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MARK SYSTEMS, INC.

CO2 Fire Suppression System

Operation and Maintenance Manual

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Version 1.8 Mark Systems Controller

Table of Contents

Introduction	Page 1
Safety Precautions	Page 2
System Design Characteristics	Page 3
Specifications	Page 4
System Operation	Page 8
Installation	Page 9
System Test	Page 21
System Components	Page 22
Maintenance Instructions	Page 47
Troubleshooting Guide	Page 51
References	Page 54
Warranty Information	Page 55

INTRODUCTION

The Mark Systems Wet Bench and Process Equipment Fire Suppression System, is a specifically engineered and designed system utilizing infrared (IR) fire detection, photoelectric smoke detection, heat detection, and carbon dioxide (CO2) extinguishing agent. Complete fire protection is provided for polypropylene and stainless steel wet benches and process stations, protecting work surface areas by local application of agent, and protecting compartmental and plenum areas by total flooding.

A carbon dioxide fire suppression system is the proper choice when the application demands avoiding any production interruption, or major or minor property damage from fire in high risk and sensitive process areas. Where the defense of clean room integrity is top priority, a CO2 fire suppression system is the answer.

Carbon dioxide is a colorless, odorless, electrically non-conductive, inert gas which is approximately 1½ times heavier than air. When discharged from a nozzle at 70°C, approximately 25% of the liquid carbon dioxide will form dry ice when released directly into the atmosphere. The dry ice helps to reduce the high temperatures caused by a fire. Stored in steel cylinders under pressure, carbon dioxide, when applied to a fire, produces a blanket of heavy gas, with the appearance of a white fog, which reduces the atmospheric oxygen concentration sufficiently to where combustion can no longer be supported.

As a fire suppression agent, carbon dioxide is dry thereby causing no damage to process or equipment since it does not wet the material or any machinery in which it comes in contact. This results in reduction or elimination of downtime and costly cleanup. Carbon dioxide is highly efficient for rapidly suppressing Class A, B, and C fires and offers a wide range of hazard protection. It suppresses a fire by reducing the oxygen concentration, fuel vapor concentration, or both in the vicinity of the fire to where these concentrations are no longer high enough to support combustion. Nearly immediate flame suppression is realized upon application of agent to the combustion zones of flammable liquids, and solid surface fires burning in similar fashion to flammable liquids.

SAFETY PRECAUTIONS

TOXICITY

Carbon dioxide is present in the atmosphere at an average concentration of about 0.03 percent by volume. It is also a normal by-product of human and animal metabolism.
Carbon dioxide influences certain vital functions in a number of important ways, including the control of respiration, the dilation and constriction of the vascular system, particularly the cerebrum, and controlling the pH of body fluids.

The concentration of carbon dioxide in the air governs the rate at which carbon dioxide is released from the lungs, and thus affects the concentration of carbon dioxide in the blood and tissues. **Danger** exists when an increasing concentration of carbon dioxide causes a reduction in the rate of release of carbon dioxide from the lungs, and a decrease in oxygen intake.

Carbon dioxide can produce unconsciousness and even death when discharged in high concentrations, such as from a fire suppression system. The physiological effects of such a discharge are related more to oxygen deprivation (suffocation), than to any inherent toxicity of carbon dioxide itself. Most people can withstand a concentration of approximately 9 percent carbon dioxide without lapsing into unconsciousness. Breathing a higher concentration of carbon dioxide could render a person helpless almost immediately.

SYSTEM

Caution: Carbon dioxide fire extinguishing systems, protecting areas where explosive atmospheres could exist, must be properly grounded.
The discharge of liquid carbon dioxide is known to produce electrostatic charges which, under certain conditions, could create a spark. In addition, objects exposed to discharge from carbon dioxide nozzles shall be grounded to dissipate possible electrostatic charges.

The discharge of carbon dioxide directly at a person may endanger their safety by eye injury, ear injury, or even falls due to the loss of balance on the impingement of the high velocity discharging gas. Contact with carbon dioxide in the form of dry ice can cause frostbite.

All necessary precautions must be made to prevent a premature discharge of the system, to warn of the existence of the system, and to follow proper procedures should such a discharge or fire occur. These include:

⇒ Disconnecting the control head on the cylinder before servicing or testing the system.
⇒ The use of safety glasses, gloves, and other protective clothing.
⇒ Installing visual and audible warning devices connected to the controller to warn workers and operators of a fire and CO2 discharge.
⇒ The placing of placards warning of the presence and the operation of the system.
⇒ The installation of manual release stations away from the protected bench or work station.
⇒ Other precautions which local codes and operating conditions may require.

SYSTEM DESIGN CHARACTERISTICS

The Mark Systems Fire Detection and Suppression Systems are designed to protect polypropylene wet benches from ignition from process fires. Such fires are most likely to result from an overheat condition in the polypropylene inserts. Although polypropylene is not easy to ignite, once burning it steadily sustains combustion. The system is also designed to protect stainless steel process and solvent stations as well by protecting expensive process loss due to fire, excessive heat, and for the preservation of clean room integrity. Since the most likely source of ignition has been shown to be electric heaters or other electrical equipment, it is essential to shut down power to the bench in the event of a fire being detected.
(**CAUTION:** ***The power for the Fire System must not be interrupted***). Relay contacts are provided by the Fire System Controller to provide these power shutdowns.

The Mark Systems Fire Detection and Suppression System is designed to suppress fires within wet benches and process tools with exhaust systems fully operating, so as to greatly minimize the contaminating effects of the products of combustion of a fire in a clean room environment. The carbon dioxide agent capacity is specifically calculated in the design process, to ensure complete extinguishing of a fire.

The system is designed to "watch" for ignition of material or solvents during processes and take action to extinguish such an occurrence. Fires that may be drawn away, out of the operator's sight, into plenums and compartments are quickly "seen" and extinguished due to designed-in detectors and nozzles placed in these areas. Heat detectors may be used in compartments (plumbing, electrical, etc.) both non-exhausted and exhausted. Benches having internal partitions may require multiple detectors and/or nozzles. The necessity of these additional detectors or nozzles are decided upon from the fabrication drawings provided for the design of the fire system.

The Fire System Controller continuously monitors the outputs of all connected detectors and, upon receiving an activation signal from any detector, responds by sending a signal to discharge the gas cylinder which will release carbon dioxide agent to the nozzles. The Fire System Controller continuously supervises all detectors and their wiring, the cylinder discharge head and it's wiring, and all power supply voltages and backup supplies.

SPECIFICATIONS

MECHANICAL

Agent Container	Spun Steel, DOT 3AA Cylinder Capacity: 25, 35, 50, 75, 100 lb. CO2 Pressure: 850 PSIA at 70°F
Piping	Nominal Type 316 Stainless Steel Tubing or Piping Rated for 5000 PSI min. burst pressure (Customer Supplied) (Ref. NFPA 12, Section 1-9, 1-10)
Nozzle	316 Stainless Steel Vent Nozzle ½" NPT Internal Thread Internal Monel filter screen up to orifice 4.5
Optical Detector	Polypropylene enclosure with sealed, water resistant seam and cable exit Operating Temperature: 0 to +55 °C Storage Temperature: -25 to +77 °C Humidity: 0 to 100%
Smoke Detector	Photoelectric type Operating Temperature: 14 to 122 °F Ambient Temperature (UL Rated): 32 to 100°F
Linear Heat Detector	Polypropylene jacketed cable

ELECTRICAL

CONTROLLER

Electronics	Linear Analog; CMOS Logic
Power Requirement	20 VAC via 115 VAC USA wall outlet power pack. (UPS Recommended) Wire Size: 18-3 AWG Supervisor Circuit Backup: 9 Volt NEDA Type 1604A Battery Optional System 24 Volt Battery Backup System for 24 Hour Protection
Power Consumption	Less than 21 Watts in "NORMAL" or "TROUBLE" 50 Watts in "DISCHARGE"

SPECIFICATIONS - ELECTRICAL cont'd

CONTROLLER

Power Protection	Control Head: PTC Fuse 1.8A Detector Power: PTC Fuse 1A Input Power: PTC Fuse 1.8A
Supervision	Detector Power Output Detector Alarm Contact Control Head Open Circuit 9 Volt Supervisor Battery Low AC Power Out or Low 24 Volt Supply Out- Internal or Backup
Alarm Contacts	Discharge Alarm: 1 Form C; 5A @120 VAC Trouble Alarm: 1 Form C; 5A @ 120 VAC Jumper select as a 2nd Discharge Alarm
Detector Circuit	Operating Voltage: 24VDC Source Current: 500mA End-of-Line Resistor: 10K Supervisory Current: 2.5mA (incl. E-O-L Res.)
Releasing Circuit	Operating Voltage: 24VDC Source Current 2.0A
CONTROL HEAD	50 Watts @24 VDC Impedance: Nominal 9 Ohms
OPTICAL DETECTOR	
Stand Alone	Dual Infrared Optical Detector Cable: 20' / 10 Conductor 24AWG, Plenum Rated connected to juction box (provided) Power Requirement: 24VDC Regulated 52mA Stand-by 78mA Alarm Output: Alarm Relay- SPST Dry Contact Fault Relay- SPST Dry Contact

SPECIFICATIONS - ELECTRICAL cont'd

OPTICAL DETECTOR- cont'd

Multiple	Dual Infrared Optical Detector Cable: 20' / 4 Conductor 22AWG, Teflon Cable, connector mounted to optional supplied junction box or with wire pigtails. Power Requirement: 12VDC Supplied by Multi-Detector Controller Output: RS-485 interface to Multi-Detector Controller
Multi-Optical Detector Controller	12 Channel Detector Controller Power Requirement: 24VDC/ 50mA + 30mA for each Detector Output: RS-232 Interface for Programming and Interrogating Detectors with PC for Set-up and Post Event Analysis Female DB-9 Connector Alarm Relay- SPST 1A Dry Contact Fault Relay- SPST 1A Dry Contact
SMOKE DETECTOR	Power Requirement: 17.7-33.0 VDC Standby Current: 45uA Alarm Current: 150mA Max. Surge Current: 160uA
LINEAR HEAT DETECTOR	Power Rating: 30VAC, 42VDC Resistance: Approx. 1 ohm per five feet
MANUAL PULL STATION	Electrical Rating: 3Amp @ 125VAC
HORN/STROBE UNIT	Power Requirement: 24VDC Input Current: 150mA avg. 290mA peak Horn rating: 91dBA avg. @ 10 feet Strobe rating: 15/75 candela

SPECIFICATIONS

DIMENSIONS

Controller	¼ DIN Enclosure: 5.67"H x 2.83"W x 5.25"D
Optical Detector	5.6"H x 3.0"W x 1.70"D
Optical Detector Junction Box	2.8"H x 5.185"W x 1.1"D
Multi-Detector Controller	6.0"H x 8.0"W x 1.09"D
Smoke Detector	1.75"H x 4.0" Dia.
Linear Heat Detector	~ .1875 Dia.
Agent Assembly w/Bracket	25 lb. : 34"H x 11.5"W x 8.75"D
	35 lb. : 43"H x 11.5"W x 8.75"D
	50 lb. : 59"H x 11.5"W x 8.75"D
	75 lb. : 64"H x 12.25"W x 9.5"D
	100 lb. : 66"H x 14"W x 10.75" D
Manual Pull Station	5.5"H x 4.13"W x 1.38"D
Horn/Strobe Unit	5.125" Sq. x 3.062" Surface Depth 1.375" Sub-surface Depth

SYSTEM OPERATION

The system is designed for fully automatic operation. One or more optical dual infrared flame detectors monitor all required protected areas of the wet bench or station, such as work surfaces, interior tub areas, and exhaust plenums. Upon "seeing" a fire of magnitude 13 kilowatt or greater, the optical detector responds by closing the contacts of it's alarm relay, and visually indicating a steadily lit internal green LED. The closed contact of the detector's alarm relay signals the Controller of the presence of a fire. One or more smoke detectors in non-exhausted attached plumbing and electrical enclosures, and separated storage cabinets actively sense the presence of smoke concentration. Upon activation the closed contact of the smoke detector signals the Controller of the presence of a fire. One or more linear heat detectors in non-exhausted and low-exhausted plumbing and electrical enclosures, continuously monitors its length for fire or over-heating devices.

The Controller responds by activating it's release circuit, energizing the Control Head of the CO2 cylinder, which fires the cylinder valve releasing agent through the discharge head to the piping and nozzles. The Controller's "DISCHARGE" and "TROUBLE" lights will illuminate, the piezo horn will sound intermittently, and the Controller alarm relay contacts will transfer. The system will continue to discharge until the cylinder is depleted.

The Controller's alarm contacts must be connected to a power interrupting device to disconnect electrical power to the bench or process station.
CAUTION: ***Power to the Controller must not be interrupted, and the exhaust system is to remain operating. The system is designed to extinguish a fire with the exhaust operating.***

The Controller's key switch may be turned to the "RESET" position, turning off the release circuit and "DISCHARGE" light. Upon the optical detector(s) no longer "seeing" a fire, and the smoke or heat detector(s) no longer sensing fire, the Controller's key switch may be turned to the "ON" position. The piezo horn will sound steadily, the "DISCHARGE" light will turn off, and the "TROUBLE" light will remain illuminated. The "ALARM SILENCE" switch may be depressed to silence the horn. The yellow "TROUBLE" led will remain illuminated until the Control Head on the cylinder is returned to the "SET" position. The light will go out and the system will return to the normal condition, indicated by the illuminated green "NORMAL" led. Had any of the detectors continued to alarm, the controller will not reset, and will return to discharge status. Regardless of the controller returning to the normal condition, if the cylinder(s) have not depleted, the system will continue to discharge until the cylinder(s) are depleted.

In the unlikely event that a fire is observed by personnel before the detector(s) alarm, a manual release pull station may be activated by the operator, or the "MANUAL DISCHARGE" switch located on the Controller may be activated. Upon activation, the Controller responds as above as if the optical detector(s) had activated. The same reset procedure as above will be followed.
An emergency manual control is also present on all CO2 fire systems. The control heads on the CO2 cylinders contain a lever-operated manual release mechanism. Activation is accomplished by removing the safety pin, then pulling down the lever to cause the discharge head to release the CO2 agent from the cylinder. **CAUTION:** ***Use of the emergency manual control will only signal a "TROUBLE" on the Controller. The "DISCHARGE" light will not illuminate and the alarm relay will not activate. Personnel will not be warned of a system discharge.***

INSTALLATION

All CO2 detection and suppression systems are specifically designed for each application.
All installation guidelines and formats, as issued on the provided engineering drawing(s) for each system, must be followed exactly.

GENERAL GUIDELINES:

Piping

- The piping system must be rated for a minimum burst pressure of 5000 psi.
- The piping should be adequately secured at each transition fitting and at two foot intervals along its runs.
- The piping should be compatible for its intended environment. It should be coated or suitably protected against damage or degradation from harsh chemicals or acids.

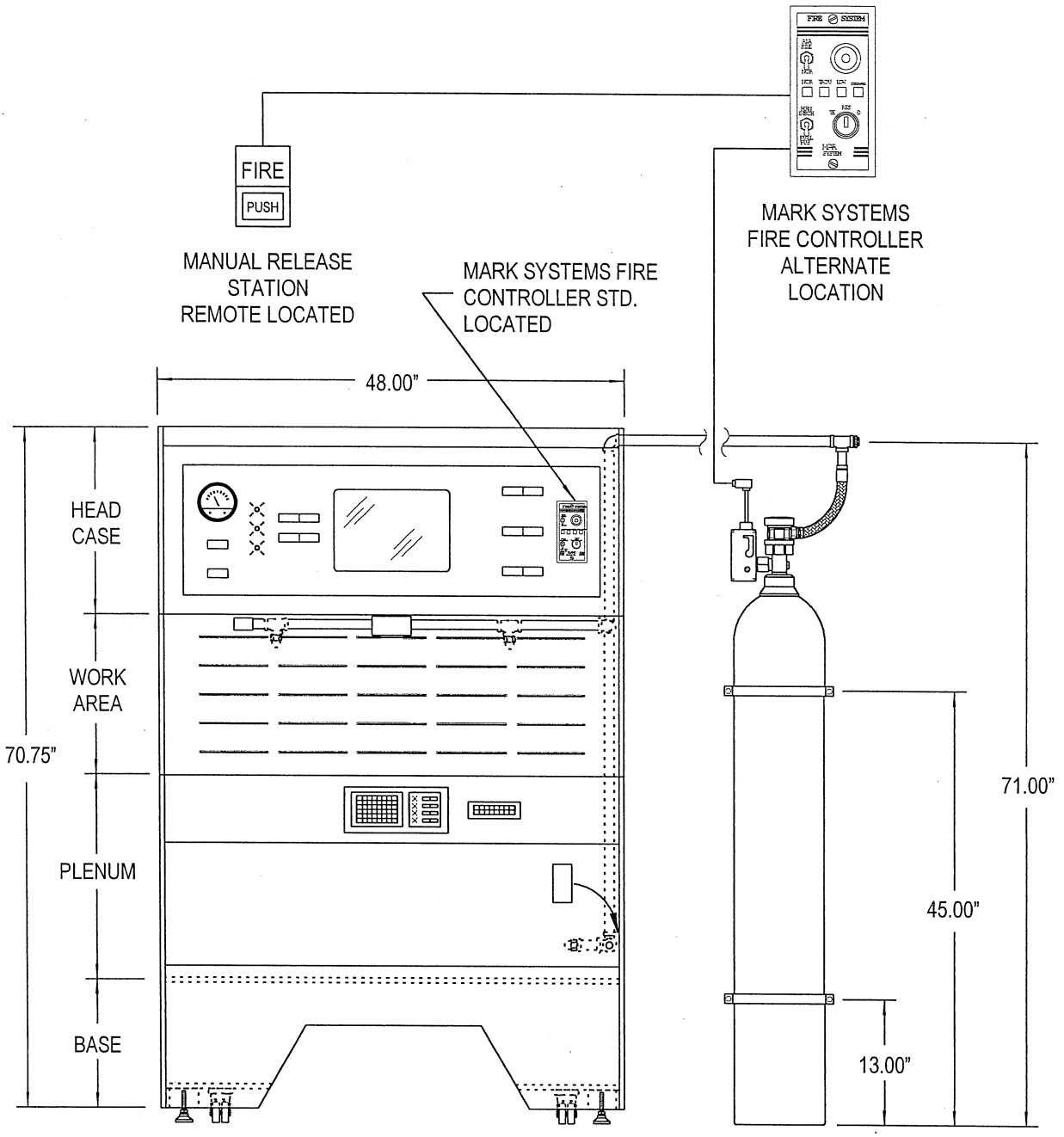
Nozzles

- The surface nozzles should be aimed toward the rear wall and rear of the work surface as illustrated on the specific engineering drawings. Never aim surface nozzles directly toward baths, open pools, or active processes. Other nozzles should be aimed as illustrated on engineering drawings.
- The nozzles should be compatible with their intended environment, and should be coated to protect against damage or degradation from harsh chemicals or acids.
- The nozzle blow-out caps should be left in place to avoid contamination of piping interior.

