



# TRANSMITTAL

TO MR. THOMAS CASCIO DATE 2-18-93  
 \_\_\_\_\_ JOB NO. #07-421.05  
 \_\_\_\_\_ RE JACKSONVILLE  
 \_\_\_\_\_  
 \_\_\_\_\_

WE ARE SENDING YOU  Attached  Under separate cover via \_\_\_\_\_  
 the following items:

- Shop Drawings  Prints  Plans  Samples  
 Copy of Letter  Change Order  Specifications  \_\_\_\_\_

COPIES	DATE	NO.	DESCRIPTION
1	2/18/93		EQUIVALENT FLARE SUBMITAL

THESE ARE TRANSMITTED As Checked Below:

- For approval  Approved as submitted  Resubmit \_\_\_\_\_ copies for approval  
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 For review and comment  \_\_\_\_\_  \_\_\_\_\_  
 For bids due \_\_\_\_\_ 19\_\_\_\_  
 Prints returned after loan to us

REMARKS PLEASE CALL IF YOU SHOULD HAVE  
ANY QUESTIONS.  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

SIGNED Kane A. John

DISTRIBUTION \_\_\_\_\_

**CITY OF JACKSONVILLE  
EAST LANDFILL CLOSURE  
EQUIVALENT FLARE SUBMITTAL**

**FEBRUARY 18, 1993**

**CITY OF JACKSONVILLE**  
**EAST DUVAL SANITARY LANDFILL CLOSURE**  
**EQUIVALENT FLARE SUBMITTAL TO THE**  
**FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATIONS**

**FEBRUARY 1993**

**Prepared for:**

**CITY OF JACKSONVILLE**  
**DEPARTMENT OF PUBLIC UTILITIES**  
**SOLID WASTE DISPOSAL DIVISION**  
**JACKSONVILLE, FLORIDA**

**Prepared by:**

**POST, BUCKLEY, SCHUH & JERNIGAN, INC.**  
**1560 Orange Avenue, Suite 700**  
**Winter Park, Florida 32789**

**07-421.00**



POST,  
BUCKLEY,  
SCHUH &  
JERNIGAN, INC.

ENGINEERING  
PLANNING

February 18, 1993

Mr. Thomas M. Cascio  
Associate Engineer IV  
Florida Department of Environmental Regulations  
Air Permitting and Standards Section  
Twin Towers Office Building  
2600 Blair Stone Road  
Tallahassee, Florida 32399-2400

RE: **East Duval Landfill**  
**Permit No. AC 16-186047**  
**Equivalent Flare**

Dear Mr. Cascio,

In response to your letter dated February 2, 1993 and subsequent telephone conversations, I have enclosed information on the recommended flare in the areas you requested.

The LFG flare system was evaluated in comparison to the Contract Specifications for the project and was found to be in conformance by our mechanical engineers. The specifications were derived from the permitted McGill Environmental System Flare Model No. EGF-60. The LFG flare can therefore be considered equivalent to the McGill Flare.

I trust this information provides the data required. If you have any questions, feel free to call.

Very truly yours,

*Karl Schmit*

Karl Schmit, E.I.  
Project Engineer  
Solid Waste Division

cc: E. Hilton/PBS&J  
C. Pearson/City of Jacksonville

KS/cla/EQFLARE  
07-421.05/3.0

**SOLID WASTE DIVISION**

1560 ORANGE AVENUE, SUITE 700, WINTER PARK, FLORIDA 32789 · TELEPHONE: 407/647-7275 · FAX: 407/647-0624

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## Section 1

# **LFG** SPECIALTIES, INC.

**ENCLOSED FLARE SUBMITTAL  
REVISION NO.1  
PROPOSAL No. 29205**

**MECHANICAL SECTION 11188**

**REFERENCE:**

**Enclosed Flare System  
East Duval Sanitary Landfill  
Jacksonville, Florida**

**PRESENTED BY:**

**LFG SPECIALTIES, INC.**  
7550 Lucerne Drive Suite 110  
Cleveland, OH 44130  
(216) 891-0305

**Date: July 31, 1992**

**Main Office**

7550 Lucerne Drive  
Suite #110  
Cleveland, Ohio 44130  
216/891-0305 FAX: 216/891-8288

**Plant**

705 Friendship Drive  
P.O. Box 332  
New Concord, Ohio 43762  
614/826-7422 614/432-4624

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- Controller Model Flame - Trol II  
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SECTION III    FLARE COMPONENTS LITERATURE  
- Flame Arrester  
- Pilot Gas 2-Way Solenoid Valve  
- Pilot Gas Pressure Regulator  
- Pilot & Enrichment Gas Pressure Gauge  
- Header Valve Actuator  
- 3-Way Solenoid Valve for the Header Valve Actuator  
- Enrichment Gas Valve Actuator  
- Purge Air Blower & Purge Pressure Switch  
- Thermocouples  
- Spark Plug  
- Igniter Transformer

SECTION IV     REFERENCES



**ENCLOSED FLARE SYSTEM**

REVISION NO. 1  
ENCLOSED FLARE SYSTEM SUBMITTAL  
EAST DUVAL SANITARY LANDFILL  
MECHANICAL SECTION 11188

**PART 1 - GENERAL**

1.01 DESCRIPTION

1. By Moretrench American Corporation (MTA).
2. By MTA.
3. Attached are shop drawings for enclosed flare, shop testing per specification will be carried out by LFG Specialties. Field testing by MTA.
4. By MTA.  
Note: All LFG Specialties' warranties are passed onto the final Customer through MTA.
5. LFG Specialties assumes responsibility for defining and labeling all wiring connections between the enclosed flare, flame-Trol II controller, and peripheral equipment included in its scope of supply.

1.02 QUALITY ASSURANCE

- A. LFG Specialties is a qualified manufacturer/supplier of enclosed flare systems, see reference list attached, Section 4.
- B. LFG Specialties complies with the outlined standards.
- C. LFG Specialties is proposed as an equal to the outlined equipment manufacturers.

1.03 SUBMITTALS

- A. This submittal covers the items outlined under 1-6. Items 7 & 8 will be supplied in the revised electrical section.
- B. Per item A above.

C. Operating Instructions

1. Six (6) O&M manuals will be supplied per the specification.
2. LFG Specialties has included three (3) days of start-up/instruction time to the Contractor, less travel and living expenses.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. The flare and control system will be protected for extended storage as required.
- B. The LFG Specialties flare and controller are shipped as fully assembled as possible. In fact, all control wiring and utility piping is prefitted to the flare stack and run to a convenient tie-in location at the base of the flare. Only items that may be damaged in shipment are removed for transport.
- D. All piping and wiring connections are covered and taped for transport.
- E. All boxes will have packing lists with item weights.

1.05 WARRANTY AND GUARANTEES

- A. See LFG Specialties standard warranty attached, Section 2.  
Note: The standard warranty does not include handling and shipment costs. LFG Specialties will extend the warranty to cover these items for the equipment manufactured and supplied on this project.

**PART 2 - MATERIALS**

2.01 GENERAL

A. Flare

1. LFG Specialties is in compliance, see Technical Data, page 10 & 11 of Proposal No. 29205 attached, Section 2.

2. In compliance, per item 1 above
3. The flare system includes the items as specified and as outlined in the attached Proposal No. 29205, Section 2.
4. In compliance as outlined in attached proposal No. 29205, Section 2, and enclosed drawings.
5. In compliance, burner will not exceed an averaged 80 dB when measured three (3) feet from stack.
6. The flare is designed for 100 mph wind loading. ✓  
Note: A properly designed and installed foundation is required to handle the shear and moment forces generated by the 100 mph wind. The foundation design and installation is the responsibility of others.
7. LFG Specialties will provide a grounding rod to be installed by the Contractor.

## 2.02 ACCESSORIES

1. A 12 inch Varec flame arrester will be provided, see attached cut-sheets, Section 3.
2. A 1/2 inch ASCO 2-way solenoid valve will be provided for the pilot gas system, see attached cut-sheets, Section 3.
3. A 1/2 inch Fisher pressure regulator will be provided for the pilot gas system, see attached cut-sheets, Section 3.
4. A McDaniel Model "MC" pressure gauge with stainless steel case will be provided for the pilot gas system, see attached cut-sheets, Section 3.
5. We take exception to the specification and propose the following alternatives for the main header valve and fuel enrichment valve:
  - A. Main header valve
    - The valve will be a 12 in. centerline butterfly type with a Bettis RP-Series pneumatic actuator and ASCO 3-way solenoid valve. The valve will

require a nitrogen cylinder to be supplied by others, see drawing and attached cut sheets, Section 3. This alternative is proposed since a pure fail safe electric valve is not available in the required size. The alternative would be an electro-hydraulic actuator unit which has a history of high maintenance requirements and added cost.

**B. Enrichment gas throttling valve**

A 1 in. throttling valve will be provided for the enrichment fuel system with a Barber Colman electric operated fail close actuator, see attached cut sheets, Section 3. Due to the size of this valve we take exception to the local/remote selector and stop-open-close switches. In place of the manual override, we will provide a bypass around the automatic operated valve with a manual block valve. The actuator will be controlled by a 4-20 mA signal from the Barber Colman temperature controller included in the Flare-Trol II control panel. Specification on the controller will be included in the electrical section submittal.

6. An American Fan Co. Model AF-8 purge air blower will be provided, see attached cut-sheets, Section 3.

**2.03 FLARE SYSTEM CONTROL PANEL**

Revised electrical/control submittal to follow in one week.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

A-H Installation by MTA. LFG Specialties will provide installation and start-up supervision as outlined in our contract/order with the Contractor.

3.03 INSPECTION AND TESTING

A & B Inspection and testing by MTA. LFG Specialties will provide assistance and supervision as outlined in our contract/order with the Contractor. Further LFG Specialties will pass on its Performance Guaranty and Warranty as outlined in the Proposal No. 29205 attached.

END OF SECTION

LFG Specialties certifies that the preceding information and attached data sheets and drawings are correct and accurate to the best of our knowledge.

Respectfully,

*Louis Kalani*

Louis Kalani  
Application Engineer

**PARAMETER SPECIFICS**

# LFG SPECIALTIES, INC.

PROPOSAL No. 29205

RESPONSE TO:

Moretrench American Corporation  
7701 Interbay Blvd.  
P.O. Box 13798  
Tampa, Florida 33681

REFERENCE:

Enclosed Flare System  
East Duval Sanitary Landfill  
Jacksonville, Florida

PRESENTED BY:

LFG SPECIALTIES  
7550 Lucerne Drive Suite 110  
Cleveland, OH 44130  
(216) 891-0305

Date: February 18, 1992

Main Office

7550 Lucerne Drive  
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Cleveland, Ohio 44130  
216/891-0305 FAX: 216/891-8288

Plant

705 Friendship Drive  
P.O. Box 332  
New Concord, Ohio 43762  
614/826-7422 614/432-4624



PROPOSAL NO: 29205

DATE: 2/18/92

LFG Specialties, Inc. is pleased to submit this proposal to furnish the following equipment in response to your RFP (request for proposal).

- I. Each 8 ft. diameter x 40 ft. OAH enclosed landfill gas flare system complete with Flame-Trol II automatic flare controller and associated peripheral equipment as described:

This flare is sized for the following conditions:

Flows

Design Range	<u>400-2,400</u>	SCFM
Maximum*	<u>2590</u>	SCFM
Minimum	<u>260</u>	SCFM

LFG (landfill gas)

Methane content	<u>52</u>	%
Supply temperature	<u>100</u>	°F
Supply pressure	<u>15</u>	in. W.C.

\* Maximum flow based on 0.6 sec. retention time at 1400°F operating temperature.

The flare will be LFG Specialties, Model EF840S4 and include the following standard equipment:

FLARE STACK

- \*\*\* Constructed of  $\frac{1}{4}$  in. A-36 carbon steel
- \*\*\* All seams welded inside and out
- \*\*\* 2 each  $2\frac{1}{2}$  in. x  $2\frac{1}{2}$  in. x  $\frac{1}{4}$  in. angle iron supports, at top of flare and at  $\frac{1}{2}$  OAH, to add strength to flare stack and control resonant vibrations
- \*\*\* 2 each lifting lugs, 180° apart at top of stack for ease of installation
- \*\*\*  $\frac{1}{2}$  in. A-36 carbon steel 9 in. wide full circumference bottom anchor flange with eight pre-drilled anchor bolt holes and sixteen support gussets.

- \*\*\* 4 each 3 in. NPT sample ports with caps installed  $\frac{1}{2}$  diameter from top of flare stack at 90° spacing ✓
- \*\*\* 4 each 1 in. NPT thermal well connections installed  $\frac{1}{2}$  diameter from tip of flare stack at 90° spacing
- \*\*\* 12 in. 150# flanged LFG inlet connection ✓
- \*\*\* 3 each 48 in. x 48 in. galvanized air intake louvers with stainless steel bearings
- \*\*\* 2 each temperature operated automatic louvers with controller to maintain optimum operating temperature and 1 each manually operated louver
- \*\*\* Fully lined with 2 in. of A.P. green refractory blanket fixed with Inconel pins and keepers ✓
- \*\*\* 1/4 in. x 2 in. 304 stainless steel plate retainer around all open edges of the insulation refractory blanket
- \*\*\* Full circumference 13 gauge expanded metal heat shield covering bottom 48 in. of flare stack ✓
- \*\*\* The exterior of the flare stack will be sandblasted and finished with two coats of heat resistant heavy duty industrial OSHA green enamel ✓

#### COMBUSTOR ASSEMBLY ✓

- \*\*\* 12 in. center burner tip flange connected to LFG inlet piping, top 6 in. of tip is 304 stainless steel
- \*\*\* 4 each 4 in. burner arms designed to produce optimum swirl, obtaining high efficiency mixing and maximum retention time, arms connected to center burner tip and constructed of 304 stainless steel ✓
- \*\*\* Full access for repair or replacement of burner assembly components through air intake louver ports

## IGNITOR ASSEMBLY ✓

- \*\*\* 2 in. diameter 304 stainless steel pilot tip with integral spark plug connection/housing
- \*\*\* Spark plug ignitor, eliminates gap problems often incurred with straight rod type ignitors
- \*\*\* 110/5,000V single pole transformer
- \*\*\* High temperature ignitor leads in  $\frac{1}{2}$  in. conduit
- \*\*\* Pilot nozzle in  $\frac{1}{2}$  in. stainless steel pipe
- \*\*\* Chromel-alumel (type k) thermocouple in stainless steel thermal well to give pilot confirmation
- \*\*\* Ultraviolet flame scanner (self-checking type) to give flame confirmation and provide flare safety shutdown

### PERIPHERAL EQUIPMENT - INCLUDED WITH ENCLOSED FLARE

- \*\*\* All control wiring and utility piping is prefitted to the flare stack and run to a convenient tie-in location at the base of the flare. The instrumentation, wiring conduits and utility piping are removed and bundled for shipment to avoid damage during flare transport.
- \*\*\* 1 each 12 in. Varec or equal all aluminum horizontal flame arrester with clean out cover to facilitate in place maintenance
- \*\*\* 1 each 12 in. carbon steel wafer type electric actuated butterfly valve with slow opening actuator to prevent flame visibility during start up and spring operated "fail safe" closing in case of a power failure
- \*\*\* 1 each purge air blower with pressure proved switch to evacuate gases remaining in flare stack prior to ignition cycle

**FLAME-TROL II  
ENCLOSED FLARE CONTROL SYSTEM**

The LFG Specialties Flame-Trol II is a technically advanced fully integrated, 100% automatic flare controller. The Flame-Trol II provides the operator full flexibility to set or change any temperature and/or time setting utilized in the automatic operation of the flare.

**FEATURES OF THE FLAME-TROL II INCLUDE:**

\*\*\* Energy saving propane pilot which requires propane only during the ignition cycle of the flare controller.

\*\*\* PILOT TEMPERATURE CONTROLLER \*\*\*

This controller senses the pilot temperature and utilizes one event setting, determined by the operator, to begin operation of the landfill gas blower. This setting is referred to as the "blower on" temperature. Once the automatic pilot has been proven by obtaining the blower on temperature the header valve will slowly open and the landfill gas blower will start.

\*\*\* PILOT TIMER \*\*\*

This timer begins the instant the ignition cycle begins. It is set by the operator at the maximum time required for the pilot to achieve the blower on temperature and the gas supply to be ignited. This time will typically be 2 to 3 minutes. At the end of this time, the pilot gas supply valve will be closed and the pilot flame extinguished, if not already shut-off by the temperature controller.

\*\*\* PILOT FAILURE INDICATOR AND SHUT DOWN \*\*\*

The pilot timer also controls the "pilot failure" function. Upon initiation of the automatic ignition cycle this timer begins timing down. Should the pilot not achieve the "blower on" temperature (set in the pilot temperature controller) in the time set in the pilot timer, the entire system will be shut down. The "pilot failure" indicator light will then come on. The system will not attempt to reignite until the pilot problem has been remedied. If it is determined that the pilot gas supply has not been exhausted or another problem with the pilot system cannot be found the operator may attempt automatic reignition by pushing the "pilot failure reset" button.

\*\*\* IGNITOR TIMER \*\*\* ✓

The ignitor timer allows the operator to set the time the ignitor will spark during the ignition cycle. This allows for the adjustment of the spark duration to compensate for the distance of the pilot gas supply from the flare; thus extending the life of the ignitor plug, transformer and other pilot components.

\*\*\* FLARE CHAMBER TEMPERATURE CONTROLLER \*\*\*

This temperature controller monitors the temperature in the flare chamber and utilizes two event settings which are:

High temperature safety shutdown - this setting simply shuts down the flare if the temperature should rise to a point of being unsafe or potentially damaging to the flare chamber. ✓

Low temperature shutdown - this setting establishes the minimum acceptable operating temperature for the flare. During operation, if the temperature should fall below this setting, the system will shutdown and not attempt to restart.

The thermocouples used to operate this part of the Flame-Trol II are two Chromel-alumel (type K) positioned at 1/2 diameter from the top of the flare stack at 180 degree spacing to ensure an accurate averaging of the stack temperature.

This controller has a constant LED readout of the flare chamber temperature.

\*\*\* Ultraviolet Flame Scanner \*\*\*

The ultraviolet scanner and associated controller provide flame confirmation and initiate "flare safety shutdown". Upon loss of flame, the scanner will automatically shutdown the blowers and close the automated header valve (if utilized). The flame scanner has a maximum response time of 4 seconds, providing almost immediate system shutdown.

The scanner also provides a safety lockout on the start up of the blowers and opening of the header valve, until confirmation of the pilot flame.

\*\*\* PURGE TIMER \*\*\*

This timer controls the length of time the purge blower runs prior to the ignition cycle commencing. Again the operator has the option to set this timer at the length of time determined to be sufficient but not unnecessarily lengthy to accomplish a complete purge of the flare chamber.

\*\*\* DOWN TIME TIMER \*\*\*

One of the most unique aspects of the Flame-Trol II is the capability to allow a specified period of time, after the methane supply has been exhausted, to rejuvenate before attempting to automatically reignite. This is the function of the "down timer". If the methane supply is exhausted the flare chamber temperature controller will shut-down the blowers and close the header valve. At this time the "down timer" will begin timing down. Once the down timer has timed completely down, the automatic ignition cycle will begin. This timer has a range of 1 second to 999 hours. The time required to allow rejuvenation and hence the time set on the down timer is determined by the operator.

\*\*\* INTERMITTENT "REAL TIME" TIMER \*\*\*

Another unique feature of the controller is the real time intermittent timer. This timer allows the operator to set the flare to automatically operate on any desired intermittent cycle. The controller employs a real time 24-hour clock in conjunction with a 7-day cycle timer. The clock has a five year life back up battery to maintain proper time, even through power outages. This ensures the flare will come on and go off at the precise time set by the operator.

The real time timer provides the operator with much greater flexibility and operation accuracy than a simple on-off timer. For example; the flare may be set to operate on any time cycle in a 24 hour period on a daily, working day, or alternate day basis. It can be set to operate from 6 AM to 8 PM, or 6 PM to 8 AM, to coincide with attended or unattended service and/or maintenance schedules.

The intermittent timer, when in operation, overrides the down time timer. Therefore, if the flare is extinguished and in the down timer mode when the intermittent timer goes to "on", the flare will attempt to automatically reignite. If it is not desired to operate on an intermittent cycle, this timer may be bypassed by simply switching it to "off".

\*\*\* MAIN HEADER VALVE INDICATORS \*\*\*

The automatic landfill gas header valve is equipped with position switches to indicate when fully closed and fully open.

The fully closed indicator is used as a permissive for automatic start.

The fully open indicator is used for a valve operation check. Should the valve not completely open for any reason, a "yellow" alarm light will show on the panel to indicate a valve malfunction.

\*\*\* LANDFILL GAS SUPPLY INDICATOR \*\*\*

A pressure indicator switch is provided for installation in the gas header just upstream of the flame arrester. This pressure indicator provides a safety shutdown for the lack of landfill gas supply to the flare for whatever reason. This shutdown will lockout the controller until the malfunction is rectified.

\*\*\* KEY LOCK SWITCH \*\*\*

The controller utilizes a key lock switch as a primary safety, cutting the power supply to the panel in the locked position.

\*\*\* EMERGENCY SHUT-DOWN \*\*\*

An easily accessible emergency shut-down button is mounted on the face of the controller. Pushing the button will immediately shut-down the flare, stop the blower and shut the automatic header valve. The system will be locked out until the shut-down is manually reset.

\*\*\* TEMPERATURE RECORDER \*\*\*

The Flame-Trol II not only monitors and displays the flare chamber temperature but also constantly records this temperature on a strip type recorder. This feature allows the operator to maintain an accurate written record of all flare activity including; down time, day and time period the flare is burning, and operating temperature. Unless specified otherwise, the recorder will be a Rustrak or equal two channel strip recorder capable of charting operating temperature as well as one other parameter such as gas flow.

If an alternative recorder is specified, it will be provided as an option and outlined accordingly in the commercial section of the proposal.

If the operator does not wish to record flare activity constantly, the temperature recorder may simply be turned off. This will in no way affect the automatic operation of the flare.

**\*\*\* INDICATOR LIGHTS \*\*\***

The controller is equipped with indicator lights in the front panel to monitor all the operating functions. Through simple observation the operator can see what function is being performed at any given time without having to open the Flame-Trol II enclosure.

**TOTAL MANUAL OPERATION OPTION**

The Flame-Trol II is equipped with a manual/off/auto switch which allows the operator to by-pass the automatic controls and operate the flare completely manually. All manual switches are isolated in an area together in the face of the controller, indicated by a different color background and labels.

The selector switch must be turned to manual before any control switches in that section will operate. Manual switches include:

- Purge on/off
- Pilot by pass (manual valve)
- Ignitor button
- Blower on/off
- Header valve open/close

**WARNING/ALARM OPTION**

The Flame-Trol II also has contact points which may be used for a local or remote warning device. A local warning device may be simply a horn, light, siren, etc.

A remote warning device would require a phone line at the flare site and an automatic phone dialer which LFG Specialties can furnish as an option. Unless specified otherwise, the automatic dialer and alarm system would be a RACO, Chatterbox Model CB-4 or equal. This system has the capability of storing and dialing up to eight (8) different phone numbers. The system utilizes a programmable synthesized voice processor to specify the cause of the alarm and/or shutdown.

This system has the option of being installed at the same time as the Flame-Trol II or being ordered separately and installed at a later date.



## ADDITIONAL CONTROL EQUIPMENT

### \*\*\* CONTROL RACK \*\*\*

The Flame-Trol II automatic flare controller, associated motor starters, main control power supply and pilot supply controls will all be mounted on a free standing control rack. The rack will be fabricated from 6 in. x 2 in. channel A-36, sandblasted and painted with rust resistant zinc oxide primer and overcoat of heavy duty industrial enamel.

The following will be fully mounted, piped and wired on the control rack.

- \*\*\* Flame-Trol II automatic flare controller in NEMA 4X (316SS) enclosure
- \*\*\* The purge blower motor starter, full voltage type, with normally open holding circuit, manual reset and overload relay, installed in NEMA 4 enclosure
- \*\*\* A 120V, 20A duplex outlet in a weatherproof NEMA 5-20R receptacle box with covers
- \*\*\* Pilot gas control system including: strainer, pressure control regulator, pressure gauge with isolation valve, fail-close solenoid valve, bypass around solenoid valve with manual block valve and main manual shut off valve
- \*\*\* An enrichment gas system including: pressure control regulator, pressure gauge with isolation valve, fail-close solenoid valve, manual flow control valve, and manual shut-off valve

**TECHNICAL DATA**

A. Required LFG pressure -- 15 in. W.C.

B. Retention times at operating temperatures --

1400°F - .62 sec.  
 1600°F - .66 sec.  
 1800°F - .69 sec. ✓  
 2000°F - .73 sec.

C. Percent excess air (approximate) at operating temperatures --

1400°F - 230%  
 1600°F - 180%  
 1800°F - 140%  
 2000°F - 110%

D. Stack effluent (calculated)

		Operating Temperatures			
		1400°F	1600°F	1800°F	2000°F
Flow	MMSCFD	59.92	51.19	44.52	39.04
N <sub>2</sub>	% vol.	73.6	72.8	72.4	71.3
O <sub>2</sub>	% vol.	13.8	12.6	11.3	10.0
CO <sub>2</sub>	% vol.	5.7	6.6	7.6	8.7
H <sub>2</sub> O	% vol.	<u>6.9</u>	<u>8.0</u>	<u>8.7</u>	<u>10.0</u>
TOTAL		100.0	100.0	100.0	100.0

E. Emissions (expected) design operating temperature

1800°F

NO <sub>2</sub>	22 ppm (v/v)
CO	125 ppm (v/v)
HC	nil
SO <sub>2</sub>	nil

Guaranteed values will be 200% of quoted expected values

- F. Destruction efficiency -- 98% overall destruction of total hydrocarbons. Guaranteed to meet E.P.A. emission standards for methane disposal in enclosed type flares
- G. Turndown Ratio -- 10:1 at design operating temperature ✓
- H. Unit Dimensions -- 8.0 ft. diameter x 40.0 ft. OAH
- I. Minimum flow rate to maintain stable flame and 98% destruction efficiency -- 260 SCFM ✓
- J. Minimum methane content required to maintain stable flame and 98% destruction efficiency -- 30%
- K. Equipment Drawing -- typical attached
- L. P&ID -- typical attached

**NOTE**

Wind loads - Designed for 100 mph wind loading (per ASCE 7-88, Exp.C)

Total weight - 12,900 lbs.

D. Equipment Warranty:

LFG Specialties guarantees the Equipment as outlined and specified in this Proposal No. 29205 for the period of eighteen (18) months from date of shipment or twelve (12) months from date of start-up, whichever occurs first.

Along with standard Material, Workmanship and Performance Warranties outlined in the standard "Terms and Conditions of Sales" attached, LFG Specialties guarantees the equipment to meet present E.P.A. emission standards when installed and operated in accordance with specified design conditions.

E. Start-up Assistance:

LFG Specialties will furnish an on site advisor during any aspect of the installation or start-up of our equipment deemed necessary by our Customers in accordance with our standard "Terms and Conditions of Sales". Included in the flare pricing, less travel and living expenses, is:

Enclosed Flare                      --- 3 days service time

Note:            Travel and living expenses to be charged customer at actual cost.

F. Field Service Rates and Availability

Additional field service time will be charged at \$365.00 per day for service technicians and \$600.00 per day for engineers, plus expenses. Associated travel, lodging, living, and miscellaneous expenses will be charged at actual costs.

Service personnel should be scheduled two weeks in advance for standard installation, start-up or service work. Service personnel are available on a 24 hour notice for emergency service requirements.

G. Scope of Work:

LFG Specialties will furnish all the Equipment and Services as outlined in this Proposal No. 29205. Equipment will be fully fabricated, painted and tested as described in proposal at LFG Specialties facility, New Concord, Ohio.

Any material/instrumentation that may be damaged in shipment will be removed, tagged and boxed separately for shipment and re-assembly in field.

This proposal only covers the supply of Equipment and installation advisory service as defined. The following items are not included or should be constructed to be included in LFG Specialties scope of supply.

- \* Construction drawings. LFG Specialties drawings will outline field installation connections (location and size), foundation bolt layouts and loading data. All equipment layout, interconnect details and foundations are the responsibilities of Customer or Customer's Representatives.
- \* All installation and civil work including foundations, equipment erection, main and interconnecting piping and wiring including required equipment and materials are the responsibilities of Customer or Customer's Representatives.
- \* All permits/licenses required for installation and/or operation of the Equipment are the responsibility of Customer or Customer's Representatives. LFG Specialties will provide necessary manufacturers data on the equipment as required for permit/license applications.
- \* Compliance testing - All compliance/performance testing will be the responsibility of the Customer. LFG Specialties will have representative/s present for tests at Customer's request and expense. LFG Specialties fully guarantees the Equipment to meet E.P.A. emission standards when operated within the specified conditions.

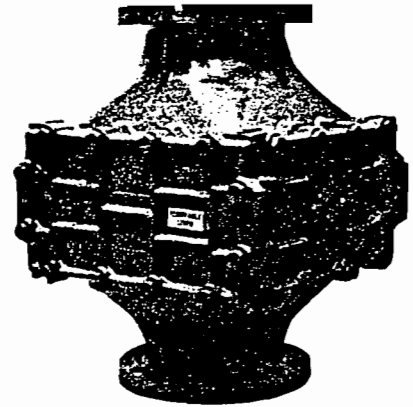
**COMPONENT LITERATURE**

## 5000 SERIES

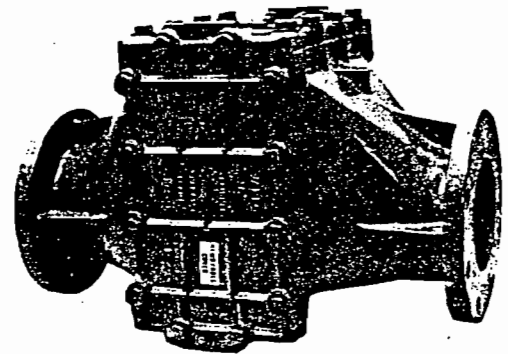
PDS 5000  
09/89

# FLAME ARRESTER

- Extensible Bank Assembly
- Three To Four Times Net Free Area Through Bank
- UL Approved
- Heavy Wall Cast Housing in 356 HT Aluminum
- Removeable Cover Plate
- Vertical or Horizontal Configuration



MODEL 5000 — VERTICAL



MODEL 5010 — HORIZONTAL

### INTRODUCTION

The VAREC 5000 Series Flame Arrester has been the industry standard for over 50 years. These arresters are used world wide throughout the petroleum, petrochemical, chemical waste treatment, and other industries where flame propagation is a potential problem. VAREC's success in this area is based on high standards for product design and manufacture.

### APPLICATIONS

VAREC 5000 Series Flame Arresters are used in gas piping systems or on petroleum storage tank roofs or digester covers. They are designed to stop the propagation of flame from external sources and can be mounted up to 15 feet from the ignition source in accordance with UL Approval. Because of this feature, these units can actually be mounted inside buildings adjacent to digest-

ers, storage tanks, compressors, boilers, engine generators and other equipment. Short runs of vent piping may be extended through walls or roofs to atmosphere. Indoor installation is often preferred in areas where extreme weather conditions exist.

Model 5000 (formerly Figure 50) is for vertical installation. Model 5010 (formerly Figure 53) is for horizontal installation.

### OPERATION

VAREC 5000 Series Flame Arresters stop the propagation of a flame by absorbing and dissipating heat through the surface area of the bank sheets. Ignited vapor attempting to pass through the arrester is forced through small passages within the bank assembly. Heat is absorbed, lowering the temperature of the gas below its ignition point and quenching the flame.

# VAREC

## DESIGN FEATURES

The net free area through all 5000 Series Flame Arrester banks is three to four times the unit pipe size. This design allows more area through each passageway which reduces surface friction. The result is increased flow capacity with minimal pressure drop. The large surface area of the bank also improves heat dissipation.

VAREC 5000 Series Flame Arresters are designed with a unique extensible aluminum bank frame. The corrugated sheets can be individually inspected and routinely cleaned without removal from the frame. Should the sheets require replacement, the entire bank assembly slides easily out of the arrester. It is not necessary to jack apart the end housings or connecting piping. Additionally, the unitized housing does not require support for proper bank alignment during maintenance as may be necessary with spiral bank arresters. VAREC's unique extensible bank feature is especially useful in applications where frequent inspection and cleaning is anticipated.

The Model 5010 is designed with an "off-set" housing. This provides an advantage over symmetrical housings and spiral bank designs. Flow capacity generally is not affected by condensate accumulation, even when installed in horizontal piping. By design, the bank is positioned above any area where condensate would accumulate. Each unit is fitted with a 1/2" NPT drain plug at the low point, providing a convenient means for routine draining. A VAREC Drip Trap should be specified for field installation at this connection to provide for safe removal of condensate.

## SPECIFICATIONS

**Sizes:** 2", 3", 4", 6", 8", 10" and 12"

**Connections:**

Aluminum — Drilled to ANSI 125 psi dimensions, flat face flange  
Steel & 316 stainless steel — Drilled to ANSI 150 psi dimensions, raised face flange

**Pressure Rating:**

Leak proof to 10 psi (69.0 kPa), standard

**Pressure Drop:** Should not exceed 1 psi (6.9 kPa)

**Location:** Within 15 feet (4.6 m) of flame source

**Configuration:**

Net Free Area — Three to four times the corresponding size standard pipe

Bank Assembly — Extensible aluminum bank frame with corrugated rectangular shaped bank sheets. Sheets arranged for individual removal. Fixed 316 S.S. bank frame.

Provision for Draining —

Model 5000 self draining

Model 5010 includes 1/2" NPT connection at low point

**Housing Materials:**

356 HT low copper aluminum, standard

Steel (ASTM A216 grade WCB), optional

316 stainless steel, optional

**Bank Assembly Material:**

Low copper aluminum extensible frame with aluminum bank sheets, standard

Low copper aluminum extensible frame with 316 stainless steel bank sheets, optional

All 316 stainless steel fixed frame with 316 stainless steel bank sheets, optional

**Approvals:**

Model 5000 UL (Underwriters Laboratories) listed in all aluminum construction with extensible bank assembly in 2", 3", 4", 6", and 10" sizes.\*

Model 5010 UL listed in all aluminum construction as above in 2", 3", and 4" sizes.\* Larger sizes pending.

\*For use on oil storage tanks, installed not more than 15 feet from the open end of the vent pipe. These test conditions may not represent the actual service conditions or piping system design. It is recommended that the arrester be independently tested under actual service conditions before installation.

## FEATURES/BENEFITS

### VAREC FEATURE

- Extensible Bank Assembly (Aluminum Frame Only)
- Three to Four Times Net Free Area Through Bank
- UL Approved
- Heavy Wall Cast Housing in 356 HT Aluminum
- Removable Cover Plate
- Vertical or Horizontal Configuration

### USER BENEFIT

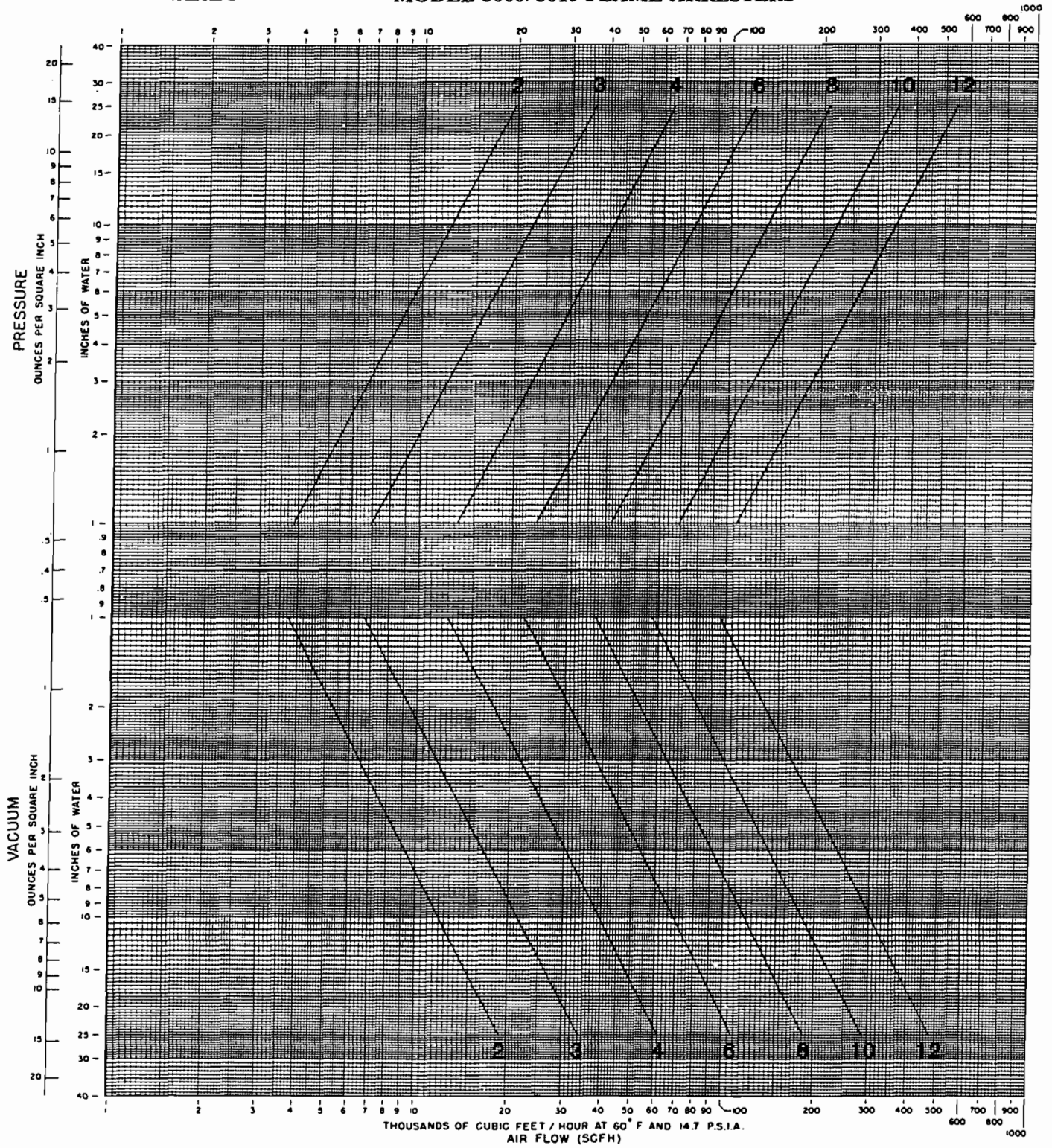
- May be cleaned in place. Bank removal does not place strain on connecting piping.
- Maximum heat dissipation and flow with minimum pressure drop
- Certifies design integrity
- Withstands H<sub>2</sub>S and other corrosive elements common to hydrocarbon gas
- Bank assembly can be cleaned or replaced without jacking housing apart
- Allows flexibility in plant gas piping layout



# FLOW CAPACITY

VAREC

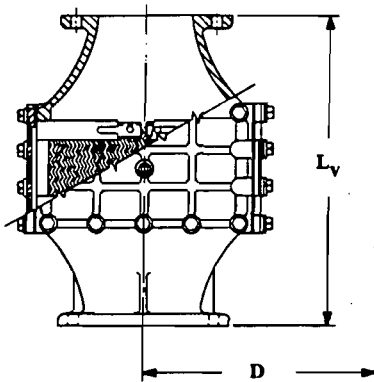
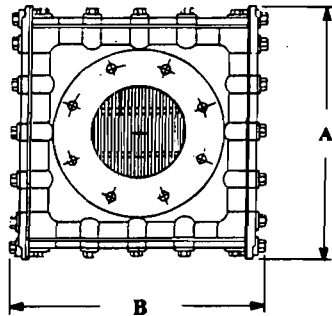
## MODEL 5000/5010 FLAME ARRESTERS



# VAREC 5000 SERIES FLAME ARRESTER

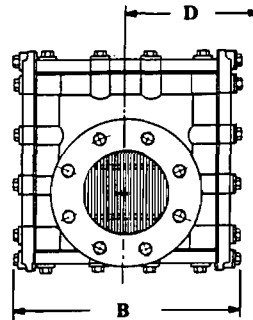
## DIMENSIONAL DRAWING

MODEL 5000

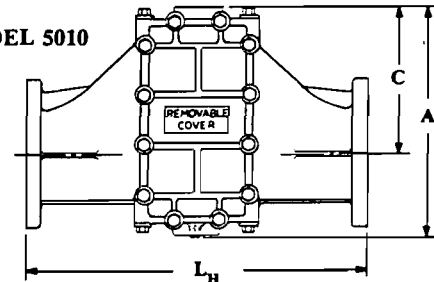


SIZE CODE	02	03	04	06	08	10	12
NOMINAL PIPE SIZE	2	3	4	6	8	10	12
	50	75	100	150	200	250	300
L <sub>V</sub> LENGTH (5000)	12 5/8 321	13 7/8 353	16 5/8 422	21 1/2 546	27 1/4 692	28 3/8 721	34 3/8 873
L <sub>H</sub> LENGTH (5010)	14 1/2 368	16 406	20 508	24 3/8 619	32 1/8 816	35 1/2 902	34 3/8 873
A WIDTH	9 229	11 3/4 298	14 1/2 368	16 1/2 419	21 5/8 549	24 610	31 787
B DEPTH	8 5/8 219	11 1/2 292	14 3/4 375	16 3/4 425	21 3/4 552	23 3/4 603	29 1/4 743
C OFFSET	5 3/8 137	7 1/4 184	9 229	10 3/4 273	14 3/8 365	16 406	20 508
D BANK CLEARANCE	19 483	23 1/4 591	28 1/8 715	31 1/8 791	38 5/8 981	41 3/8 1057	50 1270
ALUMINUM SHIPPING WEIGHT (5000)	25	45	65	100	200	240	350
	11	20	30	45	91	109	159
ALUMINUM SHIPPING WEIGHT (5010)	30	50	70	115	220	270	375
	14	23	32	52	100	123	170

Inches and lb in bold, mm and kg in light  
Flange drilling per ANSI 125 psi flat face flange (aluminum)  
or per ANSI 150 psi raised face flange (Steel & 316 S.S.)



MODEL 5010



Installation, mounting arrangement, and dimensions are preliminary general information not to be used for construction. Certified drawings are available.

## ORDERING INFORMATION

50	FLAME ARRESTER				
	Code	Model (Select One)			
	00	Vertical (Formerly Figure 50)			
	10	Horizontal (Formerly Figure 53)			
	Code	Size (Select One)			
	02	2"			
	03	3"			
	04	4"			
	06	6"			
	08	8"			
	10	10"			
	12	12"			
	Code	Housing Material (Select One)			
	01	Aluminum			
	03	Steel			
	06	316 SS			
	Code	Bank Assembly Frame and Sheet Material (Select One)			
	01	Aluminum extensible frame, aluminum sheets			
	16	Aluminum extensible frame, 316 SS sheets			
	06	316 SS fixed frame, 316 SS sheets			
50	10	08	01	01	(EXAMPLE)

**VAREC**  
a Rosemount Division

10800 Valley View St., Cypress, CA 90630-5016 TEL: (714) 761-1300 Telex: 4722044 FAX: (714) 952-2701

# INSTALLATION AND MAINTENANCE INSTRUCTIONS

## 2-WAY INTERNAL PILOT OPERATED SOLENOID VALVES DIAPHRAGM TYPE - 3/8, 1/2 AND 3/4 N.P.T. NORMALLY CLOSED OPERATION

BULLETINS

8210  
8211



Form No. V-5848

### DESCRIPTION

Bulletin 8210's are 2-way, normally closed internal pilot operated solenoid valves. Valve bodies and bonnets are of brass construction. Standard valves have a General Purpose, NEMA Type 1 Solenoid Enclosure.

Bulletin 8211's are the same as Bulletin 8210's except the solenoids are equipped with an enclosure which is designed to meet NEMA Type 4, Watertight, NEMA Type 7 (C or D) Hazardous Locations - Class I, Group C or D and NEMA Type 9 (E, F or G) Hazardous Locations - Class II, Groups E, F or G. The Explosion-Proof/Watertight Solenoid Enclosures are shown on separate sheets of Installation and Maintenance Instructions, Form Numbers V-5380 and V-5391.

### OPERATION

Normally Closed: Valve is closed when solenoid is de-energized and opens when solenoid is energized.

### MANUAL OPERATOR (Optional)

Valves with Suffix 'MO' in the catalog number are provided with a manual operator which allows manual operation when desired or during an interruption of electrical power. To operate valve manually, push in knurled cap and rotate clockwise 180°. Disengage manual operator by rotating knurled cap counterclockwise 180° before operating electrically.

### MANUAL OPERATOR LOCATION (Refer to Figures 1 and 3)

Manual operator (when shipped from factory) will be located over the valve outlet. Manual operator may be relocated at 90° increments by rotating valve bonnet. Remove bonnet screws (4) and rotate valve bonnet with solenoid to desired position. Replace bonnet screws (4) and torque in a crisscross manner to 110 ± 10 inch pounds.

If valve is installed in the system and is operational, proceed in the following manner: **WARNING: Depressurize valve and turn off electrical power supply.**

1. Remove retaining cap or clip and slip the entire solenoid enclosure off the solenoid base sub-assembly. **CAUTION:** When metal retaining clip disengages, it will spring upwards.
2. Remove bonnet screws (4) and rotate valve bonnet to desired position.
3. Replace bonnet screws (4) and torque in a crisscross manner to 110 ± 10 inch pounds. Replace solenoid enclosure and retaining clip or cap.

### INSTALLATION

Check nameplate for correct catalog number, pressure, voltage and service.

### TEMPERATURE LIMITATIONS

For maximum valve ambient and fluid temperatures, refer to chart. The temperature limitations listed are for UL applications. For non-UL applications, higher ambient and fluid temperature limitations are available. Consult factory. Check catalog number on nameplate to determine maximum temperatures.

CONSTRUCTION	COIL CLASS	CATALOG NUMBER PREFIX	MAX. AMBIENT TEMP. °F	MAX. FLUID TEMP. °F
A-C Construction (Alternating Current)	A	None or DA	77	180
	F	DF or FT	122	180
	H	HT	140	180
D-C Construction (Direct Current)	A, F or H	None, FT or HT	77	150

### POSITIONING/MOUNTING

This valve is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertical and upright so as to reduce the possibility of foreign matter accumulating in the core tube area. For mounting bracket (optional feature) dimensions, refer to Figure 2.

### PIPING

Connect piping to valve according to markings on valve body. Apply pipe compound sparingly to male pipe threads only; if applied to valve threads, it may enter the valve and cause operational difficulty. Pipe strain should be avoided by proper support and alignment of piping. When tightening the pipe, do not use valve as a lever. Wrenches applied to valve body or piping are to be located as close as possible to connection point.

**IMPORTANT:** For the protection of the solenoid valve, install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Periodic cleaning is required depending on the service conditions. See Bulletins 8600, 8601 and 8602 for strainers.

### WIRING

Wiring must comply with Local and National Electrical Codes. Housings for all solenoids are provided with connections for 1/2 inch conduit. The general purpose solenoid enclosure may be rotated to facilitate wiring by removing the retaining cap or clip. **CAUTION:** When metal retaining clip disengages, it will spring upwards. Rotate to desired position. Replace retaining cap or clip before operating.

**NOTE:** Alternating Current (A-C) and Direct Current (D-C) solenoids are built differently. To convert from one to the other, it is necessary to change the complete solenoid including the solenoid base sub-assembly and core assembly.

### SOLENOID TEMPERATURE

Standard catalog valves are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched with the hand only for an instant. This is a safe operating temperature. Any excessive heating will be indicated by the smoke and odor of burning coil insulation.

### MAINTENANCE

**WARNING:** Turn off electrical power supply and depressurize valve before making repairs. It is not necessary to remove the valve from the pipe line for repairs.

### CLEANING

A periodic cleaning of all solenoid valves is desirable. The time between cleanings will vary, depending on media and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive leakage or noise will indicate that cleaning is required.

### PREVENTIVE MAINTENANCE

1. Keep the medium flowing through the valve as free from dirt and foreign material as possible.
2. While in service, operate the valve at least once a month to insure proper opening and closing.
3. Periodic inspection (depending on media and service conditions) of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any parts that are worn or damaged.

ASCO Valves



## IMPROPER OPERATION

1. **Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A metallic click signifies that the solenoid is operating. Absence of the click indicates loss of power supply. Check for loose or blown-out fuses, open circuited or grounded coil, broken lead wires or splice connections.
2. **Burned-Out Coil:** Check for open circuited coil. Replace coil if necessary.
3. **Low Voltage:** Check voltage across coil leads. Voltage must be at least 85% of nameplate rating.
4. **Incorrect Pressure:** Check valve pressure. Pressure to valve must be within range specified on nameplate.
5. **Excessive Leakage:** Disassemble valve and clean all parts. Replace worn or damaged parts with a complete Spare Parts Kit for best results.

## COIL REPLACEMENT (Refer to Figures 1, 2 and 3)

Turn off electrical power supply and disconnect coil lead wires. Proceed in the following manner:

1. Remove retaining cap or clip, nameplate and cover. CAUTION: When metal retaining clip disengages, it will spring upwards.
2. Slip yoke containing coil, sleeves and insulating washers off the solenoid base sub-assembly. For D-C Construction, slip spring washer, coil and insulating washers off the solenoid base sub-assembly. Insulating washers are omitted when a molded coil is used.
3. Reassemble in reverse order of disassembly paying careful attention to exploded views provided for identification and placement of parts.

CAUTION: Solenoid must be fully reassembled as the housing and internal parts are part of and complete the magnetic circuit. Place insulating washers at each end of coil, if required.

## VALVE DISASSEMBLY

Depressurize valve and turn off electrical power supply. For A-C Construction, refer to Figures 1 and 2. For D-C Construction, refer to Figure 3. Proceed in the following manner:

1. Disassemble valve in an orderly fashion. Pay careful attention to exploded views provided for identification of parts.
2. Remove retaining cap or clip and slip the entire solenoid enclosure off the solenoid base sub-assembly. CAUTION: When metal retaining clip disengages, it will spring upwards. Unscrew solenoid base sub-assembly and remove bonnet gasket, core assembly and core spring.
4. For A-C Construction without manual operator, remove valve bonnet screws (4). Remove solenoid base sub-assembly, core assembly and core spring.
5. Remove diaphragm spring (A-C Construction only), diaphragm assembly and body gasket.
6. For normal maintenance, it is not necessary to disassemble the manual operator unless external leakage is evident. To disassemble, remove stem pin, manual operator stem, stem spring and stem gasket.
7. All parts are now accessible for cleaning or replacement. Replace worn or damaged parts with a complete Spare Parts Kit for best results.

## VALVE REASSEMBLY

1. Reassemble in reverse order of disassembly paying careful attention to exploded views provided for identification and placement of parts.
2. Replace body gasket and diaphragm assembly. Locate bleed hole in diaphragm assembly approximately 45° from valve outlet.
3. Replace valve bonnet and bonnet screws. Torque bonnet screws (4) in a crisscross manner to 110 ± 10 inch pounds.
4. For A-C Construction, the diaphragm spring, core assembly and core spring must be installed prior to assembly of bonnet as this is the solenoid base sub-assembly. Be sure diaphragm spring is installed properly. Closed turns of spring to seat on diaphragm assembly. For valves with a manual operator (see Figure 1), the small end of diaphragm spring seats on diaphragm assembly.
5. Install core spring in core assembly. Be sure core spring is inserted into core assembly with wide end in first. Closed end protrudes from top of core assembly.
6. Replace bonnet gasket, core assembly, core spring and solenoid base sub-assembly. Torque solenoid base sub-assembly to 175 ± 25 inch pounds.
7. If removed, replace manual operator stem gasket, stem spring, stem and stem pin.
8. Replace solenoid enclosure and retaining cap or clip.
9. After maintenance, operate the valve a few times to be sure of proper opening and closing.

## SPARE PARTS KITS

Spare Parts Kits and Coils are available for ASCO valves. Parts marked with an asterisk (\*) are supplied in Spare Parts Kits.

## ORDERING INFORMATION FOR SPARE PARTS KITS

When Ordering Spare Parts Kits or Coils Specify Valve Catalog Number, Serial Number and Voltage.

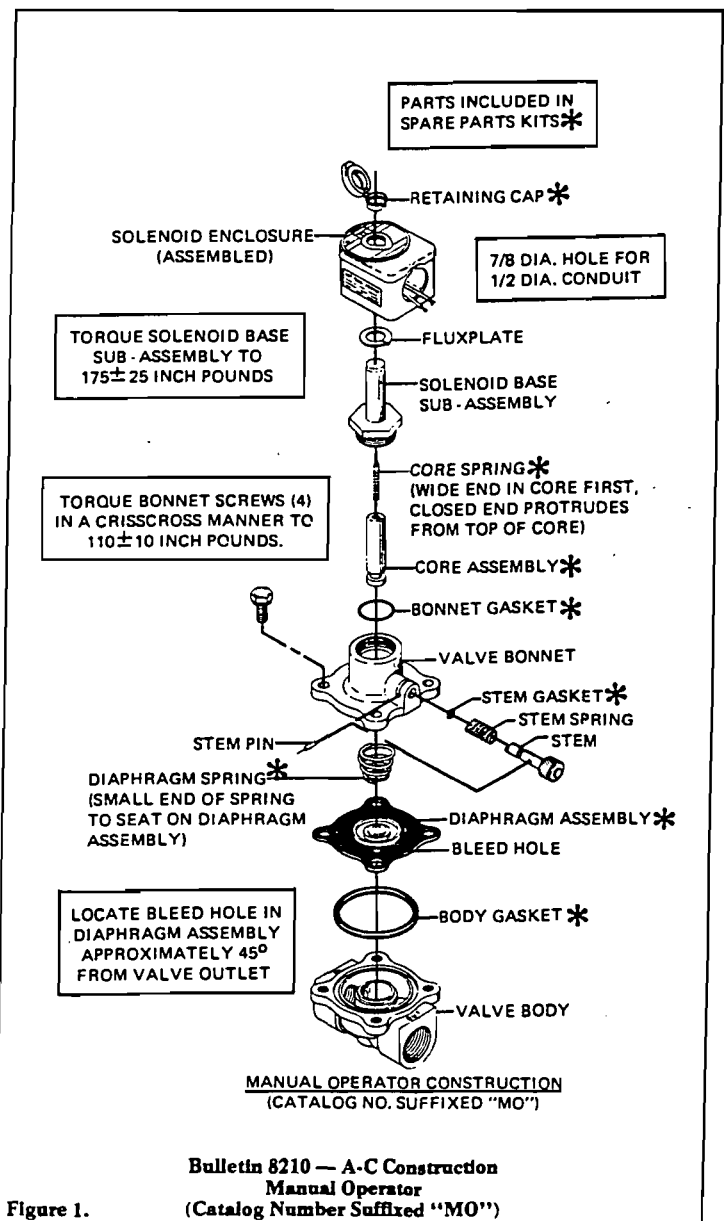


Figure 1.

