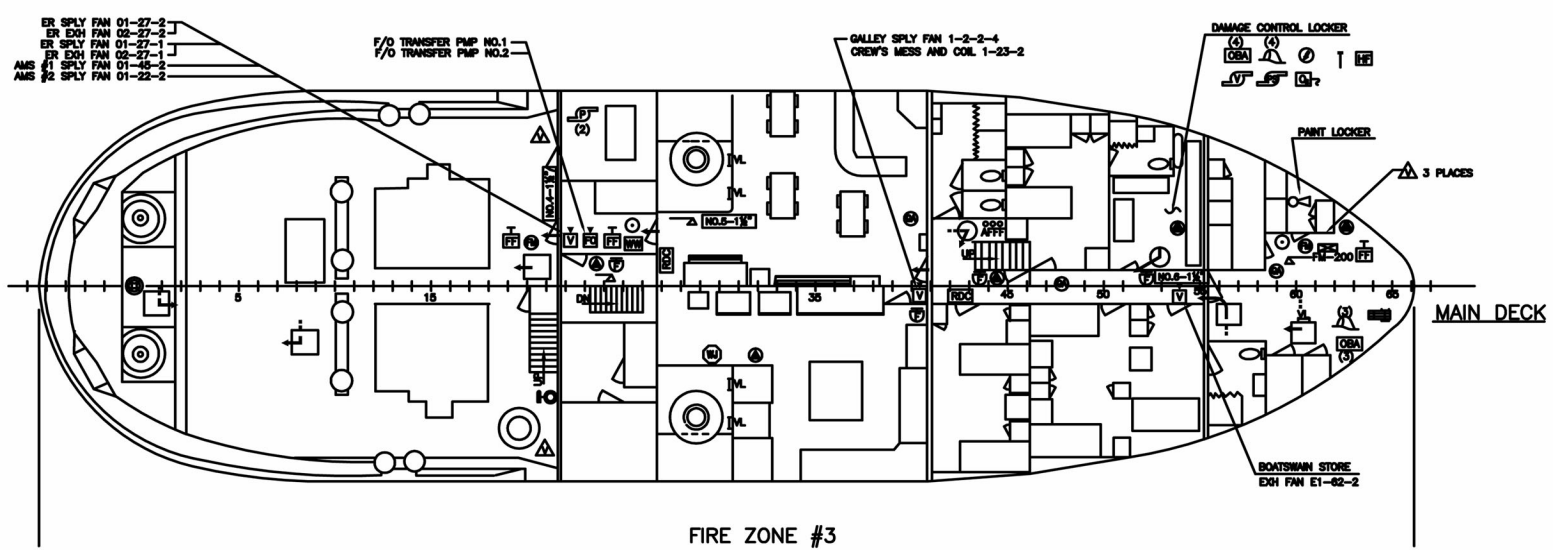
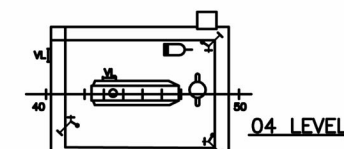
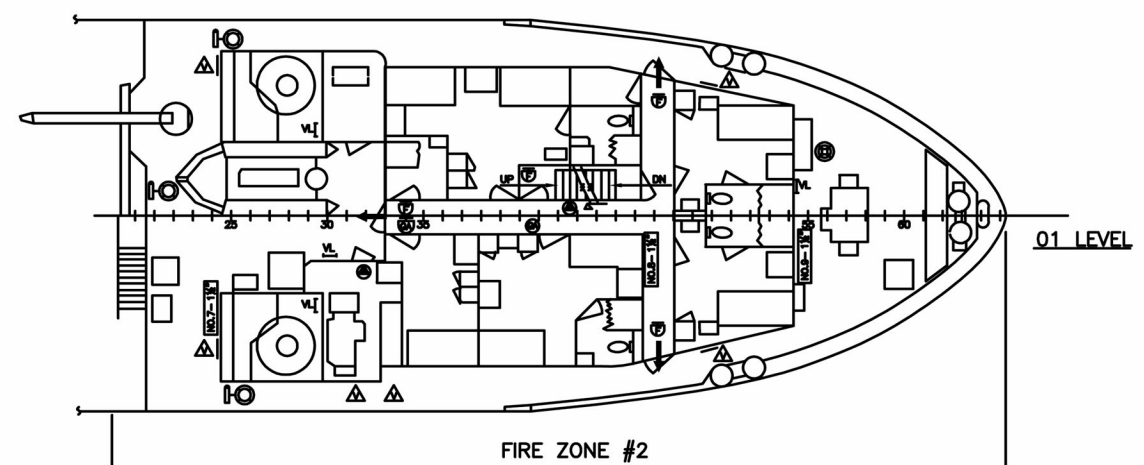
966-266-07864

SECTION XII

Appendix D As Built/Installation Drawings



STATUS OF REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A		12/31/98	MG



MASTER FIREFIGHTING & SAFETY EQUIPMENT LIST		
SYMBOL	QTY.	DESCRIPTION
[Symbol]	6	AFFF CANS
[Symbol]	1	AFFF TANKS
[Symbol]	5	ALARM AMBER STROBE LIGHT (FIXED FIRE FIGHTING SYSTEM)
[Symbol]	12	DISTRESS SIGNAL
[Symbol]	1	ELECTRICAL REPAIR KIT
[Symbol]	2	EMERGENCY FUEL SHUT OFFS
[Symbol]	1	EMERGENCY POSITION INDICATOR RADIO BEACON (EPHRS)
[Symbol]	-	ESCAPE ROUTES
[Symbol]	30	EXPOSURE SUIT
[Symbol]	12	FIRE ALARM PULL STATION
[Symbol]	6	FIRE AXE
[Symbol]	1	FIRE DETECTION PANEL
[Symbol]	2	FIRE DOOR/CRANK
[Symbol]	15	FIRE EXTINGUISHER PORTABLE
[Symbol]	3	FIRE/FOAM MONITORS
[Symbol]	7	FIREMANS OUTFIT
[Symbol]	3	FIRE PUMP
[Symbol]	2	FIRE PUMP (REMOTE START)
[Symbol]	12	FIRE STATION, 11"
[Symbol]	1	FIRST AID KIT
[Symbol]	3	FIXED FIRE FIGHTING SYSTEM PULL STATION
[Symbol]	1	FIXED FIRE FIGHTING SYSTEM GAS SIREN
[Symbol]	2	FIXED FIRE FIGHTING SYSTEM ELECTRIC HORN/STROBE
[Symbol]	3	FIXED SYSTEM STORAGE AREA, FM-200
[Symbol]	2	FM-200 ALARM BELL
[Symbol]	2	FOG APPLICATORS, 4 FT.
[Symbol]	2	FOG APPLICATORS, 10 FT.
[Symbol]	12	GENERAL ALARM BELL
[Symbol]	2	GENERAL ALARM CONTACT MAKER
[Symbol]	3	GENERAL ALARM RED STROBE LIGHT
[Symbol]	2	HYDROGEN FLUORIDE (HF) GAS SAMPLING PORT
[Symbol]	2	INFLATABLE LIFERAFT (25 MAN)
[Symbol]	30	LIFE PRESERVERS
[Symbol]	1	LIFERAFT RADIO
[Symbol]	2	LIFERAFT TRANSPONDER
[Symbol]	1	LINE THROWING DEVICE
[Symbol]	1	MAIL
[Symbol]	1	MBA METER (CONFINED SPACE ENTRANCE)
[Symbol]	1	NEIL ROBERTSON STRETCHER
[Symbol]	7	OSBA
[Symbol]	2	P-100/P-250
[Symbol]	1	PIPE REPAIR KIT
[Symbol]	2	PORTABLE BLOWER
[Symbol]	1	PORTABLE HYDROGEN FLUORIDE GAS DETECTOR KIT
[Symbol]	2	REMOTE FIRE DOOR CRANK
[Symbol]	1	RESCUE BOAT
[Symbol]	6	RING BUOY WITH LIGHT
[Symbol]	2	RING BUOY WITH LINE
[Symbol]	2	RING BUOY WITH SMOKE AND LIGHT
[Symbol]	12	SHORING
[Symbol]	1	SPACE PROTECTED WITH A SPRINKLER SYSTEM
[Symbol]	2	SPRINKLER VALVES
[Symbol]	2	STOKES LITTER
[Symbol]	2	SUBMERSIBLE PUMP
[Symbol]	13	VENT CLOSURES (MANUAL)
[Symbol]	11	VENT FAN SHUT OFFS
[Symbol]	-	VERTICAL LADDER
[Symbol]	3	WATER JEL (BURN DRESSING KIT)
[Symbol]	1	WHS CONTROL STATION

FIRE ZONES
 1 = O2 + O3 DNS
 2 = O1 DK LV.
 3 = MAIN DK LV.
 4 = BELOW MAIN DK

Marine Systems Corp. 582 'E' St. Boston, MA 02210		
DESIGN	BTWLS	DATE
DRAWN	ET	5/97
CHECKED	SAJ	5/97
ARMY APPROVAL, MARINE SAFETY OFFICER /S/ PHILIP M. EDWARDS 10/29/97		
DOT APPROVAL /S/ MICHAEL BUONOPANE 10/29/97		

Department of Transportation Research and Special Programs Administration Volpe National Transportation Systems Center Cambridge, MA 02142		
LARGE TUG 800 CLASS FIRE CONTROL AND EMERGENCY EQUIPMENT PLAN		
SIZE	FROM CASE NO.	DOT DRAWING NO.
D 19207		LGTUG-97-555-001
SCALE	NONE	SHEET 1 OF 1

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 LARGE TUG, 128 FOOT (LT-128).

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:

- LT-800-5553-1 FM-200 SYSTEM PIPING INSTALLATION AND DETAILS
- LT-800-5553-2 FM-200 SYSTEM MISCELLANEOUS MODIFICATIONS
- LT-800-5553-3 FM-200 SYSTEM ELECTRICAL MODIFICATIONS
- LT-800-5553-4 FM-200 SYSTEM LABEL PLATES AND PLACARDS
- LT-800-5231-1 WWS PIPING INSTALLATION AND DETAILS
- LT-800-5231-2 WWS LABEL PLATES AND PLACARD
- LT801-97-5553-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 13-D):

- STANDOFF: ANGLE, 42" L
- LINER: SYNTHETIC RUBBER
- 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.

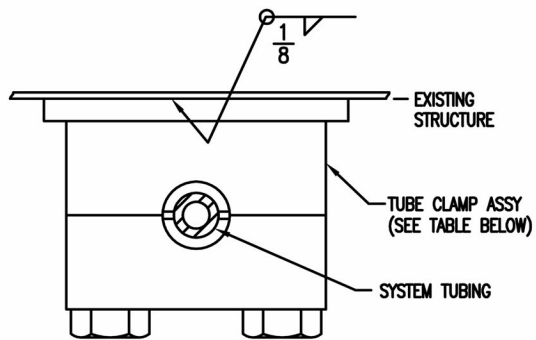
9. ALL WATERTIGHT BOUNDARY PENETRATIONS ABANDONED BY THE REMOVAL OF HALON FIRE EXTINGUISHING SYSTEMS AND VESSEL MODIFICATIONS SHALL BE WELDED CLOSED. OTHER ABANDONED BULKHEAD, DECK, AND FRAMING PENETRATIONS SHALL BE WELDED CLOSED AND ALL BRACKETS REMOVED. ALL WELDED FITTINGS SHALL BE GROUND FLUSH, PRIMED, 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 NVC 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.)

11. 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.
12. ENGINE ROOM VESTIBULE DECK GRATING SHALL BE CUT/MODIFIED AS REQUIRED TO SUPPORT THE FM-200 SYSTEM PIPING INSTALLATION.
13. DRILL HOLE, USING NO. 29 BIT, FOR SCREW, FIND NO. 93.

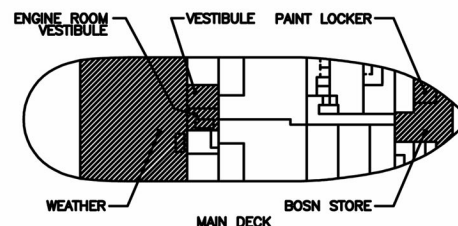
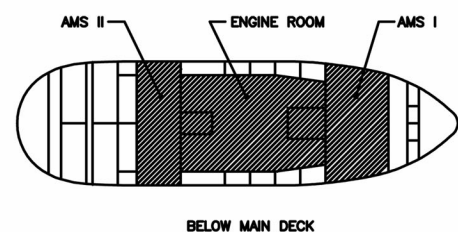
ACTUATION CABLE TABLE			
SYSTEM CABLE	COMPONENT/LOCATION		
ENGINE ROOM CABLE A	CO2 CYLINDER, CONTROL HEAD WTRIT BHD 21		
	DUAL PULL MECHANISM SEE VIEW 37-C		
	VESTIBULE BHD, FR 23		
ENGINE ROOM CABLE B	INTERIOR PULL STATION SEE VIEW 35-A		
	DUAL PULL MECHANISM SEE VIEW 37-C		
	WTRIT BHD 21		
PAINT LOCKER	EXTERIOR PULL STATION SEE VIEW 33-C		
	CYLINDER, CONTROL HEAD		
	INTERIOR PULL STATION		

ACTUATION CABLE RUN SHALL BE MADE USING PIPE, FIND NO. 103, CORNER PULLEY, FIND NO. 104, NIPPLE, FIND NO. 111, AND CABLE, FIND NO. 63



VIEW 5-B
TYPICAL TUBE CLAMP ASSEMBLY
NOT TO SCALE

TUBING SIZE	TUBE CLAMP ASSY FIND NO.
1/4" OD	133



SHEETS										STATUS OF REVISION			
9	8	7	6	5	4	3	2	ZONE	REV	DESCRIPTION	DATE	APPROVED	

PARTS LIST CONTINUED ON SHEET 2

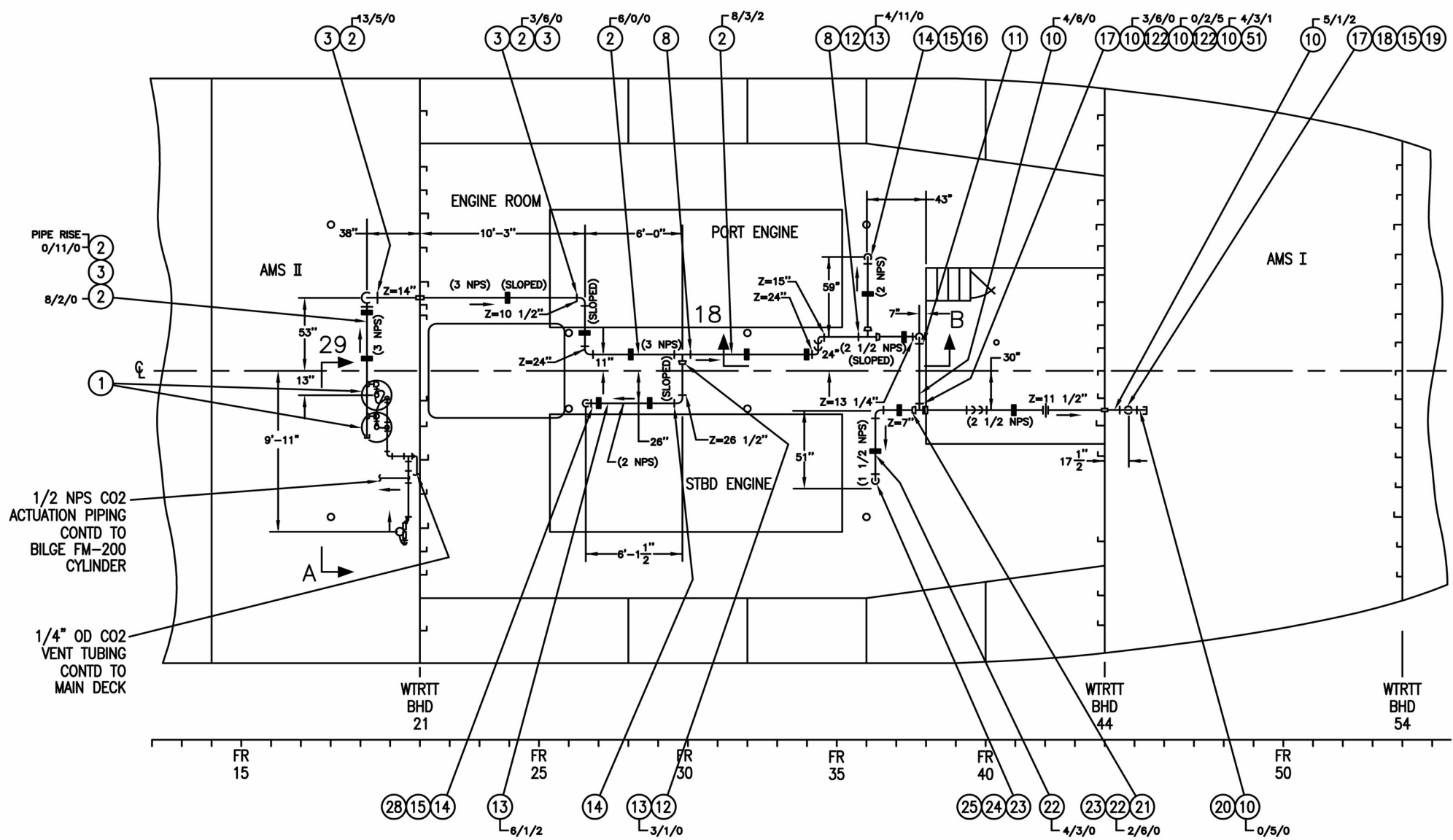
QTY REQD	QTY REQD	QTY REQD	FIND NO.	CAGE CODE	PART OR IDENTIFYING NO.	TOTAL QUANTITY REQUIRED	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)
1 EA	1 EA		53			2 EA	BUSHING, HEX HD, THD. 1/2 X 1/8 NPS, GALV	ASME B16.14	MI	0.01
2 EA			52	07971		2 EA	THREAD-0-LET. 3 X 2 1/2 NPS	COML(BONNEY FORGE)	STEEL	3.00
3 EA			51			3 EA	UNION, THD, CL 300, 2 1/2 NPS, GALV	ASME B16.39	MI	7.50
2 EA			50			2 EA	NIPPLE, THD, CLOSE, 2 1/2 NPS, GALV	ASTM A 733	STEEL	1.20
2 EA			49	IDA54	283906	2 EA	VALVE OUTLET ADAPTER, 2 1/2"	COML (KIDDE)	BRASS	6.00
4 EA			48	IDA54	294651	4 EA	STRAP, CYLINDER, 600 LB	COML (KIDDE)	STEEL	7.00
1 EA			47			1 EA	CHANNEL, C4 X 6.25 STK, 12" L	ASTM A 36	STEEL	6.25
12 EA	4 EA		46			16 EA	NUT, HEX, 1/2-16 UNC-2B, GRADE 8, ZINC PL	ASME B18.2.2	STEEL	-
12 EA	4 EA		45			16 EA	WASHER, LOCK, HLCL SPR, RGLR, 1/2 NOM, ZINC PL	ASME B18.21.1	STEEL	-
12 EA	4 EA		44		B1821BH050C200N	16 EA	SCREW, CAP, HEX HD, 1/2-16 UNC-2A X 2" L, GRADE 8, ZINC CTD	ASME B18.2.1	STEEL	0.03
2 EA			43	IDA54	270014	2 EA	STRAP, CYLINDER, 25 LB CO2	COML (KIDDE)	STEEL	1.00
1 EA			42	IDA54	870486	1 EA	CYLINDER ASSY, CO2 (25 LB CO2)	COML (KIDDE)	STEEL	84.00
1 EA	1 EA		41	IDA54	979469	2 EA	CONTROL HEAD, CABLE OPERATED	COML (KIDDE)	STEEL	3.00
1 EA			40	IDA54	872450	1 EA	DISCHARGE HEAD, PLAIN NUT	COML (KIDDE)	STEEL	4.00
1 EA			39	IDA54	252184	1 EA	DISCHARGE HOSE, CO2, 1/2"	COML (KIDDE)	STEEL	1.00
4 EA	1 EA		38			5 EA	NIPPLE, THD, 1/2 NPS, 2 1/2" L, GALV	ASTM A 733	STEEL	0.17
2 EA	1 EA		37	IDA54	486536	3 EA	PRESSURE SWITCH	COML (KIDDE)	STEEL	3.00
1 EA			36	IDA54	870652	1 EA	LEVER OPERATED CONTROL HEAD	COML (KIDDE)	BRASS	1.00
1 EA			35	IDA54	897636	1 EA	DISCHARGE DELAY, 60 SECOND	COML (KIDDE)	STEEL	13.00
1 EA			34			1 EA	CAP, THD, CL 300, 3 NPS, GALV	ASME B16.3	MI	2.90
1 EA	2 EA		33			3 EA	CAP, THD, CL 300, 1/2 NPS, GALV	ASME B16.3	MI	0.20
5 EA	1 EA	5 EA	32			11 EA	UNION, THD, CL 300, 1/2 NPS, GALV	ASME B16.39	MI	0.60
5 EA		3 EA	31			8 EA	TEE, THD, CL 300, 1/2 NPS, GALV	ASME B16.3	MI	0.70
3 EA		4 EA	30			7 EA	NIPPLE, THD, CLOSE, 1/2 NPS, GALV	ASTM A 733	STEEL	0.08
6 EA	1 EA	5 EA	29			12 EA	ELBOW, 90°, THD, CL 300, 1/2 NPS, GALV	ASME B16.3	MI	0.50
1 EA			28	IDA54	90-194028-563	1 EA	NOZZLE, DISCHARGE, 360°, 2 NPS (E1-N1, ENG RM)	COML (KIDDE)	BRASS	1.00
100 FT	35 FT	25 FT	27			160 FT	PIPE, SMLS, .840 OD X .109 WALL, GALV (1/2 NPS)	ASTM A 53	STEEL	0.85
1 EA		1 EA	26	IDA54	981574	1 EA	SIREN, PRESSURE OPERATED	COML (KIDDE)	STEEL	4.00
1 EA			25	IDA54	90-194027-359	1 EA	NOZZLE, DISCHARGE, 360°, 1 1/2 NPS (E1-N3, ENG RM)	COML (KIDDE)	BRASS	1.00
1 EA		1 EA	24			2 EA	NIPPLE, THD, CLOSE, 1 1/2 NPS, GALV	ASTM A 733	STEEL	0.30
2 EA	7 EA	1 EA	23			10 EA	ELBOW, 90°, THD, CL 300, 1 1/2 NPS, GALV	ASME B16.3	MI	2.40
10 FT	60 FT		22			70 FT	PIPE, SMLS, 1.900 OD X .145 WALL, GALV (1 1/2 NPS)	ASTM A 53	STEEL	2.27
1 EA			21			1 EA	BUSHING, HEX HD, THD, 2 1/2 X 1 1/2 NPS, GALV	ASME B16.14	MI	1.20
1 EA			20			1 EA	CAP, THD, CL 300, 2 1/2 NPS, GALV	ASME B16.3	MI	2.00
1 EA			19	IDA54	90-194018-469	1 EA	NOZZLE, DISCHARGE, 180°, 2 NPS (E2-N1, FWD MACH RM)	COML (KIDDE)	BRASS	1.00
1 EA			18			1 EA	BUSHING, HEX HD, THD, 2 1/2 X 2 NPS, GALV	ASME B16.14	MI	0.90
2 EA			17			2 EA	TEE, THD, CL 300, 2 1/2 NPS, GALV	ASME B16.3	MI	9.60
1 EA			16	IDA54	90-194028-397	1 EA	NOZZLE, DISCHARGE, 360°, 2 NPS (E1-N2, ENG RM)	COML (KIDDE)	BRASS	1.00
3 EA	1 EA		15			4 EA	NIPPLE, THD, CLOSE, 2 NPS, GALV	ASTM A 733	STEEL	1.00
3 EA	1 EA		14			4 EA	ELBOW, 90°, THD, CL 300, 2 NPS, GALV	ASME B 16.3	MI	4.00
25 FT	1 FT		13			26 FT	PIPE, SMLS, 2.375 OD X .154 WALL, GALV (2 NPS)	ASTM A 53	STEEL	3.65
2 EA			12			2 EA	BUSHING, HEX HD, THD, 3 X 2 NPS, GALV	ASME B16.14	MI	1.80
4 EA			11			4 EA	ELBOW, 90°, THD, CL 300, 2 1/2 NPS, GALV	ASME B16.3	MI	1.20
40 FT			10			40 FT	PIPE, SMLS, 2.875 OD X .203 WALL, GALV (2 1/2 NPS)	ASTM A 53	STEEL	5.79
1 EA			9			1 EA	BUSHING, HEX HD, THD, 3 X 2 1/2 NPS, GALV	ASME B16.14	MI	1.70
2 EA			8			2 EA	TEE, THD, CL 300, 3 NPS, GALV	ASME B16.3	MI	13.00
1 EA			7			1 EA	PIPE, SMLS, 4.000 OD X .226 WALL, 3 1/4" L (3 1/2 NPS)	ASTM A 53	STEEL	2.47
2 EA			6			2 EA	PIPE, SMLS, 3.500 OD X .300 WALL, 3 1/4" L (3 NPS)	ASTM A 53	STEEL	2.05
	1 EA		5			1 EA	PIPE, SMLS, 2.375 OD X .218 WALL, 3 1/4" L (2 NPS)	ASTM A 53	STEEL	0.99
1 EA			4			1 EA	TUBING, ROUND, 1.125 OD X .109 WALL, 3 1/4" L	ASTM A 513	STEEL	0.32
6 EA			3			6 EA	ELBOW, 90°, THD, CL 300, 3 NPS, GALV	ASME B16.3	MI	9.80
55 FT			2			55 FT	PIPE, SMLS, 3.500 OD X .216 WALL, GALV (3 NPS)	ASTM A 53	STEEL	7.58
2 EA			1	IDA54	90-100601-001	2 EA	CYLINDER ASSY, 600 LB (364 LB FM-200)	COML (KIDDE)	STEEL	726.00

PARTS LIST

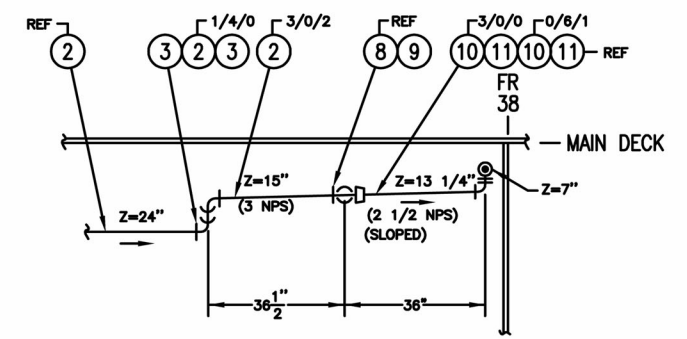
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TOLERANCES ON: 2 PLACES ± 3 PLACES ± ANGLES ±	CONTRACTOR 2R341	
DRAWN BY AM	DATE 01/20/98	
CHECKER JAS/GC	ENGINEER TR	
DESIGN APPROVAL	RPE (FP) APPROVAL	
DRAWING APPROVAL		
		U.S. ARMY LT-128 FM-200 SYSTEM PIPING INSTALLATION AND DETAILS
SIZE D	CAGE CODE 19207	LT-800-5553-1
SCALE 3"=1'-0"		SHEET 1 OF 9

DISTRIBUTION STATEMENT A.
APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION IS UNLIMITED.