Detection

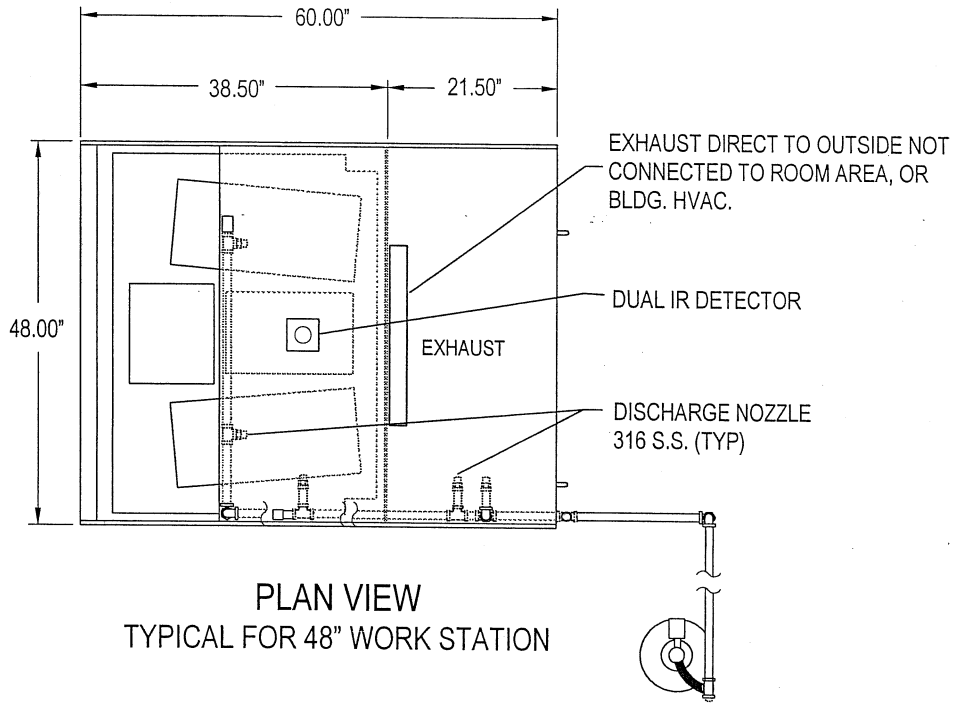
- The Dual IR optical detectors must be installed and aimed as illustrated on the specific engineering drawings to permit full view by each detector.
- The polypropylene enclosure of the Dual IR detector must be compatible with its intended environment, able to withstand exposure to intended chemicals and acids.
- The Linear Heat detector must be installed in the locations as illustrated on the specific engineering drawings, and specifically located and secured following the guidelines as shown in the following installation illustrations.

Note: Since the quantity and type of equipment required will differ from one system to the next, the following illustrations are meant to provide a basis for a typical application only.