Bulletin 8210 — A-C Construction Manual Operator (Catalog Number Suffix "MO")

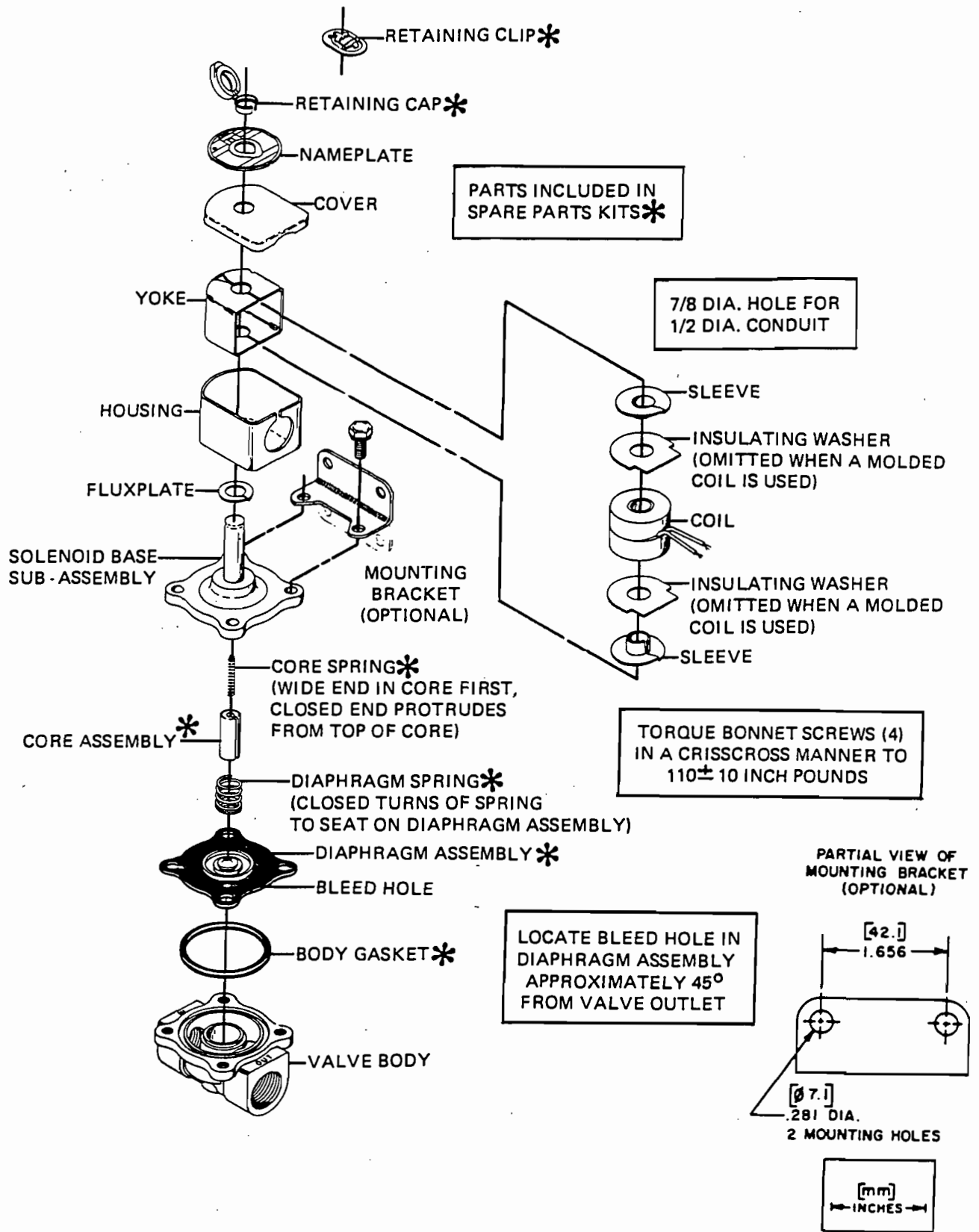


Figure 2.

Bulletin 8210 — A-C Construction  
 General Purpose Solenoid Enclosure Shown.  
 For Explosion-Proof/Watertight Solenoid Enclosure used on Bulletin 8211, see Form No. V-5391.

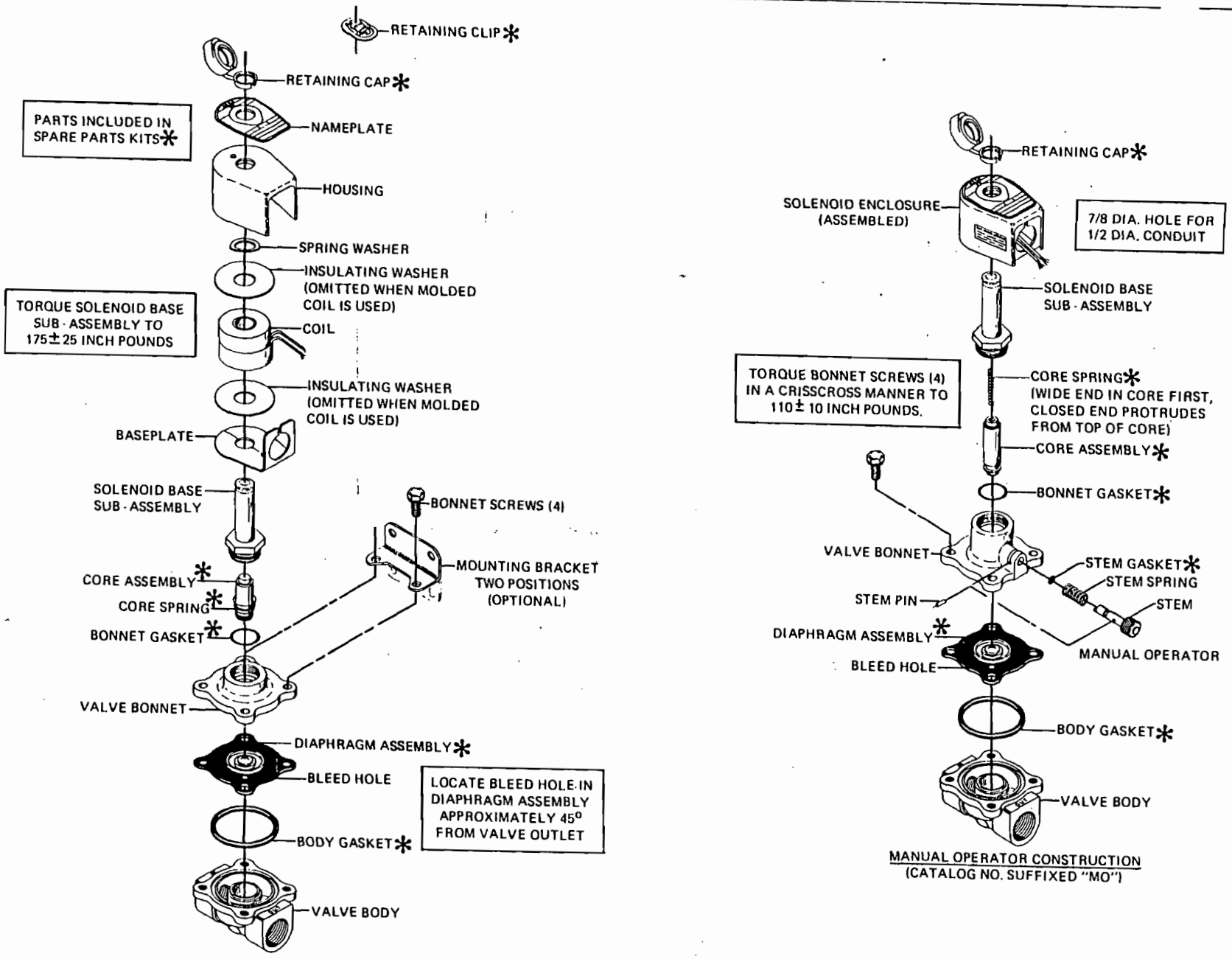


Figure 3.

Bulletin 8210 — D-C Construction  
 General Purpose Solenoid Enclosure Shown.  
 For Explosion-Proof/Watertight Solenoid Enclosure used on Bulletin 8211, see Form No. V-5380.

Pilot Gas Pressure Regulator

Fisher Controls

Instruction Manual

Series 64 & 67 LP-Gas Regulators



July 1986

Form MCK-1108

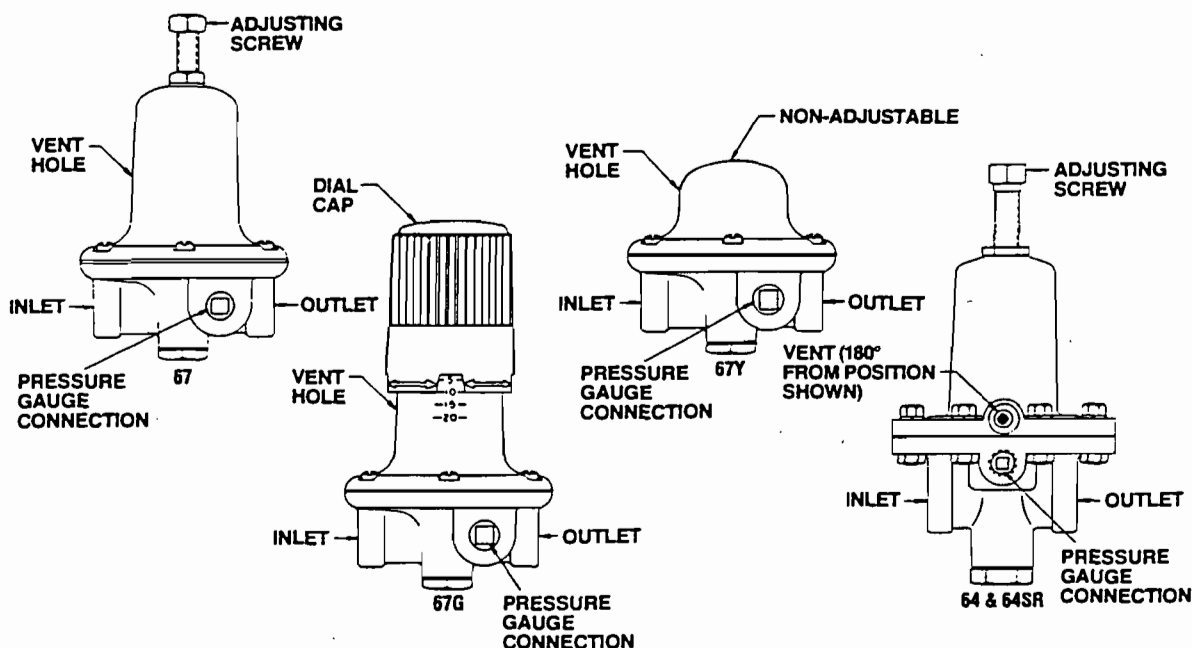


Figure 1. Series 64 and 67

**WARNING**

Fisher equipment must be installed, operated, and maintained in accordance with federal, state, and local codes and Fisher instructions. The installation in most states must also comply with NFPA No. 54 and 58 standards.

Only personnel trained in the proper procedures, codes, standards, and regulations of the LP-gas industry should install and service this equipment. Failure to follow these instructions or to properly install and maintain this equipment could result in an explosion and/or fire causing property damage and personal injury or death.

**Things To Tell The Gas Customer:**

1. Point out the regulator's vent (or vent assembly) to the customer and stress that this opening must remain

unobstructed at all times. Tell the customer to be sure to check the vent opening after a freezing rain, sleet storm, or snow to make sure ice has not formed in the vent.

2. Show the customer the shutoff valve on the container. The customer should close this valve immediately if gas can be smelled, appliance pilot lights fail to stay on or appear higher than usual, or any other abnormal situation occurs.

3. Tell the customer to call your company to service the regulator. If the regulator vents gas or a leak develops in the system, only a qualified gas serviceman should install or service the regulator.

**Introduction**

**Scope of Manual**

This instruction manual covers installation and maintenance



Table 1. Specifications

Type Number	Inlet & Outlet Connections	Vent Opening	Adjustment	Outlet Adjustment Range	Internal Relief Valve	Max. Vapor Capacity BTU/Hr Propane <sup>(1)</sup>
64	1/2-inch FNPT	1/4-inch FNPT	Wrench	3-100 psig (4 springs)	No	5,250,000
64SR	1/2-inch FNPT	1/4-inch FNPT	Wrench	3-35 psig (3 springs)	Yes	3,600,000
67	1/4-inch FNPT	Hole in spring case	Wrench or handwheel	3-100 psig (4 springs)	No	1,150,000
67G	1/4-inch FNPT	Hole in spring case	Dial Cap	5-100 psig (3 springs)	No	1,150,000
67Y	1/4-inch FNPT	Hole in spring case	Nonadjustable	10, 15, or 20 psig	No	700,000

1. Based on inlet pressure 20 psig greater than outlet with 20% droop. Liquid capacity 160 gph for 64 Series; 3-5 gph for 67 Series.

nance for the following high pressure regulators: Types 64, 64SR, 67, 67G, and 67Y.

## Description

All of the regulators are designed for high pressure (pounds per square inch) service and can be used on either vapor or liquid service. Their outlet pressure ranges from 3 to 100 psig.

Types 64 and 64SR are used for either first-stage (reducing container pressure to around 10 psig for a second-stage regulator) or final-stage high pressure service (reducing container pressure to a lower pressure for a high pressure burner). The 67 Series is intended for final-stage high pressure applications. The regulators are normally painted red.

## Specifications

Table 1 lists the specifications for the regulators. Contact the factory if the regulators are to be used on any service other than LP-gas, natural gas, or air. Temperature limits are -20° to 150° F and maximum inlet pressure is 250 psig.

## Installation

### WARNING:

All vents should be kept open to permit free flow of air into and out of the regulator. Protect openings against the entrance of rain, snow, ice formation, paint, mud, insects, or any other foreign material that could plug the vent or the vent line.

LP-gas may discharge to the atmosphere

through the vent of Type 64SR. An obstructed vent which limits air or gas flow can interfere with proper pressure regulation and could result in personal injury or property damage. Failure to use a vent line where there can be a hazardous accumulation of gas could result in personal injury or property damage.

Never use a first-stage (pounds to pounds) regulator on low pressure (inches of water column) service because personal injury or property damage could occur.

Before installing the regulator, check for damage which might have occurred in shipment. Also check for and remove any dirt or foreign matter which may have accumulated in the regulator body or the pipeline. Apply pipe compound to the male threads of the pipe.

Make sure gas flow through the regulator is in the correct direction—"Inlet" and "Outlet" connections are clearly marked on the regulator. The installation should be adequately protected from vehicular traffic and damage from other external sources.

If possible, install the regulator with the vent pointed down to allow condensate to drain. A hood or enclosure must be used to protect the regulator's vent opening from the elements on outdoor installations. An auxiliary vent assembly, such as the Fisher Y602 Series, could also be used for vent protection on Type 64 and 64SR.

Install the regulator high enough above ground level—at least 18-inches—so that rain splatter cannot freeze in the vent. Do not install the regulator in a location where there can be excessive water accumulation or ice formation, such as directly beneath a downspout, gutter, or roof line of a building.

Type 64 Series regulators installed indoors are limited to 20 psig maximum inlet pressure. A vent line to the



outside of the building is required for the Type 64SR. A vent assembly, such as Fisher Y602 Series, should be used on the end of the vent line. The same installation precautions apply to vent assemblies as the integral regulator vents covered previously. To install the vent line, remove the vent screen and apply a good grade of pipe dope to the male threads of the line. Vent piping or tubing must not restrict the flow passage of the 64SR's internal relief valve. Type 67 Series regulators should not be used on indoor installations.

Installation with shutoff valves ahead of the Type 64SR is recommended on liquid service, see figure 2. Installations with shutoffs downstream of the 64SR can trap liquid between the regulator and the shutoff. The trapped liquid can vaporize, opening the regulator's internal relief valve and exhausting gas through the vent. On installations where it is impossible to install the 64SR without using shutoffs between the regulator and the burner, either install the regulator in a safe location or run a line from the regulator vent to a safe location so that any discharge through the relief valve will not create a hazard.

## Adjustment

The outlet pressure of all the regulators except Type 67Y can be adjusted. If it becomes necessary to adjust the outlet pressure on Types 64, 64SR, or 67, loosen the locknut at the top of the spring case. Turn the adjusting screw or handwheel clockwise to increase or counterclockwise to decrease the outlet pressure setting. Tighten the locknut to maintain the adjustment setting.

On Type 67G regulators, move the dial cap until the arrow on the cap points to the desired outlet pressure setting stamped on the spring case.

## Overpressure Protection

### WARNING

Personal injury or system damage may result if these regulators are installed without appropriate overpressure protection. Maximum emergency outlet pressure for the 67 Series is 50 psig over the outlet pressure setting, or 100 psig, whichever is greater. Maximum emergency outlet pressure for the 64 Series is 220 psig. Outlet pressures greater than these above the setpoint may cause damage to regulator parts, leaks in the regulator, or personal injury due to bursting of pressure-containing parts or explosion of accumulated gas.

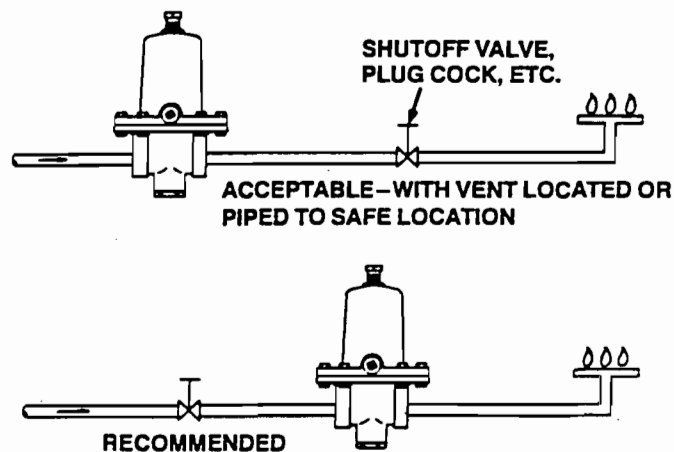


Figure 2. Type 64SR on Liquid Service Requires Care with Downstream Restrictions

If the regulator is exposed to an overpressure condition, it must be inspected for any damage that may have occurred.

Large volumes of gas may discharge through the Type 64SR vent during internal relief valve operation which can result in fire or explosion from accumulated gas.

A relief valve is required downstream of all the regulators (except Type 64SR) used on final-stage service. Type 64SR has an internal relief valve and does not require a separate relief valve downstream. The internal relief valve opens when downstream pressure reaches approximately 125% to 250% of the setpoint. When the internal relief valve opens, gas escapes through the 64SR's vent. The 64SR's internal relief valve gives overpressure protection against excessive build-up resulting from seat leakage due to worn parts or chips of foreign material on the orifice.

## Maintenance

### WARNING

To avoid personal injury or equipment damage, do not attempt any maintenance or disassembly without first isolating the regulator from system pressure and relieving all internal pressure.

Regulators that have been disassembled for repair must be tested for proper operation before being returned to service. Only parts manufactured by Fisher should be used for repairing Fisher regulators. Relight pilot lights according to normal startup procedures.

Due to normal wear or damage that may occur from external sources, these regulators must be inspected and maintained periodically. The frequency of inspection and replacement of the regulators depends upon the severity of service conditions or the requirements of local, state, and federal regulations. Even under ideal conditions, these regulators should be replaced after 15 years from the date of manufacture or sooner should inspection reveal the need.

Visually inspect the regulator each time a gas delivery is made for:

1. Improper installation.
2. Plugged or frozen vent.
3. Wrong regulator or no regulator in the system.
4. Internal or external corrosion.
5. Age of the regulator.
6. Any other condition that could cause the uncontrolled escape of gas.

Failure to do the above could result in personal injury or property damage.

Make sure the regulator vent, vent assembly, or vent line does not become plugged by mud, insects, ice, snow, paint, etc. The vent screen (Type 64 and 64SR only) aids in keeping the vent from becoming plugged,

and the screen should be clean and properly installed.

Replace any regulators that have had water in their spring case or show evidence of external or internal corrosion. Checking for internal corrosion requires complete removal of the spring case and shut down of the gas system. Closely examine regulators directly connected to the container valve by means of a solid POL adaptor (horizontal mounting) for signs of corrosion. Correct any improper installations.

Older regulators are more likely to catastrophically fail because of worn or corroded parts. Replace regulators over 15 years of age; other service or environmental conditions may dictate replacement of the regulator before it becomes 15 years old, refer to Fisher Bulletin LP-32.

## Regulator Repair

Regulators that have been disassembled for repair must be tested for proper operation before being returned to service. Only parts manufactured by Fisher should be used for the repair of Fisher regulators. Be sure to give the complete type number of the regulator when corresponding with the factory.

While this information is presented in good faith and believed to be accurate, Fisher Controls does not guarantee satisfactory results from reliance upon such information. Nothing contained herein is to be construed as a warranty or guarantee, express or implied, regarding the performance, merchantability, fitness

or any other matter with respect to the products, nor as a recommendation to use any product or process in conflict with any patent. Fisher Controls reserves the right, without notice, to alter or improve the designs or specifications of the products described herein.

# THE MCDANIEL LINE

Pilot & Enrichment Gas Pressure Gauge

BEST AVAILABLE COPY

## LOW PRESSURE MODEL "MC"

**CASES:** Alloy Steel (MC-3) or 304  
Stainless (MCX) Watertight  
with Full Area Relief

### DIAL SIZES

Nominal Diameter 4" or 6"

### CONNECTIONS

1/4" or 1/2" NPT or BSP (Metric) Bottom or Back  
Connected

### CONFIGURATIONS

Rear or Front Flanges for Panel Mounting.

### SENSITIVE ELEMENT

Capsule - Brass (MC-3) or SS(MCX)

### MOVEMENT

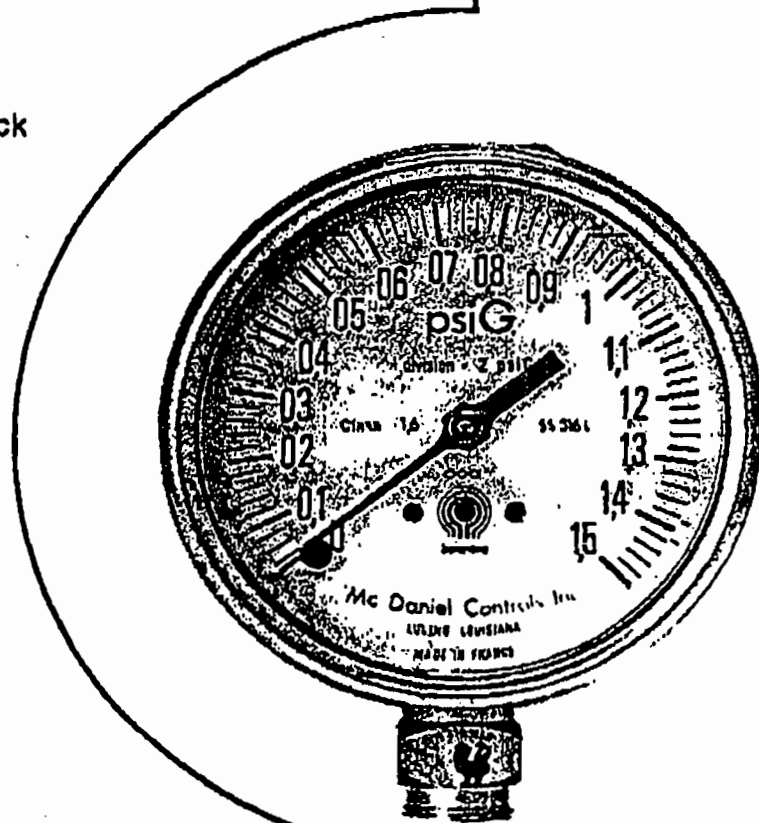
Precision Geared - Brass

### OVERRANGE PROTECTION

20 times full scale pressure intermittent

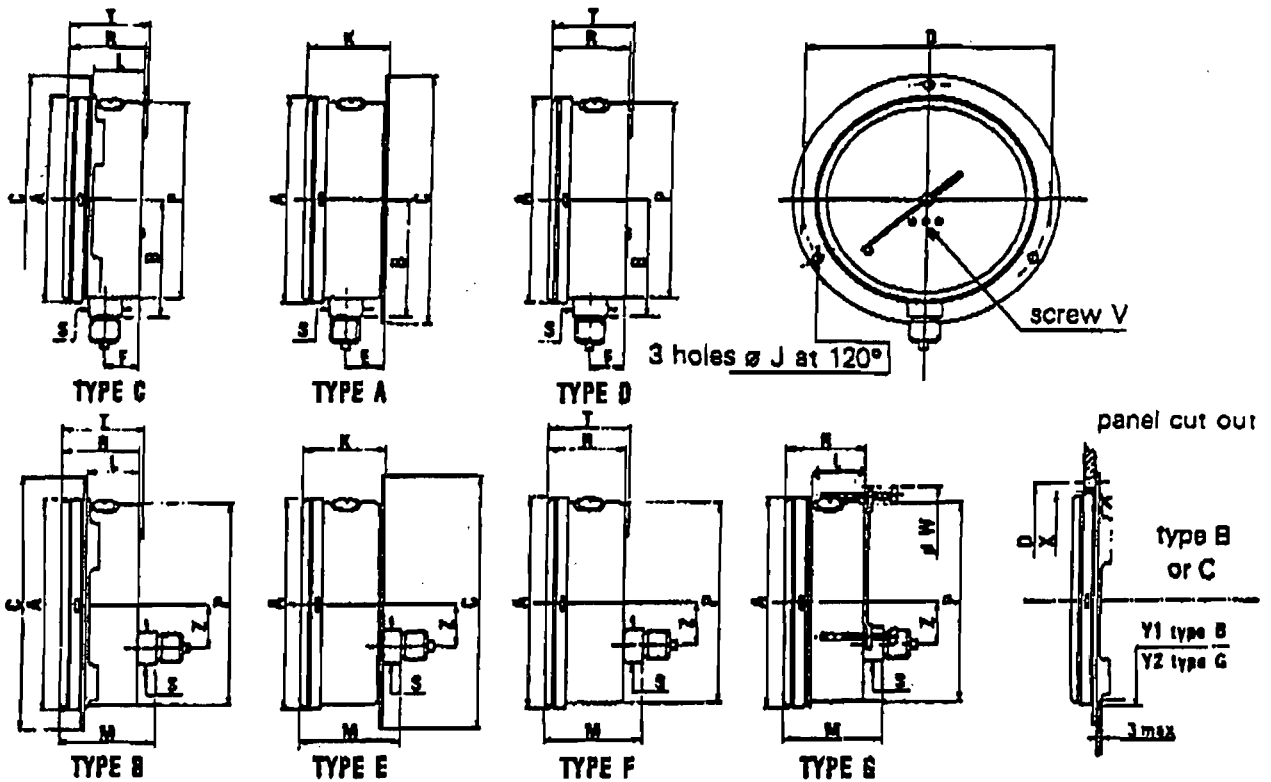
### RANGES

1.6" WC to 160" WC or equivalents in ounces, PSI or Metric Systems.  
Standard Numerical Values.



**Rugged, Reliable and Economical**

# MODEL "MC" DIMENSIONAL DATA

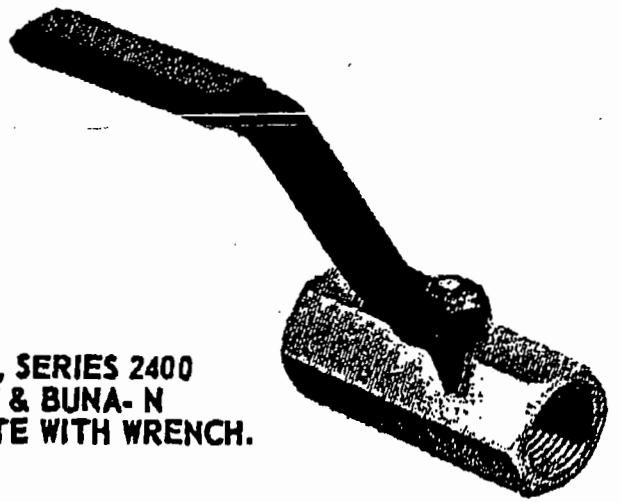


DIMENSIONS	A	B	C	D	E	F	J	K	L	M	P	R	S	T	W	X	Y1	Y2	Z	Wgt
2 1/4"	2.54	1.62	3.18	2.87	0.81	0.46	0.14	2.08	1.60	2.33	2.30	1.94	0.65	2.08	2.99	2.58	2.48	2.34	0	0.42
3"	3.41	2.31	4.33	3.88	1.02	0.98	0.22	2.22	1.48	2.81	3.13	2.13	0.87	2.22	3.94	3.44	3.31	3.19	0.89	0.88
4"	4.18	2.88	5.18	4.65	1.00	0.81	0.22	2.22	1.55	2.81	3.88	2.16	0.87	2.21	4.66	4.21	3.98	3.90	1.24	1.34
6"	6.91	3.54	7.08	6.61	1.00	0.81	0.22	2.22	1.55	2.91	6.59	2.15	0.87	2.21	6.94	6.71			1.24	1.87

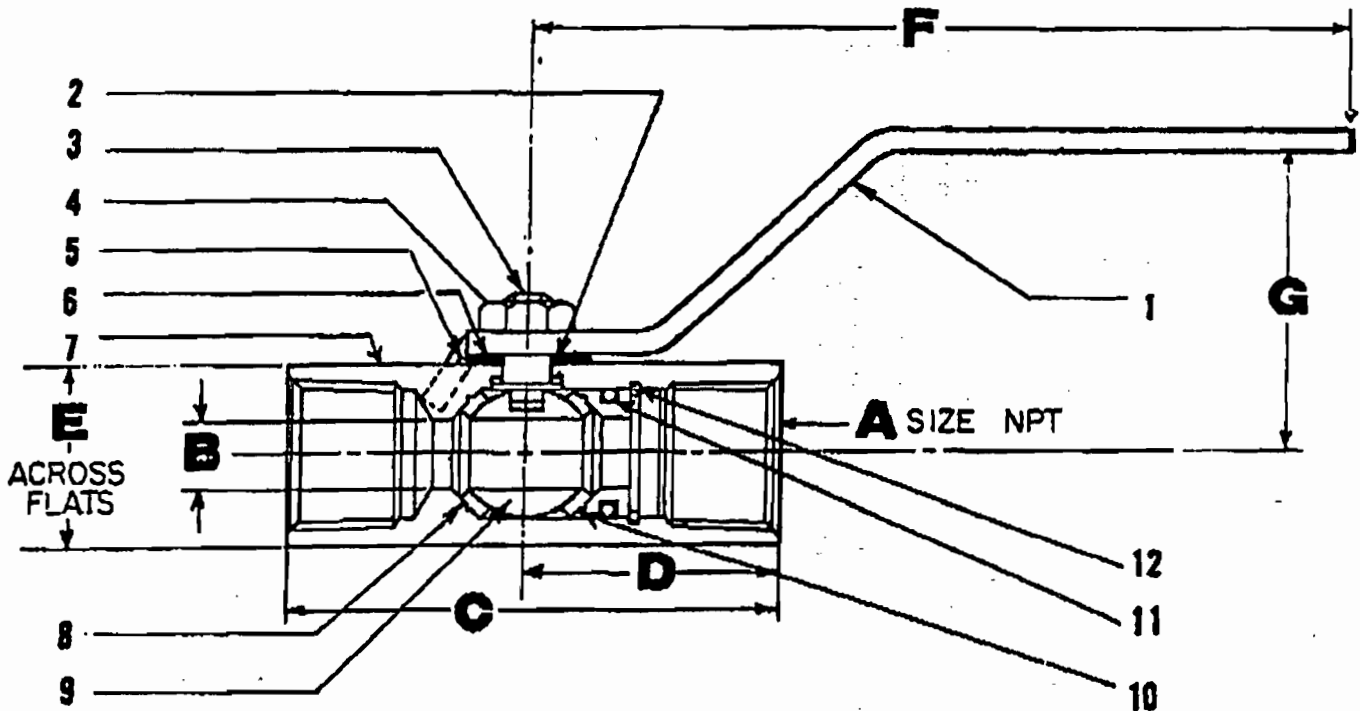
## MODEL "MC" PRICE LIST

Pressure Range Inches W. C.	MC-3 Brass Intervals		MCX All Stainless	
	4"	6"	4"	6"
0 - 1.6 .....	-	86.50	-	-
0 - 2.4 .....	-	73.50	-	-
0 - 4 .....	64.00	73.50	-	159.50
0 - 6 .....	57.50	67.00	154.50	159.50
0 - 10 .....	57.50	67.00	144.50	159.50
0 - 16, 25, 40, 60, 100 or 160 .....	57.50	67.00	144.50	163.50
<b>OTHER CONFIGURATIONS (ADD TO BASIC PRICE)</b>				
Front or Rear Flange .....	4.00	5.00	4.00	5.00
Lower Back Connected .....	5.00	5.00	NC	NC
Vacuum Ranges .....	12.50		12.50	

# HALE Econoliner Ball Valve



HALE ECONOLINER BALL VALVE 150 S.P. , 600 W.O.G. , SERIES 2400  
(H-747) BRASS BALL VALVE , GLASS FILLED TFE SEAT & BUNA- N  
" O " RINGS, BRASS BALL, THREADED ENDS, COMPLETE WITH WRENCH.



Valve Size	Dimensions, Inches							
	WT./Lbs.	A	B	C	D	E	F	G
1/4"	.56	1/4-14	3/8	2 1/4	1 1/8	1	4 1/4	1 3/4
3/8"	.62	3/8-14	1/2	2 3/4	1 1/4	1 1/8	4 1/4	1 1/8
1"	1.46	1-11 1/2	3/4	3 3/4	1 3/8	1 1/2	5 1/2	2 3/4
1 1/4"	2.33	1 1/4-11 1/2	1 1/8	3 3/4	1 3/8	1 3/8	5 1/2	2 1/4
1 1/2"	3.51	1 1/2-11 1/2	1	4 3/4	2 1/8	2 1/4	6 1/2	2 3/4
2"	4.89	2-11 1/2	1 1/4	4 1/4	2 3/4	2 3/8	6 1/4	2 3/4

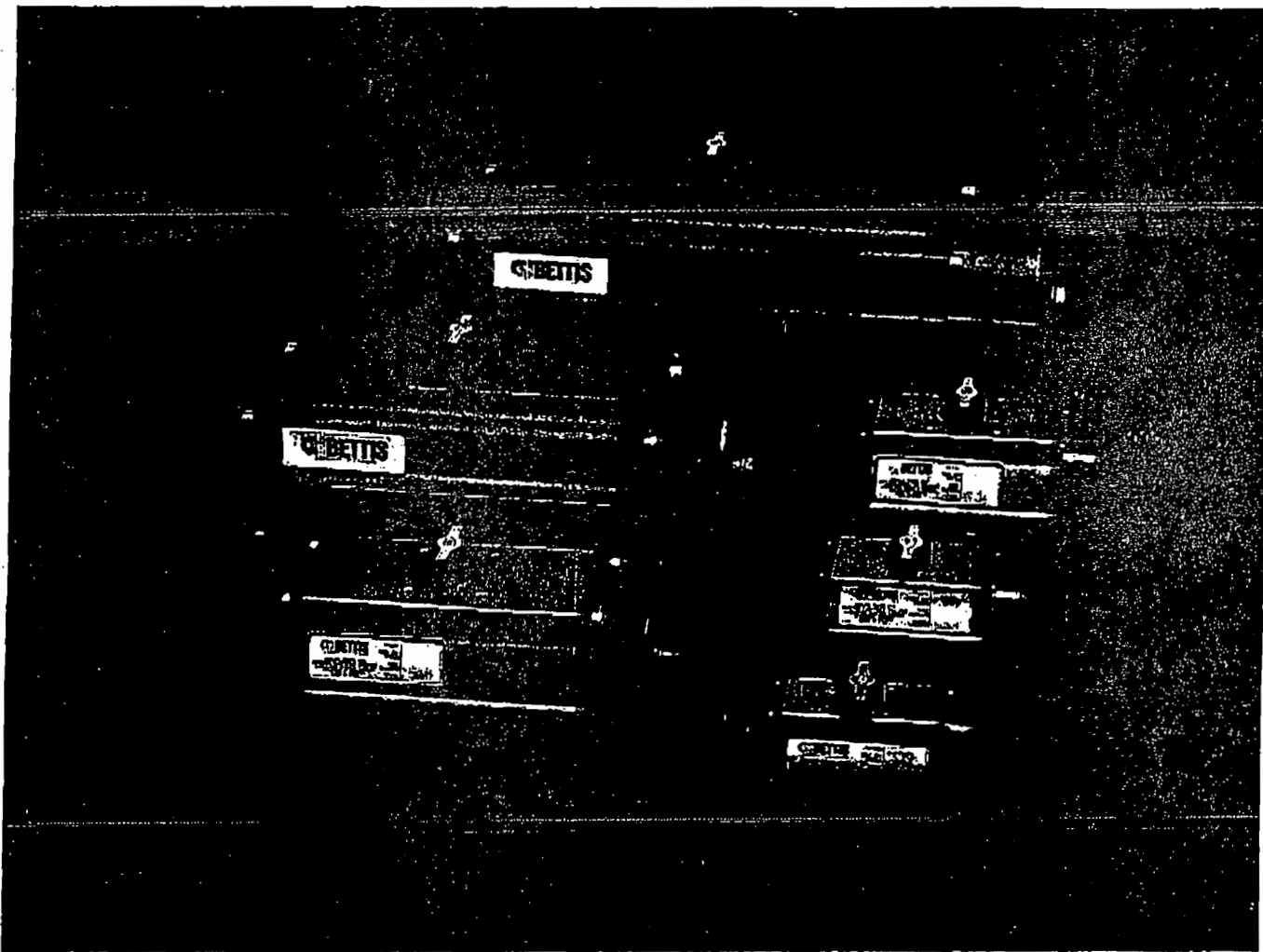


Hale Oilfield Products Division

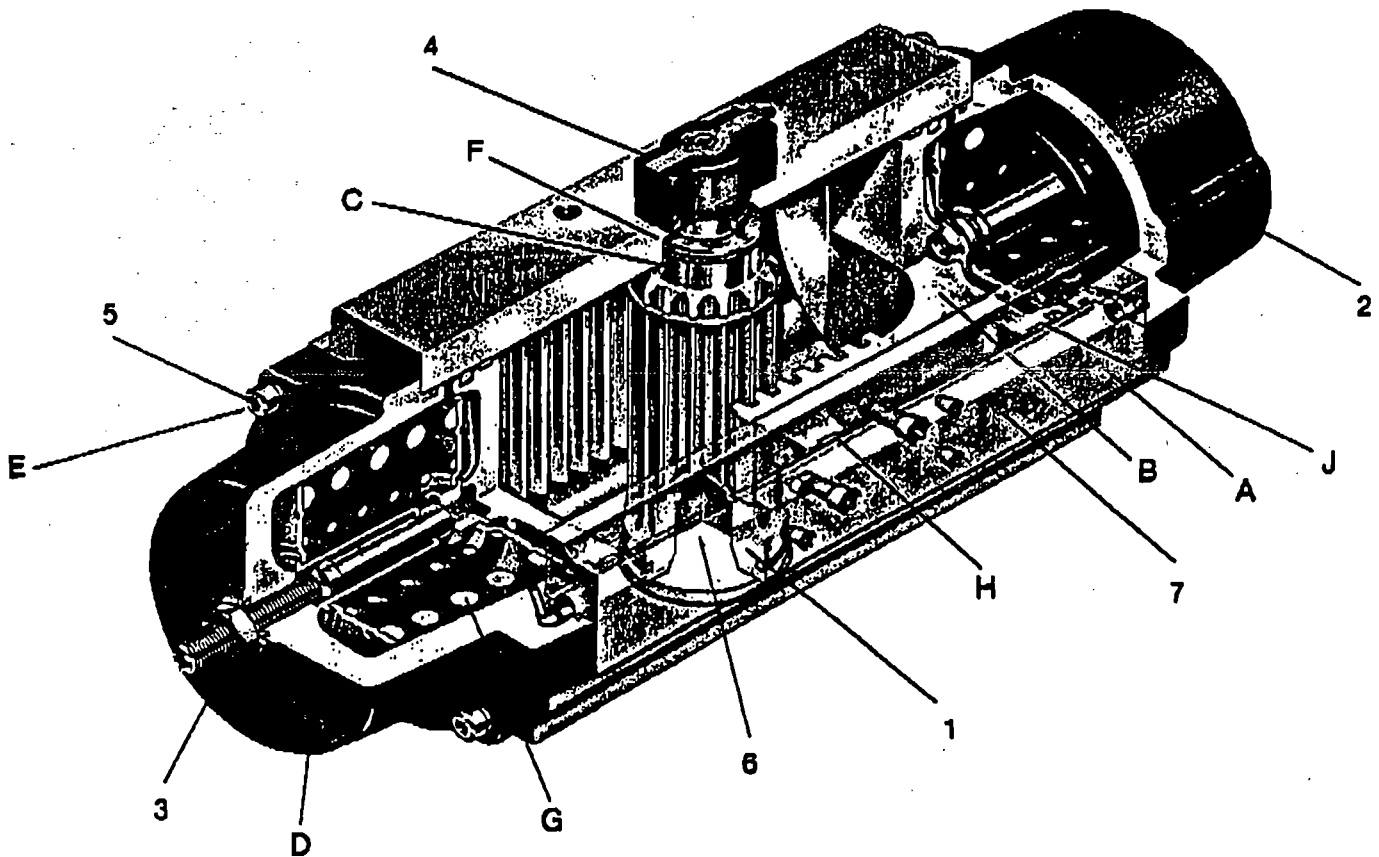
A Condec Company  
4428 West 12th  
Houston, Texas 77055  
(713) 680-2214



# RP-Series Pneumatic Actuators



Models: RP5000-RP11000



### Features

1. Bottom loaded, one piece blow-out proof output shaft, is retained by a safety redundant internal retaining ring.

2. Self-contained space saving spring modules allow safe and simple conversion from double-acting to spring-return or to a different spring configuration.

3. Integral position stops allow up to  $\pm 5$  degrees field adjustment at the 90 degree position.

4. Easily removable position indicator allows access to male output shaft and accessory mounting.

5. All fasteners are stainless steel.

6. Square female drive allows direct mount capability for a "low profile" valve actuator assembly.

7. Advanced UV resistant fluoropolymer impregnation of internal and external housing surfaces plus fluoropolymer coating on output drive shaft and end caps provides excellent hostile environment protection.

### Materials of Construction

A. Body: Precision-extruded aluminum alloy, hard anodized and fluoropolymer impregnated.

B. Pistons: Cast aluminum alloy, dichromate dipped.

C. Output Shaft/Pinion: Carbon steel, fluoropolymer coated.

D. End Caps: Cast aluminum alloy, fluoropolymer coated.

E. Fasteners: All stainless steel.

F. Seals: Nitrile standard.

Viton, optional.

G. Springs: Carbon steel, phosphate coated, oil dipped.

H. Heel Bearing: PEEK Alloy.

J. Piston Bearing: Fluoroplastic.

# Typical Specifications

The following information may be used as a guide to compile specifications for rack and pinion pneumatic actuators. GH-Bettis RP-Series actuators meet, or exceed, all the specifications stated below.

## 1.0 Bettis RP-Series Pneumatic Rack & Pinion Actuators

1.1 The pneumatic actuator shall be quarter-turn, opposed piston rack and pinion type of a totally enclosed design with no external moving linkages.

1.2 The actuator shall be capable of  $95\frac{1}{2}^{\circ}$  rotation and shall include external travel stops with a minimum of  $10^{\circ}$  adjustment.

1.3 The actuator shall be rated for continuous operation using dry or lubricated non-corrosive gas and suitable for mounting in any position.

1.4 Ambient temperature range shall be from  $-40^{\circ}\text{F}$  to  $+200^{\circ}\text{F}$ . For high temperature service, the actuator shall be rated from  $0^{\circ}\text{F}$  to  $+350^{\circ}\text{F}$ .

## 2.0 Construction

2.1 Actuator housing shall be precision extruded aluminum, hard anodized with external and internal UV resistance fluoropolymer impregnation.

2.2 Actuator shall be supplied with all stainless steel fasteners.

2.3 The drive shaft and pinion shall be one piece steel, bottom loaded blowout-proof with a fluoropolymer coating and secured by non-exposed, redundant stainless steel retaining rings for safety.

2.4 End caps shall be cast aluminum UV resistant fluoropolymer coated.

2.5 Actuator shall incorporate internal porting to permit use of either direct mount or remote controls with a minimum of external tubing.

2.6 Actuator shall be provided with a mechanical visual position indicator, easily removable to expose drive shaft to permit manual and accessory operation.

## 3.0 Design

3.1 Double-acting and spring-return models shall be offered and field convertible by only the replacement of end caps or spring module assemblies.

3.2 All spring module assemblies must be of self contained field service safe design.

3.3 Spring design shall allow safe conversion of spring modules to fit application requirements.

3.4 Special tools shall not be required to adjust or accomplish field conversions.

3.5 There shall be no bearing area outboard of the pressure containing or weather seals.

3.6 Use of self-threading or thread forming fasteners shall be strictly prohibited.

3.7 Actuator must not incorporate any metal-to-metal pressure seals.

3.8 All springs must be shot peened and corrosion protected to ensure maximum cycle life.

3.9 Actuator shall be field reversible to provide  $\pm 5^{\circ}$  travel adjustment at outboard end of travel and non-adjustable  $\frac{1}{2}^{\circ}$  nominal over travel in opposite direction.

3.10 Full tooth engagement, at the pitch line, shall be maintained throughout full range of travel minimizing potential tooth failure.

## Materials of Construction

A. Body: Precision-extruded aluminum alloy, hard anodized and fluoropolymer impregnated.

B. Pistons: Cast aluminum alloy, dichromate dipped.

C. Output Shaft/Pinion: Carbon steel, fluoropolymer coated.

D. End Caps: Cast aluminum alloy, fluoropolymer coated.

E. Fasteners: All stainless steel.

F. Seals: Nitrile standard. Viton, optional.

G. Springs: Carbon steel, phosphate coated, oil dipped.

H. Heel Bearing: PEEK Alloy.

J. Piston Bearing: Fluoroplastic.

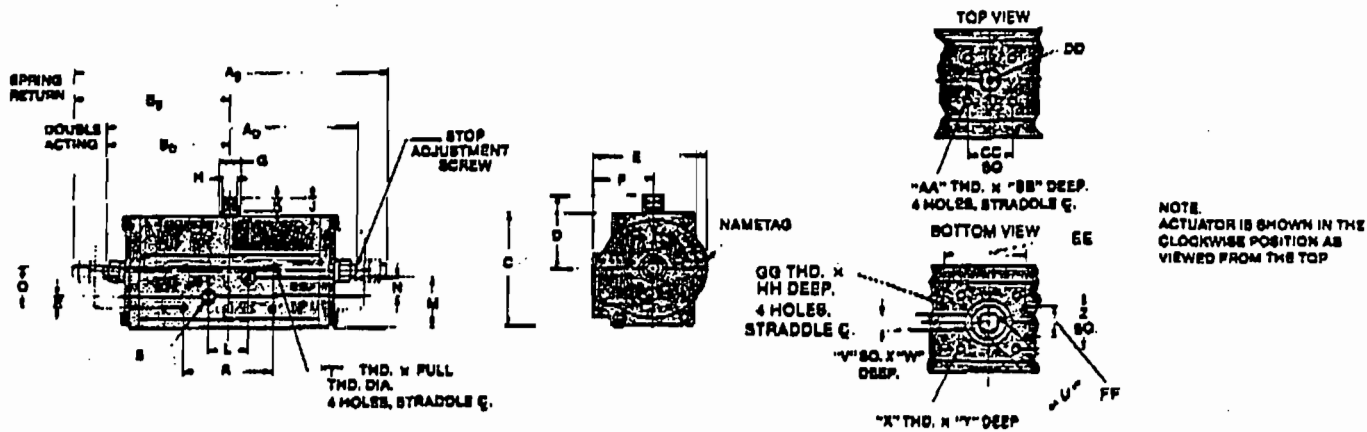


# Torque Ratings

## Spring-Return Actuators

Model Number		Torque Unit	Spring Torque Output		Air Torque Output at Operating Pressure—Psi									
Basic	Spring Set		Start	End	40		60		80		100		120	
					Start	End	Start	End	Start	End	Start	End	Start	End
250	3	lb.-in.	104	67	-	-	113	70	178	133	229	195	301	258
	5	lb.-in.	175	112	-	-	-	-	128	54	189	118	251	179
	6	lb.-in.	209	135	-	-	-	-	-	-	-	-	-	-
450	2	lb.-in.	125	81	135	83	248	198	381	309	473	421	586	533
	4	lb.-in.	254	162	-	-	158	54	271	167	383	279	486	382
	6	lb.-in.	381	243	-	-	-	-	-	-	283	137	406	251
1000	3	lb.-in.	418	270	202	48	449	278	698	526	947	775	1198	1025
	5	lb.-in.	898	450	-	-	-	-	500	212	749	464	998	710
	6	lb.-in.	1181	594	-	-	-	-	-	-	1508	821	2089	1181
2250	2	lb.-in.	659	364	690	395	1253	658	1816	1521	2378	2084	2559	2647
	4	lb.-in.	1320	787	-	-	816	228	1379	788	2028	1351	2505	1814
	6	lb.-in.	1980	1181	-	-	-	-	-	-	-	-	-	-
5000	3	lb.-in.	2340	1180	-	-	2380	1200	3570	2400	4760	3590	5960	4780
	5	lb.-in.	3910	1980	-	-	-	-	2780	815	3970	2010	5180	3200
	6	lb.-in.	5100	2570	-	-	-	-	-	-	-	-	-	-
11000	2	lb.-in.	3400	1720	3480	1780	6060	4380	8660	6960	11300	9560	13900	12200
	4	lb.-in.	6790	3430	-	-	4330	932	6830	3530	9520	6130	12100	8730
	6	lb.-in.	10200	5150	-	-	-	-	-	-	7790	2700	10400	5300

# Dimensions



## Mounting Dimensions

Model	R	S	T Thd.	U min.	V min.	W	X Thd.	Y	Z	AA Thd.	BB	CC	DD	EE	FF	GG	HH	
250	in.	2.992	1/4 NPT	10-24 unc	.56	.489	1.08	3/20 unc	.35	1.392	10-24 unc	.28	1.57	m 5 x 0.8	3.25	1.17	1/20 unc	.35
450	in.	2.992	1/4 NPT	10-24 unc	.722	.551	1.08	1/20 unc	.35	1.392	10-24 unc	.28	1.57	m 5 x 0.8	3.25	1.17	1/20 unc	.35
1000	in.	2.992	1/4 NPT	10-24 unc	.996	.748	1.09	3/16 unc	.59	2.840	1/8-18 unc	.31	2.25	m 5 x 0.8	4.31	1.75	1/16-18 unc	.38
2250	in.	2.992	1/4 NPT	10-24 unc	1.155	.888	1.57	3/16 unc	.59	2.840	1/8-18 unc	.31	2.25	m 5 x 0.8	4.31	1.75	1/16-18 unc	.38
5000	in.	2.992	1/4 NPT	10-24 unc	1.320	1.063	1.58	3/16 unc	.75	3.480	1/8-18 unc	.31	2.25	m 5 x 0.8	10.00	3.48	1/16-18 unc	.75
11000	in.	2.992	1/4 NPT	10-24 unc	1.790	1.418	1.77	3/11 unc	.94	3.898	1/8-18 unc	.31	2.25	m 5 x 0.8	10.00	3.89	3/11 unc	.94

## General Dimensions

Model	A	A <sub>1</sub>	B	B <sub>1</sub>	C	D	E	F	G	H	J	K	L	M	N	P	Q
250	in.	6.26	7.25	3.18	3.62	3.03	2.00	2.80	1.50	2.56	.374	.48	.38	.98	1.39	.50	1.062
450	in.	6.78	7.75	3.39	3.87	3.78	2.37	3.50	1.81	.56	.374	.48	.38	.98	1.39	.50	1.062
1000	in.	8.89	9.75	4.34	4.87	4.72	3.03	4.23	2.38	1.54	.625	.67	.50	.98	1.52	.50	1.062
2250	in.	11.50	13.75	5.75	6.87	6.51	3.68	5.31	2.80	1.12	.875	.92	.75	.98	1.75	.50	1.062
5000	in.	14.50	21.12	7.25	10.66	7.72	4.80	7.95	3.13	1.12	.875	1.00	.75	1.25	1.75	.50	1.062
11000	in.	19.00	27.25	9.50	13.63	9.61	5.71	9.35	4.88	1.12	.875	1.00	.75	1.25	4.63	.86	1.062

**Temperature:**

**Media:** - 40F to + 200F.

**Ambient:** NEMA 4, - 40F to + 180F.

NEMA 4-7-9, - 40F to + 125F.

**Coil Rating:**

- 1. NEMA 4: Continuous duty molded Class H Insulation.
- 2. NEMA 4-7-9: Continuous duty molded Class B Insulation.

**Coil Voltage:**

- 1. 120VAC-60Hz/110VAC-50 Hz.
- 2. 240VAC-60Hz/220VAC-50Hz/120VDC.
- 3. 48VAC-60Hz/44VAC-50Hz/24VDC.
- 4. 24VAC-60Hz/22VAC-50Hz/12VDC.