REVISION			
ZONE	REV	DESCRIPTION	DATE



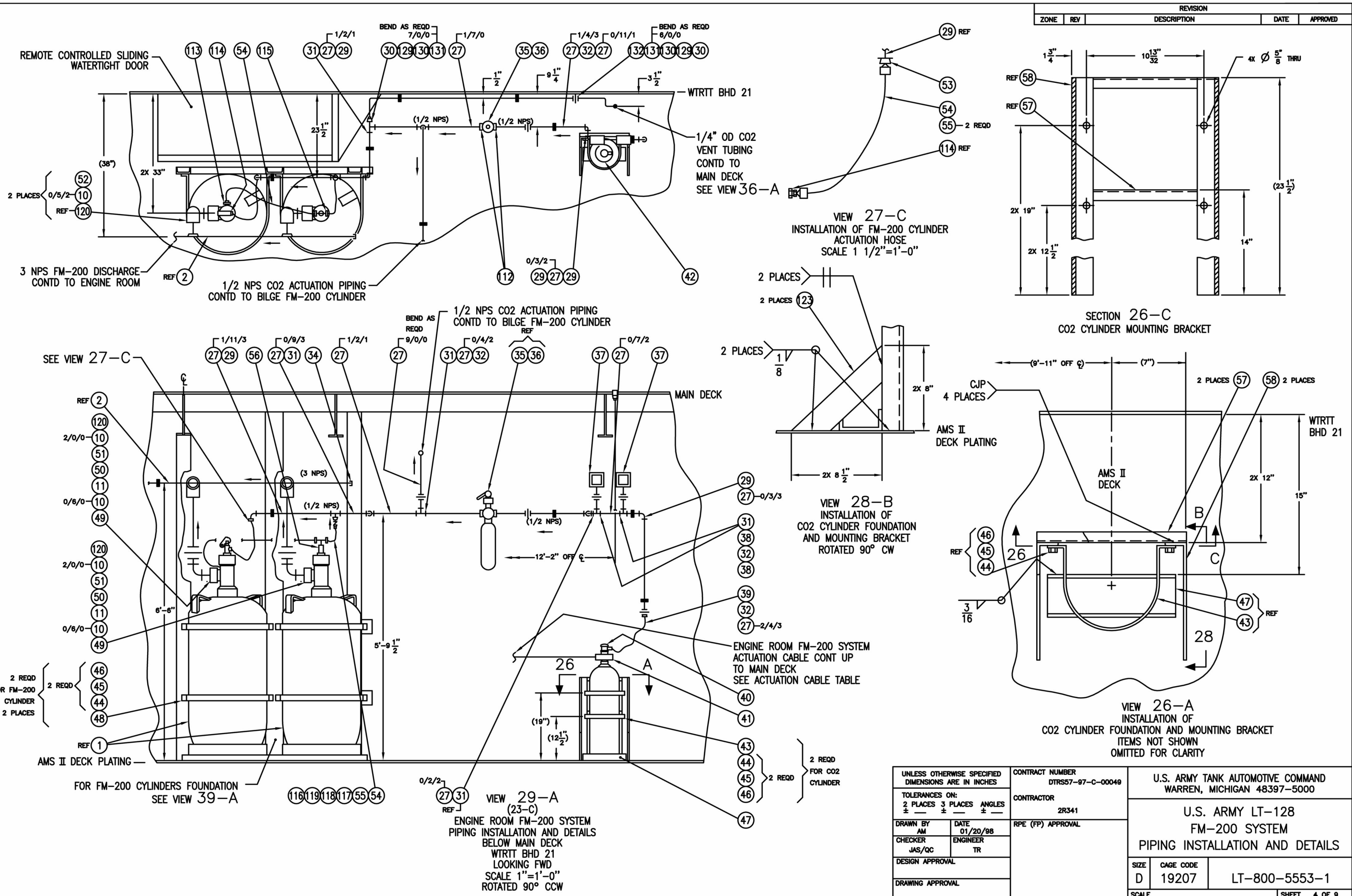
VIEW 21-A
ENGINE ROOM FM-200 SYSTEM
PIPING INSTALLATION AND DETAILS
BELOW MAIN DECK
SCALE 1/4"=1'-0"



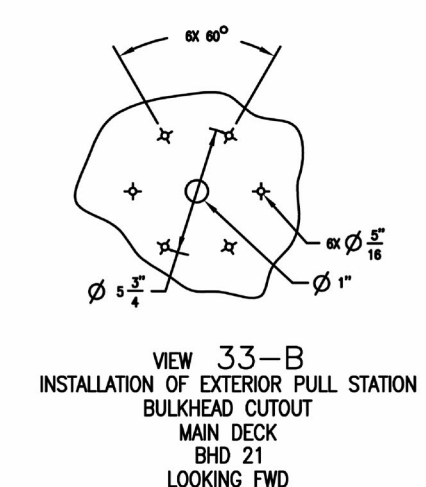
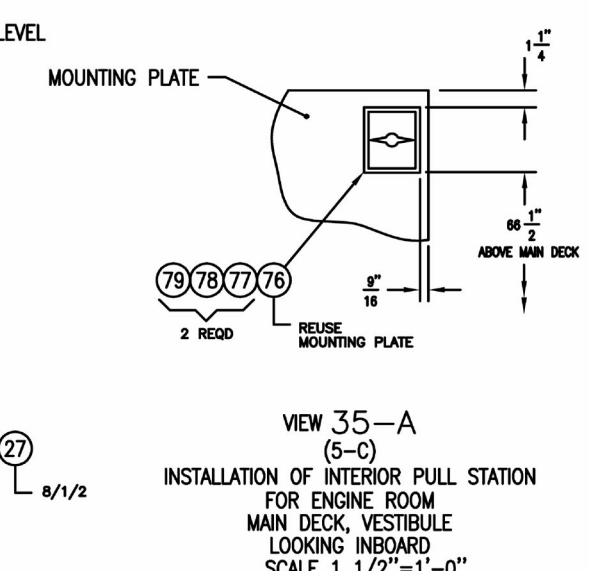
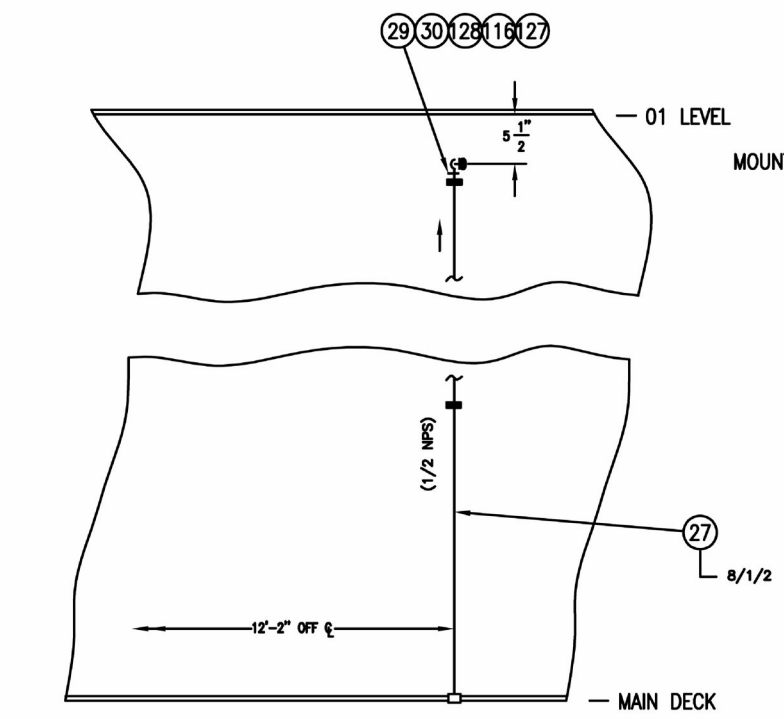
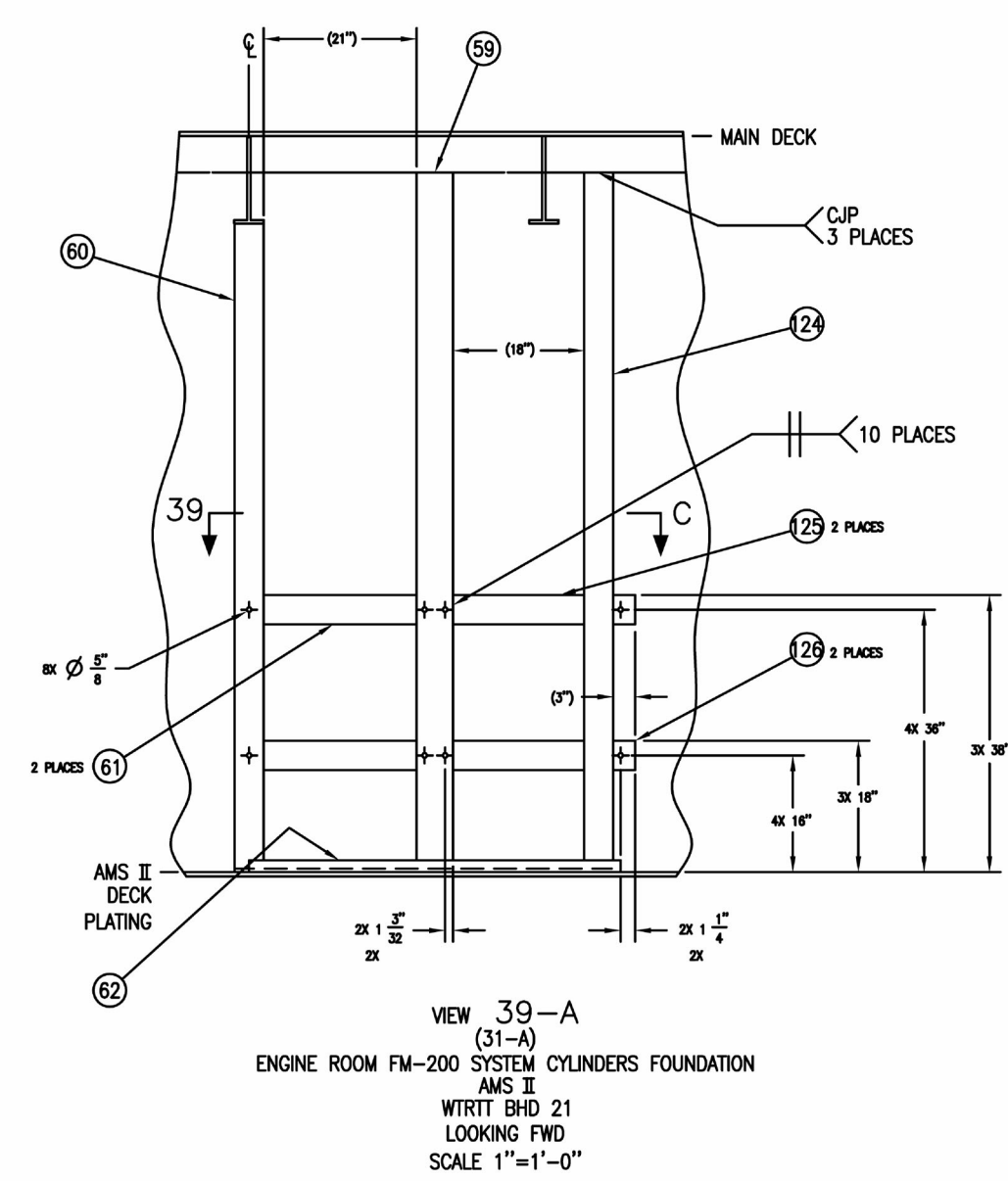
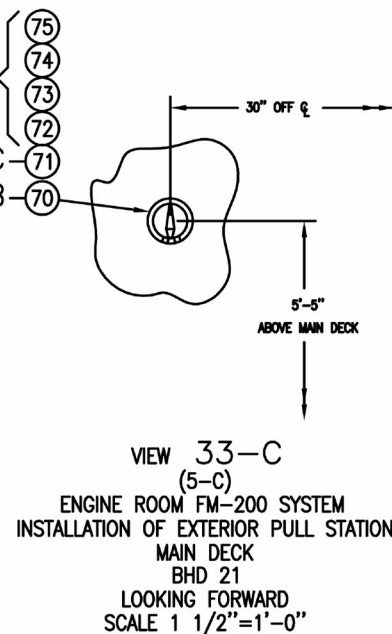
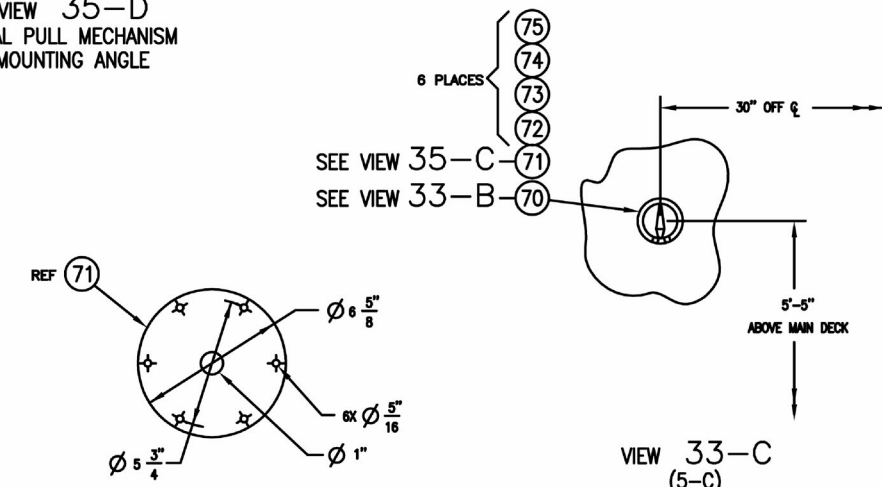
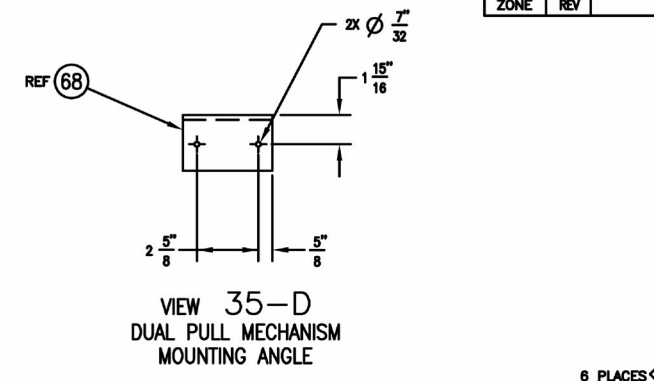
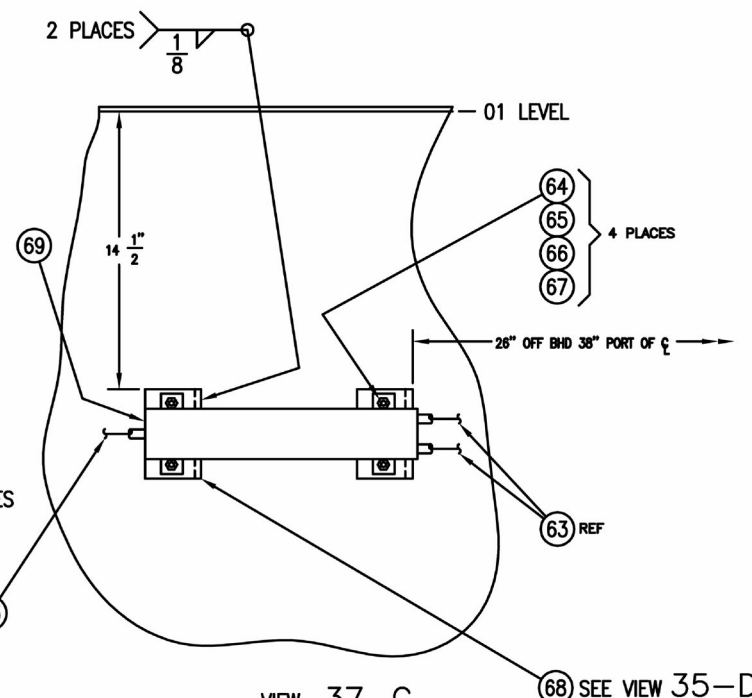
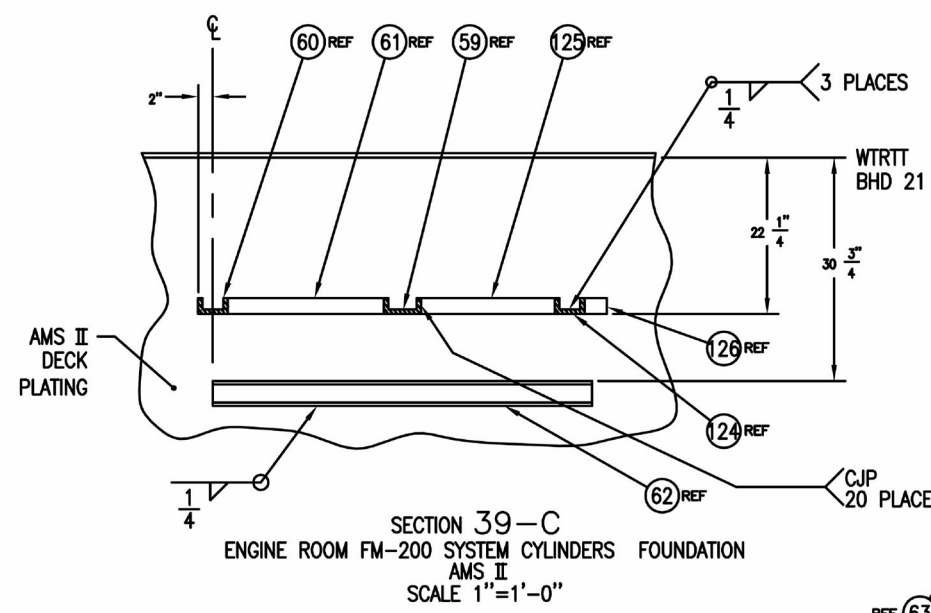
VIEW 18-B
ENGINE ROOM FM-200 SYSTEM
PIPING INSTALLATION AND DETAILS
BELOW MAIN DECK
LOOKING OUTBOARD
SCALE 1/2"=1'-0"

LOCAL NOTE:
1. "H" INDICATES APPROXIMATE PIPE HANGERS LOCATION, SEE NOTE 7.
2. FOR PIPE PENETRATION INSTALLATION AND DETAILS, SEE VIEW 16-C.

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 LT-128 FM-200 SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL	SIZE D	CAGE CODE 19207
CHECKER JAS/QC	ENGINEER TR		LT-800-5553-1	
DESIGN APPROVAL			SCALE	SHEET 3 OF 9
DRAWING APPROVAL				

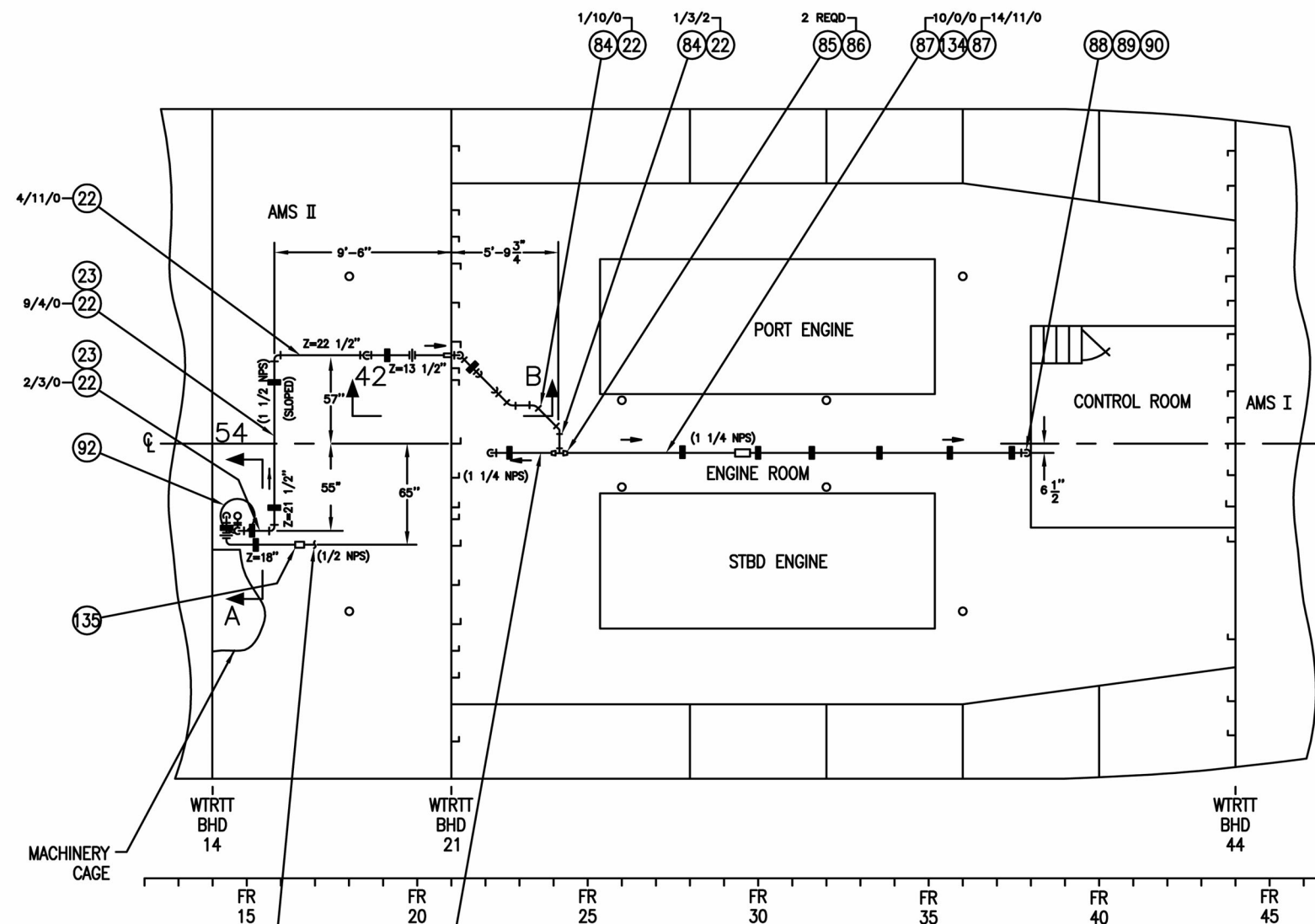


REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



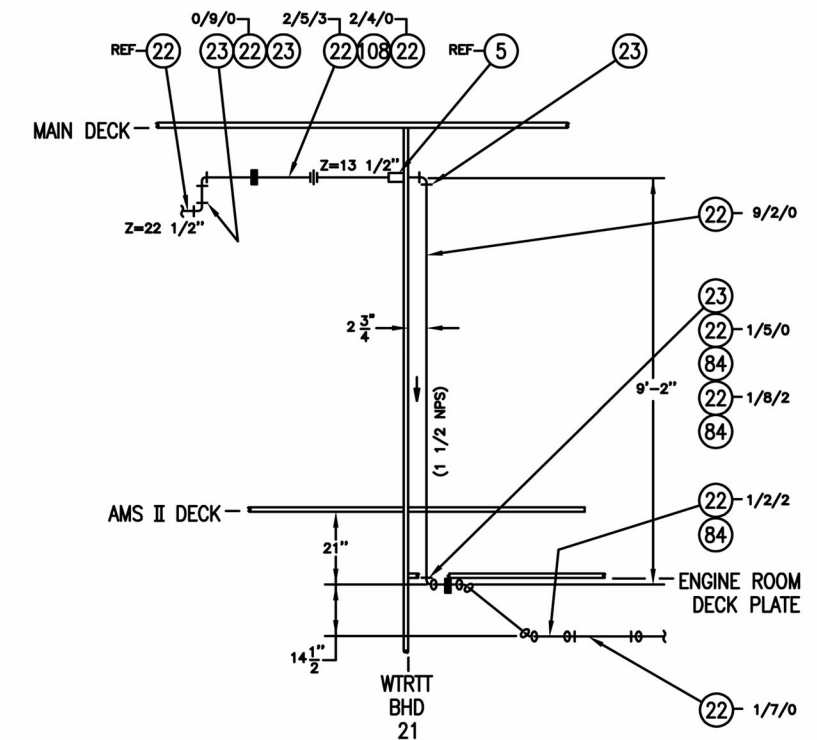
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±	CONTRACT NUMBER DTRS57-97-C-00049	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
	CONTRACTOR 2R341	U.S. ARMY LT-128 FM-200 SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL	SIZE D
CHECKER JAS/QC	ENGINEER TR	DESIGN APPROVAL	CAGE CODE 19207
DRAWING APPROVAL			LT-800-5553-1
			SCALE SHEET 5 OF 9

REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



VIEW 45-A
ENGINE ROOM BILGE FM-200 SYSTEM
PIPING INSTALLATION AND DETAILS
BELOW MAIN DECK,
SCALE 1/4"=1'-0"

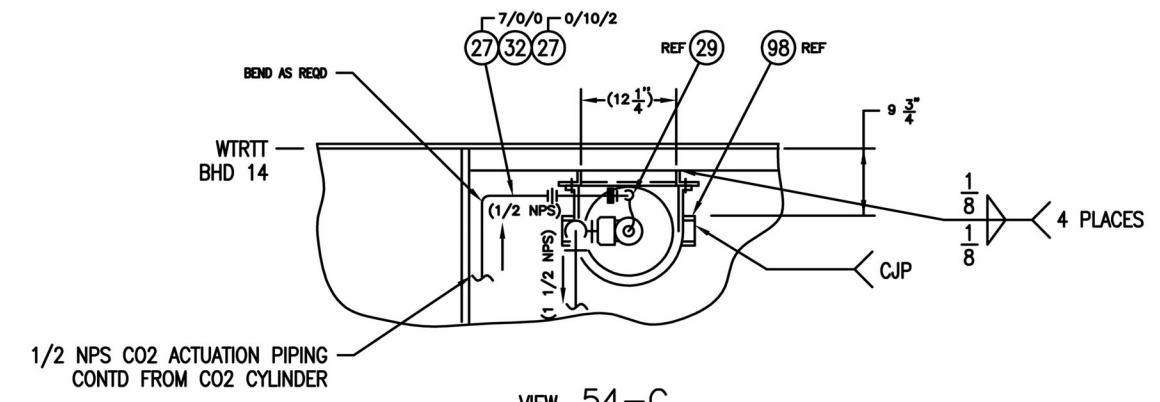
LOCAL NOTE:
1. "H" INDICATES APPROXIMATE PIPE HANGERS LOCATION, SEE NOTE 7.
2. FOR PIPE PENETRATION INSTALLATION AND DETAILS, SEE VIEW 16-C.



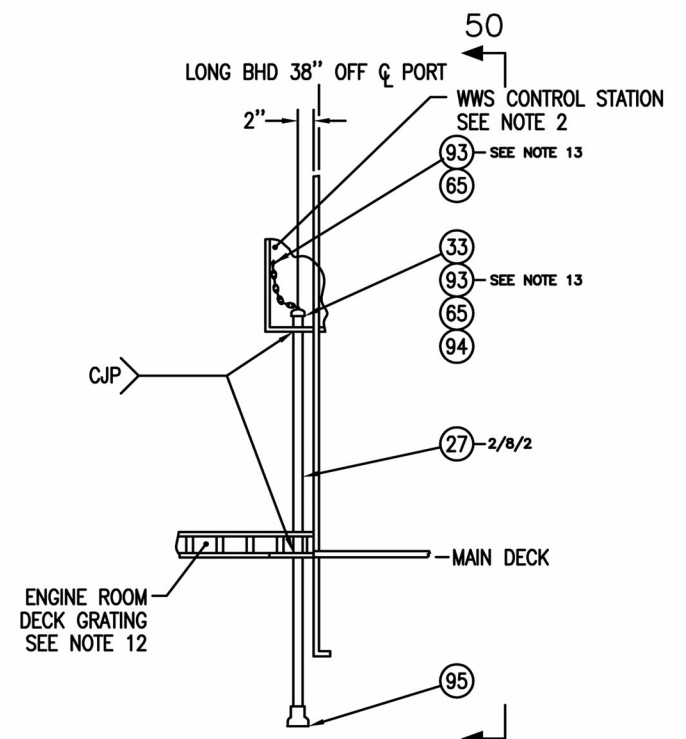
VIEW 42-B
ENGINE ROOM BILGE FM-200 SYSTEM
PIPING INSTALLATION AND DETAILS
BELOW MAIN DECK,
SCALE 1/2"=1'-0"

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRS57-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± — ± — ± —		CONTRACTOR 2R341		U.S. ARMY LT-128 FM-200 SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL		SIZE D	CAGE CODE 19207
CHECKER JAS/QC	ENGINEER TR			LT-800-5553-1	
DESIGN APPROVAL				SCALE	SHEET 6 OF 9
DRAWING APPROVAL					

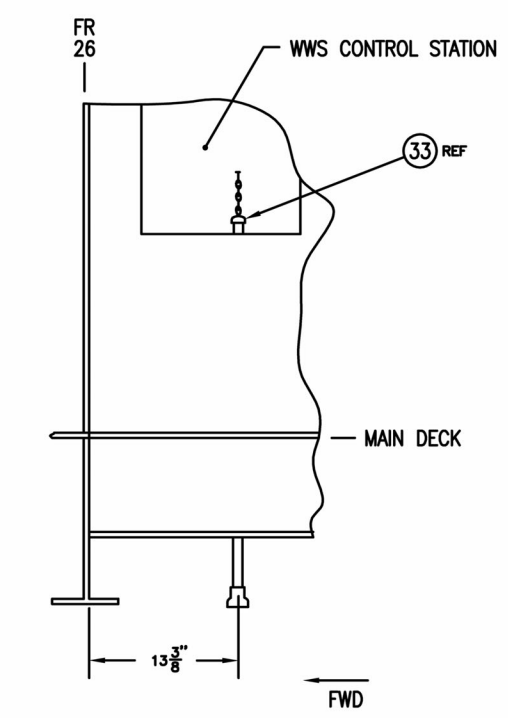
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



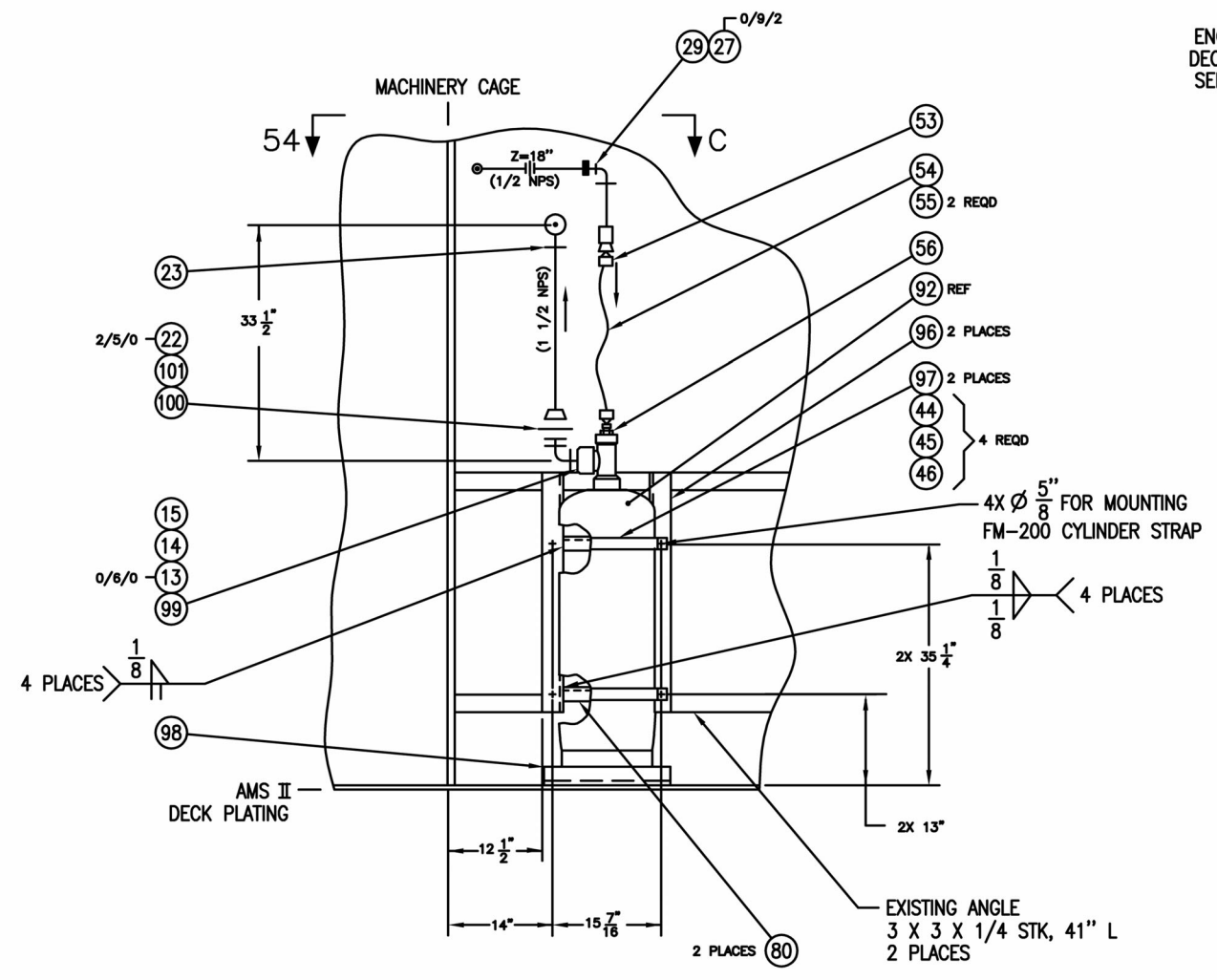
VIEW 54-C
ENGINE ROOM BILGE FM-200 SYSTEM
PIPING INSTALLATION AND DETAILS
SCALE 1"=1'-0"



VIEW 52-C
INSTALLATION OF
ENGINE ROOM FM-200 SYSTEM
SAMPLING PORT
MAIN DECK, ENGINE ROOM VESTIBULE
PORT SIDE
FR 25
LOOKING AFT
SCALE 1 1/2"=1'-0"



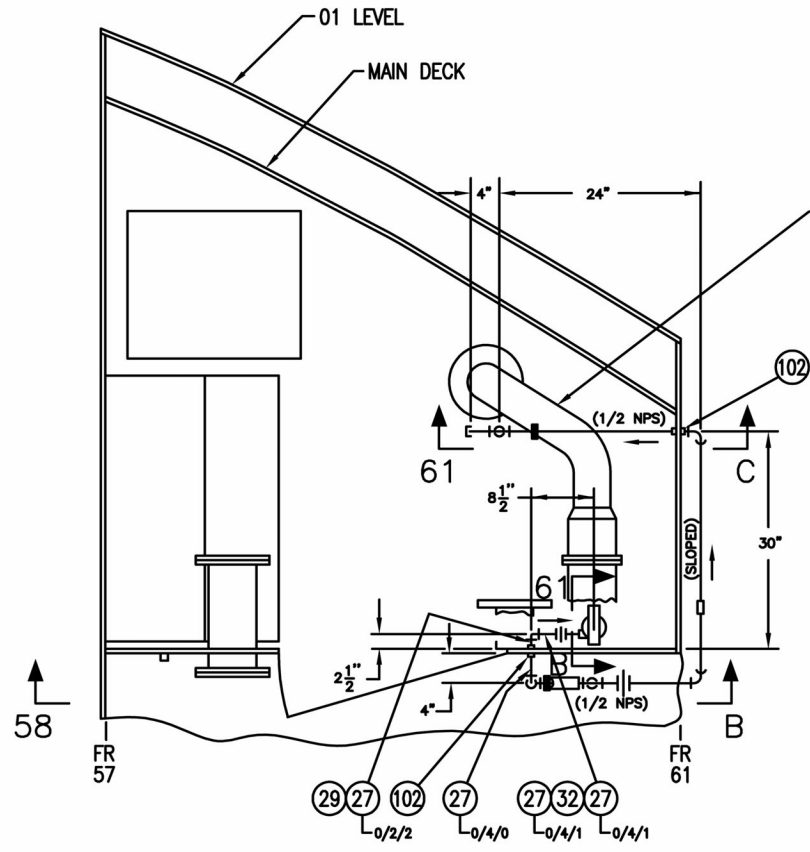
VIEW 50-B
INSTALLATION OF
ENGINE ROOM FM-200 SYSTEM
SAMPLING PORT
MAIN DECK
PORT SIDE
LOOKING INBOARD
SCALE 1 1/2"=1'-0"



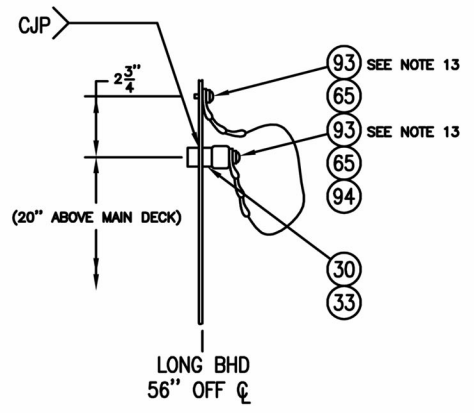
VIEW 54-A
(47-C)
ENGINE ROOM BILGE FM-200 SYSTEM
PIPING INSTALLATION AND DETAILS
WTRTT BHD 14
LOOKING AFT
SCALE 1"=1'-0"
ROTATED 90° CW

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	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL	U.S. ARMY LT-128 FM-200 SYSTEM PIPING INSTALLATION AND DETAILS
CHECKER JAS/QC	ENGINEER TR		
DESIGN APPROVAL			
DRAWING APPROVAL			SIZE D
			CAGE CODE 19207
			SCALE
			LT-800-5553-1
			SHEET 7 OF 9

REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED

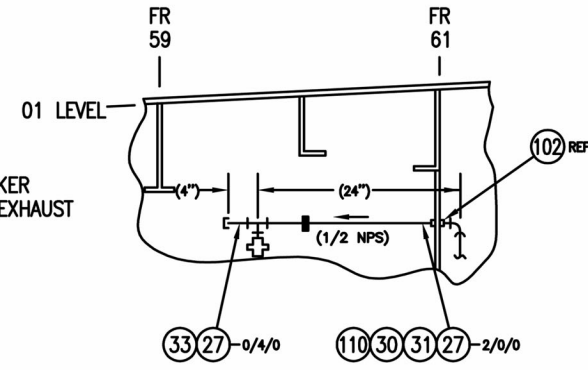


VIEW 63-B
PAINT LOCKER FM-200 SYSTEM
PIPING INSTALLATION AND DETAILS
MAIN DECK
SCALE 1"=1'-0"
ITEMS NOT SHOWN
OMITTED FOR CLARITY

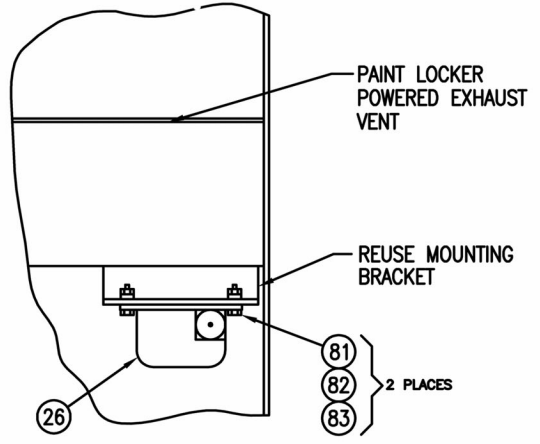


VIEW 63-A
INSTALLATION OF PAINT LOCKER FM-200 SYSTEM
SAMPLING PORT
MAIN DECK
FR 58
LOOKING FWD

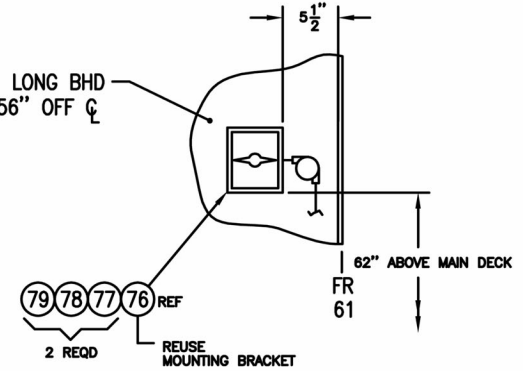
LOCAL NOTE:
1. "■" INDICATES APPROXIMATE PIPE HANGERS LOCATION. SEE NOTE 7.