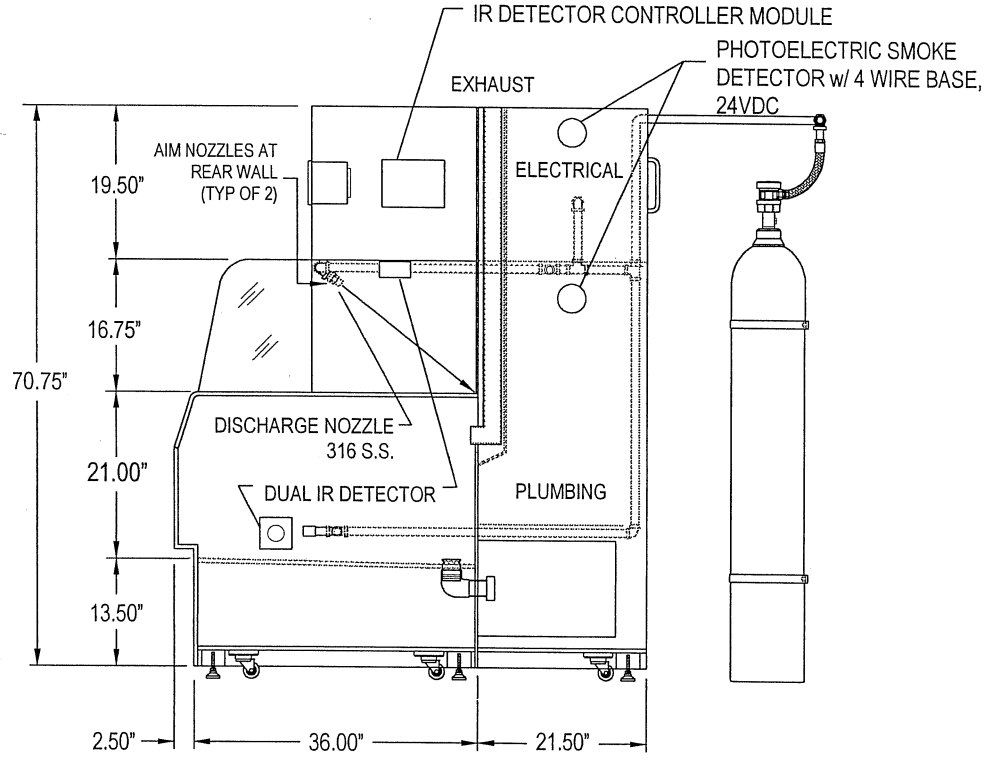


FRONT VIEW

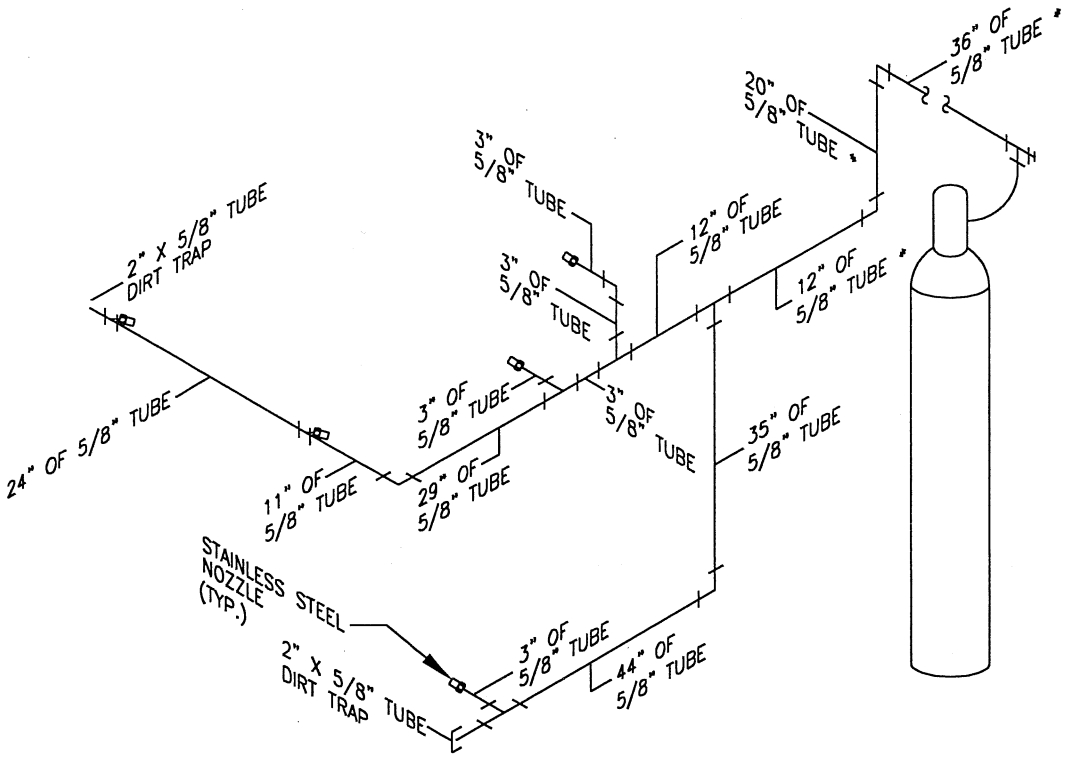
TYPICAL FOR 48" WORK STATION



PLAN VIEW
TYPICAL FOR 48" WORK STATION

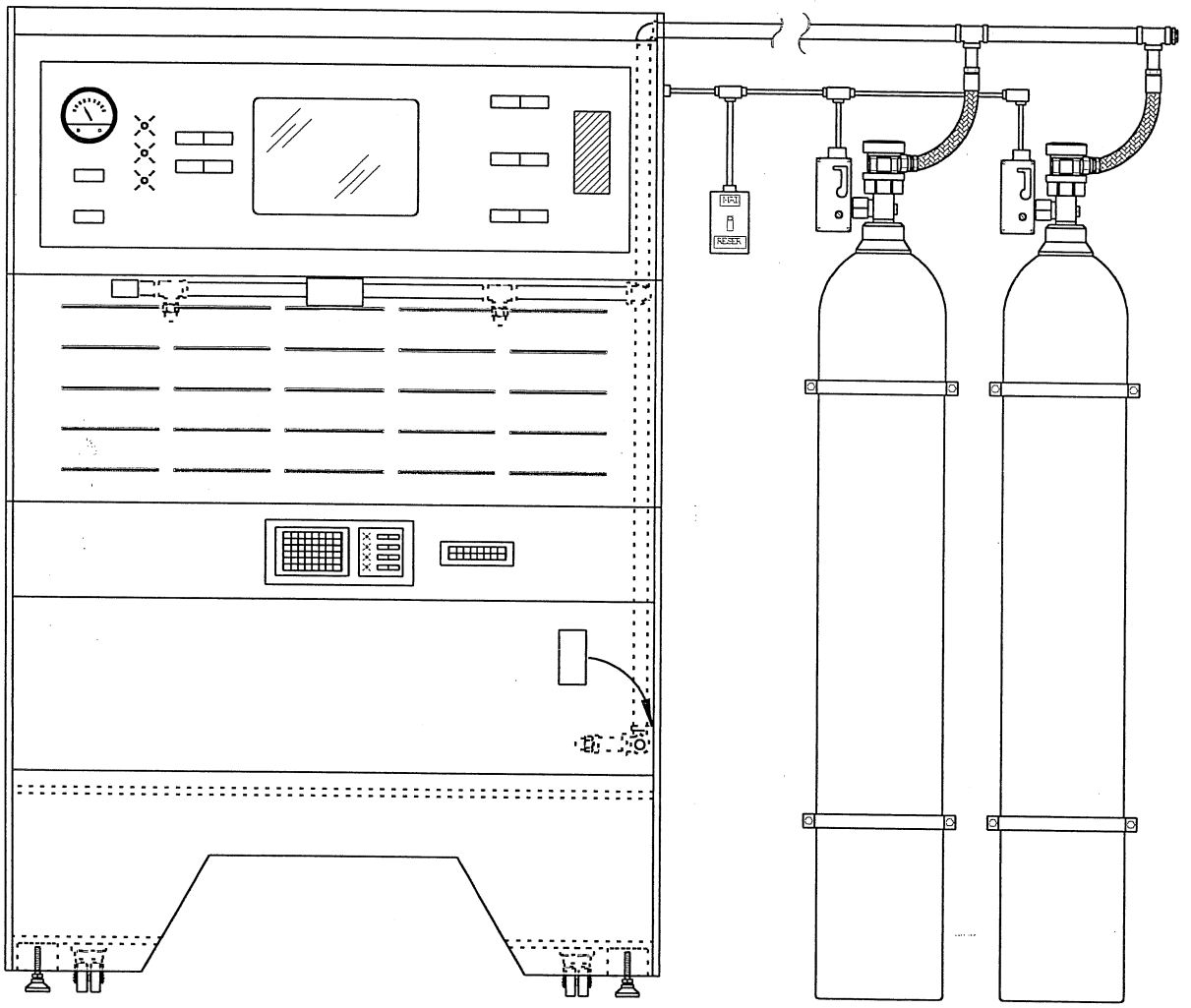


SIDE VIEW
TYPICAL FOR 48' WORK STATION



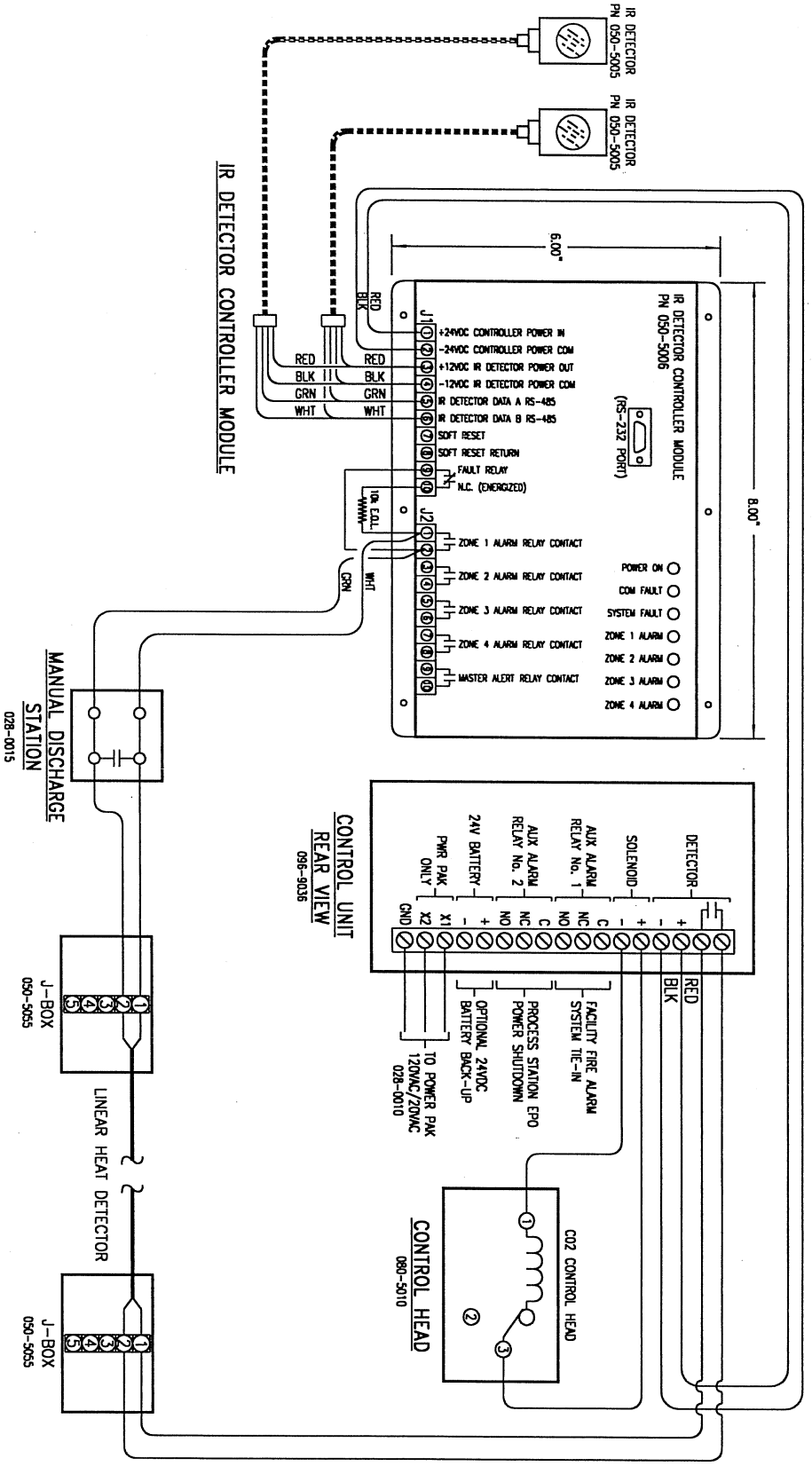
ISOMETRIC PIPING DIAGRAM

TYPICAL FOR 48" WORK STATION

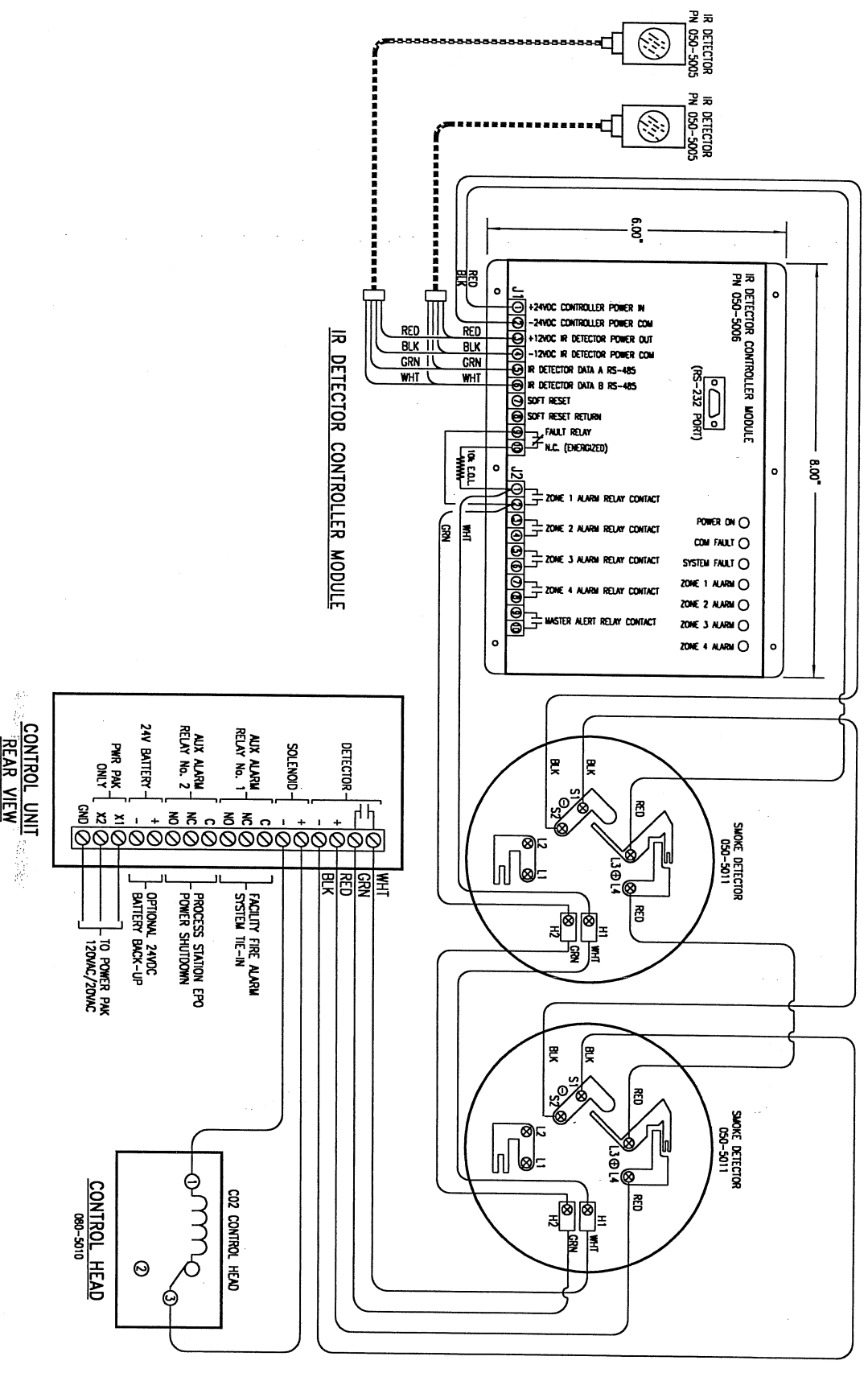


FRONT VIEW

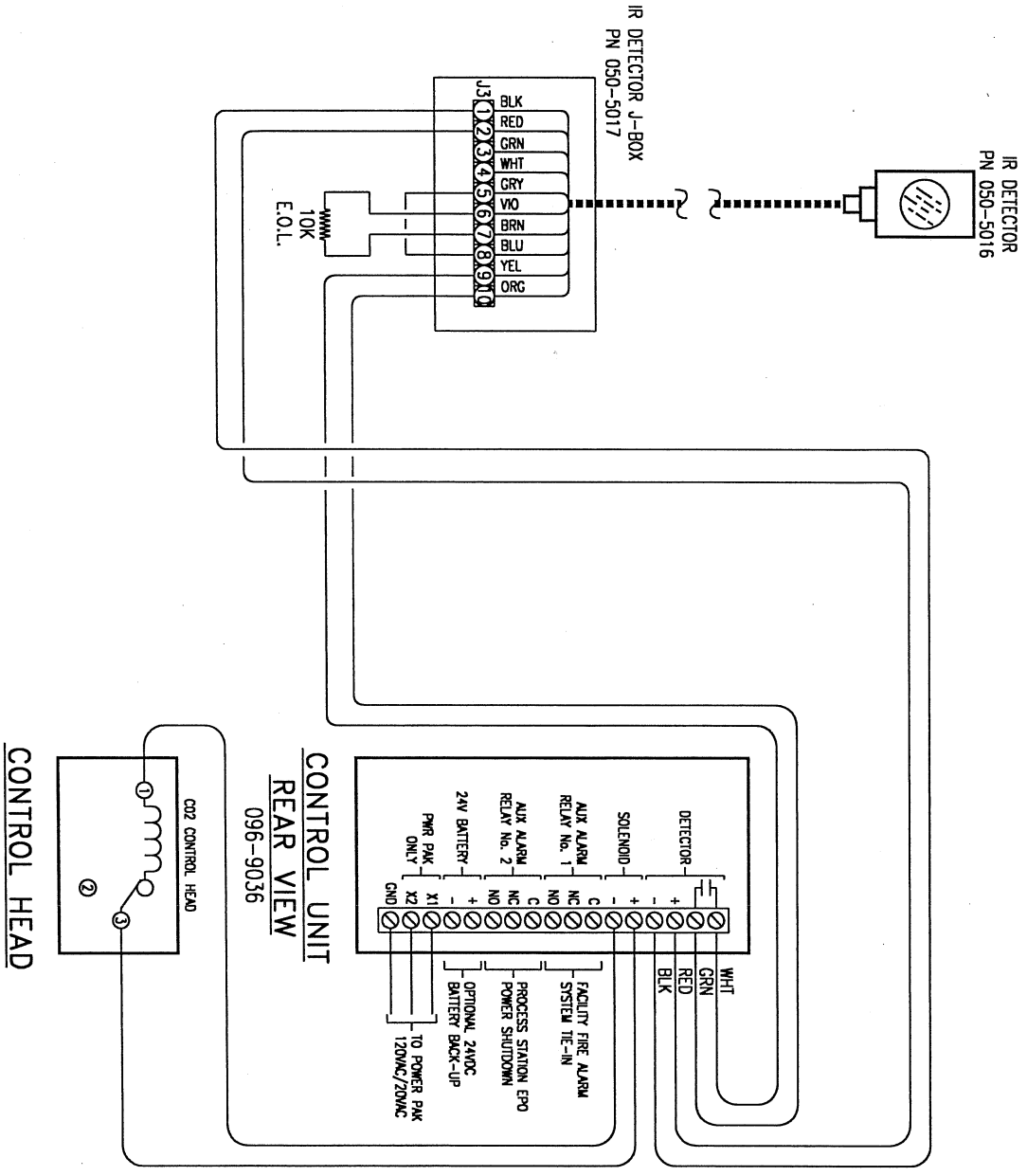
OPTIONAL CONNECTED RESERVE
TYPICAL FOR 48" WORK STATION



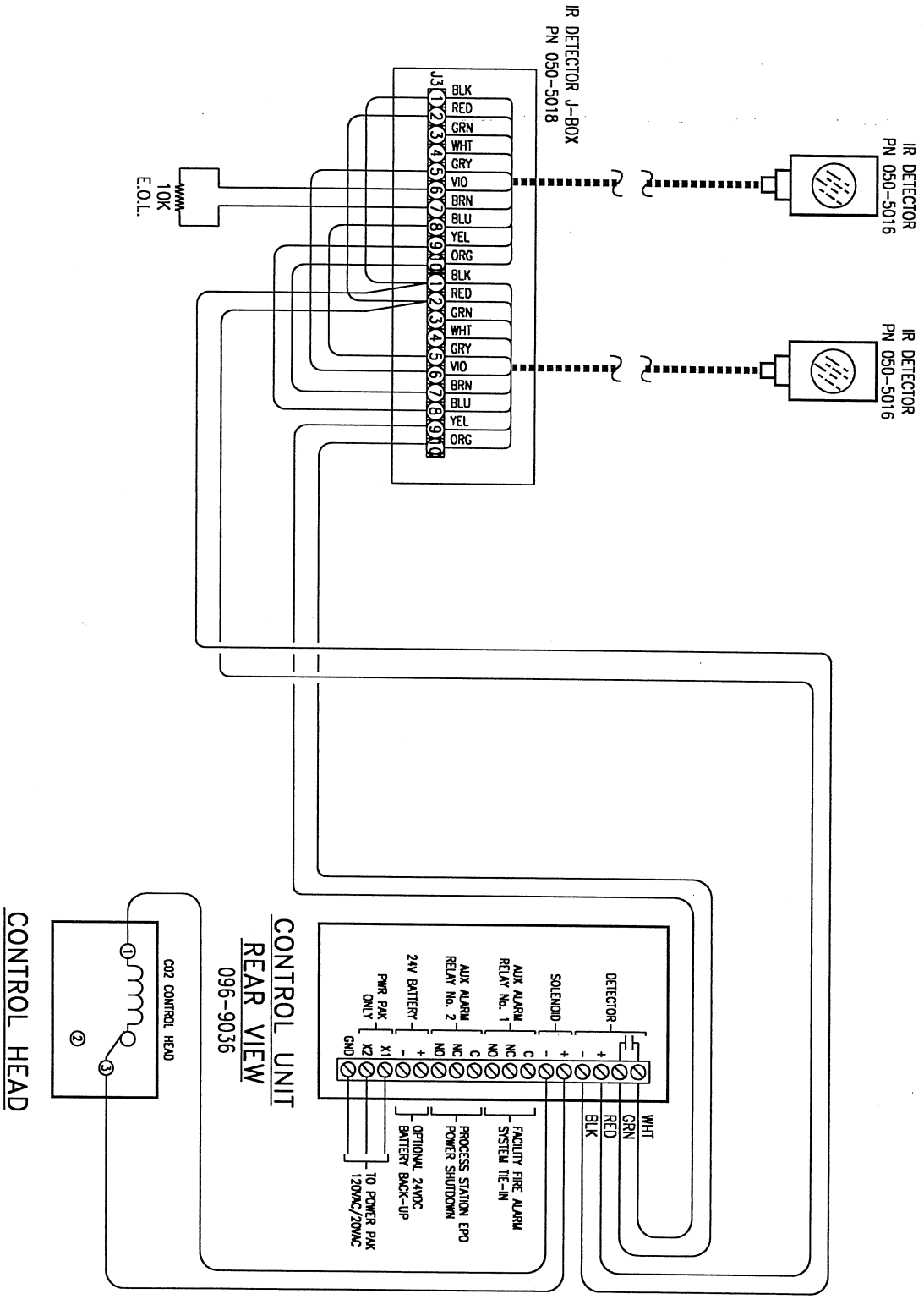
TYPICAL WIRING DIAGRAM FOR LINEAR HEAT DETECTOR AND MULTIPLE OPTICAL DETECTORS



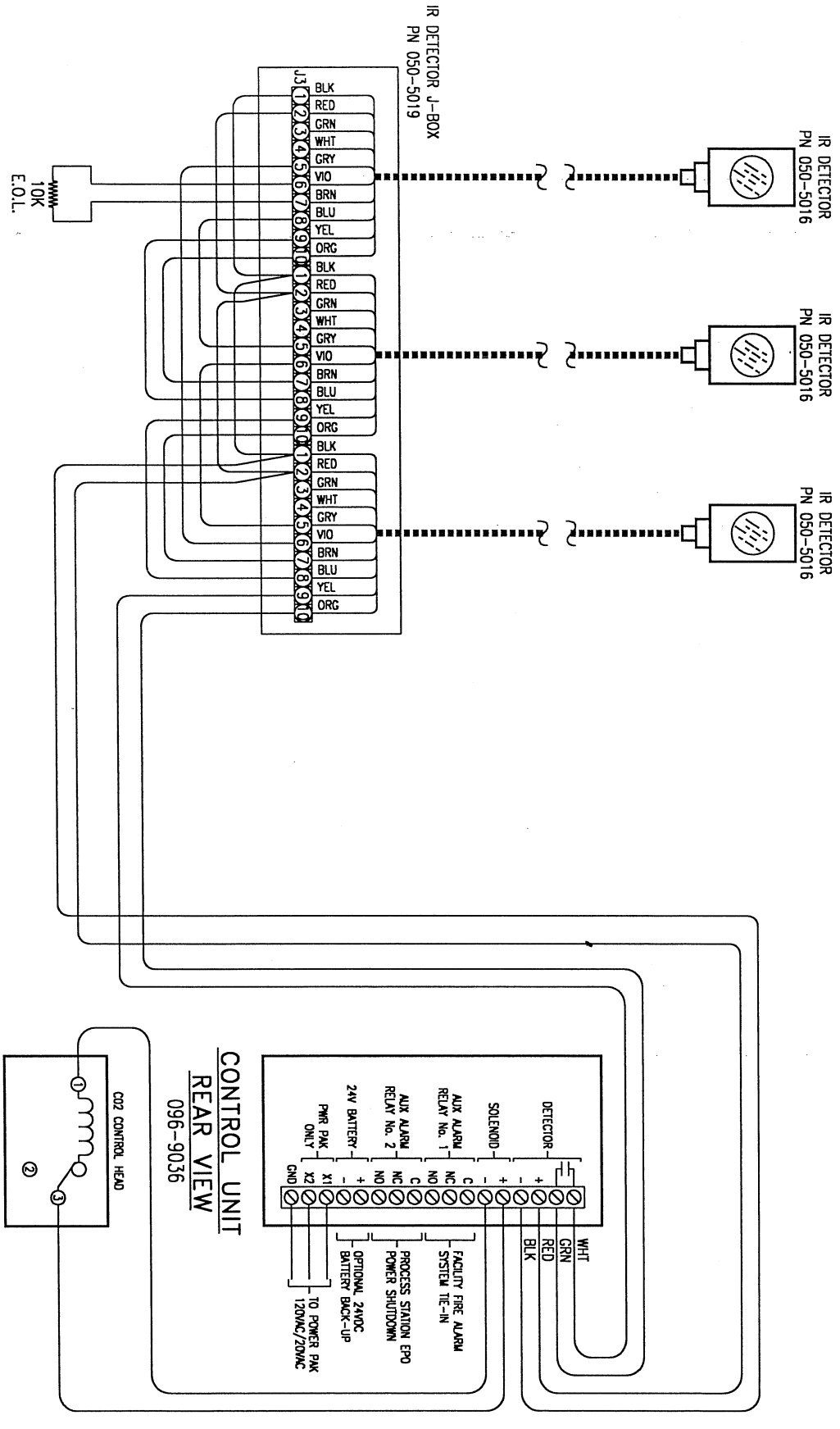
TYPICAL WIRING DIAGRAM FOR SMOKE DETECTORS
AND MULTIPLE OPTICAL DETECTORS



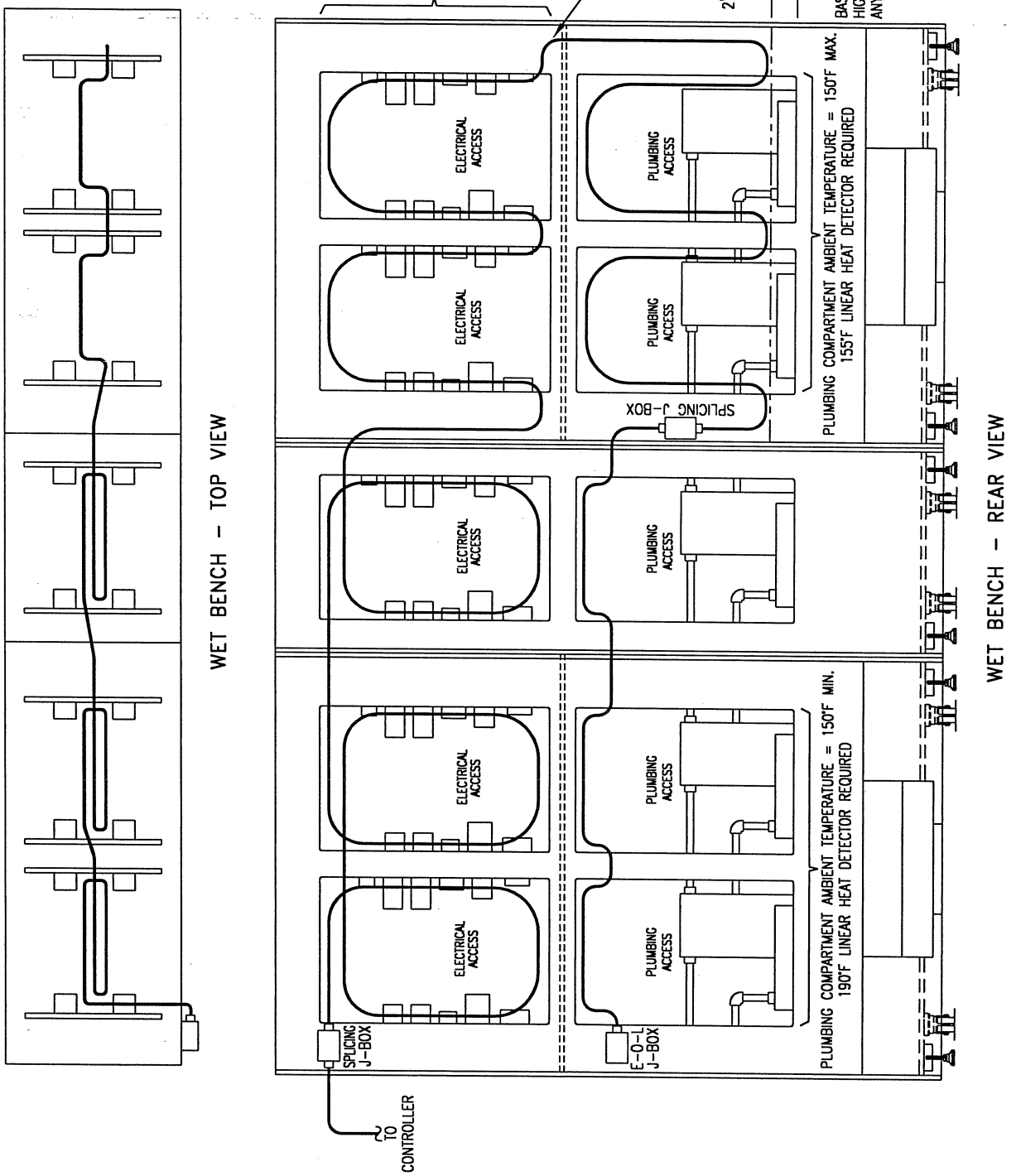
TYPICAL WIRING FOR SINGLE
STAND ALONE OPTICAL DETECTOR