**Coil Voltage Variation:** +/- 10% of Nominal.

**Power Consumption:** 6 Watts

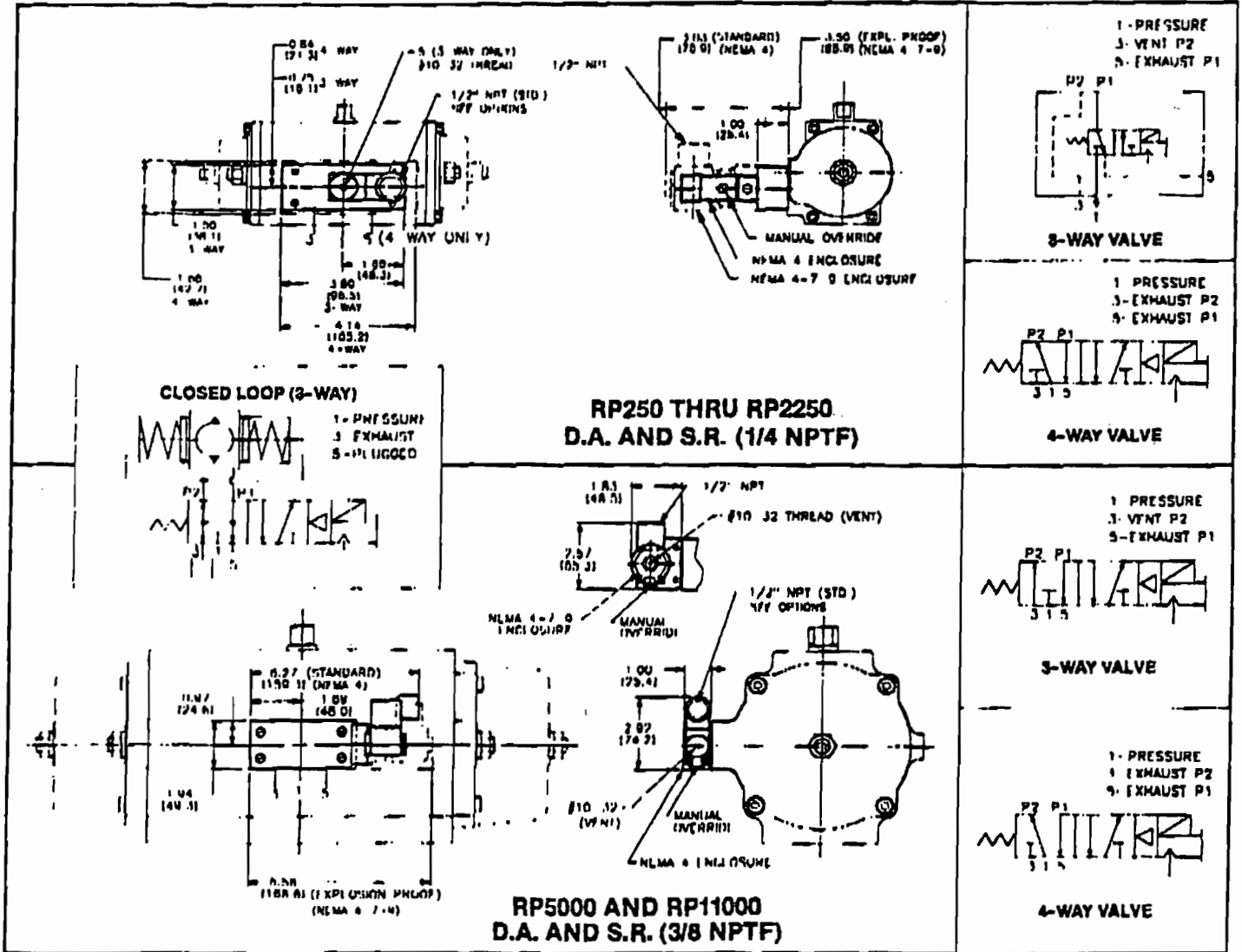
**Materials:**

**Valve Body** = Aluminum, anodized.

**Seals/O-Rings** = Nitrile.

**Fasteners** = Stainless Steel assembly and attachment.

**Dimensions**



# Sizing Information

The following is designed to aid in correctly selecting GH-Bettis Rack and Pinion Actuators.

Accurate valve torques must be determined at extremes and intermediate valve positions, valve size and type, as application requirements including differential pressure, media, temperature, and the valve manufacturers suggested safety factor affect required torque at specific valve positions and direction of travel.

### For Double-Acting

Using the minimum operating pressure available at the actuator's installed location, select a column from the Torque Rating Chart of less than, or equal pressure. Look down the column until an output torque is selected which is greater than the valve's maximum operating requirement. Determine the correct actuator model number which appears on the same line as the selected output torque.

### For Spring-Return

The valve's maximum torque requirement at specific positions and direction of travel must be

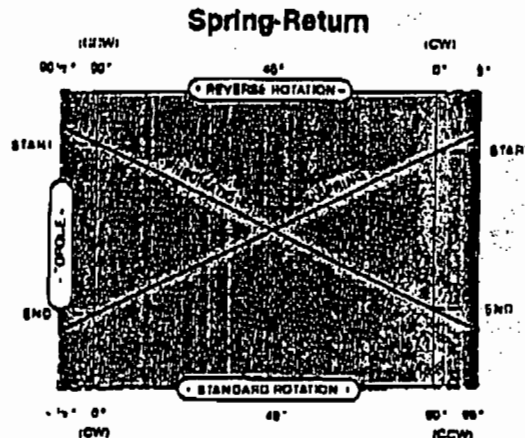
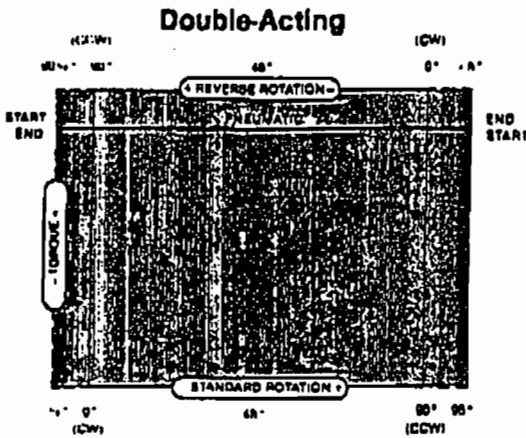
exceeded by the actuator's spring start, end, air start, and end, as appropriate.

### On-Off Fail-Closed Applications

1. Select appropriate actuator spring end and air start torque for maximum valve seating and break torque requirements respectively.
2. Select spring start and air end torque for maximum valve torque requirement at full open position.
3. Compare spring start torque to maximum valve stem allowable torque.

### On-Off Fail-Open Applications

1. Select appropriate actuator spring start and air end torque for maximum valve break and seating torque requirement respectively.
2. Select spring end and air start torque for maximum valve torque requirement at full open position.
3. Compare air start torque to maximum stem allowable torque. For modulating and other severe service applications minimum actuator torque 25% greater than valve torque requirement at all positions of travel is recommended.



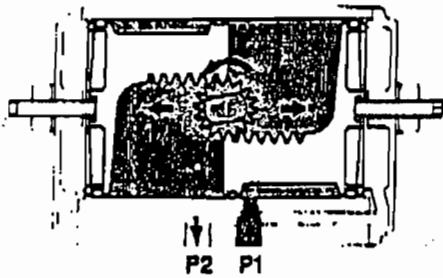
# Torque Ratings

## Double-Acting Actuators

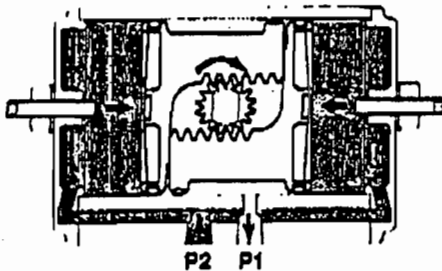
Model	Air Torque Output at Operating Pressure—Psig					
	Torque Unit	40	60	80	100	120
250	lb.-in.	25	37	50	62	75
450	lb.-in.	225	337	450	582	675
1000	lb.-in.	500	750	1000	1250	1500
2250	lb.-in.	1125	1687	2250	2812	3375
5000	lb.-in.	2500	3750	5000	6250	7500
11000	lb.-in.	5500	8250	11000	13750	16500

# Operation

## Double-acting (TOP VIEW)



For counterclockwise output rotation, apply pressure to Port 1, which will force the pistons apart. The linear travel of the pistons is converted to a rotation of the drive shaft by the rack to pinion connection. The volume outside each piston is exhausted at Port 2.



For clockwise output rotation, apply pressure to Port 2, which will force the pistons to move together. The volume between the pistons is exhausted at Port 1.

### Reverse Rotation

When required, the pistons can be inverted in the housing resulting in a clockwise rotation when pressure is applied to Port 1.

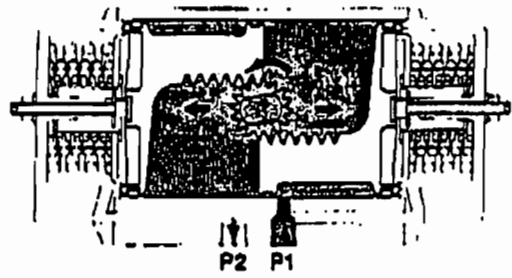
## Travel Stop Adjustment

Drive shaft rotation is limited to 90° plus or minus 5° by the stop screws located in each end cap which limit the pistons outward travel.

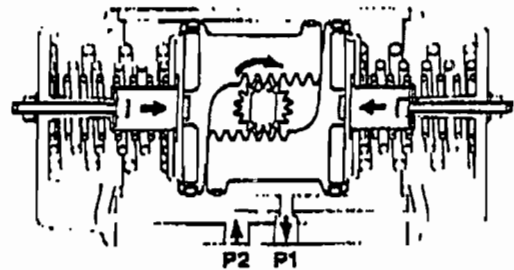
### Standard Assembly

Adjustment of the counterclockwise rotation limit is accomplished by rotating the stop screws to reduce or increase output rotation.

## Spring Return (TOP VIEW)



For counterclockwise output rotation, apply pressure to Port 1, which will force the pistons apart and compress the springs. The linear travel of the pistons is converted to a rotation of the drive shaft by the rack to pinion connection. The volume outside each piston is exhausted at Port 2.



For clockwise output rotation, the volume between the pistons is exhausted at Port 1, causing the springs to force the pistons together. The volume outside the pistons is vented at Port 2.

### Reverse Rotation

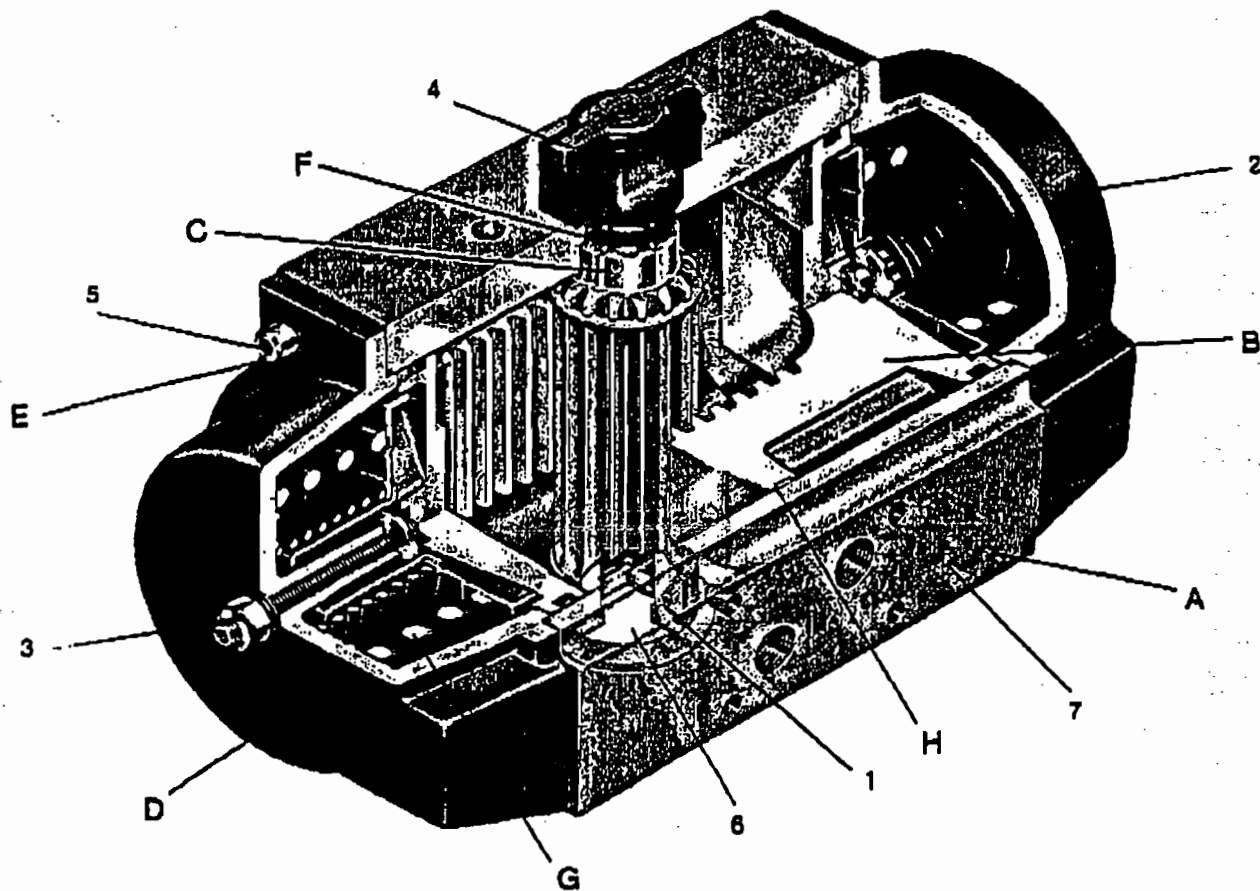
When required, the pistons can be inverted in the housing resulting in a clockwise rotation when pressure is applied to Port 1 and a counterclockwise rotation when Port 1 is vented.

### Reverse Assembly

When required, the pistons can be inverted in the housing allowing travel stop adjustment of the clockwise output rotation.

# Design and Construction

Models RP250-RP2250



## Mechanical Components

The Bettis RP-Series pneumatic rack & pinion actuators are specifically designed for "quarter-turn" rotating mechanisms and are ideally suited for operation of plug, butterfly, or ball valves. These quality constructed and uncomplicated actuators provide a dependable, reliable and economic method of opening and closing a valve.

Double-acting models, requiring pressure to rotate in both directions, are available with output torques to 16,500 lb-in. Spring-return models, requiring pressure to rotate in one direction, are available with spring ending output torques up to 5150 lb-in. Standard operating pressures are 40 to 120 PSIG. Operating media for both double-acting and

spring-return models may be dry or lubricated non-corrosive gas. Standard operating temperatures are from  $-40^{\circ}$  to  $+200^{\circ}$  Fahrenheit. Optional, high temperature trim is available for  $0^{\circ}$  to  $+350^{\circ}$  Fahrenheit. All models are factory lubricated for the optimum cycle life of the actuator. All actuators are constructed for indoor or outdoor installation.



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Tlx: 230409

**Important:** Due to GH-Bettis' continuing commitment to engineering product advancement, data presented herein is subject to change.

# INSTALLATION AND MAINTENANCE INSTRUCTIONS

## 3-WAY SOLENOID VALVES, NORMALLY OPEN NORMALLY CLOSED AND UNIVERSAL CONSTRUCTION

BULLETIN

8320



Form No. V5291R2-T84

**DESCRIPTION**

Bulletin 8320 is a small 3-way solenoid operated valve with all three pipe connections located in the body. The bodies are of brass or stainless steel construction. Standard valves have General Purpose, Nema Type I Solenoid Enclosures. Valves that are equipped with a solenoid enclosure which is designed to meet Nema Type 4-Watertight, Nema Type 7 (C or D) Hazardous Locations - Class I, Group C or D, and Nema Type 9 (E, F or G) Hazardous Locations - Class II, Group E, F or G are shown on separate sheets of Installation and Maintenance Instructions, Form Numbers V-5391 and V-5381.

**MANUAL OPERATORS (OPTIONAL)**

Valves with suffix "MO" or "MS" in catalog number are provided with a Manual Operator which allows manual operation when desired or during an interruption of electrical power.

**OPERATION**

**Normally Closed:** Applies pressure when solenoid is energized; exhausts pressure when solenoid is de-energized.

**Normally Open:** Applies pressure when solenoid is de-energized; exhausts pressure when solenoid is energized.

**Universal:** For normally closed or normally open operation, selection or diversion of pressure can be applied at Port 1 (A), 2 (B), or 3 (C).

**FLOW DIAGRAMS**

NORMALLY OPEN PRESS AT 3 (C)	NORMALLY CLOSED PRESS AT 2 (B)	UNIVERSAL-PRESS AT ANY ORIFICE.	FORM
			SOLENOID DE-ENERGIZED
			SOLENOID ENERGIZED

**NOTE:** Port Markings 1, 2, and 3 correspond directly to A, B and C.

**INSTALLATION**

Check Nameplate for correct Catalog Number, pressure, voltage and service.

**POSITIONING**

Valve may be mounted in any position.

**PIPING**

Connect piping to valve according to markings on valve body. Refer to Flow Diagram provided. Apply pipe compound sparingly to male pipe threads only; if applied to valve threads, it may enter valve and cause operational difficulty. Pipe strain should be avoided by proper support and alignment of piping. When tightening pipe, do not use valve as a lever.

**IMPORTANT:** For protection of the solenoid valve, install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Periodic cleaning is required depending on the service conditions. See Bulletin 8600, 8601 and 8602 for strainers.

**WIRING**

Wiring must comply with Local and National Electrical Codes. For valves equipped with an explosion-proof, watertight solenoid enclosure, the electrical fittings must be approved for use in the approved hazardous locations. Housings for all solenoids are made with connections for 1/2 inch conduit. The general purpose enclosure may be rotated to facilitate wiring by removing the retaining cap.

**NOTE**

Alternating Current (A-C) and Direct Current (D-C) solenoids are built differently. To convert from one to the other, it is necessary to change the complete solenoid, including the core assembly.

**SOLENOID TEMPERATURE**

Standard catalog valves are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched with the bare hand for only an instant. This is a safe operating temperature. Any excessive heating will be indicated by the smoke and odor of burning coil insulation.

**MAINTENANCE**

**WARNING:** Turn off electrical power and line pressure to valve before making repairs. It is not necessary to remove valve from pipe line for repairs.

**CLEANING**

A periodic cleaning of all solenoid valves is desirable. The time between cleanings will vary, depending on the media and service conditions. In general, if the voltage to the coils is correct, sluggish valve operation or excessive leakage will indicate that cleaning is required.

**IMPROPER OPERATION**

- Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A metallic click signifies the solenoid is operating. Absence of the click indicates loss of power supply. Check for loose or blown-out fuses, open-circuited or grounded coil, broken lead wires or splice.
- Burned-Out Coil:** Check for open-circuited coil. Replace coil, if necessary.
- Low Voltage:** Check voltage across the coil leads. Voltage must be at least 85% of nameplate rating.
- Incorrect Pressure:** Check valve pressure. Pressure to valve must be within the range specified on nameplate.
- Excessive Leakage:** Disassemble valve and clean all parts. Replace parts that are worn or damaged with a complete Spare Parts Kit for best results.

**COIL REPLACEMENT (REF. FIG. 2)**

Turn off electrical power, disconnect coil lead wires and proceed as follows:

- Remove retaining cap, nameplate and cover.
- Slip yoke containing coil, sleeves and insulating washers off the solenoid base sub-assembly. Insulating washers are omitted when molded coil is used. In some D. C. Constructions, a single flux plate over the coil replaces yoke, sleeves and insulating washers.
- Reassemble in reverse order of disassembly.

**VALVE DISASSEMBLY AND REASSEMBLY (REF. FIG. 2)**

Turn off electrical power supply and de-pressurize valve.

- Remove retaining cap and slip entire solenoid off solenoid base sub-assembly or plugnut/core tube sub-assembly.
- Unscrew bonnet or solenoid base sub-assembly. Remove core assembly, core spring and body gasket.
- Remove end cap, body gasket, disc spring, disc holder, disc or disc holder assembly.
- All parts are now accessible for cleaning or replacement. Replace worn or damaged parts with a complete Spare Parts Kit for best results.
- Reassemble in reverse order of disassembly paying careful attention to exploded view provided.

**TEMPERATURE LIMITATIONS**

For maximum valve ambient and fluid temperatures, refer to chart below. For higher ambient and fluid temperatures, consult factory. Check catalog number and watt rating on nameplate to determine the maximum temperatures.

WATTAGE	CATALOG NUMBER COIL PREFIX	COIL CLASS	MAXIMUM AMBIENT TEMP. °F	MAXIMUM FLUID TEMP. °F
6	none or DA, S	A	77	160
15.4	none or DA, S	A	77	200
6, 15.4	CF, FI, or SP	P	122	200
6, 15.4	HT	H	110	250
9, 10.7	none or DP, SP	P	77	200
9.7	none or FT, HF, S, SP	A, F or H	77	125
18.8	none or FT, HF, S, SP	A, F or H	77	150
20	none or DP, SP	P	77	200

Spare Parts Kits and Coils are available for ASCO valves. Parts marked with an asterisk (\*) are supplied in Spare Parts Kits.

**ORDERING INFORMATION FOR SPARE PARTS KITS**

When Ordering Spare Parts Kits or Coils Specify Valve Catalog Number, Serial Number and Voltage.





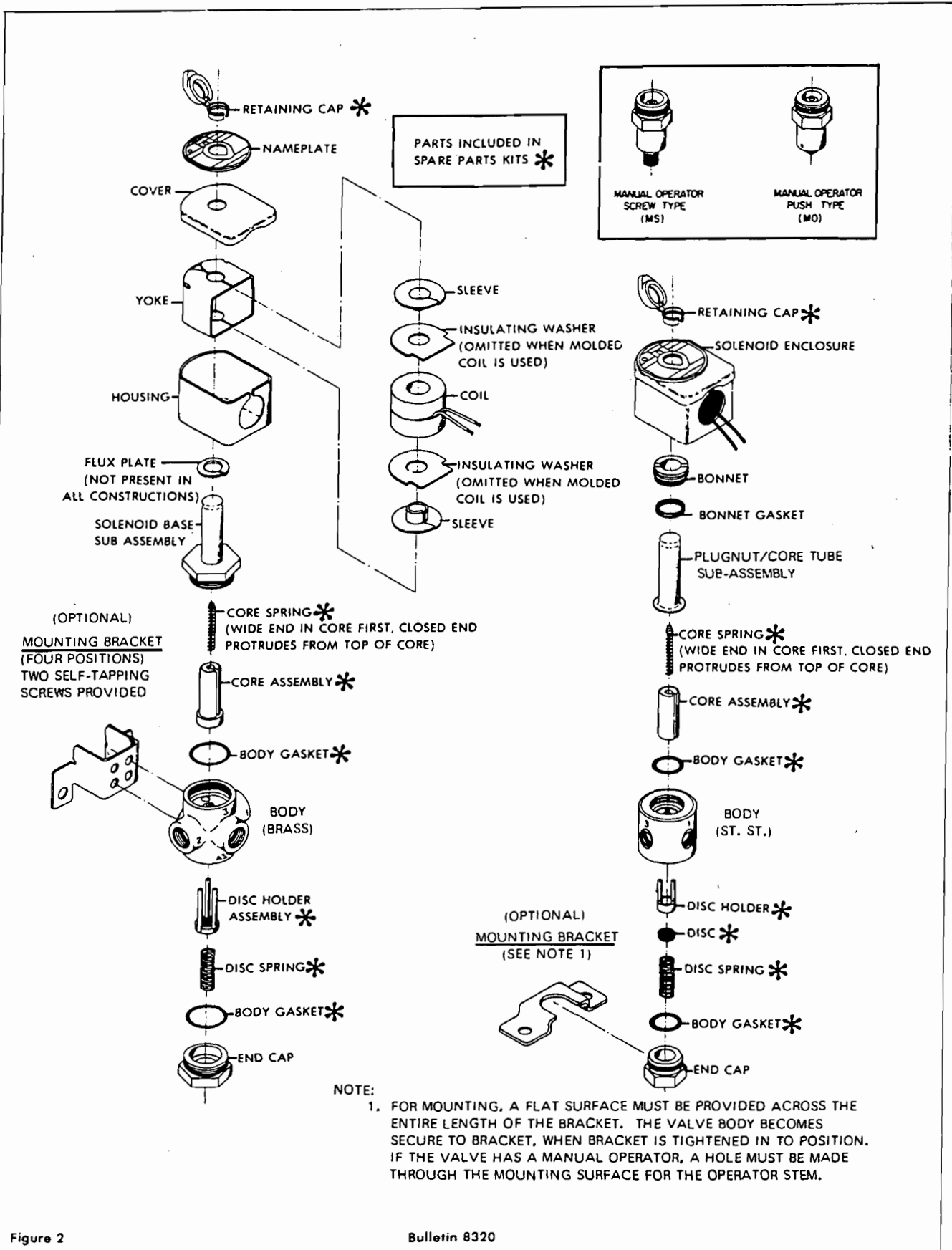


Figure 2

Bulletin 8320



**ASCO Valves**

Automatic Switch Co. FLORHAM PARK, NEW JERSEY 07932

FORM NO. V-5291R2

PRINTED IN U. S. A.

1969

# INSTALLATION & MAINTENANCE INSTRUCTIONS

**ASCO.**

CATALOG NOS.  
80161 80163  
80162 80164

## GENERAL PURPOSE AND WATERTIGHT EXPLOSION-PROOF SOLENOIDS

Form No. V6391R6

### DESCRIPTION

Catalog numbers 80161 and 80162 solenoids are equipped with a Type 1, General Purpose Solenoid Enclosure. When installed just as a solenoid and not attached to an ASCO valve, the core has a 0.250-28 UNF-2B tapped hole, 0.38 full thread.

Catalog numbers 80163 and 80164 solenoids are equipped with a combination watertight and explosion-proof solenoid enclosure designed to meet Enclosure Type 3-Raintight, Type 4-Watertight, Type 7 (C & D) Explosion-Proof Class I, Groups C & D and Type 9 (E, F, & G)-Dust Ignition-Proof Class II, Groups E, F, & G and have a temperature range code of T4A. When installed just as a solenoid and not attached to an ASCO valve, the core has a 0.250-28 UNF-2B tapped hole, 0.38 full thread.

### OPERATION

When the solenoid is energized, the core is drawn into the solenoid base sub-assembly. **IMPORTANT:** When the solenoid is de-energized, the initial return force for the core, whether developed by spring, pressure or weight, must exert a minimum force to overcome residual magnetism created by the solenoid. Minimum return force for AC Construction is 11 ounces, and 5 ounces for DC Construction.

### INSTALLATION

Check nameplate for correct catalog number, voltage, frequency, wattage and service.

**IMPORTANT:** To protect the solenoid valve or operator, install a strainer or filter, suitable for the service involved in the inlet side as close to the valve or operator as possible. Clean periodically depending on service conditions. See ASCO Bulletins 8600, 8601 and 8602 for strainers.

#### Positioning

This solenoid is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertically and upright to reduce the possibility of foreign matter accumulating in the solenoid base sub-assembly area.

#### Wiring

Wiring must comply with local codes and the National Electrical Code. On some solenoids, a green grounding wire is provided. Use rigid metallic conduit to ground all enclosures not provided with a green grounding wire. The general purpose solenoid housing has a 7/8" diameter hole to accommodate 1/2" conduit. To facilitate wiring, the general purpose solenoid enclosure may be rotated 360° by removing the retaining cap or clip. **WARNING:** When metal retaining clip disengages, it will spring upward. Rotate solenoid enclosure to desired position. Then replace retaining cap or clip before operating. For the combination watertight and explosion-proof solenoid enclosure, electrical fittings must be approved for use in the approved hazardous locations. The watertight and explosion-proof solenoid enclosure has a 1/2" conduit connection.

**NOTE:** Alternating current (AC) and direct current (DC) solenoids are built differently. To convert from one to the other, it is necessary to change the complete solenoid including the core and solenoid base sub-assembly, not just the coil. Consult ASCO.

#### Solenoid Enclosure Assembly

Catalog Numbers 80161, 80162, 80163 and 80164 may be assembled as a complete unit. Tightening is accomplished by means of a hex flange at the base of the solenoid enclosure. **CAUTION:** Care must be taken not to mar the upper core surface, when installing core or positioning solenoid.

#### Solenoid Temperature

Standard solenoids are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched by hand only for an instant. This is a safe operating temperature. Any excessive heating will be indicated by the smoke and odor of burning coil insulation.

### MAINTENANCE

**WARNING:** Turn off electrical power supply and depressurize solenoid operator and/or valve before making repairs.

#### Cleaning

All solenoid operators and valves should be cleaned periodically. The time between cleaning will vary depending on medium and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. Clean strainer or filter when cleaning the valve.

#### Preventive Maintenance

1. Keep the medium flowing through the solenoid operator or valve as free from dirt and foreign material as possible.
2. While in service, the solenoid operator or valve should be operated at least once a month to insure proper opening and closing.
3. Depending on the medium and service conditions, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any parts that are worn or damaged.

#### Causes Of Improper Operation

1. **Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A metallic "click" signifies that the solenoid is operating. Absence of the "click" indicates loss of power supply. Check for loose or blown fuses, open-circuited or grounded coil, broken lead wires or splice connections.
2. **Burned-Out Coil:** Check for open-circuited coil. Replace if necessary. Check supply voltage; it must be the same as specified on nameplate and as marked on the coil.
3. **Low Voltage:** Check voltage across the coil leads. Voltage must be at least 85% of nameplate rating.

#### Coil Replacement

**WARNING:** Turn off electrical power supply.

Catalog Numbers 80161 and 80162 General Purpose Solenoid Enclosure. (Refer to Figures 1 and 2)

1. Disconnect coil lead wires and grounding wire, if present.
2. Remove retaining cap or clip from top of solenoid.  
**WARNING:** When metal retaining clip disengages, it will spring upward.
3. Remove the following parts:

Figure 1.  
Catalog Numbers  
80161 and 80162  
(Alternate Construction)

- Cover
- Spring washer
- Yoke
- Sleeves (2)
- Coil

Figure 2.  
Catalog Numbers  
80161 and 80162

- Nameplate
- Cover
- Yoke
- Sleeves (2)
- Insulating washers\*
- Coil

\* Insulating Washers are omitted when a molded coil is used.

Form No. V6391R6

44444

**ASCO Valves**



Automatic Switch Co. 50-60 Hanover Road, Florham Park, New Jersey 07932

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4. Coil is now accessible for replacement. Reassemble in reverse order of disassembly. Use exploded views for identification and placement of parts.

**CAUTION:** Solenoid must be fully reassembled because the housing and internal parts complete the magnetic circuit. Be sure to replace insulating washer at each end of non-molded coil.

Catalog Numbers 80163 and 80164 Watertight and Explosion-proof Solenoid Enclosure (Refer to Figure 3)

1. Unscrew housing with retaining ring and nameplate attached.
2. Remove spacer from top of yoke.
3. Slip yoke containing coil, sleeves, and insulating washers off solenoid base sub-assembly. Insulating washers are omitted when a molded coil is used.
4. Remove insulated tubing from coil lead wires and install on the new coil.
5. Coil is now accessible for replacement. Reassemble in reverse order of disassembly. Use exploded view for identification and placement of parts.
6. Torque housing cover to  $110 \pm 10$  inch pounds, ( $12.4 \pm 1.1$  newton-meters).

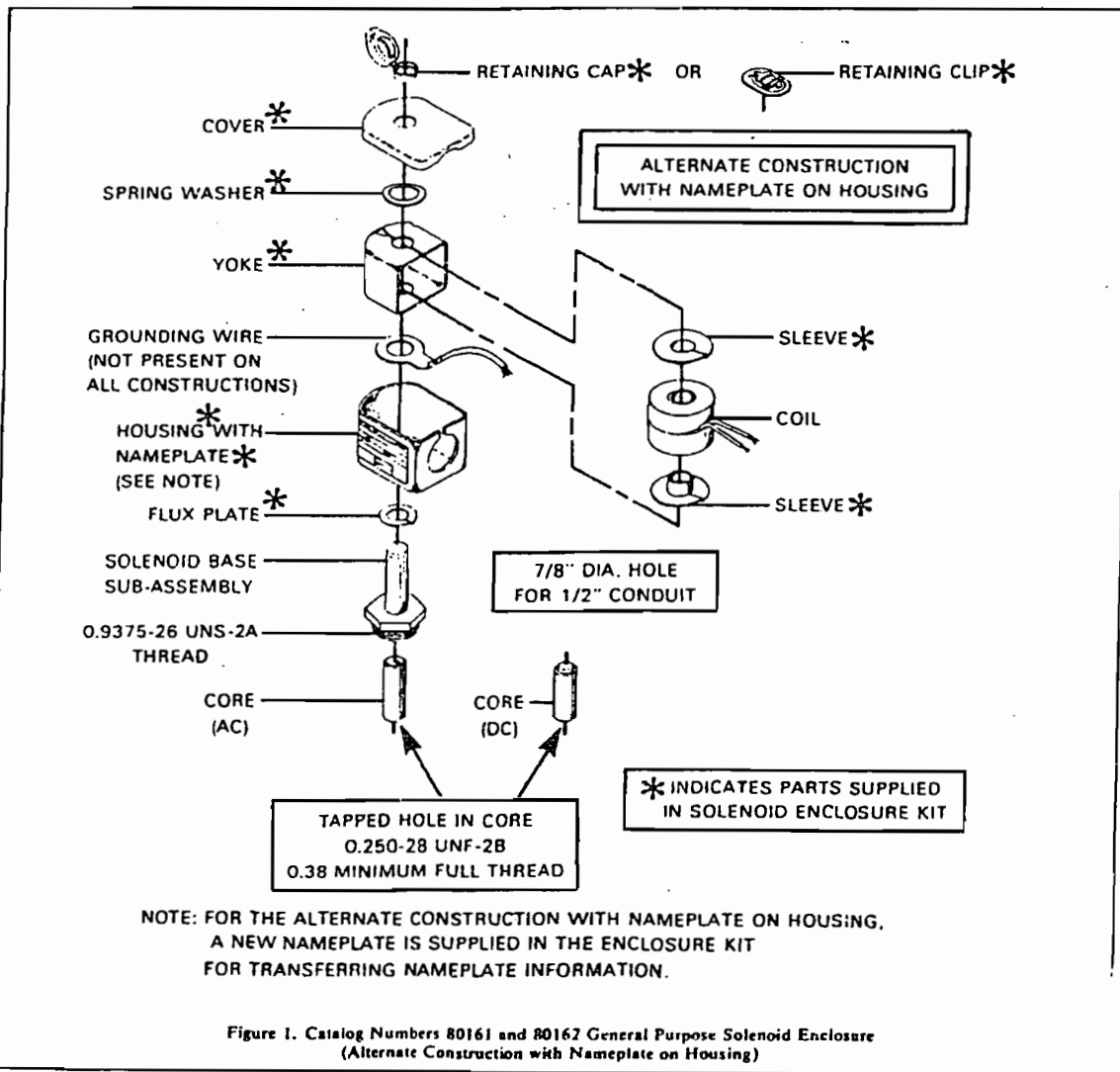
**CAUTION:** Solenoid must be fully reassembled because the housing and internal parts complete the magnetic circuit. Be sure to replace insulating washer at each end of non-molded coil.

**NOTE:** Catalog Numbers 80163 and 80164-Installation and maintenance of explosion-proof equipment requires more than ordinary care to insure safe performance. All finished surfaces of the solenoid are constructed to provide a flame-proof seal. Be sure that the surfaces are wiped clean before reassembly.

**ORDERING INFORMATION FOR  
ASCO SOLENOID ENCLOSURE KITS OR COILS**

Parts marked with an asterisk (\*) in the exploded view are supplied in solenoid enclosure kit.

- When Ordering ASCO Solenoid Enclosure Kits, Specify Catalog Number, Serial Number, Voltage, and Frequency.
- When Ordering Coils for ASCO Solenoid Operators or Valves, order the number stamped on your coil.



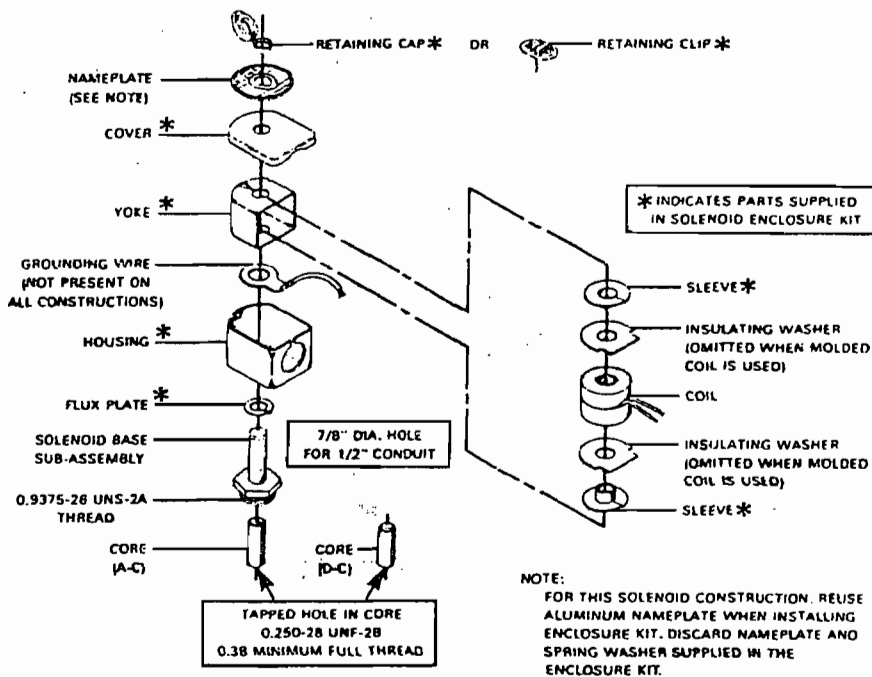


Figure 2. Catalog Number 80161 and 80162 General Purpose Solenoid Enclosure

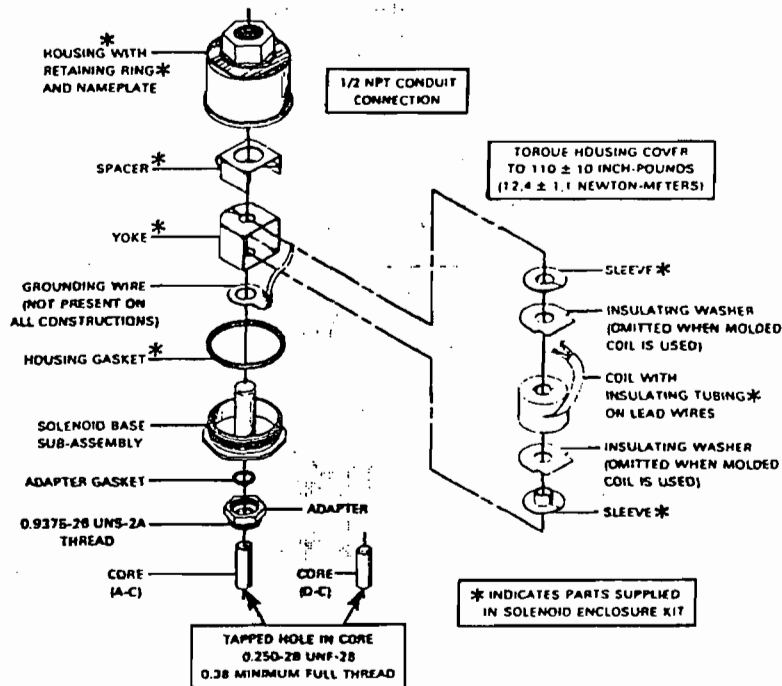


Figure 3. Catalog Numbers 80163 and 80164 Watertight and Explosion-Proof Solenoid Enclosure.

**To control gas or liquid,  
ASCO® Solenoid and Air  
Operated Valves give  
you the largest selection  
and the highest reliability**

ASCO is your best choice for 2, 3 and 4 way solenoid and air operated valves. They are made with state-of-the-art materials and production techniques. And, every ASCO product is 100% tested before shipment. Nobody provides higher reliability. Moreover, ASCO offers you over 2,000 catalog-listed solenoid valves plus air operated valves to choose from. Special designs are available. See below for details.



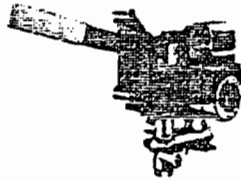
**2 Way Red-Hat®  
Solenoid Valves**  
Pipe sizes from 1/4" to 3". Temperatures from -340°F. to +400°F. Pressures to 2200 psi.



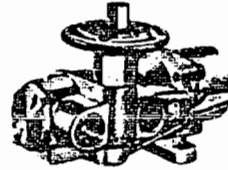
**3 Way Red-Hat®  
Solenoid Valves**  
Pipe sizes from 1/4" to 2". Temperatures from -340°F. to +400°F. Pressures to 600 psi.



**4 Way Red-Hat®  
Solenoid Valves**  
Pipe sizes from 1/4" to 1". Temperatures from -65°F. to +200°F. Pressures to 350 psi. Poppet, slide or spool type; group and pad mounted; single and dual solenoid constructions.



**Manual Reset Valves**  
A wide range of 2, 3 and 4 way manual reset valves for a wide variety of fluids is available with electrically tripped, no voltage release or free handle movements.



**2, 3 and 4 Way  
Air Operated Valves**  
These valves are engineered and manufactured to the same high quality standards as ASCO solenoid valves; the only difference is that the solenoid has been replaced by an air operator.

**To sense pressure or  
temperature of gases or  
liquids, ASCO TRI-POINT®  
switches give you  
highest quality, best  
value and widest selection**

ASCO TRI-POINT pressure and temperature switches are constructed from two separate components: a switch unit and a transducer unit. Using variations of these stock units, we can supply you with 2,000 different pressure switches and over 500 different temperature switches — right off the shelf! And, each unit is 100% tested before shipment to assure dependable performance.

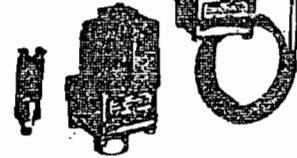


**TRI-POINT  
Pressure Switches**  
Pressures from 12" H<sub>2</sub>O to 6000 psig. Transducers for air, water, gas, oil, steam and corrosive service. Adjustable and fixed deadband types. Repeatability of ±1% of full operating range.



**TRI-POINT  
Temperature  
Switches**  
Temperatures from -60°F. to +640°F. Transducers for air, water, gas, oil, steam and corrosive service. Adjustable and fixed deadband types. Repeatability of 1°F.

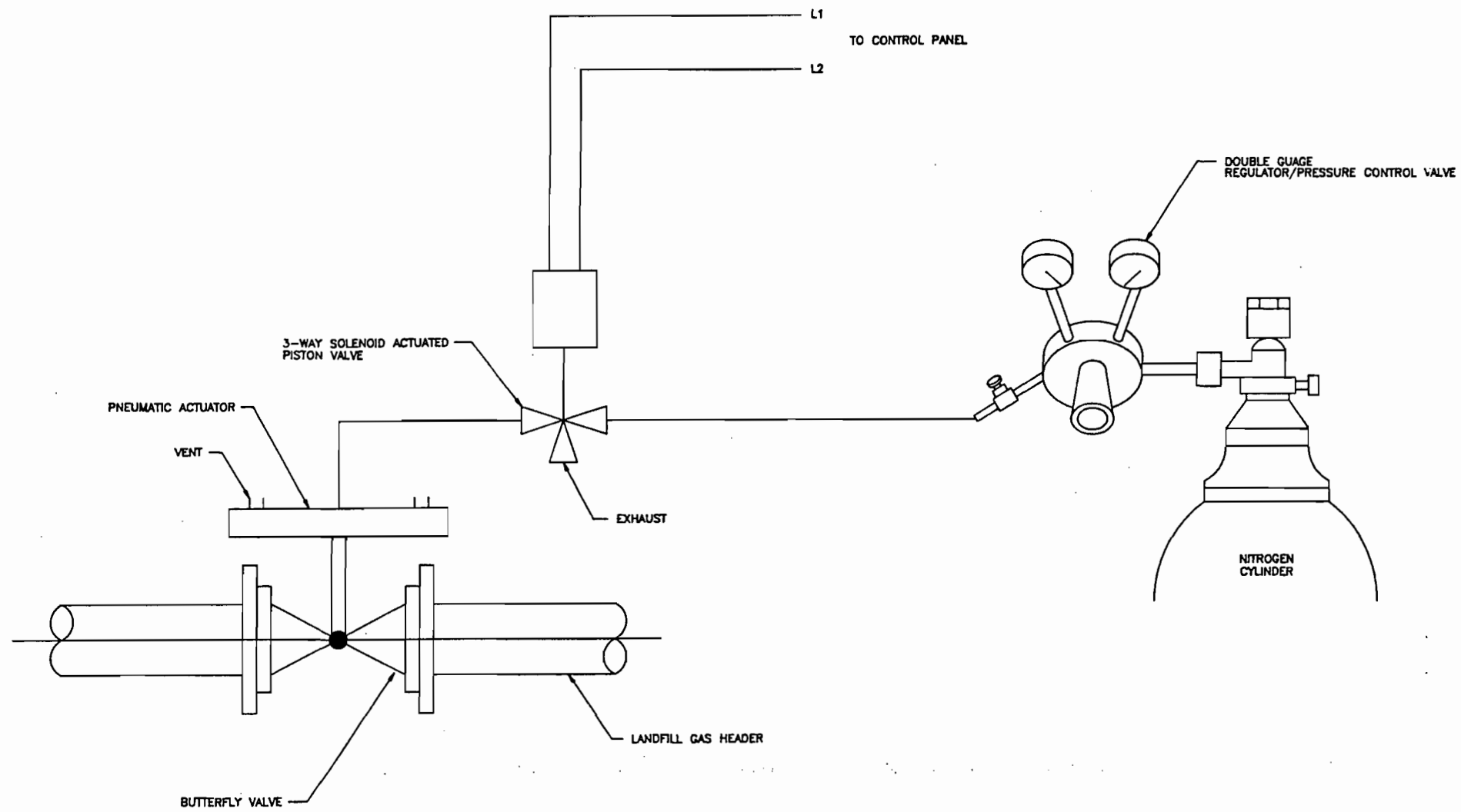
**Also Available  
In Compact Size  
for Pressure and  
Temperature**



**For complete information  
on ASCO Solenoid and  
Air Operated Valves or  
Pressure and Temperature  
Switches, write for  
free ASCO Catalogs.**



**ASCO** Products are designed and manufactured by **Automatic Switch Co.**, Florham Park, New Jersey 07932, Telephone (201) 966-2000



REV.	DESCRIPTION	DATE	BY

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**LFG SPECIALTIES, INC.**

HEAD OFFICE  
 7550 LUCERNE DRIVE #110  
 CLEVELAND, OHIO 44130  
 (216) 891-0305

PLANT  
 705 FRIENDSHIP DRIVE  
 NEW CONCORD, OHIO 43762  
 (614) 826-7422

TITLE	SCALE 1"=1'
PROJECT NAME	DATE
TYPICAL ELECTRO-PNEUMATIC HEADER BUTTERFLY VALVE	ENGINEER R.N.
CUSTOMER	DRAWN BY J.P.
P.L. NUMBER	APPROVED BY M.R.
PROJECT NUMBER	
10045-4	
SHEET	OF

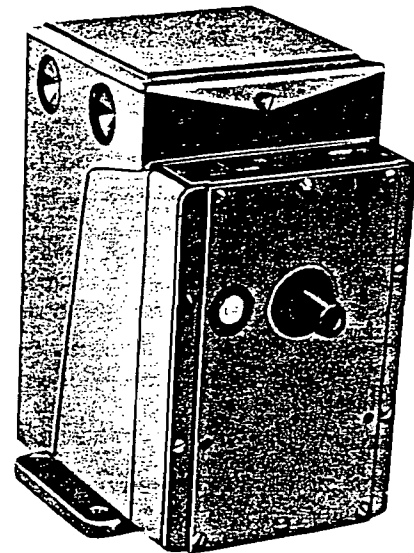


**SERIES EA ELECTRIC ACTUATORS  
LOW TORQUE, MEDIUM TORQUE AND SPRING RETURN**

**Identification**

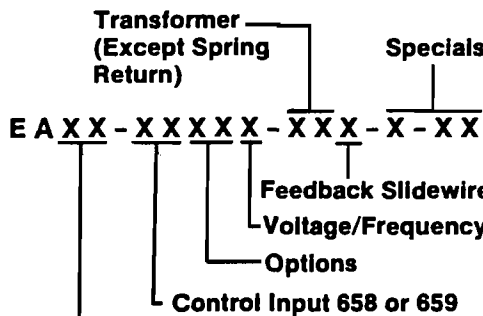
Actuators of this family may be easily identified by referring to the part number shown on the actuator nameplate on top of the gear case. The date of manufacture is stamped on the case (four digits, the first two representing the week of the year, and the last two representing the year).

These actuators provide the requirements of both damper control and valve control applications where it is desirable to move the load in either direction, or to stop it at any point in the stroke. All models contain feedback slidewires for true position-proportional control.



**Figure 1.**

**BASIC ACTUATOR NUMBER SYSTEM  
AND SPECIFICATIONS**



**LOW TORQUE**

	Travel Limits	Time in Seconds	Torque in Lbs In.
21	90°†	12	50*
22	180°†	25	50*
23	90°†	12	50
24	180°†	25	50

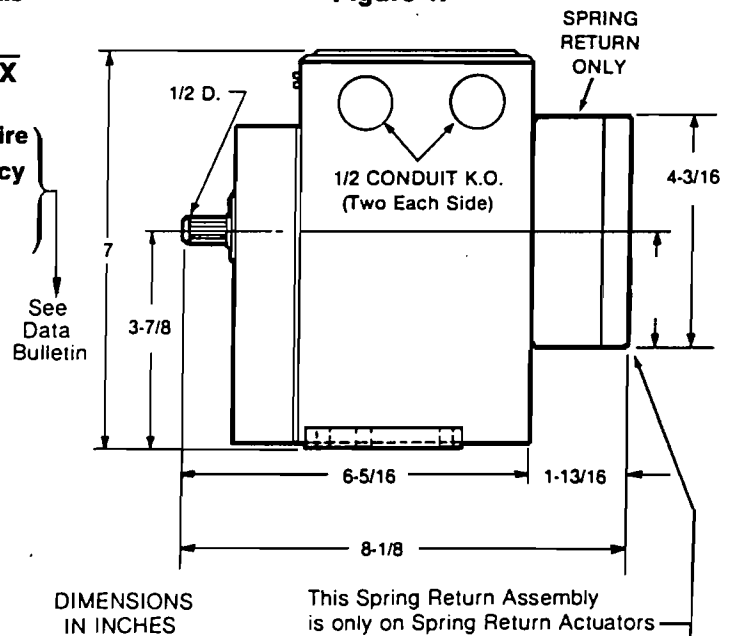
\*No built-in auxiliary switch  
†No travel limit switches

**SPRING RETURN**

	Travel Limits	Time in Seconds	Torque in Lbs In.
C.W. Spring Return With One S.P.D.T. Switch 41	90°	45	50
42	180°	90	50
CCW Spring Return With One S.P.D.T. Switch 44	180°	90	50

**MEDIUM TORQUE**

	Travel Limits	Time in Seconds	Torque in Lbs In.
51	90°	12 Adj.	60
52	180°	25 Adj.	60
55	90°	40 Adj.	220
56	180°	80 Adj.	220
53	90°	12	60
54	180°	25	60
57	90°	40	220
58	180°	80	220
60	90°	65	450
61	180°	130	450



**Figure 2.**



**SERIES EA ELECTRIC ACTUATORS**

The Series EA are reversible Actuators with the driving motor and gear train completely submerged in oil and sealed in a die cast aluminum case, insuring long life with a minimum of maintenance. A Barber-Colman shaded pole motor drives a hardened steel output shaft through a train of precision-hobbed gears. The high torque unit has two induction motors — one for driving in each direction. Cam-operated limit switches stop the actuator shaft at the CW and CCW ends of travel (except low torque models). The wiper arm on the proportional actuator's feedback slidewire is driven directly by the output shaft. All control and power wiring is brought out to large coded screw-type terminals.

**HIGH TORQUE ACTUATOR**

The High Torque Actuator will position heavy dampers, large butterfly and globe valves, blast gates, air and gas valves, vortex controls, hydraulic couplings, and will drive speed-changing screws and slide gates requiring a torque proportional Actuator. Power consumption is 190W. Shipping weight is 30 pounds. Ambient temperature range is -40°F to +130°F.

Two 1/2-inch conduit knockouts are provided on each side. The crank arm is not included as part of the Actuator.

Working in conjunction with a position-proportional primary or intermediate controller, these heavy duty power units are ideal for the proportional regulation of fuel valves, butterfly valves, and dampers, driving speed changing screws on variable speed transmissions and similar applications.

The following 60 Hz Models with either options 00, 01, 02, 03, 04, 05, 06 or 07 are UL Listed:

Codes	Voltage In Vac
EA51 thru 58	24,120,240
EA21,22,23,24	120
EA42,44	24,120,240



**WRITE THE COMPLETE 15-DIGIT MODEL NUMBER**

**EAXX-XX XX X-XX X-X-XX**

Travel Limits	Time in Seconds	Torque in Lb. in.
†71 90°	20	550
†72 180°	40	550
†73 90°	33	1100
†74 180°	65	1100
†75 90°	57	1300
†76 180°	115	1300

Control Input Signal	Converter Model Number
00 = Line Voltage	—
11 = 4-20mAdc	658A-00001
12 = 4-12mAdc	658A-00002
13 = 12-20mAdc	658A-00003
14 = 2-12mAdc	658A-00004
15 = 2-7mAdc	658A-00005
16 = 7-12mAdc	658A-00006
19 = Other, Special	658A-00008-000-X-XX
31 = Slidewire	659A-00000
21 = 4-20mAdc	658A-00011
22 = 4-12mAdc	658A-00012
23 = 12-20mAdc	658A-00013
24 = 2-12mAdc	658A-00014
25 = 2-7mAdc	658A-00015
26 = 7-12mAdc	658A-00016
28 = Other, Special	658A-00018-000-X-XX
41 = Slidewire	659A-00010

Specials	
0-00 = None	
<b>Feedback Slidewire</b>	
0 = 100 ohm	
1 = 135 ohm	
2 = 500 ohm	
3 = 1000 ohm	
<b>Transformer</b>	
00 = None	
01 = Built-in 120-24 Vac Transformer*	
02 = Built-in 240-24 Vac Transformer*	
*Not available with 658A or 659A	
<b>Motor Voltage/Frequency</b>	
0 = 120/60	
1 = 120/50 (N/A EA74, 76)	
3 = 240/60	
4 = 240/50 (AVAIL. EA 73 ONLY)	
Special = Consult Factory	

Options
00 = None
01 = Two Auxillary Switches SPDT
02 = Four Auxillary Switches SPDT
03 = Rear Shaft
04 = 100 ohm Rear Slidewire
05 = 100 ohm Rear Slidewire with Two Switches
06 = 1000 ohm Rear Slidewire
07 = 1000 ohm Rear Slidewire with Two Switches
36 = Weather Resistant Cover
41 = One 100 ohm Rear Slidewire + Weather Resistant Case
42 = Two 100 ohm Rear Slidewires + Weather Resistant Case
43 = Three 100 ohm Rear Slidewires + Weather Resistant Case

The Model 658A is a Current to Position Converter.  
The Model 659A is a Resistance to Position Converter.