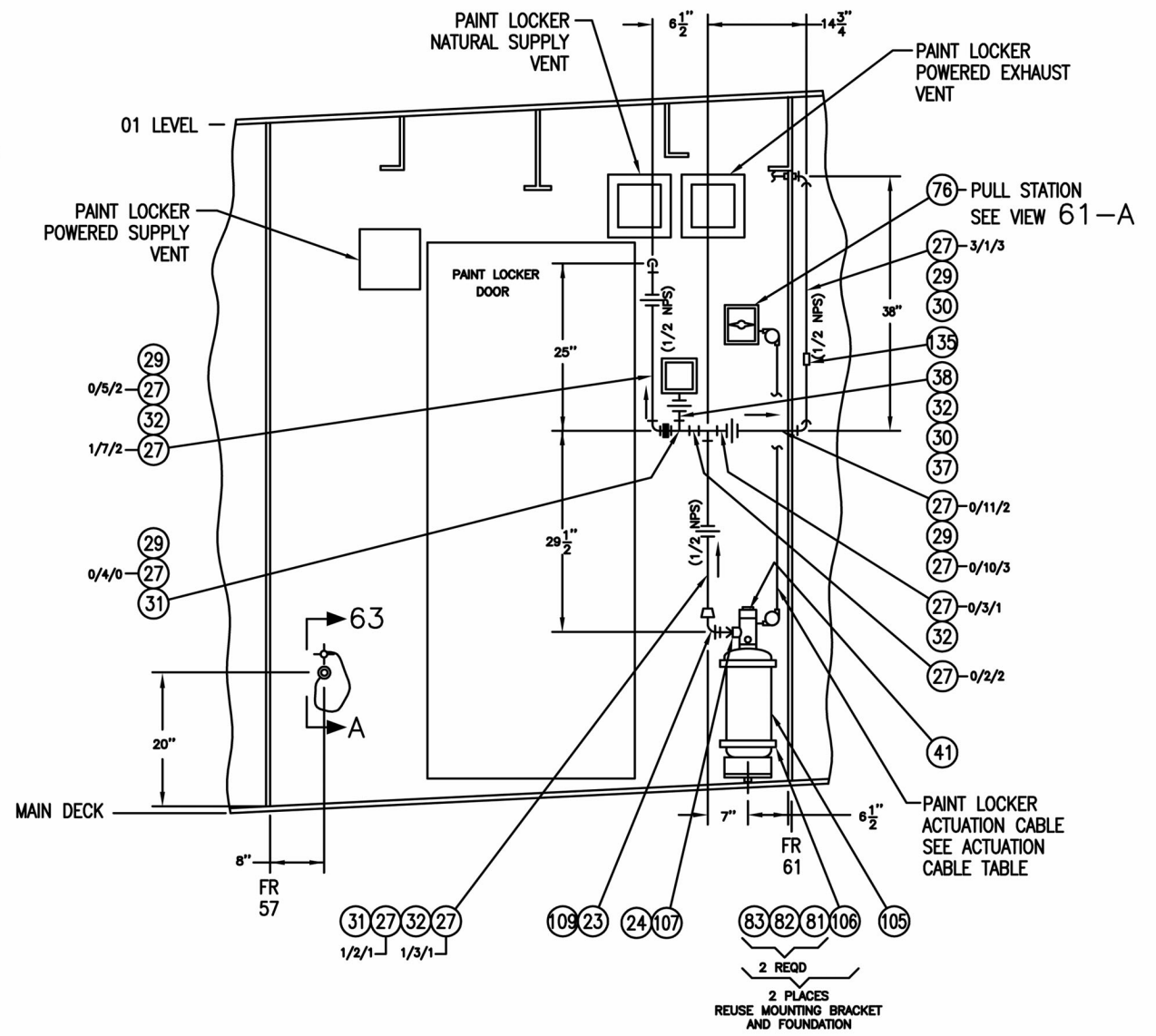
VIEW 61-C
PAINT LOCKER FM-200 SYSTEM
PIPING INSTALLATION AND DETAILS
LOOKING OUTBOARD
SCALE 1"=1'-0"



VIEW 61-B
PAINT LOCKER FM-200 SYSTEM
PIPING INSTALLATION AND DETAILS
INSTALLATION OF SIREN
LOOKING FWD
ITEMS NOT SHOWN
OMITTED FOR CLARITY



VIEW 61-A
PAINT LOCKER FM-200 SYSTEM
PIPING INSTALLATION AND DETAILS
INSTALLATION OF INTERIOR PULL STATION
LOOKING OUTBOARD
SEE ACTUATION CABLE TABLE
SCALE 1 1/2"=1'-0"



VIEW 58-B
PAINT LOCKER FM-200 SYSTEM
PIPING INSTALLATION AND DETAILS
LONG BHD 56" OFF CL
LOOKING OUTBOARD
SCALE 1"=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
TOLERANCES ON: 2 PLACES ± .005 3 PLACES ± .003 ANGLES ± .005		CONTRACTOR 2R341		U.S. ARMY LT-128 FM-200 SYSTEM PIPING INSTALLATION AND DETAILS
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL	SIZE D
CHECKER JAS/QC	ENGINEER TR		CAGE CODE 19207
DESIGN APPROVAL			LT-800-5553-1
DRAWING APPROVAL			SCALE

SIZE	CAGE CODE	LT-800-5553-1
D	19207	
SCALE		SHEET 8 OF 9

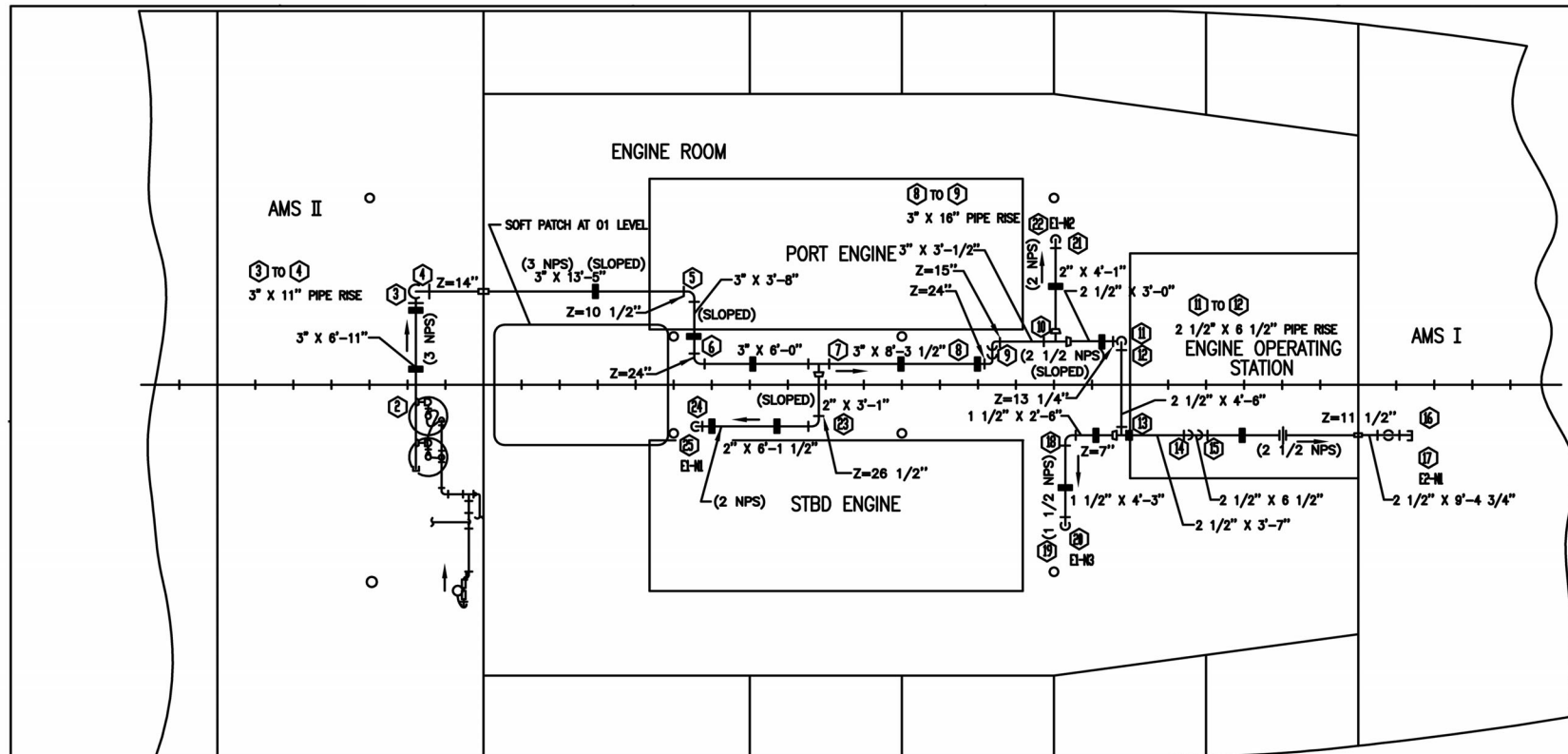


DIAGRAM 70-C
ENGINE ROOM FM-200 SYSTEM
MODELING AND FLOW ANALYSIS DIAGRAM
BELOW MAIN DECK
SCALE 1/4"=1'-0"

ZONE		REV	REVISION DESCRIPTION	DATE	APPROVED

NOZZLE FLOW CHART		
NODE POINT	DESCRIPTION	FLOW
25	ENGINE ROOM E1-N1	211 Lbs.
22	ENGINE ROOM E1-N2	129.6 Lbs.
20	ENGINE ROOM E1-N3	129.5 Lbs.
17	FWD AUX MACHINERY SPACE E2-N1	257.9 Lbs.
17	ENGINE ROOM BILGE E1-N1	75 Lbs.
19	ENGINE ROOM BILGE E1-N2	75 Lbs.
7	PAINT LOCKER E1-N1	11 Lbs.

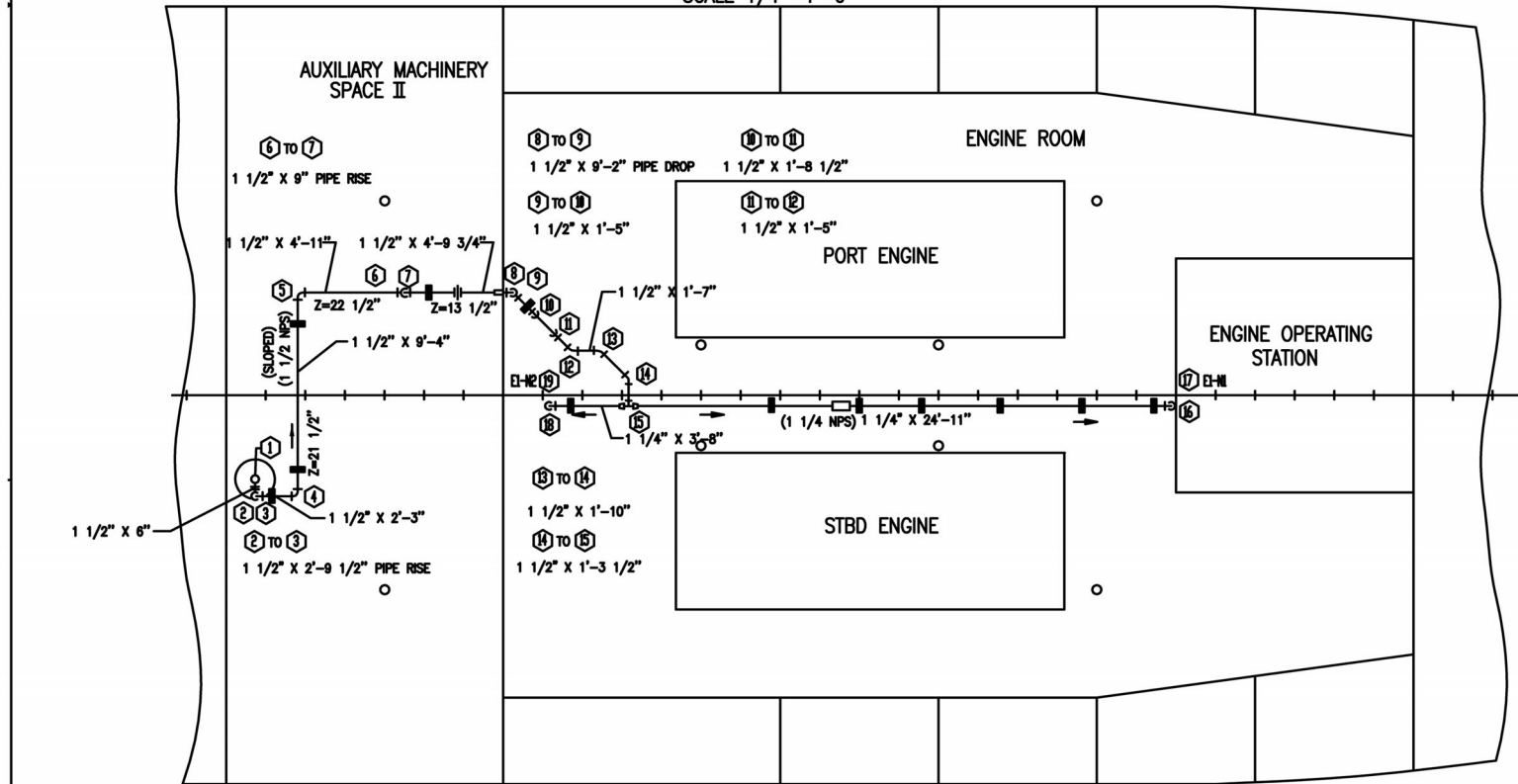


DIAGRAM 70-A
ENGINE ROOM BILGE FM-200 SYSTEM
MODELING AND FLOW ANALYSIS DIAGRAM
BELOW MAIN DECK
SCALE 1/4"=1'-0"

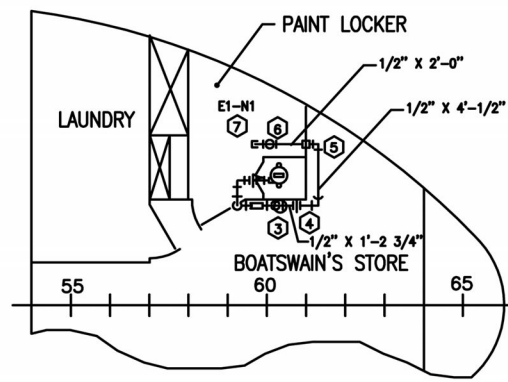


DIAGRAM 66-A
PAINT LOCKER FM-200 SYSTEM
MODELING AND FLOW ANALYSIS DIAGRAM
SCALE 1/4"=1'-0"

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 LT-128 FM-200 SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL		
CHECKER JAS/QC	ENGINEER TR			
DESIGN APPROVAL				
DRAWING APPROVAL				
SIZE D	CAGE CODE 19207	LT-800-5553-1		
SCALE	SHEET 9 OF 9			

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 LARGE TUG (LT-128).
- 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
27	LSDSGA-4	DSGA-4
- MOUNT JUNCTION BOX FM2-JB1 IN OVERHEAD OF MESS/RECREATION SPACE ON FORWARD SIDE OF BHD 26.
- ELECTRICAL CABLE PENETRATIONS SHALL BE MADE USING CABLE PENETRATION LIST AS A GUIDE.
- EXISTING INSULATION DISTURBED OR DAMAGED BY THIS MODIFICATION SHALL BE REPLACED OR REPAIRED TO A LIKE NEW CONDITION.
- REVISE DIRECTORY OF EMERGENCY LIGHTING PANEL NO. 1 TO REFLECT "FM-200 ALARMS/EQUIPMENT SHUTDOWNS" FOR CIRCUIT EL1-1EL-B.
- NEWLY INSTALLED MATERIAL AND DISTURBED AREAS SHALL BE CLEANED, PAINTED, AND MARKED USING DEPARTMENT OF ARMY TECHNICAL BULLETIN TB 43-0144 AS A GUIDE.
- NEW ELECTRICAL CABLE SHALL BE TAGGED USING CABLE TAGS, FIND NO. 24, 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.
- IDENTIFICATION OF EQUIPMENT SHALL BE ACCOMPLISHED USING REFERENCE 2 AS A GUIDE.
- TEMPLATE MOUNTING HOLE LOCATION FROM BELL, FIND NO 20, INSTALL WELDING PAD, FIND NO. 16, ON WTRTT BULKHEAD 21.
- TEMPLATE MOUNTING HOLE LOCATION FROM ELECTRIC HORN, FIND NO 19, INSTALL WELDING PAD, FIND NO. 16, ON WTRTT BULKHEAD 21 AND 44.
- TEMPLATE MOUNTING HOLE LOCATION FROM BELL, FIND NO 20, AND INSTALL WELDING PAD, FIND NO. 16, ON PAINT LOCKER BULKHEAD.
- TEMPLATE MOUNTING HOLE LOCATION FROM JUNCTION BOX, FIND NO 8, AND INSTALL WELDING PAD, FIND NO. 16, ON BULKHEAD.
- TEMPLATE MOUNTING HOLE LOCATION FROM JUNCTION BOX, FIND NO 8, AND DRILL 1/4 INCH HOLES FOR SCREW, FIND NO. 12.

CABLE PENETRATION LIST											
CIRCUIT DESIGNATION	CABLE TYPE	PENETRATION LOCATION	FIND NO.			CIRCUIT DESIGNATION	CABLE TYPE	PENETRATION LOCATION	FIND NO.		
			STUFFING TUBE	PACKING ASSEMBLY	PREFORMED PACKING (O-RING)				STUFFING TUBE	PACKING ASSEMBLY	PREFORMED PACKING (O-RING)
EL1-1EL-B	LSDSGU-4	EMER LTG PANEL NO. 1	2	3	4	EL1-1EL-B(8)	LSDSGU-4	AMB STROBE LT (ER STBD)	5	3	-
		JUNCTION BOX FM2-JB1	5	3	-			ENG RM CONTROL STATION	USE EXIST WTRTT CABLE TRANSIT		
EL1-1EL-B(1)	LSDSGU-4	JUNCTION BOX FM2-JB1	5	3	-			BHD (FR 44)	USE EXIST WTRTT CABLE TRANSIT		
		BHD (FR 40)	USE EXIST CABLE PENETRATION					AMB STROBE LT (AMS I)	5	3	-
		LONG JOINER BHD	USE EXIST CABLE PENETRATION			EL1-1EL-B(9)	LSDSGU-4	JUNCTION BOX FM2-JB2	5	3	-
		JOINER BHD (FR 45)	USE EXIST WIREWAY					ER VESTIBULE	USE EXIST WTRTT CABLE TRANSIT		
		JOINER BHD (FR 50)	USE EXIST WIREWAY					BHD (FR 21)	6	7	-
		BHD (FR 54)	USE EXIST CABLE PENETRATION					ER ALARM BELL	5	3	-
EL1-1EL-B(2)	LSDSGU-4	PRESS SWITCH PS-2	2	3	4	EL1-1EL-B(10)	LSDSGU-4	AMB STROBE LT (ER CENTER)	5	3	-
		PNT LKR ALARM BELL	5	3	-			AMB STROBE LT (ER STBD)	5	3	-
PP3-1K-K(2)	LSDSGU-4 (EXISTING)	PRESS SWITCH PS-2	2	3	4	EDP1-24EK-M(4)	LSDSGU-4 (EXISTING)	ER FM-200 RELAY PNL BOX	EXISTING UNDISTURBED PENETRATION		
		PNT LKR EXH FAN CONT	EXISTING UNDISTURBED PENETRATION					BHD (FR 21)	EXISTING UNDISTURBED PENETRATION		
EL1-1EL-B(3)	LSDSGU-4	JUNCTION BOX FM2-JB1	5	3	-	ELC-24EP-B(3)	LSDSGA-4	EMER GEN BATTERY CHARGER	2	3	4
		BHD (FR 26)	USE EXIST CABLE PENETRATION					O1 LEVEL DECK	USE EXIST CABLE PENETRATION		
		MAIN DECK	USE EXIST WTRTT CABLE TRANSIT					JOINER BHD (FR 32)	USE EXIST WIREWAY		
		BHD (FR 21)	USE EXIST WTRTT CABLE TRANSIT					BHD (FR 26)	USE EXIST CABLE PENETRATION		
		PRESS SWITCH PS-1	2	3	4			MAIN DECK	USE EXIST WTRTT CABLE TRANSIT		
EL1-1EL-B(4)	LSDSGU-4	PRESS SWITCH PS-1	2	3	4			BHD (FR 21)	USE EXIST WTRTT CABLE TRANSIT		
		AMB STROBE LT (AMS II)	5	3	-	ELC-24EP-B(4)	LSDSGA-4	PRESS SWITCH PS-1A	2	3	4
EL1-1EL-B(5)	LSDSGU-4	AMB STROBE LT (AMS II)	5	3	-			BHD (FR 21)	USE EXIST WTRTT CABLE TRANSIT		
		BHD (FR 21)	USE EXIST WTRTT CABLE TRANSIT					ELECTRIC HORN (ENG RM)	5	3	-
EL1-1EL-B(6)	LSDSGU-4	AMB STROBE LT (ER PORT)	5	3	-	ELC-24EP-B(5)	LSDSGA-4	ELECTRIC HORN (ENG RM)	5	3	-
		AMB STROBE LT (ER PORT)	5	3	-			ENG RM CONTROL STATION	USE EXIST WTRTT CABLE TRANSIT		
		JUNCTION BOX FM2-JB2	5	3	-			BHD (FR 44)	USE EXIST WTRTT CABLE TRANSIT		
EL1-1EL-B(7)	LSDSGU-4	JUNCTION BOX FM2-JB2	5	3	-			ELECTRIC HORN (AMS I)	5	3	-
		AMB STROBE LT (ER CENTER)	5	3	-						

PARTS LIST CONTINUED ON SHEET 5

- 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.
- ALL WIRE SCREW TERMINATIONS WILL BE MADE USING INSULATED, RING TONGUE, TERMINAL LUGS. WIRES WILL BE LABELLED WITH TERMINAL NUMBER AT TERMINATION.
- THE ELECTRIC HORN/STROBE, FIND NO. 19, 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.

FIND NO.	CAGE CODE	PART OR IDENTIFYING NUMBER	TOTAL QUANTITY REQUIRED	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)
15	07337	SS-B	2 EA	COVER, JUNCTION BOX, BLANK	COML (RED DOT)	ALUMINUM	0.70
14			10 EA	NUT, HEX, NO. 10-32 UNF-2B, ZINC PL	ASME B18.2.2	STEEL	-
13			10 EA	WASHER, LOCK, HLCL SPR, RGLR, NO. 10 NOM, ZINC PL	ASME B18.21.1	STEEL	-
12			10 EA	SCREW, MACHINE, PAN HD, CROSS REC, NO. 10-32 UNF-2A X 1/2" L	ASME B18.6.3	STEEL	-
11	02116	MAX-AC-A	5 EA	LIGHT, STROBE, AMBER, 115 VAC	COML (WHEELLOCK)		0.70
10			5 EA	PIPE, SMLS, .840 OD X .109 WALL, GALV (1/2 NPS), 8" L	ASTM A 53	STEEL	0.85
9	07337	S-1	5 EA	COVER, JUNCTION BOX, WITH ONE 1/2 NPT HOLE	COML (RED DOT)	ALUMINUM	0.70
8	07337	S-48	7 EA	JUNCTION BOX, STD, 5 EA 3/4" OUTLETS, 4 PLUGS, W/MTG	COML (RED DOT)	ALUMINUM	0.70
7			1 EA	PACKING, PREFORMED, CLASS 2, TYPE II, SIZE B	MIL-P-16685		-
6	M24235/9-002		1 EA	STUFFING TUBE, SIZE B (1/2 NPT FEMALE)	MIL-S-24235/9	BRASS	0.20
5	M19622/3-002		20 EA	STUFFING TUBE, NPT, SIZE 2	MIL-C-19622/3	NYLON	0.25
4	M83461/1-214		10 EA	PACKING, PREFORMED, (SIZE 2 STUFFING)	MIL-P-83461/1		-
3	M19622/17-004		30 EA	PACKING ASSEMBLY, SIZE 2 (.425 ID BUSHING)	MIL-S-19622/17		1.00
2	M19622/1-002		10 EA	STUFFING TUBE, STRAIGHT, SIZE 2	MIL-C-19622/1	NYLON	0.25
1	M24643/15-02UN		350 FT	CABLE, ELECTRICAL, 1000 V, TYPE LSDSGU-4	MIL-C-24643/15		1.00

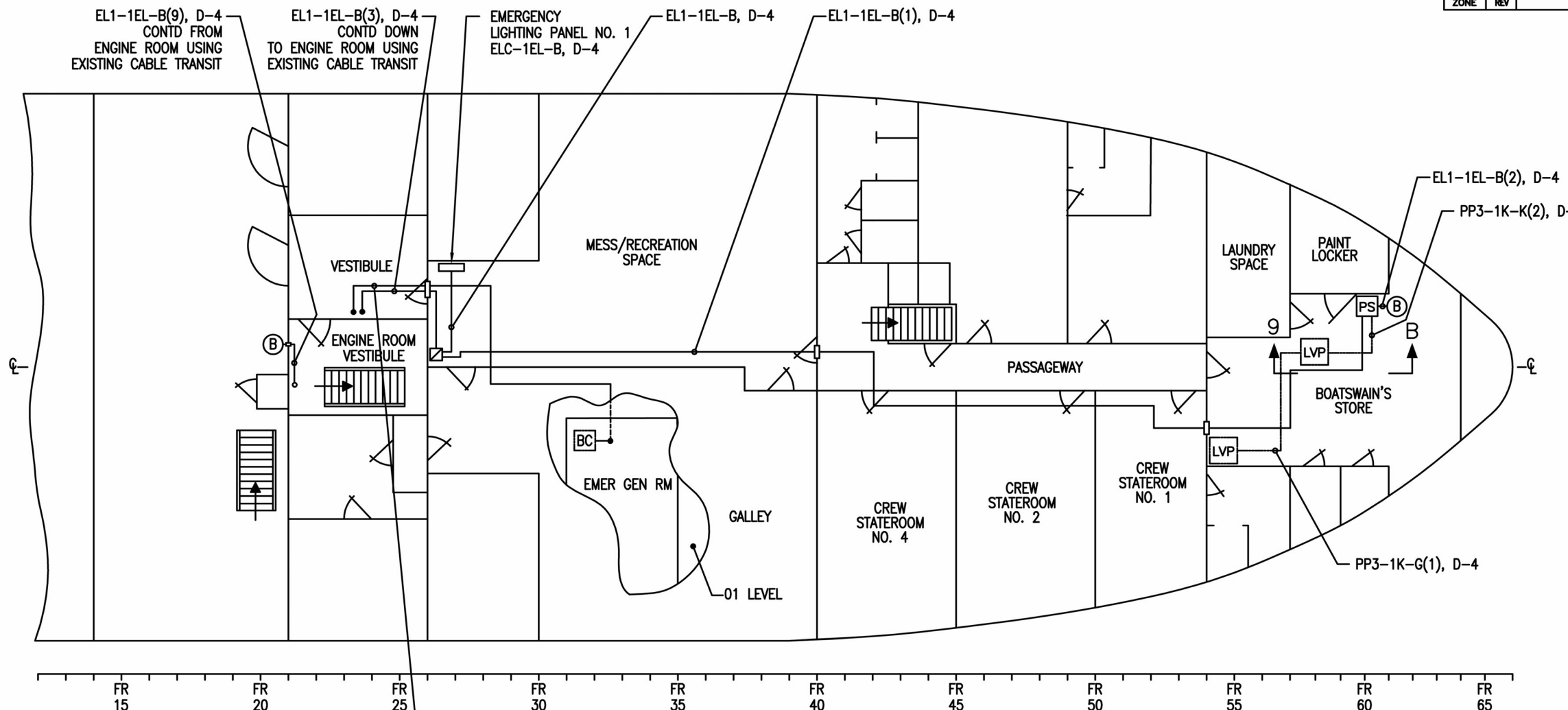
PARTS LIST

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	
DRAWN BY AM	DATE 1/20/98	U.S. ARMY LT-128 FM-200 SYSTEM ELECTRICAL MODIFICATIONS
CHECKED BY TR/RF	ENGINEER GS	
DESIGN APPROVAL	RPE (FP) APPROVAL	SIZE D
DRAWING APPROVAL		CAGE CODE 19207
		LT-800-5553-3
		SCALE NONE
		SHEET 1 OF 5

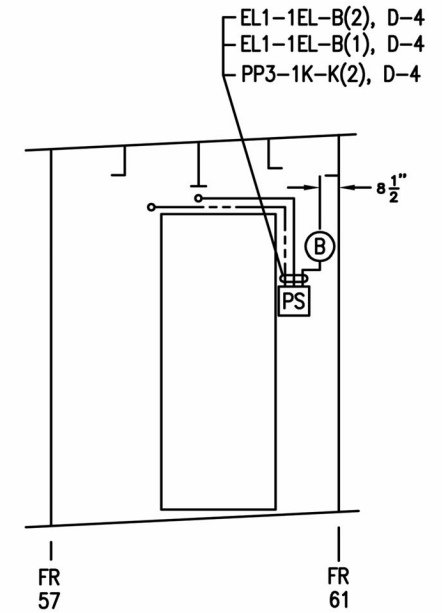
DISTRIBUTION STATEMENT A.
APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION IS UNLIMITED.