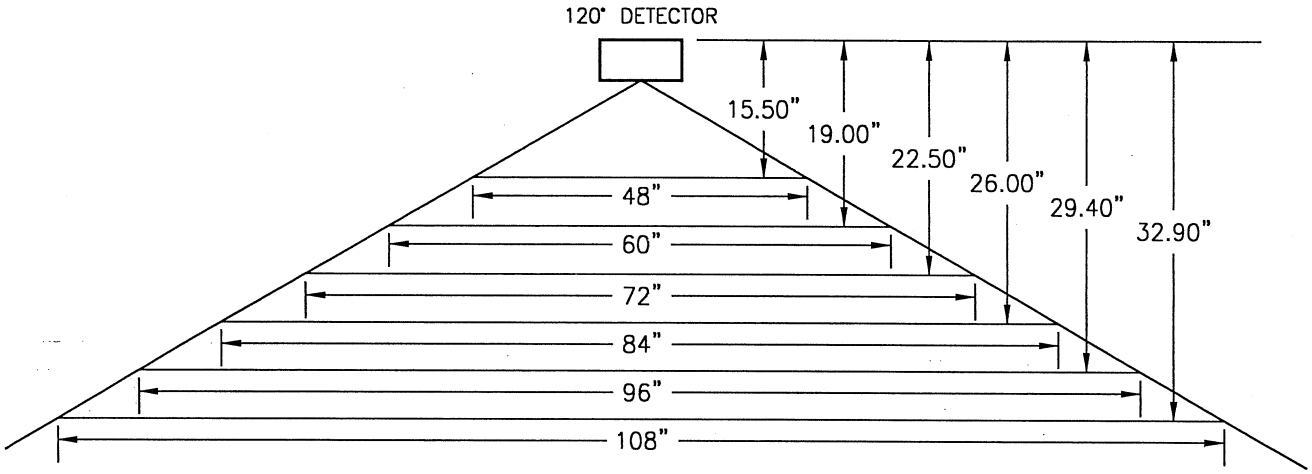
TYPICAL WIRING FOR DUAL
STAND ALONE OPTICAL DETECTORS



TYPICAL WIRING FOR TRIPLE
STAND ALONE OPTICAL DETECTORS



LINEAR HEAT DETECTOR
TYPICAL INSTALLATION



MINIMUM HEIGHT REQUIREMENT
OF OPTICAL DETECTOR
OVER WORK SURFACE

INSTALLATION GUIDELINES FOR OPTIMUM OPTICAL DETECTOR PLACEMENT

SYSTEM TEST

The system may be tested by the following procedure:

CAUTION: ***The Control Head(s) on the system to be tested must be removed from the CO2 cylinders before testing the system to prevent an accidental cylinder discharge.***

Aim the portable IR Tester (Part #050-5007 or Equiv.) at the first IR Detector to be tested for several seconds. Verify that the detector's internal green LED is steadily illuminated.
The red "DISCHARGE" light on the Controller should be illuminated, the piezo horn should be sounding intermittently, the System Alarm Relay should transfer, and the Control Head should have activated. Verify that the actuating pin of the Control Head has moved to its fully actuated position. Verify that the power to the bench (or other protected device) has been shut down by the Controller.

Turn the key switch on the Controller to the "RESET" position, then to the "ON" position.
Return the Control Head to the "SET" position with a flat blade screwdriver (the emergency release lever should be in it's normal position and safety pin in place); remove screwdriver. Verify that the actuating pin has retracted to it's normal position. Verify that the Controller has returned to the normal status.

Repeat the above test procedure for each remaining IR Optical Detector. Any Manual Release stations should also be tested, observing for the same functional parameters as with the detectors.

Each Smoke Detector (if equipped) may also be tested. ***The testing of smoke detectors should be performed only in strict accordance with procedures instituted for the clean room or other production areas.*** Smoke detectors with the label "THIS DETECTOR CONTAINS A BUILT-IN SENSITIVITY TEST FEATURE" may be tested by introducing a magnet to the location of the label, causing activation of the detector. Verify activation of the Controller and system as in the activation of the optical detector(s) above.

The Linear Heat Detection (if equipped) is tested by causing a short-circuit at the end of its run, across the end-of-line resistor located within the termination box at the end of the detection run.

Once all operational functions have been verified, and the Controller has been reset with no indicators illuminated, other than the "NORMAL" light, the Control Head may be re-installed onto the cylinder.

CAUTION: ***The Electric Control Head must be manually reset, visually indicating the "SET" position, and the tamper/safety pin in place before installing onto cylinder. Failure to perform and verify this procedure can result in unwanted discharging of cylinder.***

SYSTEM COMPONENTS

FIRE CONTROLLER

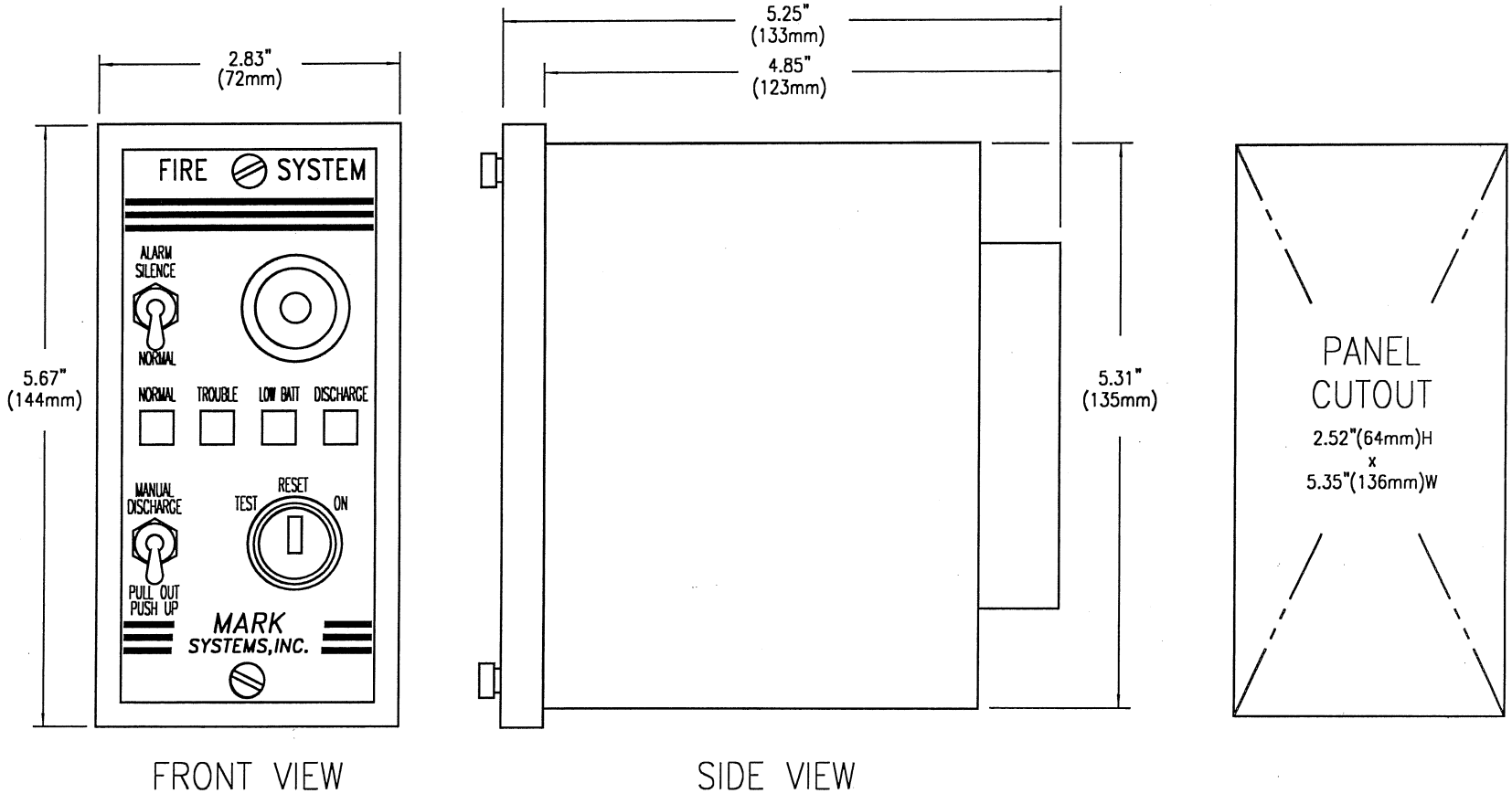
The Mark Systems Fire Controller is a single-zone, single-release compact system controller capable of operating and responding to various optical, smoke, and linear heat detectors. The front panel provides visual status indication of normal and trouble condition, supervisor circuit battery condition, and discharge alarm warning. Audible warning of a trouble condition or discharge is provided by a panel mounted piezo horn. A local manual discharge switch is provided on the front panel. An internal multi-segment LED bar located on the circuit board visually indicates which supervisor circuit is in trouble.

The Controller is available in different configurations supporting older model 12 volt optical and smoke detectors, current model 24 volt optical and smoke detection, and a model that provides a 30 second delay before discharge after receiving fire verification from connected detectors. Power for the Controller is provided from an external 115VAC wall outlet power pack provided with each controller.

Because of it's compact size, the Controller easily installs locally, if desired, on the wet bench or process station in the head case or base. The recommended location would be in a location away from the protected device, especially when relying on the use of the controller's manual discharge switch.

A 24 volt battery backup system is available providing power for the controller to allow for complete operation of the suppression system.

FIRE CONTROLLER DIMENSIONS



FRONT VIEW

SIDE VIEW

CO2 CYLINDER/VALVE ASSEMBLY

CAUTION: ***Charged CO2 Cylinders are highly pressurized and extremely hazardous. If not handled properly CO2 Cylinders are capable of violent discharge, resulting in serious bodily injury, death, or property damage. Trained, experienced personnel only should handle and install CO2 Cylinders.***

Carbon Dioxide is stored in steel cylinders under its own vapor pressure. The cylinders are manufactured in accordance with D.O.T. regulations and are available in 25, 35, 50, 75, and 100 pound capacities. Each cylinder is equipped with a forged brass valve assembly containing a safety burst disc protecting against over-pressurization.

The 25, 35, and 50 pound cylinders contain an internal 'bent' siphon tube, allowing the cylinder to be installed lying on its side. These cylinders are marked on their side with an indicator line and statement "THIS LINE UP IF CYLINDER NOT VERTICAL". When installing in this position, the cylinder must be installed according to this line.

The 75 and 100 pound cylinders contain a 'straight' siphon tube and must only be installed in the vertical position.

The valve of each cylinder mates with a discharge head for agent release and distribution to the protected area(s).

See Table 1 and Figures 1&2 following for cylinder data.

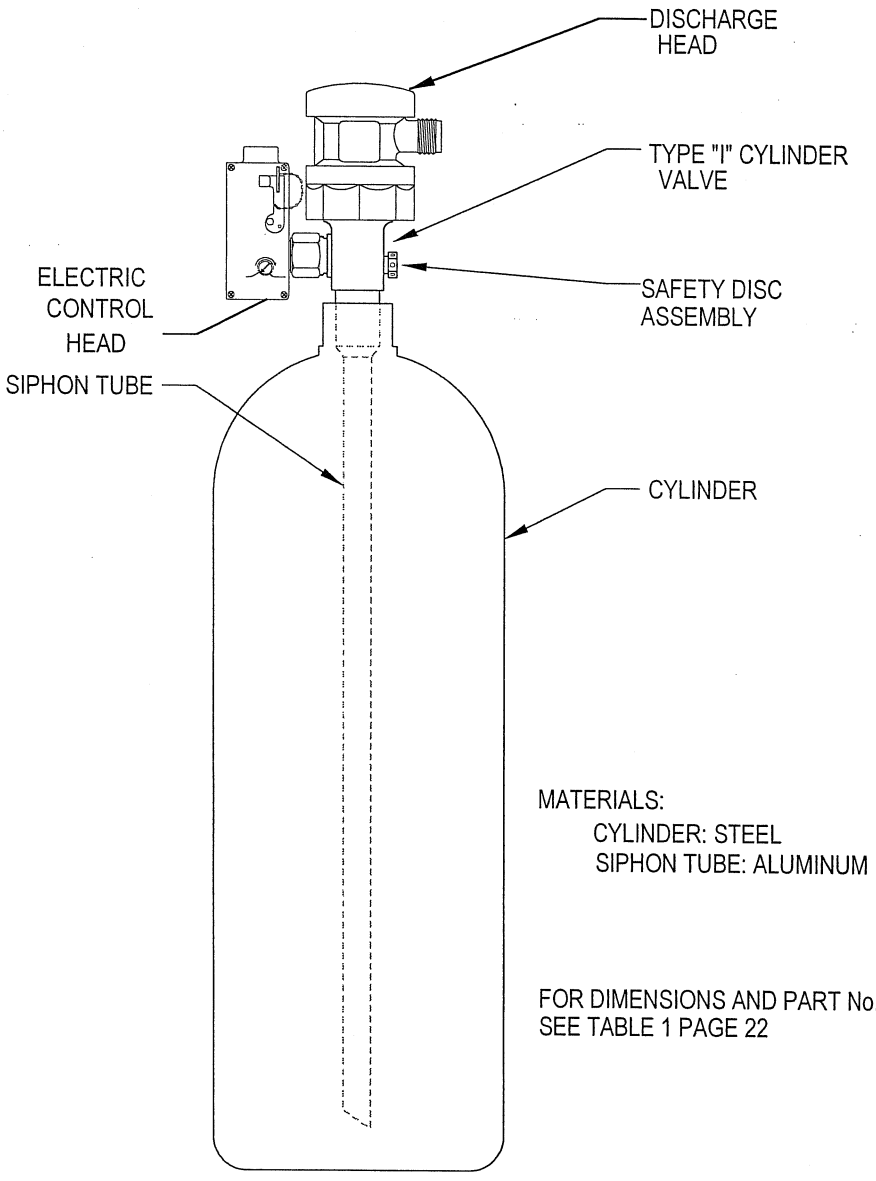
TABLE 1

Part Number	Cylinder Capacity (lbs.)	Nominal Charged Wt. (lbs.)	Height * (Inches)	Diameter (Inches)	Volume (Cu. In.)
075-5001	25	84	34	8.5	1040
075-5002	35	114	43	8.5	1510
075-5003	50	155	59	8.5	2300
075-5004	75	205	64	9.25	3055
075-5005	100	288	66	10.50	4070

* NOTE: Height including Discharge Head plus 2" clearance for Discharge Head removal.

CAUTION: ***The 35, 50, 75, and 100 pound cylinders are factory-equipped with a protection cap which threads securely over the valve assembly as a safety feature providing protection during handling.***
Except when the cylinders are connected to the system piping or being filled, the protection cap must be installed at all times. Do not move or handle these larger CO2 cylinders unless the protection cap is installed.