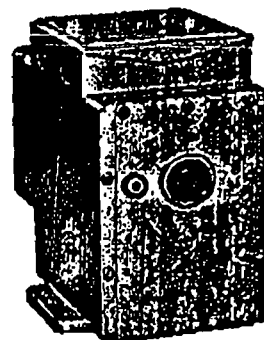


# SPRING RETURN ACTUATOR

The Spring Return Actuator will proportionately position fuel valves, butterfly valves, dampers and similar applications which require return to a normal position upon power interruption.

The output shaft is power operated in both directions to position the damper or other controlled devices as required. An internal electrical holding circuit maintains the proper damper position at setpoint. The enclosed return spring drives the output shaft and gear train to return the damper to a normal position on power interruption.

Power consumption is 28W. Shipping Weight is 8 pounds. Ambient temperature range is -40°F to +136°F



## WRITE THE COMPLETE 15-DIGIT MODEL NUMBER

EAXX-XX XX X-00 X-X-XX

	Travel Limits	Time in Seconds	Torque in Lb. In.
CW Spring Return With One SPDT Switch Δ†41	90°	45	50
Δ42	180°	90	50
CCW Spring Return With One SPDT Switch Δ44	180°	90	50

<p>Control Input Signal</p> <p>00 = Contact</p> <p>11 = 4-20mAdc</p> <p>12 = 4-12mAdc</p> <p>13 = 12-20mAdc</p> <p>14 = 2-12mAdc</p> <p>15 = 2-7mAdc</p> <p>16 = 7-12mAdc</p> <p>19 = Other, Special</p> <p>31 = Slidewire</p>	<p>Converter Model Number</p> <p>—</p> <p>658A-00001</p> <p>658A-00002</p> <p>658A-00003</p> <p>658A-00004</p> <p>658A-00005</p> <p>658A-00008</p> <p>658A-00008-000-X-XX</p> <p>659A-00000</p>
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<p>Specials</p> <p>0-00 = None</p> <p>Feedback Slidewire</p> <p>0 = 100 ohm</p> <p>Motor Voltage/Frequency</p> <p>Δ0 = 120/60</p> <p>Δ3 = 240/60 (N/A EA41)</p> <p>†4 = 240/50 (N/A EA41)</p> <p>Δ5 = 24/60° (N/A EA41)</p> <p>*Not Available with 658A or 659A</p>	<p>Options</p> <p>00 = None</p> <p>†38 = Weather Resistant Cover</p>
---	--

The above combinations of Input Converters mounted to the Series EA are UL Listed. The following codes are for weather resistant Input Converters mounted to the Series EA — to order the EA Series weather resistant you must select Weather Resistant Cover Option 38. Weather resistant combinations, 50 Hz models, and specials are not UL Listed.

21 = 4-20mAdc	658A-00011	} Weather Resistant Converter
22 = 4-12mAdc	658A-00012	
23 = 12-20mAdc	658A-00013	
24 = 2-12mAdc	658A-00014	
25 = 2-7mAdc	658A-00015	
26 = 7-12mAdc	658A-00016	
29 = Other, Special	658A-00018-000-X-XX	
41 = Slidewire	659A-00010	

File No.  
 E9429 (less options)  
 E57965 (with or without options)

†Not UL Listed.

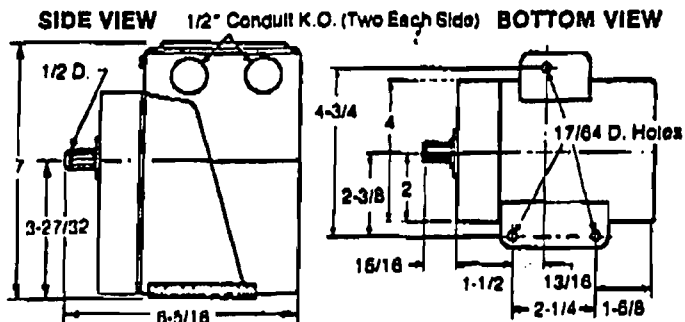
^CSA Approved for base models and voltages as noted.

File No.  
 LR3728-129M

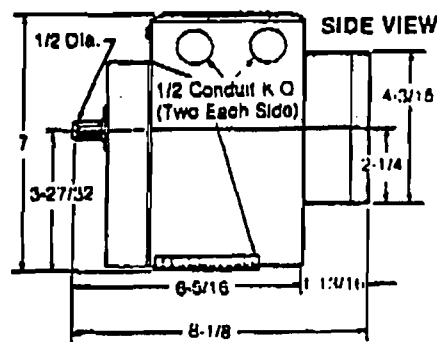
## DIMENSIONS

All Dimensions in Inches

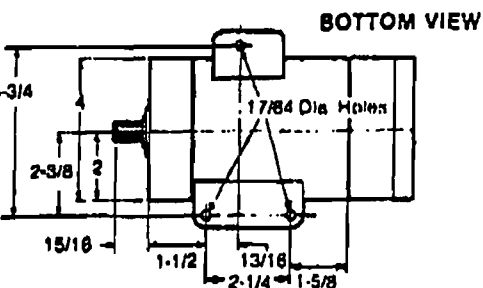
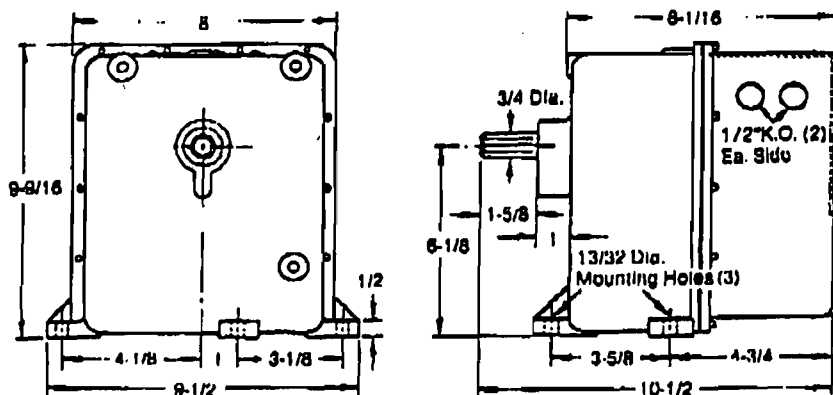
### Medium Torque and Low Torque



### Spring Return



### High Torque



Low and medium torque and spring return output shafts have the standard 12 tooth spline. Reference ANSI B5.15.

Mounting should be upright for the longest life. Models with adjustable speed must not be mounted upside down or with the output shaft upward.

### Medium, Low, and Spring Return Accessories



Crank Arm (A-3767) or (same figure)  
Crank Arm (A-13120) with Splined Hole for Motor Shaft  
Radius Adj. from 7/8" to 3-1/8"



Straight Linkage Connector A-3795 or (same figure)  
Swivel Linkage Connector A-13053  
5/16" Dia. Hole



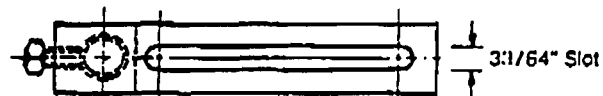
90° Angle Bracket (13-1187)

MOUNT FOR DAMPERS

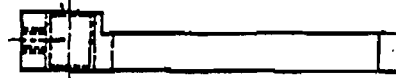


20° Connecting Link, 5/16" Dia. (A-3768 - Red Only)

### High Torque Accessories



Crank Arm (A-4120)  
Radius Adj. from 1" to 5"



Connecting Link (A-4122)  
1/2" Dia. Rods. Adj. from 15-3/4" to 24-3/4"



1/2" Conduit Nipple Extension (X-6880) for Mounting 65XA on Hi Torque Actuator (2 ea. required)

**Barber-Colman Company**  
INDUSTRIAL INSTRUMENTS DIVISION

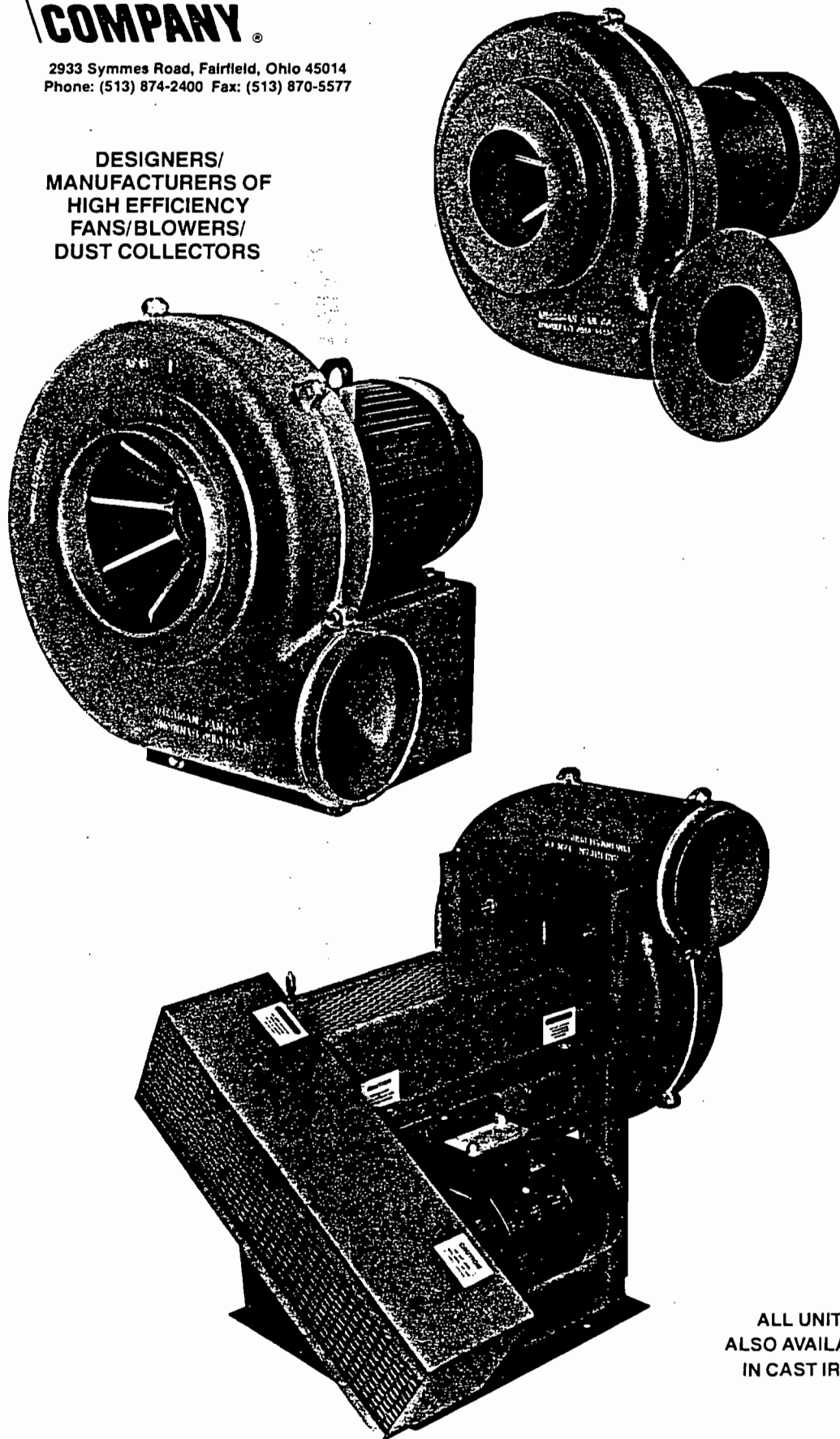
1354 Clifflord Avenue  
P.O. Box 2940  
Loves Park, IL U.S.A. 61132-2940

Purge Air Blower



2933 Symmes Road, Fairfield, Ohio 45014  
Phone: (513) 874-2400 Fax: (513) 870-5577

DESIGNERS/  
MANUFACTURERS OF  
HIGH EFFICIENCY  
FANS/BLOWERS/  
DUST COLLECTORS



ALL UNITS  
ALSO AVAILABLE  
IN CAST IRON

BULLETIN  
AF-0301

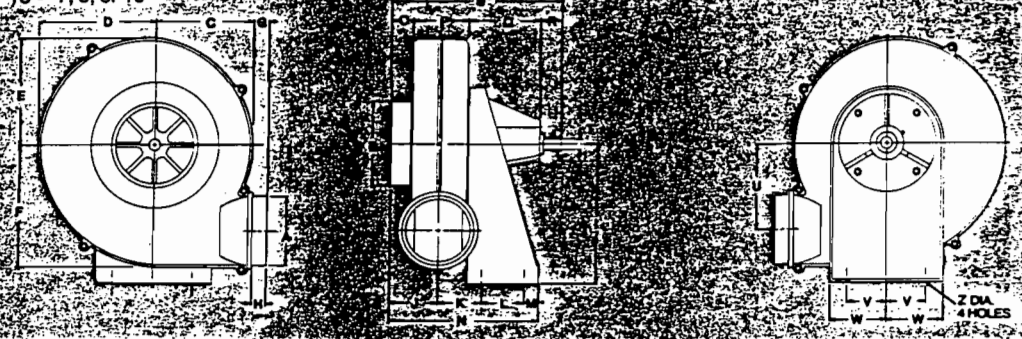
**PRESSURE  
BLOWERS  
ALUMINUM  
OR CAST**

# DIMENSIONAL DATA

AF SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	Z
8	4	4	4 <sup>1</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>16</sub>	5 <sup>3</sup> / <sub>32</sub>	6 <sup>1</sup> / <sub>16</sub>	1 <sup>3</sup> / <sub>8</sub>	1	10	2 <sup>7</sup> / <sub>8</sub>	2 <sup>7</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>4</sub>	9 <sup>3</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>16</sub>	3	11 <sup>3</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>4</sub>	4 <sup>1</sup> / <sub>16</sub>	2 <sup>7</sup> / <sub>8</sub>	4	7 <sup>1</sup> / <sub>8</sub>
9	4	5	6	7 <sup>1</sup> / <sub>4</sub>	6 <sup>7</sup> / <sub>32</sub>	7 <sup>3</sup> / <sub>4</sub>	1 <sup>3</sup> / <sub>16</sub>	1	10	3 <sup>1</sup> / <sub>16</sub>	2 <sup>3</sup> / <sub>16</sub>	3 <sup>3</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>4</sub>	10 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>2</sub>	3 <sup>3</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>16</sub>	3	11 <sup>3</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>4</sub>	5 <sup>1</sup> / <sub>8</sub>	2 <sup>7</sup> / <sub>8</sub>	4	7 <sup>1</sup> / <sub>8</sub>
10	5	6	6 <sup>1</sup> / <sub>16</sub>	8 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>32</sub>	9	1 <sup>1</sup> / <sub>8</sub>	1	10	3 <sup>3</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>4</sub>	10 <sup>1</sup> / <sub>32</sub>	1 <sup>1</sup> / <sub>2</sub>	3 <sup>3</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>16</sub>	3	11 <sup>3</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>4</sub>	6 <sup>3</sup> / <sub>8</sub>	2 <sup>7</sup> / <sub>8</sub>	4	7 <sup>1</sup> / <sub>8</sub>
12	6	7	7 <sup>3</sup> / <sub>4</sub>	9 <sup>1</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>2</sub>	10 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>8</sub>	1	11 <sup>1</sup> / <sub>2</sub>	3 <sup>3</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>16</sub>	4 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>4</sub>	12 <sup>23</sup> / <sub>32</sub>	1 <sup>1</sup> / <sub>2</sub>	4 <sup>1</sup> / <sub>4</sub>	5 <sup>1</sup> / <sub>16</sub>	4	15 <sup>3</sup> / <sub>16</sub>	1	7 <sup>1</sup> / <sub>16</sub>	3 <sup>3</sup> / <sub>4</sub>	4 <sup>1</sup> / <sub>2</sub>	3 <sup>3</sup> / <sub>8</sub>
15	8	*	9 <sup>3</sup> / <sub>8</sub>	11	10	12	1 <sup>1</sup> / <sub>16</sub>	1	15	4 <sup>7</sup> / <sub>16</sub>	4 <sup>3</sup> / <sub>8</sub>	4 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>4</sub>	14 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>2</sub>	5 <sup>7</sup> / <sub>8</sub>	5 <sup>1</sup> / <sub>16</sub>	4	16 <sup>3</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>8</sub>	7 <sup>1</sup> / <sub>8</sub>	3 <sup>3</sup> / <sub>4</sub>	5	3 <sup>3</sup> / <sub>8</sub>

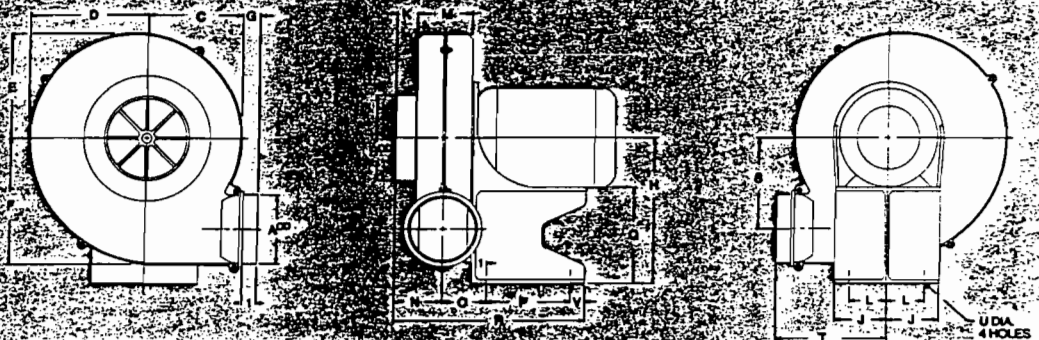
\*"B" Dimension on AF-15 = 7, 8, or 10

## ARRANGEMENT 2 CAST ALUMINUM BASE



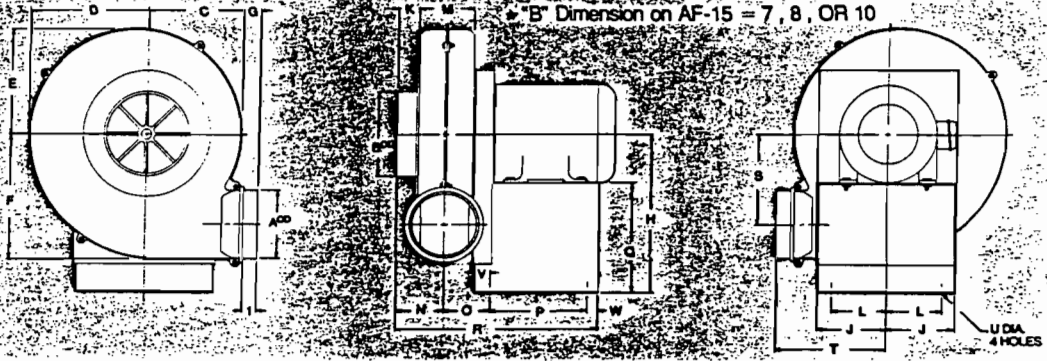
AF SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	Q	P	Q	R	S	T	U	V
8	4	4	4 <sup>1</sup> / <sub>16</sub>	5 <sup>3</sup> / <sub>16</sub>	5 <sup>3</sup> / <sub>32</sub>	6 <sup>1</sup> / <sub>16</sub>	1 <sup>3</sup> / <sub>8</sub>	8 <sup>1</sup> / <sub>2</sub>	3 <sup>3</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>8</sub>	2 <sup>3</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>2</sub>	2 <sup>7</sup> / <sub>8</sub>	2 <sup>7</sup> / <sub>8</sub>	5	5	11 <sup>3</sup> / <sub>16</sub>	4 <sup>1</sup> / <sub>16</sub>	6 <sup>3</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>16</sub>	1
9	4	5	6	7 <sup>1</sup> / <sub>4</sub>	6 <sup>7</sup> / <sub>32</sub>	7 <sup>3</sup> / <sub>4</sub>	1 <sup>3</sup> / <sub>16</sub>	10 <sup>1</sup> / <sub>2</sub>	3 <sup>3</sup> / <sub>4</sub>	1 <sup>3</sup> / <sub>16</sub>	2 <sup>3</sup> / <sub>4</sub>	3 <sup>3</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>16</sub>	6	7	13 <sup>3</sup> / <sub>8</sub>	5 <sup>1</sup> / <sub>8</sub>	7 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>16</sub>	1
10	5	6	6 <sup>1</sup> / <sub>16</sub>	8 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>32</sub>	9	1 <sup>1</sup> / <sub>8</sub>	10 <sup>1</sup> / <sub>2</sub>	3 <sup>3</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>2</sub>	2 <sup>3</sup> / <sub>4</sub>	3 <sup>3</sup> / <sub>4</sub>	3 <sup>3</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>16</sub>	6	7	13 <sup>3</sup> / <sub>16</sub>	6 <sup>3</sup> / <sub>8</sub>	7 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>16</sub>	1

## ARRANGEMENT 4 CAST ALUMINUM BASE



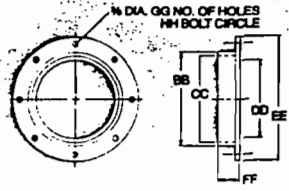
AF SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	FRAME SIZE
10	5	6	6 <sup>1</sup> / <sub>16</sub>	8 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>32</sub>	9	1 <sup>1</sup> / <sub>8</sub>	11 <sup>1</sup> / <sub>2</sub>	5	1 <sup>1</sup> / <sub>2</sub>	4	3 <sup>3</sup> / <sub>4</sub>	3 <sup>3</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>4</sub>	7	8	14 <sup>7</sup> / <sub>16</sub>	6 <sup>3</sup> / <sub>8</sub>	7 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	143-7
12	6	7	7 <sup>3</sup> / <sub>4</sub>	9 <sup>1</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>2</sub>	10 <sup>7</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>8</sub>	11 <sup>1</sup> / <sub>2</sub>	5	1 <sup>1</sup> / <sub>2</sub>	4	4 <sup>1</sup> / <sub>4</sub>	3 <sup>3</sup> / <sub>8</sub>	3 <sup>3</sup> / <sub>16</sub>	7	8	15	7 <sup>1</sup> / <sub>16</sub>	8 <sup>7</sup> / <sub>8</sub>	7 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	143-7
12	6	7	7 <sup>3</sup> / <sub>4</sub>	9 <sup>1</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>2</sub>	10 <sup>7</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>8</sub>	11 <sup>1</sup> / <sub>2</sub>	5	1 <sup>1</sup> / <sub>2</sub>	4	4 <sup>1</sup> / <sub>4</sub>	3 <sup>3</sup> / <sub>8</sub>	3 <sup>3</sup> / <sub>16</sub>	8	7	16 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>16</sub>	8 <sup>7</sup> / <sub>8</sub>	7 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	144-7
15	8	*	9 <sup>3</sup> / <sub>8</sub>	11	10	12	1 <sup>1</sup> / <sub>16</sub>	15	6 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>2</sub>	4 <sup>7</sup> / <sub>8</sub>	5 <sup>7</sup> / <sub>8</sub>	4 <sup>7</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>8</sub>	8 <sup>3</sup> / <sub>4</sub>	11 <sup>1</sup> / <sub>2</sub>	20 <sup>1</sup> / <sub>2</sub>	7 <sup>7</sup> / <sub>8</sub>	10 <sup>1</sup> / <sub>16</sub>	9 <sup>1</sup> / <sub>16</sub>	1 <sup>7</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>16</sub>	143-7
15	8	*	9 <sup>3</sup> / <sub>8</sub>	11	10	12	1 <sup>1</sup> / <sub>16</sub>	15	6 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>2</sub>	4 <sup>7</sup> / <sub>8</sub>	5 <sup>7</sup> / <sub>8</sub>	4 <sup>7</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>8</sub>	8 <sup>3</sup> / <sub>4</sub>	10 <sup>1</sup> / <sub>2</sub>	20 <sup>1</sup> / <sub>2</sub>	7 <sup>7</sup> / <sub>8</sub>	10 <sup>1</sup> / <sub>16</sub>	9 <sup>1</sup> / <sub>16</sub>	1 <sup>7</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>16</sub>	143-7
15	8	*	9 <sup>3</sup> / <sub>8</sub>	11	10	12	1 <sup>1</sup> / <sub>16</sub>	15	6 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>2</sub>	4 <sup>7</sup> / <sub>8</sub>	5 <sup>7</sup> / <sub>8</sub>	4 <sup>7</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>8</sub>	8 <sup>3</sup> / <sub>4</sub>	9 <sup>3</sup> / <sub>4</sub>	20 <sup>1</sup> / <sub>2</sub>	7 <sup>7</sup> / <sub>8</sub>	10 <sup>1</sup> / <sub>16</sub>	9 <sup>1</sup> / <sub>16</sub>	1 <sup>7</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>16</sub>	144-7

## ARRANGEMENT 4 STEEL BASE



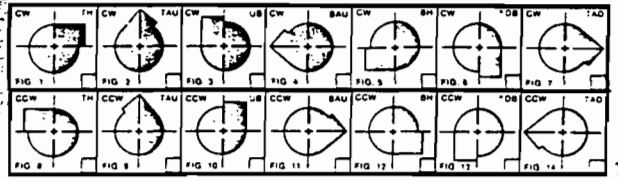
\*"B" Dimension on AF-15 = 7, 8, OR 10

## FLANGES



COLLAR O.D.	PART NO.	BB	CC	DD	EE	FF	GG	HH
4	414	4 <sup>1</sup> / <sub>16</sub>	4 <sup>1</sup> / <sub>32</sub>	3 <sup>1</sup> / <sub>16</sub>	7 <sup>3</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>4</sub>	4	6 <sup>1</sup> / <sub>8</sub>
5	415	5 <sup>1</sup> / <sub>8</sub>	5 <sup>1</sup> / <sub>32</sub>	4 <sup>1</sup> / <sub>16</sub>	7 <sup>7</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>4</sub>	4	6 <sup>3</sup> / <sub>4</sub>
6	416	6 <sup>1</sup> / <sub>16</sub>	6 <sup>1</sup> / <sub>32</sub>	5 <sup>1</sup> / <sub>2</sub>	9	1 <sup>1</sup> / <sub>16</sub>	4	8
7	417	7 <sup>1</sup> / <sub>2</sub>	7 <sup>1</sup> / <sub>32</sub>	6 <sup>1</sup> / <sub>4</sub>	9 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>16</sub>	8	8 <sup>7</sup> / <sub>8</sub>
8	418	9	8 <sup>1</sup> / <sub>32</sub>	7 <sup>1</sup> / <sub>2</sub>	13 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>2</sub>	8	11 <sup>3</sup> / <sub>4</sub>
10	419	10 <sup>1</sup> / <sub>16</sub>	10 <sup>1</sup> / <sub>32</sub>	—	16	1 <sup>1</sup> / <sub>8</sub>	8	14 <sup>1</sup> / <sub>4</sub>

## DISCHARGE POSITIONS



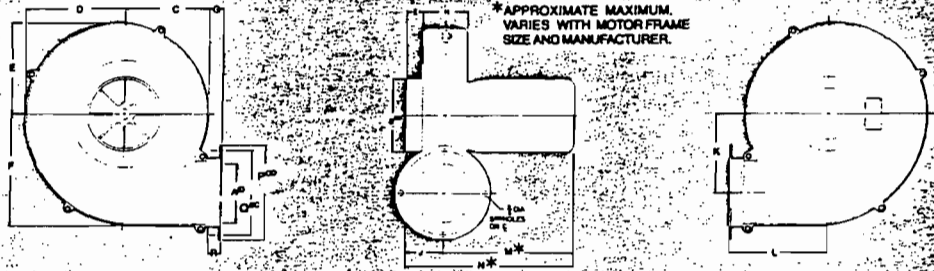
NOTE: ROTATION VIEWED FROM DRIVEN SIDE

# DIMENSIONAL DATA

AF SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	P	Q	R	S
8	3 <sup>1</sup> / <sub>16</sub>	4	4 <sup>1</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>16</sub>	5 <sup>3</sup> / <sub>32</sub>	6 <sup>1</sup> / <sub>16</sub>	1 <sup>5</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>8</sub>	2 <sup>7</sup> / <sub>8</sub>	4 <sup>1</sup> / <sub>16</sub>	6 <sup>1</sup> / <sub>16</sub>	13 <sup>3</sup> / <sub>8</sub>	16 <sup>1</sup> / <sub>4</sub>	7 <sup>3</sup> / <sub>4</sub>	6 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>4</sub>	4
9	3 <sup>3</sup> / <sub>16</sub>	5	6	7 <sup>1</sup> / <sub>4</sub>	6 <sup>17</sup> / <sub>32</sub>	7 <sup>3</sup> / <sub>4</sub>	1 <sup>7</sup> / <sub>16</sub>	3 <sup>3</sup> / <sub>4</sub>	1 <sup>3</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>16</sub>	5 <sup>5</sup> / <sub>8</sub>	7 <sup>7</sup> / <sub>16</sub>	13 <sup>3</sup> / <sub>8</sub>	16 <sup>1</sup> / <sub>16</sub>	7 <sup>3</sup> / <sub>4</sub>	6 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>4</sub>	4
10	4 <sup>1</sup> / <sub>16</sub>	6	6 <sup>1</sup> / <sub>16</sub>	8 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>32</sub>	9	1 <sup>1</sup> / <sub>8</sub>	3 <sup>3</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>2</sub>	3 <sup>3</sup> / <sub>8</sub>	6 <sup>3</sup> / <sub>8</sub>	8 <sup>1</sup> / <sub>16</sub>	13 <sup>3</sup> / <sub>8</sub>	17	7 <sup>7</sup> / <sub>8</sub>	6 <sup>3</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>4</sub>	4
12	5 <sup>1</sup> / <sub>2</sub>	7	7 <sup>3</sup> / <sub>4</sub>	9 <sup>1</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>2</sub>	10 <sup>7</sup> / <sub>16</sub>	1 <sup>7</sup> / <sub>16</sub>	4 <sup>1</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>2</sub>	3 <sup>5</sup> / <sub>8</sub>	7 <sup>7</sup> / <sub>16</sub>	9 <sup>1</sup> / <sub>16</sub>	14 <sup>7</sup> / <sub>8</sub>	18 <sup>1</sup> / <sub>2</sub>	9	8	1 <sup>1</sup> / <sub>16</sub>	4
15	7 <sup>1</sup> / <sub>2</sub>	*	9 <sup>3</sup> / <sub>8</sub>	11	10	12	2 <sup>1</sup> / <sub>16</sub>	5 <sup>7</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub>	4 <sup>1</sup> / <sub>16</sub>	7 <sup>7</sup> / <sub>8</sub>	11 <sup>1</sup> / <sub>16</sub>	18 <sup>1</sup> / <sub>16</sub>	23 <sup>3</sup> / <sub>8</sub>	13 <sup>1</sup> / <sub>2</sub>	11 <sup>3</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>2</sub>	8

\* "B" Dimension on AF-15 = 7, 8, or 10

## ARRANGEMENT 4 FLANGE MOUNT

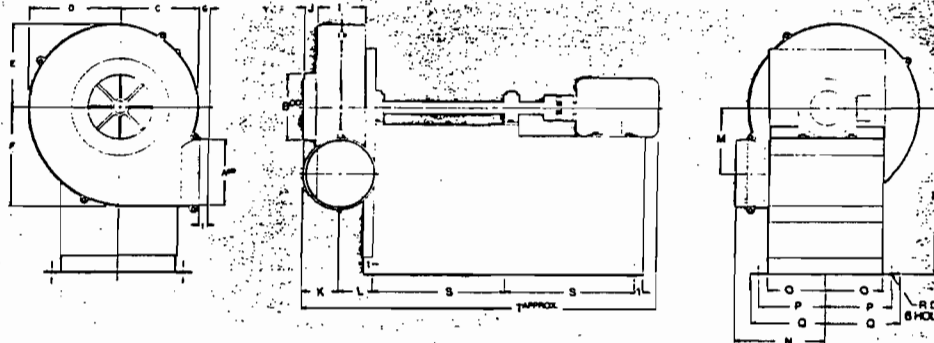


AF SIZE	A	B	C	D	E	F	G	H	I	J	K	L*	M	N	O	P	Q	R	S	56 143-T 145-T			182-T 184-T		213-T 215-T		254-T				
																				T*	T*	T*	S	T*	T*	S	T*	T*	S	T*	
8	4	4	4 <sup>1</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>16</sub>	5 <sup>3</sup> / <sub>32</sub>	6 <sup>1</sup> / <sub>16</sub>	1 <sup>5</sup> / <sub>8</sub>	15	3 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>8</sub>	2 <sup>7</sup> / <sub>8</sub>	3	4 <sup>9</sup> / <sub>16</sub>	6 <sup>1</sup> / <sub>16</sub>	5	6	7	7 <sup>1</sup> / <sub>16</sub>	13 <sup>3</sup> / <sub>4</sub>	34 <sup>3</sup> / <sub>8</sub>	34 <sup>1</sup> / <sub>2</sub>	35 <sup>1</sup> / <sub>2</sub>	—	—	—	—	—	—	—	—	
9	4	5	6	7 <sup>1</sup> / <sub>4</sub>	6 <sup>17</sup> / <sub>32</sub>	7 <sup>3</sup> / <sub>4</sub>	1 <sup>7</sup> / <sub>16</sub>	15	3 <sup>3</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>16</sub>	3 <sup>1</sup> / <sub>16</sub>	3 <sup>3</sup> / <sub>8</sub>	5 <sup>5</sup> / <sub>8</sub>	7 <sup>7</sup> / <sub>16</sub>	5	6	7	7 <sup>1</sup> / <sub>16</sub>	13 <sup>3</sup> / <sub>4</sub>	34 <sup>1</sup> / <sub>16</sub>	34 <sup>1</sup> / <sub>16</sub>	35 <sup>1</sup> / <sub>16</sub>	14 <sup>3</sup> / <sub>4</sub>	35 <sup>1</sup> / <sub>16</sub>	36 <sup>1</sup> / <sub>16</sub>	—	—	—	—	—	—
10	5	6	6 <sup>1</sup> / <sub>16</sub>	8 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>32</sub>	9	1 <sup>1</sup> / <sub>8</sub>	15	3 <sup>3</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>2</sub>	3 <sup>3</sup> / <sub>8</sub>	3 <sup>3</sup> / <sub>8</sub>	6 <sup>3</sup> / <sub>8</sub>	7 <sup>7</sup> / <sub>16</sub>	5	6	7	7 <sup>1</sup> / <sub>16</sub>	13 <sup>3</sup> / <sub>4</sub>	35	35 <sup>5</sup> / <sub>8</sub>	36 <sup>3</sup> / <sub>8</sub>	14 <sup>3</sup> / <sub>4</sub>	35 <sup>1</sup> / <sub>16</sub>	36 <sup>1</sup> / <sub>16</sub>	—	—	—	—	—	—
12	6	7	7 <sup>3</sup> / <sub>4</sub>	9 <sup>1</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>2</sub>	10 <sup>7</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>8</sub>	15	4 <sup>1</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>2</sub>	3 <sup>3</sup> / <sub>8</sub>	3 <sup>3</sup> / <sub>8</sub>	7 <sup>7</sup> / <sub>16</sub>	8 <sup>7</sup> / <sub>8</sub>	5	6	7	7 <sup>1</sup> / <sub>16</sub>	13 <sup>3</sup> / <sub>4</sub>	35 <sup>1</sup> / <sub>2</sub>	35 <sup>5</sup> / <sub>8</sub>	36 <sup>3</sup> / <sub>8</sub>	14 <sup>3</sup> / <sub>4</sub>	35 <sup>1</sup> / <sub>16</sub>	36 <sup>1</sup> / <sub>16</sub>	—	—	—	—	—	—
15	8	*	9 <sup>3</sup> / <sub>8</sub>	11	10	12	1 <sup>1</sup> / <sub>16</sub>	19 <sup>1</sup> / <sub>16</sub>	5 <sup>7</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub>	4 <sup>1</sup> / <sub>16</sub>	4 <sup>3</sup> / <sub>16</sub>	7 <sup>7</sup> / <sub>8</sub>	10 <sup>1</sup> / <sub>16</sub>	7	8	9	9 <sup>1</sup> / <sub>16</sub>	17 <sup>1</sup> / <sub>16</sub>	43 <sup>3</sup> / <sub>4</sub>	43 <sup>1</sup> / <sub>16</sub>	44 <sup>1</sup> / <sub>16</sub>	18 <sup>1</sup> / <sub>16</sub>	44 <sup>7</sup> / <sub>8</sub>	45 <sup>7</sup> / <sub>8</sub>	19 <sup>1</sup> / <sub>2</sub>	44 <sup>3</sup> / <sub>4</sub>	46 <sup>1</sup> / <sub>4</sub>	20 <sup>1</sup> / <sub>16</sub>	46 <sup>1</sup> / <sub>16</sub>	

\* "B" Dimension on AF-15 = 7, 8, or 10

\*AF-15 CW or CCW-DB  
add one inch to dimension shown

## ARRANGEMENT 8

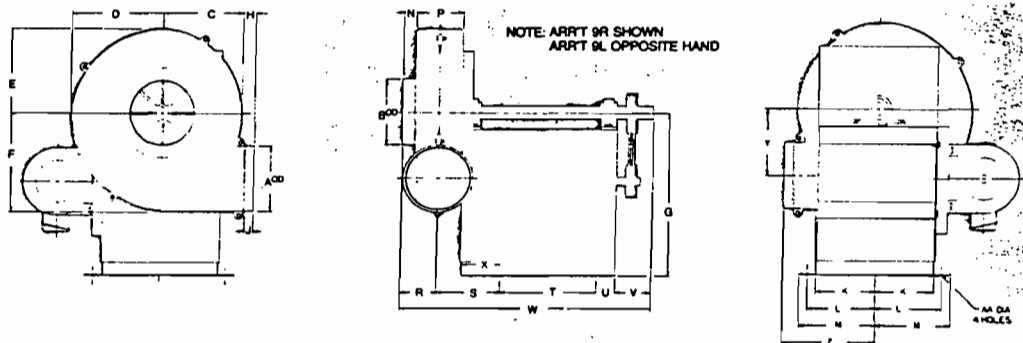


AF SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S*	T	U	V	W*	X	Y	Z	AA	SHAFT DIA.	KEYWAY	MAXIMUM MOTOR FRAME SIZE
8	4	4	4 <sup>1</sup> / <sub>16</sub>	5 <sup>1</sup> / <sub>16</sub>	5 <sup>3</sup> / <sub>32</sub>	6 <sup>1</sup> / <sub>16</sub>	15	1 <sup>5</sup> / <sub>8</sub>	1	5	6	7	1 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>2</sub>	2 <sup>7</sup> / <sub>8</sub>	3	12	1	3	21 <sup>1</sup> / <sub>16</sub>	1	4 <sup>1</sup> / <sub>16</sub>	6 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>16</sub>	3/4	3/16 X 3/32	184-T
9	4	5	6	7 <sup>1</sup> / <sub>4</sub>	6 <sup>17</sup> / <sub>32</sub>	7 <sup>3</sup> / <sub>4</sub>	15	1 <sup>7</sup> / <sub>16</sub>	1	5	6	7	1 <sup>1</sup> / <sub>16</sub>	3 <sup>3</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>16</sub>	3 <sup>3</sup> / <sub>8</sub>	12	1	3	22 <sup>1</sup> / <sub>16</sub>	1	5 <sup>5</sup> / <sub>8</sub>	7 <sup>7</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>16</sub>	3/4	3/16 X 3/32	184-T
10	5	6	6 <sup>1</sup> / <sub>16</sub>	8 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>32</sub>	9	15	1 <sup>1</sup> / <sub>8</sub>	1	5	6	7	1 <sup>1</sup> / <sub>2</sub>	3 <sup>3</sup> / <sub>4</sub>	3 <sup>3</sup> / <sub>8</sub>	3 <sup>3</sup> / <sub>8</sub>	12	1	3	22 <sup>1</sup> / <sub>2</sub>	1	6 <sup>3</sup> / <sub>8</sub>	7 <sup>7</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>16</sub>	1	1/4 X 1/8	184-T
12	6	7	7 <sup>3</sup> / <sub>4</sub>	9 <sup>1</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>2</sub>	10 <sup>7</sup> / <sub>16</sub>	15	1 <sup>1</sup> / <sub>8</sub>	1	5	6	7	1 <sup>1</sup> / <sub>2</sub>	4 <sup>1</sup> / <sub>4</sub>	3 <sup>3</sup> / <sub>8</sub>	3 <sup>3</sup> / <sub>8</sub>	12	1	3	23	1	7 <sup>7</sup> / <sub>16</sub>	8 <sup>7</sup> / <sub>8</sub>	7 <sup>1</sup> / <sub>16</sub>	1	1/4 X 1/8	184-T
15	8	*	9 <sup>3</sup> / <sub>8</sub>	11	10	12	19 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	1	7	8	9	1 <sup>1</sup> / <sub>2</sub>	5 <sup>7</sup> / <sub>8</sub>	4 <sup>7</sup> / <sub>16</sub>	7 <sup>7</sup> / <sub>8</sub>	12	2 <sup>1</sup> / <sub>16</sub>	4 <sup>3</sup> / <sub>4</sub>	31	4 <sup>1</sup> / <sub>16</sub>	7 <sup>7</sup> / <sub>8</sub>	10 <sup>1</sup> / <sub>16</sub>	9 <sup>1</sup> / <sub>16</sub>	1 <sup>1</sup> / <sub>16</sub>	3/8 X 3/16	256-T

\* "B" Dimension on AF-15 = 7, 8, or 10

\*AF-15 CW or CCW-DB  
add one inch to dimension shown

## ARRANGEMENT 9 (ARRANGEMENT 1 SAME AS SHOWN, LESS MOTOR AND DRIVES)



REPRESENTED BY

**AMERICAN  
FAN  
COMPANY**

2933 Symmes Road, Fairfield, Ohio 45014  
Phone: (513) 874-2400 Fax: (513) 870-5577

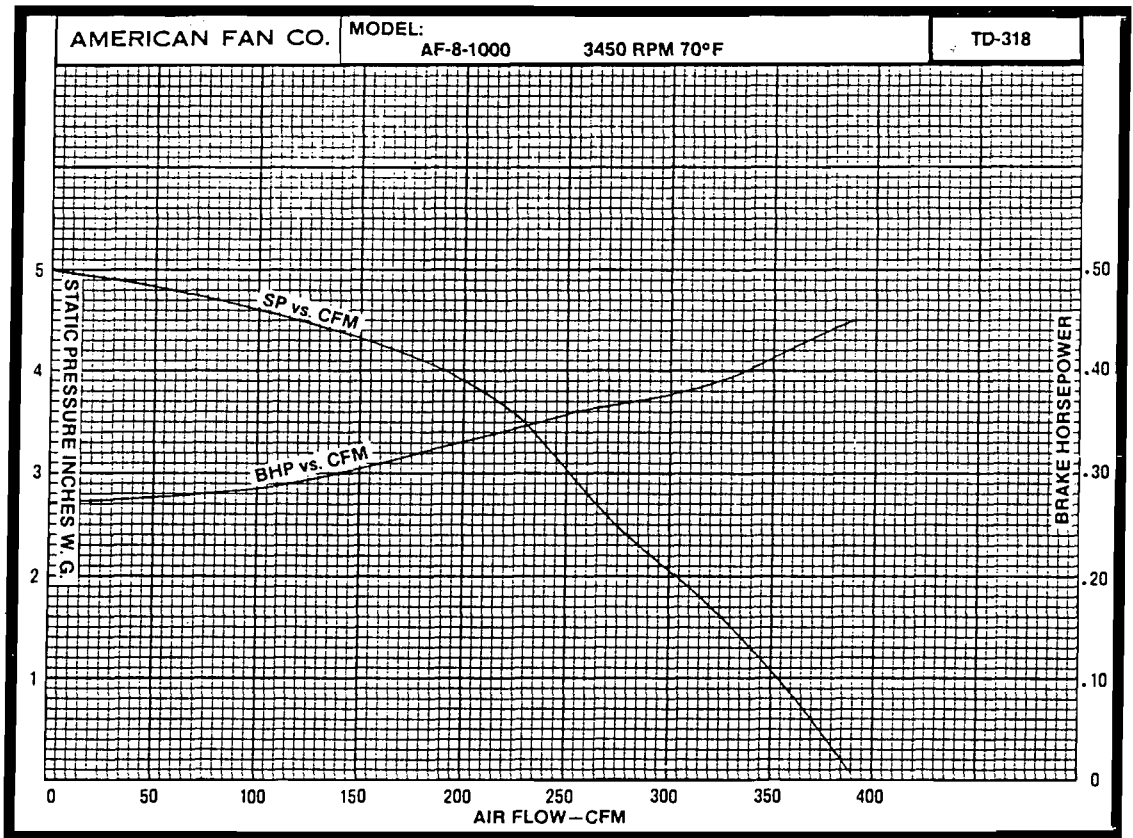
# AF PRESSURE BLOWERS



SIZE 8-1000 AIR DENSITY: .075 LBS./CU. FT.

CFM	OV	0.50 SP		1.00 SP		1.50 SP		2.00 SP		2.50 SP		3.00 SP		3.50 SP		4.00 SP		4.50 SP		5.00 SP		6.00 SP		7.00 SP		8.00 SP		9.00 SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
87	1000	1304	0.02	1702	0.04	2032	0.06	2316	0.09	2567	0.12	2796	0.15	3007	0.19	3203	0.23	3389	0.27	3566	0.31	3894	0.40	4196	0.50	4477	0.61	4741	0.72
105	1200	1419	0.02	1762	0.04	2078	0.07	2355	0.10	2605	0.13	2832	0.16	3040	0.20	3237	0.24	3421	0.28	3595	0.32	3919	0.42	4221	0.52	4502	0.62	4766	0.74
122	1400	1522	0.03	1838	0.05	2134	0.08	2403	0.11	2645	0.14	2871	0.18	3079	0.21	3273	0.25	3455	0.29	3628	0.34	3952	0.43	4251	0.53	4528	0.64	4791	0.76
140	1600	1640	0.04	1952	0.06	2205	0.09	2459	0.12	2696	0.15	2914	0.19	3118	0.23	3312	0.27	3494	0.31	3666	0.36	3986	0.45	4284	0.55	4561	0.66	4822	0.78
157	1800	1764	0.05	2059	0.08	2297	0.11	2527	0.13	2753	0.17	2965	0.20	3166	0.24	3352	0.29	3533	0.33	3705	0.38	4025	0.47	4319	0.58	4594	0.69	4855	0.81
175	2000	1888	0.06	2163	0.09	2415	0.12	2608	0.16	2820	0.18	3025	0.22	3218	0.26	3404	0.31	3579	0.35	3745	0.40	4064	0.50	4358	0.61	4632	0.72	4890	0.84
192	2200	2015	0.08	2281	0.11	2520	0.14	2724	0.17	2901	0.21	3093	0.24	3281	0.29	3457	0.33	3631	0.38	3796	0.42	4105	0.52	4397	0.63	4671	0.75	4929	0.87
209	2400	2141	0.09	2405	0.13	2623	0.16	2838	0.20	3010	0.24	3173	0.28	3350	0.31	3523	0.36	3689	0.40	3848	0.45	4156	0.55	4440	0.66	4711	0.78	4968	0.91
227	2600	2270	0.11	2528	0.15	2736	0.19	2940	0.22	3128	0.26	3280	0.31	3431	0.35	3595	0.39	3755	0.43	3911	0.48	4208	0.59	4491	0.70	4755	0.82	5007	0.94
244	2800	2400	0.13	2653	0.18	2859	0.22	3044	0.25	3232	0.29	3398	0.34	3538	0.38	3676	0.43	3830	0.47	3978	0.52	4269	0.63	4543	0.74	4806	0.86	5054	0.99
262	3000	2536	0.16	2779	0.20	2983	0.25	3158	0.29	3325	0.33	3507	0.37	3656	0.42	3787	0.47	3911	0.52	4057	0.57	4325	0.67	4603	0.78	4858	0.90	5106	1.03
279	3200	2676	0.19	2905	0.23	3106	0.28	3281	0.33	3440	0.37	3609	0.41	3767	0.46	3904	0.51	4027	0.57	4144	0.62	4409	0.72	4669	0.83	4919	0.95	5158	1.08
297	3400	2816	0.23	3032	0.26	3230	0.32	3405	0.37	3559	0.41	3713	0.46	3869	0.51	4017	0.56	4144	0.61	4260	0.67	4490	0.79	4740	0.89	4984	1.01	5219	1.14
314	3600	2958	0.27	3160	0.30	3356	0.36	3528	0.42	3682	0.46	3823	0.51	3972	0.56	4118	0.61	4257	0.66	4378	0.72	4595	0.84	4821	0.96	5063	1.07	5285	1.20
332	3800	3101	0.31	3290	0.34	3483	0.40	3652	0.46	3806	0.52	3945	0.57	4077	0.61	4221	0.67	4359	0.72	4490	0.78	4711	0.90	4912	1.04	5134	1.15	5352	1.27
349	4000	3244	0.36	3420	0.38	3609	0.45	3777	0.51	3929	0.58	4068	0.63	4197	0.68	4326	0.73	4462	0.78	4592	0.84	4829	0.96	5027	1.10	5215	1.24	5433	1.36
367	4200	3388	0.42	3557	0.43	3736	0.50	3903	0.56	4053	0.63	4193	0.70	4319	0.75	4441	0.80	4566	0.85	4694	0.91	4938	1.03	5145	1.17	5330	1.32		
384	4400	3534	0.47	3696	0.50	3864	0.55	4030	0.62	4177	0.69	4316	0.76	4443	0.82	4562	0.88	4677	0.93	4798	0.99	5039	1.11	5263	1.24	5447	1.39		
401	4600	3682	0.54	3836	0.56	3994	0.60	4155	0.68	4303	0.76	4439	0.83	4568	0.91	4686	0.96	4798	1.01	4907	1.07	5142	1.20	5365	1.33				
419	4800	3830	0.60	3977	0.64	4124	0.67	4282	0.75	4430	0.83	4563	0.90	4690	0.98	4810	1.05	4921	1.11	5028	1.16	5246	1.29	5467	1.43				
436	5000	3978	0.68	4118	0.71	4257	0.74	4410	0.81	4556	0.90	4689	0.98	4814	1.06	4934	1.14	5045	1.21										
454	5200	4127	0.76	4261	0.80	4395	0.82	4539	0.89	4682	0.97	4816	1.06	4939	1.14	5057	1.23	5170	1.31										
471	5400	4276	0.85	4403	0.89	4535	0.92	4669	0.97	4809	1.06	4942	1.15	5064	1.23	5180	1.32	5292	1.41										
489	5600	4425	0.94	4547	0.99	4675	1.02	4800	1.05	4937	1.14	5068	1.24	5191	1.33	5305	1.42	5416	1.51										
506	5800	4575	1.04	4691	1.10	4815	1.12	4934	1.15	5066	1.23	5194	1.33	5318	1.43	5431	1.52												

CFM	OV	10.00 SP		11.00 SP	
		RPM	BHP	RPM	BHP
87	1000	4991	0.84	5228	0.97
105	1200	5016	0.86	5253	0.99
122	1400	5041	0.88	5278	1.01
140	1600	5068	0.90	5304	1.03
157	1800	5101	0.93	5336	1.06
175	2000	5135	0.96	5369	1.09
192	2200	5172	1.00	5404	1.13
209	2400	5211	1.04	5442	1.17
227	2600	5250	1.08	5482	1.21
244	2800	5290	1.12		
262	3000	5340	1.17		
279	3200	5392	1.22		
297	3400	5444	1.28		





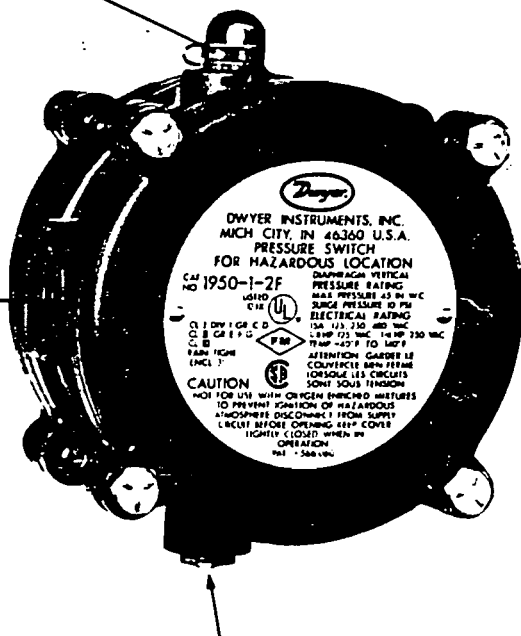


# INTEGRAL EXPLOSION-PROOF PRESSURE SWITCHES

## Specifications - Installation and Operating Instructions

UL and CSA Listed, FM Approved For  
 CL I GR. C,D - CL II GR. E,F,G - CL III

SET POINT  
 ADJUSTMENT SCREW



1/2" NPT  
 ELECTRICAL  
 CONDUIT  
 CONNECTION

VENT DRAIN PLUG

Model 1950 Switches: Operating ranges and dead bands.

To order specify Model Number	Operating Range Inches, W.C.	Approximate Dead Band	
		At Min. Set Point	At Max. Set Point
1950-04	0.03 to 0.35	0.02	0.09
1950-00	0.07 to 0.15	0.04	0.05
1950-0	0.15 to 0.5	0.10	0.15
1950-1	0.4 to 1.6	0.15	0.20
1950-5	1.4 to 5.5	0.3	0.4
1950-10	3.0 to 11.0	0.4	0.5
1950-20	4.0 to 20.0	0.4	0.6

Model Number	Operating Range PSI	Approximate Dead Band	
		Min. Set Point	Max. Set Point
1950P-2	.5 to 2.0	0.3 PSI	0.3 PSI
1950P-8	1.5 to 8.0	1.0 PSI	1.0 PSI
1950P-15	3.0 to 15.0	0.9 PSI	0.9 PSI
1950P-25	4.0 to 25.0	0.7 PSI	0.7 PSI
1950P-50	15.0 to 50	1.0 PSI	1.5 PSI

**PHYSICAL DATA**

**Temperature limits:** -40°F to 140°F. 0°F to 140°F for 1950P-8, 15, 25, and 50.  
**Rated Pressure:** 1950 - 45 IN. W.C., 1950P - 35 PSI, 1950P-50 only - 70 PSI.  
**Maximum surge pressure:** 1950 - 10 PSI, 1950P - 50 PSI, 1950P-50 only - 90 PSI.