NO.	DRAWING TITLE	DRAWING NUMBER
2	FM-200 SYSTEM LABEL PLATES AND PLACARDS	LT-800-5553-4
1	FM-200 SYSTEM PIPING INSTALLATION AND DETAILS	LT-800-5553-1
LIST OF REFERENCES		

REVISION			
ZONE	REV	DESCRIPTION	DATE



VIEW 13-B
CABLING DIAGRAM
FM-200 ALARMS/EQUIPMENT SHUTDOWNS
MAIN DECK/01 LEVEL
SCALE 1/4"=1'-0"



VIEW 9-B
CABLING DIAGRAM
FM-200 ALARMS/EQUIPMENT SHUTDOWNS
PAINT LOCKER
MAIN DECK
SCALE 1/2"=1'-0"

SYMBOL LEGEND

- ☒ JUNCTION BOX (FIND NO. 8 AND 15)
- Ⓐ AMBER STROBE LIGHT (FIND NO. 8, 9, 10, AND 11)
- Ⓑ ALARM BELL (FIND NO. 20)
- Ⓟ PRESSURE SWITCH (REF NO. 1)
- ☐ ELECTRIC HORN (FIND NO. 19)
- 15 A EXISTING SPARE
- CIRCUIT BREAKER
- Ⓛ VP EXISTING MOTOR CONTROLLER
- Ⓡ P EXISTING ENGINE ROOM FM-200 RELAY PANEL BOX
- Ⓛ BC EXISTING EMER GEN BATTERY CHARGER
- EXISTING ELECTRICAL CABLE

ELC-24EP-B(3), DSGA-4
CONTD DOWN
TO ENGINE ROOM USING
EXISTING CABLE TRANSIT

EMERGENCY
LIGHTING PANEL NO. 1
ELC-1EL-EL1
(MESS/RECREATION SPACE)

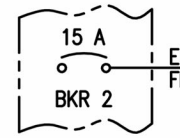
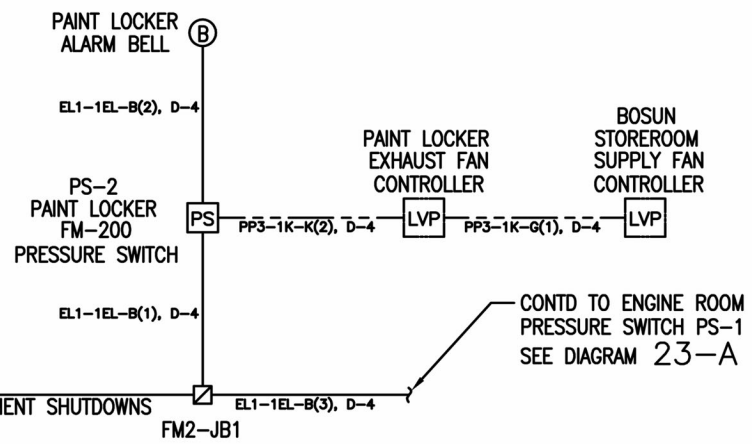


DIAGRAM 13-A
ONE-LINE DIAGRAM
FM-200 ALARMS/EQUIPMENT SHUTDOWNS (PAINT LOCKER)

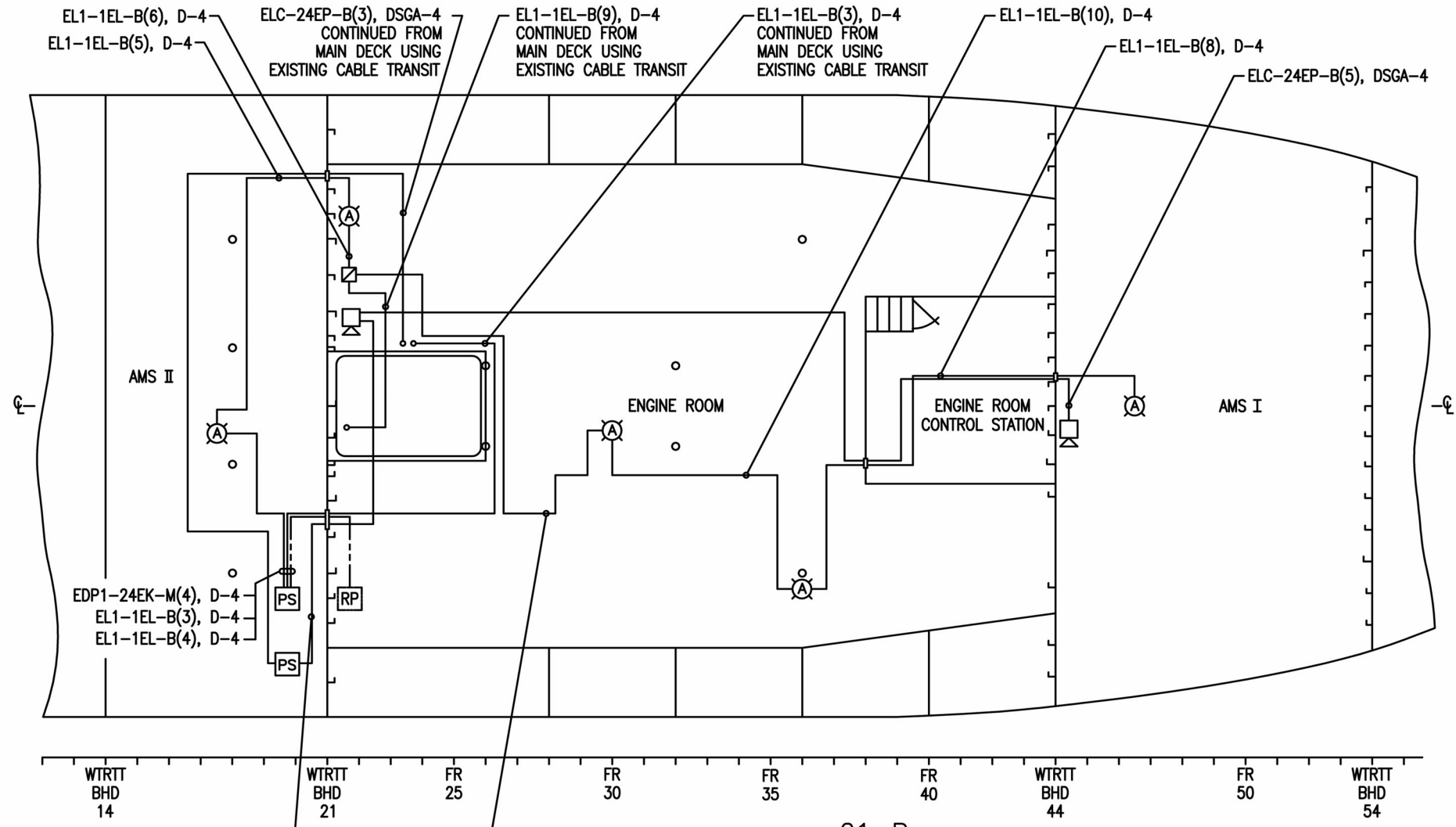


CONTD TO ENGINE ROOM
PRESSURE SWITCH PS-1
SEE DIAGRAM 23-A

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRS57-97-C-00049
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± .005 ± .003 ± .005		CONTRACTOR 2R341
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL
CHECKER JAS/QC	ENGINEER TR	
DESIGN APPROVAL		
DRAWING APPROVAL		

U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000		
U.S. ARMY LT-128 FM-200 SYSTEM ELECTRICAL MODIFICATIONS		
SIZE D	CAGE CODE 19207	LT-800-5553-3
SCALE	SHEET 2 OF 5	

REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



VIEW 21-B
CABLING DIAGRAM
FM-200 ALARMS/EQUIPMENTS SHUTDOWNS
BELOW MAIN DECK
SCALE 1/4"=1'-0"

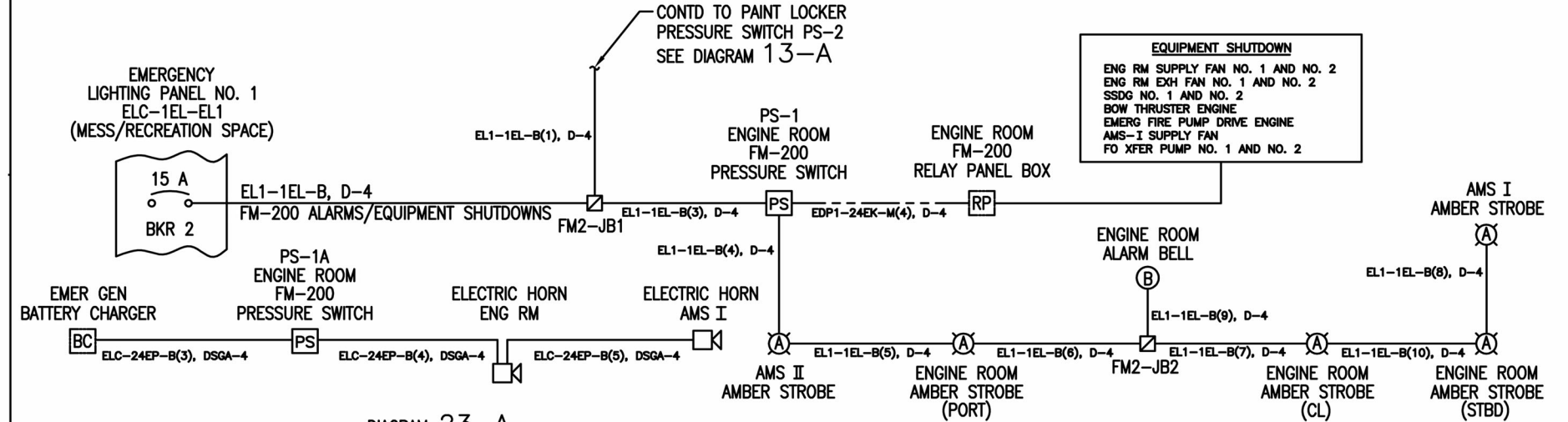


DIAGRAM 23-A
ONE-LINE DIAGRAM
FM-200 ALARMS/EQUIPMENT SHUTDOWNS (ENGINE ROOM)

EQUIPMENT SHUTDOWN
 ENG RM SUPPLY FAN NO. 1 AND NO. 2
 ENG RM EXH FAN NO. 1 AND NO. 2
 SSDG NO. 1 AND NO. 2
 BOW THRUSTER ENGINE
 EMERG FIRE PUMP DRIVE ENGINE
 AMS-I SUPPLY FAN
 FO XFER PUMP NO. 1 AND NO. 2

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	
TOLERANCES ON:	
2 PLACES	± .005
3 PLACES	± .002
ANGLES	± .005
DRAWN BY	DATE
AM	01/20/98
CHECKER	ENGINEER
JAS/QC	TR
DESIGN APPROVAL	
DRAWING APPROVAL	

CONTRACT NUMBER	DTRS57-97-C-00049
CONTRACTOR	2R341
RPE (FP) APPROVAL	

U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000		
U.S. ARMY LT-128 FM-200 SYSTEM ELECTRICAL MODIFICATIONS		
SIZE	CAGE CODE	LT-800-5553-3
D	19207	
SCALE	SHEET 3 OF 5	

REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED

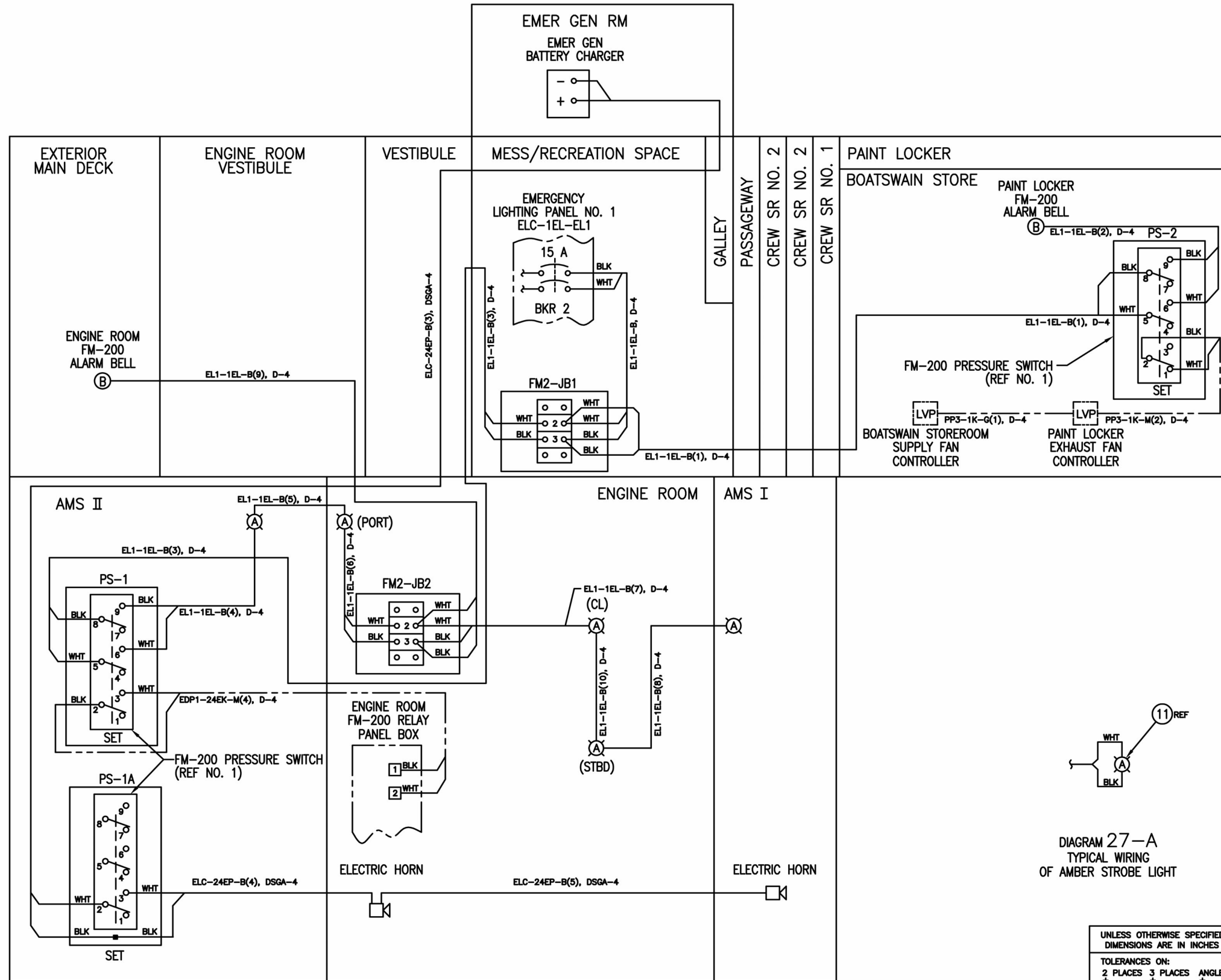


DIAGRAM 30-A
ELEMENTARY DIAGRAM
FM-200 ALARMS/EQUIPMENT SHUTDOWNS

LOCAL NOTE:

1. FOR TYPICAL WIRING OF AMBER STROBE LIGHT (A) SEE VIEW 27-A
2. FOR TYPICAL WIRING OF ALARM BELL (B) SEE VIEW 26-A
3. FOR TERMINAL ARRANGEMENT OF FM-200 PRESSURE SWITCH IN SET POSITION SEE VIEW 25-A

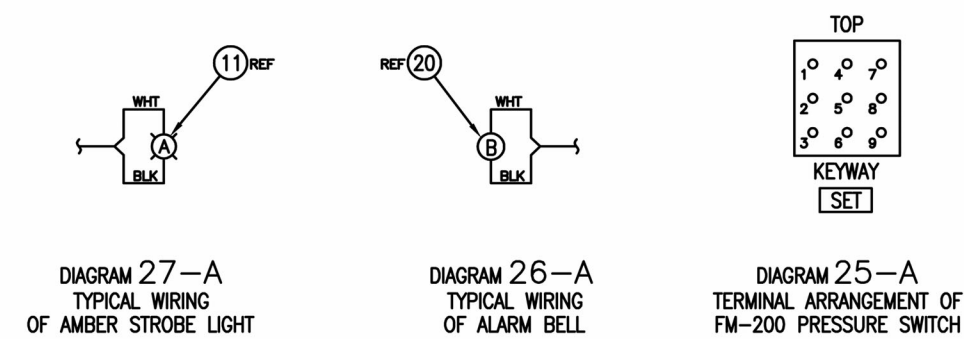


DIAGRAM 27-A
TYPICAL WIRING
OF AMBER STROBE LIGHT

DIAGRAM 26-A
TYPICAL WIRING
OF ALARM BELL

DIAGRAM 25-A
TERMINAL ARRANGEMENT OF
FM-200 PRESSURE SWITCH

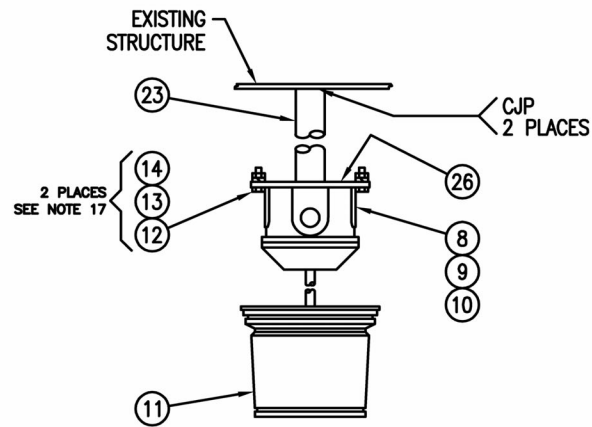
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRS57-97-C-00049
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL
CHECKER JAS/QC	ENGINEER TR	
DESIGN APPROVAL		
DRAWING APPROVAL		

U.S. ARMY TANK AUTOMOTIVE COMMAND
WARREN, MICHIGAN 48397-5000

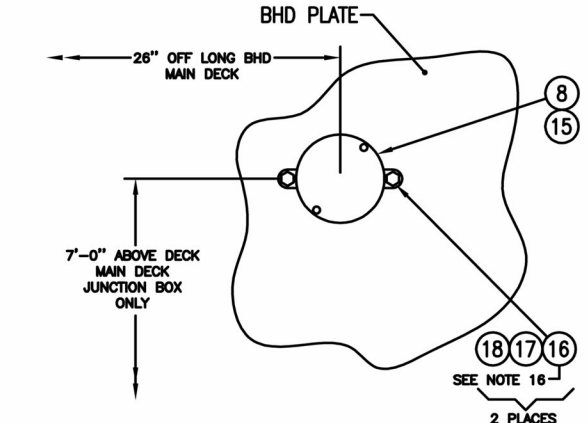
U.S. ARMY LT-128
FM-200 SYSTEM
ELECTRICAL MODIFICATIONS

SIZE D	CAGE CODE 19207	LT-800-5553-3
SCALE		SHEET 4 OF 5

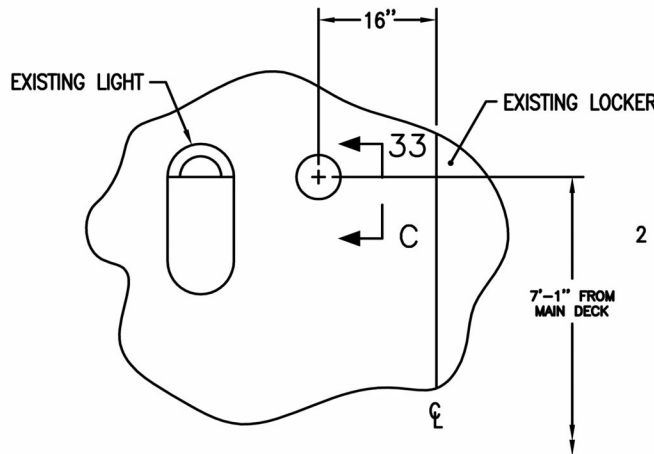
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



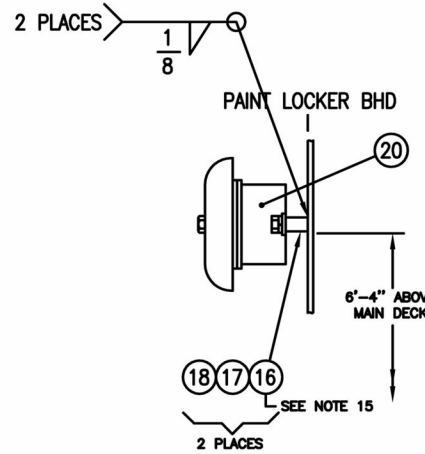
VIEW 39-C
TYPICAL FM-200
AMBER STROBE LIGHT INSTALLATION
ENGINE ROOM
(FR 30, 22" OFF ϕ , STBD)
(FR 36, STBD)
(30" FWD OF BHD 21)
(62" INBOARD OF SIDE SHELL)
AMS I
(43" FWD OF BHD 44, ON ϕ)
AMS II
(6" FWD OF FR 17,
80 1/2" OFF ϕ , STBD)
SCALE 3"=1'-0"



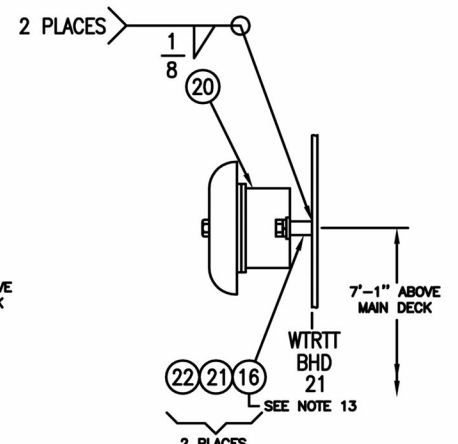
VIEW 37-C
TYPICAL FM-200
JUNCTION BOX INSTALLATION
SCALE 3"=1'-0"
2 PLACES



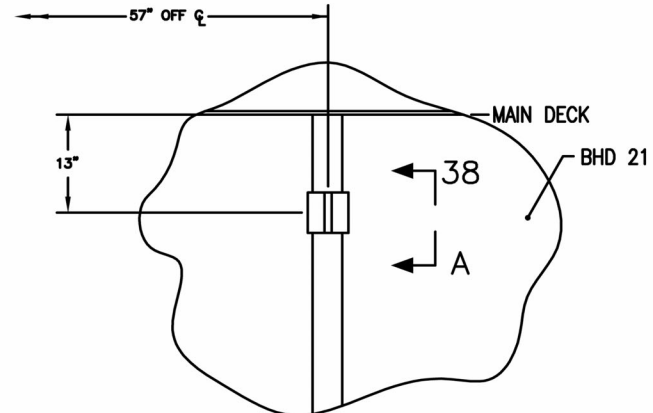
VIEW 36-C
ENGINE ROOM ALARM BELL INSTALLATION
MAIN DECK
BHD 21
LOOKING FWD
SCALE 1"=1'-0"



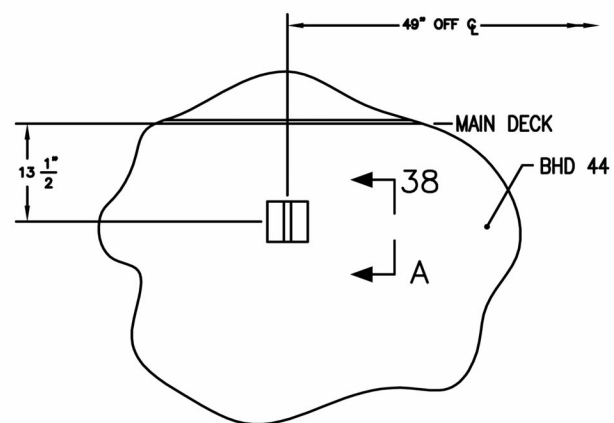
VIEW 35-C
INSTALLATION OF
PAINT LOCKER ALARM BELL
SCALE 3"=1'-0"



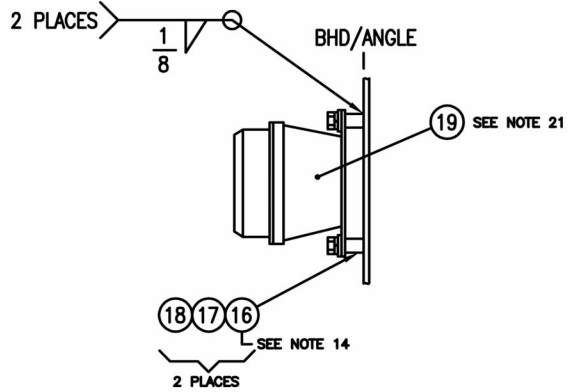
VIEW 33-C
INSTALLATION OF
ENGINE ROOM ALARM BELL
SCALE 3"=1'-0"



VIEW 37-B
ENGINE ROOM ELECTRIC HORN INSTALLATION
BELOW MAIN DECK
BHD 21
LOOKING AFT
SCALE 1"=1'-0"



VIEW 39-A
AMS I ELECTRIC HORN INSTALLATION
BELOW MAIN DECK
BHD 44
LOOKING AFT
SCALE 1"=1'-0"



VIEW 38-A
INSTALLATION OF
ELECTRIC HORN
SCALE 3"=1'-0"
2 PLACES

FIND NO.	CAGE CODE	PART OR IDENTIFYING NUMBER	TOTAL QUANTITY REQUIRED	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)
27		M24643/15-02AN	200 FT	CABLE, ELECTRICAL, 1000 V, TYPE LSDSGA-4	MIL-C-24643/15		1.00
26			5 EA	PLATE, 1/4 STK, 5" DIA	ASTM A 36	STEEL	1.11
25	06383	MLT1S-CP	2 PKG	CABLE TIES, 1 INCH MAX DIA (100 EACH PER PACKAGE)	COML (PANDUIT)	CRES	1.00
24	06383	AP350HWB6-C	1 PKG	CABLE TAGS (100 EACH PER PACKAGE)	COML (PANDUIT)	ALUMINUM	0.70
23			5 EA	PIPE, SMLS, 1.315 OD X .133 WALL, GALV, 18" L (1 NPS)	ASTM A 53	STEEL	1.68
22			2 EA	WASHER, LOCK, HLCL SPR, RGLR, 1/4 NOM, ZINC PL	ASME B18.21.1	CRES	-
21			2 EA	SCREW, CAP, HEX HD, 1/4-20 UNC-2A, 1/2" L	ASME B18.6.3	CRES	-
20	73274	96UA6S-115	2 EA	BELL, 6 INCH DIA, WATERTIGHT, 115 VAC	COML (HOSE-McCANN)		1.00
19	7X933	867STR(A)-AQ	2 EA	HORN/STROBE, ELECTRONIC, SURFACE MOUNT, 24 V	COML (EGS)		2.00
18			10 EA	WASHER, LOCK, HLCL SPR, RGLR, 1/4 NOM, ZINC PL	ASME B18.21.1	STEEL	-
17		B1821BH025C075N	10 EA	SCREW, CAP, HEX HD, 1/4-20 UNC-2A X 3/4" L, GRADE B, ZINC CTD	ASME B18.2.1	STEEL	-
16	76857	9565	12 EA	PAD, WELDING, FOR MOUNTING BOXES	COML (OCEANIC)	STEEL	-

PARTS LIST (CONTINUED FROM SHEET 1)

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 \pm \pm \pm	CONTRACTOR 2R341	
DRAWN BY AM	DATE 01/20/98	U.S. ARMY LT-128 FM-200 SYSTEM ELECTRICAL MODIFICATIONS
CHECKER JAS/QC	ENGINEER TR	
DESIGN APPROVAL	RPE (FP) APPROVAL	SIZE D
DRAWING APPROVAL		CAGE CODE 19207
		LT-800-5553-3
		SCALE

LABEL PLATE LIST					
ITEM NO.	INSCRIPTION	LABEL STYLE	QTY REQD	LOCATION	REMARKS
1	PAINT LOCKER CYLINDER CONTROL PULL BOX	B-3	1 EA	BOSN STORE FR 60, PORT	MT NEAR PULL BOX
2	PS-2	A-1	1 EA	BOSN STORE FR 60, PORT	MT ON PS
3	FOR LABEL PLATE DEPICTION SEE VIEW 14-C	-	1 EA	BOSN STORE FR 60, PORT	MT NEAR BELL
4	PAINT LOCKER FM-200 SYSTEM HF GAS SAMPLING PORT	B-3	1 EA	BOSN STORE FR 58, PORT	MT ABOVE SAMPLING PORT
5	ENGINE ROOM CYLINDER CONTROL PULL BOX	B-3	2 EA	VESTIBULE (1) EXT MN DK (1)	MT NEAR PULL BOX
6	PS-1	A-1	1 EA	AMS II FR 21, STBD	MT ON PS
7	FOR LABEL PLATE DEPICTION SEE VIEW 14-B	-	1 EA	MN DK FR 21, PORT	MT NEAR BELL
8	ENGINE ROOM FM-200 SYSTEM HF GAS SAMPLING PORT	B-3	1 EA	VESTIBULE FR 25, PORT	MT NEAR SAMPLING PORT
9	CONTROL CYLINDER	B-1	2 EA	AMS II (1) BOSN STORE (1)	MT NEAR CYLINDER
10	FOR LABEL PLATE DEPICTION SEE VIEW 14-A	-	3 EA	ENG RM DOOR (1) AMS I (1) PAINT LKR (1)	MT NEAR HORN
11	FOR LABEL PLATE DEPICTION SEE VIEW 19-B	-	3 EA	ENG RM DOOR (1) PAINT LKR DOOR (1) AMS I SLD, FWD (1)	MT ON DOOR
12	FOR LABEL PLATE DEPICTION SEE VIEW 22-C	-	1 EA	BOSN STORE FR 60, PORT	MT NEAR CONTROL CYLINDER
13	FOR LABEL PLATE DEPICTION SEE VIEW 22-A	-	1 EA	AMS II FR 21, STBD	MT NEAR CONTROL CYLINDER
14	FOR LABEL PLATE DEPICTION SEE VIEW 30-C	-	1 EA	BOSN STORE FR 60, PORT	MT NEAR PULL BOX
15	FOR LABEL PLATE DEPICTION SEE VIEW 30-A	-	2 EA	VESTIBULE (1) EXT MN DK (1)	MT NEAR PULL BOX
16	FM2-JB1	A-1	1 EA	MESS/RCN SPACE FR 26, PORT	MT ON JB
17	FM2-JB2	A-1	1 EA	ENG RM FR 21, PORT	MT ON JB
18	FM-200 DISCH WARNING LIGHT	B-2	5 EA	ENG RM (3) AMS I (1) AMS II (1)	MT NEAR LIGHT
19	ENG RM FM-200 RELAY PANEL BOX	A-3	1 EA	ENG RM FR 21, STBD	MT ON PANEL BOX

LABEL PLATE LIST (CONTINUED)					
ITEM NO.	INSCRIPTION	LABEL STYLE	QTY REQD	LOCATION	REMARKS
20	WARNING CONTAINS TWO POWER SOURCES	A-3	2 EA	BOSN STORE (1) AMS II (1)	MT NEAR PS
21	FOR LABEL PLATE DEPICTION SEE VIEW 19-C	-	1 EA	ENG RM FR 38, PORT	MT ON PANEL
22	FOR LABEL PLATE DEPICTION SEE VIEW 27-C	-	1 EA	BOSN STORE FR 59, PORT	MT ON DOOR
23	FOR LABEL PLATE DEPICTION SEE VIEW 27-A	-	2 EA	VESTIBULE (1) EXT MN DK (1)	MT NEAR PULL BOX
24	ENGINE ROOM SUPPLY DAMPER PORT	B-3	1 EA	MAIN DECK FR 27, PORT	MT NEAR INTAKE GRILL
25	ENGINE ROOM SUPPLY DAMPER STBD	B-3	1 EA	MAIN DECK FR 27, STBD	MT NEAR INTAKE GRILL
26	AMS I SUPPLY COVER	B-2	1 EA	01 LEVEL FR 45, PORT	MT ON INSIDE OF COVER
27	AMS I EXHAUST COVER	B-2	1 EA	01 LEVEL FR 51, STBD	MT ON INSIDE OF COVER
28	ENGINE ROOM EXH DAMPER PORT	B-3	1 EA	02 LEVEL FR 27, PORT	MT BELOW EXH GRILL
29	ENGINE ROOM EXH DAMPER STBD	B-3	1 EA	02 LEVEL FR 27, STBD	MT BELOW EXH GRILL
30	PAINT LOCKER PWR SUPPLY DAMPER	B-2	1 EA	BOSN STORE FR 59, PORT	MT NEAR VENT CLOSURE
31	PAINT LOCKER PWR EXH DAMPER	B-2	1 EA	BOSN STORE FR 60, PORT	MT NEAR VENT CLOSURE
32	PAINT LOCKER NAT SUPPLY DAMPER	B-2	1 EA	BOSN STORE FR 61, PORT	MT NEAR VENT CLOSURE
33	FOR LABEL PLATE DEPICTION SEE VIEW 38-C	-	1 EA	AMS II FR 21, STBD	MT NEAR FM-200 CYLINDERS
34	FM-200/CO2 VENT DO NOT PAINT OPENING	B-2	1 EA	MN DK FR 21, STBD	MT NEAR CO2 PIPING
35	PS-1A	A-1	1 EA	AMS II FR 21, STBD	MT ON PS

SHEETS				STATUS OF REVISION				
5	4	3	2	REV	ZONE	DESCRIPTION	DATE	APPROVED
x	x			A	30-A 34-A	MODIFIED ENGINE ROOM INSTRUCTION PLATE & OPERATION PLACARD ORDER OF PROCEDURES SWITCHING STEPS 2 AND 3.	10/01/99	BRM

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 LT-800-5553-1) ONBOARD U.S. ARMY LARGE TUG, 128 FOOT (LT-128).
- 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 MOUNTING), 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 MOUNTING), FIND NO. 1, SHALL BE INSTALLED USING TAPE, FIND NO. 4. TAPE SHALL BE APPLIED TO ENTIRE BACKING OF LABEL PLATE.
- THE PAINT LOCKER AND ENGINE 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 — .250 INCH
 PLACARD TITLE —
 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 WILL REQUIRE DRILLING AT THE TIME OF INSTALLATION, TO ACCOMMODATE INDICATOR LAMP.