75 & 100 LB.
CARBON DIOXIDE CYLINDER
STRAIGHT SIPHON TUBE



MATERIALS:
CYLINDER: STEEL
SIPHON TUBE: ALUMINUM

FOR DIMENSIONS AND PART No.
SEE TABLE 1 PAGE 22

FIGURE 1

25 LB., 35 LB. & 50 LB.
CARBON DIOXIDE CYLINDER
BENT SIPHON TUBE

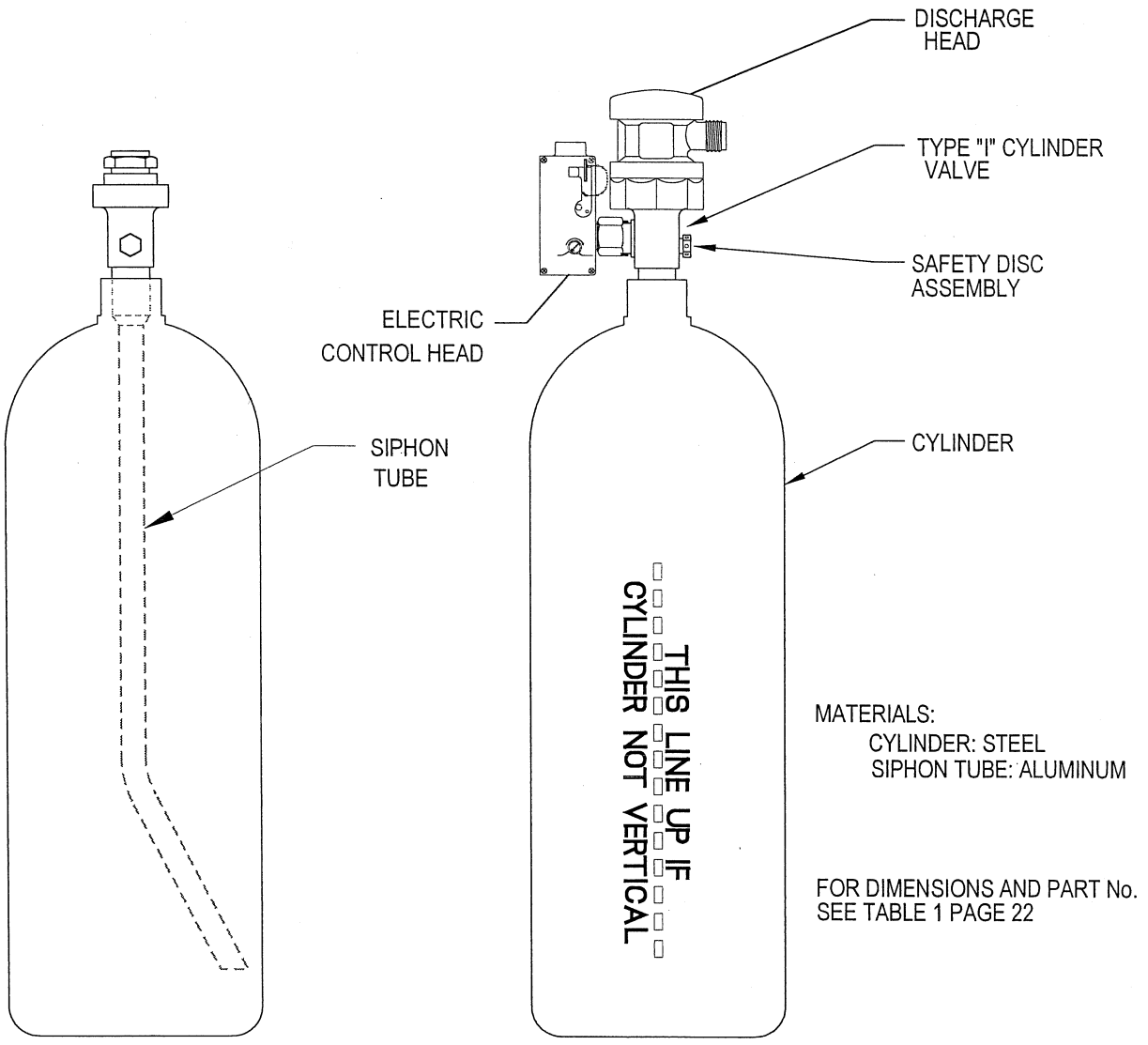
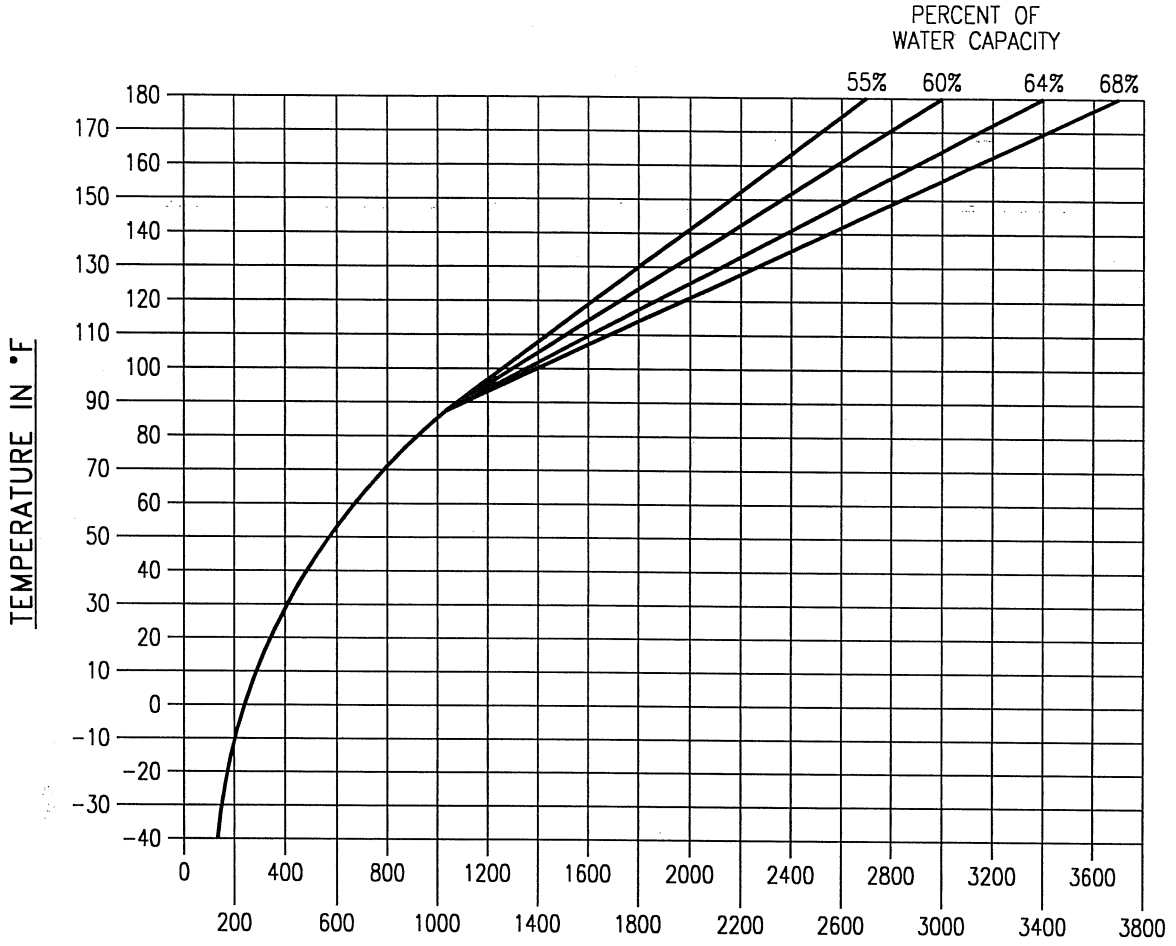


FIGURE 2

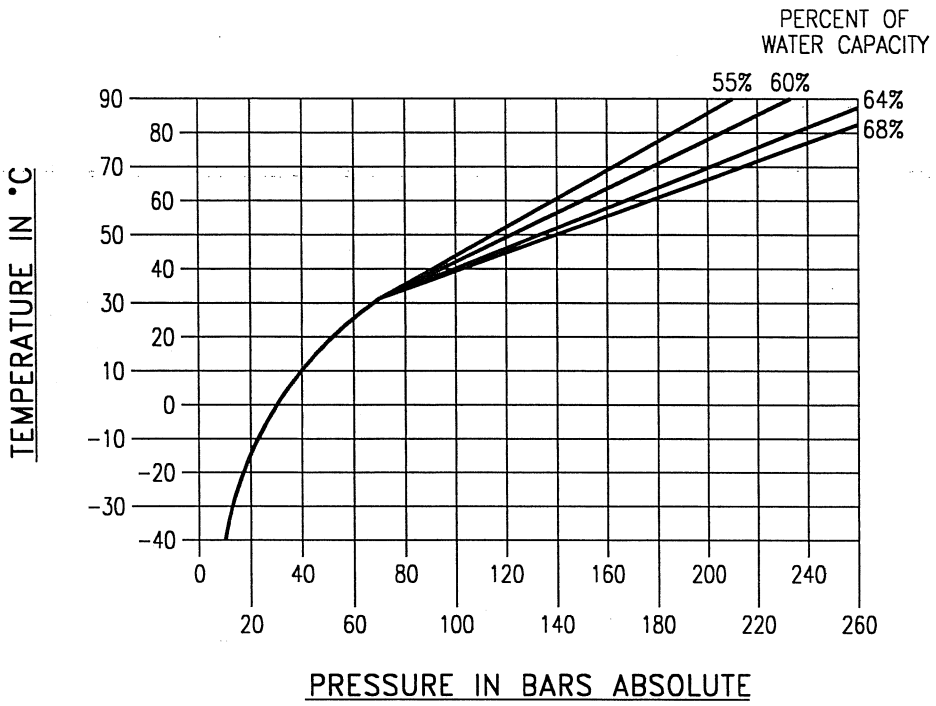


$$\text{PERCENT OF WATER CAPACITY} = \frac{\text{RATED } CO_2 \text{ CAPACITY OF CYLINDER IN LBS.}}{\text{WATER CAPACITY OF CYLINDER IN LBS. AT 60°F}} \times 100$$

CRITICAL TEMPERATURE OF CO_2 = 88°F

RATED CO_2 CAPACITY OF CYL. IN LBS.	PERCENT OF WATER CAPACITY
10	55
15, 20, 25, 35	60
50	64
75, 100	68

PRESSURE VS. TEMPERATURE FOR CARBON DIOXIDE CYLINDERS (ENGLISH)



$$\text{PERCENT OF WATER CAPACITY} = \frac{\text{RATED } CO_2 \text{ CAPACITY OF CYLINDER IN KG.}}{\text{WATER CAPACITY OF CYLINDER IN KG. AT 16°C}} \times 100$$

CRITICAL TEMPERATURE OF CO_2 = 31°C

RATED CO_2 CAPACITY OF CYL. IN KG.	PERCENT OF WATER CAPACITY
4.5	55
6.8, 9.0, 11.3, 15.8	60
22.6	64
34.0, 45.3	68

PRESSURE VS. TEMPERATURE FOR CARBON DIOXIDE CYLINDERS (METRIC)

DISCHARGE HEAD

The discharge head is assembled to the top of the cylinder valve and contains a spring-loaded piston which, when pressurized by carbon dioxide vapor, is designed to depress the main check in the valve and discharge the contents of the cylinder. The piston has a non-uniform cross-section which provides the mechanical advantage to depress the valve's main check. The discharge outlet is designed to mate to a flexible hose for connection to the distribution piping.

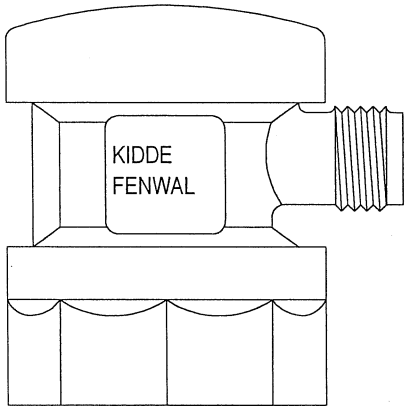
Two different discharge heads are available.
Part Number 080-5001, a plain-nut discharge head, discharges the contents of the cylinder upon activation of the cylinder valve by its attached control head, or upon application of pressure entering through the outlet of the discharge head.

Part Number 080-5012, a grooved-nut discharge head, can only be actuated by the cylinder valve by its attached control head. Carbon dioxide fluid entering the outlet will not actuate the cylinder valve.

CAUTION: ***Discharge heads must be permanently connected to the system piping. Never attach discharge heads to cylinder valves until the cylinders are secured in cylinder straps or racking.***

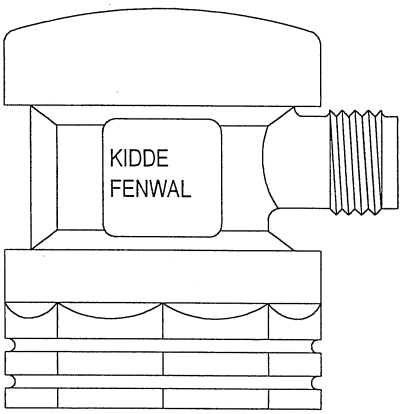
Under no circumstances is the discharge head to remain attached to the cylinder valve after removal from service, during shipment, handling, storage, or during filling. Failure to follow these instructions could result in serious bodily injury, death, or property damage.

PLAIN NUT
DISCHARGE HEAD



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

GROOVED NUT
DISCHARGE HEAD



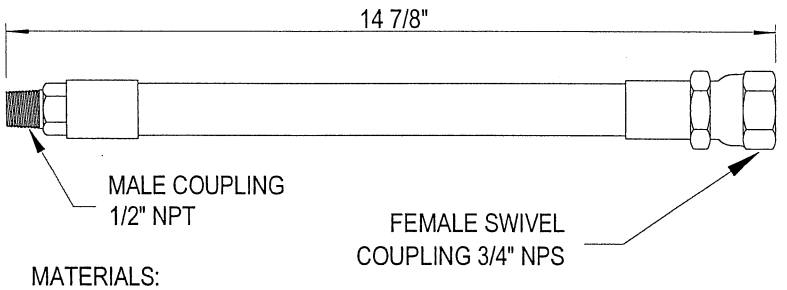
MATERIALS:
- BODY: BRASS
- O-RINGS: RUBBER
- SPRING: STAINLESS STEEL
- STOP CHECK: BRASS

FLEXIBLE HOSE

Flexible discharge hoses are used to provide the interconnection between the discharge head and the system piping or distribution manifold. The hoses are manufactured of wire-reinforced rubber.
Two different flexible hoses are available.
Part number 080-5002 is a ½" outlet hose used with all cylinder sizes.
Part number 080-5003 is a ¾" outlet hose used with 75 and 100 pound cylinders in multiple cylinder systems.

CAUTION: ***Flexible hoses must be connected to the system piping and to the discharge head before attaching the discharge head to the cylinder valves to prevent injury in the event of inadvertent CO2 discharge.***

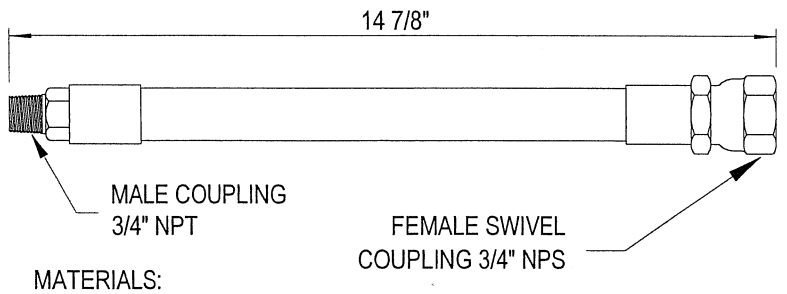
FLEXIBLE HOSE
1/2" OUTLET



MATERIALS:

HOSE: 5/8", RUBBER W/
INTERNAL WIRE BRAID
COUPLINGS: CADMIUM PLATED STEEL

FLEXIBLE HOSE
3/4" OUTLET



MATERIALS:

HOSE: 5/8", RUBBER W/
INTERNAL WIRE BRAID
COUPLINGS: CADMIUM PLATED STEEL

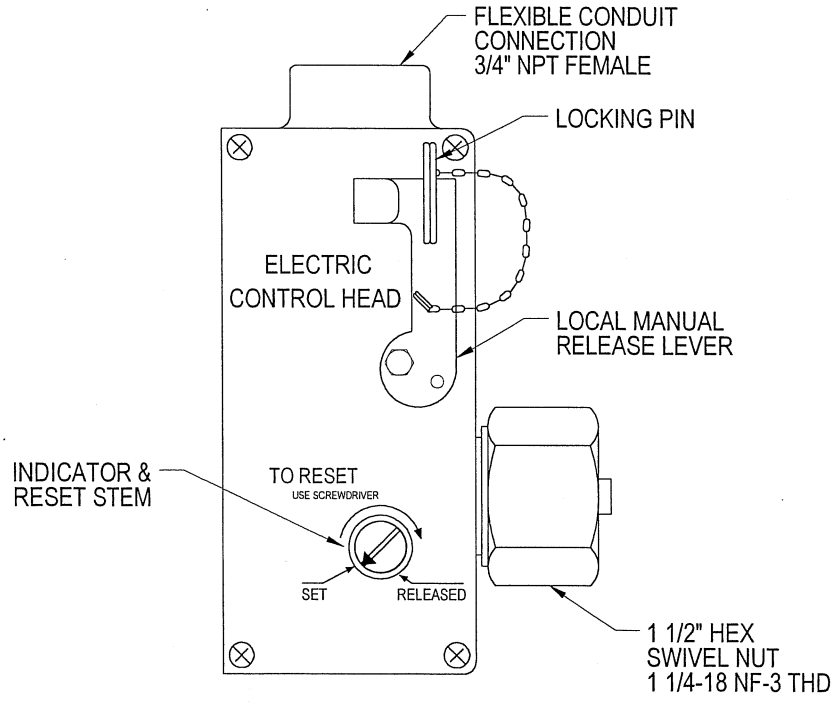
ELECTRIC CONTROL HEAD

The electric control head, part number 080-5010, is an electromechanical device used to actuate CO2 cylinder valves, stop valves, or directional valves. The electric control head attaches to the control port of the CO2 cylinder valve. An electrical signal energizes a solenoid in the control head which trips a spring-loaded mechanism and displaces an actuating pin. The actuating pin engages the pilot check on a cylinder valve, which allows CO2 vapor to pressurize the inlet side of the discharge head's spring-loaded piston, causing the release of CO2 through the discharge head. The electric control head is also equipped with a manual release lever for local operation. The manual release lever is protected by a tamper/safety pin which must be pulled prior to activating the manual release lever.

The electric control head contains a microswitch with contacts used to break the electrical actuating signal to the solenoid upon the action of the spring-loaded mechanism, reducing the overall power consumption of the system controller. The actuating pin latches in the released position and must be mechanically reset. Electrical connections should be made to the Electric Control Head by flexible conduit for protecting the wiring, and allowing ease of installation and removal of control head for maintenance and testing of the suppression system.

One control head is required for suppression systems with one or two cylinders. Two control heads are required for suppression systems having three or more CO2 cylinders.