**Pressure Connections:** 1/8" NPT.

**Electrical Rating:** 15 amps, 125, 250, 480 volts, 60 Hz. A.C. Resistive 1/8 H.P. @ 125 volts, 1/4 H.P. @ 250 volts, 60 Hz. A.C.

**Wiring connections:** 3 screw type; common, norm. open and norm. closed.

**Conduit connections:** 1/2" NPT.

**Set point adjustment:** Screw type on top of housing. Field adjustable.

**Housing:** Anodized cast aluminum.

**Diaphragm:** Molded fluorosilicone rubber. 04 model, silicone on nylon.

**Calibration Spring:** Stainless Steel.

**Installation:** Mount with diaphragm in vertical position.

**Weight:** 3 1/4 lbs. 04 model, 4 lbs., 7 oz.

**Response Time:** Because of restrictive effect of flame arrestors, switch response time may be as much as 10-15 seconds where applied pressures are near set point.

**NOTE:** The last number-letter combination in the 1950 model number identifies the switch electrical rating (number) and diaphragm material (letter). The 2F combination is standard as described in the physical data above. In the case of special models, a number 1 rating is the same as 2; a number 3 or 4 rating is 10A 125, 250, 480 VAC - 1/8 HP 125 VAC, 1/4 HP 250 VAC; and a number 5 or 6 rating is 1A 125 VAC. A letter B indicates a Buna-N diaphragm, N; Neoprene, S; Silicone, and V; Viton.

The New Model 1950 Explosion-Proof Switch combines the best features of the popular Dwyer Series 1900 Pressure Switch with a compact explosion-proof housing.

The unit is U.L. and CSA listed, FM approved for use in Class I, Groups C & D, Class II, Groups E, F, & G and Class III atmospheres. It is also totally rain-tight for outdoor installations. Twelve models allow set-points from .03 to 20 inches W.C. and from .5 to 50 PSI.

Easy access to the SPDT switch for electrical hook-up is provided by removing the top plate of the three-part aluminum housing. Adjustment to the set point of the switch can be made without disassembly of the housing. The unit is very compact, about half the weight and bulk of equivalent conventional explosion-proof switches.

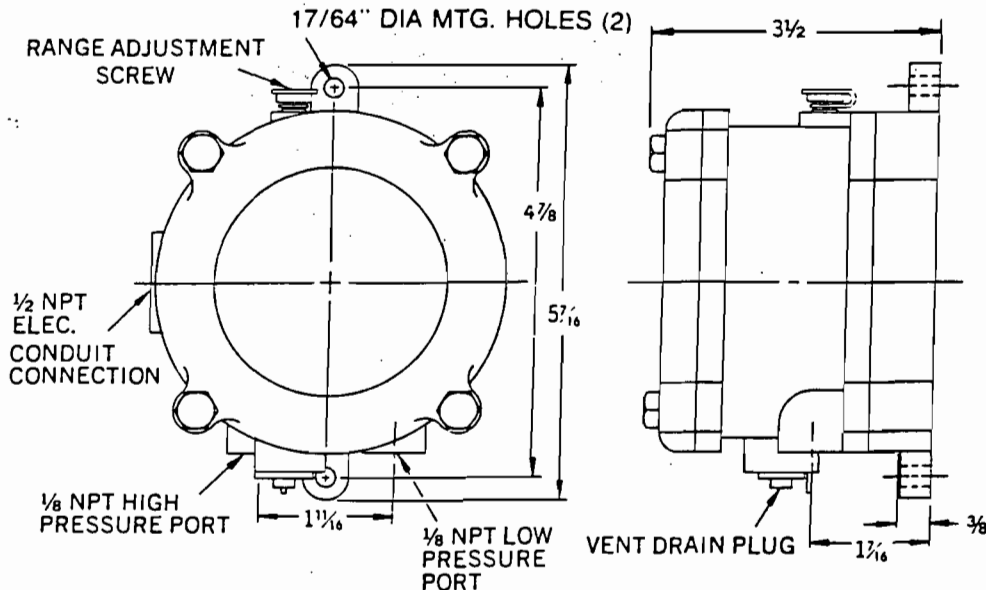
**CAUTION:** Use of the Model 1950 switch with explosive media connected to the low pressure port (including differential pressure applications in such media) is not recommended. Switch contact arcing can cause an explosion inside the switch housing which, while contained, may render the switch inoperative. If switch is being used to sense a single positive pressure relative to atmosphere, run a line from the low pressure port to a non-hazardous area free of combustible gases.

# SERIES 1950

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# INTEGRAL EXPLOSION-PROOF PRESSURE SWITCHES

## Installation and Operating Instructions



NOTE: For dimensions of Model 1950-04, request drawing 28-700175-00.

1950 SWITCH OUTLINE DIMENSIONS

### INSTALLATION

Select a location that is free from excessive vibration, corrosive atmosphere and where the ambient temperature is between  $-40^{\circ}$  and  $+140^{\circ}$ F. Switch may be installed outdoors or in areas where the hazard of explosion exists. (See pg. 1 for specific types of hazardous service).

Mount standard switches with the diaphragm in a vertical plane and with switch lettering and Dwyer nameplate in an upright position. Some switches are position sensitive and may not reset properly unless they are mounted with the diaphragm vertical. (Special units can be furnished for other than vertical mounting arrangements if required.)

Connect switch to source of pressure, vacuum or differential pressure. Metal tubing with 1/4" O.D. is recommended, but any tubing which will not restrict the air flow can be used. Connect to the two 1/8" NPT female pressure ports as noted below:

- A. Differential pressures - connect pipes or tubes from source of greater pressure to high pressure port marked HIGH PRESS., and from source of lower pressure to low pressure port marked LOW PRESS.
- B. Pressure only (above atmospheric) - connect tube from source of pressure to high pressure port. The low pressure port is left open to atmosphere.
- C. Vacuum only (below atmospheric pressure) - connect tube from source of vacuum to low pressure port. The high pressure port is left open to atmosphere.

To make electrical connections, remove the three hex head screws from the cover and, after loosening the fourth captive screw, swing the cover aside. Electrical connections to the standard single pole, double throw snap switch are provided by means of screw terminals marked "common", "norm open", and "norm closed". The normally open contacts close and the normally closed contacts open when pressure increases beyond the set point. Switch loads for standard models should not exceed the maximum specified current rating of 15 amps resistive. Remember that switch capabilities decrease with an increase in ambient temperature, load inductance, or cycling rate. Whenever

an application involves one or more of these factors, the user may find it desirable to limit the switched current to 10 amps or less in the interest of prolonging switch life.

### ADJUSTMENT

To change the set point:

- A. Remove the plastic cap and turn the slotted Adjustment Screw at the top of the housing clockwise to raise the set point pressure and counter-clockwise to lower the set point. After calibration, replace the plastic cap.
- B. The recommended procedure for calibrating or checking calibration is to use a "T" assembly with three rubber tubing leads, all as short as possible and the entire assembly offering minimum flow restriction. Run one lead to the pressure switch, another to a manometer of known accuracy and appropriate range, and apply pressure through the third tube. Make final approach to the set point very slowly. Note that manometer and pressure switch will have different response times due to different internal volumes, lengths of tubing, fluid drainage, etc. Be certain the switch is checked in the position it will assume in use, i.e. with diaphragm in a vertical plane and switch lettering and Dwyer nameplate in an upright position.
- C. For highly critical applications it is a good idea to check the set point adjustment and reset it as necessary once or twice in the first few months of operation. This will compensate for any change in initial tension which may occur in the spring and diaphragm. For most applications this change will not be significant and no resetting will be required.

### MAINTENANCE

The moving parts of these switches need no maintenance or lubrication. The only adjustment is that of the set point. Care should be taken to keep the switch reasonably clean. Periodically the vent drain plug should be rotated one turn clockwise then returned to its original position. This will dislodge deposits which could accumulate in applications where there is excessive condensation within the switch.

Litho in U.S.A. 2/89



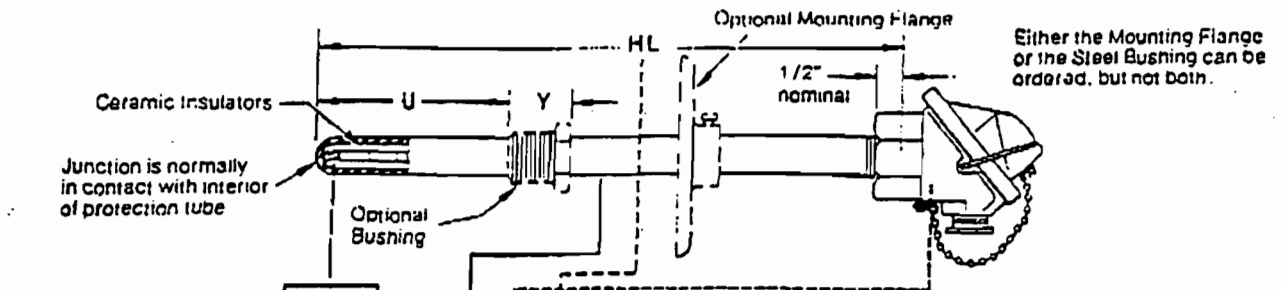
DWYER INSTRUMENTS, INC.

P.O. Box 373, Michigan City, Indiana 46360, U.S.A.

Phone: 219/879-8000 Telex: 25916 Fax: 219/872-9057



**Straight Metal Pipe or Tube Protection — Closed or Open End**



**ORDERING NUMBER**

X XX X — XX X HL — X00 — X — XX

**THERMOCOUPLE TYPE**

- J — Iron-Constantan
- K — Chromel-Alumel
- T — Copper-Constantan (20 ga. only)
- E — Chromel-Constantan

**THERMOCOUPLE WIRE**

See *Compatibility Table*

**AWG and Limits of Error**

- 08 — 8—Standard
- 09 — 8—Special Limits
- 14 — 14—Standard
- 15 — 14—Special Limits
- 20 — 20—Standard
- 21 — 20—Special Limits

**NUMBER OF ELEMENTS**

See *Compatibility Table*

- One
- Two
- 2 — Single twisted, ungrounded
- 3 — Butt-welded, grounded
- 4 — Single butt-welded, ungrounded
- 5 — Butt-welded, ungrounded, dual common
- 6 — Butt-welded, ungrounded, isolated dual

**PROTECTION TUBE OR PIPE**

See *Compatibility Table*

Tube	OD (In.)	Material
01	1-5/8	Coated cast iron
09	1-5/8	Cast iron
*41	1-1/4	Ceramic coated steel; immersion depth is nom. HL-2"
**42	1-1/4	Ceramic coated steel with spring; immersion depth is nom. HL-8" (HL = 18" min.)
45	1-1/8	Mechanite (n/a in 42" and 48" length)

\*Only with additional fitting code 0; for replacement element specify A-11711-XXX-X-XX

\*\*Only with additional fitting code 0; for replacement element specify A-11080-XXX-X-XX

Pipe	Nom. Size (In.)	Material (See Table for ID and head mounting NPT)
03	1/2	Low carbon black steel
05	1XH	Low carbon black steel
06	1/8	Steel, SAE 1020
07	1/4	Steel, SAE 1026
08	1XH	Steel, SAE 1025
11	3/4	446 SS
12	1/2	446 SS
13	1	446 SS
16	1/2	Inconel 601
17	3/4	Inconel 601
18	1/4	304 SS
19	1/2	304 SS

Either the Mounting Flange or the Steel Bushing can be ordered, but not both.

**U DIMENSION**  
Specify in whole inches. Applicable only when additional fitting code is 8, or A thru N. Otherwise insert 00. Maximum U dimension is HL minus 2".

**ADDITIONAL FITTINGS**

- 0 — None
- 2 — Adjustable flange (not with prot. tube codes 41 or 42)
- 8 — Standard welded bushing:

NPT (Thrd Size)	Material	Available with Pipe Code
1/2"	Black steel	06
1/2"	Black steel	07,17
3/4"	Black steel	03,12,16,19,44
1"	Black steel	11,17
1-1/2"	Black steel	05,08,13

**Optional welded bushings:**

A — 1/2"	Black steel	06,07,18
E — 1/2"	316 SS	06,07,18
B — 3/4"	Black steel	03,06,07,12,16,18,19,44
F — 3/4"	316 SS	03,06,07,12,16,18,19,44
G — 1"	316 SS	03,06,07,11,12,16,17,18,19
M — 1-1/4"	Black steel	03,05,08,11,12,13,16,17,19,44
N — 1-1/4"	316 SS	03,05,08,11,12,13,16,17,19,44
H — 1-1/2"	316 SS	03,05,08,11,12,13,16,17,19,44

**HOT END**

- 0 — Closed
- 8 — Open

**HOT LENGTH, HL**

Specify in whole inches. 12" minimum and increments of 6". Maximum standard length is 48"

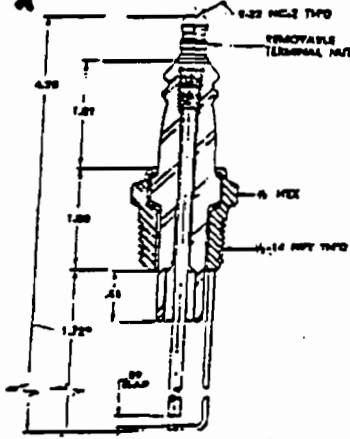
**COLD END TERMINATION**

- 1 — General purpose head, cast iron
- 2 — Weatherproof head, internal threads, cast iron
- 3 — General purpose head, aluminum
- B — Explosion proof head, cast iron body, aluminum cover

# Spark Plug

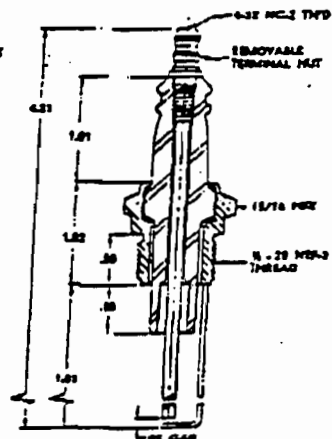
## Auburn Ignition Assemblies

## Auburn Ignition Assemb

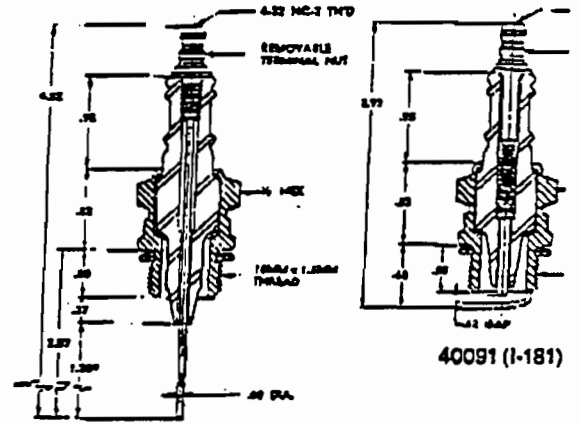


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40070 (I-64-3)

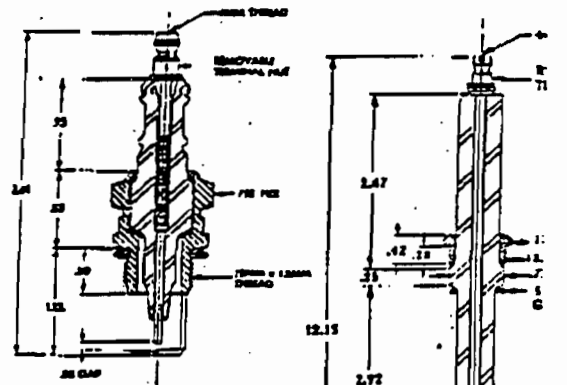
with 3.75" side wire extension



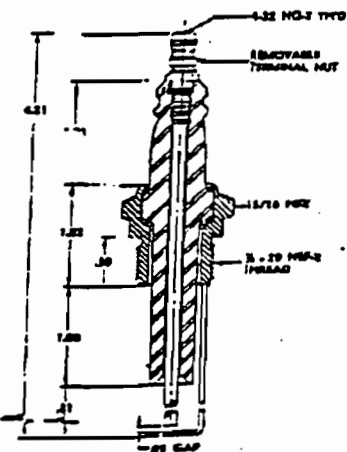
40074 (I-65-1)



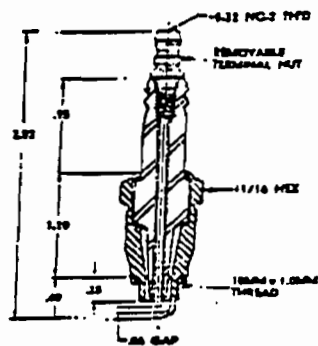
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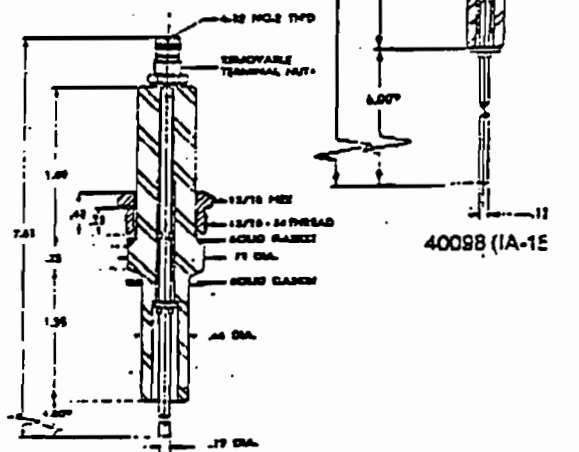
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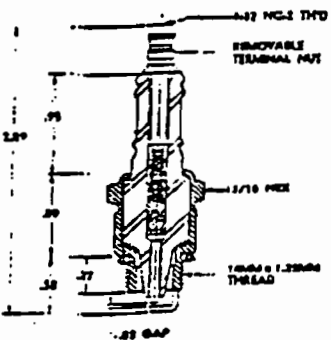
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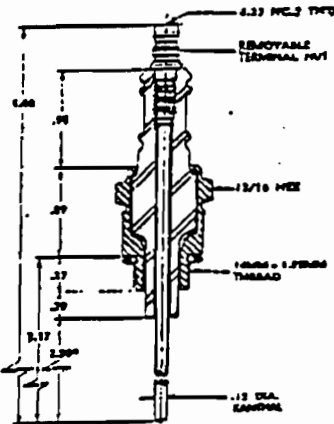
40080 (I-101)



40094 (IA-9)



40084 (I-141)



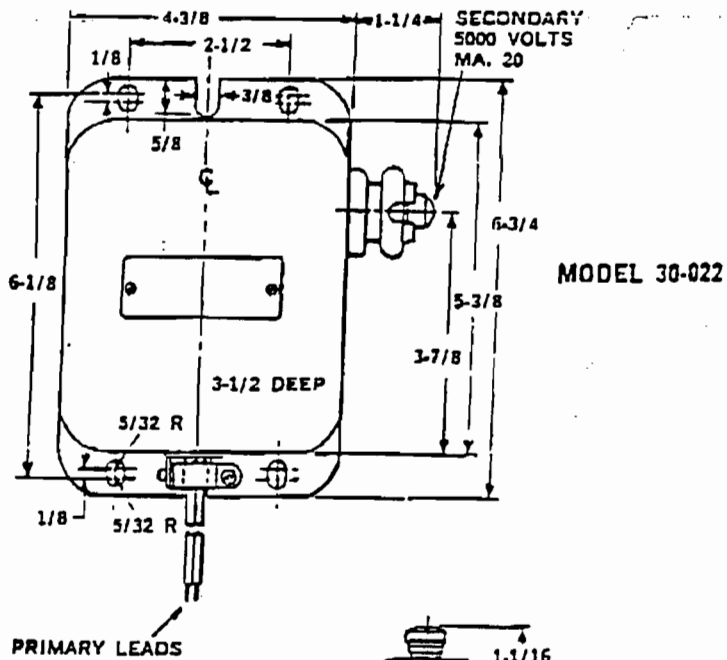
40088 (I-143)

Standard—Other lengths available upon request.

Standard—Other lengths available upon request.

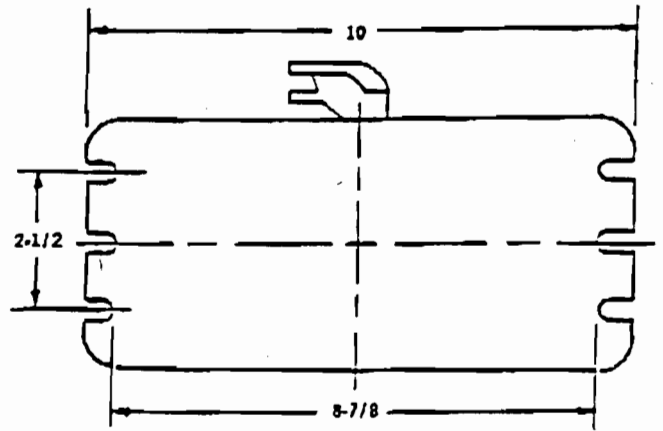
IGNITION TRANSFORMERS

SINGLE IGNITION GROUNDED TYPES

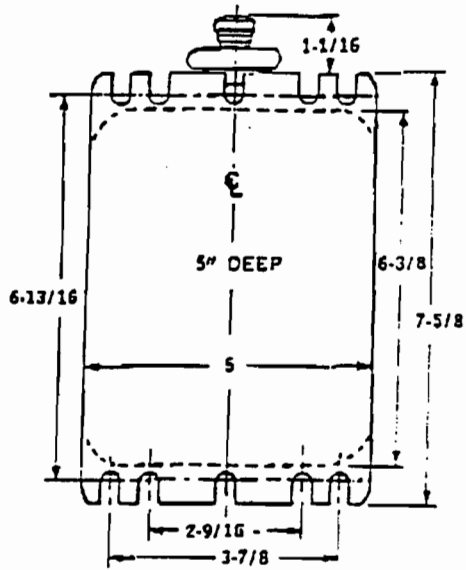


DUAL IGNITION MIDPOINT GROUNDED TYPES

MODEL 30-026

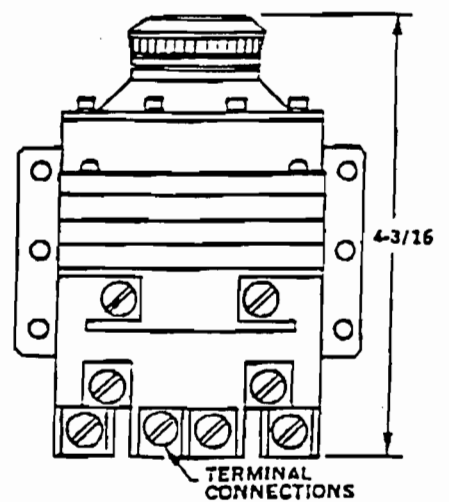
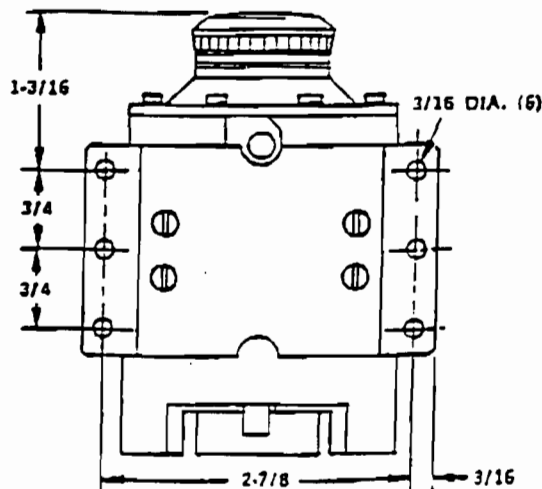
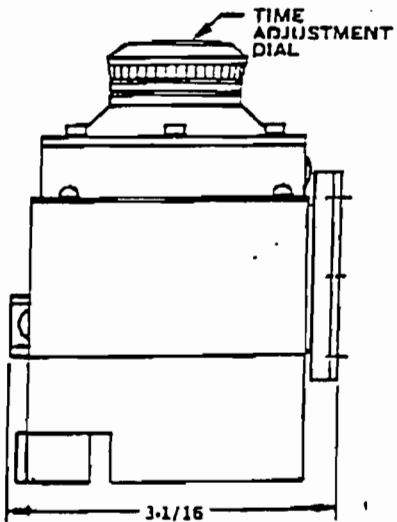
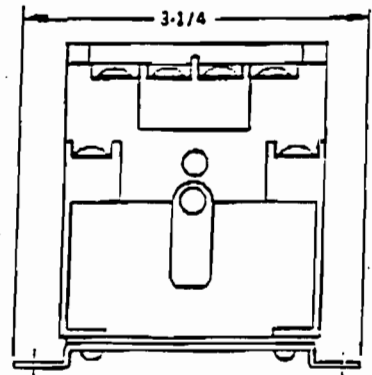


MODEL 30-079



RESET TIMER FOR PRE-VENTILATION

38-159-1 AGASTAT  
(With Calibrated Dial Adjustment)



**REFERENCES**

# LFG SPECIALTIES, INC.

## REFERENCES AND PROJECT EXPERIENCE

LFG Specialties takes pride in being the first manufacturer to develop and produce flares and controllers specifically designed for the efficient combustion of landfill gas. We are happy to provide the following references for our LFG flares and Flame-Trol controllers.

Customer: Browning-Ferris Industries

Contact: Mr. Richard Echols Phone: (713) 870-7801

Site: Modern Landfill Type: 14"x20' utility  
Belleville, IL

Site: Lyons Development Type: 12"x25' utility  
New Hudson, MI

Site: Fill Sand Landfill Type: 6 5/8"x20 utility  
Wheatland, OK

Site: Glenwillow Landfill Type: 8'x40' enclosed  
Glenwillow, OH

Site: Warner Hill Landfill Type: 8'x40' enclosed  
Garfield Hts., OH

Customer: Waste Management of North America

Contact: Mr. Hal Wood Phone: (205) 745-0181

Site: Valleyview Landfill Type: 8"x20' utility  
Stevenson, AL

Contact: Mr. Larry Moree Phone: (504) 665-8225

Site: Woodside Landfill Type: 4"x16' utility  
Walker, LA

Customer: City of Akron

Contact: Mr. Ken Kostura Phone: (216) 928-8293

Site: Akron City Landfill Type: 6"x20' portable  
Akron, OH

### Main Office

7550 Lucerne Drive  
Suite #110  
Cleveland, Ohio 44130  
216/891-0305 FAX: 216/891-8288



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### Plant

705 Friendship Drive  
P.O. Box 332  
New Concord, Ohio 43762  
614/826-7422 614/432-4624

Customer: Kelly Run Sanitation, Inc.

Contact: Mr. Jeff Dworek

Phone: (412) 384-7382

Site: Kelly Run Landfill  
Elizabeth, PA

Type: 4"x20' portable

Customer: Municipal Authority of Westmoreland County

Contact: Mr. Kenneth Volk

Phone: (412) 929-7694

Site: Westmoreland Landfill  
Monessen, PA

Type: 6"x20' portable  
rental package

Should you have any questions or require further information on our products or services, please contact us.

LFG Specialties, Inc. - An industry leader in design innovation, quality engineering, and manufacturing of landfill gas equipment and control systems.

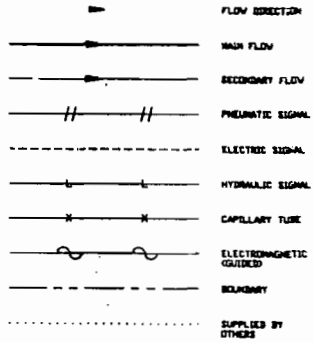
**SHOP-DRAWING PLANS**

# LFG

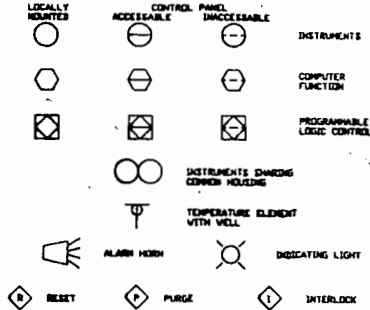
# SPECIALTIES, INC.

## LEGEND

### PIPING & INSTRUMENT LINE SYMBOLS



### INSTRUMENT OR FUNCTION SYMBOLS



### VALVES, REGULATORS, AND OTHER DEVICES

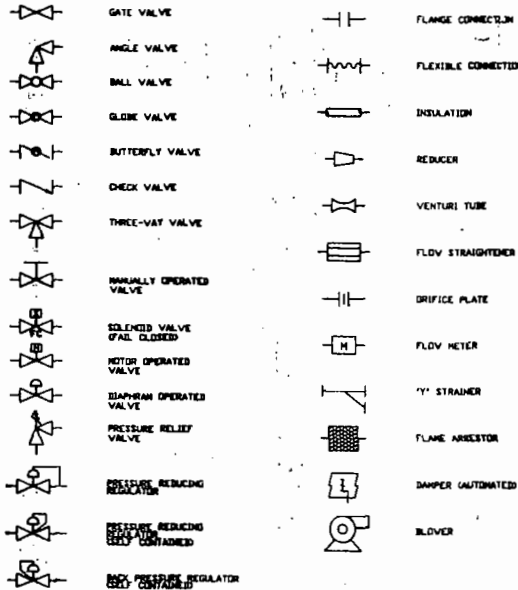


TABLE OF STANDARD IDENTIFICATION LETTERS

FIRST LETTER	SECOND LETTER	THIRD LETTER	FOURTH LETTER
A	ANALYSIS	ALARM	ALARM
B	BURNER, COMBUSTION	USER'S CHOICE	
C	CONNECTION	CONTROL	CONTROL
D	DIFFERENTIAL	DIFFERENTIAL	
E	VOLTAGE	SENSOR	SENSOR
F	FLOW RATE	USER'S CHOICE	
G	GAUGE	GLASS, VIEWING DEVICE	
H	HAND	USER'S CHOICE	HIGH
I	CURRENT (ELECTRICAL)	INDICATOR	
J	POWER	USER'S CHOICE	
K	TIME	CONTROL STATION	
L	LEVEL	CONTROL	LOW
M	USER'S CHOICE	USER'S CHOICE	
N	USER'S CHOICE	USER'S CHOICE	
O	USER'S CHOICE	ORIFICE, RESTRICTION	
P	PRESSURE, VACUUM	POINT (TEST) CONNECTION	
Q	QUANTITY	INTEGRATE, TOTALIZE	
R	RADIATION	RECORDER	
S	SPEED, FREQUENCY	SAFETY	SWITCH
T	TEMPERATURE	TRANSMIT	
U	MULTIVARIABLE	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION	VALUE, DAMPER, LOUVER	VALUE, DAMPER, LOUVER
W	WEIGHT, FORCE	WELL	
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED
Y	EVENT, STATE	Y AXIS	UNCLASSIFIED
Z	POSITION, DIMENSION	Z AXIS	UNCLASSIFIED

### ABBREVIATIONS (OTHERS)

AS	AIR SUPPLY	FG	LANDFILL GAS
COND	CONDENSATE	HCC	MOTOR CONTROL CENTER
CPL	COUPLING	HS	MOTOR STARTER
ES	ELECTRICAL SUPPLY	PS	PIPE STAND/SUPPORT
ESD	EMERGENCY SHUT DOWN	PVC	POLY VINYL CHLORIDE
GS	GAS SUPPLY	SC	SAMPLE CONNECTION
HDPE	HIGH DENSITY POLYETHYLENE	SS	STAINLESS STEEL
IAS	INSTRUMENT AIR SUPPLY	VS	WATER SUPPLY
KOT	KNOCK-OUT TANK		

REV.	DESCRIPTION	DATE	BY

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**LFG SPECIALTIES, INC.**

PLANT: 705 FRIENDSHIP DRIVE, NEW CONCORD, OHIO 43762 (614) 826-7482

HEAD OFFICE: 7550 LUCERNE DRIVE #110, CLEVELAND, OHIO 44130 (216) 891-0305

SCALE: N.T.S. DATE: 11-91

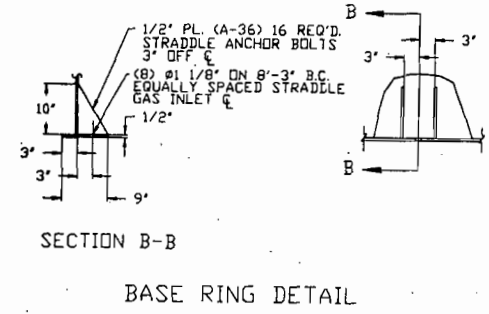
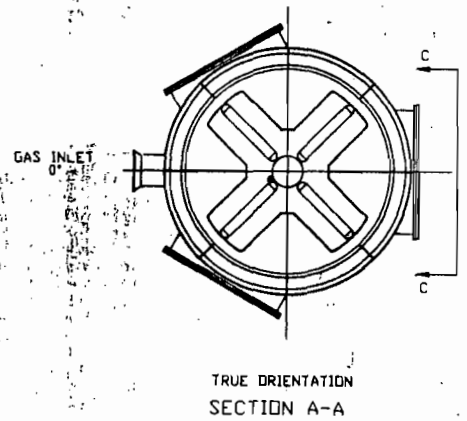
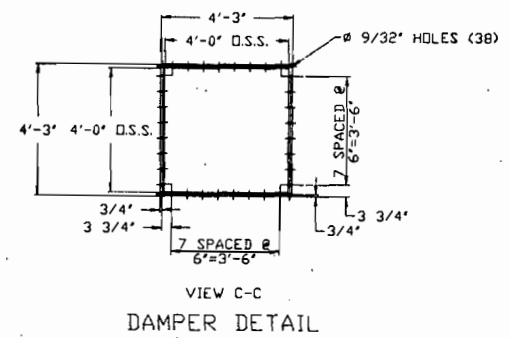
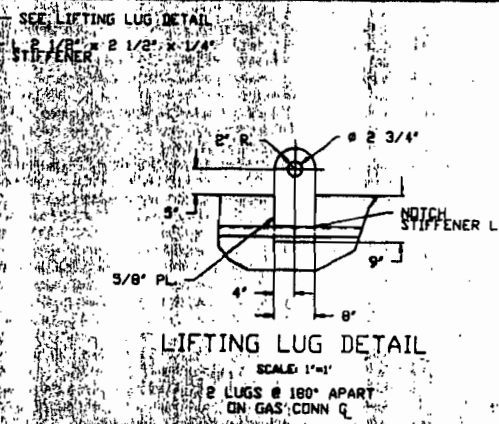
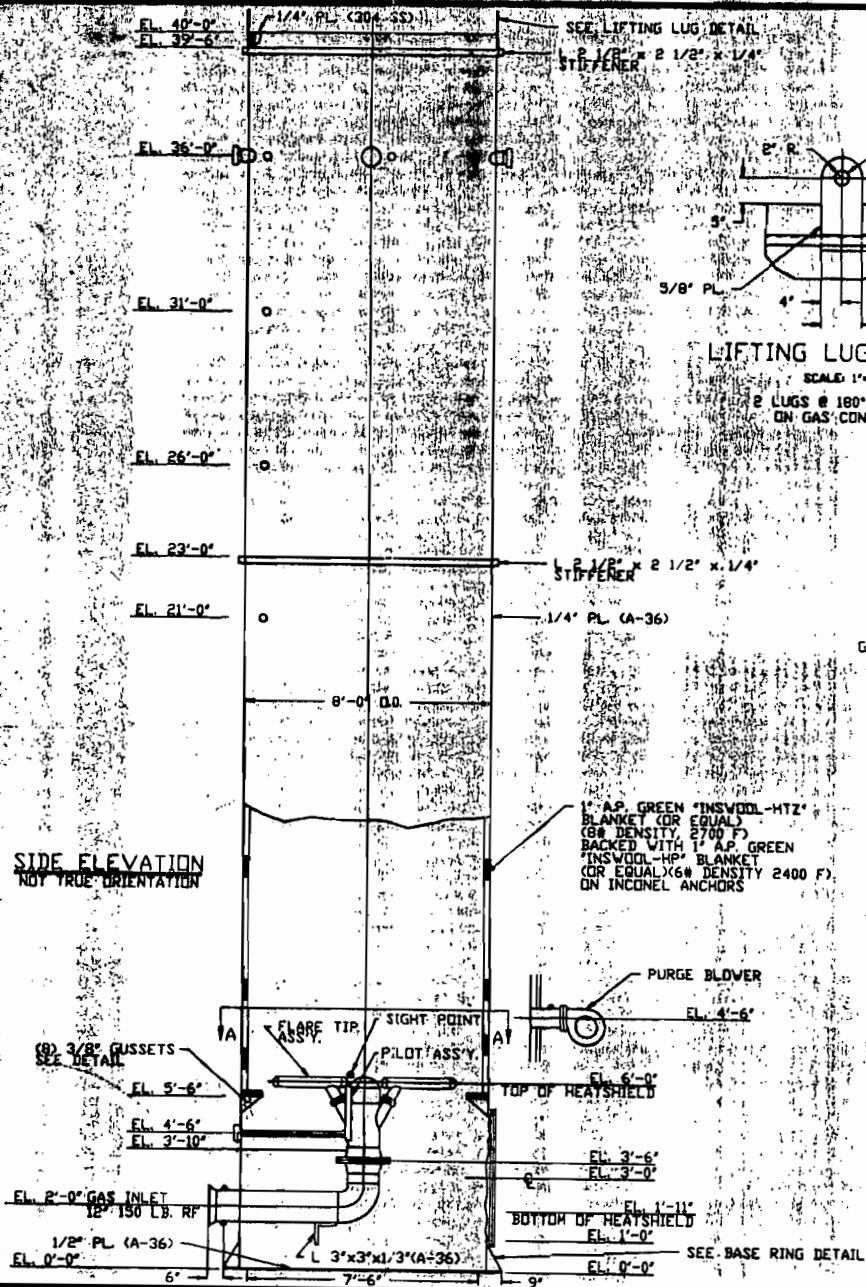
PROJECT NAME: STANDARD LEGEND

DRAWING NUMBER: 10013

SHEET: 1



ENCLOSED FLARE MODEL - EF840 I 12



REV.	DESCRIPTION	DATE	BY

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(216) 891-0305

PLANT  
705 FRIENDSHIP DRIVE  
NEW CONCORD, OHIO 43762  
(614) 886-7422

SCALE: 1/2"=1'

DATE: 6/16/92

DESIGNER: R.N.

CHECKED: J.P.

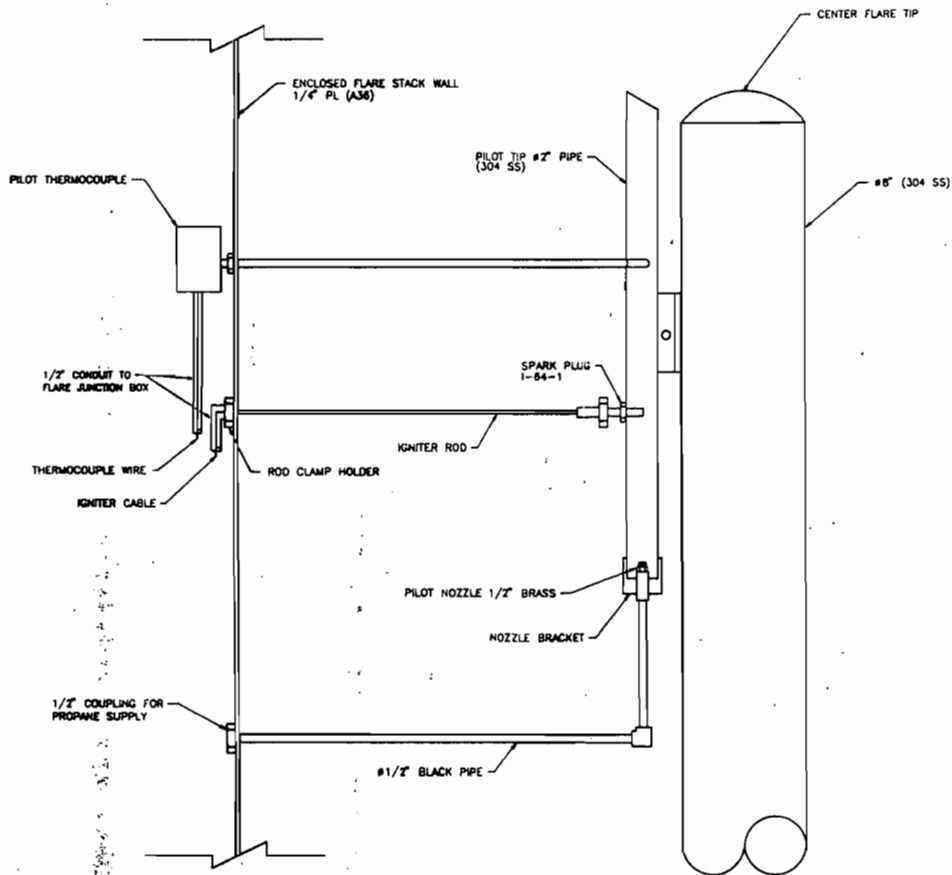
APPROVED BY: L.K.

PROJECT NUMBER: 10043-1

FILE: LFG ENCLOSED FLARE ASSEMBLY SECTIONS & DETAILS

PROJECT NAME: EAST DUVAL SANITARY LANDFILL

CUSTOMER: MORETRENCH AMERICAN CORP.



REV.	DESCRIPTION	DATE	BY

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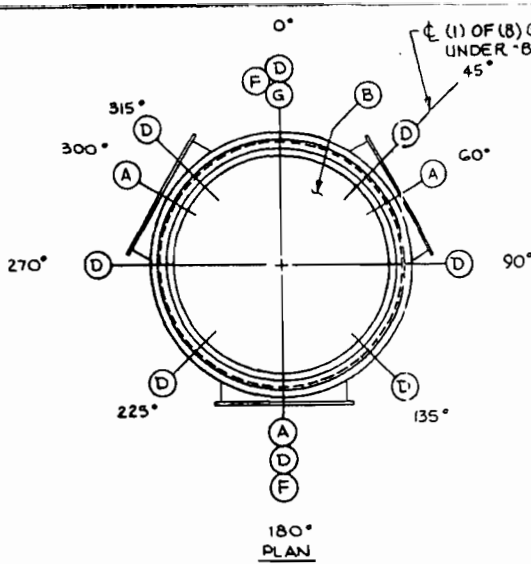
**LFG SPECIALTIES, INC.**

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7550 LUCERNE DRIVE B110  
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(216) 891-0385

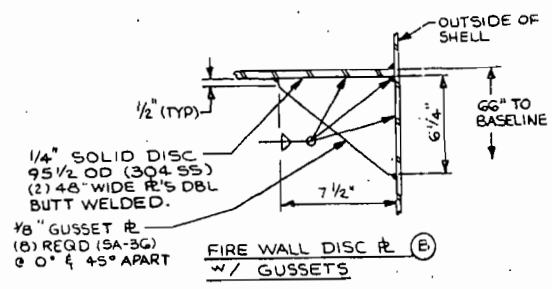
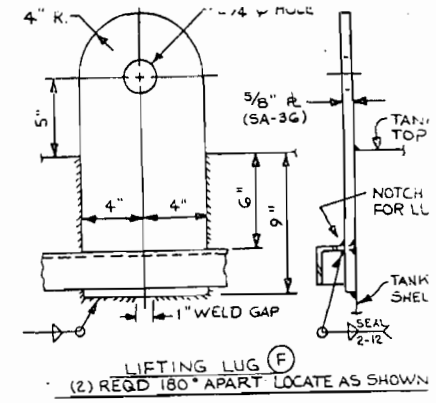
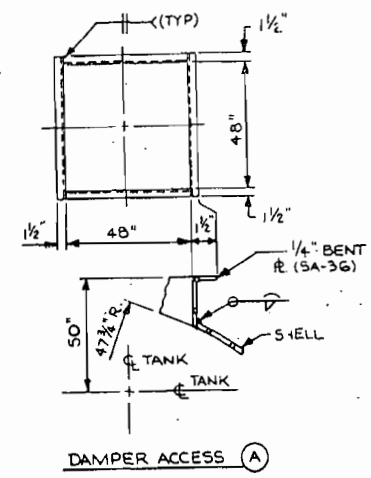
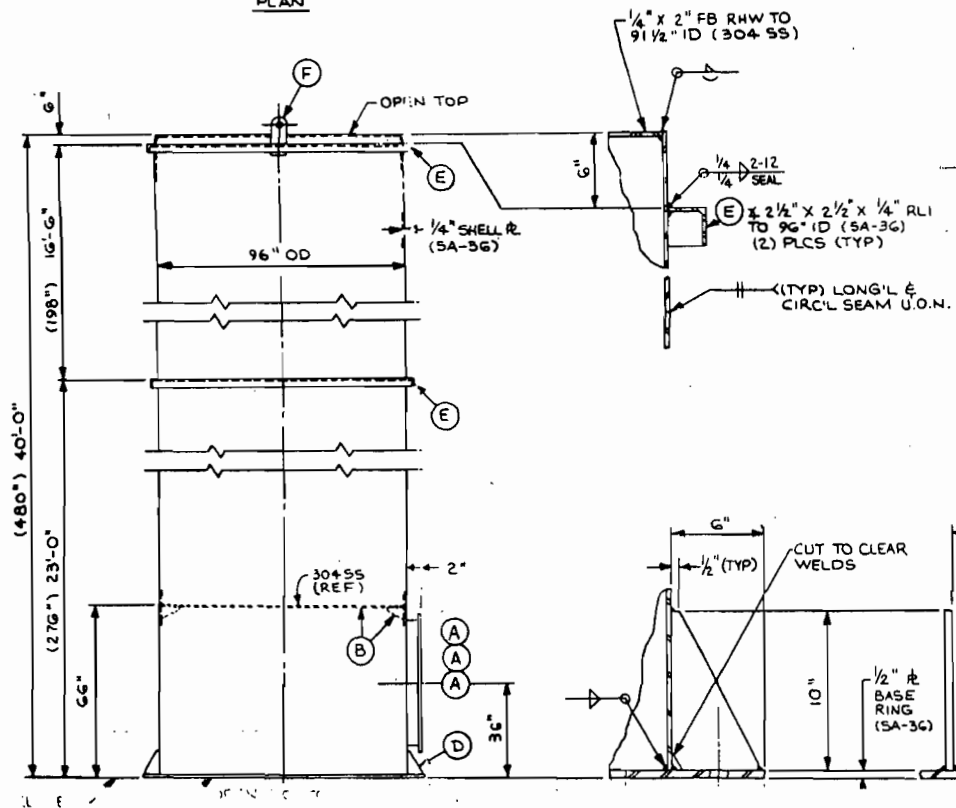
PLANT  
705 FRIENDSHIP DRIVE  
NEW CONCORD, OHIO 43762  
(614) 866-7422

TITLE	IGNITER PILOT SYSTEM
SCALE	NONE
DATE	6/17/92
DESIGNED BY	R.N.
DRAWN BY	J.P.
CHECKED BY	L.K.
APPROVED BY	
PROJECT NUMBER	
CUSTOMER	EAST DUVAL SANITARY LANDFILL
P.O. NUMBER	
CUSTOMER	MORETRENCH AMERICAN CORP.
DRAWING NUMBER	10043-3
SHEET	3

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(1) OF (8) GUSSETS EQ SP UNDER "B" DISC.



GENERAL NOTES

FABRICATION PER THIS DWG

LABELLED	YES	NO
DESIGN PRESSURE	ATM PSI	
DESIGN TEMP	AMB °F	
CORROSION ALLOW	NA	
P.W.H.I	YES	NO
RADIOGRAPH	NA	
SHOP TEST	NA	
INSPECTION BY	MWC	
MATERIAL SHELL	SA-3G	
FLANGES	SA-3G	COUPLINGS NA
NOZZLE NECKS	SA-3G	W.W. NECK SA-3G
BARRIES	NA	INT PIPE NA
SUPPORTS	SA-3G	HOLD DOWN LUGS SA-3G
INT APPURTENANCES	NA	SA-3G
EXT APPURTENANCES	NA	
BOLTS	NA	NUTS NA
GASKETS	NA	
SANDBLAST	SP-G ALL	SB INT SP-G ALL

TYPE OF COVERS NA

ALL NOZZLE AND MANWAY BOLT HOLES TO STRADDLE NORTH / RADIAL SOUTH CENTER LINES OR THEIR PARALLEL LINES UNLESS OTHER WISE SHOWN

EST. CAP. 11400 GALS

EST. WT. FULL OF WATER 185

SPCS OR STOS NA

ITEM	DESCRIPTION	QTY	REMARKS
G	GAS INLET BY OTHERS		
F	2	R	LIFT LUG
E	2	R	REINFORCING ANGLE
D	8	R	ANCHOR CHAIR

**SPECIALTIES, INC.**

PLANT

705 FRIENDSHIP DRIVE  
NEW CONCORD, OHIO 43762  
(614) 826-7422

90" x 40" - 0" FLARE STACK

SCALE	DATE	BY	CHKD	APP'D
		NEDINE	WALKER	R.N.
				BRUNY
				J.P.
				DESIGNED BY
				D.S.
				PER APPROV

## Section 2

# **LFG** SPECIALTIES, INC.

**ENCLOSED FLARE SUBMITTAL  
REVISION NO. II**

**ELECTRICAL SECTION 11188**

**REFERENCE:**

**Enclosed Flare System  
East Duval Sanitary Landfill  
Jacksonville, Florida**

**PRESENTED BY:**

**LFG SPECIALTIES, INC.  
7550 Lucerne Drive Suite 110  
Cleveland, OH 44130  
(216) 891-0305**

**Date: September 28, 1992**

**Main Office**

7550 Lucerne Drive  
Suite #110  
Cleveland, Ohio 44130  
216/891-0305 FAX: 216/891-8288

**Plant**

705 Friendship Drive  
P.O. Box 332  
New Concord, Ohio 43762  
614/826-7422 614/432-4624

INDEX

- SECTION I            ENCLOSED FLARE SYSTEM SUBMITTAL - REVISION NO. II  
                         - Electrical section
- SECTION II           ENCLOSED FLARE SYSTEM, PROPOSAL NO. 29205  
                         - Controller Model Flame - Trol II
- SECTION III          FLARE COMPONENTS LITERATURE  
                         - Panel Enclosure  
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                         - Control Relays  
                         - Surge Protectors  
                         - Louver & Enrichment Controller  
                         - Pilot Lights & Selector Switches  
                         - Purge, Pilot, Ignitor and Down Time Delay Timers  
                         - Weekly Timer  
                         - Pilot & Combustion Chamber Temperature Controllers  
                         - Chart Recorder  
                         - Beacon Alarm Light  
                         - Programmable Logic Controller  
                         - Ultra Violet Scanner
- SECTION IV          SHOP TESTING

**GENERAL**

PROPOSAL NO: 29205

FLARE CONTROLLER SECTION

**FLAME-TROL II  
ENCLOSED FLARE CONTROL SYSTEM**

The LFG Specialties Flame-Trol II is a technically advanced fully integrated, 100% automatic flare controller. The Flame-Trol II provides the operator full flexibility to set or change any temperature and/or time setting utilized in the automatic operation of the flare.

FEATURES OF THE FLAME-TROL II INCLUDE:

\*\*\* Energy saving propane pilot which requires propane only during the ignition cycle of the flare controller.

\*\*\* PILOT TEMPERATURE CONTROLLER \*\*\*

This controller senses the pilot temperature and utilizes one event setting, determined by the operator, to begin operation of the landfill gas blower. This setting is referred to as the "blower on" temperature. Once the automatic pilot has been proven by obtaining the blower on temperature the header valve will slowly open and the landfill gas blower will start.

\*\*\* PILOT TIMER \*\*\*

This timer begins the instant the ignition cycle begins. It is set by the operator at the maximum time required for the pilot to achieve the blower on temperature and the gas supply to be ignited. This time will typically be 2 to 3 minutes. At the end of this time, the pilot gas supply valve will be closed and the pilot flame extinguished, if not already shut-off by the temperature controller.

\*\*\* PILOT FAILURE INDICATOR AND SHUT DOWN \*\*\*

The pilot timer also controls the "pilot failure" function. Upon initiation of the automatic ignition cycle this timer begins timing down. Should the pilot not achieve the "blower on" temperature (set in the pilot temperature controller) in the time set in the pilot timer, the entire system will be shut down. The "pilot failure" indicator light will then come on. The system will not attempt to reignite until the pilot problem has been remedied. If it is determined that the pilot gas supply has not been exhausted or another problem with the pilot system cannot be found the operator may attempt automatic reignition by pushing the "pilot failure reset" button.



\*\*\* IGNITOR TIMER \*\*\*

The ignitor timer allows the operator to set the time the ignitor will spark during the ignition cycle. This allows for the adjustment of the spark duration to compensate for the distance of the pilot gas supply from the flare; thus extending the life of the ignitor plug, transformer and other pilot components.

\*\*\* FLARE CHAMBER TEMPERATURE CONTROLLER \*\*\*

This temperature controller monitors the temperature in the flare chamber and utilizes two event settings which are:

High temperature safety shutdown - this setting simply shuts down the flare if the temperature should rise to a point of being unsafe or potentially damaging to the flare chamber.

Low temperature shutdown - this setting establishes the minimum acceptable operating temperature for the flare. During operation, if the temperature should fall below this setting, the system will shutdown and go into down time mode for restart.

The thermocouples used to operate this part of the Flame-Trol II are two Chromel-alumel (type K) positioned at 1/2 diameter from the top of the flare stack at 180 degrees spacing to ensure an accurate averaging of the stack temperature.

This controller has a constant LED readout of the flare chamber temperature.

\*\*\* Ultraviolet Flame Scanner \*\*\*

The ultraviolet scanner and associated controller provide flame confirmation and initiate "flare safety shutdown". Upon loss of flame, the scanner will automatically shutdown the blowers and close the automated header valve (if utilized). The flame scanner has a maximum response time of 4 seconds, providing almost immediate system shutdown.

The scanner also provides a safety lockout on the start up of the blowers and opening of the header valve, until confirmation of the pilot flame.

\*\*\* PURGE TIMER \*\*\*

This timer controls the length of time the purge blower runs prior to the ignition cycle commencing. Again the operator has the option to set this timer at the length of time determined to be sufficient but not unnecessarily lengthy to accomplish a complete purge of the flare chamber.

\*\*\* DOWN TIME TIMER \*\*\*

One of the most unique aspects of the Flame-Trol II is the capability to allow a specified period of time, after the methane supply has been exhausted, to rejuvenate before attempting to automatically reignite. This is the function of the "down timer". If the methane supply is exhausted the flare chamber temperature controller will shut-down the blowers and close the header valve. At this time the "down timer" will begin timing down. Once the down timer has timed completely down, the automatic ignition cycle will begin. This timer has a range of 1 second to 999 hours. The time required to allow rejuvenation and hence the time set on the down timer is determined by the operator.