FOR PARTS LIST, SEE SHEET 2

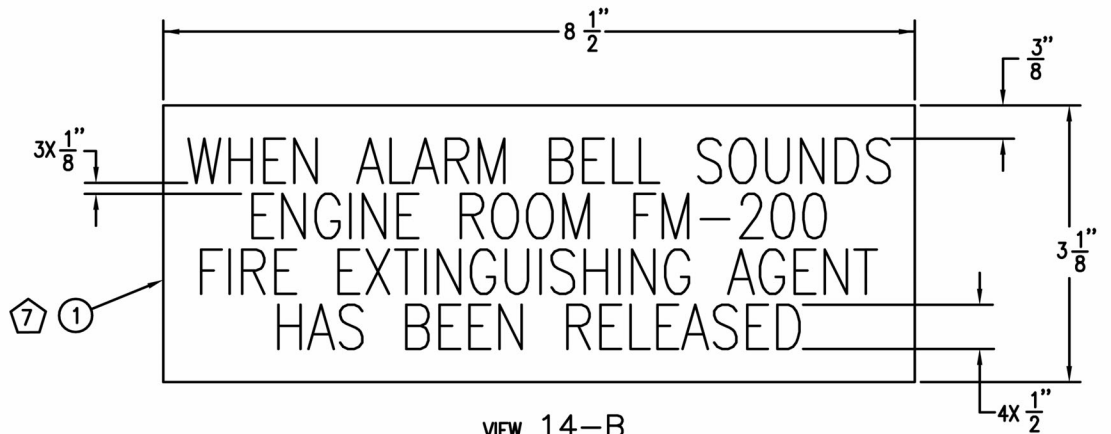
DISTRIBUTION STATEMENT A.
 APPROVED FOR PUBLIC RELEASE;
 DISTRIBUTION IS UNLIMITED.

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 ± .005 ± .005 ± .005		CONTRACTOR 2R341		U.S. ARMY LT-128 FM-200 SYSTEM LABEL PLATES AND PLACARDS	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL		SIZE D	CAGE CODE 19207
CHECKER JS/RF	ENGINEER AK			LT-800-5553-4	
DESIGN APPROVAL				SCALE 1/1	SHEET 1 OF 5
DRAWING APPROVAL					

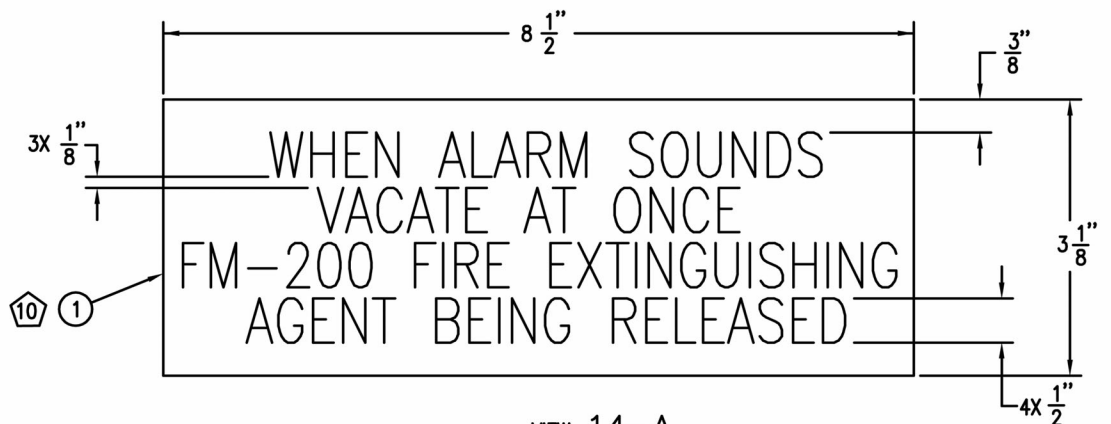
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



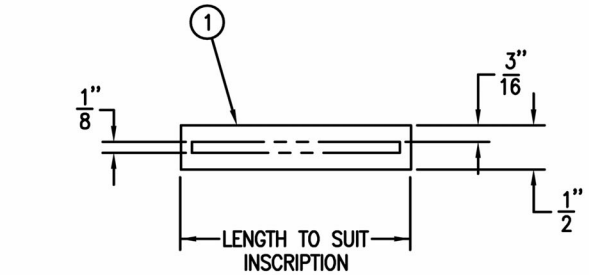
VIEW 14-C
PAINT LOCKER FM-200 SYSTEM ALARM BELL
LABEL PLATE



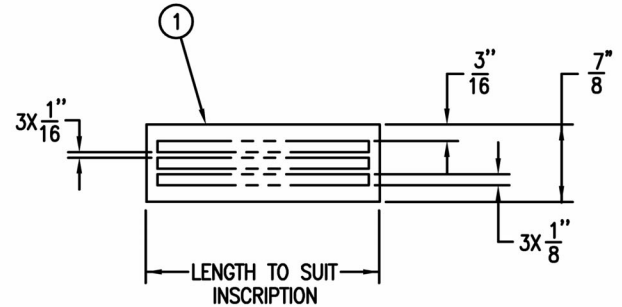
VIEW 14-B
ENGINE ROOM FM-200 SYSTEM ALARM BELL
LABEL PLATE



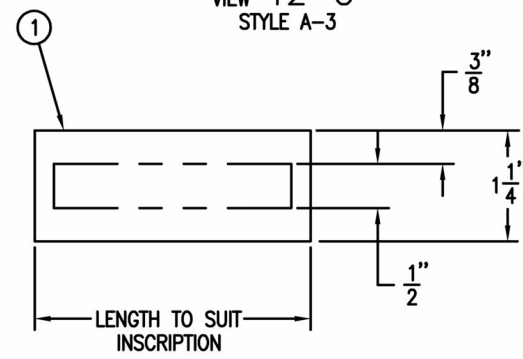
VIEW 14-A
FM-200 SYSTEM HORN
LABEL PLATE



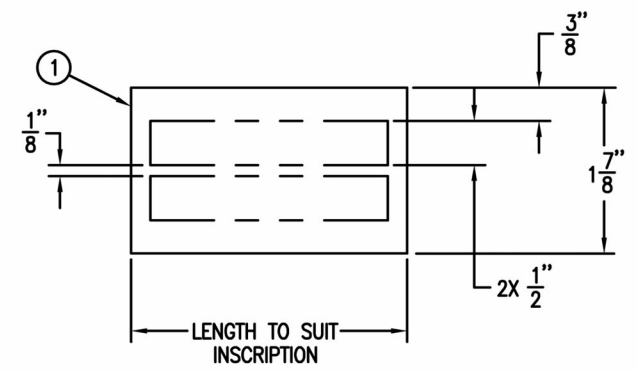
VIEW 12-D
STYLE A-1



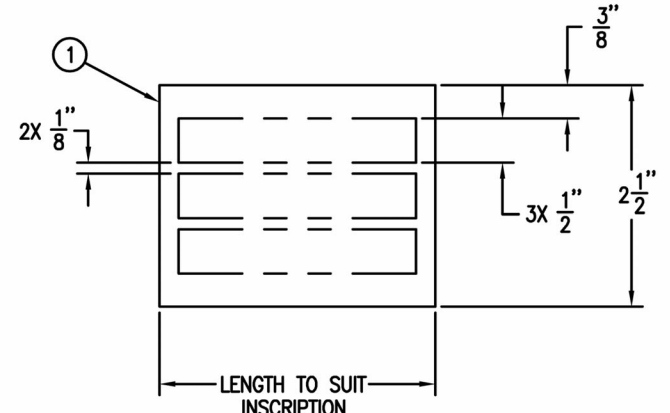
VIEW 12-C
STYLE A-3



VIEW 12-B
STYLE B-1



VIEW 10-C
STYLE B-2



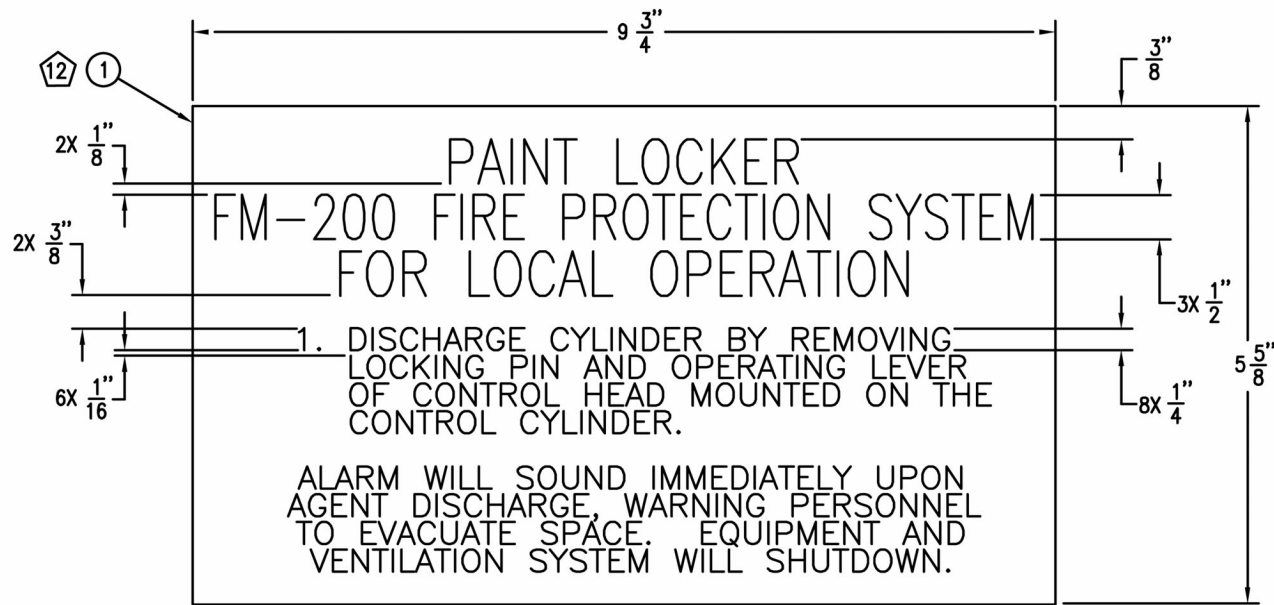
VIEW 10-B
STYLE B-3

FIND NO.	CAGE CODE	PART OR IDENTIFYING NUMBER	TOTAL QUANTITY REQUIRED	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)
4	06KR7	PRO-2032	2 EA	TAPE, POLYETHYLENE, BLACK CLOSED CELL, DOUBLE COATED	COML (PRO TAPE)		—
3	06KR7	PRO-3032	2 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, 1/16" THK, UV PROTECTED		PHEN	—
1			48 EA	LABEL PLATE, LAMINATED PHENOLIC PLASTIC, WHITE CORE WITH RED SURFACE, 1/16" THK, UV PROTECTED		PHEN	—

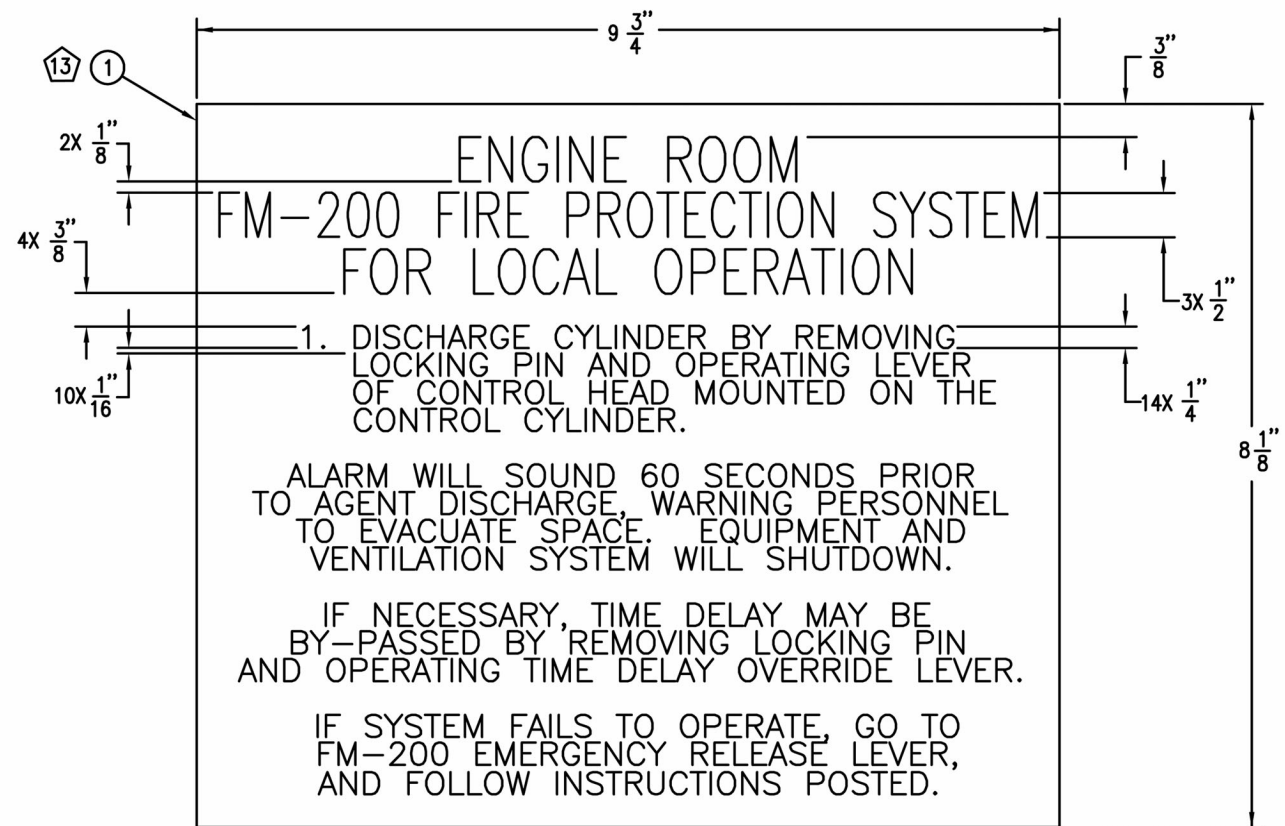
PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRS57-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± .005 ± .002 ± .002		CONTRACTOR 2R341		U.S. ARMY LT-128 FM-200 SYSTEM LABEL PLATES AND PLACARDS	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL		SIZE D	CAGE CODE 19207
CHECKER JS/RF	ENGINEER AK				LT-800-5553-4
DESIGN APPROVAL				SCALE	SHEET 2 OF 5
DRAWING APPROVAL					

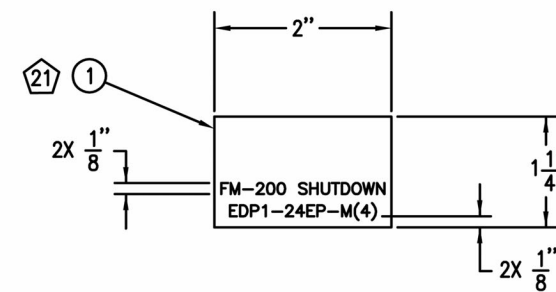
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



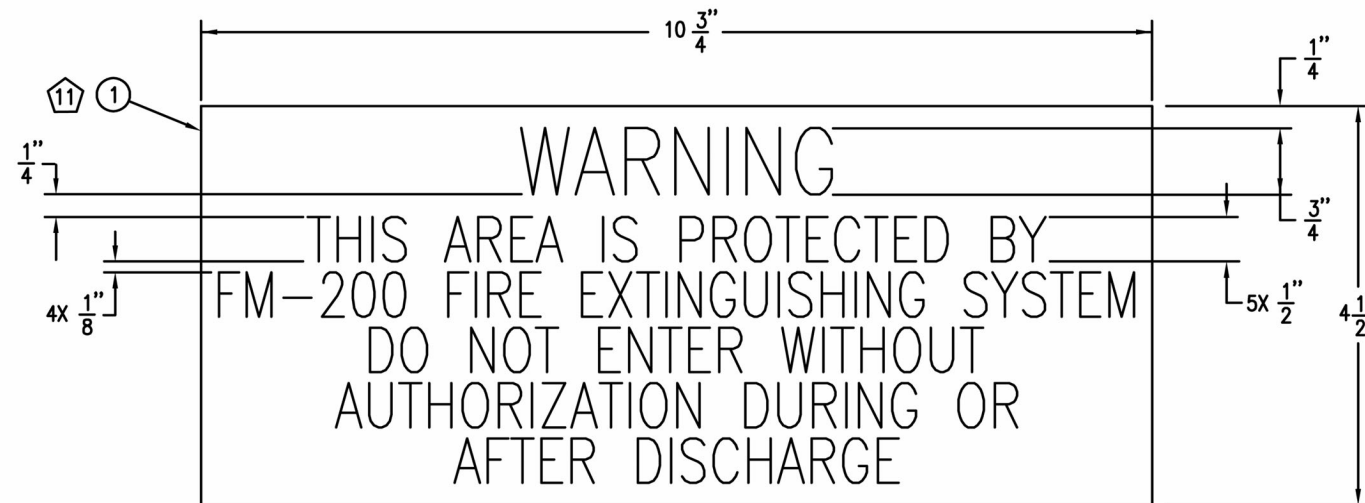
VIEW 22-C
PAINT LOCKER FM-200 SYSTEM
LOCAL OPERATION INSTRUCTION PLATE



VIEW 22-A
ENGINE ROOM FM-200 SYSTEM
LOCAL OPERATION INSTRUCTION PLATE



VIEW 19-C
FM-200 SHUTDOWN LABEL PLATE
MCHRY DC CONTROL DISTR PANEL
SEE NOTE 7



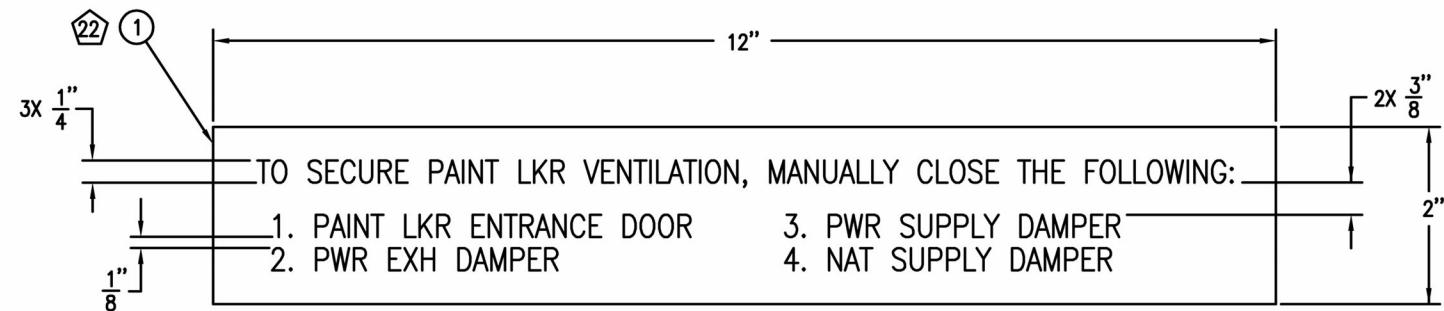
VIEW 19-B
FM-200 SYSTEM
WARNING LABEL PLATE

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 ± .005 3 PLACES ± .002 ANGLES ± .005		CONTRACTOR 2R341	U.S. ARMY LT-128 FM-200 SYSTEM LABEL PLATES AND PLACARDS	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL	SIZE D	CAGE CODE 19207
CHECKER JS/RF	ENGINEER AK			LT-800-5553-4
DESIGN APPROVAL			SCALE	SHEET 3 OF 5
DRAWING APPROVAL				

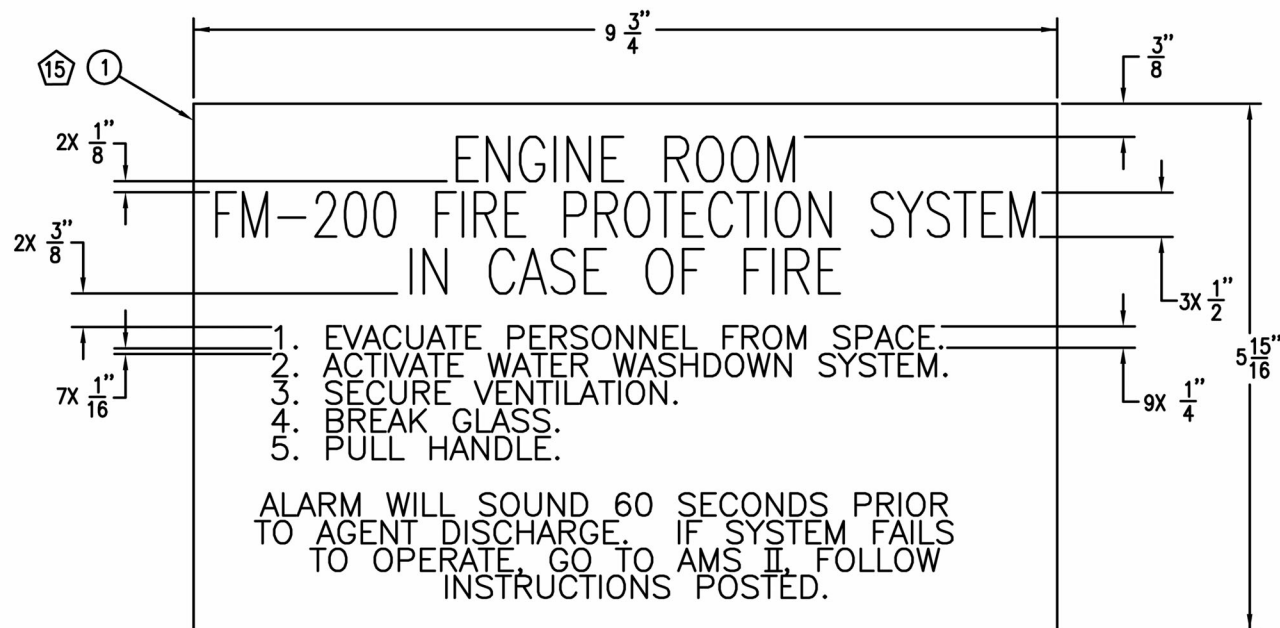
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



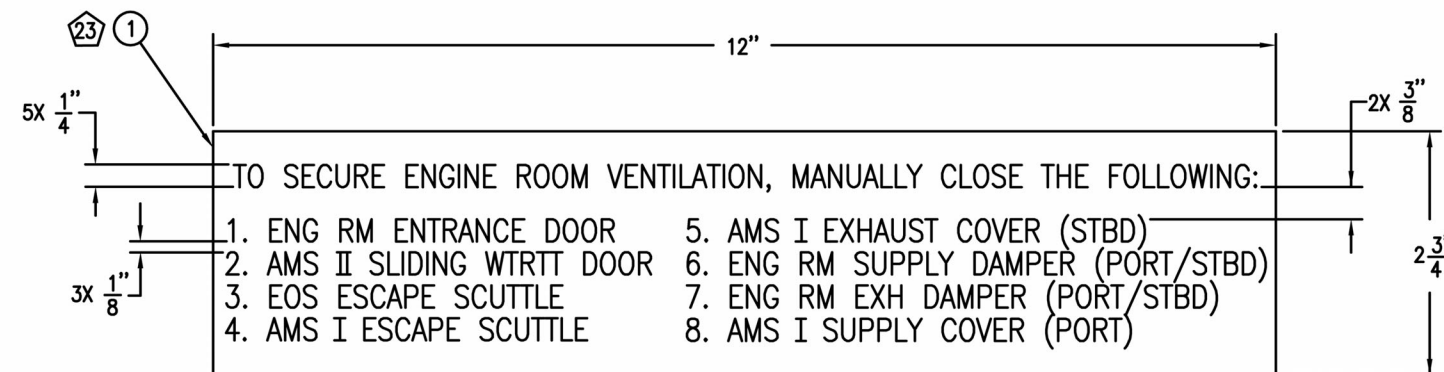
VIEW 30-C
PAINT LOCKER FM-200 SYSTEM
REMOTE OPERATION INSTRUCTION PLATE



VIEW 27-C
PAINT LOCKER FM-200 SYSTEM
VENTILATION CLOSURE INSTRUCTION PLATE



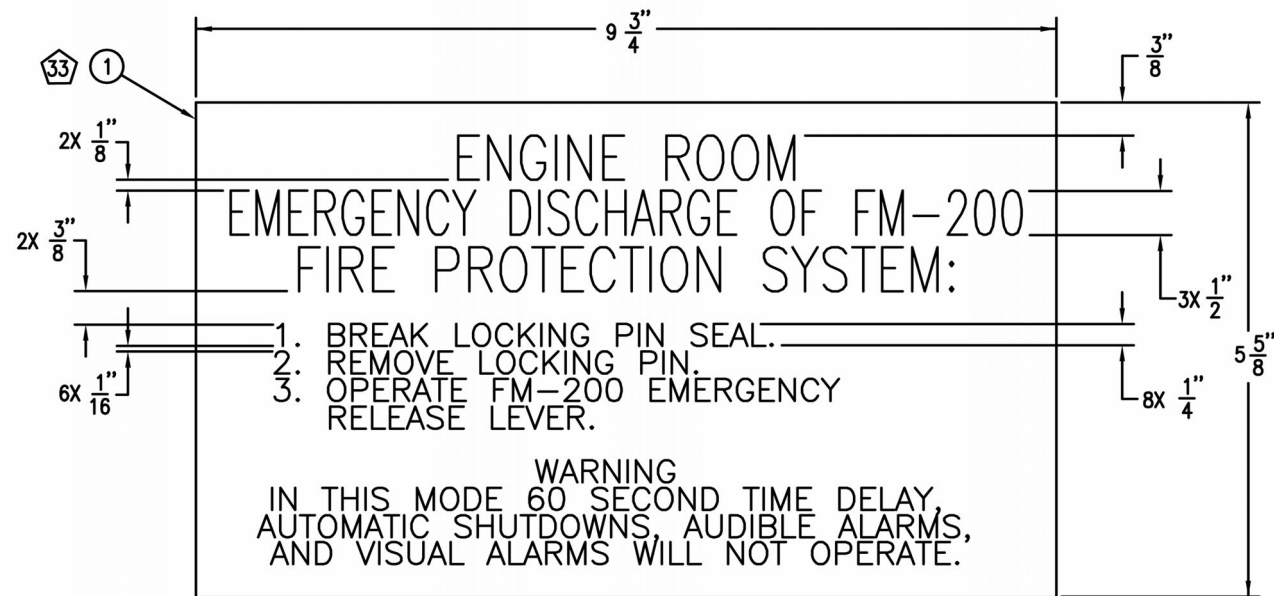
VIEW 30-A
ENGINE ROOM FM-200 SYSTEM
REMOTE OPERATION INSTRUCTION PLATE



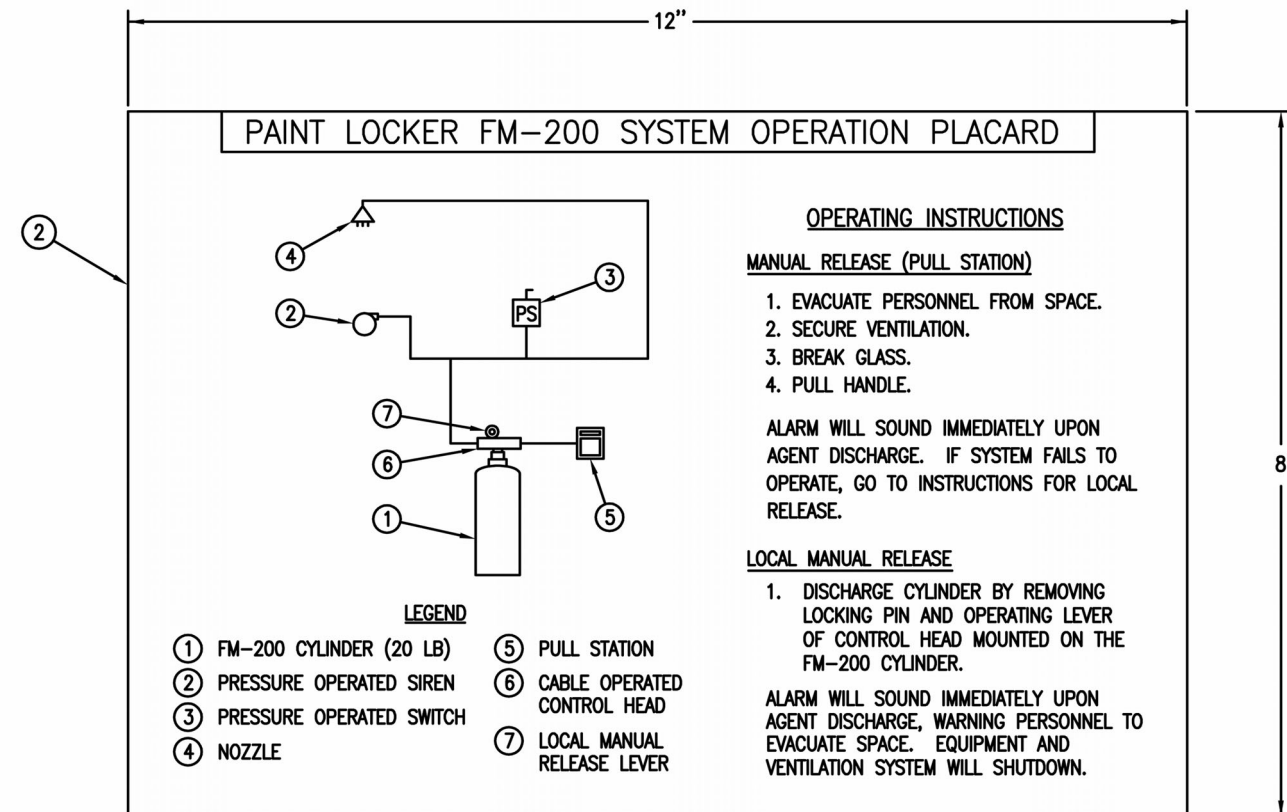
VIEW 27-A
ENGINE ROOM FM-200 SYSTEM
VENTILATION CLOSURE INSTRUCTION PLATE

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 LT-128 FM-200 SYSTEM LABEL PLATES AND PLACARDS	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL		SIZE D	CAGE CODE 19207
CHECKER JS/RF	ENGINEER AK			LT-800-5553-4	
DESIGN APPROVAL				SCALE	
DRAWING APPROVAL				SHEET 4 OF 5	