CAUTION: ***Control heads must be in the set position before attaching to the cylinder valve to prevent the accidental discharge of CO2.***



CYLINDER STRAP

Cylinder straps are designed to retain cylinders in place against a wall or other supporting structures, to prevent the cylinders from being damaged and from the possibility of creating a hazard by tip-over.

Cylinder straps are manufactured of heavy gauge steel and protected by a coating of paint.

Two single cylinder straps are provided with each 75 and 100 pound cylinders, and one or two single cylinder straps are provided with each 25, 35, and 50 pound cylinder. Double cylinder straps are provided for cylinders in multiple cylinder systems and for reserve cylinder systems.

Also available are cylinder rack assemblies for more complex multiple cylinder systems.

See Table 2 and Table 3 below for cylinder strap dimensions.

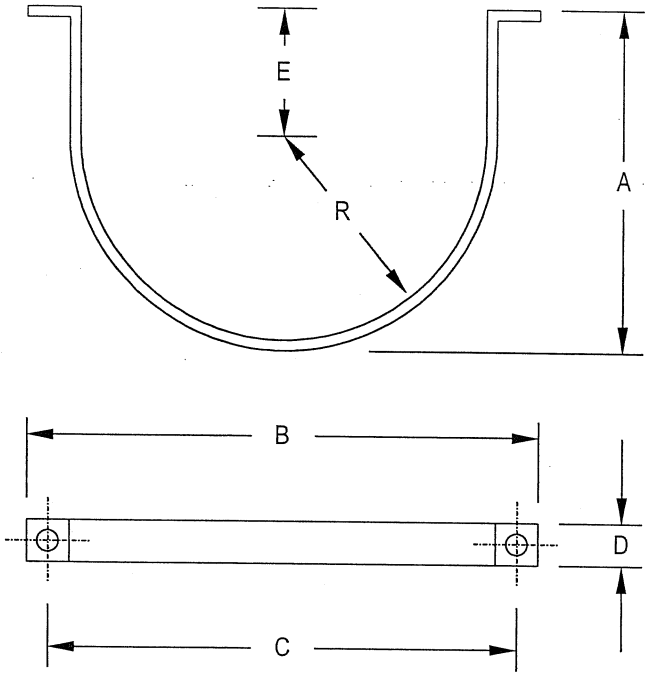
TABLE 2 SINGLE CYLINDER STRAP DIMENSIONS

Part Number	Cylinder Size	A		B		C		D		E		R	
		IN.	MM	IN.	MM	IN.	MM	IN.	MM	IN.	MM	IN.	MM
080-5005	25, 35, 50	7.94	202	11.5	292	10.4	264	1.00	25.4	3.50	88.9	4.25	108
080-5006	75	5.63	143	12.3	312	11.1	282	1.25	31.8	3.75	95.2	4.63	118
080-5008	100	10.0	254	14.0	356	12.4	315	1.75	44.4	4.50	114	5.31	135

TABLE 3 DOUBLE CYLINDER STRAP DIMENSIONS

Part Number	Cylinder Size	A		B		C		D		E		R	
		IN.	MM	IN.	MM	IN.	MM	IN.	MM	IN.	MM	IN.	MM
080-5007	50, 75	7.75	197	22.8	579	21.5	546	1.75	44.4	2.88	73.1	4.63	118
080-5009	100	10.3	262	25.6	650	24.3	617	1.75	44.4	4.72	120	5.28	134

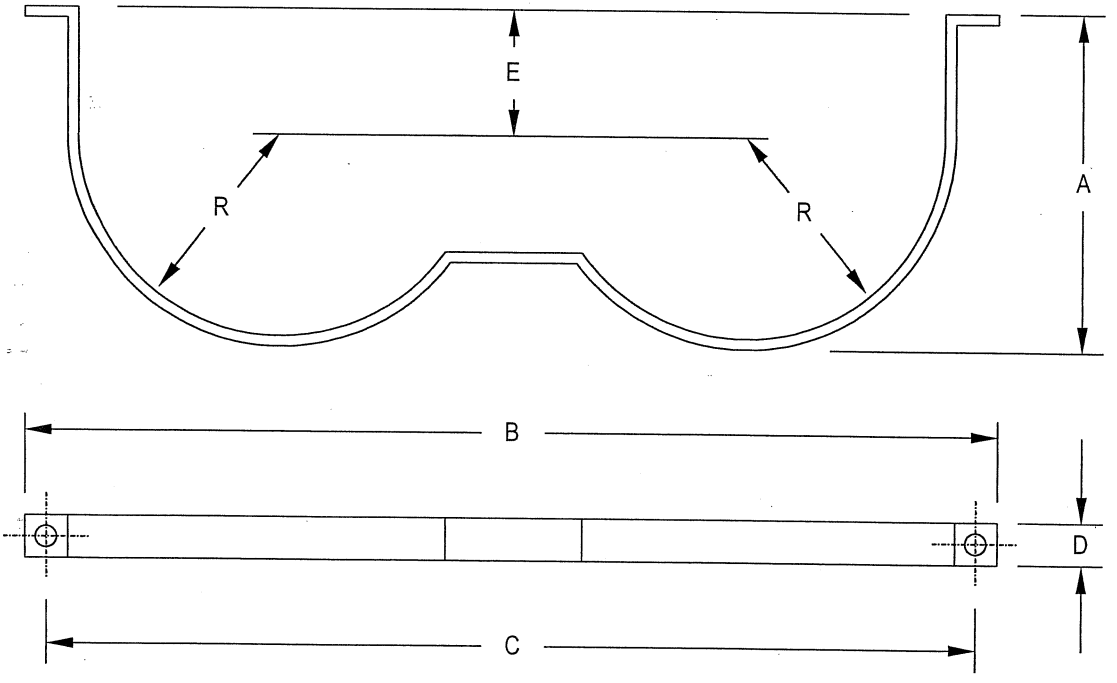
CAUTION: ***All CO2 cylinders must be supported at all times with cylinder straps. Cylinders in service, out of service, in reserve systems, and spare cylinders either empty or full must be supported with cylinder straps or stored in their cylinder rack.***



SINGLE CYLINDER STRAP

MATERIAL: STEEL

FOR DIMENSIONAL INFORMATION SEE TABLE 2 PAGE 32



DOUBLE CYLINDER STRAP

MATERIAL: STEEL

FOR DIMENSIONAL INFORMATION SEE TABLE 3 PAGE 32

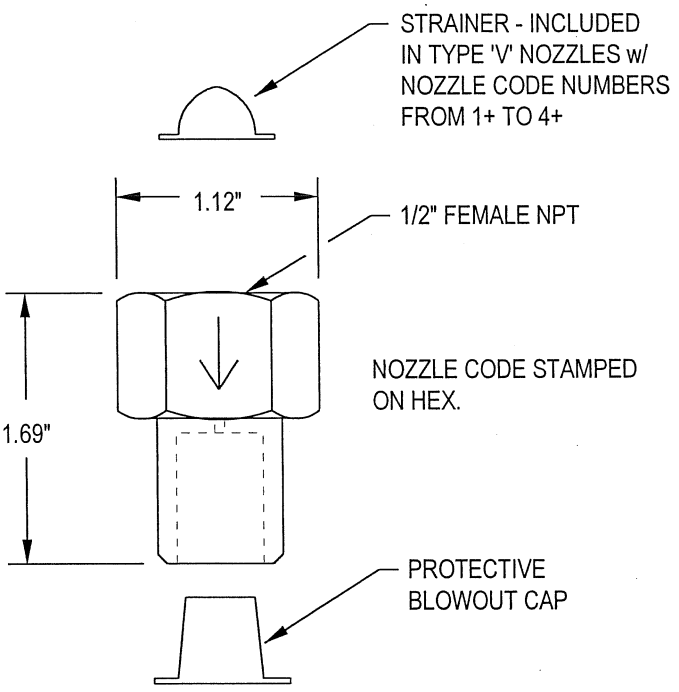
TYPE 'V' VENT DISCHARGE NOZZLE

The Type 'V' discharge nozzle is a single-orifice nozzle used to control the distribution of CO2 into the protected area. The nozzles are designed to provide the proper combination of flow rate and discharge pattern to protect vital equipment and processes in a total-flooding manner, or local application.

The Type 'V' discharge nozzles are permanently marked to identify the nozzle's orifice size and the direction of flow of the CO2 agent.

The nozzle material is Type 316 Stainless Steel. A Teflon coated version of the nozzle is available for installations in highly acidic and corrosive atmospheres. All nozzles are equipped with plastic end caps to prevent gas and liquid infiltration into the nozzle and piping while in the static state. Nozzles with orifice codes 1.5 thru 4.5 are supplied with an internal Monel strainer.

Part numbering scheme is 074-5005-X, where 'X' represents the orifice size code. 074-5005-XT, where 'X' represents the orifice size code, and 'T' represents Teflon coating. Orifice codes are determined specifically per application by calculation through the fire system design process.



DISCHARGE NOZZLE

316 STAINLESS STEEL

OPTICAL FIRE DETECTOR

Part number 050-5016, an optical fire detector, is a polypropylene enclosed multi-spectral sensor array consisting of wide band IR, near band IR, and visible sensors. A built-in LED flashes every ten seconds to indicate power 'ON', rapidly flashes for an 'alert' level fire, and lights steady for an 'alarm' level fire. The detector connects to a junction box where all wiring terminations are established.

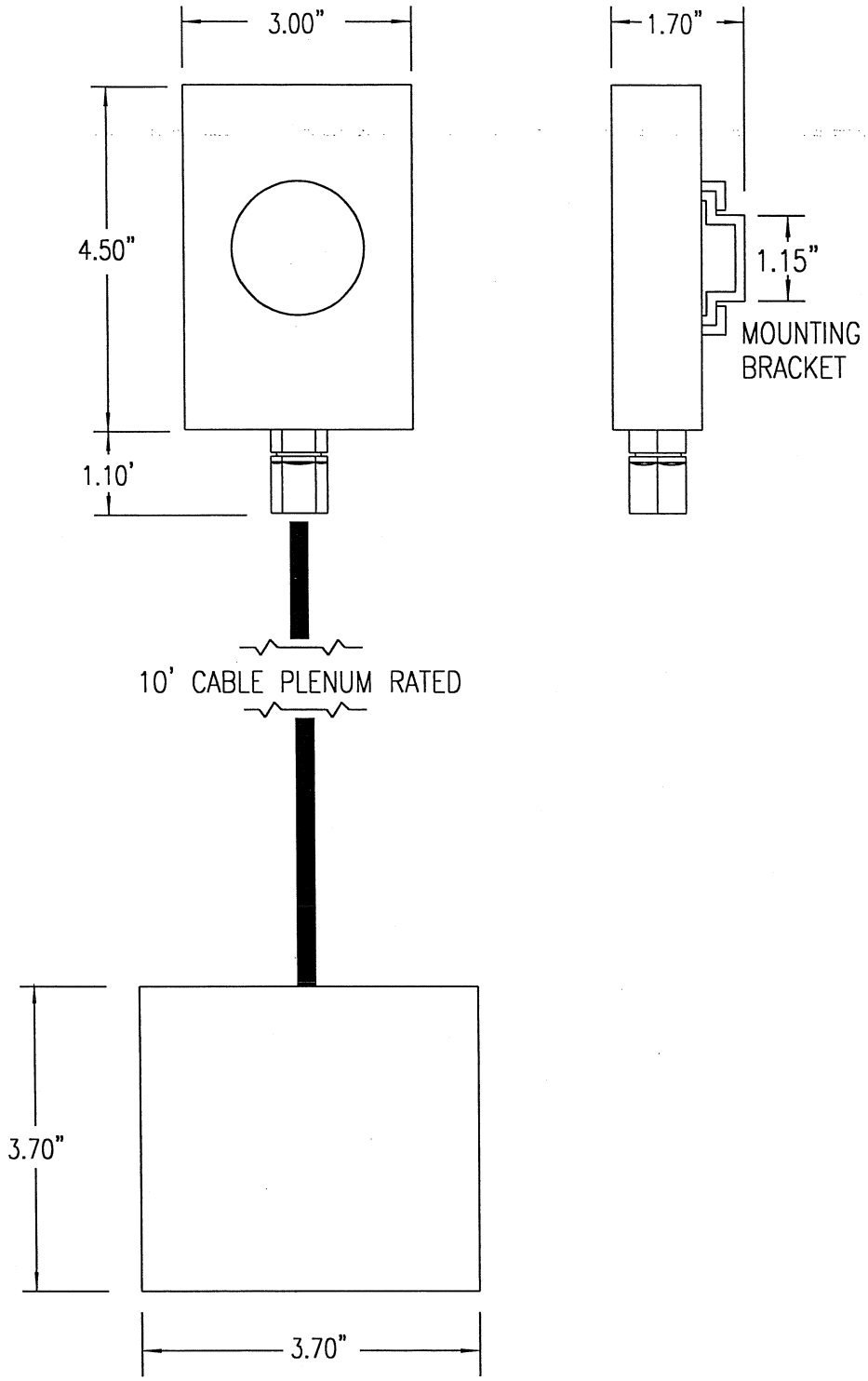
The detector is designed to see all types of hydrocarbon and non-hydrocarbon fires. It will respond to a polypropylene fire of four inch diameter (3kW) for 'alert' at six feet distance. It will respond to a polypropylene fire of eight inch diameter (13kW) for 'alarm' at six feet distance. The detector features a 120° field-of-view. Multiple detectors may be required to protect large surface and plenum areas to maintain safe coverage.

An internal fault relay, energized with a closed contact during normal operation, will de-energize with an open contact upon internal circuit failure, loss of power to the detector, or a break in any wiring of the detector. A 10Kohm end-of-line resistor installs in the junction box of a single detection system, and in the 'last' detector of a multi-detection system.
An internal alarm relay, de-energized with an open contact during normal operation, will energize with a closed contact upon the detector 'seeing' a fire of magnitude 13kW. The contact closure signals the controller of the presence of a fire, and to initiate the release of CO2 agent.

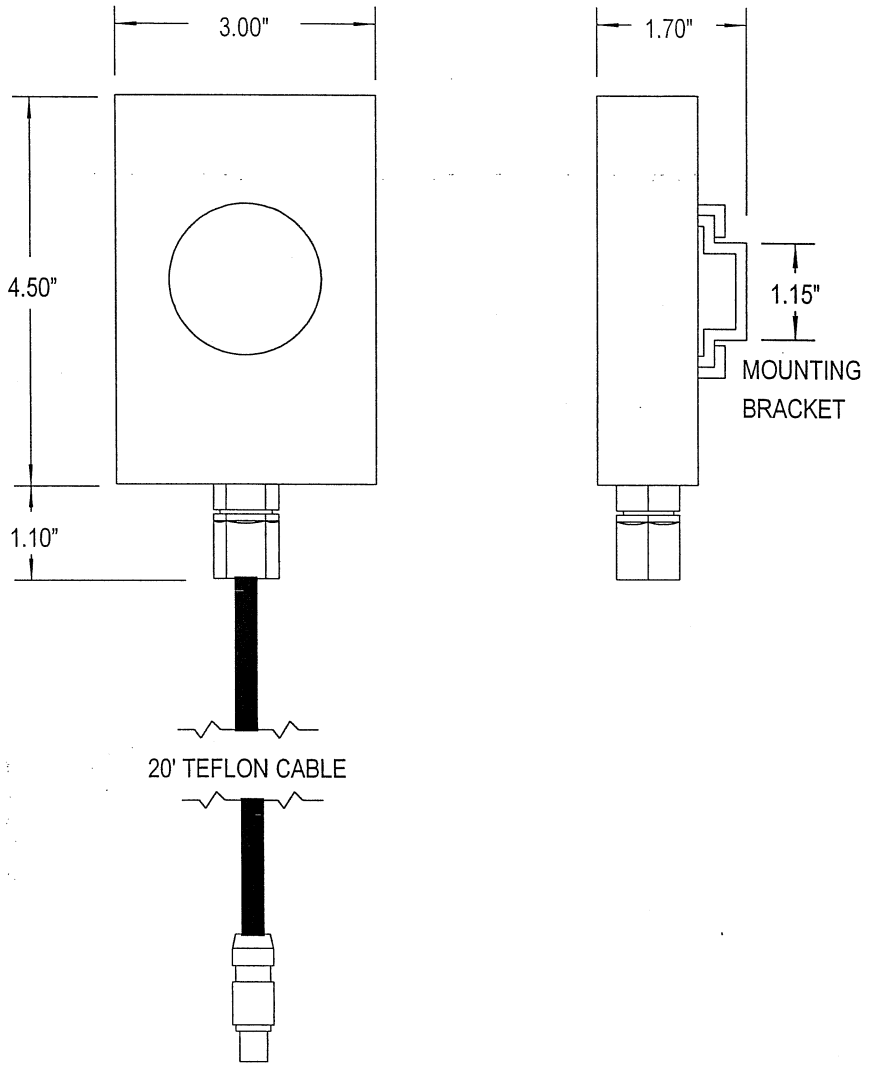
The detector enclosure is of molded polypropylene with a sealed water resistant seam and cable exit. The cable is a shielded multi-conductor PVC jacketed cable of twenty foot length.

Part number 050-5009 is a detector used in a multiple detection system with a multi-channel controller module. It is supplied without the built-in relays as above, but communicates to the controller via RS-485 interface. This detector also uses a multi-conductor Teflon jacketed terminated with a 4-conductor connector. The connectors plug onto a junction box capable of connecting three detectors to a multi-channel controller, or to another junction box.

Part number 050-5012 is an explosion-proof enclosed multi-spectrum detector. It senses radiant energy in the ultraviolet (UV), visible, and infrared (IR) spectrums. The radiant signatures of all types of flaming fires will alert the detector of their presence.