\*\*\* INTERMITTENT "REAL TIME" TIMER \*\*\*

Another unique feature of the controller is the real time intermittent timer. This timer allows the operator to set the flare to automatically operate on any desired intermittent cycle. The controller employs a real time 24-hour clock in conjunction with a 7-day cycle timer. The clock has a five year life back up battery to maintain proper time, even through power outages. This ensures the flare will come on and go off at the precise time set by the operator.

The real time timer provides the operator with much greater flexibility and operation accuracy than a simple on-off timer. For example; the flare may be set to operate on any time cycle in a 24 hour period on a daily, working day, or alternate day basis. It can be set to operate from 6 AM to 8 PM, or 6 PM to 8 AM, to coincide with attended or unattended service and/or maintenance schedules.

The intermittent timer, when in operation, overrides the down time timer. Therefore, if the flare is extinguished and in the down timer mode when the intermittent timer goes to "on", the flare will attempt to automatically reignite. If it is not desired to operate on an intermittent cycle, this timer may be bypassed by simply switching it to "off".

\*\*\* MAIN HEADER VALVE INDICATORS \*\*\*

The automatic landfill gas header valve is equipped with position switches to indicate when fully closed and fully open.

The fully closed indicator is used as a permissive for automatic start.

\*\*\* KEY LOCK SWITCH \*\*\*

The controller utilizes a key lock switch as a primary safety, cutting the power supply to the panel in the locked position.

\*\*\* EMERGENCY SHUT-DOWN \*\*\*

An easily accessible emergency shut-down button is mounted on the face of the controller. Pushing the button will immediately shut-down the flare, stop the blower and shut the automatic header valve. The system will be locked out until the shut-down is manually reset.

\*\*\* TEMPERATURE RECORDER \*\*\*

The Flame-Trol II not only monitors and displays the flare chamber temperature but also constantly records this temperature on a chart type recorder. This feature allows the operator to maintain an accurate written record of all flare activity including; down time, day and time period the flare is burning, and operating temperature. Unless specified otherwise, the recorder will be a Honeywell or equal three channel recorder capable of charting operating temperature as well as two other parameters.

\*\*\* INDICATOR LIGHTS \*\*\*

The controller is equipped with indicator lights in the front panel to monitor all the operating functions. Through simple observation the operator can see what function is being performed at any given time without having to open the Flame-Trol II enclosure.

### **TOTAL MANUAL OPERATION OPTION**

The Flame-Trol II is equipped with a manual/off/auto switch which allows the operator to by-pass the automatic controls and operate the flare completely manually. All manual switches are isolated in an area together in the face of the controller, indicated by a different color background and labels.

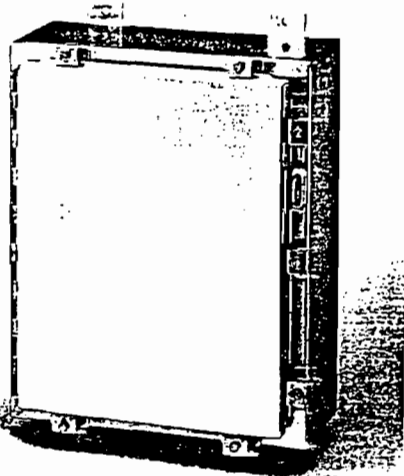
The selector switch must be turned to manual before any control switches in that section will operate. Manual switches include:

- Purge on/off
- Pilot by pass (manual valve)
- Ignitor button
- Blower on/off
- Header valve open/close

### **WARNING/ALARM OPTION**

The Flame-Trol II also has contact points which may be used for a local or remote warning device. A local warning device may be simply a horn, light, siren, etc. A remote warning device would require a phone line at the flare site and an automatic phone dialer.

**COMPONENT LITERATURE**



### Application

Designed to house electrical and electronic controls, instruments, and components in areas which may be regularly hosed down or are otherwise very wet.

### Construction

- 16 gauge bodies and 14 gauge doors Type 304 stainless steel on all sizes through 24.00x24; remaining (larger) sizes 14 gauge. Also Type 316 stainless steel.
- Type 316 stainless steel has the best corrosion-resistance of the standard stainless steels
- Seems continuously welded and ground smooth, no holes or knockouts
- Door and body stiffeners in large enclosures for extra rigidity
- Rolled lip around three sides of door and all sides or enclosure opening excludes liquids and contaminants
- Stainless steel door clamp assembly assures watertight seal
- Hasp and staple for padlocking
- Door removed by pulling stainless steel continuous hinge pin
- Removable and reversible steel print pocket
- Oil-resistant door gasket attached with oil-resistant adhesive and held in place with stainless steel retaining strips
- Collar studs provide for mounting optional panels
- All exterior hardware on Type 316 stainless steel enclosures is Type 316 stainless steel

### Finish

Enclosures are unpainted. cover, sides, top, bottom, and back have smooth brushed finish.

### Industry Standards

NEMA/EEMAC Type 3, Type 4, Type 4X, Type 12, and Type 13  
 UL 508 Type 4 and 4X  
 JIC standard EGP-1-1967  
 CSA Enclosure 4 (Specify CSA label when ordering)  
 IEC 529, IP66

### Accessories

Air Conditioners .....	3
Blowers .....	3
Electrical Interlocks .....	1
Fan Cooling Products .....	390. 3
Fast Operating Clamp Assembly .....	4
Heat Exchangers .....	380-3
Lighting Kit .....	410. 4
Panel Support Kit .....	4
Panels (See table)	
Rack Mounting Angle Kit .....	4
Swing-Out Panel Kit .....	4
Terminal Kit Assembly .....	4
Window Kit .....	4

## Standard Sizes - Type 304 Stainless Steel      Standard Sizes (Cont.)

### Single Door Stainless Steel NEMA 4X Enclosures

### Single Door Stainless Steel NEMA 4X Enclosures

Enclosure Catalog Number	Enclosure Size AxBxC	Panel Catalog Number	Panel Size DxE	Center Stiffener	H	Enclosure Catalog Number	Enclosure Size AxBxC	Panel Catalog Number	Panel Size DxE	Center Stiffener	H
A-16H1206SSSLP	16.00x12.00x6.00 (406x305x152)	A-16P12	13.00x9.00 (330x229)	Not Included	—	A-36H3008SSSLP	36.00x30.00x8.00 (914x762x203)	A-36P30	33.00x27.00 (838x686)	Not Included	9.00 (229)
A-16H2006SSSLP	16.00x20.00x6.00 (406x508x152)	A-20P16	17.00x13.00 (432x330)	Not Included	—	A-42H3608SSSLP	42.00x36.00x8.00 (1067x914x203)	A-42P36	39.00x33.00 (991x838)	Included	9.88 (251)
A-16H1606SSSLP	16.00x16.00x6.00 (406x406x152)	A-16P16	13.00x13.00 (330x330)	Not Included	—	A-48H3608SSSLP	48.00x36.00x8.00 (1219x914x203)	A-48P36	45.00x33.00 (1143x838)	Included	11.38 (289)
A-20H1606SSSLP	20.00x16.00x6.00 (508x406x152)	A-20P16	17.00x13.00 (432x330)	Not Included	—	A-20H1610SSSLP	20.00x16.00x10.00 (508x406x254)	A-20P16	17.00x13.00 (432x330)	Not Included	—
A-20H2006SSSLP	20.00x20.00x6.00 (508x508x152)	A-20P20	17.00x17.00 (432x432)	Not Included	—	A-24H2010SSSLP	24.00x20.00x10.00 (610x508x254)	A-24P20	21.00x17.00 (686x432)	Not Included	—
A-24H2006SSSLP	24.00x20.00x6.00 (610x508x152)	A-24P20	21.00x17.00 (533x432)	Not Included	—	A-36H2410SSSLP	36.00x24.00x10.00 (914x610x254)	A-36P24	33.00x21.00 (838x533)	Not Included	—
A-16H1208SSSLP	16.00x12.00x8.00 (406x305x203)	A-16P12	13.00x9.00 (330x229)	Not Included	—	A-36H3010SSSLP	36.00x30.00x10.00 (914x762x254)	A-36P30	33.00x27.00 (838x686)	Not Included	9.00 (229)
A-20H1608SSSLP	20.00x16.00x8.00 (508x406x203)	A-20P16	17.00x13.00 (432x330)	Not Included	—	A-42H3010SSSLP	42.00x30.00x10.00 (1067x762x254)	A-42P30	39.00x27.00 (991x686)	Included	9.88 (251)
A-20H2408SSSLP	20.00x24.00x8.00 (508x610x203)	A-24P20	21.00x17.00 (533x432)	Not Included	—	A-24H2412SSSLP	24.00x24.00x12.00 (610x610x305)	A-24P24	21.00x21.00 (533x533)	Not Included	—
A-24H1608SSSLP	24.00x16.00x8.00 (610x406x203)	A-24P16	21.00x13.00 (533x330)	Not Included	—	A-30H2412SSSLP	30.00x24.00x12.00 (762x610x305)	A-30P24	27.00x21.00 (686x533)	Not Included	—
A-24H2008SSSLP	24.00x20.00x8.00 (610x508x203)	A-24P20	21.00x17.00 (533x432)	Not Included	—	A-36H3012SSSLP	36.00x30.00x12.00 (914x762x305)	A-36P30	33.00x27.00 (838x686)	Not Included	9.00 (229)
A-24H2408SSSLP	24.00x24.00x8.00 (610x610x203)	A-24P24	21.00x21.00 (533x533)	Not Included	—	A-36H3612SSSLP	36.00x36.00x12.00 (914x914x305)	A-36P36	33.00x33.00 (838x838)	Not Included	9.00 (229)
A-24H3008SSSLP	24.00x30.00x8.00 (610x762x203)	A-30P24	27.00x21.00 (686x533)	Not Included	—	A-48H3612SSSLP	48.00x36.00x12.00 (1219x914x305)	A-48P36	45.00x33.00 (1143x838)	Included	11.38 (289)
A-30H2008SSSLP	30.00x20.00x8.00 (762x508x203)	A-30P20	27.00x17.00 (686x432)	Not Included	—	A-60H3612SSSLP	60.00x36.00x12.00 (1524x914x305)	A-60P36	57.00x33.00 (1448x838)	Included	14.38 (365)
A-30H2408SSSLP	30.00x24.00x8.00 (762x610x203)	A-30P24	27.00x21.00 (686x533)	Not Included	—	A-30H2416SSSLP	30.00x24.00x16.00 (762x610x406)	A-30P24	27.00x21.00 (686x533)	Not Included	—
A-30H3008SSSLP	30.00x30.00x8.00 (762x762x203)	A-30P30	27.00x27.00 (686x686)	Not Included	7.00 (178)	A-36H3016SSSLP	36.00x30.00x16.00 (914x762x406)	A-36P30	33.00x27.00 (838x686)	Not Included	9.00 (229)
A-36H2408SSSLP	36.00x24.00x8.00 (914x610x203)	A-36P24	33.00x21.00 (838x533)	Not Included	—	A-48H3616SSSLP	48.00x36.00x16.00 (1219x914x406)	A-48P36	45.00x33.00 (1143x838)	Included	11.38 (289)

Millimeter dimensions ( ) are for reference only; do not convert metric dimensions to inch.  
 \* Panels must be ordered separately. Optional aluminum and plywood panels are available for most sizes. See Accessories.

**Need More Information?**

- Chemical Resistance Chart ..... pg. 459
- Industry Standards ..... pg. 451
- Materials and Finishes ..... pg. 456
- Price List ..... pg. 10

**Modify to Your Specifications**

We can modify or customize this enclosure to your specs. See page 446 for more information.

**Standard Sizes - Type 316 Stainless Steel**

**Single Door Stainless Steel NEMA Type 4X Enclosures**

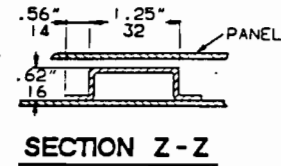
Enclosure Catalog Number	Enclosure Size AxBxC	*Panel Catalog Number	Panel Size DxE	Center Stiffener	H
* A-16H1206SS6LP	16.00x12.00x6.00 (406x305x152)	A-16P12	13.00x9.00 (330x229)	Not Included	—
* A-20H1606SS6LP	20.00x16.00x6.00 (508x406x152)	A-20P16	17.00x13.00 (432x330)	Not Included	—
* A-24H2008SS6LP	24.00x20.00x8.00 (610x508x203)	A-24P20	21.00x17.00 (533x432)	Not Included	—
* A-24H2408SS6LP	24.00x24.00x8.00 (610x610x203)	A-24P24	21.00x21.00 (533x533)	Not Included	—
* A-30H2408SS6LP	30.00x24.00x8.00 (762x610x203)	A-30P24	27.00x21.00 (686x533)	Not Included	—
* A-36H3008SS6LP	36.00x30.00x8.00 (914x762x203)	A-36P30	33.00x27.00 (838x686)	Not Included	9.00 (229)
* A-30H2412SS6LP	30.00x24.00x12.00 (762x610x305)	A-30P24	27.00x21.00 (686x533)	Not Included	—
* A-36H3012SS6LP	36.00x30.00x12.00 (914x762x305)	A-36P30	33.00x27.00 (838x686)	Not Included	9.00 (229)
* A-48H3616SS6LP	48.00x36.00x16.00 (1219x914x406)	A-48P36	45.00x33.00 (1143x838)	Included	11.38 (289)

Millimeter dimensions ( ) are for reference only; do not convert metric dimensions to inch.

\* Panels must be ordered separately. Optional aluminum and plywood panels are available for most sizes. See Accessories.

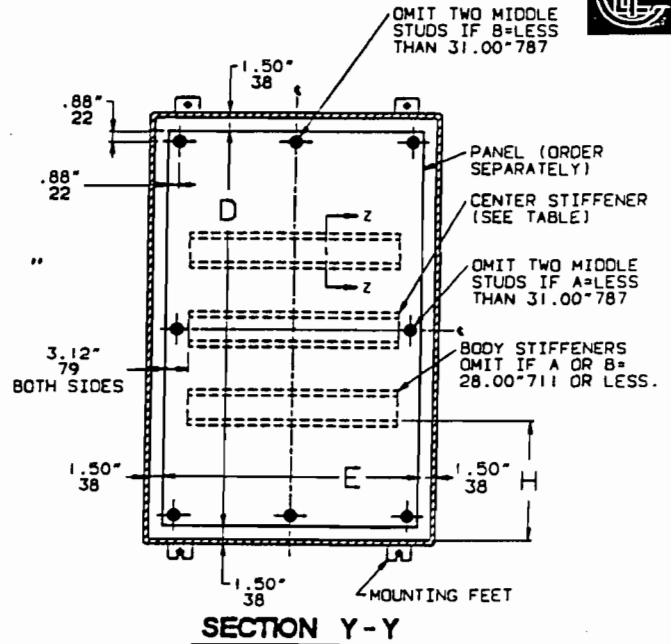
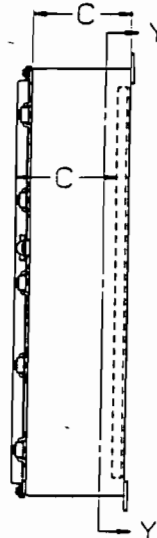
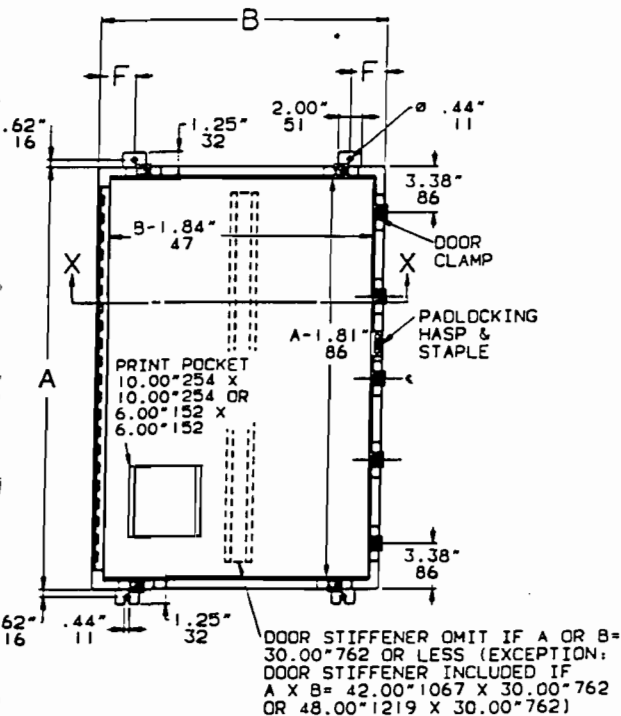
\* NEW CATALOG ITEMS

NOTE: F = 3.00 when B is 16.00 (406) or more. F = 1.25 when B is less than 16.00 (406).



C487-D  
Section B

SEE PAGE 69 FOR SECTION VIEW X-X



Inch  
Millimeters

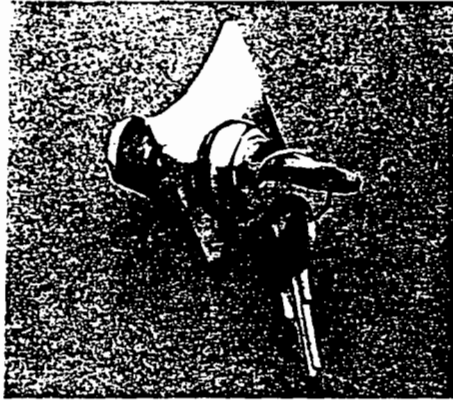


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Fax: 612-421-1556



## BEST AVAILABLE COPY

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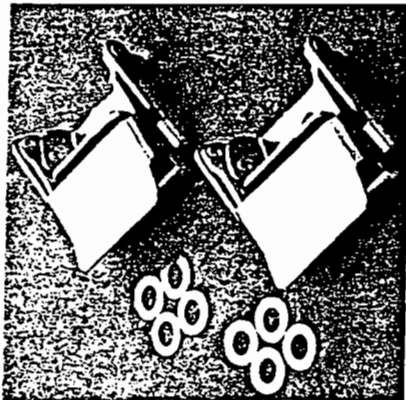
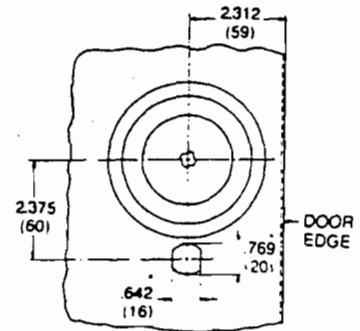


### Lock Kit for NEMA 1 Enclosures

Uses Type L12 cylinder lock in conjunction with the standard "T" handle. It is necessary to drill or punch one hole in the door to receive the cylinder lock. Complete installation instructions are furnished. Note: this lock kit will not fit Extra Large NEMA 1 Enclosures. Punches for locks and latches must be ordered separately (see page 420).

Catalog Number	Description
A-L12B	Lock kit for NEMA 1 enclosures

See price list for factory installation charges.

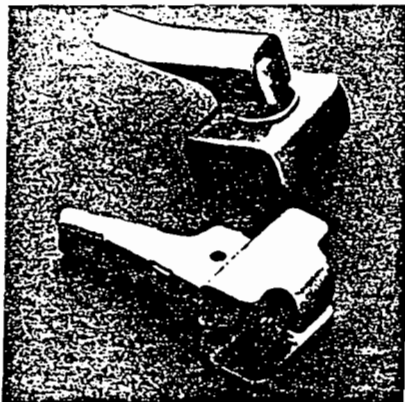


### Fast-Operating JIC Clamp

Provides quick access to enclosure or wireway interiors. Install on standard clamp bracket used on Hoffman JIC boxes, JIC troughs, oil-tight wireway, NEMA 4X wireway, and similar custom enclosures. Clamps are available in plated steel or stainless steel.

Catalog Number	Description	Quantity
A-L23	Plated steel clamp	1
A-L23SS	Stainless steel clamp	1

See price list for factory installation charges.

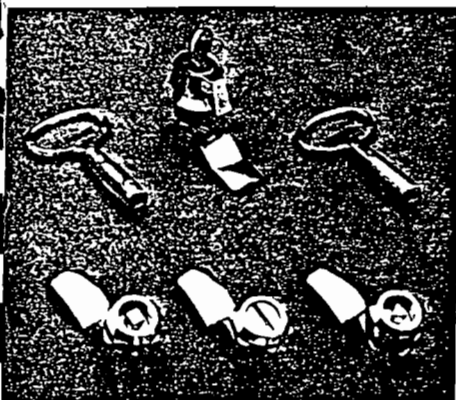


### Fast-Operating Clamp Assembly

Provides quick access to enclosures which have conventional screw clamps. Install on clamp brackets used on single door NEMA 4, 4X, 12 and EMVRFI enclosures as well as similar custom order enclosures. The entire clamp assembly is stainless steel.

Catalog Number	Quantity
A-FC412SS	2

See price list for factory installation charges.



### Latch Kits for NEMA 4 and 12 Enclosures

Fits NEMA 4 and 12 enclosures which have conventional external screw clamps. Requires only a quarter-turn (90°) to open or close. An internal O-ring and external gasket assures a water-tight and dust-tight seal. Installation requires a hole punched or drilled in the door for each latch. Complete instructions are furnished. A square or triangular key is required for tamper resistant latches. Latch is die-cast zinc with chrome finish. Punches for locks and latches must be ordered separately; see page 420 for ordering information.

Catalog number D-L36 is designed for field installation on all DesignLine enclosures except DesignLine Instrument Enclosures (Bul. D-1), DesignLine "DLB" Lift-Off Cover Quick-Release Latch Boxes (Bul. D-2), and DesignLine Disconnect Rack Enclosures (Bul. D-16). No modification required for installation.

Catalog Number	Description
A-L31	Slotted insert
A-L32	7mm square insert
A-L35	7mm triangle insert
* D-L36	Keylocking latch
A-L32Y	Key for A-L32
A-L35Y	Key for A-L35

\* NEW CATALOG ITEM

Top 1 to r: A-L32Y, D-L36, A-L35Y  
Bottom 1 to r: A-L32, A-L31, A-L35

C1001-C





4823 North Ridge Road Perry, Ohio 44081-9716  
 (216) 259-2500 FAX (216) 259-5015

**FINALLY A WIRE MARKER THAT MAKES SENSE**

Controls Unlimited can supply you with just what you need. We can apply up to eight, alphanumeric symbols per line to handle your PC numbering systems. Each line is repeated five times per marker.

We have no minimum order, fast delivery, and our marker is permanent! This marker is water and oil resistant for those tough industrial environments. Thanks to the advanced technology in adhesives there is no unwrapping. See reverse side for specs.

ORDERING INFORMATION

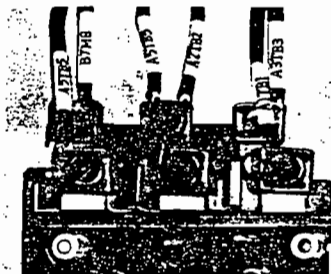
HOW TO ORDER:

1. List wording or numbering required for each marker.
2. List quantity next to wording of each marker.
3. Send this information along with your purchase order.
4. Please keep a copy of your list for reference.
5. Our Fax line is also accessible 24 hours a day.

PRICE:	<u>QUANTITY</u>	<u>EACH</u>	
	1 - 999	\$ .10	I010010
	1,000 +	\$ .08	I010010
	Blanks	\$ .05	I010010
	(Price subject to change without notice)		I010010
			I010010

ORDER FROM: Controls Unlimited, Inc.  
 4823 North Ridge Road  
 Perry, Ohio 44081-9716  
 216-259-2500

FAX 216-259-5015



12345678	12345678	12345678
12345678	12345678	12345678
12345678	12345678	12345678
12345678	12345678	12345678
12345678	12345678	12345678
ABC+---2	ABC+---2	ABC+---2
ABC+---2	ABC+---2	ABC+---2
ABC+---2	ABC+---2	ABC+---2
ABC+---2	ABC+---2	ABC+---2
ABC+---2	ABC+---2	ABC+---2
I010010	I010010	I010010
I010010	I010010	I010010
I010010	I010010	I010010
I010010	I010010	I010010
I010010	I010010	I010010

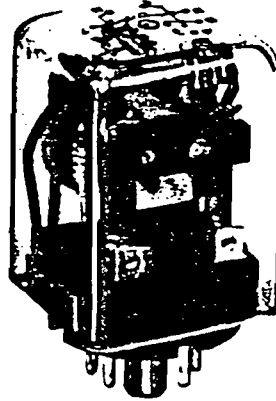


# Eagle Signal Control Relays

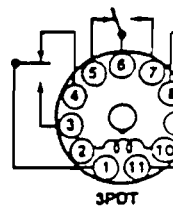
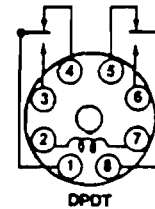
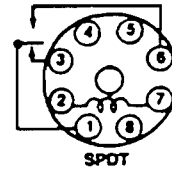
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## General Information

- Polycarbonate dust cover has low moisture absorption and high impact strength.
- Integral indicator light available.
- Polyurethane insulated magnet wire improves heat dissipation.
- Low level, gold diffused silver contacts optional.
- All standard configurations are recognized under the Component Program of U.L. Inc., File E39908. CSA certified by request only. File LR26861.



22 Series Enclosed  
Plug-In Relay



## Specifications

<b>Insulating Material:</b>	Phenolic/polycarbonate
<b>Dust Cover:</b>	Clear polycarbonate
<b>Coil Bobbin Material:</b>	Nylon
<b>Coil Winding:</b>	Polyurethane insulated magnet wire
<b>Insulation Resistance:</b>	100 Megohms minimum
<b>Dielectric Strength:</b>	500 Volts R.M.S. 60 Hz between open contacts. 1500 volts R.M.S. 60 Hz between all elements.
<b>Temperature Range:</b>	
<b>D.C.:</b>	-55° to +85°C (-67° to +185°F)
<b>A.C.:</b>	-55° to +72°C (-67° to +161°F)
<b>Life Expectancy:</b>	
<b>Mechanical:</b>	In excess of 20 million operations
<b>Electrical:</b>	100,000 minimum at full rated load
<b>Pull-In Speed:</b>	12 milliseconds typical (including bounce)
<b>Drop-out Speed:</b>	10 milliseconds typical (including bounce)
<b>Duty Cycle:</b>	Continuous
<b>Weight:</b>	Approximately 3 oz. (85 Gr.) all models

## Coil Specifications A.C. Coils

Rated Voltage 50/60Hz	1 and 2 Pole		3 Pole		Must Operate Volts Max
	DC Res. (Ohms) ± 10%	Average Current MA.* (60Hz)	DC Res. (Ohms) ± 10%	Average Current MA.* (60Hz)	
6	5	367	4.2	500	4.8
12	27	183	16.5	250	9.6
24	90	91.7	66	125	19
120	2250	18.3	1680	25	96
240	9100	9.2	6640	12.5	192

## D.C. Coils

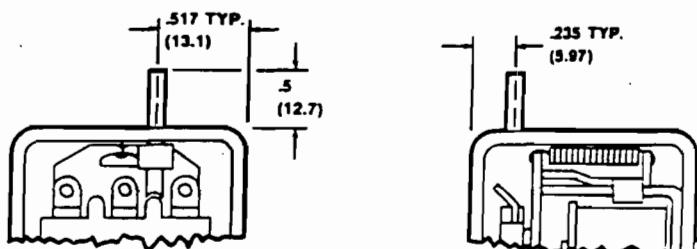
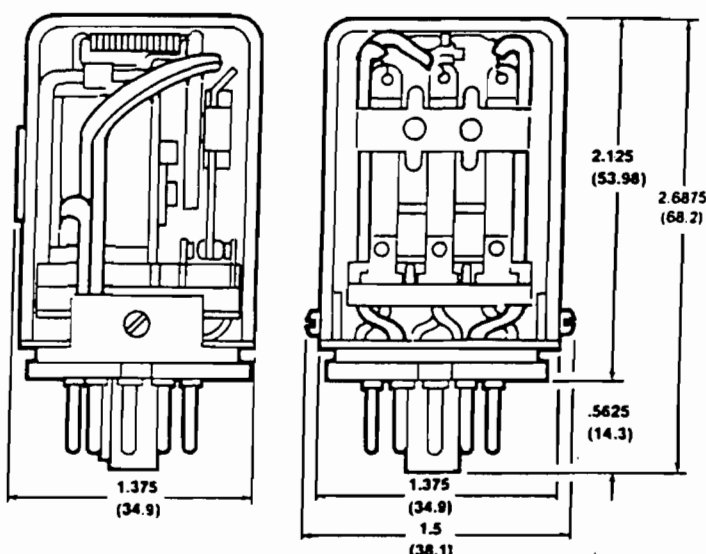
Rated Voltage 50/60Hz	1 and 2 Pole		3 Pole		Must Operate Volts Max
	DC Res. (Ohms) ± 10%	Average Current MA.* (60Hz)	DC Res. (Ohms) ± 10%	Average Current MA.* (60Hz)	
6	30	200	24	250	4.5
12	120	100	96	125	9
24	480	50	380	62.5	18
48	1920	25	1530	31.3	36
110	10100	10.9	8050	13.6	82

\* Average current values do not include indicating light current draw (Feature 02).

## Contact Rating

Materials	Rating
Fine Silver Gold Flashed (Ag)	5 Amp, 28 VDC (resistive) 5 Amp, 250 VAC, 125 VA, 120 VAC 1/10 HP, 125 VAC, 240 VA, 240 VAC 1/4 HP, 250 VAC
Silver Cadmium Oxide (AgCdO)	10 Amp, 28 VDC (resistive) 10 Amp, 250 VAC, 125 VA, 120 VAC 1/4 HP, 125 VAC, 240 VA, 250 VAC 1/3 HP, 250 VAC
Fine Silver Gold Diffused (AuAg)	Low level applications (Specify Feature 07)

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FEATURE 01 MANUAL OPERATOR

	Sockets	Retainers
1C	60SR2P05	60SR3B02F1
2C	60SR2P06	60SR3B02F1
	60SR2P51	60SR2P51F1
3C	60SR3P05	60SR3B02F1
	60SR3P06	60SR3B02F1
	60SR3P51	60SR2P51F1

**22 Series  
Ordering Information**



**Relay Type**

- 22P** General Purpose, enclosed, plug-in  
Heat treated fine silver,  
gold flashed 5 amp contacts.
- 22Q** General Purpose, enclosed, plug-in  
silver cadmium oxide 10 Amp contacts

**Contact Forms**

- 1C** - SPDT
- 2C** - DPDT
- 3C** - 3PDT

**Coil Voltage Type**

- A** - Alternating Current
- D** - Direct Current

**Features**

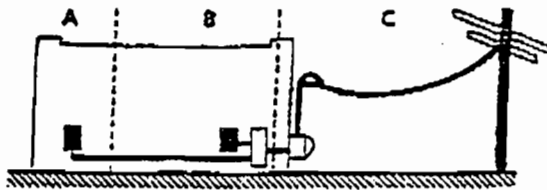
(More than one feature may be specified.)

- 00 (or blank)** - Standard relay
- 01** - Manual (push-to-test) operator
- 02** - Indicating light (except 48 volt)
- 07** - Low level, gold diffused  
fine silver, heat treated contacts.  
(22P Series Only)

**Rated Voltages**

- 006** - 6 Volts (AC or DC)
- 012** - 12 Volts (AC or DC)
- 024** - 24 Volts (AC or DC)
- 048** - 48 Volts D.C.
- 110** - 110 Volts D.C.
- 120** - 120 Volts A.C.
- 240** - 240 Volts A.C.

SECONDARY AC POWER LINE PROTECTION



ANSI/IEEE C62-41-1980 Location Categories:

- A. Outlets and Long Branch Circuits
- B. Major Feeders and Short Branch Circuits
- C. Outside end Service Entrance

SECONDARY SURGE ARRESTERS

For Category "C" ■ Service Entry Locations, installed per NEC ▼ Article 280

Description	Catalog Number	Price	Current		
			1,500A	5,000A	10,000
Typical Clamping Voltage					
175Vac Phase to Ground Maximum Two or Three Wire Grounded Service (120V or 4W Systems) Without Indicator ●	SP1175	\$ 39.00	600V	1000V	1500V ◆
With Indicator ●	SP1175I	45.00	600V	1000V	1500V ◆
650Vac Phase to Ground Maximum Three or Four Wire Grounded Services (120V, 240V or 4W Systems) Including mounting bracket Without Indicator	SP3650	103.00	1800V	2500V	3400V ◆
With Indicator	SP3650I	118.00	1800V	2500V	3400V ◆

▼ NEC is a registered trademark of the National Fire Protection Association  
 ● Two 175V surge arresters may be installed to protect 208Y/120Vac 3Ø-1W grounded services  
 ◆ Voltage shown with units having 18" lead length. Performance values will be improved by 200V per 6" reduction in lead length.  
 ■ Can also be installed in category "B" locations.  
 UL Listed 6J54 File No. E121482



SP1175



SP3650

- **What is the rating of SPX's external fuse?**

The withstand rating of the fuse is 35-50 amps at continuous current.

- **What test parameters do we use to design the fusible link?**

The fusible link is designed to withstand multiple transients at 10,000 A, 8/20 $\mu$ s waveform.

- **What type of wire is used on SP1175?**

14 AWG stranded PVC, 600V insulation.

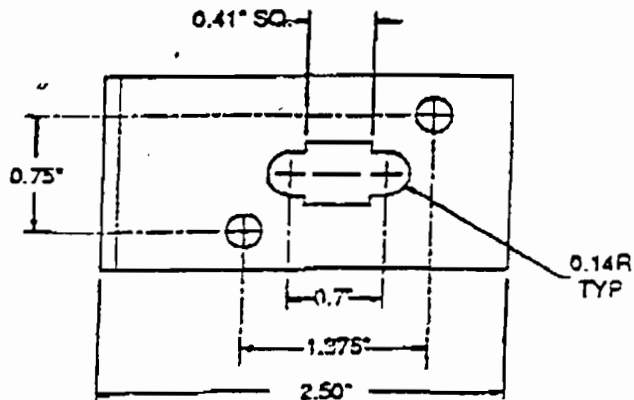
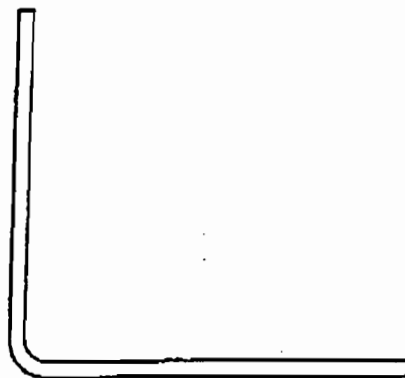
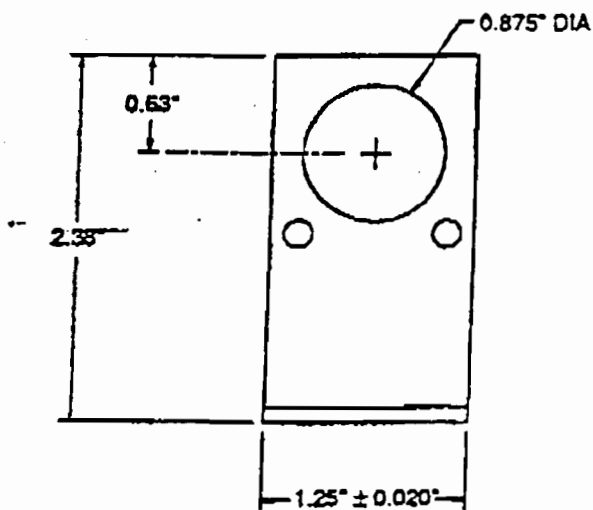
- **Where should the SP1175 be wired-in?**

The SP1175 is installed on the load side of the main breaker, preferably inside the panel.

- **On which side of the service entrance box should the device be placed?**

Wherever the device can fit in the breaker panel with the shortest leads.

- **What are the dimensions of the SP3650 mounting bracket?**



# SPX Series Q & As

- *What is the difference in technology between Square D's SPX series and the previous J9200 series?*

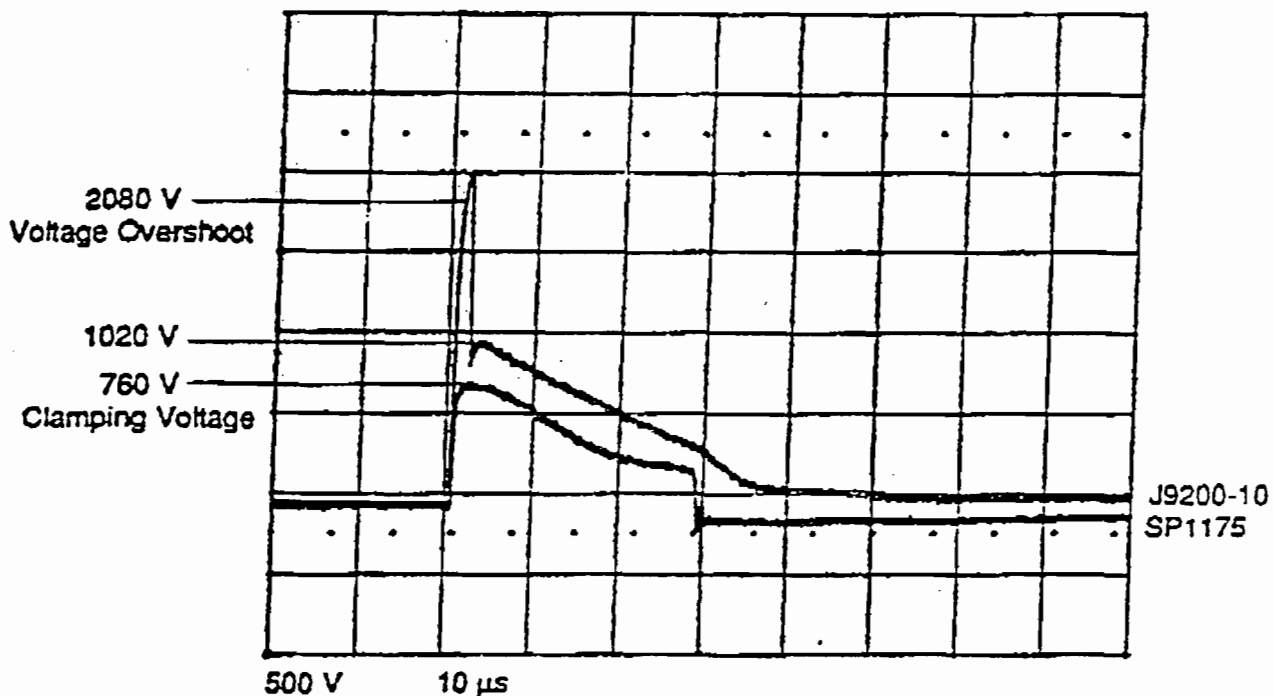
## J9200 Series

This arrester has an air gap structure in series with a silicon carbide block. When the voltage across the device is sufficiently high, the gap flashes over allowing the surge current to flow. This current is limited by a resistive block in series with the gap. This block allows the gap to recover when the AC line voltage approaches zero, thus returning the arrester to its non-conducting state. This flash-over is dependent on how fast the transient is, thereby allowing significant voltage overshoot. This voltage shoot may be hundreds of volts higher than the manufacturer's specified clamping voltage.

## SPX Series

This arrester is based on metal oxide varistor (MOV) technology. The varistor is a continuous block of material unlike the J9200's gap structure. The MOV has high energy handling capability with a substantially low clamping voltage. Absence of a gap allows the arrester to conduct immediately upon application of a voltage above the nominal varistor voltage. The MOV device without the gap structure has little dependence on the characteristics of the transient (i.e., how fast the transient is), thus allowing it to have a very minimum overshoot.

In comparing the two devices, the SPX series has several advantages over the J9200 series. Due to the high flash-over voltage, the J9200 arresters cannot "see" the lower voltage transients that would be clamped by the SPX products. The SPX series will respond more quickly since it is not dependent on the rise time of the transient (see figure below).

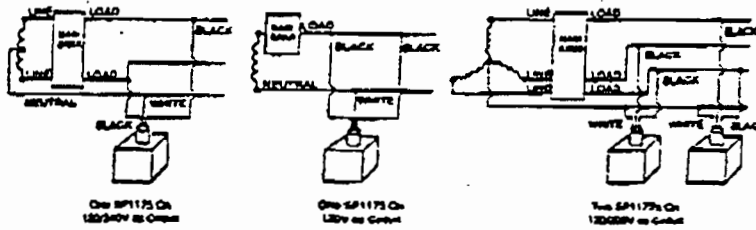


- *What is the fusible link in the SP3650 designed to do?*

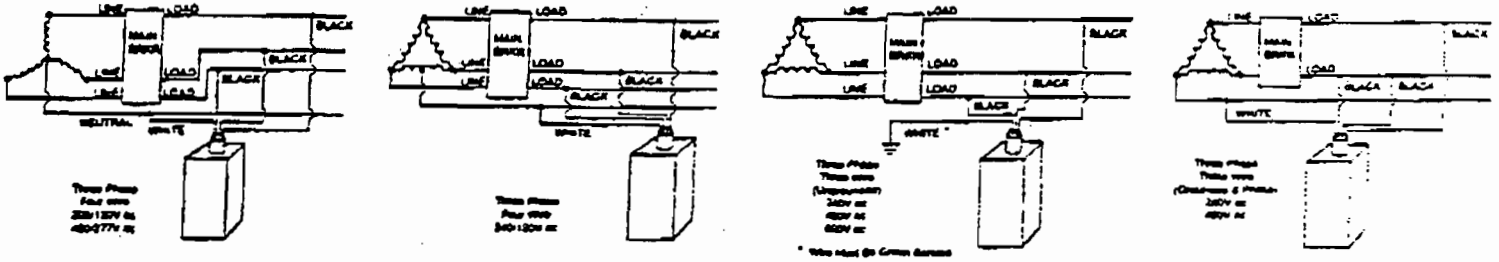
The SP3650 is a varistor-based unit. Varying amplitudes of transients occur with some probability. Stronger transients can overload a protector. Overloads result when transients exceed a device's rating. Overloads cause localized heating in varistors which can fuse adjacent elements, resulting in a lowering of the protector's stand-off voltage. Over time, overloads may force the protector's stand-off voltage to decrease to the line voltage, initiating a leakage current and internal heating. If these end-of-life conditions are reached, thermal runaway drives the device to a near short, currents rise significantly, and the fusible link opens, avoiding a hard short and its possible effects on the AC line.

• *What are the wiring diagram options for the SP1175 and SP3650?*

SP1175 WIRING DIAGRAMS



SP3650 WIRING DIAGRAMS



• *Is there any way to test these parts?*

By testing the arrester's resistance and capacitance, it can be shown whether or not the fusible links are open and whether the arrester can be considered to be in working order. To do these tests, the arrester must be disconnected from the AC power lines. The white wire of the arrester should be connected to one probe of a capacitance meter. Each black wire should be connected in turn to the other probe of the meter and the capacitance observed. If a fusible link is open, the capacitance measured will be the stray capacitance of the wires, just a few picofarads. If the link being checked is still intact, observed capacitance will be significant. For a new SP1175, typical values will be about 6,000 picofarads, while 2,000 picofarads will be typical for an SP3650. The measured value of a good device would be expected to decrease with aging. However, it would still be thousands of picofarads, rather than a value typical of stray capacitance of adjacent unconnected wires.



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### 1. INTRODUCTION

The MAQ type controller is a microprocessor based, single zone temperature controller from Barber-Colman Company featuring Touch-Tune™ automatic tuning, auto/manual select, "load line" adjustment, sensor offset, a setting "lock" function, and power failure memory, as well as complete setup and configuration from the front of the instrument.

Options include a choice of alarm functions (including a Standby function), internal INSTA-SET™ Memory, process variable output or percent output, and RS-485 digital communications.

MAQ6-6 temperature controllers come from the factory already calibrated. All that is necessary to be done is to mount and wire the controller, enter the control setpoints and tune the controller.

Setpoint entry is straightforward and the displays are easy to read. This instruction manual contains all the necessary information for installing and using MAQ6-6 controllers. Refer also to the MAQ6-6 Data Bulletin (1251/DB12) and the MAQ6-6 Price List (1251/PL12).



## 1.2 THE KEYS

Note that keystrokes to access modes and displays on the MAQ6-6 differ slightly from other MAQ controllers.

### INCREASE KEY

Used to increment the SV display.

### DECREASE KEY

Used to decrement the SV display.

### FAST KEY

Simultaneously pressing this key and the increase or decrease key will cause the setting value to change at a faster rate.

### MODE KEY

Used to select the temperature setting mode. Simultaneously pressing the mode key and the Up arrow key selects the auxiliary mode. PV display will indicate the function. SV display will show setting value of the particular function.

### AUXILIARY MODE KEY

Simultaneously pressing this invisible key and the mode key selects the basic setting mode. Once in the basic setting mode, pressing the mode key will step the controller through the functions. Mode display will indicate the function. SV display will show

setting of the particular function.

Pressing the auxiliary mode key, the fast key, and the mode key (and holding for 3 seconds) selects the feedback pot adjusting mode. Refer to Section 5 for specific instructions.

### AUTO-TUNING KEY

Pressing this key and the auxiliary mode key causes auto-tuning to be performed. Once auto-tuning is complete (Yellow AT LED goes OFF), the tuning values are stored in memory. To retune, press the auto-tuning key and mode key a second time.

To reset the auto-tune constants to default values (or previously entered constants before auto-tuning was started), press the auto-tuning key and mode key. With the AT LED still blinking, press the auto-tuning key and mode key a second time. Refer to Section 6 for specific instructions.

### AUTO/MANUAL KEY

Pressing this key with PV and SV displayed, toggles the controller between automatic (PID) control and manual control. The red "MAN" LED is lit in the manual mode and the SV display indicates percent output. Percent output can be adjusted using the Up and Down arrow keys.

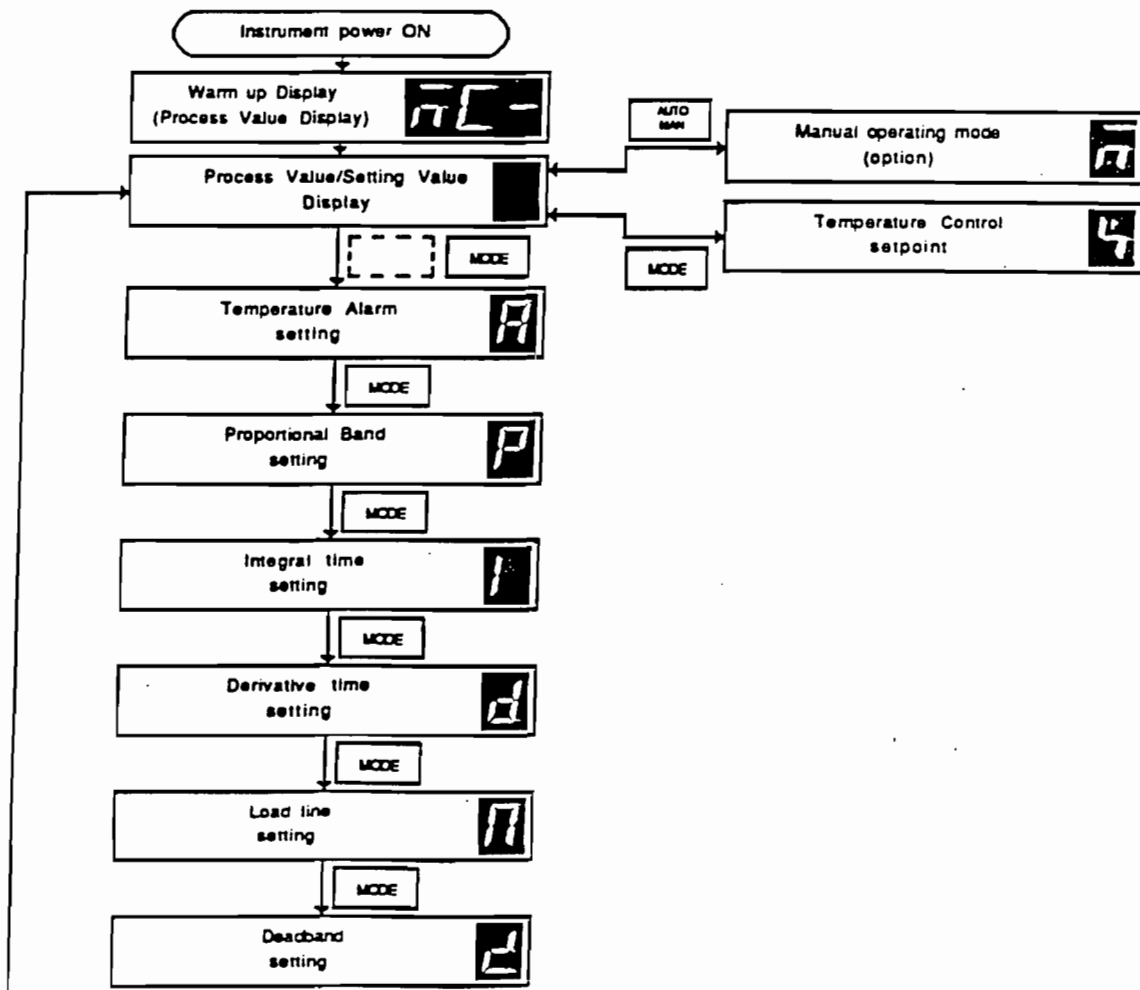



Figure 2. Basic Setting Mode


### Proportional Band Setting

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	PB Setting	Process Temperature

The range is 0.1% to 200.0% of the scaling value.

Use the arrow keys to change the setting. Press the mode key to enter the setting and step to the next function.

### Integral Time Setting


MODE DISPLAY	SV DISPLAY	PV DISPLAY
	Integral Time Setting	Process Temperature

The range is 0 to 3600 seconds.

Setting the integral to zero disables the function.

Use the arrow keys to change the setting. Press the mode key to enter the setting and step to the next function.

### Derivative Time Setting


MODE DISPLAY	SV DISPLAY	PV DISPLAY
	Derivative Time Setting	Process Temperature

The range is 0 to 1800 seconds.

Setting the derivative to zero disables the function.

Use the arrow keys to change the setting. Press the mode key to enter the setting and step to the next function.

### Load Line Setting

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	Load Line Setting	Process Temperature


The range is 0% to 100%

A Load Line entry helps prevent overshoot caused by "reset windup".

When operating in the Manual control mode, an entry matching the duty factor of the load can be used.

Use the arrow keys to change the setting. Press the mode key to enter the setting and step to the next function.


### Deadband Setting

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	Deadband Setting	Process Temperature

The range is from 1% to 100% of PB Span.

Use the arrow keys to change the setting. Press the mode key to enter the setting and step to the next function.

### Manual Output Mode

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	Manual Output Setting	Process Temperature

The controller must be in the PV/SV display mode. Auto or Man control will be indicated by the LED display on the instrument.

The range is from 0% to 100%.

If output high and low limits have been set, the range will be limited to those settings.

Use the arrow keys to change the setting.

### 3. AUXILIARY SETTINGS

With the PV/SV display showing, simultaneously press (and hold for 3 seconds) the Up arrow key and the mode key.

For initial power up, refer to Table 1 for the "as shipped" setting values. Once the controller is in the auxiliary mode, pressing the mode key allows the setting values to be examined or changed.

Use the arrow keys (and the "Fast" key) to change the setting values. Pressing the mode key enters the displayed value and steps the controller to the next function.

#### NOTE:

After approximately 30 seconds without a keystroke, the controller will read in and use the setting displayed in the SV display EVEN IF THE MODE KEY HAS NOT BEEN PRESSED.

Make certain the desired value is on the display before pressing the mode key or leaving the controller unattended.

#### Setting Value Lock

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	--	Loct

Use the arrow keys to lock or unlock the BASIC setting values. Press the mode key to enter the setting and step to the next function.

The display shown above indicates the setting values are UNLOCKED. The temperature setpoint and any of the setting values in the basic setting mode or auxiliary setting mode can be changed from the front of the controller.

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	Loc 1	Loct

The display shown above indicates the setting values are LOCKED.

None of the basic setting mode functions can be changed.

Auto-Tuning will not occur.

Auto/Man will function.

Auxiliary setting functions can be changed.

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	Loc 2	Loct

The display shown above indicates the setting values are LOCKED EXCEPT FOR THE TEMPERATURE CONTROL SETPOINT.

None of the other basic setting mode functions can be changed.

Auto-Tuning will not occur.

Auto/Man will function.

Auxiliary setting functions can be changed.

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	Loc 3	Loct

The display shown above indicates the setting values are UNLOCKED. HOWEVER, all changes made to the setting values after the controller was placed in the "LOC3" position WILL BE LOST IF POWER TO THE CONTROLLER IS INTERRUPTED.

Auto-Tuning will not occur.

Auto/Man will function.

Auxiliary setting functions can be changed.

#### Scaling High Limit

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	Scaling High Limit (see Table 2)	4FLH

The range will depend on the input the controller has been configured to use (refer to Table 2).

Use the arrow key to change the setting. Press the mode key to enter the setting and step to the next function.

#### Scaling Low Limit

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	Scaling Low Limit (see Table 2)	4FL

The range will depend on the input the controller has been configured to use (refer to Table 2).

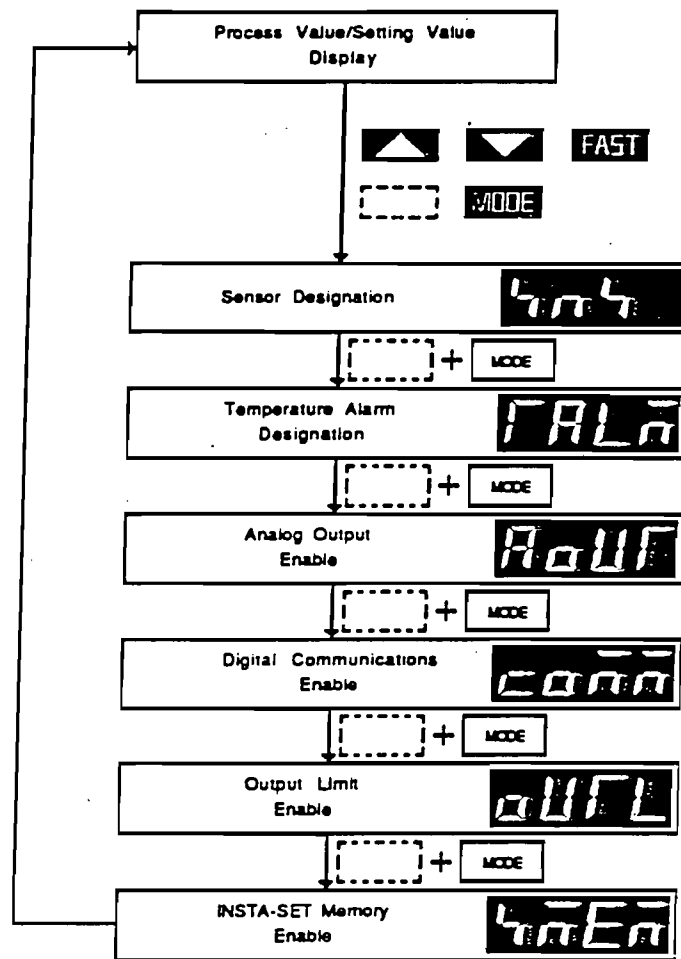


Figure 4. Configuration Mode

for BOTH the original and the new sensor are retained in memory. Section 8 shows the calibration sequence. Note that changing between degrees C and degrees F (with the same sensor type, e.g. Type K thermocouple) does NOT require recalibration.