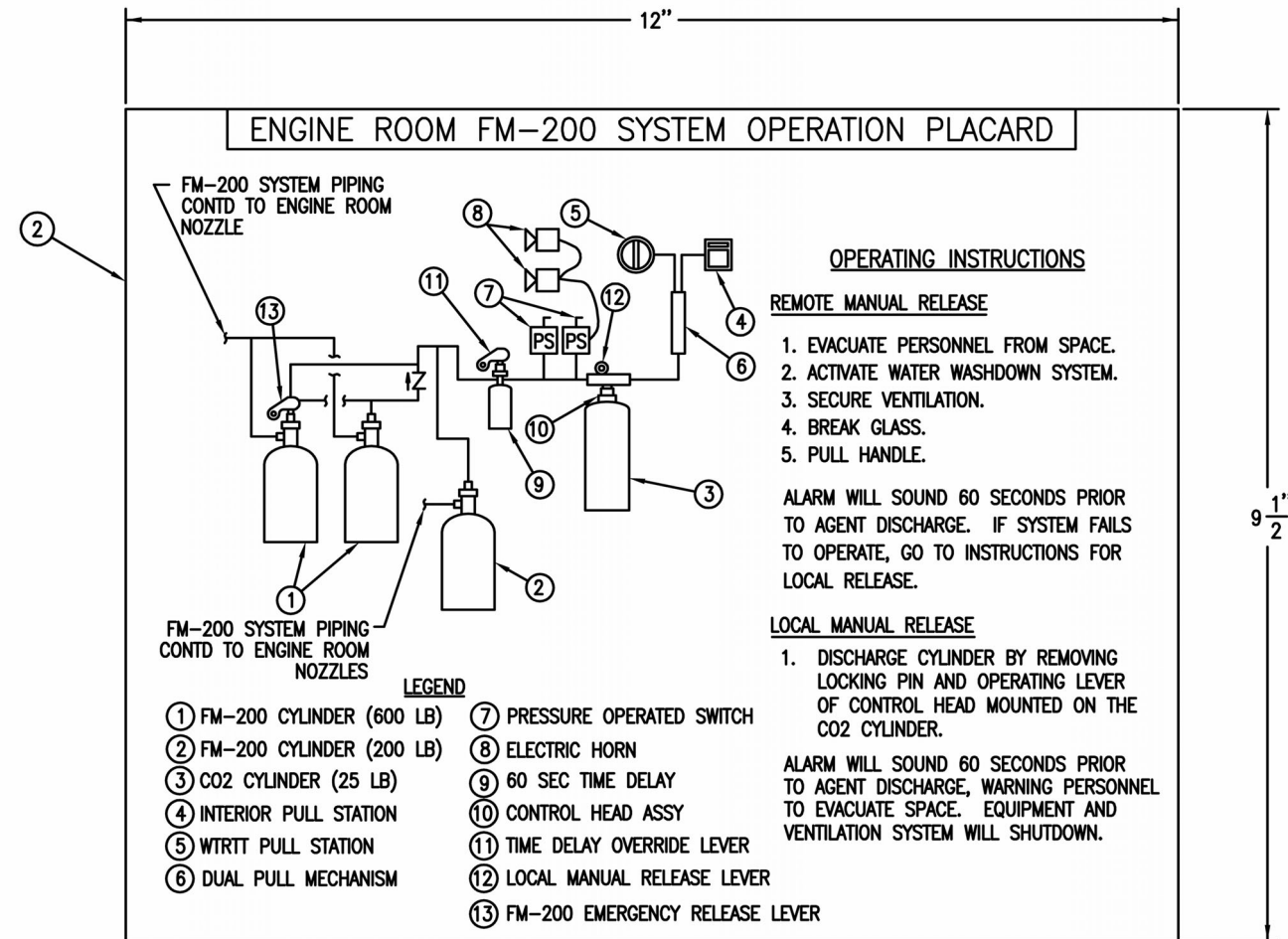
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



VIEW 38-C
ENGINE ROOM FM-200 SYSTEM
EMERGENCY DISCHARGE OPERATION INSTRUCTION PLATE



VIEW 38-A
PAINT LOCKER FM-200
SYSTEM OPERATION PLACARD



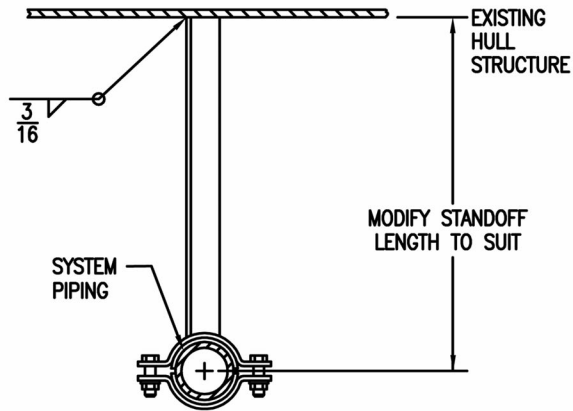
VIEW 34-A
ENGINE ROOM FM-200
SYSTEM OPERATION PLACARD

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 ± .005 3 PLACES ± .010 ANGLES ± .010		CONTRACTOR 2R341		U.S. ARMY LT-128 FM-200 SYSTEM LABEL PLATES AND PLACARDS	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL		SIZE D	CAGE CODE 19207
CHECKER JS/RF	ENGINEER AK			LT-800-5553-4	
DESIGN APPROVAL				SCALE	
DRAWING APPROVAL				SHEET 5 OF 5	

NOTES:

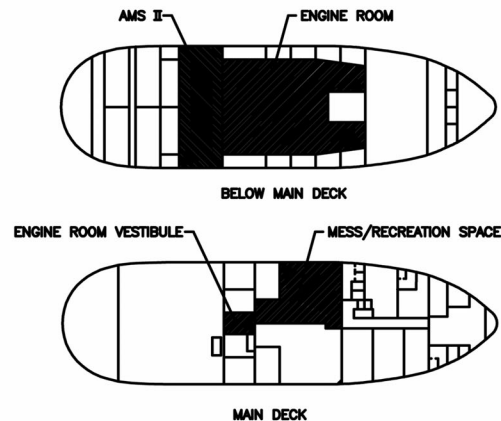
- THIS DRAWING HAS BEEN DEVELOPED AS AN INSTALLATION DRAWING FOR MISCELLANEOUS MODIFICATIONS ASSOCIATED WITH THE ENGINE ROOM FM-200 FIRE SUPPRESSION SYSTEM ON THE U.S. ARMY LARGE TUG, 128 FOOT (LT-128).
- ALL WORK SHALL BE PERFORMED UTILIZING GOOD COMMERCIAL PRACTICES AND SHALL SATISFY THE STANDARDS, 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.
- UPON INSTALLATION, HYDRAULIC PIPING SHALL BE CLEANED, BLOWN OUT, AND SUBJECTED TO A FUNCTIONAL TEST. FOLLOWING TESTING, A VISUAL EXAMINATION FOR LEAKAGE SHALL BE PERFORMED AT ALL JOINTS, CONNECTIONS, AND REGIONS OF HIGH STRESS.
- 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.
- EXISTING INSULATION DISTURBED OR DAMAGED BY THIS INSTALLATION SHALL BE REPLACED OR REPAIRED TO A LIKE NEW CONDITION.
- PIPE HANGERS:
ALL TUBING 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-B):
- STANDOFF: ANGLE, 42° L
- LINER: SYNTHETIC RUBBER
- 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.
- ALL WELDED FITTINGS SHALL BE GROUND FLUSH, PRIMED AND PAINTED IN ACCORDANCE WITH TB 43-0144, "PAINTING OF WATERCRAFT".
- DRILL A 3/16" DEEP HOLE ON MESS/RCN SPACE BHD 26 FOR MOUNTING CONDUIT HOLDING CLIP, FIND NO 29 (USE NO. 29 DRILL). MOUNT TO BHD 26 USING SCREW, FIND NO. 30 AND WASHER, FIND NO. 31.
- TEMPLATE NUMBER, SIZE, AND SPACING OF BOLT HOLES FROM RELOCATED LIFE PRESERVER STOWAGE BOX ON ENGINE ROOM VESTIBULE LONG BHD, 38" OFF CL. APPROPRIATE HARDWARE SHALL BE SUPPLIED FOR INSTALLATION.
- DRILL AND TAP BHD 26 FOR SCREW, FIND NO. 3, USING BACKING PLATE, FIND NO. 2, AS A TEMPLATE.
- REMOVE INDICATOR CABLE IN ITS ENTIRETY. INSTALL NEW INDICATOR CABLE, FIND NO. 7, IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS. SEE INSTALLATION SPECIFICATIONS. GREASE, FIND NO. 35, REQUIRED FOR INSTALLATION.
- LENGTH OF TUBING, FIND NO. 8 AND 9, AND CONDUIT, FIND NO. 10, SHALL BE DETERMINED AT THE TIME OF INSTALLATION.
- CONDUIT, FIND NO. 10, SHALL BE SUPPORTED FROM OVERHEAD WITH CABLE TIES, FIND NO. 34.
- LABEL PLATE, FIND NO. 14 AND 15 SHALL BE INSTALLED USING TAPE, FIND NO. 37.

- TEMPLATE NUMBER, SIZE, AND SPACING OF BOLT HOLES FROM RELOCATED TELEFLEX INDICATOR ASSEMBLY ON SHEET, FIND NO. 38.
- HYDRAULIC SYSTEM SHALL BE REFILLED WITH LUBRICATING OIL, FIND NO. 36.
- TEMPLATE NUMBER, SIZE, AND SPACING OF BOLT HOLES ON BHD 26 USING HAND PUMP BRACKET, (SEE VIEW 18-B).
- WELDING STUD, FIND NO. 24, SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.



VIEW 5-B
TYPICAL PIPE HANGER ASSEMBLY
NOT TO SCALE

PIPE SIZE	HANGER ASSEMBLY FIND NO.
1/4 NPS (0.50 OD TUBING)	32
1/2 NPS (0.75 OD TUBING)	33



DISTRIBUTION STATEMENT A
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DISTRIBUTION IS UNLIMITED.

NO.	DRAWING TITLE	DRAWING NUMBER
2	FM-200 SYSTEM LABEL PLATES AND PLACARDS	LT-800-5553-4
1	WWS PIPING INSTALLATION AND DETAILS	LT-800-5231-1

LIST OF REFERENCES

SH		STATUS OF REVISION				
3	2	ZONE	REV	DESCRIPTION	DATE	APPROVED

FIND NO.	CAGE CODE	PART OR IDENTIFYING NUMBER	TOTAL QUANTITY REQUIRED	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)
38			1 EA	SHEET, 13 GA (.0897) STK	ASTM A 569	STEEL	0.40
37	06KR7	PRO-3032	1 EA	TAPE, POLYETHYLENE, WHITE CLOSED CELL, DOUBLE COATED	COML (PRO TAPES)		-
36			2 GA	OIL LUBRICATING, INTERVAL COMBUSTION ENERGY, OE/HDO-10 SYMBOL, 10W SAE VISCOSITY GRADE	MIL-PRF-2104G		7.62
35			1 EA	GREASE, KEYSTONE NO. 44	COML		5.00
34	06383		1 EA	TIE, CABLE, 11.4" LONG, 3.0" MAX DIA (100 EA PER PKG)	COML (PANDUIT)	NYLON	-
33			4 EA	HANGER, ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 1/2 NPS	ASTM F 708	SEE NOTE 7	0.50
32			4 EA	HANGER, ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 1/4 NPS	ASTM F 708	SEE NOTE 7	0.25
31			2 EA	WASHER, PLAIN, TYPE B, RGLR, NO. 8, ZINC PL	ASME B.18.22.1	STEEL	-
30			2 EA	SCREW, TAPPING, PAN HD, TYPE I, CROSS REC, 8-32 UNC-2A X 1/4" L, ZINC CTD	ASME B18.6.4	STEEL	-
29	63705	A-5671	2 EA	CLIP, HOLDING, CONDUIT	COML (WALZ & KRENZER)		0.13
28	28968	8U-SS	1 EA	UNION ELBOW, SIZE 8 (1/2" TUBE)	COML (HOKE)	CRES	1.00
27	28968	12LU-SS	1 EA	UNION ELBOW, SIZE 12 (3/4" TUBE)	COML (HOKE)	CRES	1.00
26			1 EA	PLATE, 1/4" STK, 11" X 11"	ASTM A 36	STEEL	15.98
25		B1821BH031C200N	6 EA	SCREW, CAP, HEX HD, 3/8-16 UNC-2A, 2" L, GRADE 8, ZINC CTD	ASME B18.2.1	STEEL	0.05
24	85105	101-010-023	4 EA	STUD, WELDING, TYPE CFL, 1/4-20 UNC-2A X 1 1/4" L (FERRULE P/N 101-010-023)	COML (NELSON)	STEEL	-
23	28968	12FR-SS	3 EA	FERRULE, REAR, SIZE 12	COML (HOKE)	CRES	-
22	28968	12FF-SS	3 EA	FERRULE, FRONT, SIZE 12	COML (HOKE)	CRES	-
21	28968	8FR-SS	4 EA	FERRULE, REAR, SIZE 8	COML (HOKE)	CRES	-
20	28968	8FF-SS	4 EA	FERRULE, FRONT, SIZE 8	COML (HOKE)	CRES	-
19			16 EA	NUT, HEX, 3/8-16 UNC-2B, GRADE 8, ZINC PL	ASME B18.2.2	STEEL	0.10
18			16 EA	WASHER, PLAIN, TYPE B, RGLR, 3/8 NOM, ZINC PL	ASME B18.22.1	STEEL	-
17			16 EA	WASHER, LOCK, HLCL SPR, RGLR, 3/8 NOM, ZINC PL	ASME B18.21.1	STEEL	-
16		B1821BH038C150N	6 EA	SCREW, CAP, HEX HD, 3/8-16 UNC-2A X 1 1/2" L, GRADE 8, ZINC CTD	ASME B18.2.1	STEEL	0.06
15			1 EA	LABEL PLATE, LAMINATED PHENOLIC PLASTIC, RED CORE WITH WHITE SURFACE		PHEN	-
14			1 EA	LABEL PLATE, LAMINATED PHENOLIC PLASTIC, RED CORE WITH WHITE SURFACE		PHEN	-
13	63705	A-5693	3 EA	CONNECTOR, CONDUIT	COML (WALZ & KRENZER)		2.00
12	28968	8U-SS	1 EA	UNION, TUBE, SIZE 8 (1/2" TUBE)	COML (HOKE)	CRES	2.00
11	28968	12U-SS	1 EA	UNION, TUBE, SIZE 12 (3/4" TUBE)	COML (HOKE)	CRES	2.00
10	63705	A-5264	30 FT	CONDUIT, CABLE	COML (WALZ & KRENZER)	CRES	0.57
9			30 FT	TUBING, SMLS, 0.50 OD X .083 WALL	ASTM A 269	CRES	0.40
8			30 FT	TUBING, SMLS, 0.75 OD X .095 WALL	ASTM A 269	CRES	0.66
7	63705	A-5222	30 FT	CABLE, INDICATOR	COML (WALZ & KRENZER)	STEEL	0.05
6	63705	A-WK-384-1-APC.1	1 EA	PACKING GLAND	COML (WALZ & KRENZER)		0.50
5	39428	90692A258	2 EA	PIN, SPRING, 3/16" DIA X 1 3/4" L	COML (McMASTER CARR)	STEEL	-
4	63705	D-WK-492-A6 PIECE NO. 2	1 EA	HAND CRANK, HINGED HANDLE	COML (WALZ & KRENZER)	ALUMINUM	3.00
3			4 EA	SCREW, MACHINE, FLAT CTSK HD, TYPE II, CROSS REC, 1/4-20 UNC-2A X 3/4" L	ASME B18.6.3	STEEL	-
2			1 EA	PLATE, 1/4" STK	ASTM A 36	STEEL	0.68
1	39428	9891K31	1 EA	SEAL, U-CUP, 1.0" ID X 1.250" OD X 1/4" WD	COML (McMASTER CARR)	BUNA-N	-

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRSS7-97-C-00049	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± .005 ± .005 ± .005		CONTRACTOR 2R341	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL	
CHECKER JS	ENGINEER TR/AK		
DESIGN APPROVAL			
DRAWING APPROVAL			

U.S. ARMY TANK AUTOMOTIVE COMMAND
WARREN, MICHIGAN 48397-5000

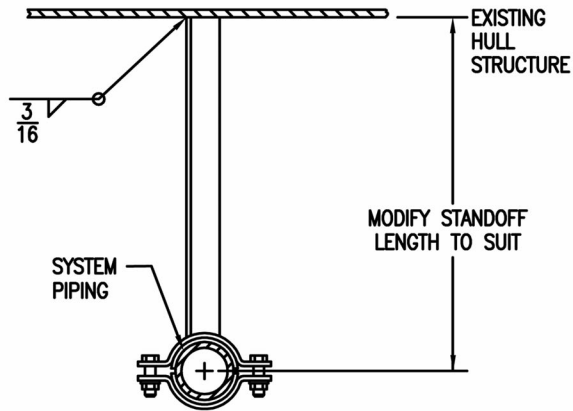
U.S. ARMY LT-128
FM-200 SYSTEM
MISCELLANEOUS MODS

SIZE D	CAGE CODE 19207	LT-800-5553-2
SCALE 1"=1'-0"		SHEET 1 OF 3

NOTES:

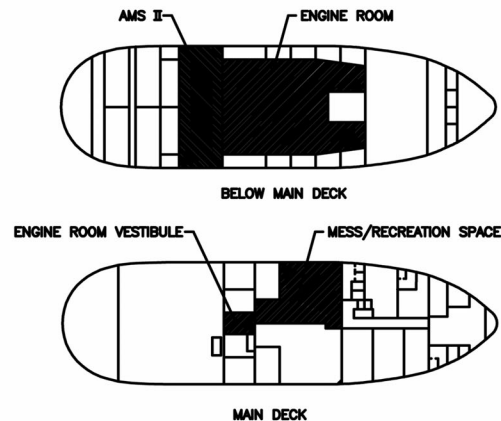
- THIS DRAWING HAS BEEN DEVELOPED AS AN INSTALLATION DRAWING FOR MISCELLANEOUS MODIFICATIONS ASSOCIATED WITH THE ENGINE ROOM FM-200 FIRE SUPPRESSION SYSTEM ON THE U.S. ARMY LARGE TUG, 128 FOOT (LT-128).
- ALL WORK SHALL BE PERFORMED UTILIZING GOOD COMMERCIAL PRACTICES AND SHALL SATISFY THE STANDARDS, 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.
- UPON INSTALLATION, HYDRAULIC PIPING SHALL BE CLEANED, BLOWN OUT, AND SUBJECTED TO A FUNCTIONAL TEST. FOLLOWING TESTING, A VISUAL EXAMINATION FOR LEAKAGE SHALL BE PERFORMED AT ALL JOINTS, CONNECTIONS, AND REGIONS OF HIGH STRESS.
- 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.
- EXISTING INSULATION DISTURBED OR DAMAGED BY THIS INSTALLATION SHALL BE REPLACED OR REPAIRED TO A LIKE NEW CONDITION.
- PIPE HANGERS:
ALL TUBING 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-B):
- STANDOFF: ANGLE, 42° L
- LINER: SYNTHETIC RUBBER
- 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.
- ALL WELDED FITTINGS SHALL BE GROUND FLUSH, PRIMED AND PAINTED IN ACCORDANCE WITH TB 43-0144, "PAINTING OF WATERCRAFT".
- DRILL A 3/16" DEEP HOLE ON MESS/RCN SPACE BHD 26 FOR MOUNTING CONDUIT HOLDING CLIP, FIND NO 29 (USE NO. 29 DRILL). MOUNT TO BHD 26 USING SCREW, FIND NO. 30 AND WASHER, FIND NO. 31.
- TEMPLATE NUMBER, SIZE, AND SPACING OF BOLT HOLES FROM RELOCATED LIFE PRESERVER STOWAGE BOX ON ENGINE ROOM VESTIBULE LONG BHD, 38" OFF CL. APPROPRIATE HARDWARE SHALL BE SUPPLIED FOR INSTALLATION.
- DRILL AND TAP BHD 26 FOR SCREW, FIND NO. 3, USING BACKING PLATE, FIND NO. 2, AS A TEMPLATE.
- REMOVE INDICATOR CABLE IN ITS ENTIRETY. INSTALL NEW INDICATOR CABLE, FIND NO. 7, IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS. SEE INSTALLATION SPECIFICATIONS. GREASE, FIND NO. 35, REQUIRED FOR INSTALLATION.
- LENGTH OF TUBING, FIND NO. 8 AND 9, AND CONDUIT, FIND NO. 10, SHALL BE DETERMINED AT THE TIME OF INSTALLATION.
- CONDUIT, FIND NO. 10, SHALL BE SUPPORTED FROM OVERHEAD WITH CABLE TIES, FIND NO. 34.
- LABEL PLATE, FIND NO. 14 AND 15 SHALL BE INSTALLED USING TAPE, FIND NO. 37.

- TEMPLATE NUMBER, SIZE, AND SPACING OF BOLT HOLES FROM RELOCATED TELEFLEX INDICATOR ASSEMBLY ON SHEET, FIND NO. 38.
- HYDRAULIC SYSTEM SHALL BE REFILLED WITH LUBRICATING OIL, FIND NO. 36.
- TEMPLATE NUMBER, SIZE, AND SPACING OF BOLT HOLES ON BHD 26 USING HAND PUMP BRACKET, (SEE VIEW 18-B).
- WELDING STUD, FIND NO. 24, SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.



VIEW 5-B
TYPICAL PIPE HANGER ASSEMBLY
NOT TO SCALE

PIPE SIZE	HANGER ASSEMBLY FIND NO.
1/4 NPS (0.50 OD TUBING)	32
1/2 NPS (0.75 OD TUBING)	33



DISTRIBUTION STATEMENT A
APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION IS UNLIMITED.

NO.	DRAWING TITLE	DRAWING NUMBER
2	FM-200 SYSTEM LABEL PLATES AND PLACARDS	LT-800-5553-4
1	WWS PIPING INSTALLATION AND DETAILS	LT-800-5231-1

LIST OF REFERENCES

SH		STATUS OF REVISION				
3	2	ZONE	REV	DESCRIPTION	DATE	APPROVED

FIND NO.	CAGE CODE	PART OR IDENTIFYING NUMBER	TOTAL QUANTITY REQUIRED	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)
38			1 EA	SHEET, 13 GA (.0897) STK	ASTM A 569	STEEL	0.40
37	06KR7	PRO-3032	1 EA	TAPE, POLYETHYLENE, WHITE CLOSED CELL, DOUBLE COATED	COML (PRO TAPES)		-
36			2 GA	OIL LUBRICATING, INTERVAL COMBUSTION ENERGY, OE/HDO-10 SYMBOL, 10W SAE VISCOSITY GRADE	MIL-PRF-2104G		7.62
35			1 EA	GREASE, KEYSTONE NO. 44	COML		5.00
34	06383		1 EA	TIE, CABLE, 11.4" LONG, 3.0" MAX DIA (100 EA PER PKG)	COML (PANDUIT)	NYLON	-
33			4 EA	HANGER, ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 1/2 NPS	ASTM F 708	SEE NOTE 7	0.50
32			4 EA	HANGER, ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 1/4 NPS	ASTM F 708	SEE NOTE 7	0.25
31			2 EA	WASHER, PLAIN, TYPE B, RGLR, NO. 8, ZINC PL	ASME B18.22.1	STEEL	-
30			2 EA	SCREW, TAPPING, PAN HD, TYPE I, CROSS REC, 8-32 UNC-2A X 1/4" L, ZINC CTD	ASME B18.6.4	STEEL	-
29	63705	A-5671	2 EA	CLIP, HOLDING, CONDUIT	COML (WALZ & KRENZER)		0.13
28	28968	8U-SS	1 EA	UNION ELBOW, SIZE 8 (1/2" TUBE)	COML (HOKE)	CRES	1.00
27	28968	12LU-SS	1 EA	UNION ELBOW, SIZE 12 (3/4" TUBE)	COML (HOKE)	CRES	1.00
26			1 EA	PLATE, 1/4" STK, 11" X 11"	ASTM A 36	STEEL	15.98
25		B1821BH031C200N	6 EA	SCREW, CAP, HEX HD, 3/8-16 UNC-2A, 2" L, GRADE 8, ZINC CTD	ASME B18.2.1	STEEL	0.05
24	85105	101-010-023	4 EA	STUD, WELDING, TYPE CFL, 1/4-20 UNC-2A X 1 1/4" L (FERRULE P/N 101-010-023)	COML (NELSON)	STEEL	-
23	28968	12FR-SS	3 EA	FERRULE, REAR, SIZE 12	COML (HOKE)	CRES	-
22	28968	12FF-SS	3 EA	FERRULE, FRONT, SIZE 12	COML (HOKE)	CRES	-
21	28968	8FR-SS	4 EA	FERRULE, REAR, SIZE 8	COML (HOKE)	CRES	-
20	28968	8FF-SS	4 EA	FERRULE, FRONT, SIZE 8	COML (HOKE)	CRES	-
19			16 EA	NUT, HEX, 3/8-16 UNC-2B, GRADE 8, ZINC PL	ASME B18.2.2	STEEL	0.10
18			16 EA	WASHER, PLAIN, TYPE B, RGLR, 3/8 NOM, ZINC PL	ASME B18.22.1	STEEL	-
17			16 EA	WASHER, LOCK, HLCL SPR, RGLR, 3/8 NOM, ZINC PL	ASME B18.21.1	STEEL	-
16		B1821BH038C150N	6 EA	SCREW, CAP, HEX HD, 3/8-16 UNC-2A X 1 1/2" L, GRADE 8, ZINC CTD	ASME B18.2.1	STEEL	0.06
15			1 EA	LABEL PLATE, LAMINATED PHENOLIC PLASTIC, RED CORE WITH WHITE SURFACE		PHEN	-
14			1 EA	LABEL PLATE, LAMINATED PHENOLIC PLASTIC, RED CORE WITH WHITE SURFACE		PHEN	-
13	63705	A-5693	3 EA	CONNECTOR, CONDUIT	COML (WALZ & KRENZER)		2.00
12	28968	8U-SS	1 EA	UNION, TUBE, SIZE 8 (1/2" TUBE)	COML (HOKE)	CRES	2.00
11	28968	12U-SS	1 EA	UNION, TUBE, SIZE 12 (3/4" TUBE)	COML (HOKE)	CRES	2.00
10	63705	A-5264	30 FT	CONDUIT, CABLE	COML (WALZ & KRENZER)	CRES	0.57
9			30 FT	TUBING, SMLS, 0.50 OD X .083 WALL	ASTM A 269	CRES	0.40
8			30 FT	TUBING, SMLS, 0.75 OD X .095 WALL	ASTM A 269	CRES	0.66
7	63705	A-5222	30 FT	CABLE, INDICATOR	COML (WALZ & KRENZER)	STEEL	0.05
6	63705	A-WK-384-1-APC.1	1 EA	PACKING GLAND	COML (WALZ & KRENZER)		0.50
5	39428	90692A258	2 EA	PIN, SPRING, 3/16" DIA X 1 3/4" L	COML (McMASTER CARR)	STEEL	-
4	63705	D-WK-492-A6 PIECE NO. 2	1 EA	HAND CRANK, HINGED HANDLE	COML (WALZ & KRENZER)	ALUMINUM	3.00
3			4 EA	SCREW, MACHINE, FLAT CTSK HD, TYPE II, CROSS REC, 1/4-20 UNC-2A X 3/4" L	ASME B18.6.3	STEEL	-
2			1 EA	PLATE, 1/4" STK	ASTM A 36	STEEL	0.68
1	39428	9891K31	1 EA	SEAL, U-CUP, 1.0" ID X 1.250" OD X 1/4" WD	COML (McMASTER CARR)	BUNA-N	-

PARTS LIST

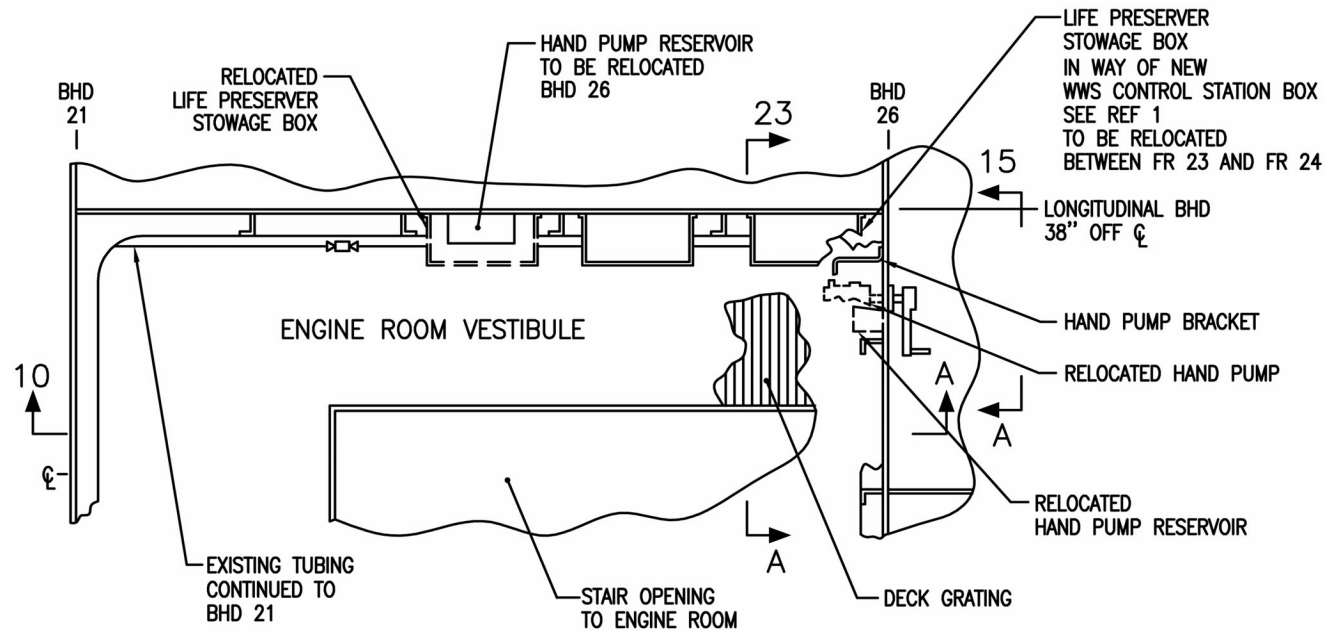
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRSS7-97-C-00049	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± .005 ± .010 ± .015		CONTRACTOR 2R341	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL	
CHECKER JS	ENGINEER TR/AK		
DESIGN APPROVAL			
DRAWING APPROVAL			