STAND ALONE OPTICAL FIRE
DETECTOR AND JUNCTION BOX



OPTICAL FIRE DETECTOR

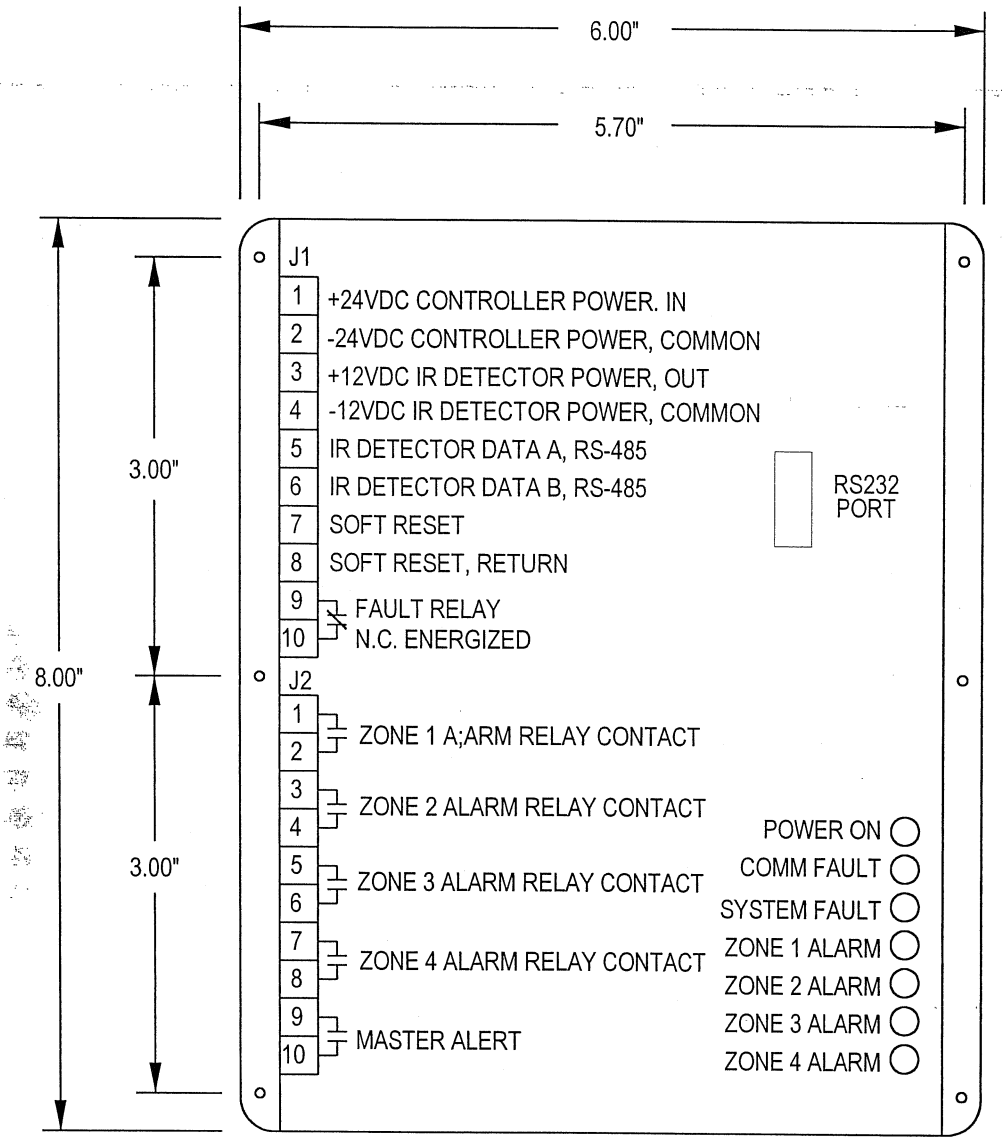
FOR MULTI-DETECTOR SYSTEM

OPTICAL FIRE DETECTOR MULTI-CHANNEL CONTROL MODULE

Part number 050-5006, a twelve channel controller module, is provided for multiple optical detector installations. The controller module governs the overall operation of the detector system. The controller is fully digital and communicates with each detector via RS-485 interface. The controller module provides event history tables which reveal time and date stamped alert, alarm, and fault histories for each connected detector. To retrieve the information stored in non-volatile memory, the controller may be interrogated using an IBM compatible personal computer, and available software. The PC's serial port connects to the controller via RS-232 interface. The controller accepts a male DB-9 connector.

The programming of the controller is also accomplished through the RS-232 interface. Programming is required for the controller to recognize the presence of connected detectors. The controller is factory programmed for all provided detectors. It is important to remember that detectors of one system may not be connected to controllers of another system. Any replacement detectors or add-on detectors require that the controller be reprogrammed. Software is available for field programming for such situations. All controllers are normally factory programmed with all detectors set for Zone 1, and all zones set to alarm at the 13kW 'alarm' level.

The controller module has a built-in common SPST relay for 'fault' and master 'alert', and individual 'alarm' relays for each zone.
During normal operation, the fault relay is energized with closed contacts, the alert relay is de-energized with open contacts, and the zone alarm relay is de-energized with open contacts. Should any detector fail or become disconnected causing a loss of communication, or should a general failure occur within the controller module, the fault relay will de-energize and its contacts open. A 10Kohm end-of-line resistor is provided connected integral with the fault relay and the zone alarm relay to monitor the connections between the detector controller module, and the fire system controller. LED's are provided to indicate the controller module status. A green LED indicates 'power on', two yellow LED's indicate 'comm fault' (communication fault) and 'system fault', and red LED's indicate 'alarm' for each zone.



CONTROLLER MODULE

ENCLOSURE DIMENSIONS

SMOKE DETECTORS

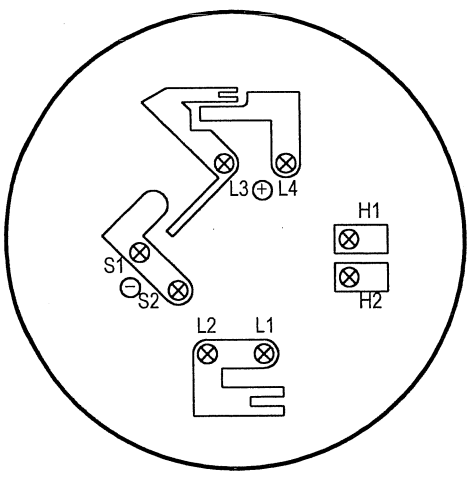
Part number 050-5011 is a photoelectric smoke detector designed for the detection of smoldering and flaming fires.

The unit is comprised of an LED source and a silicon photo diode receiving element. In a normal standby condition, the receiving element receives no light from the pulsing light source. In the event of a fire, smoke enters the detector and light is reflected from the smoke particles to the receiving element. The light received is converted into an electronic signal.

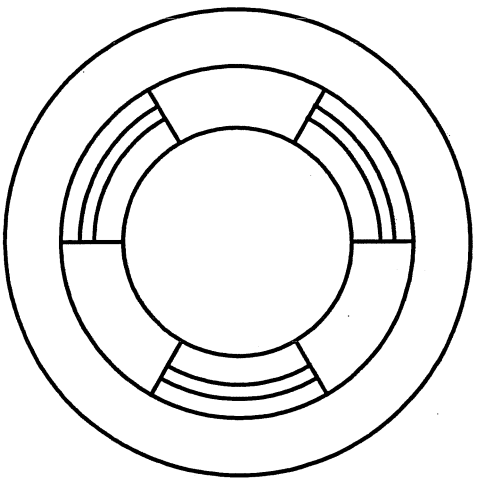
Signals are processed in the comparator circuitry, and when two consecutive signals exceeding the basic level are received within a specified period of time, the time delay circuit triggers an SCR switch to activate the alarm signal.

The mounting base for the smoke detector, part number 050-5041, contains an LED which will continuously illuminate to indicate an alarm condition. The LED remains lit until power is interrupted by resetting the control panel. The head-to-base terminations are designed such that an open circuit is created whenever the detector head is removed. When multiple detectors are used in a system, this 'open circuit' wiring method of the detectors will create a 'trouble' in the supervisory circuit should any detector be removed. This method includes mixing optical and smoke detectors as well. A 10Kohm end-of-line resistor is provided for installation on the last detector in the wiring chain.

Access to the wiring terminals of the smoke detector base is achieved by removing the detector head. The detector base may remain permanently mounted, with the wiring passing through the center hole of the base and connecting to terminal screws on the top side.



BASE



DOME

HEAT DETECTOR

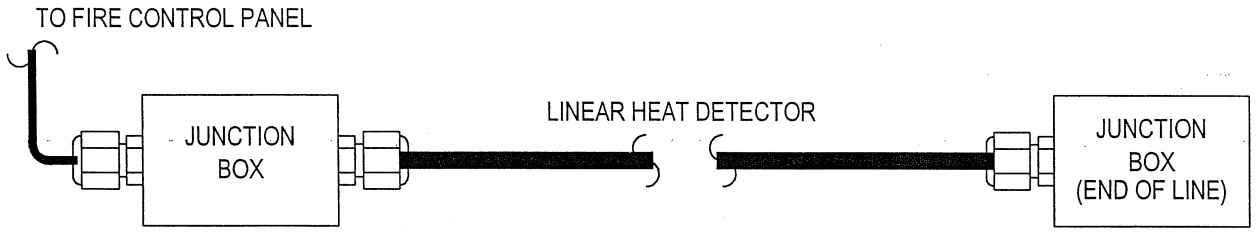
The Linear Heat Detector is a cable that detects heat anywhere along its length. The sensor cable is comprised of two steel conductors individually insulated with a heat sensitive polymer. The insulated conductors are twisted together to impose a spring pressure between them, then wrapped with a protective tape and finished with an outer jacket suitable for the environment in which the detector will be installed.

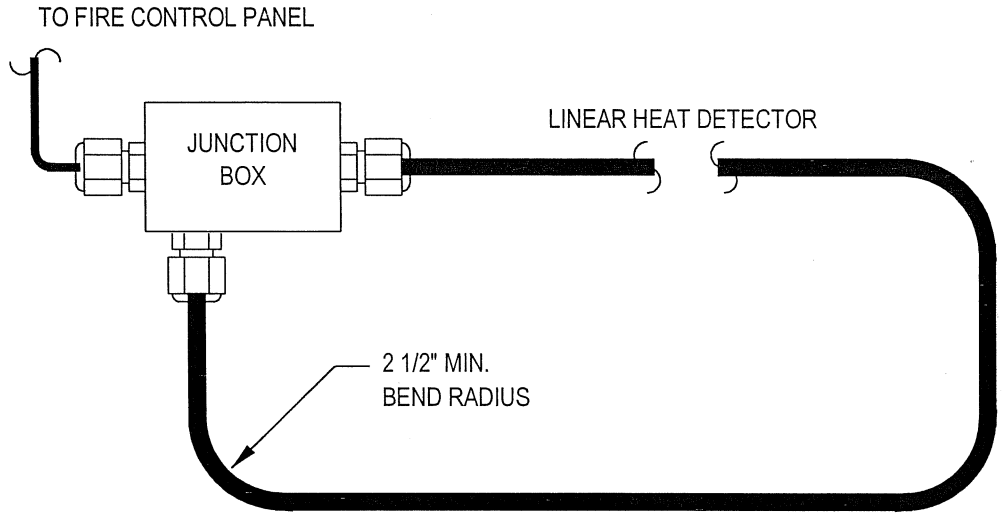
The detector is a fixed temperature digital sensor and is therefore capable of initiating an alarm once its rated activation temperature is reached. At the rated temperature, the heat sensitive polymer insulation yields to the pressure upon it, permitting the inner conductors to move into contact with each other thereby initiating an alarm signal. This action takes place at the first heated point anywhere along the detector's length. It does not require that a specific length be heated in order to initiate an alarm, nor is system calibration necessary to compensate for changes in the installed ambient temperature, or for changes in the length of cable used on the detection circuit.

The Linear Heat Detector contains an extruded jacket of polypropylene. It features high resiliency, good abrasion resistance, exceptional high temperature performance and oil resistance. and resistance to many common chemicals.

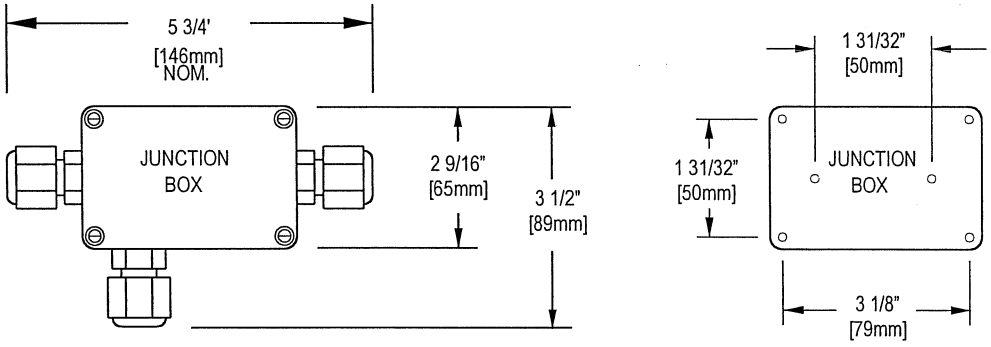
Installation of the detector must be made in continuous runs without taps or branches in accordance with applicable sections of NFPA 70 National Electrical Code, NFPA 72 National Fire Alarm Code, or as determined by the local "authority having jurisdiction". The detector has the additional benefit of being suitable for installation close to the hazard in order to provide a rapid response. Caution must be taken to maintain a minimum bending radius of 2 ½" to avoid damaging the two internal conductors. Nylon mounting clips are provided to secure the linear heat detector along its installed length, which help to locate it in close proximity to desired protected devices. The clips also aid in maintaining the required minimum bend radius.

Copper wire with a minimum conductor size of 18AWG shall be installed from the control panel out to a junction box at the hazard area where it is then connected to the beginning of the heat detector portion of the circuit. An end-of-line termination box is installed at the end of the heat detector run, with a 4.7K end-of-line resistor installed within the termination box across the end of the run. A combination splicing/termination junction box is also available for installations where the source and termination ends would be located within the same compartment. Splices may be made using only factory-supplied and specified splicing devices. The use of wire nuts or other splicing methods are never permitted for use on this Linear Heat Detector.



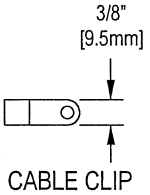


HEAT DETECTOR INSTALLATION OPTIONS



FRONT VIEW

REAR VIEW



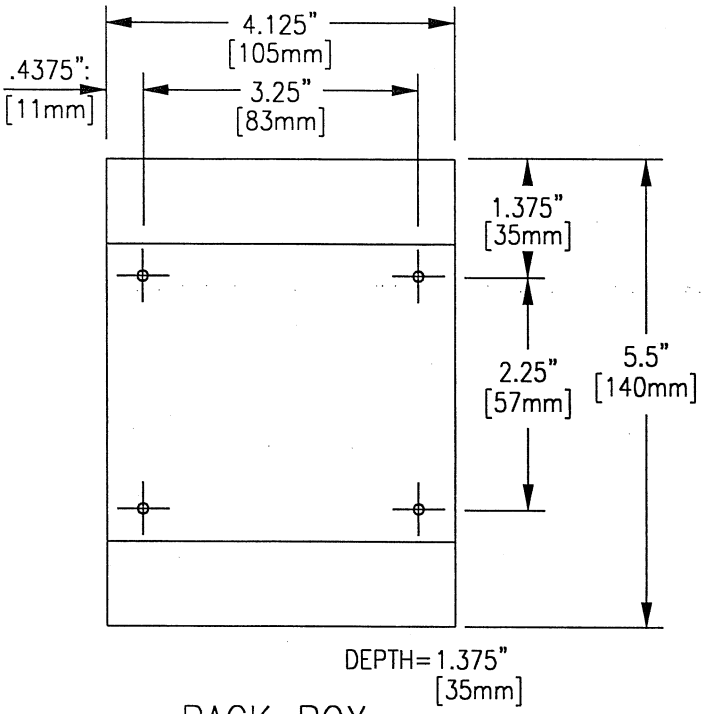
JUNCTION BOX DIMENSIONS

MANUAL PULL STATION

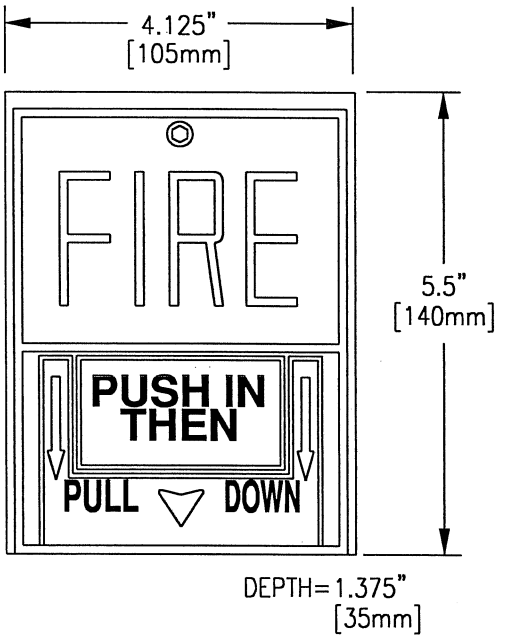
The Manual Pull Station, part number 028-0015, is a non-coded, dual action, manual fire alarm station. It is constructed of red-colored Lexan with a textured finish and white lettering. The back plate is constructed of red-painted 16 ga. steel and supports the internal switch which has one set of normally open contacts. The switch is pre-wired to a two position barrier terminal block, accessed on the rear of the back plate.