Use the arrow keys to scroll to the desired sensor. Pressing the mode key and the invisible key will enter the new sensor type and step the controller to the next configuration. Pressing the mode key by itself will enter the new sensor type and return the controller to the PV/SV display.

### Temperature Alarm Designation

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	Temperature Alarm Type (see Table 4)	ALARM

The PV display shown above indicates the controller is in the temperature alarm designating mode.

The actual alarm type being used will be shown in the SV display (see Table 4). If the hardware is present, any of the alarm types shown may be selected. Use the arrow keys to scroll to the desired alarm. Pressing the mode key and the invisible key will enter the new alarm type and step the controller to the next configuration. Pressing the mode key by itself will enter the new alarm type and return the controller to the PV/SV display.

**CAUTION:** Hardware is required in order to add the alarm function. The software can be configured to operate the front panel LED, but the relay and terminals are required for proper operation.

### Analog Output Enable

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	POUR	POUR

Use the arrow keys to toggle the SV display. The PV/SV display shown above indicates the transmitting output is enabled. If the hardware is present and the SV display appears as above, an output (4 to 20 mA) representing the process value temperature will be present at Terminals 23 and 24.

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	POUR	POUR

If the SV display appears as above and hardware is present, a 4 to 20 mA output representing the Percent Output will be present at Terminals 23 and 24.

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	--	POUR

If the SV display appears as shown above (whether or not the hardware is present), the transmitting output will not function.

Pressing the mode key and the invisible key will enter the new analog output type and step the controller to the next configuration. Pressing the mode key by itself will enter the analog output type and return the controller to the PV/SV display.

### Communications Enable

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	U4E	COMM

Use the arrow keys to toggle the SV display. The PV/SV display shown above indicates digital communications is enabled. If the hardware is present and the SV display appears as above, the RS-485 digital communications will function (see 1251/IN 14).

ALARM TYPE	SV DISPLAY	ALARM TYPE	SV DISPLAY
NONE		HIGH DEVIATION ALARM with STANDBY FUNCTION	
HIGH DEVIATION ALARM		LOW DEVIATION ALARM with STANDBY FUNCTION	
LOW DEVIATION ALARM		DEVIATION BAND ALARM (deenergized within the Band) with STANDBY FUNCTION	
DEVIATION BAND ALARM (deenergized within the Band)		PROCESS ALARM (ABSOLUTE VALUE)	
DEVIATION RANGE BAND ALARM (energized within the Band)			

Table 4. Alarm Designation Characters

position (the SV display will stabilize) press the Up arrow key a second time.

### Close Adjustment

Press the Down arrow key one time. The Close output LED will light and the actuator will run to the close position. Once the actuator reaches the full close position (the SV display will stabilize) press the Down arrow key a second time.

Press the mode key to return to the PV/SV display.

## 6. USING TOUCH-TUNE™

Pressing the invisible key and the "AT" key causes the controller to automatically set values for the proportional band, integral, derivative, and loadline.

Note that the controller must be unlocked (--) for autotuning to function.

In order to determine proper tuning constants, the controller introduces a fluctuation to the process.

Depending on the relationship of the setting value to the process temperature, the controller chooses from three different types of fluctuation:

If the process temperature is greatly less than the setting value, the fluctuation is introduced as the process temperature approaches the setting value from below. This method prevents the temperature from exceeding the setting value and is best suited for systems with short lag times.

If the process temperature is close to the setting value, the fluctuation is introduced at the setting value. This method allows for smaller temperature deviations and is best suited for systems with long lag times.

If the process temperature is much greater than the setting value, the fluctuation is introduced as the process temperature approaches the setting value from above. This method is best suited for cooling (direct) action.

Use the descriptions above as GENERAL guidelines on when to initiate the auto-tuning process.

ALWAYS observe controller response until you are certain the process is at temperature and stable.

**NOTE:** If load conditions change, it may be necessary to retune the controller. Be certain to observe controller response during changing load conditions.

Pressing the invisible key and the AT key causes auto-tuning to be performed. The AT light blinks to indicate tuning is being performed and turns off once tuning is completed.

To retune the controller, press the invisible key and the AT key a second time.

To reset the tuning constants to default values, press the invisible key and the AT key. With the AT LED still blinking, press the invisible key and the AT key a second time.

## 7. USING INSTA-SET™ MEMORY

The optional Insta-Set memory provides for storage of as many as eight sets of temperature control data (control setpoint, tuning constants, load line setting, temperature alarm settings, and deadband setting).

Individual recipes are called by external switch selection. A MACS switch unit is available for connecting as many as 49 separate controllers.

To use the memory function, connect the MACS switch unit (or other suitable device) to Terminals 8, 9, 10, and 11 on the rear of the controller. The switch is used to connect various combinations of Terminals 8, 9, and 10 to the memory common, Terminal 11 (the switching scheme is shown in Figure 6).

To store Insta-Set #1, select Switch 1 (Terminals 8, 9, and 10 open). A "1" will be displayed on the front of the instrument. Enter the first set of control setpoints and they will automatically be saved as Insta-Set #1.

To store Insta-Set #2, select Switch 2 (Terminal 8 connected to Terminal 11). A "2" will be displayed on the front of the instrument. Enter the second set of control setpoints and they will automatically be saved as Insta-Set #2.

Etcetera.

The Insta-Set number displayed on the front of the instrument indicates the control setpoints currently in use by the controller.

When control setpoints are entered, those setpoints will automatically be stored in the Insta-Set number then appearing on the front of the instrument.

The Insta-Set number CANNOT be changed while in the Setting modes (Basic or Auxiliary) or while Auto-Tuning is being performed.

Adjust the output of the millivolt source to the high scale limit of the sensor type being used. Use the arrow keys to adjust the meter to read 20.00 mA.

Pressing the mode key while holding in the invisible key will enter the value and step the controller to the next adjustment.


Note that SV display IS NOT used during the Process Variable Output calibration. Ignore any numbers appearing on the SV display.

#### Percent Output Zero Adjust

If the Percent Output is being calibrated, before calibrating, set the proportional band to 0.1 and the control setpoint to the middle value of the sensor being used.

Note that this explanation assumes heating (reverse) action on Output 1.

Return to the calibration mode. Keep the invisible key depressed and use the mode key to step to the Analog Output Zero Adjust display.


MODE DISPLAY	SV DISPLAY	PV DISPLAY
	Use Milliammeter Display	AAE

Adjust the output of the millivolt source to the HIGH scale limit of the sensor type being used. Use the arrow keys to adjust the meter to read 4.00 mA.

Pressing the mode key while holding in the invisible key will enter the Zero value and step the controller to the Span adjustment.

Note that SV display IS NOT used during the Percent Output calibration. Ignore any numbers appearing on the SV display.

#### Percent Output Span Adjust

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	Use Milliammeter Display	AA4


Adjust the output of the millivolt source to the LOW scale limit of the sensor type being used. Use the arrow keys to adjust the meter to read 20.00 mA.

Pressing the mode key while holding in the invisible key will enter the value and step the controller to the next adjustment.

Note that SV display IS NOT used during the Process Variable Output calibration. Ignore any numbers appearing on the SV display.

#### Feedback Pot Adjustment

Note that this is the same procedure described in Section 5. Make certain the feedback potentiometer is connected to the proper terminals at the rear of the controller (Terminal 25 is Open; Terminal 26 is Wiper; Terminal 27 is Close).

MODE DISPLAY	SV DISPLAY	PV DISPLAY
	Feedback Display 255 = Open 0 = Closed	AE4-

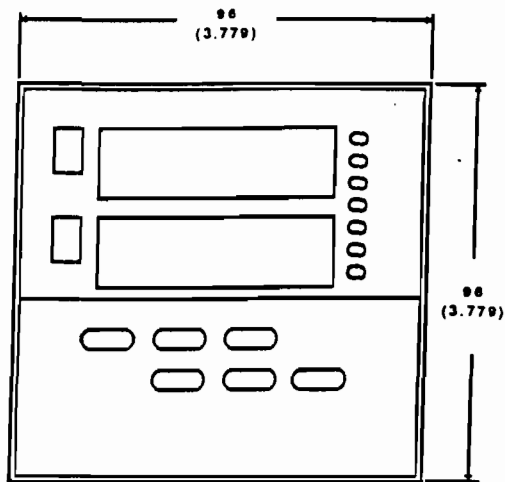
#### Open Adjustment

Press the Up arrow key one time. The Open output LED will light and the actuator will run to the open position. Once the actuator reaches the full open position (the SV display will stabilize) press the Up arrow key a second time.

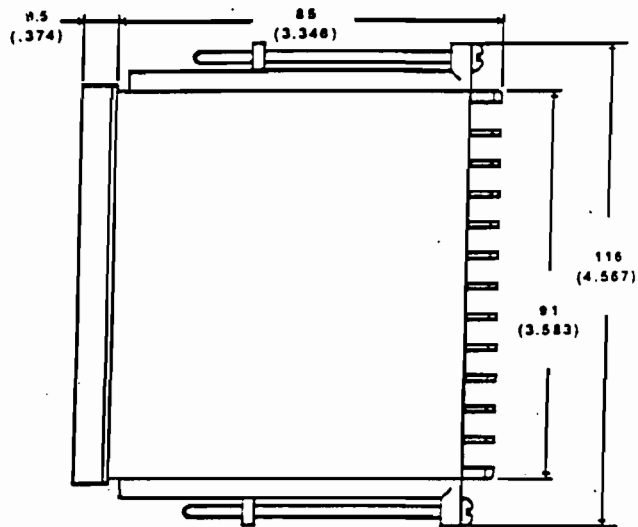
#### Close Adjustment

Press the Down arrow key one time. The Close output LED will light and the actuator will run to the close position. Once the actuator reaches the full close position (the SV display will stabilize) press the Down arrow key a second time.

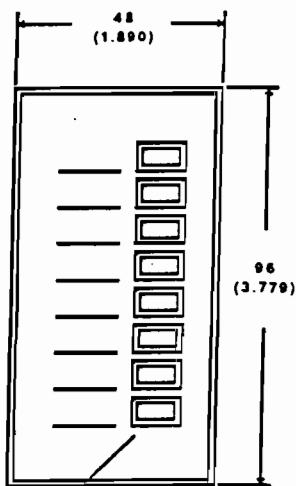
Press the mode key to return to the PV/SV display.



MAQ

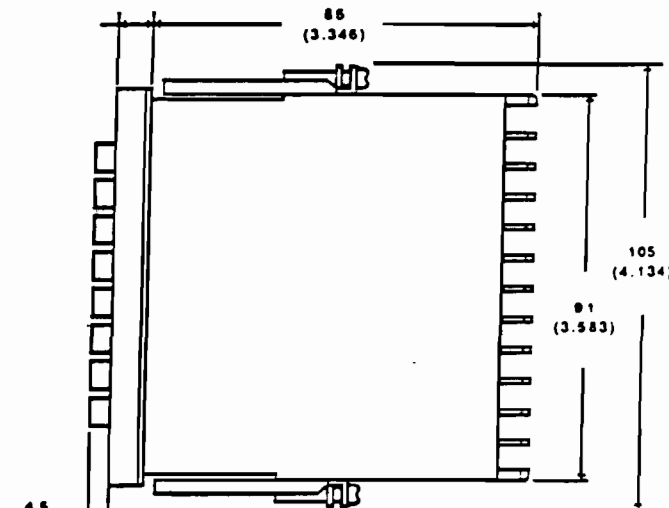


MAQ Panel thickness 1 to 15 mm (.039 to .591)



MACS

8 pushbutton selector switches



MACS Panel thickness 1 to 8 mm (.039 to .315)

All dimensions are in millimeters with inches following in ( ).

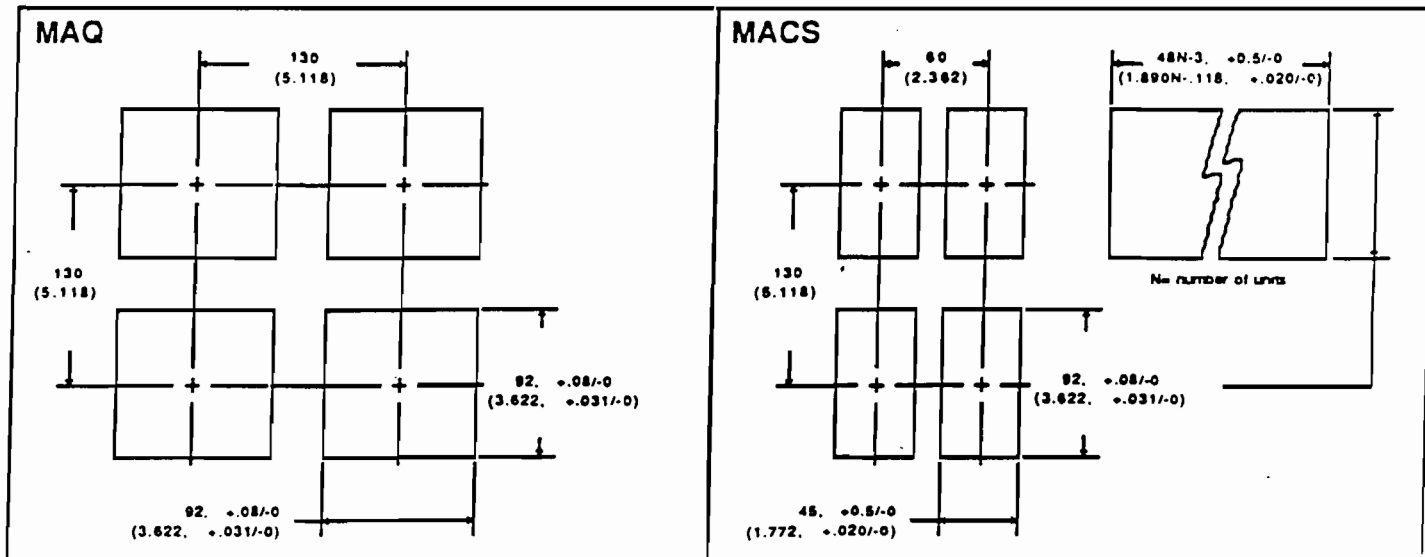
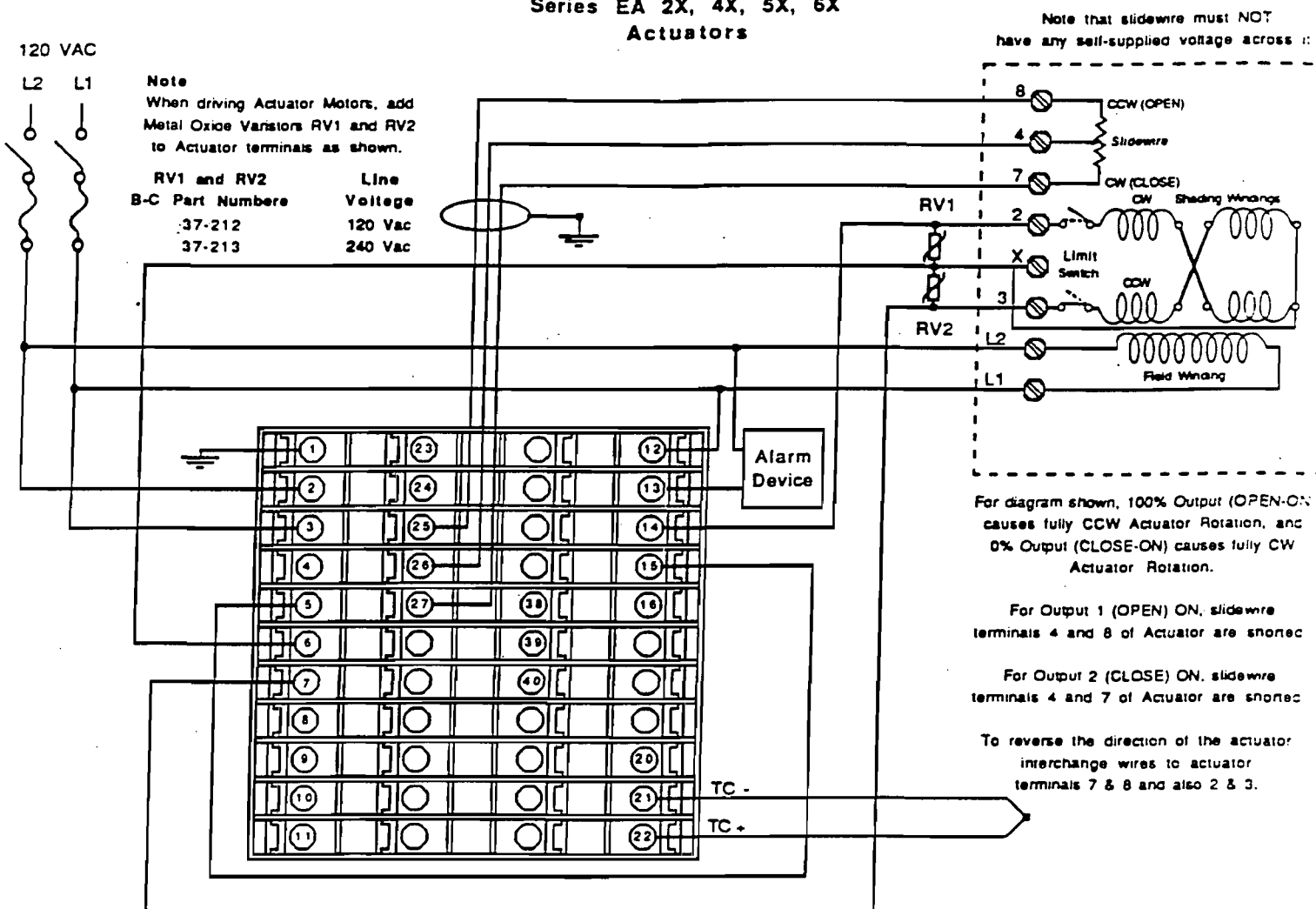


Figure 5. Cutout & External Dimensions



# Output Wiring for MAQ6-6 Electric Actuator Positioning Controller (Reverse Acting)

**Barber-Colman  
Series EA 2X, 4X, 5X, 6X  
Actuators**



**Memory Number  
Terminal Connections**

1		5	
2		6	
3		7	
4		8	

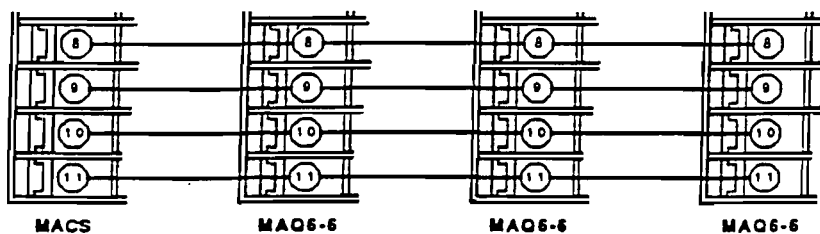
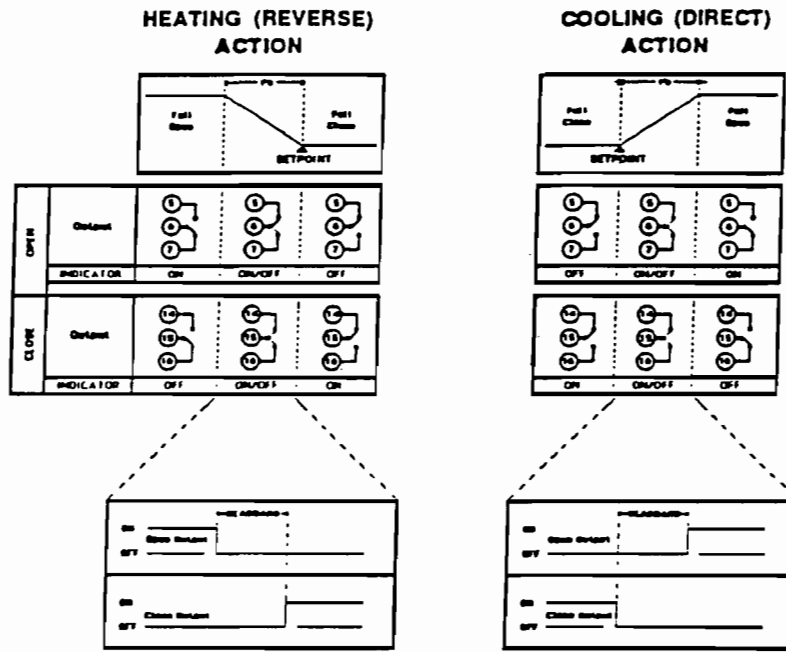
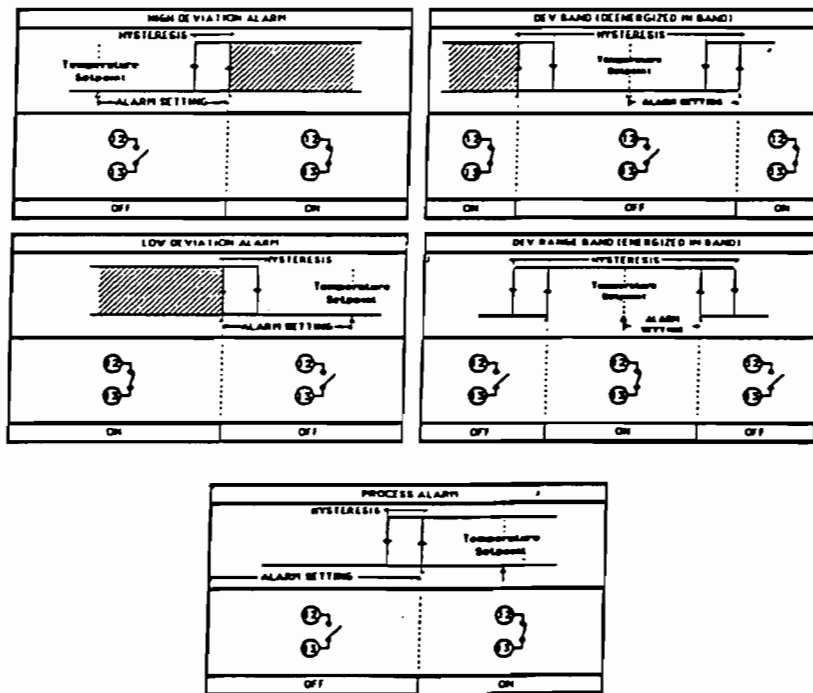


Figure 7. Sample Wiring Using BC Series 2X, 4X, 5X, 6X Actuators



Temperature Control Output



Temperature Alarm Output

Note the shaded areas indicate the location of the Standby function.

Figure 8. Output Action Description



## GE Push Buttons

# CR104P Heavy-Duty Push Buttons

600 Volts Maximum AC/DC  
10 Amperes Continuous



### Description

Standard and illuminated push buttons and selector switches are available. Both push buttons and selector switches are available with key or for conventional operation. The CR104P push-button line also includes press-to-test and standard indicating lights, mushroom head, joy stick, push-pull and push-push operators.

Chrome-plated octagonal rings project an attractive, quality appearance. Positive feel selector switches give a quality touch in all illuminated, solid color, spring return, and maintained units.

### Application

Especially adapted to machine-tool service or any application where oil or coolant is present. The convenient one-hole mounting makes this line suitable for general purpose use in equipment of all kinds where panel mounting is possible. This line is ideal for applications where oillightness, watertightness and long life are essential.

All units are suitable for use in NEMA Type 1, 3, 3R, 4, 4X<sup>①</sup>, 12 and 13 applications when mounted in enclosures rated for those same applications.<sup>②</sup>

- ① Although not needed on all Type 4X applications, protective caps provide improved resistance to some corrosive materials. They are not required by UL.
- ② CR104PTP units are suitable for Type 1, 12, and 13 applications only.
- ③ Maximum make and break currents are 60 and 6 Amperes respectively for voltages of 120 and below.

### Features

- **Ease of assembly**—one screw contact block mounting. Octagonal ring provides ease in front panel mounting and enclosure applications.
- **Greater torque**—due to the eight-sided ring design, greater torque can be developed during assembly and installation to provide oillightness.
- **Stocking inventories reduced**—forms may be furnished as complete units or as components, allowing building block construction from a minimum of stock.
- **Color Coded**—colored knobs and caps are available in kit forms for easy field conversion.

### Ordering Directions

Order by complete Catalog Number. Example: CR104PBG91B1 at **\$34.20, GO-10G**. To order complete devices, see information on pages 7-3 through 7-19. Catalog Number and price do not include nameplate. All nameplates must be ordered as a separate item from pages 7-26 and 7-27.

### Contact Ratings - Standard Contact Blocks AC Ratings, NEMA A600 Heavy Pilot Duty

Maximum AC Voltage	Continuous Current Amperes	AC Voltamperes @ 60/50 Hertz <sup>①</sup>	
		Make	Break
600	10	7200	720

### DC Ratings, NEMA P600

Maximum Make or Break Amperes		
125 Volts	250 Volts	600 Volts
1.1	0.55	0.2

### Contact Ratings - Logic Reed Switch Contact Blocks

	AC Ratings	DC Ratings
Operating Voltage Continuous Current (Maximum) Resistive. Watts (Voltamperes)	2-120 Volts 001- 15 Ampere 8 Voltamperes Maximum	2-30 Volts 001- 15 Ampere 4.5 Voltamperes Maximum

### References:

Descriptive bulletin GEA-10877  
Distributor mailer GEE-7021

Nameplate Selection ..... pages 7-26, 7-27  
Drilling Plan and  
Dimensions ..... page 7-28

# CR104P Heavy-Duty, Non-illuminated Push Buttons

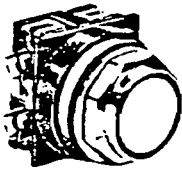
600 Volts Maximum AC/DC  
10 Amperes Continuous  
Suitable for Use in NEMA Type 1,  
3, 3R, 4, 4X, 12, and 13 Applications ①

## Push Button Units (Momentary Contacts)

Units are supplied factory assembled when ordered with contact blocks,  
except 2 1/8-inch diameter mushroom head which is not attached.

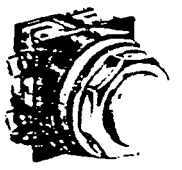
Operator Only (Select contact blocks from pg. 7-20)			Operator Assembled with 1NO-1NC Contacts		Operator Assembled with 2NO-2NC Contacts		Operator Assembled with 1NO Contact		Operator Assembled with 1NC Contact	
Button Color	Catalog Number CR104	List Price, GO-10G	Catalog Number CR104	List Price, GO-10G	Catalog Number CR104	List Price, GO-10G	Catalog Number CR104	List Price, GO-10G	Catalog Number CR104	List Price, GO-10G

### Standard (Flush)



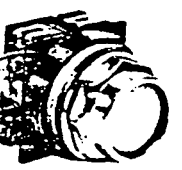
Black	PBG00B1	\$16.20	FEG91B1	\$34.20	PBG92B1	\$52.20	FEG10B1	\$25.20	PBG01B1	\$25.20
Red	PBG00R1	16.20	FEG91R1	34.20	PBG92R1	52.20	FEG10R1	25.20	PBG01R1	25.20
Green	PBG00G1	16.20	FEG91G1	34.20	PBG92G1	52.20	FEG10G1	25.20	PBG01G1	25.20
Clear ②	PBG00C1	16.20	FEG91C1	34.20	PBG92C1	52.20	FEG10C1	25.20	PBG01C1	25.20
(Combination) ③	PBG00U1	16.20	FEG91U1	34.20	PBG92U1	52.20	FEG10U1	25.20	PBG01U1	25.20
(Combination) ④	PBG00V1	16.20	FEG91V1	34.20	PBG92V1	52.20	FEG10V1	25.20	PBG01V1	25.20
None ⑤	PBG00A1 ⑥	15.90	FEG91A1 ⑥	33.90	PBG92A1 ⑥	51.90	FEG10A1 ⑥	24.90	PBG01A1 ⑥	24.90

### Extended Button



Black	FBG00B2	16.20	FEG91B2	34.20	PBG92B2	52.20	FEG10B2	25.20	PBG01B2	25.20
Red	FBG00R2	16.20	FEG91R2	34.20	PBG92R2	52.20	FEG10R2	25.20	PBG01R2	25.20
Green	FBG00G2	16.20	FEG91G2	34.20	PBG92G2	52.20	FEG10G2	25.20	PBG01G2	25.20
Clear ②	FBG00C2	16.20	FEG91C2	34.20	PBG92C2	52.20	FEG10C2	25.20	PBG01C2	25.20
(Combination) ③	FBG00U2	16.20	FEG91U2	34.20	PBG92U2	52.20	FEG10U2	25.20	PBG01U2	25.20
(Combination) ④	FBG00V2	16.20	FEG91V2	34.20	PBG92V2	52.20	FEG10V2	25.20	PBG01V2	25.20
None ⑤	FBG00A2 ⑥	15.90	FEG91A2 ⑥	33.90	PBG92A2 ⑥	51.90	FEG10A2 ⑥	24.90	PBG01A2 ⑥	24.90

### Recessed Button



Black	FEG00B3	16.20	FEG91B3	34.20	PBG92B3	52.20	FEG10B3	25.20	PBG01B3	25.20
Red	FEG00R3	16.20	FEG91R3	34.20	PBG92R3	52.20	FEG10R3	25.20	PBG01R3	25.20
Green	FEG00G3	16.20	FEG91G3	34.20	PBG92G3	52.20	FEG10G3	25.20	FEG01G3	25.20
Clear ②	FEG00C3	16.20	FEG91C3	34.20	PBG92C3	52.20	FEG10C3	25.20	PBG01C3	25.20
(Combination) ③	FEG00U3	16.20	FEG91U3	34.20	PBG92U3	52.20	FEG10U3	25.20	FEG01U3	25.20
(Combination) ④	FEG00V3	16.20	FEG91V3	34.20	PBG92V3	52.20	FEG10V3	25.20	FEG01V3	25.20
None ⑤	FEG00A3 ⑥	15.90	FEG91A3 ⑥	33.90	PBG92A3 ⑥	51.90	FEG10A3 ⑥	24.90	FEG01A3 ⑥	24.90

### Mushroom Head (1 3/8-inch diameter)

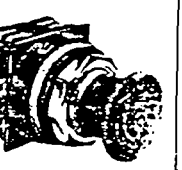


Black	PBM00B5	34.20	PBM91B5	52.20	PBM92B5	70.20	PBM10B5	43.20	PBM01B5	43.20
Red	PBM00R5	34.20	PBM91R5	52.20	PBM92R5	70.20	PBM10R5	43.20	PBM01R5	43.20
Green	PBM00G5	34.20	PBM91G5	52.20	PBM92G5	70.20	PBM10G5	43.20	PBM01G5	43.20
Yellow	PBM00E5	34.20	PBM91E5	52.20	PBM92E5	70.20	PBM10E5	43.20	PBM01E5	43.20
None ⑤	PBM00A6	28.20	PBM91A6	46.20	PBM92A6	64.20	PBM10A6	37.20	PBM01A6	37.20

### (2 3/8-inch diameter)

Black	PRM00B6	34.20	PRM91B6	52.20	PBM92B6	70.20	PRM10B6	43.20	PRM01B6	43.20
Red	PRM00R6	34.20	PRM91R6	52.20	PBM92R6	70.20	PRM10R6	43.20	PRM01R6	43.20
Green	PRM00G6	34.20	PRM91G6	52.20	PBM92G6	70.20	PRM10G6	43.20	PRM01G6	43.20
Yellow	PRM00E6	34.20	PRM91E6	52.20	PBM92E6	70.20	PRM10E6	43.20	PRM01E6	43.20
None ⑤	PRM00A6	28.20	PRM91A6	46.20	PBM92A6	64.20	PRM10A6	37.20	PRM01A6	37.20

### Mushroom Head (push to latch, turn to release)



Red (Only)	PTR20A0R	52.20	PTR20A0R91	70.20	PTR20A0R92	88.20	PTR20A0R1	61.20	PTR20A0R01	61.20
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**Note:** Catalog Number and price do not include nameplate. All nameplates must be ordered as a separate item from pages 7-26, 7-27

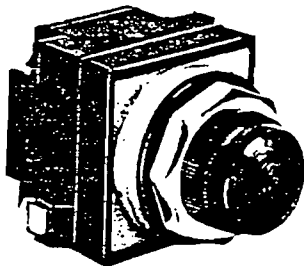
- ① When mounted in enclosures rated for those same applications. For some NEMA Type 4X applications, protective caps will provide improved corrosion resistance.
- ② To order package of legend inserts, refer to page 7-22.
- ③ Includes package of one each of black, red, green and yellow color caps.
- ④ Includes package of one each of orange, blue, brown and white color caps.
- ⑤ Select required color cap or mushroom-head button from page 7-22. 1 3/8 in. and 2 3/8 in. dia. operators are interchangeable.
- ⑥ To order assembled units with buttons of unlisted colors, substitute the following letters in place of "A" in Catalog Number: E (Yellow), L (Blue), M (Orange), N (Brown) and W (White). Price is same as those units with buttons of listed colors.



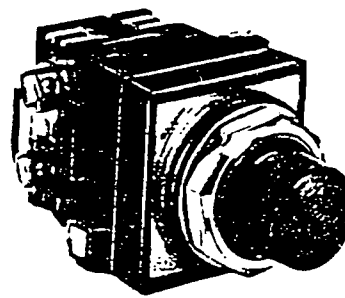
# GE Push Buttons

## CR104P Heavy-Duty Indicating Lights

600 Volts Maximum AC/DC  
 10 Amperes Continuous  
 Suitable for Use in NEMA Type 1,  
 3, 3R, 4, 4X, 12 and 13 Applications ①



Standard indicating light



Push-to-test indicating light

Units are supplied factory assembled when ordered with lenses.

### Standard and Push-to-test Indicating Light Units, Transformer Type

Operating Voltage	Color of Lens	Standard Unit Catalog Number ② CR104	List Price, GO-10G	Push-to-test Unit Catalog Number ② CR104	List Price, GO-10G
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### Transformer Type with 6-Volt Secondary, No. 755 Lamp

Operating Voltage (60/50 Hz)	Color of Lens	Standard Unit Catalog Number ②	List Price, GO-10G	Push-to-test Unit Catalog Number ②	List Price, GO-10G
		CR104	GO-10G	CR104	GO-10G
120 Volts	Red	PLG32R	\$84.20	PLT32R	\$82.20
	Green	PLG32G	84.20	PLT32G	82.20
	Amber	PLG32M	84.20	PLT32M	82.20
	Blue	PLG32L	84.20	PLT32L	82.20
	White	PLG32W	84.20	PLT32W	82.20
	Yellow	PLG32E	84.20	PLT32E	82.20
Clear	PLG32C	84.20	PLT32C	82.20	
	Less Lens ③	PLG32	60.00	PLT32	78.00
240 Volts	Red	PLG33R	84.20	PLT33R	82.20
	Green	PLG33G	84.20	PLT33G	82.20
	Amber	PLG33M	84.20	PLT33M	82.20
	Blue	PLG33L	84.20	PLT33L	82.20
	White	PLG33W	84.20	PLT33W	82.20
	Yellow	PLG33E	84.20	PLT33E	82.20
Clear	PLG33C	84.20	PLT33C	82.20	
	Less Lens ③	PLG33	60.00	PLT33	78.00
480 Volts	Red	PLG34R	84.20	PLT34R	82.20
	Green	PLG34G	84.20	PLT34G	82.20
	Amber	PLG34M	84.20	PLT34M	82.20
	Blue	PLG34L	84.20	PLT34L	82.20
	White	PLG34W	84.20	PLT34W	82.20
	Yellow	PLG34E	84.20	PLT34E	82.20
Clear	PLG34C	84.20	PLT34C	82.20	
	Less Lens ③	PLG34	60.00	PLT34	78.00
600 Volts	Red	PLG35R	84.20	PLT35R	82.20
	Green	PLG35G	84.20	PLT35G	82.20
	Amber	PLG35M	84.20	PLT35M	82.20
	Blue	PLG35L	84.20	PLT35L	82.20
	White	PLG35W	84.20	PLT35W	82.20
	Yellow	PLG35E	84.20	PLT35E	82.20
Clear	PLG35C	84.20	PLT35C	82.20	
	Less Lens ③	PLG35	60.00	PLT35	78.00

### Standard and Push-to-test Indicating Light Units, Full Voltage

Operating Voltage	Color of Lens	Standard Unit Catalog Number ② CR104	List Price, GO-10G	Push-to-test Unit Catalog Number ② CR104	List Price, GO-10G
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### Full Voltage Type

Operating Voltage (# Lamp)	Color of Lens	Standard Unit Catalog Number ②	List Price, GO-10G	Push-to-test Unit Catalog Number ②	List Price, GO-10G
		CR104	GO-10G	CR104	GO-10G
6 Volts (# 755 Lamp)	Red	PLG16R	\$52.20	PLT16R	\$70.20
	Green	PLG16G	52.20	PLT16G	70.20
	Amber	PLG16M	52.20	PLT16M	70.20
	Blue	PLG16L	52.20	PLT16L	70.20
	White	PLG16W	52.20	PLT16W	70.20
	Yellow	PLG16E	52.20	PLT16E	70.20
Clear	PLG16C	52.20	PLT16C	70.20	
	Less Lens ③	PLG16	48.00	PLT16	66.00
12 Volts (# 756 Lamp)	Red	PLG17R	52.20	PLT17R	70.20
	Green	PLG17G	52.20	PLT17G	70.20
	Amber	PLG17M	52.20	PLT17M	70.20
	Blue	PLG17L	52.20	PLT17L	70.20
	White	PLG17W	52.20	PLT17W	70.20
	Yellow	PLG17E	52.20	PLT17E	70.20
Clear	PLG17C	52.20	PLT17C	70.20	
	Less Lens ③	PLG17	48.00	PLT17	66.00
24 Volts (# 1819 Lamp)	Red	PLG18R	52.20	PLT18R	70.20
	Green	PLG18G	52.20	PLT18G	70.20
	Amber	PLG18M	52.20	PLT18M	70.20
	Blue	PLG18L	52.20	PLT18L	70.20
	White	PLG18W	52.20	PLT18W	70.20
	Yellow	PLG18E	52.20	PLT18E	70.20
Clear	PLG18C	52.20	PLT18C	70.20	
	Less Lens ③	PLG18	48.00	PLT18	66.00
120 Volts (# 120PSB Lamp)	Red	PLG22R	52.20	PLT22R	70.20
	Green	PLG22G	52.20	PLT22G	70.20
	Amber	PLG22M	52.20	PLT22M	70.20
	Blue	PLG22L	52.20	PLT22L	70.20
	White	PLG22W	52.20	PLT22W	70.20
	Yellow	PLG22E	52.20	PLT22E	70.20
Clear	PLG22C	52.20	PLT22C	70.20	
	Less Lens ③	PLG22	48.00	PLT22	66.00

**Notes:** Catalog Number and price do not include nameplate. All nameplates must be ordered as a separate item from pages 7-26 and 7-27.  
 Resistor forms of standard and push-to-test indicating lights are available. Contact nearest GE Electrical Distribution & Control sales office for proper selection and pricing.

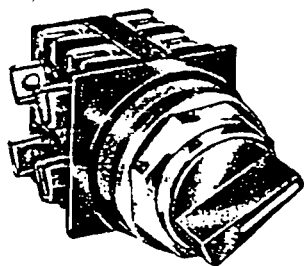
- ① When mounted in enclosures rated for those same applications. For some NEMA Type 4X applications, protective caps will improve corrosion resistance.
- ② "CR104PXG . . ." Catalog Number on light unit label identifies only the "power source" component of each complete unit listed above.
- ③ Select required lens from page 7-23 and order as a separate item.
- ④ 6-, 12-, and 24-Volt units have same lamp socket; lamps are therefore interchangeable for voltage change.

**References:**  
 Descriptive Bulletin GEA-10877  
 Distributor Mailer GED-7031

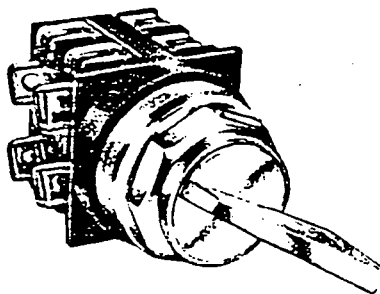
Nameplate Selection . . . . . pages 7-26, 7-27  
 Drilling Plan and Dimensions . . . . . page 7-28  
 Lamp Ordering Information . . . . . page 7-24

# CR104P Heavy-Duty, Non-illuminated Selector Switches

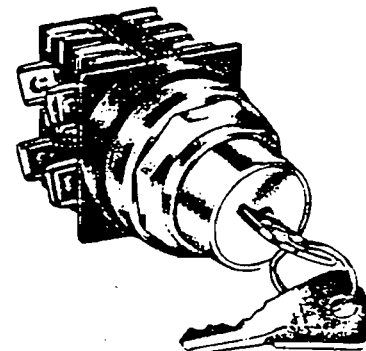
600 Volts Maximum AC/DC  
10 Amperes Continuous  
Suitable for Use in NEMA Type 1,  
3, 3R, 4, 4X, 12 and 13 Applications ①



Knob-operated selector switch



Lever-operated selector switch



Cylinder lock selector switch

## 2-Position, Non-illuminated Knob-, Lever-, and Cylinder Lock-operated Selector Switches ②

Units are supplied factory assembled when ordered with contact blocks.

Viewed from front of panel		Contact Block	Catalog Numbers and Prices								
Contacts	Operator Position		Standard Knob Black ③ CR104	List Price, GO-10G	Wing Lever, Chrome ④ CR104	List Price, GO-10G	Cylinder Lock, Remove key from:				
Left	Right	O = Open X = Closed					Left Only CR104	Right Only CR104	Left and Right CR104	Center Only CR104	List Price, GO-10G

### Maintained

Operator Only	↔	None	PSG12E	\$22.20	PSM21	\$22.20	PSK21A00L	PSK21A00R	PSK21A00M	-	\$58.20
① NC	NC X O	1NO-1NC	PSG12E91	40.20	PSM21A91	40.20	PSK21A91L	PSK21A91R	PSK21A91M	-	78.20
② NO	NO O X	1NO-1NC	-	-	-	-	PSK21A91L51③	PSK21A91R51③	PSK21A91M51③	-	88.20
③ NC	L-NC X O	2NO-2NC	PSG12E92	58.20	PSM21A92	58.20	PSK21A92L	PSK21A92R	PSK21A92M	-	94.20
④ NO	L-NO X O R-NC X O R-NO O X										

### Spring Return Left To Center

Operator Only	↔	None	PSG12E	34.20	PSM12	34.20	-	-	-	FSK12A00C	70.20
① NC	NC O X	1NO-1NC	PSG12E91	52.20	PSM12A91	52.20	-	-	-	PSK12A91C	88.20
② NO	NO X O	1NO-1NC	-	-	-	-	-	-	-	PSK12A91C51③	100.20
③ NC	L-NC O X	2NO-2NC	PSG12E92	70.20	PSM12A92	70.20	-	-	-	PSK12A92C	106.20
④ NO	L-NO X O R-NC O X R-NO X O										

### Spring Return Right To Center

Operator Only	↔	None	PSG63E	34.20	PSM63	34.20	-	-	-	PSK63A00C	70.20
① NC	NC X O	1NO-1NC	PSG63E91	52.20	PSM63A91	52.20	-	-	-	PSK63A91C	88.20
② NO	NO O X	1NO-1NC	-	-	-	-	-	-	-	PSK63A91C51③	100.20
③ NC	L-NC X O	2NO-2NC	PSG63E92	70.20	PSM63A92	70.20	-	-	-	PSK63A92C	106.20
④ NO	L-NO X O R-NC X O R-NO O X										

**Note:** Catalog Number and price do not include nameplate. All nameplates must be ordered as a separate item from pages 7-27 and 7-28. Two keys included with each cylinder lock.

- ① When mounted in enclosures rated for those same applications. For some NEMA Type 4X applications, protective caps will improve corrosion resistance.
- ② For additional cam operation information, refer to page 7-28.
- ③ To order knob in a color other than black, replace the "B" in listed Catalog Numbers with E (Yellow), G (Green), L (Blue), R (Red).
- ④ To order black lever, replace "A" in Catalog Number with "B", before 91 or 92 contact digits. Example: the Catalog Number for a maintained 1NO-1NC operator with black lever is CR104PSM21B91.
- ⑤ CH501 keyed cylinder lock. Other listed cylinder locks are alike and use identical keys. Dissimilar locks are also available; contact nearest GE Electrical Distribution & Control sales office.

#### References:

Descriptive bulletin GEA-10877  
Distributor mailer GED-7021

Nameplate Selection ..... pages 7-26, 7-27  
Drilling Plan and Dimensions ..... page 7-28

Extra Keys for Cylinder Lock Selector Switches ..... page 7-24



# GE Push Buttons

## CR104P Heavy-Duty, Non-illuminated Selector Switches

600 Volts Maximum AC/DC  
10 Amperes Continuous  
Suitable for Use in NEMA Type 1.  
3, 3R, 4, 4X, 12 and 13 Applications ①

### 3-Position Non-illuminated, Knob-, Lever-, and Cylinder Lock-operated Selector Switches ②

Units are supplied factory assembled when ordered with contact blocks.

Viewed from front of panel		Contact Block	Catalog Numbers and Prices							
Contacts	Operator Position		Standard Knob Black ③ CR104	List Price GO-10G	Wing Lever Chrome ④ CR104	List Price GO-10G	Cylinder Lock. Remove Key from:			
Left	Right	O = Open X = Closed				Left Only CR104	Center Only CR104	Right Only CR104	All Positions CR104	List Price GO-10G

#### Maintained

Operator Only	None	PSG34B	\$22.20	PSM34	\$22.20	PSK34A00L	PSK34A00C	PSK34A00R	PSK34A00W	\$58.20																												
<table border="0"> <tr><td>⑤</td><td>NC</td><td>NC</td><td>X</td><td>O</td><td>O</td></tr> <tr><td>○</td><td>NO</td><td>NO</td><td>O</td><td>O</td><td>X</td></tr> </table>	⑤	NC	NC	X	O	O	○	NO	NO	O	O	X	1NO-1NC 1NO-1NC	PSG34B91	40.20	PSM34A91	40.20	PSK34A91L PSK34A91L51 ⑤	PSK34A91C PSK34A91C51 ⑤	PSK34A91R PSK34A91R51 ⑤	PSK34A91W PSK34A91W51 ⑤	78.20 88.20																
⑤	NC	NC	X	O	O																																	
○	NO	NO	O	O	X																																	
<table border="0"> <tr><td>⑤</td><td>NC</td><td>⑤</td><td>L-NC</td><td>X</td><td>O</td><td>O</td></tr> <tr><td>○</td><td>NO</td><td>○</td><td>L-NO</td><td>O</td><td>O</td><td>X</td></tr> <tr><td></td><td></td><td></td><td>R-NC</td><td>X</td><td>O</td><td>O</td></tr> <tr><td></td><td></td><td></td><td>R-NO</td><td>O</td><td>O</td><td>X</td></tr> </table>	⑤	NC	⑤	L-NC	X	O	O	○	NO	○	L-NO	O	O	X				R-NC	X	O	O				R-NO	O	O	X	2NO-2NC	PSG34B92	58.20	FSM34A92	58.20	PSK34A92L	PSK34A92C	PSK34A92R	PSK34A92W	94.20
⑤	NC	⑤	L-NC	X	O	O																																
○	NO	○	L-NO	O	O	X																																
			R-NC	X	O	O																																
			R-NO	O	O	X																																
Operator Only	None	PSG32B	22.20	PSM32	22.20	PSK32A00L	PSK32A00C	PSK32A00R	PSK32A00W	58.20																												
<table border="0"> <tr><td>⑤</td><td>NC</td><td>NC</td><td>O</td><td>X</td><td>O</td></tr> <tr><td>○</td><td>NO</td><td>NO</td><td>X</td><td>O</td><td>O</td></tr> </table>	⑤	NC	NC	O	X	O	○	NO	NO	X	O	O	1NO-1NC	PSG32B91	40.20	PSM32A91	40.20	PSK32A91L	PSK32A91C	PSK32A91R	PSK32A91W	78.20																
⑤	NC	NC	O	X	O																																	
○	NO	NO	X	O	O																																	
<table border="0"> <tr><td>⑤</td><td>NC</td><td>⑤</td><td>L-NC</td><td>O</td><td>X</td><td>O</td></tr> <tr><td>○</td><td>NO</td><td>○</td><td>L-NO</td><td>X</td><td>O</td><td>O</td></tr> <tr><td></td><td></td><td></td><td>R-NC</td><td>O</td><td>X</td><td>O</td></tr> <tr><td></td><td></td><td></td><td>R-NO</td><td>X</td><td>O</td><td>O</td></tr> </table>	⑤	NC	⑤	L-NC	O	X	O	○	NO	○	L-NO	X	O	O				R-NC	O	X	O				R-NO	X	O	O	2NO-2NC	PSG32B92	58.20	PSM32A92	58.20	PSK32A92L	PSK32A92C	PSK32A92R	PSK32A92W	94.20
⑤	NC	⑤	L-NC	O	X	O																																
○	NO	○	L-NO	X	O	O																																
			R-NC	O	X	O																																
			R-NO	X	O	O																																
Operator Only	None	PSG33B	22.20	PSM33	22.20	PSK33A00L	PSK33A00C	PSK33A00R	PSK33A00W	58.20																												
<table border="0"> <tr><td>⑤</td><td>NC</td><td>NC</td><td>O</td><td>X</td><td>O</td></tr> <tr><td>○</td><td>NO</td><td>NO</td><td>O</td><td>O</td><td>X</td></tr> </table>	⑤	NC	NC	O	X	O	○	NO	NO	O	O	X	1NO-1NC	PSG33B91	40.20	PSM33A91	40.20	PSK33A91L	PSK33A91C	PSK33A91R	PSK33A91W	78.20																
⑤	NC	NC	O	X	O																																	
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<table border="0"> <tr><td>⑤</td><td>NC</td><td>⑤</td><td>L-NC</td><td>O</td><td>X</td><td>O</td></tr> <tr><td>○</td><td>NO</td><td>○</td><td>L-NO</td><td>O</td><td>O</td><td>X</td></tr> <tr><td></td><td></td><td></td><td>R-NC</td><td>O</td><td>X</td><td>O</td></tr> <tr><td></td><td></td><td></td><td>R-NO</td><td>O</td><td>O</td><td>X</td></tr> </table>	⑤	NC	⑤	L-NC	O	X	O	○	NO	○	L-NO	O	O	X				R-NC	O	X	O				R-NO	O	O	X	2NO-2NC	PSG33B92	58.20	PSM33A92	58.20	PSK33A92L	PSK33A92C	PSK33A92R	PSK33A92W	94.20
⑤	NC	⑤	L-NC	O	X	O																																
○	NO	○	L-NO	O	O	X																																
			R-NC	O	X	O																																
			R-NO	O	O	X																																
Operator Only	None	PSG35B	22.20	PSM35	22.20	PSK35A00L	PSK35A00C	PSK35A00R	PSK35A00W	58.20																												
<table border="0"> <tr><td>⑤</td><td>NC</td><td>⑤</td><td>L-NC</td><td>X</td><td>O</td><td>O</td></tr> <tr><td>○</td><td>NO</td><td>○</td><td>L-NO</td><td>O</td><td>O</td><td>X</td></tr> <tr><td></td><td></td><td></td><td>R-NC</td><td>O</td><td>X</td><td>O</td></tr> <tr><td></td><td></td><td></td><td>R-NO</td><td>O</td><td>O</td><td>X</td></tr> </table>	⑤	NC	⑤	L-NC	X	O	O	○	NO	○	L-NO	O	O	X				R-NC	O	X	O				R-NO	O	O	X	2NO-2NC	PSG35B92	58.20	PSM35A92	58.20	PSK35A92L	PSK35A92C	PSK35A92R	PSK35A92W	94.20
⑤	NC	⑤	L-NC	X	O	O																																
○	NO	○	L-NO	O	O	X																																
			R-NC	O	X	O																																
			R-NO	O	O	X																																
Operator Only	None	PSG36B	22.20	PSM36	22.20	PSK36A00L	PSK36A00C	PSK36A00R	PSK36A00W	58.20																												
<table border="0"> <tr><td>⑤</td><td>NC</td><td>⑤</td><td>L-NC</td><td>X</td><td>X</td><td>O</td></tr> <tr><td>○</td><td>NO</td><td>○</td><td>L-NO</td><td>O</td><td>O</td><td>X</td></tr> <tr><td></td><td></td><td></td><td>R-NC</td><td>O</td><td>X</td><td>X</td></tr> <tr><td></td><td></td><td></td><td>R-NO</td><td>X</td><td>O</td><td>O</td></tr> </table>	⑤	NC	⑤	L-NC	X	X	O	○	NO	○	L-NO	O	O	X				R-NC	O	X	X				R-NO	X	O	O	2NO-2NC	PSG36B92	58.20	PSM36A92	58.20	PSK36A92L	PSK36A92C	PSK36A92R	PSK36A92W	94.20
⑤	NC	⑤	L-NC	X	X	O																																
○	NO	○	L-NO	O	O	X																																
			R-NC	O	X	X																																
			R-NO	X	O	O																																

### 4-Position Non-illuminated, Knob- and Lever-operated, and Cylinder Lock Selector Switches

Operator Only	None ⑥	PSG47B	22.20	PSM47	22.20	-	-	-	PSK47A00Z	58.20																																
<table border="0"> <tr><td>⑤</td><td>NC</td><td>⑤</td><td>L-NC</td><td>X</td><td>O</td><td>O</td><td>O</td></tr> <tr><td>○</td><td>NO</td><td>○</td><td>L-NO</td><td>O</td><td>O</td><td>X</td><td>O</td></tr> <tr><td></td><td></td><td></td><td>R-NC</td><td>O</td><td>O</td><td>O</td><td>X</td></tr> <tr><td></td><td></td><td></td><td>R-NO</td><td>O</td><td>X</td><td>O</td><td>O</td></tr> </table>	⑤	NC	⑤	L-NC	X	O	O	O	○	NO	○	L-NO	O	O	X	O				R-NC	O	O	O	X				R-NO	O	X	O	O	2NO-2NC ⑥	PSG47B92	58.20	PSM47A92	58.20	-	-	-	PSK47A92Z	94.20
⑤	NC	⑤	L-NC	X	O	O	O																																			
○	NO	○	L-NO	O	O	X	O																																			
			R-NC	O	O	O	X																																			
			R-NO	O	X	O	O																																			

Note: Catalog Number and price do not include nameplate. All nameplates must be ordered as a separate item from pages 7-26 and 7-27. Two keys included with each cylinder lock.