U.S. ARMY TANK AUTOMOTIVE COMMAND
WARREN, MICHIGAN 48397-5000

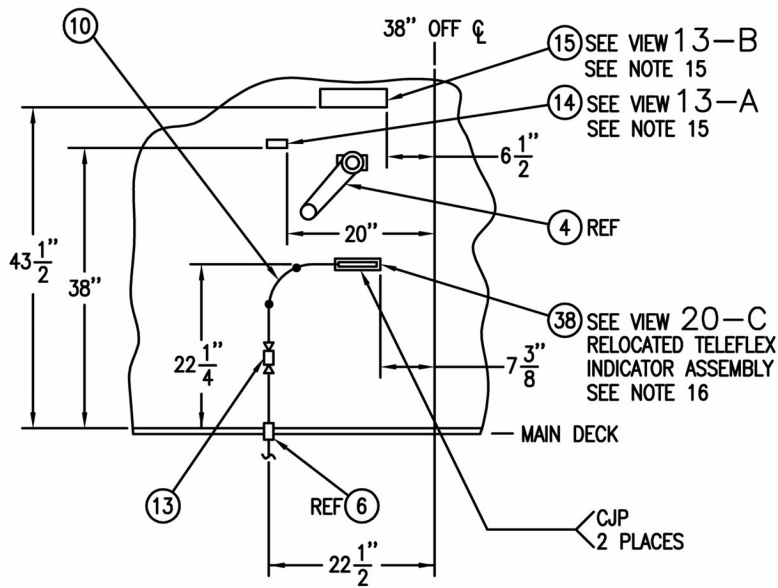
U.S. ARMY LT-128
FM-200 SYSTEM
MISCELLANEOUS MODS

SIZE D	CAGE CODE 19207	LT-800-5553-2
SCALE 1"=1'-0"		SHEET 1 OF 3

REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED

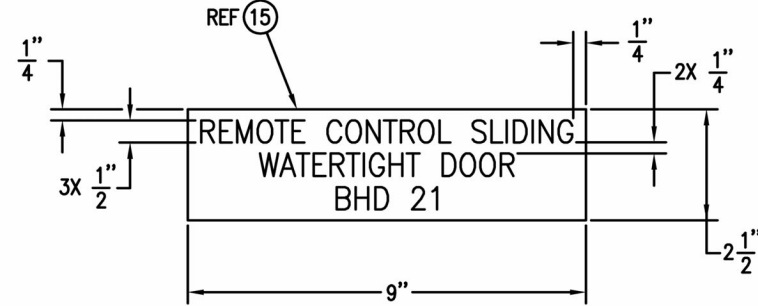


VIEW 15-C
FM-200 SYSTEM
MISCELLANEOUS MODIFICATIONS
MAIN DECK
PORT SIDE

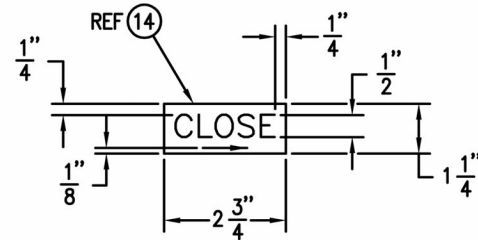


VIEW 15-A
INSTALLATION OF
RELOCATED TELEFLEX INDICATOR ASSEMBLY
BHD 26
LOOKING AFT
ROTATED 90° CW

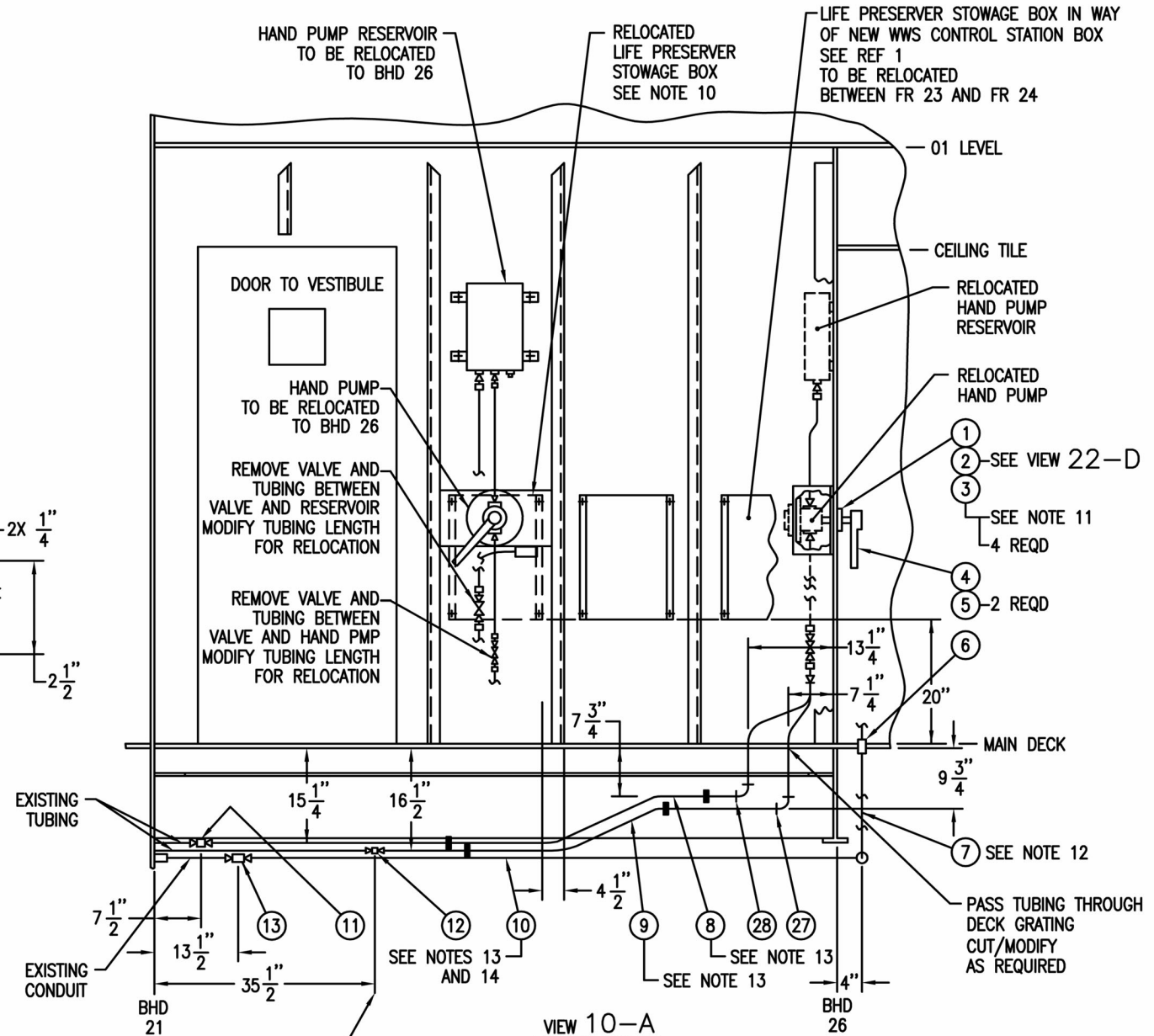
- LOCAL NOTE:
- "■" INDICATES APPROXIMATE PIPE HANGER LOCATION. SEE NOTE 7.
 - "•" INDICATES APPROXIMATE CONDUIT HOLDING CLIP. SEE NOTE 9.



VIEW 13-B
LABEL PLATE
SCALE 6"=1'-0"



VIEW 13-A
LABEL PLATE
SCALE 6"=1'-0"



VIEW 10-A
FM-200 SYSTEM
MISCELLANEOUS MODIFICATIONS
LONGITUDINAL BHD 38" OFF ϕ
LOOKING OUTBOARD

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRS57-97-C-00049
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES \pm — — — \pm — — —		CONTRACTOR 2R341
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL
CHECKER JS	ENGINEER TR/AK	
DESIGN APPROVAL		
DRAWING APPROVAL		

U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000		
U.S. ARMY LT-128 FM-200 SYSTEM MISCELLANEOUS MODS		
SIZE D	CAGE CODE 19207	LT-800-5553-2
SCALE	SHEET 2 OF 3	

NOTES:

1. THIS DRAWING HAS BEEN DEVELOPED AS A DETAILED DESIGN/INSTALLATION DRAWING FOR INSTALLATION OF A WATER WASHDOWN SYSTEM ASSOCIATED WITH THE ENGINE ROOM FM-200 FIRE SUPPRESSION SYSTEM ON THE U.S. ARMY LARGE TUG, 128 FOOT (LT-128).
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) AND THE STATEMENT OF WORK ASSOCIATED WITH THIS CONTRACT.
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. 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.
5. 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 NVIC 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.
6. 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.
7. EXISTING INSULATION DISTURBED OR DAMAGED BY THIS INSTALLATION SHALL BE REPLACED OR REPAIRED TO A LIKE NEW CONDITION.
8. REQUIRED PIPE LENGTHS ARE DISCLOSED AS "XX/XX/XX", REPRESENTING FITTING TO FITTING CENTER LINE DISTANCE IN FT/IN/FOURTHS.
9. "Z" DIMENSION REPRESENTS DISTANCE FROM DECK ABOVE TO PIPE CENTER LINE.
10. CRES FITTINGS CONFORM TO DIMENSIONS OF ASME B16.3 AND CHEMICAL REQUIREMENTS OF ASTM A 351, GRADE CFB (SIMILAR TO GRADE 304).
11. 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 13-C):
 - STANDOFF: ANGLE, 42° L
 - LINER: SYNTHETIC RUBBER
 - 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.

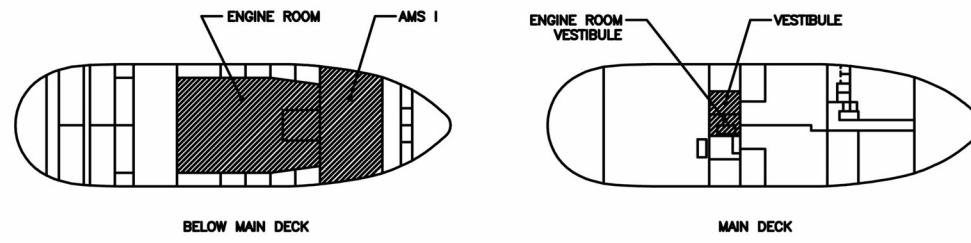
12. ENGINE ROOM VESTIBULE DECK GRATING SHALL BE CUT/MODIFIED AS REQUIRED TO SUPPORT THE WWS PIPING INSTALLATION.
13. ALL WATERTIGHT BOUNDARY PENETRATIONS ABANDONED BY THE REMOVAL OF HALON FIRE EXTINGUISHING SYSTEMS AND VESSEL MODIFICATIONS SHALL BE WELDED CLOSED. OTHER ABANDONED BULKHEAD, DECK, AND FRAMING 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".
14. GASKETS, FIND NO. 21, 39, AND 58, ARE MANUFACTURED BY:
 THERMOSEAL INC.
 2350 CAMPBELL RD.
 SIDNEY, OH 45365
 PHONE (937) 498-2222
15. EXISTING 3/4 NPS AIR SERVICE PIPING SHALL BE MODIFIED AS REQUIRED TO SUPPORT THE WWS PIPING INSTALLATION. SEE VIEW 14-A FOR DETAILS.

SHEETS					STATUS OF REVISION				
6	5	4	3	2	ZONE	REV	DESCRIPTION	DATE	APPROVED

PARTS LIST CONTINUED ON SHEET 2

FIND NO.	CAGE CODE	PART OR IDENTIFYING NUMBER	TOTAL QUANTITY REQUIRED	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)
45		1 EA	1	PLATE, 1/4 STK, 17" X 18"	ASTM A 36	STEEL	21.69
44		2 EA	2	PLATE, 1/4 STK, 5 3/4" X 17 1/2"	ASTM A 36	STEEL	7.23
43		2 EA	2	PLATE, 1/4 STK, 5 3/4" X 17"	ASTM A 36	STEEL	6.52
42		4 EA	4	NUT, HEX, 5/8-11 UNC-2B	ASME B18.2.2	MONEL	0.10
41		4 EA	4	SCREW, CAP, HEX HD, 5/8-11 UNC-2A X 2 3/4" L	ASME B18.2.1	MONEL	0.39
40	2E666	11 EA	11	FLANGE, SWLDG, CL 150, 2 NPS	COML (CAMCO)	CRES	2.50
39		7 EA	7	GASKET, NITRILE C-4401, SMALL FLAT RING, 2 NPS, 1/16" THK	SEE NOTE 14		0.10
38	72423	FIG 6870-400	1 EA	FLANGE, SWLDG, CL 150, 2 NPS	COML (FLAGG)	CNA	3.78
37	2E666		2 EA	ELBOW, 45°, SWLDG, CL 150, 2 NPS	COML (CAMCO)	CRES	2.02
36	0WJY8		1 EA	STRAINER, "Y", FLANGED, MODEL 150YFSS, 2 NPS	COML (SSI)	CRES	20.00
35	72219	85-208-27	1 EA	VALVE, BALL, SWLDG, 1000 PSI WOG, 2 NPS, W/LOCKING HANDLE	COML (CONBRACO)	CRES	7.12
34			3 FT	PIPE, SMLS, UNS C70600, 2.375 OD X .083 WALL (2 NPS)	ASTM B 466	CNA	2.06
33	2E666		4 EA	ELBOW, 45°, SWLDG, CL 150, 1 1/4 NPS	COML (CAMCO)	CRES	1.05
32	2E666		6 EA	FLANGE, SWLDG, 1 1/4 NPS	COML (CAMCO)	CRES	1.87
31	2E666		2 EA	ELBOW, 90°, SWLDG, CL 150, 1 1/2 NPS	COML (CAMCO)	CRES	1.64
30	2E666		2 EA	INSERT, SWLDG, CL 3000, 1 1/2 TO 1 1/4 NPS	COML (CAMCO)	CRES	1.13
29	2E666		1 EA	INSERT, SWLDG TO THD, CL 3000, 1 1/2 TO 1/4 NPS	COML (CAMCO)	CRES	1.13
28	2E666		2 EA	TEE, SWLDG, CL 150, 1 1/2 NPS	COML (CAMCO)	CRES	2.08
27			10 FT	PIPE, SMLS, GRADE TP304H, 1.900 OD X .145 WALL (1 1/2 NPS)	ASTM A 312	CRES	2.72
26	2E666		1 EA	INSERT, SWLDG, CL 3000, 2 TO 1 1/2 NPS	COML (CAMCO)	CRES	2.87
25	2E666		3 EA	ELBOW, 90°, SWLDG, CL 150, 1 1/4 NPS	COML (CAMCO)	CRES	1.32
24	2E666		1 EA	INSERT, SWLDG TO THD, CL 3000, 1 1/4 TO 1/4 NPS	COML (CAMCO)	CRES	1.04
23			50 FT	PIPE, SMLS, GRADE TP304H, 1.660 OD X .140 WALL (1 1/4 NPS)	ASTM A 312	CRES	2.27
22	2E666		2 EA	INSERT, SWLDG, CL 3000, 2 TO 1 NPS	COML (CAMCO)	CRES	2.87
21			3 EA	GASKET, NITRILE C-4401, SMALL FLAT RING, 1 1/4 NPS, 1/16" THK	SEE NOTE 14		0.10
20	2E666		3 EA	INSERT, SWLDG TO THD, CL 3000, 2 TO 1/4 NPS	COML (CAMCO)	CRES	2.87
19	2E666		7 EA	ELBOW, 90°, SWLDG, CL 150, 2 NPS	COML (CAMCO)	CRES	2.25
18	72423	FIG 6801-400	1 EA	ELBOW, 90°, SWLDG, 2 NPS	COML (FLAGG)	CNA	0.67
17	2E666		1 EA	INSERT, SWLDG, CL 3000, 2 TO 1 1/4 NPS	COML (CAMCO)	CRES	2.87
16	07971		1 EA	BRAZOLET, REDUCING, TUBE, SB BRANCH, 3 1/2 X 2 NPS	COML (BONNEY FORGE)	BRONZE	2.25
15			50 FT	PIPE, SMLS, GRADE TP304H, 2.375 OD X .154 WALL (2 NPS)	ASTM A 312	CRES	3.65
14	2E666		6 EA	TEE, SWLDG, CL 150, 2 NPS	COML (CAMCO)	CRES	3.31
13	2E666		4 EA	ELBOW, 45°, SWLDG, CL 150, 1 NPS	COML (CAMCO)	CRES	0.61
12	2E666		5 EA	ELBOW, 90°, SWLDG, CL 150, 1 NPS	COML (CAMCO)	CRES	0.88
11	2E666		4 EA	TEE, SWLDG, CL 150, 1 1/4 NPS	COML (CAMCO)	CRES	1.90
10	2E666		12 EA	FLANGE, SWLDG, CL 150, 1 NPS	COML (CAMCO)	CRES	1.25
9	2E666		6 EA	INSERT, SWLDG, CL 3000, 1 1/4 TO 1 NPS	COML (CAMCO)	CRES	1.04
8			90 FT	PIPE, SMLS, GRADE TP304H, 1.315 OD X .133 WALL (1 NPS)	ASTM A 312	CRES	1.68
7	2E666		12 EA	INSERT, SWLDG TO THD, CL 3000, 1 TO 1/4 NPS	COML (CAMCO)	CRES	0.91
6	2E666		12 EA	TEE, SWLDG, CL 150, 1 NPS	COML (CAMCO)	CRES	1.11
5	99134	TF10	25 EA	NOZZLE, SPRAY, MODEL TF, 120° FULL CONE, 1/4 MPT	COML (BETE)	CRES	0.23
4	2E666		8 EA	INSERT, SWLDG TO THD, CL 3000, 1/2 TO 1/4 NPS	COML (CAMCO)	CRES	0.28
3	2E666		10 EA	ELBOW, 90°, SWLDG, CL 150, 1/2 NPS	COML (CAMCO)	CRES	0.33
2			70 FT	PIPE, SMLS, GR TP304H, .840 OD X .109 WALL (1/2 NPS)	ASTM A 312	CRES	0.85
1	2E666		8 EA	INSERT, SWLDG, CL 3000, 1 TO 1/2 NPS	COML (CAMCO)	CRES	0.91

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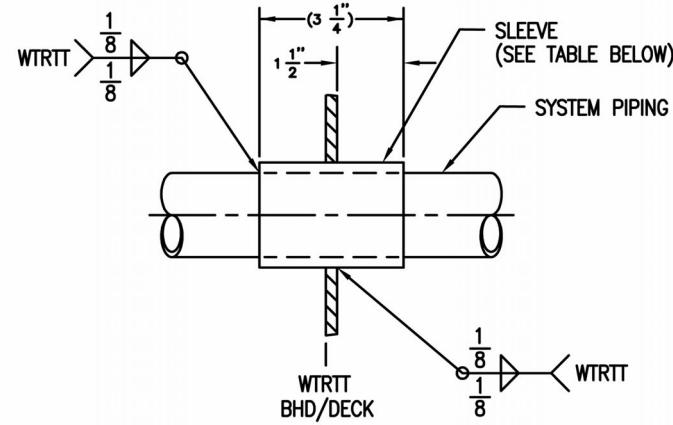


UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRS57-97-C-00049	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± — ± — ± —		CONTRACTOR 2R341	
DRAWN BY AM	DATE 1/20/98	RPE (FP) APPROVAL	
CHECKED BY JS	ENGINEER AK		
DESIGN APPROVAL			
DRAWING APPROVAL			

U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000		
U.S. ARMY LT-128 WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS		
SIZE D	CAGE CODE 19207	LT-800-5231-1
SCALE 3/4" = 1'-0"		SHEET 1 OF 6

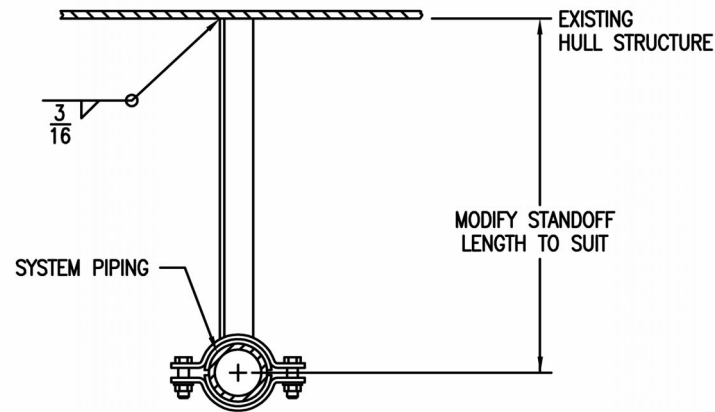
1	WWS LABEL PLATES AND PLACARD	LT-800-5231-2
NO.	DRAWING TITLE	DRAWING NUMBER
LIST OF REFERENCES		

REVISION			
ZONE	REV	DESCRIPTION	DATE



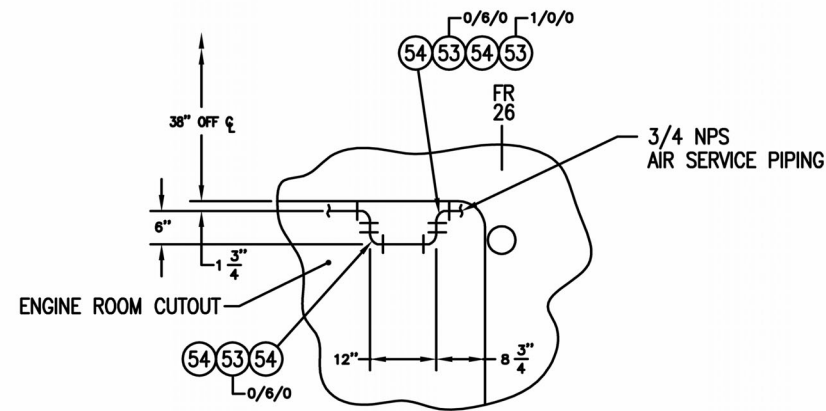
VIEW 15-C
TYPICAL WATERTIGHT BULKHEAD PENETRATION
NOT TO SCALE

PIPE SIZE	SLEEVE FIND NO.
1 1/4 NPS	51
2 NPS	49



VIEW 13-C
TYPICAL PIPE HANGER ASSEMBLY
NOT TO SCALE

PIPE SIZE	HANGER ASSEMBLY FIND NO.
1/2 NPS	63
1 NPS	64
1 1/4 NPS	65
1 1/2 NPS	66
2 NPS	67



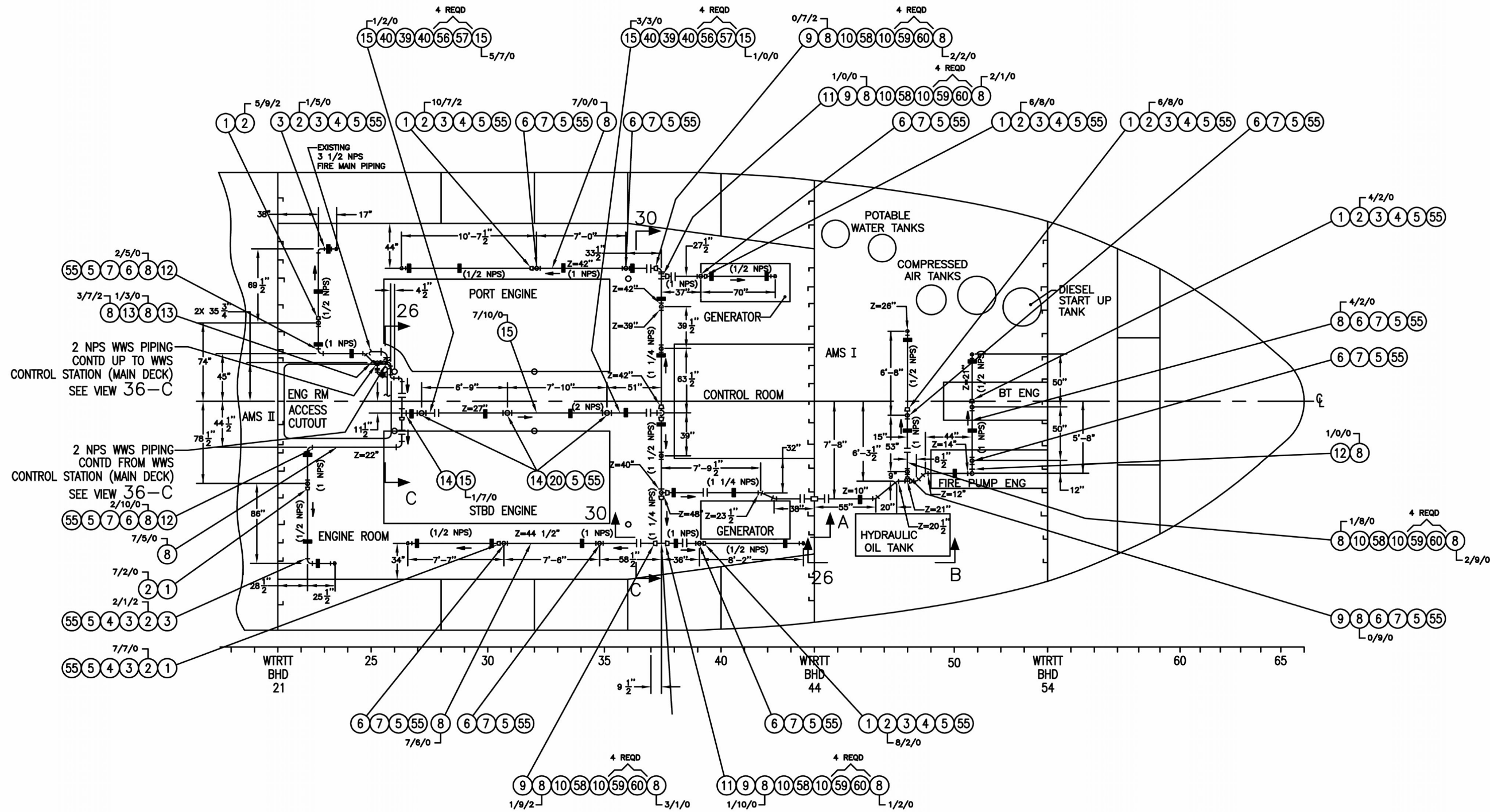
VIEW 14-A
MODIFICATION TO AIR SERVICE PIPING
BELOW MAIN DECK
SEE NOTE 15

FIND NO.	CAGE CODE	PART OR IDENTIFYING NUMBER	TOTAL QUANTITY REQUIRED	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)
67			4 EA	HANGER ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 2 NPS	ASTM F 708	SEE NOTE 11	2.00
66			1 EA	HANGER ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 1 1/2 NPS	ASTM F 708	SEE NOTE 11	1.50
65			5 EA	HANGER ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 1 1/4 NPS	ASTM F 708	SEE NOTE 11	1.25
64			10 EA	HANGER ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 1 NPS	ASTM F 708	SEE NOTE 11	1.00
63			13 EA	HANGER ASSY, SPLIT CAP, SGL LEG STDF, W/LINER, 1/2 NPS	ASTM F 708	SEE NOTE 11	0.50
62	01599	MK-MK-06	1 EA	PIN, HITCH, 3/16 X 3 1/2 SIZE	COML (REID)		-
61	2E666		1 EA	ELBOW, 45°, THD, CL 150, 1/2 NPS	COML (CAMCO)	CRES	0.50
60			36 EA	NUT, HEX, 1/2-13 UNC-2B	ASME B18.2.2	CRES	0.10
59			36 EA	SCREW, CAP, HEX HD, 1/2-13 UNC-2A X 2 1/4" L	ASME B18.2.1	CRES	0.15
58			6 EA	GASKET, NITRILE C-4401, SMALL FLAT RING, 1 NPS, 1/16" THK	SEE NOTE 14		0.10
57			24 EA	NUT, HEX, 5/8-11 UNC-2B	ASME B18.2.2	CRES	0.10
56			24 EA	SCREW, CAP, HEX HD, 5/8-11 UNC-2A X 2 3/4" L	ASME B18.2.1	CRES	0.39
55	7N423	SPC1	25 EA	GUARD, SPRINKLER	COML (BROOKS)	STEEL	-
54	72423	FIG 6801-150	4 EA	ELBOW, 90°, SWLDG, 3/4 NPS	COML (FLAGG)	CNA	0.43
53			5 FT	PIPE, SMLS, UNS C70600, 1.050 OD X .148 WALL (3/4 NPS)	ASTM B 466	CNA	1.71
52	72423	FIG 6815-400	1 EA	UNION, SWLDG, 2 NPS	COML (FLAGG)	CNA	2.11
51			1 EA	TUBING, ROUND, 2.250 OD X .156 WALL, 3 1/4" L	ASTM A 513	STEEL	0.94
50			1 RO	TAPE, ANTI-SEIZE, SIZE II	MIL-T-27730	PTFE	0.03
49			2 EA	TUBING, ROUND, 2.875 OD X .278 WALL, 3 1/4"	ASTM A 513	STEEL	1.05
48			2 EA	TUBE, ROUND, 3.000" OD X .125" WALL, 3" L	ASTM A 513	STEEL	0.96
47	72219	76-103-01	1 EA	VALVE, BALL, THD, 2000 PSI WOG, 1/2 NPS	COML (CONBRACO)	CRES	1.25
46			2 EA	NIPPLE, THD, CL 125, CLOSE, 1/2 NPS	ASTM A 733	CRES	0.08

PARTS LIST (CONTINUED FROM SHEET 1)

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 ± .005 ± .010 ± .015		CONTRACTOR 2R341		U.S. ARMY LT-128 WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 1/20/98	RPE (FP) APPROVAL		SIZE D	CAGE CODE 19207
CHECKED BY JS	ENGINEER AK			LT-800-5231-1	
DESIGN APPROVAL				SCALE	
DRAWING APPROVAL				SHEET 2 OF 6	

REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED

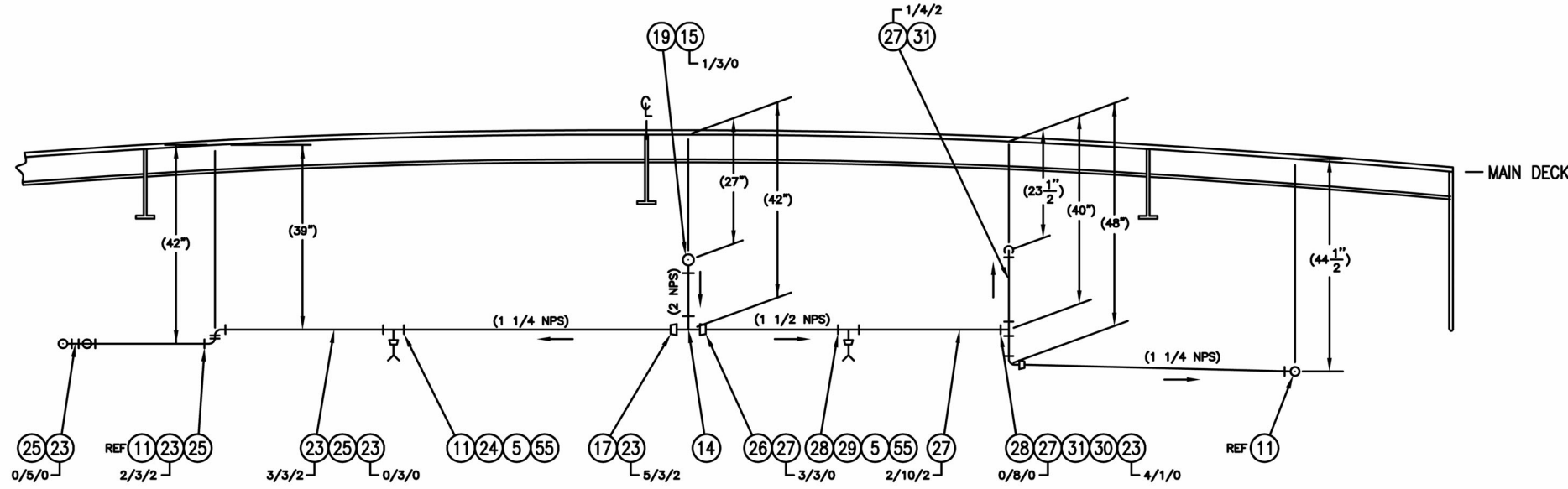


VIEW 21-A
ENGINE ROOM WATER WASHDOWN SYSTEM
PIPING INSTALLATION AND DETAILS
BELOW MAIN DECK
SCALE 1/4"=1'-0"

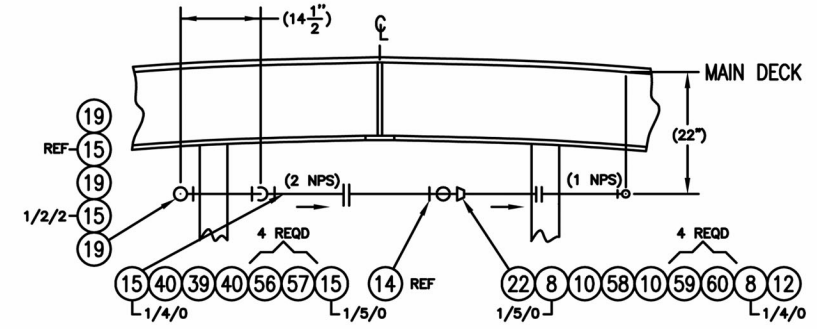
- LOCAL NOTE:
1. "■" INDICATES APPROXIMATE PIPE HANGER LOCATION, SEE NOTE 11.
 2. FOR PIPE PENETRATION INSTALLATION AND DETAIL, SEE VIEW 15-C.