The Manual Pull Station may be semi-flush mounted by attaching directly to a standard single-gang electrical box. It may be surface mounted using the available matching surface back box, part number 028-0017, which allows for conduit connection as well.

Operation of the Manual Pull Station is achieved by pushing in, then pulling down the handle. The handle latches in the down position and closes the normally-open switch.. The handle is manually restored by unscrewing the allen-head screw, then pivoting the housing forward, allowing the spring-loaded handle to return to its normal position. The housing may then be pivoted back into normal position and re-secured with the allen-head screw.



BACK BOX



MANUAL PULL STATION

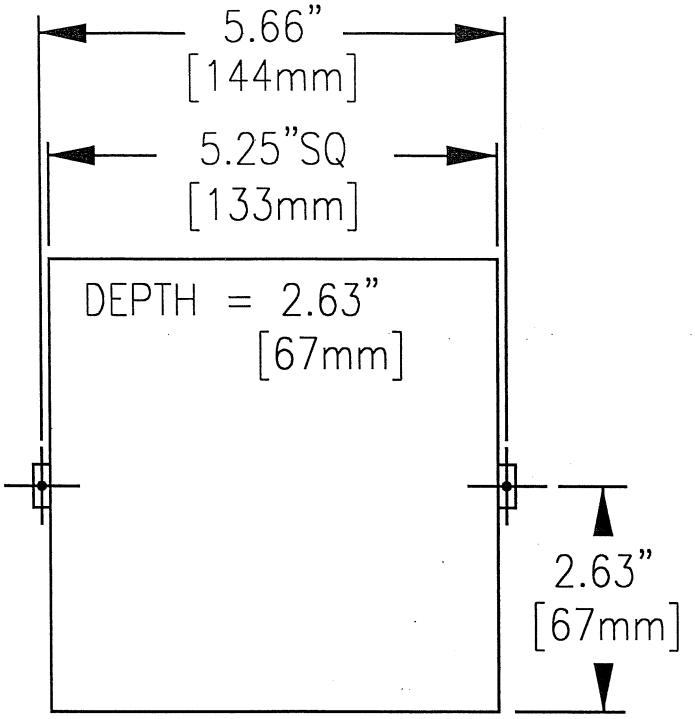
MANUAL PULL STATION DIMENSIONS

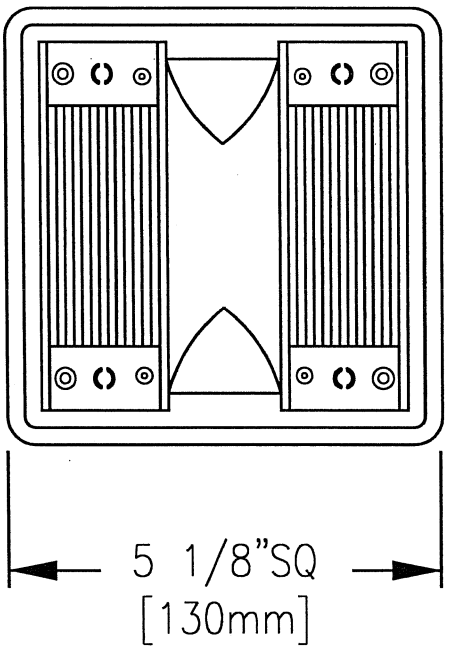
HORN/STROBE UNIT

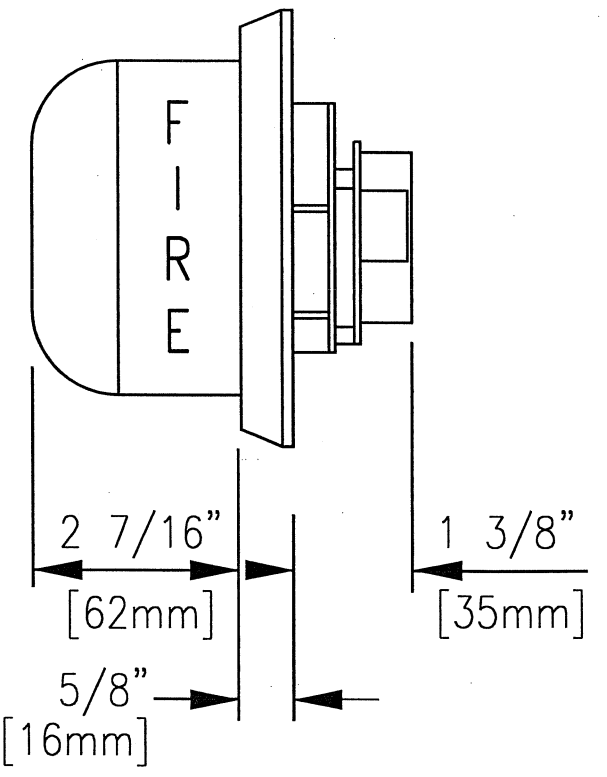
The Horn/Strobe Unit, part number 028-0016, is a multi-tone notification appliance with an integrated Xenon flashtube strobe light. The horn has two output sound levels- standard and high dBA, and the strobe light has a 15/75 candela rating.

The Horn/Strobe Unit is intended for indoor mounting only. It may be surface mounted on a flat panel surface, or installed on an available surface mount back box, part number 028-0018, which allows for conduit connection. Both the unit housing and back box are constructed of durable red-colored plastic, and the Xenon flashtube and circuitry are enclosed in a rugged Lexan lens.

Wire connections are achieved by the rear-mounted terminal block, which also allows for terminating with end-of-line resistor. Jumper shunt wires are provided on the terminal block to allow the horn and strobe alarms to operate in unison.







WHEELOCK HORN/STROBE DIMENSIONS

MAINTENANCE INSTRUCTIONS

DAILY

Verify the Control Panel is in the normal operating condition (green "NORMAL" LED illuminated; no other indicator lamps illuminated).

MONTHLY

CAUTION: ***When performing the following test, power to the wet bench will be interrupted as part of the test. Be sure that this power interruption will not interrupt any processing which is in progress.***

DETECTOR TEST PROCEDURE

Remove the control head(s) from the CO2 cylinder(s).

CAUTION: ***The Control Head(s) on the system to be tested must be removed from the CO2 cylinders before testing the system to prevent an accidental cylinder discharge.***

*Note: The system may be tested by turning the key switch to the "TEST" position which will disable power to the electric control head. The "ALARM SILENCE" switch may be set to the 'up' position to silence the piezo horn. The yellow "TROUBLE" LED should be illuminated. This method would not require removing the control head from the cylinder assembly when testing. This method is ***not*** recommended since the integrity of the electric control head is not being included in the test.

Aim the portable IR Tester (Part #050-5007 or Equiv.) at the first IR Optical Detector to be tested for several seconds. Verify that the detector's internal green LED is steadily illuminated. The red "DISCHARGE" LED should be illuminated, the green "NORMAL" LED should be off, the piezo horn should be intermittently sounding, and the alarm relay should transfer disabling power to the wet bench or process station. The Control Head should have activated visually indicating the "RELEASED" position. Verify that the actuating pin of the Control Head has moved to its fully actuated position.

To reset system to normal, turn the key switch on the controller to "RESET" for several seconds until the "DISCHARGE" LED and the green detector LED are no longer illuminated. Return the key switch to the "ON" position. With a screwdriver return the control head to the "SET" position (the emergency release lever should be in it's normal position and safety pin in place). Verify that the actuating pin has retracted to it's normal position. Verify the controller has returned to the normal condition with the green "NORMAL" LED illuminated.

Repeat the above test procedure for each remaining IR Optical Detector. Any Manual Release station should also be tested, observing for the same functional parameters as with the detectors.

Each Smoke Detector (if equipped) should also be tested. The testing of smoke detectors should be performed only in strict accordance with procedures instituted for the clean room or other production areas. Smoke detectors with the label "THIS DETECTOR CONTAINS A BUILT-IN SENSITIVITY TEST

FEATURE" may be tested by introducing a magnet to the location of the label, causing activation of the detector. Verify activation of the Controller and system as in the activation of the optical detector(s) above.

Each Linear Heat Detector (if equipped) should also be tested. Gain access to the end-of-line termination box at the end of the detector run. Cause a short-circuit across the end-of-line resistor. Verify activation of the Control Panel and system as in the activation of the optical detector(s) above.

If the system is equipped with a Battery Backup System, remove power from the Controller's AC power pack. Verify that the controller's yellow "TROUBLE" LED has illuminated, the piezo horn is sounding, and the number six segment of the internal supervisor LED bar is illuminated.

Once all operational functions have been verified, and the Controller has been reset with only the green "NORMAL" LED illuminated, and the Control Head has been reset to the "SET" position and the actuating pin is in its fully retracted position, the Control Head may be re-installed onto the cylinder.

CAUTION: ***The Electric Control Head must be manually reset, visually indicating the "SET" position, and the tamper/safety pin in place before installing onto cylinder. Failure to perform and verify this procedure can result in unwanted discharging of cylinder.***

To reset power to the bench or tool, operate the reset button on the contactor box, shunt-trip relay, or the reset on the bench controller as appropriate for your installation.

SEMI-ANNUAL

Perform the monthly checkout procedure above as well as the following:

CAUTION: ***The following checkout procedure shall be performed only by persons thoroughly familiar with safety precautions for the handling of charged compressed gas cylinders.***
Carbon dioxide is a refrigerant and will cause frostbite and burns if sprayed on exposed skin.
Appropriate protective covering shall be worn over skin.
Eye protection shall be worn and extreme caution observed when handling these compressed gas cylinders.

Remove the Electric Control Head from the cylinder valve and set aside.
Disconnect flex hose from the Discharge Head.
Remove cylinder bracket(s); remove cylinder and weigh cylinder. Loss of weight of cylinder greater than or equal to 10% indicates need of service. (See Table X on page X for nominal charged weight ratings of CO2 Cylinders).
If service is required, return cylinder to a local authorized service center to test and recharge the cylinder(s) (a Kidde Distributor, a fire equipment service center capable of servicing Kidde equipment, or an industrial gas supplier capable of servicing Kidde equipment).
Should a desired supplier be not capable of servicing Kidde equipment, a recharge adapter is available from the factory.
Visually inspect piping, clamps and hangers for damage. If visual inspection shows no damage, disconnect flex hose from piping inlet. Connect a source of regulated (100 psi) dry air or nitrogen

to pipe inlet and blow through pipeline, checking for free flow from the nozzle(s). Correct any obstructions in pipe or nozzle. If plastic blow-out caps were installed, re-install caps into nozzle(s). Re-install flex hose to piping inlet.

Replace fully charged cylinder and it's bracket(s).Reconnect flex hose to the Discharge Head. Reconnect the Electric Control Head to the cylinder valve, verifying that the Control Head is in the "SET" position, the manual release lever is in the normal position, and the tamper/safety pin is in place. Verify that the Controller is in the normal operating mode ("NORMAL" is the only lamp illuminated).

ANNUAL

Perform the monthly and semi-annual checks as above, plus the following:

Remove the Electric Cont0rol Head(s) from the Cylinder Valve(s).
Check the supervisory circuits of the Fire System Controller as follows:

- Disconnect the 10K End-of-Line Resistor installed at the last optical detector. Verify the yellow "TROUBLE" LED has illuminated and the piezo horn is sounding. Re-connect the resistor and verify the Controller has returned to the normal condition.
- For any installed Manual Release Station, disconnect the 10K End-of-Line Resistor installed at the Manual Release Station. Verify the yellow "TROUBLE" LED has illuminated and the piezo horn is sounding. Re-connect the resistor and verify the Controller has returned to the normal condition.
- Disconnect one of the connection wires at the Electric Control Head(s). Verify the yellow "TROUBLE" LED has illuminated and the piezo horn is sounding. Re-connect the wire previously removed and verify the Controller has returned to the normal condition.
- Disconnect the 9 volt battery from the Controller. Verify the yellow "TROUBLE" LED has illuminated and the piezo horn is sounding. Re-connect the battery and verify the Controller has returned to the normal condition.
- If the system is equipped with an external battery backup system the two 12 Volt Sealed Lead Acid batteries should be replaced every three years. Refer to date label located inside backup system.

RECHARGE

The system is designed for easy recharge. Spare cylinders are available from the factory. Return used cylinders for recharge to an authorized local Kidde Distributor, a fire equipment service center capable of servicing Kidde CO2 cylinders, or an industrial gas supplier capable of servicing Kidde CO2 Cylinders. Should a desired supplier be not capable of servicing Kidde equipment, a recharge adapter is available from the factory.

CYLINDER REPLACEMENT

CAUTION: ***Care must be taken during recharge of the system. Agent containers, even though empty, may still contain quantities of agent.***
Carbon dioxide is a refrigerant and will cause frostbite and burns if sprayed on exposed skin. Appropriate protection shall be worn over exposed skin.
Eye protection shall be worn and extreme caution observed when handling these compressed gas cylinders.

Have replacement CO2 cylinder/valve assembly(s) ready.
Return Electric Control Head to the "SET" position with a screwdriver, verifying the manual release lever is in the normal position, and the tamper/safety pin is in position.
With power still applied to the Controller, verify the Controller is in the normal operating mode ("NORMAL" is the only lamp illuminated).

- Remove power from the Fire Controller.
- Remove the control head from the old cylinder valve and set aside, taking care not to damage wires.

For safety reasons, if possible, do not disconnect flex hose from the discharge head.

- Remove discharge head from cylinder valve.
- Remove cylinder bracket(s); remove old cylinder and set aside.
- Replace with new fully charged cylinder; re-install cylinder bracket(s).
- Install discharge head onto new cylinder valve.
- Return power to the Fire Controller.
- Verify the Control Head is in the "SET" position and install onto cylinder valve.

System is now back in service.

Return old cylinder to local authorized service center for testing and recharge (a Kidde Distributor, a fire equipment service center capable of servicing Kidde equipment, or an industrial gas supplier capable of servicing Kidde equipment).
Should a desired local supplier be not capable of servicing Kidde equipment, a recharge adapter is available from the factory.

CAUTION: ***Discharge heads must be permanently connected to the system piping. Never attach discharge heads to cylinder valves until the cylinders are secured in cylinder straps or racking.***
Under no circumstances is a discharge head to remain attached to a cylinder valve after removal from service, during shipment, handling, storage, or during filling.
Failure to follow these instructions could result in serious bodily injury, death, or property damage.

TROUBLESHOOTING GUIDE

Symptom		Solution
• Controller in trouble condition: Internal LED bar illuminated:	#1	- key switch in "RESET" or "TEST" position - #3 PTC fuse open on internal power supply bd. - Control Head wiring open circuit - Control Head not in "SET" position - malfunctioning Control Head
	#2	- unused
	#3	- key switch in "RESET" position - detection malfunction; if S7 Controller is connected, faulty or wrong serial detector is connected - detection wiring open circuit - detection end-of-line resistor missing
	#4	- key switch in "RESET" position - #2 PTC fuse open on internal power supply bd. - malfunctioning internal power supply
	#5	- 9 Volt supervisor battery low or missing
	#6	- AC power out or low - malfunctioning AC wall outlet power supply - #1 PTC fuse open on internal power supply bd.
	#7	- malfunctioning Controller - discharged batteries of connected backup system
• Piezo horn sounds continuously and will not silence		- malfunctioning Controller - possible internal short circuit at horn wire terminals

POST-DISCHARGE ANALYSIS

In order to determine the origin of fire detection by the system, depending on the type of detection installed with the suppression system, interrogation may be performed to pinpoint the area which may have experienced a fire.

CAUTION: ***Any of the following interrogation procedures may disable the detector's ability to detect a fire event during the interrogation process.***

Interrogation of:

1) Dual IR Detectors with S7 Controller:

Connect the S7 Controller's RS-232 port to a personal computer's serial port.
Insert the S7 diskette and type the .EXE title as printed on the diskette label.
The following instructions are based on software version 1.10 and titled FS7SX.EXE.

Type the number of the serial port of the PC connected.
At the main menu type [E] to access Event Log.
Type [V] to view Event Log.
Type [H] for instructions and definitions of codes.
Determine from the event log which, if any, detector(s) indicate an "am" event status code. (The Controllers as delivered are programmed to alarm at an alarm level, 13 kW, fire event).
Determining the location of any "alarmed" detector reveals where a fire event occurred.
Continue following the software instructions to exit software and return the Controller to the normal status.

2) Dual IR Stand-Alone Detector (no controller)

A *Computer Interface Unit* is required to connect between the Stand-Alone Detector and the Personal Computer.
Make the appropriate connections to the Computer Interface Unit, and turn on the power switch. Make sure the slide switch, accessible through the rear of the unit's enclosure, is in the "up" position.
Insert the S7 diskette and type the .EXE title as printed on the diskette label.
The following instructions are based on software version 1.10 and titled S7R.EXE.

Type the number of the serial port of the PC connected.
Type the serial number of the detector to interrogate or type [S] if unknown.
At the main menu type [E] to access and view Event Log.
Type [H] for instructions and definitions of codes.
Determine from the event log if this detector indicates an "am" event status code, which would indicate if a fire event occurred.

continued-

Interrogation- *continued*

Connect the Computer Interface Unit to any other Stand-Alone detectors and repeat the above procedure searching for any other fire event locations within the protected areas of the tool or station.

3) Linear Heat Detection

Disconnect the source end of the Linear Heat Detector at it's junction box.
Connect a digital ohmmeter to the ends of the detector wires.
The ohmmeter should read 10Kohm minimum indicating no fire event along it's length.
Should the ohmmeter indicate a very low resistance reading, a fire event or physical damage has occurred somewhere along it's length. Either will cause a short circuit between the two internal conductors. Given that the Linear Heat Detector has a resistance rating of one ohm per foot, the approximate location of the short circuit may be determined by the resistance reading of the ohmmeter, and thereby calculating the distance to the short circuit..

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