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 LT-128 WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL		SIZE D	CAGE CODE 19207
CHECKER JS	ENGINEER AK			LT-800-5231-1	
DESIGN APPROVAL				SCALE	
DRAWING APPROVAL				SHEET 3 OF 6	

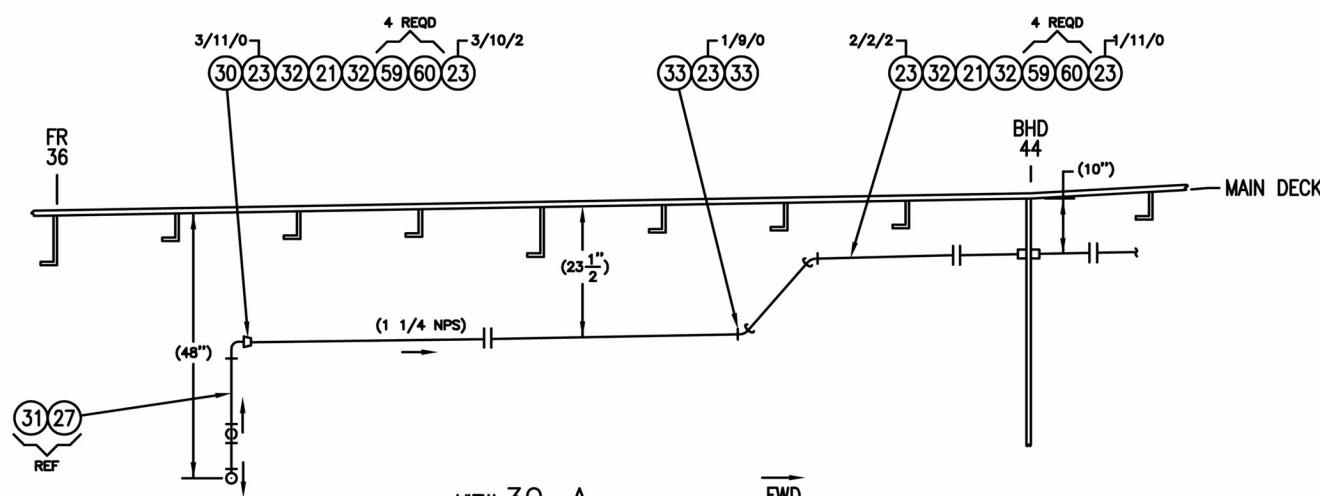
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



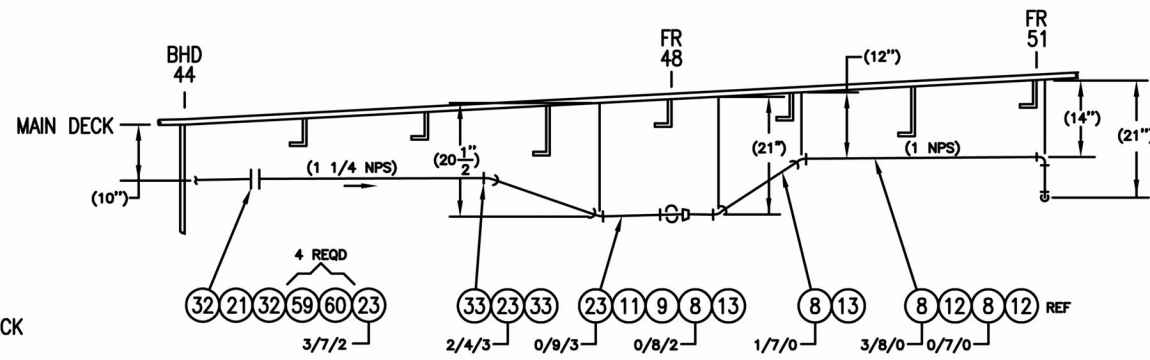
VIEW 30-C
(21-C)
ENGINE ROOM WATER WASHDOWN SYSTEM
PIPING INSTALLATION AND DETAILS
FR 37
LOOKING FWD
ROTATED 90° CCW
ITEMS NOT SHOWN
OMITTED FOR CLARITY



VIEW 26-C
(22-C)
ENGINE ROOM WATER WASHDOWN SYSTEM
PIPING INSTALLATION AND DETAILS
FR 26
LOOKING FWD
ROTATED 90° CCW
ITEMS NOT SHOWN
OMITTED FOR CLARITY



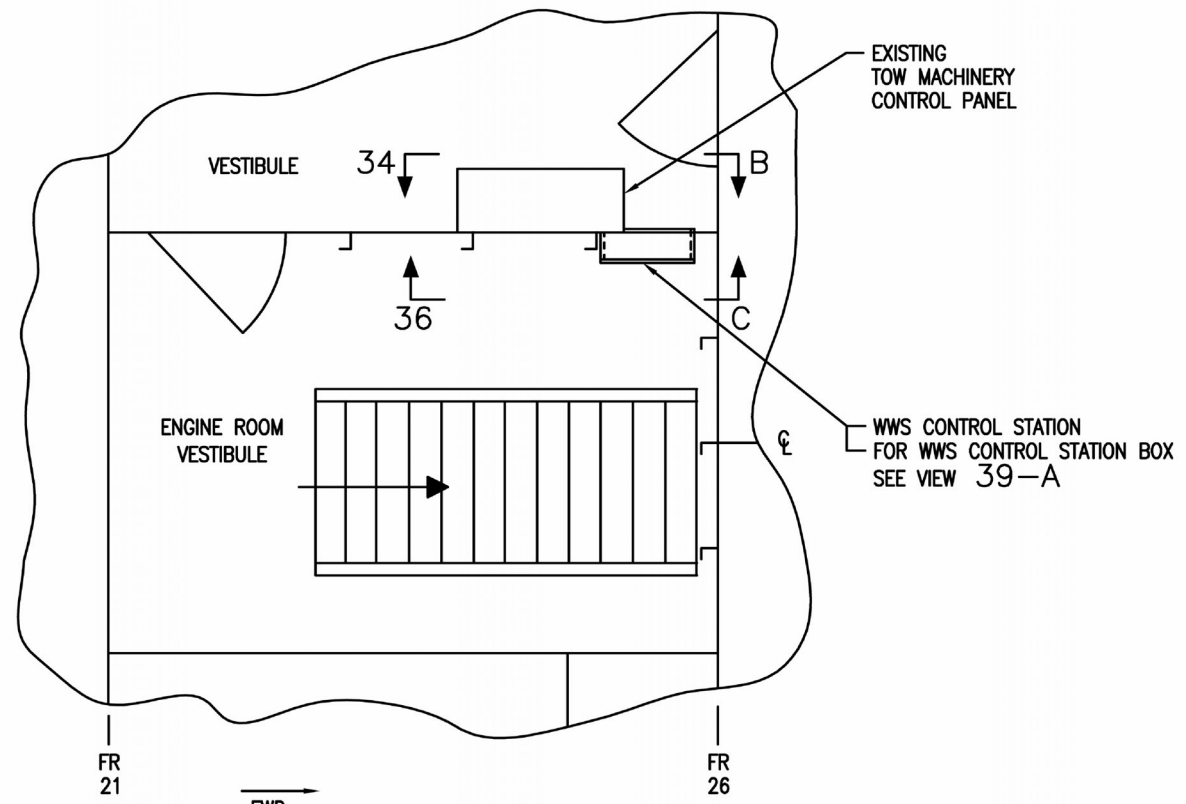
VIEW 30-A
(21-B)
ENGINE ROOM WATER WASHDOWN SYSTEM
PIPING INSTALLATION AND DETAILS
STBD SIDE
LOOKING INBOARD
ITEMS NOT SHOWN
OMITTED FOR CLARITY



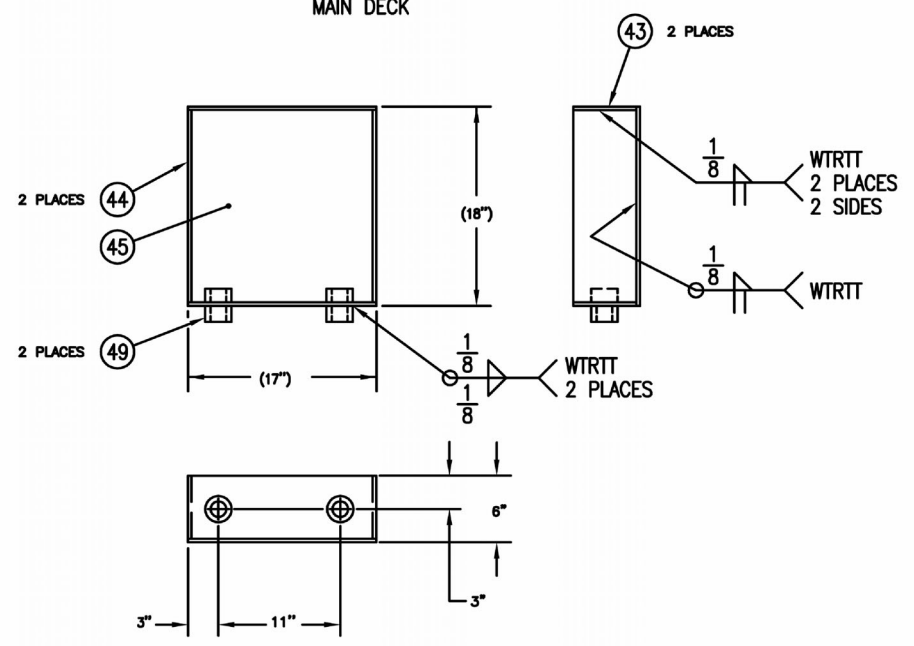
VIEW 26-B
(20-B)
ENGINE ROOM WATER WASHDOWN SYSTEM
PIPING INSTALLATION AND DETAILS
STBD SIDE
LOOKING INBOARD
ITEMS NOT SHOWN
OMITTED FOR CLARITY

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 LT-128 WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL		SIZE D	CAGE CODE 19207
CHECKER JS	ENGINEER AK				
DESIGN APPROVAL					
DRAWING APPROVAL					
				SCALE	SHEET 4 OF 6

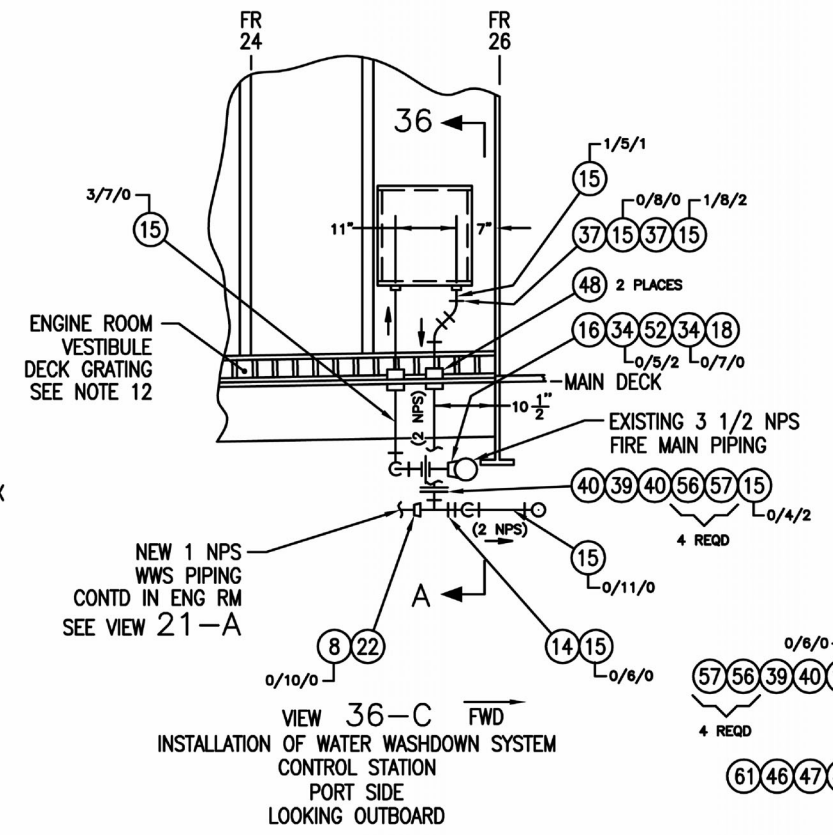
REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



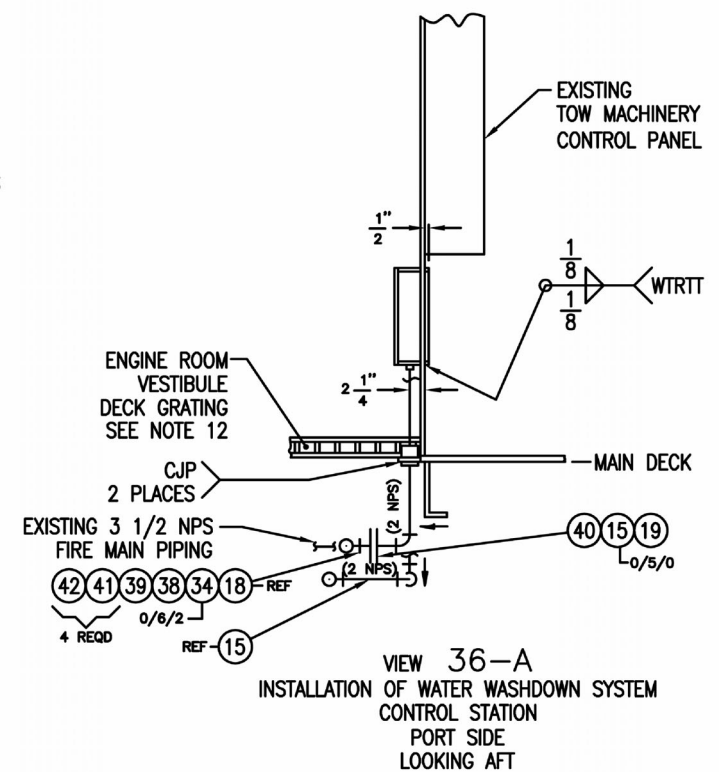
VIEW 39-B
INSTALLATION OF WATER WASHDOWN SYSTEM
CONTROL STATION
MAIN DECK



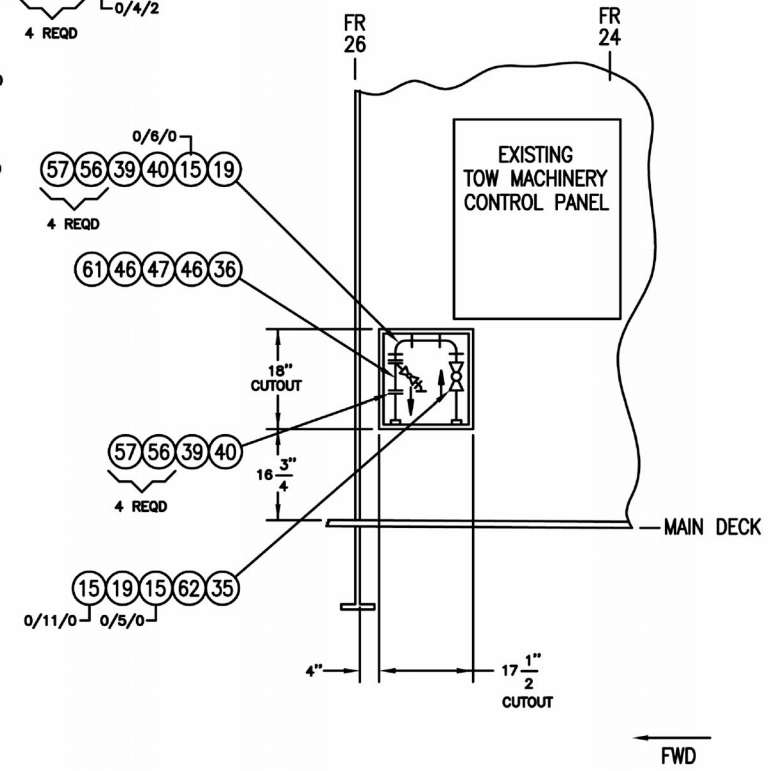
VIEW 39-A
WATER WASHDOWN SYSTEM
CONTROL BOX
SCALE 1 1/2"=1'-0"



VIEW 36-C FWD
INSTALLATION OF WATER WASHDOWN SYSTEM
CONTROL STATION
PORT SIDE
LOOKING OUTBOARD



VIEW 36-A
INSTALLATION OF WATER WASHDOWN SYSTEM
CONTROL STATION
PORT SIDE
LOOKING AFT

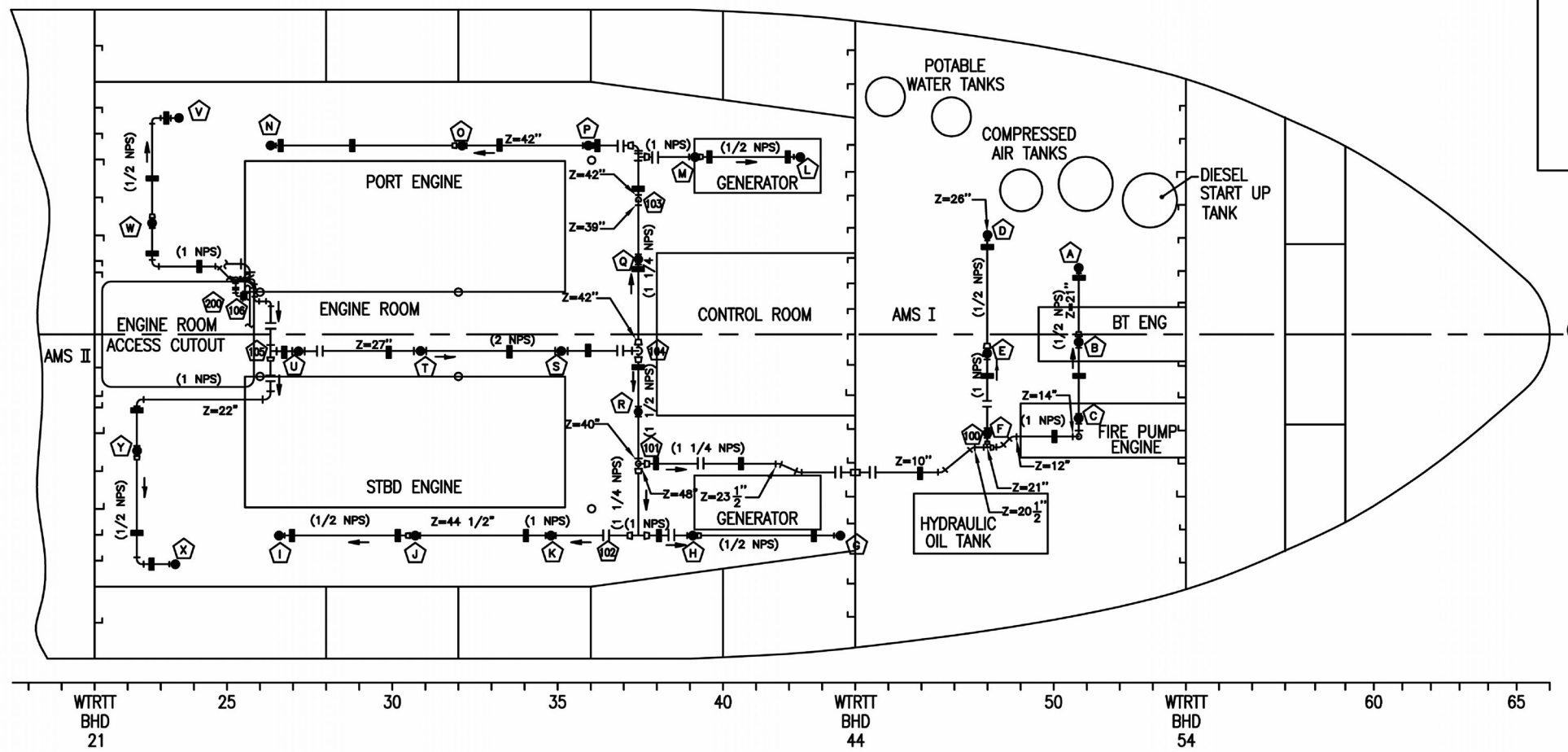


VIEW 34-B
INSTALLATION OF WATER WASHDOWN SYSTEM
CONTROL STATION
PORT SIDE
LOOKING INBOARD
ROTATED 180°

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 LT-128 WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL		SIZE D	CAGE CODE 19207
CHECKER JS	ENGINEER AK				LT-800-5231-1
DESIGN APPROVAL					
DRAWING APPROVAL					

U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
U.S. ARMY LT-128 WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS	
SIZE D	CAGE CODE 19207
LT-800-5231-1	
SHEET 5 OF 6	

REVISION				
ZONE	REV	DESCRIPTION	DATE	APPROVED



WATER SUPPLY/DEMAND

FIRE AND SALTWATER SERVICE PUMP:
 RATED AT 200 GPM @ 123 (+) 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:
 145.2 GPM TOTAL FLOW WHILE MAINTAINING 80 PSI AT ALL NOZZLES AND 103.5 PSI AT THE PUMP DISCHARGE.

- SYMBOL LEGEND**
- WATER SPRAY NOZZLE
 - ◻ HYDRAULIC REFERENCE POINT
 - Z" DISTANCE FROM DECK ABOVE
 - FLOW DIRECTION
 - NEW PIPE
 - EXISTING PIPE

DIAGRAM 45-A
 ENGINE ROOM WATER WASHDOWN SYSTEM
 MODELING AND FLOW ANALYSIS DIAGRAM
 SCALE 1/4"=1'-0"

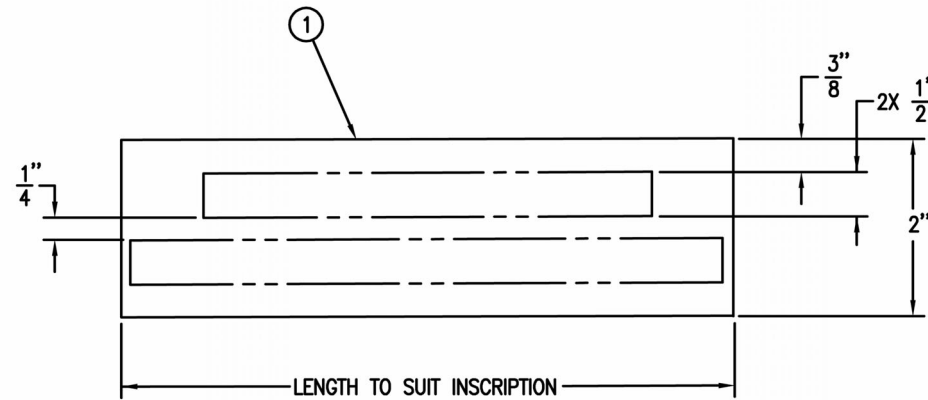
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NUMBER DTRS57-97-C-00049		U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48397-5000	
TOLERANCES ON: 2 PLACES 3 PLACES ANGLES ± ± ±		CONTRACTOR 2R341			
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL		U.S. ARMY LT-128 WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS	
CHECKER JS	ENGINEER AK				
DESIGN APPROVAL				SIZE D	CAGE CODE 19207
DRAWING APPROVAL					LT-800-5231-1
SCALE				SHEET 6 OF 6	

NOTES:

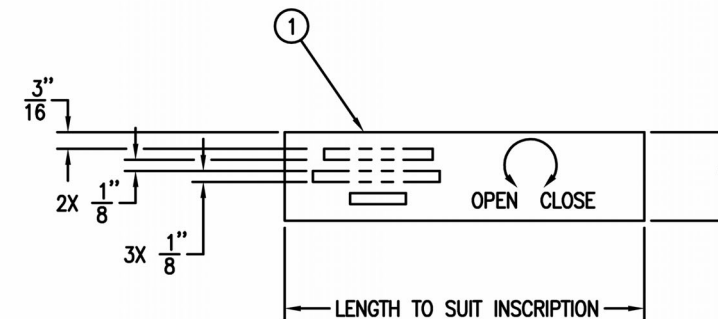
- THIS DRAWING HAS BEEN DEVELOPED AS A GUIDANCE DRAWING FOR THE FABRICATION AND INSTALLATION OF LABEL PLATES AND SYSTEM OPERATION PLACARD ASSOCIATED WITH THE WATER WASHDOWN SYSTEM PIPING INSTALLATION AND DETAILS (DRAWING LT-800-5231-1) ONBOARD U.S. ARMY LARGE TUG, 128 FOOT (LT-128).
- ALL LABEL PLATES SHALL HAVE SMOOTH EDGES AND BE LOCATED SO THAT THE INSCRIPTION IS READILY DISCERNIBLE AND NOT OBSCURED BY PIPES OR OTHER OBJECTS.
- LABEL PLATE, 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.
- THE ENGINE ROOM 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 PLACARD SHALL BE MOUNTED IN A SUITABLE LOCATION NEAR THE ENG RM WWS CONTROL STATION, 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	VESTIBULE FR 26, PORT	MOUNT ABOVE CONTROL STATION
2	ENG RM WWS CONTROL VALVE WWS-1	V-3	1 EA	VESTIBULE FR 25, PORT	MOUNT AT BOTTOM OF CONTROL STATION
3	ENG RM WWS STRAINER BLOW OFF WWS-2	V-3	1 EA	VESTIBULE FR 25, PORT	MOUNT AT BOTTOM OF CONTROL STATION

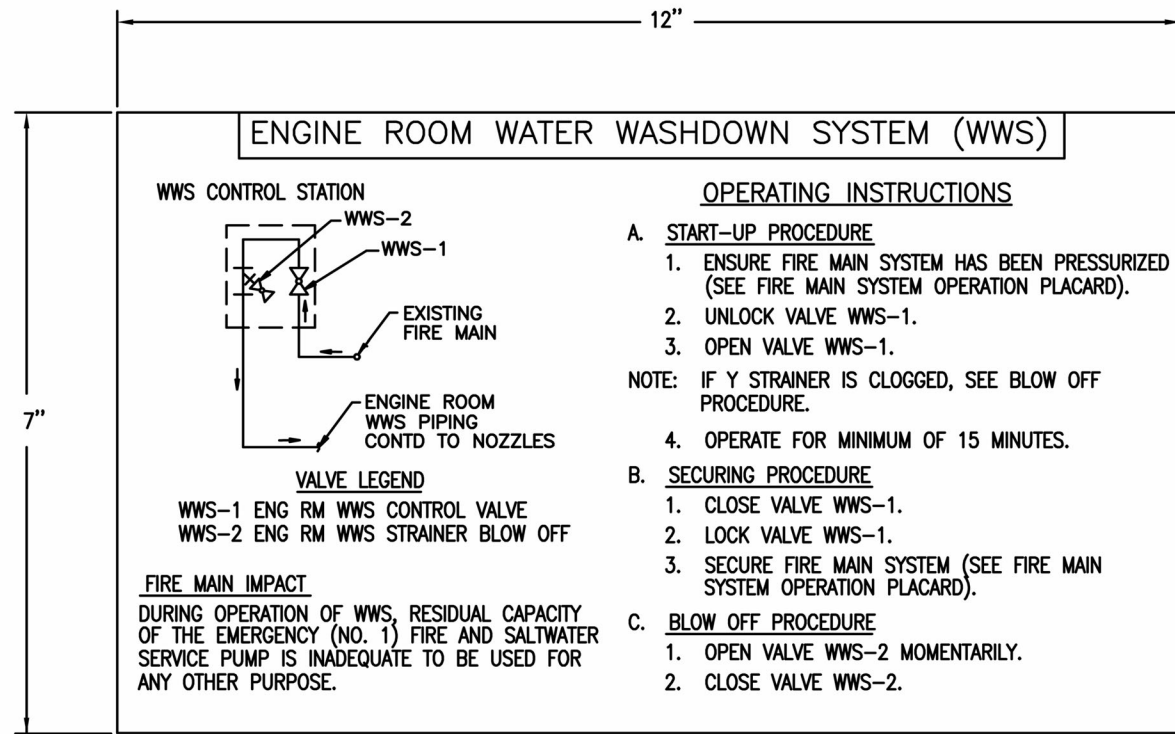
FIND NO.	CAGE CODE	PART OR IDENTIFYING NUMBER	TOTAL QUANTITY REQUIRED	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL	UNIT WEIGHT (LB)
3	06KR7	PRO-3032	1 EA	TAPE, POLYETHYLENE, WHITE CLOSED CELL, DOUBLE COATED	COML (PRO TAPES)		--
2			1 EA	SYSTEM OPERATION PLACARD, LAMINATED PHENOLIC PLASTIC, WHITE CORE WITH RED SURFACE, 1/16" THK, UV PROTECTED		PHEN	--
1			3 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 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 LT-128 WATER WASHDOWN SYSTEM LABEL PLATES AND PLACARD	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL		SIZE D	CAGE CODE 19207
CHECKER JS/RF	ENGINEER AK			LT-800-5231-2	
DESIGN APPROVAL				SCALE 1/1	SHEET 1 OF 2
DRAWING APPROVAL					

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②

VIEW 13-A
ENGINE ROOM WATER WASHDOWN SYSTEM
OPERATION PLACARD

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 LT-128 WATER WASHDOWN SYSTEM LABEL PLATES AND PLACARD	
DRAWN BY AM	DATE 01/20/98	RPE (FP) APPROVAL			
CHECKER JS/RF	ENGINEER AK				
DESIGN APPROVAL					
DRAWING APPROVAL					
SIZE D	CAGE CODE 19207	LT-800-5231-2		SCALE	
				SHEET 2 OF 2	

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.

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 TM 55-1925-227-24&P	DATE 16 August 1991	TITLE Fire Fighting System for Large Tug (LT)
--	-------------------------------	---

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
----------------------------	--	-----------

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25-30; the proponent agency is OAASA						Use Part II (<i>reverse</i>) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE
TO: (<i>Forward to proponent of publication or form</i>) (<i>Include ZIP Code</i>) Technical Publication Information Office, TACOM. RI. Rock Island Arsenal. IL 61299-7630						FROM: (<i>Activity and location</i>) (<i>Include ZIP Code</i>)	
PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS							
PUBLICATION/FORM NUMBER TM 55-1925-227-24&P						DATE 16 August 1991	TITLE Fire Fighting System for Large Tug (LT)
ITEM	PAGE	PARA-GRAPH	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON	
<i>* Reference to line numbers within the paragraph or subparagraph.</i>							
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
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PART II - REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER TM 55-1925-227-24&P	DATE 16 August 1991	TITLE Fire Fighting System for Large Tug (LT)
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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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RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25-30; the proponent agency is OAASA						Use Part II (<i>reverse</i>) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE
TO: (<i>Forward to proponent of publication or form</i>) (<i>Include ZIP Code</i>) Technical Publication Information Office, TACOM. RI. Rock Island Arsenal. IL 61299-7630						FROM: (<i>Activity and location</i>) (<i>Include ZIP Code</i>)	
PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS							
PUBLICATION/FORM NUMBER TM 55-1925-227-24&P						DATE 16 August 1991	TITLE Fire Fighting System for Large Tug (LT)
ITEM	PAGE	PARA-GRAPH	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON	
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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 dekameters = 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 cu. feet

Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
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	square 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
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