- ① When mounted in enclosures rated for those same applications. For some NEMA Type 4X applications, protective caps will improve corrosion resistance.
- ② For additional cam operation information, refer to page 7-28.
- ③ To order knob in a color other than black, replace the "B" in listed Catalog Numbers with E (Yellow), G (Green), L (Blue), R (Red).
- ④ To order black wing lever, replace "A" in Catalog Number with "B" before 91 or 92 contact digits. Example: the Catalog Number for a maintained, 1NO-1NC, operator with black wing lever is CR104PSM32B91.
- ⑤ CH501 keyed cylinder lock. Other listed cylinder locks are alike and use identical keys. Dissimilar locks are also available: contact nearest GE Electrical Distribution & Control sales office.
- ⑥ Two double circuit contact blocks, mounted side by side, is standard arrangement. No more than two contact blocks, single and/or double, may be used with this operator.

#### References:

Descriptive bulletin GEA-10877  
Distributor mailer GED-702

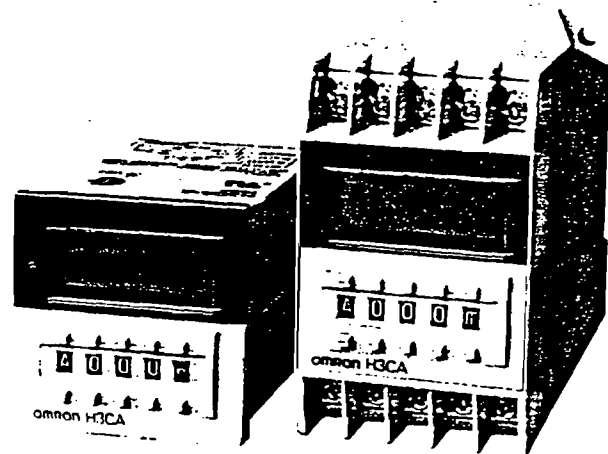
Nameplate Selection ..... pages 7-26, 7-27  
Drilling Plan and Dimensions ..... page 7-28

Extra Keys for Cylinder Lock Selector Switches ..... page 7-24

**OMRON****Solid-State Timer****H3CA**

1/16 DIN, Digital-Set Timer with  
0.1 Second to 9,990 Hours Range

- 8 field-selectable operation modes
- Universal AC/DC supply voltage timers available
- Operations include ON-delay, Repeat cycle, Signal Interval/OFF-delay, Signal-OFF delay (I and II), Interval, Cycle and Signal ON-delay/OFF-delay
- Selectable no-voltage start, reset, gate and check inputs expand capabilities
- Time remaining LCD bar graph and LCD output status indicator
- Panel mounting adapters, sockets, and accessories may be ordered separately

**Ordering Information**■ **TIMERS**

Add the supply voltage to the part number when you order ON-delay only timers H3CA-8 and H3CA-8H. For example, H3CA-8H-AC/100/110/120.

Timing function		8 field-selectable functions		ON-delay only	
Contact type	Time limit	SPDT	SPDT	SPDT	DPDT
	Instantaneous	-	-	SPDT	-
Terminal form		11-pin round socket	Front mounted screw terminals	8-pin round socket	
Part number		H3CA-A	H3CA-FA	H3CA-8H	H3CA-8
Supply voltages	AC	24 to 240 V, 50/60 Hz or		Specify 24 V, 100/110/120 V, or 200/220/240 V; 50/60 Hz	
	DC	12 to 240 V		Specify 12 V, 24 V, 48 V or 110 V	

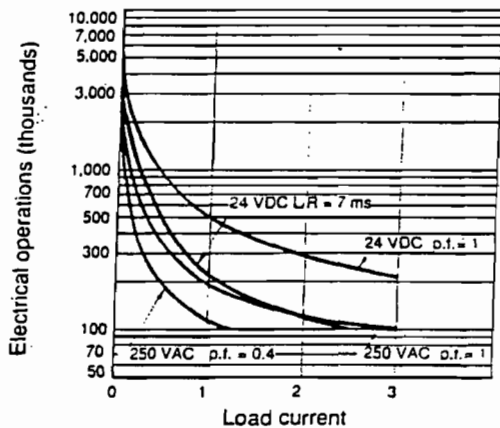
■ **ACCESSORIES**

Description		Part number	
Sockets	H3CA-A timer	Bottom surface or track mounting, top screw terminals	P2CF-11
		Back mounting, for use with Y92F-30 mounting adapter, bottom screw terminals	P3GA-11
	H3CA-8, H3CA-8H timers	Bottom surface or track mounting, top screw terminals	P2CF-08
		Back mounting, for use with Y92F-30 mounting adapter, bottom screw terminals	P3G-08
Panel mounting adapters	Fits behind panel, ideal for side by side installation. Use P3G□-□ sockets.		Y92F-30
	Installs through panel front; timer face fits bezel, rear of timer clips to adapter. Use P3G□-□ sockets. Fits 65-66 mm (2.56 - 2.59 in) x 52-53 mm (2.04 - 2.09 in) panel cutout. Charcoal gray face plate measures 88 H x 58 W mm (3.46 x 2.28 in).		Y92F-70
	Installs through panel front; timer face fits bezel, rear of timer clips to adapter. Use P3G□-□ sockets. Fits 55 x 45 mm (2.17 x 1.77 in) panel cutout. Charcoal gray face plate measures 58 H x 50 W mm (2.28 x 1.97 in).		Y92F-71
Protective cover	Hard plastic cover; not for use with Y92F-70 or Y92F-71 panel adapters.		Y92A-48B
	Soft plastic cover; not for use with Y92F-70 or Y92F-71 panel adapters.		Y92A-48D
Mounting track	DIN rail, 50 cm (1.64 ft) length		PFP-50N
	DIN rail, 1 m (3.28 ft) length		PFP-100N
	End plate		PFP-M
	Spacer		PFP-S



# Engineering Data

## ■ ELECTRICAL SERVICE LIFE



## Timing Charts

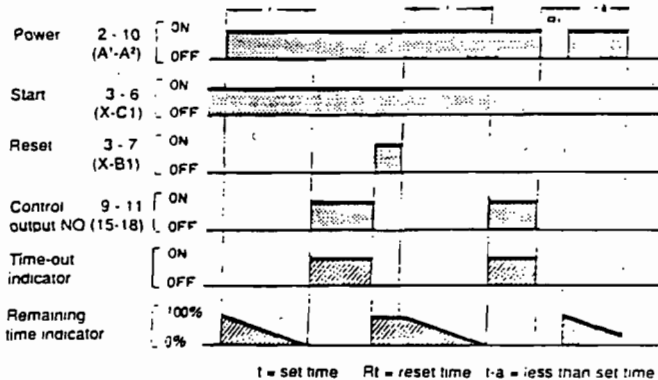
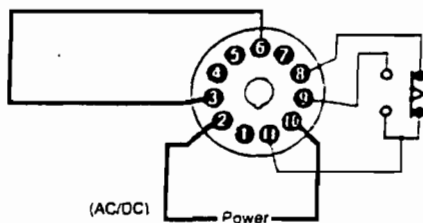
In the schematic diagrams, each thick line indicates the external wiring necessary for the selected operation.

### ■ (H3CA-A, H3CA-FA)

#### Mode A ON-Delay

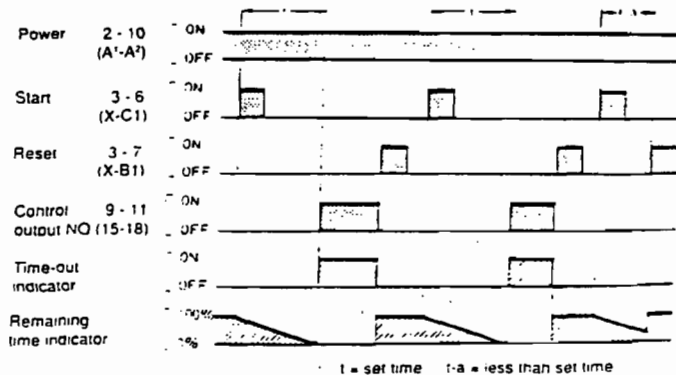
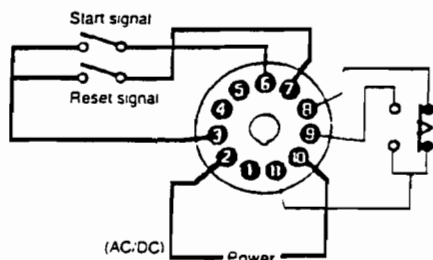
##### Power-ON Start/Power-OFF Reset

The start terminals are connected. Timing starts when power is applied. The output is energized when the accumulated time equals the set time. The output remains energized until power is disconnected or a reset input is applied.



#### Signal Start

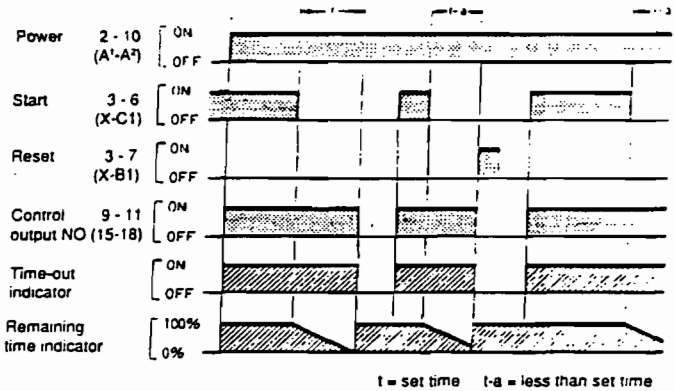
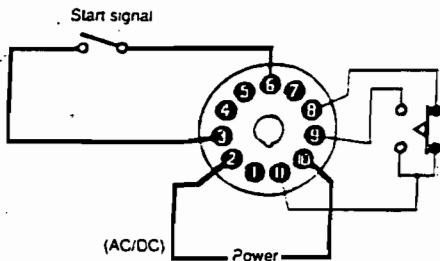
Power is applied continuously. Timing starts at the leading edge of the start input. The output is energized when the accumulated time equals the set time. Subsequent start signals during or after timing will not be accepted. The output relay will remain energized until a reset input is applied or power is interrupted.



In the schematic diagrams, each thick line indicates the external wiring necessary for the selected operation.

### Mode D Signal OFF-Delay (I)

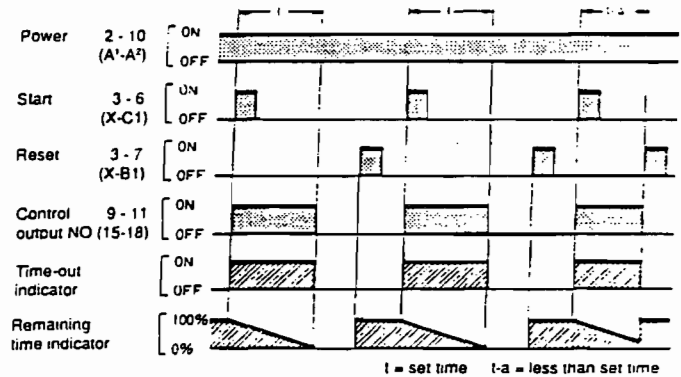
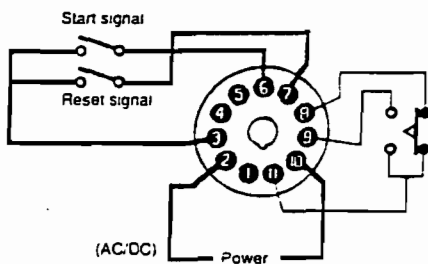
Power is continuously applied. The output relay is energized at the leading edge of the start input. Timing starts at the trailing edge of the start input. The output relay is de-energized when the accumulated time equals the set time.



### Mode E Interval

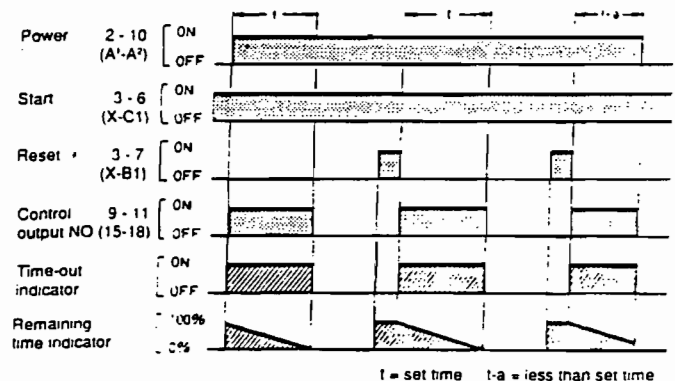
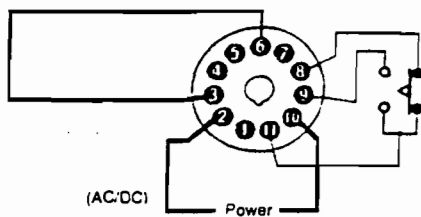
#### Signal Start

Power is applied continuously. Timing starts at the leading edge of the start input. The output relay is only energized during timing. The timer is reset when power is disconnected or a reset input is applied.



#### Power-ON Start/Power-OFF reset

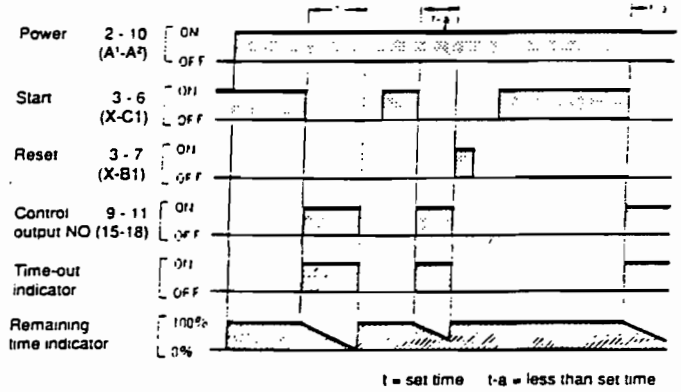
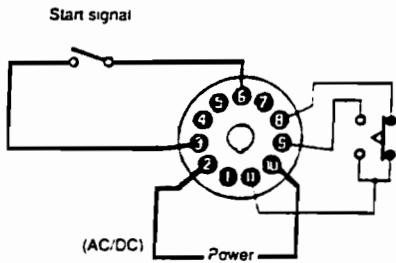
The start terminals are connected. Timing starts when power is applied. The output relay is only energized during timing. The timer is reset when power is disconnected or a reset input is applied.



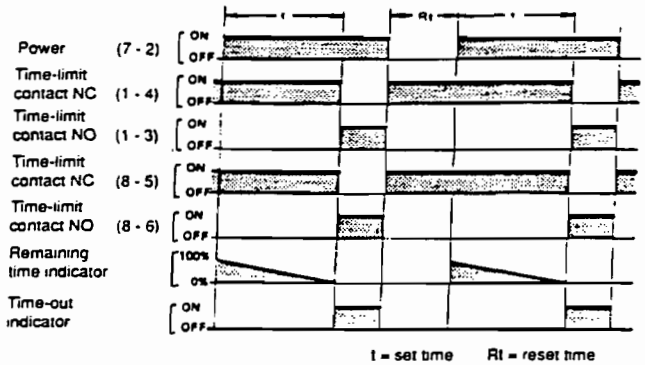
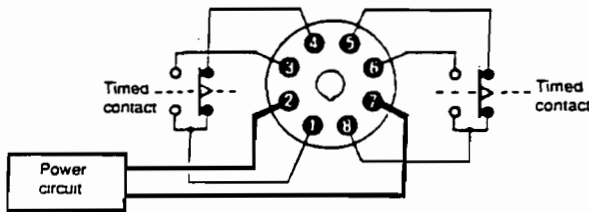
In the schematic diagrams, each thick line indicates the external wiring necessary for the selected operation.

**Mode H Signal OFF-Delay (II)**

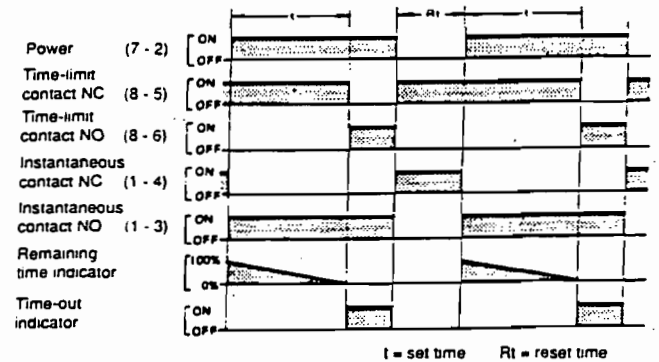
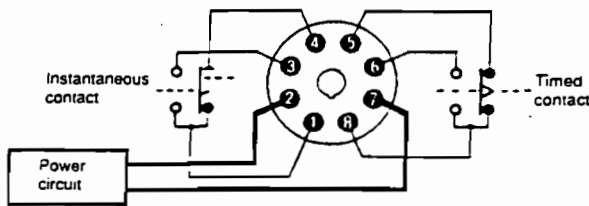
Power is continuously applied. Timing starts at the trailing edge of the start input. The output relay is energized during timing.



■ H3CA-8



■ H3CA-8H

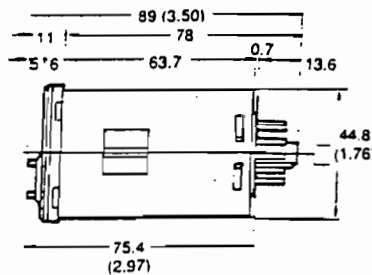
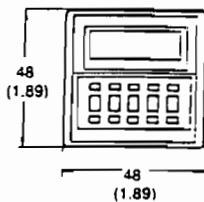


**Dimensions**

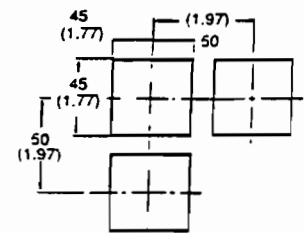
Unit: mm (inch)

■ TIMERS

H3CA-A



Panel cutout

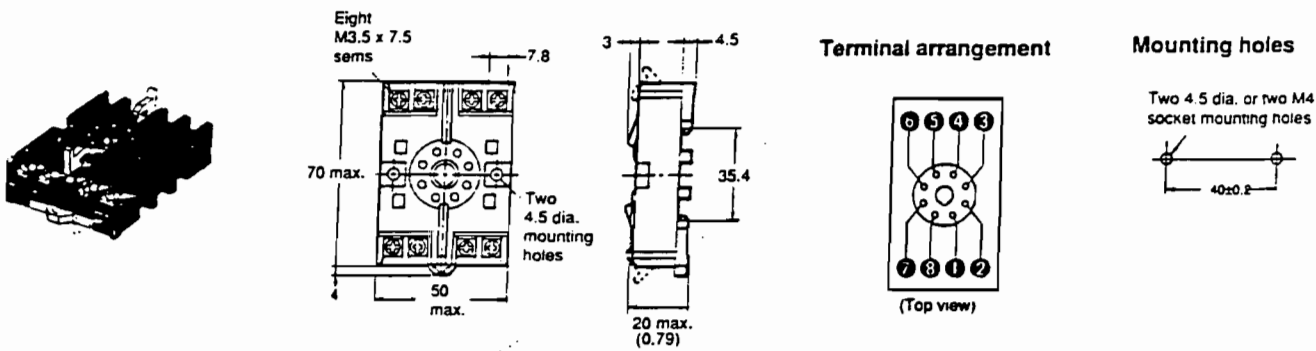


Note: Recommended panel thickness is 1 to 3.2 mm.

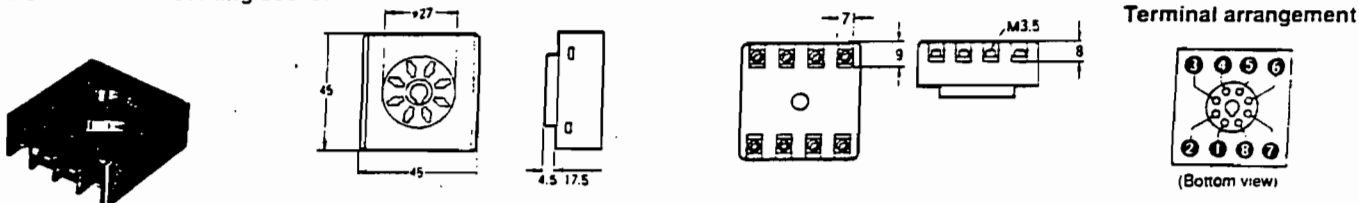
Panel cutout conforms to DIN 43700.

**8-Pin Sockets for H3CA-8, H3CA-8H**

P2CF-08 Bottom surface or track mounting



**P3G-08 Back mounting socket**

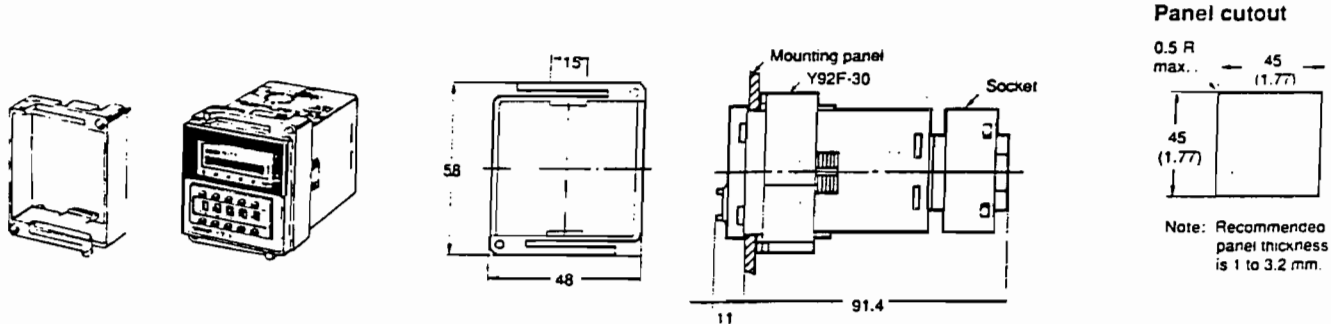


**■ PANEL MOUNTING ADAPTERS**

For H3CA, H3CA-8, H3CA-8H

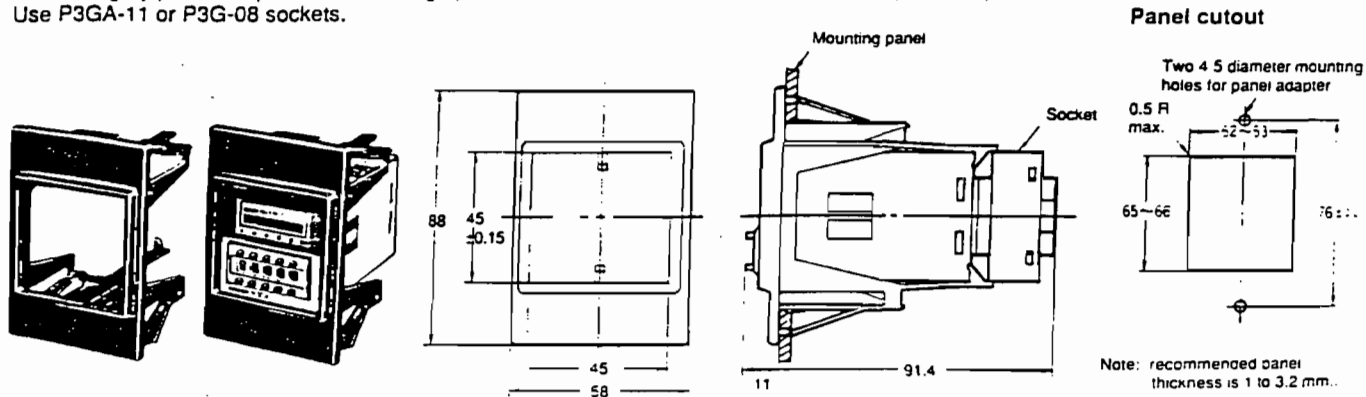
**Y92F-30 Mounting Adapter**

Adapter installs behind the panel. It is ideal for side by side installation. Use P3GA-11 or P3G-08 sockets.



**Y92F-70 Mounting Adapter**

Charcoal gray panel adapter installs through panel front. Timer fits bezel, rear of timer clips to adapter. Use P3GA-11 or P3G-08 sockets.



■ CONTACT SIGNAL INPUTS

Input Signal Requirements

Resistance	1 KΩ max.
Residual voltage	1 V max. when the contact makes
Contact material	Gold-plated contacts recommended

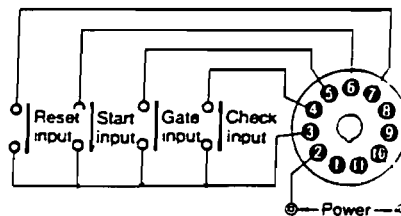
H3CA-A

- Start input contact between terminals 3 and 6.
- Reset input contact between terminals 3 and 7.
- Gate input contact between terminals 3 and 5.
- Check input contact between terminals 3 and 4.

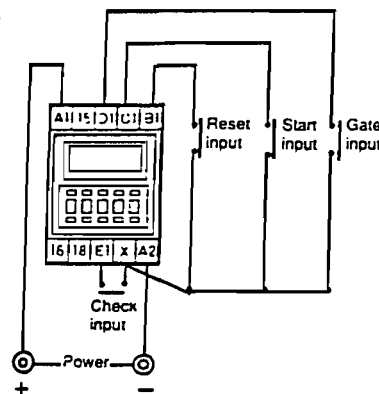
H3CA-FA

- Start input contact between terminals X and C1.
- Reset input contact between terminals X and B1.
- Gate input contact between terminals X and D1.
- Check input contact between terminals X and E1.

H3CA-A



H3CA-FA



■ SOLID-STATE SIGNAL INPUTS

Input Signal Requirements

Input type	Open collector transistor
Voltage when collector is OFF	20 V min.
Saturated voltage when transistor is ON	1 V max.
Collector current	50 mA max.
Input current between collector and base	0.5 μA max.
Resistance when transistor is ON	1 KΩ max.
Residual voltage when transistor is ON	1 V max.
Resistance when transistor is OFF	200 KΩ min.

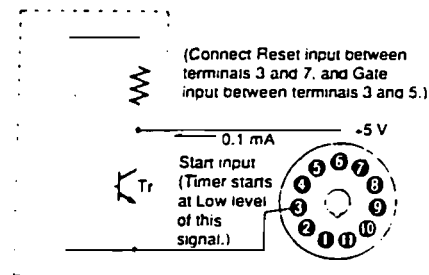
H3CA-A and H3CA-FA

Solid-state input terminal connections are the same as those for contact signal inputs.

Solid-State Inputs (Not Open Collector Type)

Proximity and photoelectric sensors often have NPN or PNP type solid-state output circuits and rated supply voltages ranging from 6 to 30 VDC. These signals are applied to the timer according to the diagram below.

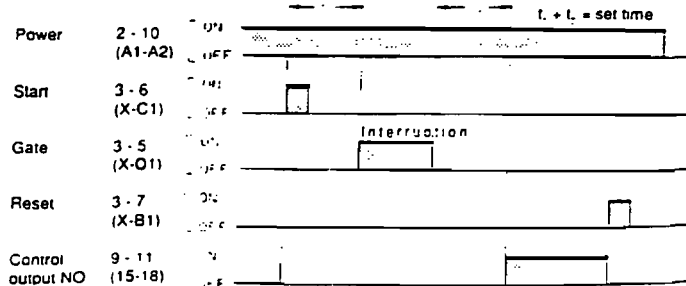
Solid-state circuit (proximity sensor, proximity sensor, etc.)



■ CUMULATIVE TIMING

Using the Gate Input with ON-Delay

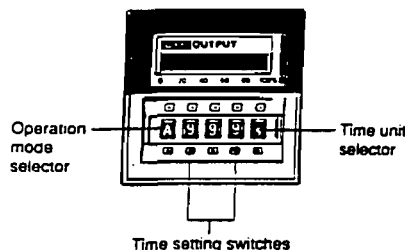
When the gate signal is closed, timing is temporarily stopped. When the gate signal opens, timing resumes at the point of interruption. The gate input terminal permits the timer to sum up times  $t_1$  and  $t_2$  as shown in the timing chart.



## Operation

### ■ SELECTING TIME RANGE

Use the rightmost pushwheel switch to select the time range. Use the three center pushwheel switches to select the time setting between 000 and 999. For ranges with 0.1 time units, the decimal point is assumed to be between middle and right digits.



Time unit	Timing range
0.1 s	0.1 to 99.9 seconds
s	1 to 999 seconds
0.1 m	0.1 to 99.9 minutes
m	1 to 999 minutes
0.1 h	0.1 to 99.9 hours
h	1 to 999 hours
10 h	10 to 9990 hours

### ■ SELECTING OPERATION MODES (H3CA-A, H3CA-FA)

The operation mode is selected by the leftmost pushwheel switch.

Mode	Operation
A	ON-delay
B	Repeat cycle
C	Signal Interval/OFF-delay
D	Signal OFF-delay I
E	Interval
F	Cycle
G	Signal ON-delay/OFF-delay
H	Signal OFF-delay II

### ■ CAUTIONS

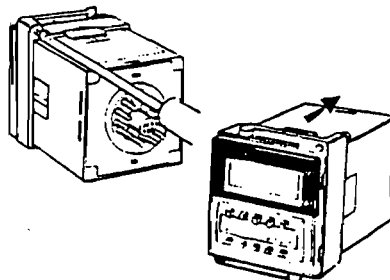
Do not change the time unit or time range while the timer is in operation. Otherwise, the timer may malfunction or be damaged. Be sure to turn off the power supply to the timer before changing any of the selections.

## Mounting

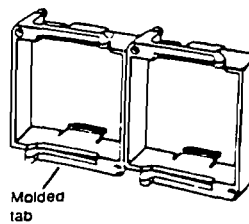
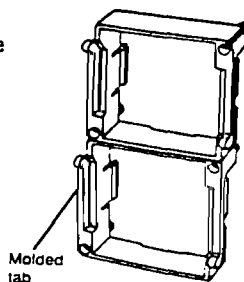
### ■ PANEL MOUNTING

#### Using Y92F-30 Adapter

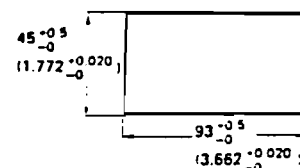
Insert the timer through the panel cutout. Push the Y92F-30 adapter from the rear of the timer as far forward toward the panel as possible. Wire the P3G socket, then push it onto the rear of the timer. Then, tighten the two retaining screws. To release the adapter, lift the tab at the rear of the adapter.



Several timers may be mounted close together using Y92F-30 adapter as shown here. When mounting two or more timers in a vertical line, arrange the adapters so that their molded tabs are positioned on the right and left sides. When mounting two or more timers in a horizontal line, arrange the adapters so that their molded tabs are positioned on the top and bottom sides.



#### Panel cutout for side-by-side mounting of two timers

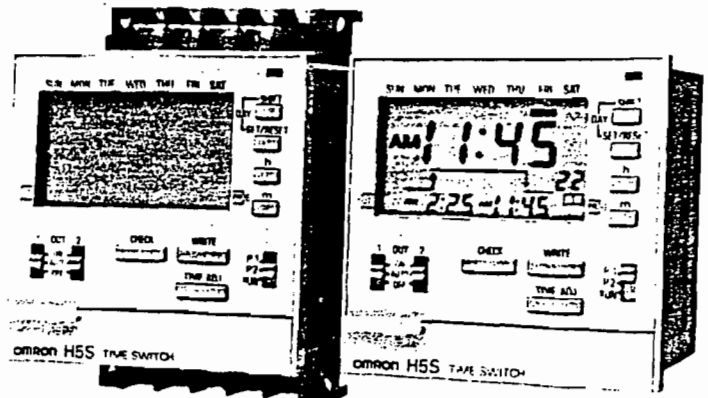


## Weekly Timer

## H5S

Timer Provides Prompted Programming, Flexibility in Programs Within the Week

- AM/PM display
- 24 program steps
- A different program possible each day
- Over midnight settings possible
- Two independent 15 A control circuits with manual override
- Automatic or manual operation following power failure
- Field-adjustable ON/OFF, cycle and pulse output
- Easy-to-use prompted programming
- Wide supply voltage range
- Battery backup for memory protection
- Protective cover and other accessories may be ordered separately



## Ordering Information

### ■ TIMERS

Timing function	ON/OFF and cycle operations up to one week	
Contact type	Two SPST-NO time limit contacts with manual override switches	
Terminal form	Screw terminals	
Mounting	Panel mounting	Surface or track mounting
Part number	H5S-B	H5S-FB
Supply voltage	100 to 240 VAC, 50/60 Hz	

### ■ TIME RANGES

Time setting range	00:00 a.m. to 11:59 p.m.
Program capacity	24 steps: ON = 1 step, OFF = 1 step, CYCLE = 4 steps, PULSE = 1 step
Cycle length	From 1 minute up to a full week
Display time division	1 minute
Operation	Weekly operation (multiple-day operation possible) Cycle operation Pulse-out operation (pulse width can be set in units of 1 second from 1 to 59 seconds and in units of 1 minute from 1 to 60 minutes) Day override operation (operation for one day can be also executed on any other day) Forced ON/OFF operation Manual or automatic operation selectable on recovery from power failure

### ■ ACCESSORIES

Description	Part number
Hard plastic cover	Y92A-72C
Track mounting adapter for H5S-FB	Y92F-90
Mounting track	50 cm (1.64 ft) length
	1 m (3.28 ft) length
	End plate
	PFP-50N
	PFP-100N
	PFP-M

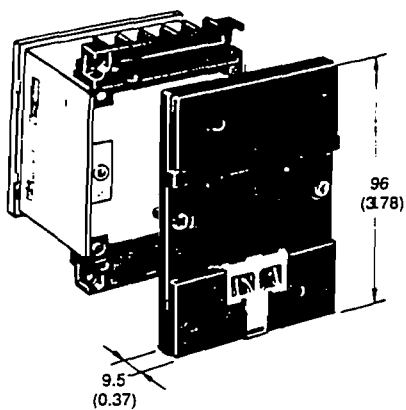
# Specifications

Part number		H5S-B	H5S-FB
Supply voltage	AC	100 to 240 V, 50/60 Hz	
	DC	-	
Operating voltage		85 to 110% of rated voltage (85 to 264 VAC), 50/60 Hz	
Power consumption	AC	10 VA	
	DC	-	
Timing functions		ON and OFF programming	
Reset (boot) input		No-voltage, 0.2 sec minimum	
Control output	Type	SPST-NO x 2 circuits	
	Time limit	1 sec to 59 seconds or 1 min to 60 min	
	Pulse	15 A, 250 VAC resistive load	
	Max. load	100 mA, 5 VDC	
Repeat accuracy		±0.01%, ±0.08 second max.	
Long-term error		±15 seconds per month at 25°C (77°F); ±4 seconds/week, ±1 minute/4 months	
Setting error		Included in "Repeat Accuracy"	
Indicators		10 mm LCD; day, hours (a.m., p.m.), minutes (0:00 to 11:59 a.m., 0:00 to 11:59 p.m.) Digital display of program steps during operation Timing chart display of program steps during operation	
Materials		Plastic	
Mounting		Panel	Surface and track with adapter
Connections		Terminal screws	
Weight		200 g (7 oz.)	
Approvals	UL	Recognized, File No. E52800	
	CSA	Certified, File No. LR65830	
	Others	SEV, File No. 1021	
Operating ambient temperature		-10° to 55°C (14° to 131°F)	
Humidity		35 to 85% RH	
Vibration	Mechanical durability	10 to 55 Hz, 0.75 mm (0.03 in) double amplitude	
	Malfunction durability	10 to 55 Hz, 0.5 mm (0.02 in) double amplitude	
Shock	Mechanical durability	30 G	
	Malfunction durability	10 G	
Variation due to voltage change		Included in "Repeat accuracy"	
Variation due to temperature change		Included in "Repeat accuracy"	
Insulation resistance		100 MΩ minimum between current-carrying terminals and non-current-carrying metal parts: operation circuit and contact control output circuit; non-continuous contacts	
Dielectric strength		2,000 VAC, 50/60 Hz for 1 minute between current-carrying terminals and non-current-carrying metal parts, and operation circuit and contact control output circuit. 1,000 VAC, 50/60 Hz for 1 minute between non-continuous contacts	
Service life	Electrical	50,000 operations minimum, 15 A, 250 VAC, resistive load	
		50,000 operations minimum, 1 HP, 250 VAC, motor load	
		50,000 operations minimum, 10 A, 250 VAC, inductive load (p.f.=0.7)	
		50,000 operations minimum, 100 W, 100 VAC, lamp load	
		10,000 operations minimum, 300 W, 100 VAC, lamp load	



■ TRACK MOUNTING ADAPTER

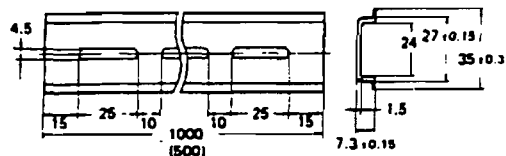
Y92F-90



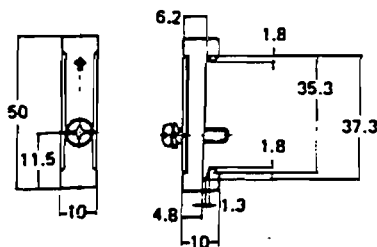
The H5S-FB timer can be mounted on DIN rail track using the Y92F-90 adapter. Two screws supplied with the timer fasten the adapter to the timer.

■ MOUNTING TRACK AND ACCESSORIES

PFP-100N/PFP-50N DIN Rail



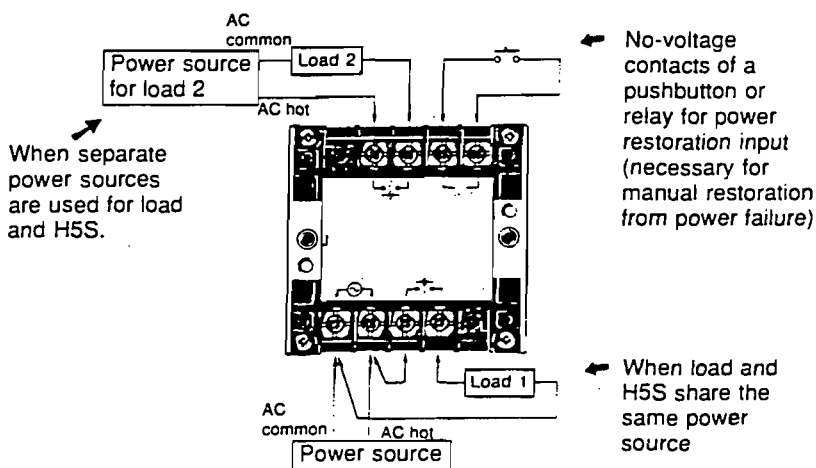
PFP-M End Plate



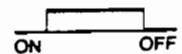
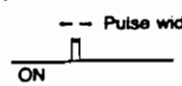
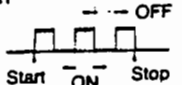
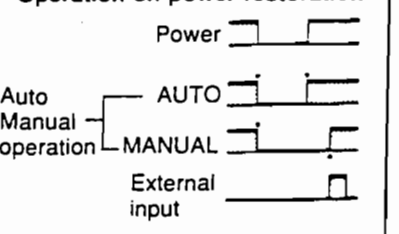
Connections

■ H5S-B PANEL MOUNTING TYPE

(Rear view)

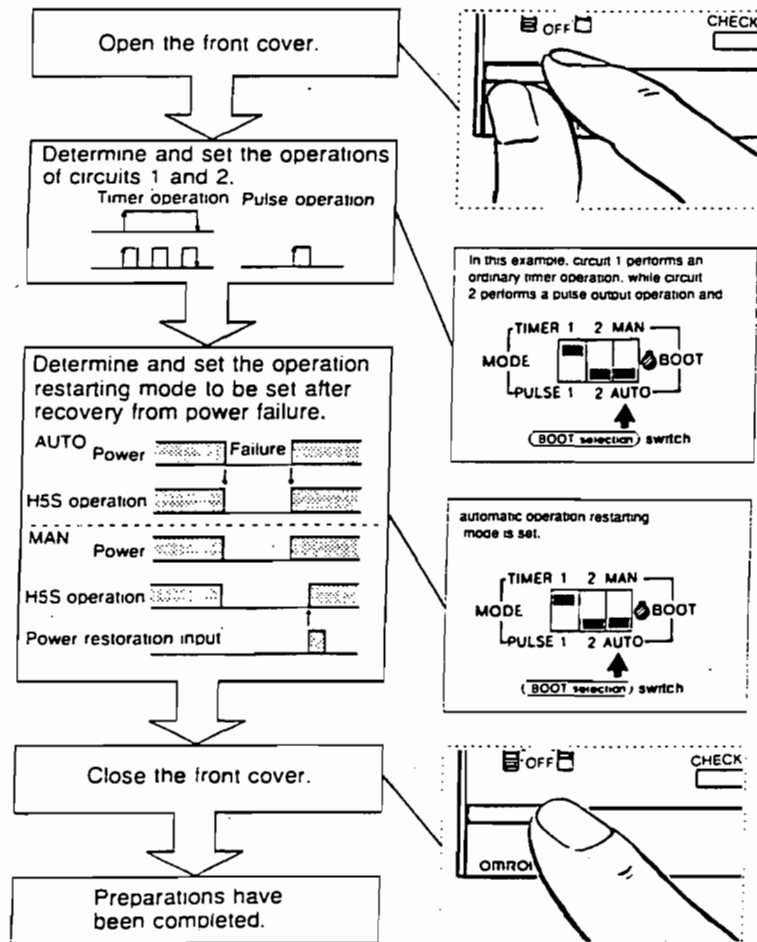


■ OPERATING FUNCTIONS

<p><b>Timer Operation</b></p> 	<p>Controls the output according to the set time of ON and OFF (the time can be set in units of 1 minute)</p>
<p><b>Pulse-Output operation</b></p> 	<p>Produces the output for a fixed duration at the set ON (pulse width: 1 to 59 seconds, or 1 minute to 59 minutes). The pulse width can be set in units of 1 second or 1 minute.</p>
<p><b>Cycle operation</b></p> 	<p>Repeatedly performs an ON/OFF operation during a specific period, which can be set in units of 1 minute</p>
<p><b>Forced ON/OFF operation</b></p>	<p>Forcibly turns ON/OFF the output by a slide switch</p>
<p><b>Operation on power restoration</b></p> 	<p>AUTO: Operation is automatically started on power recovery                  MANUAL: Operation is started by applying an external no-voltage signal of 0.2 sec minimum after power recovery.</p> <p>Note that the signal must be a low to high transition (open to closed switching).</p>
<p><b>Day override operation</b></p>	<p>Executes a day's operation on another day. The specified new operation is performed only for one week. This could be used for holidays.</p>

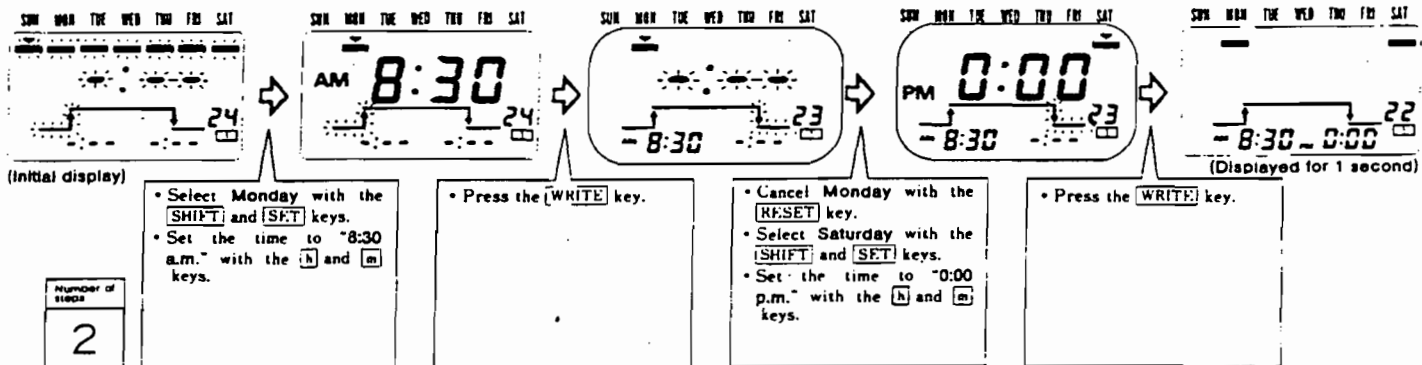
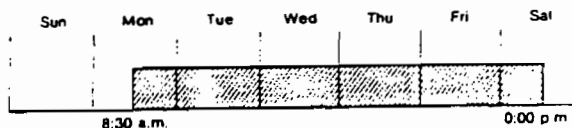
■ PROGRAMMING

Before setting the parameters necessary for each operation, the operation of circuits (outputs 1 and 2) must be determined. Also, specify whether the operation is restarted automatically or manually after power failure recovery.



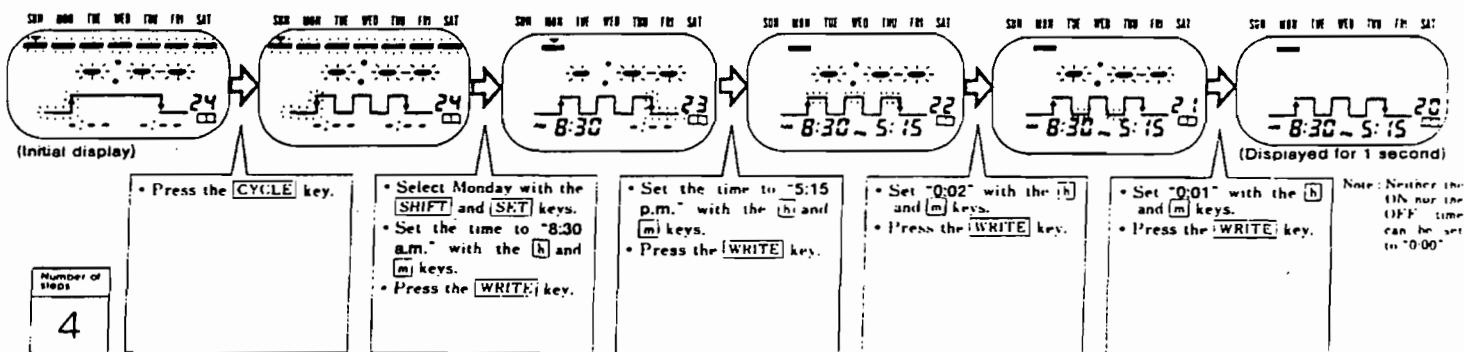
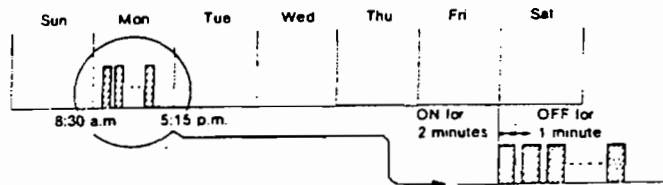
### Multiple-Day Operation

The timer turns ON circuit 1 at 8:30 a.m. on Monday, and turns it OFF at 0:00 p.m. on Saturday. Set mode selector to P1.



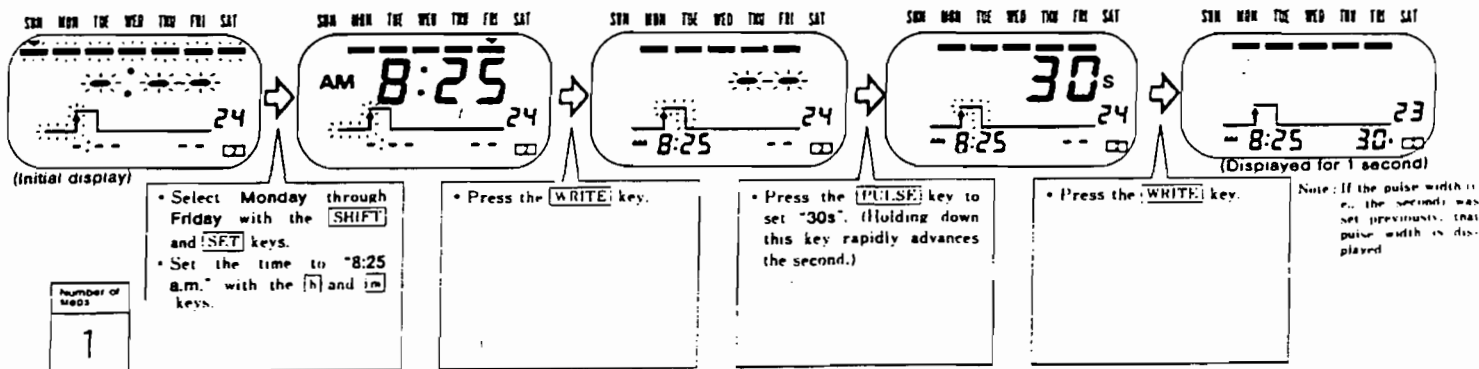
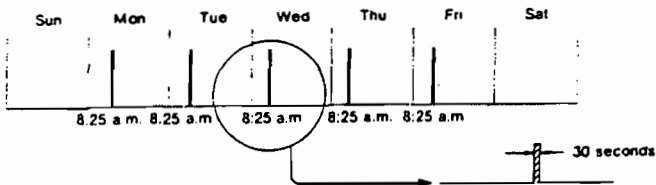
### Cycle Operation

Circuit 1 is set to turn ON for 2 minutes and OFF for 1 minute repeatedly, from 8:30 a.m. to 5:15 p.m. on Monday. Set mode selector to P1.



### Pulse Output Operation

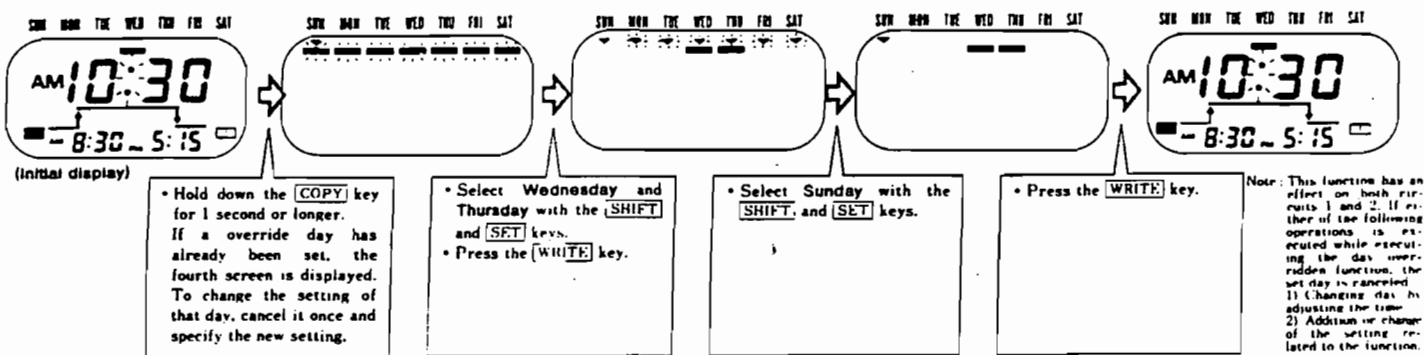
Circuit 2 is turned ON for 30 seconds at 8:25 a.m., Monday through Friday. Set mode selector to P2.



## BEST AVAILABLE COPY

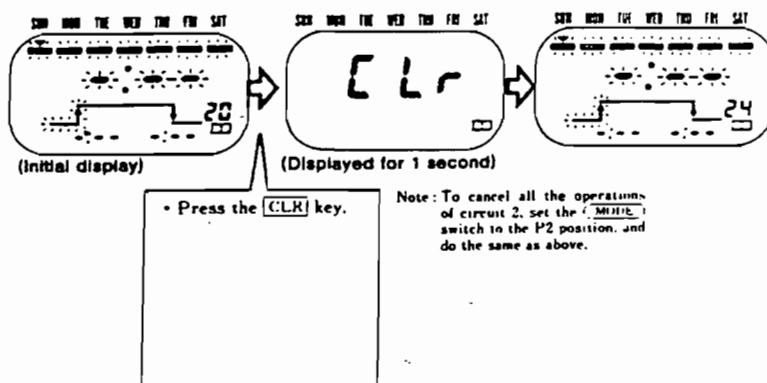
## Day Override

Wednesday and Thursday are holidays in the next week, the operations set for Sunday will be executed on these days. (The time switch executes the new program for only one week from the day next to when the program is set. After the one week, the timer operates according to the previous program.)

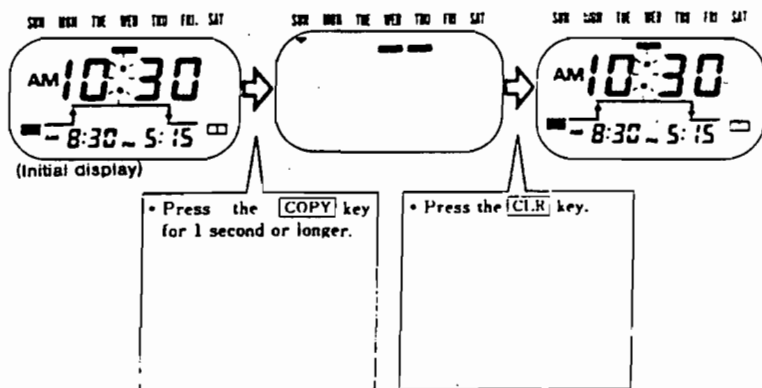


## Canceling the Setting

All the operations of circuit 1 or 2 can be cancelled. In the following example, all the operations of circuit 1 are cancelled. Set mode selector switch to P1.



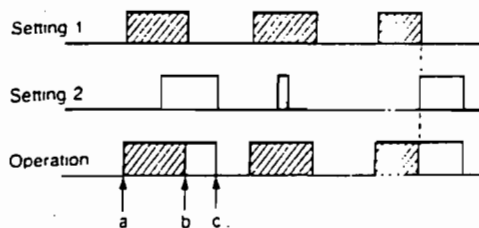
In the next example an overridden operation is cancelled. Set mode selector to RUN.



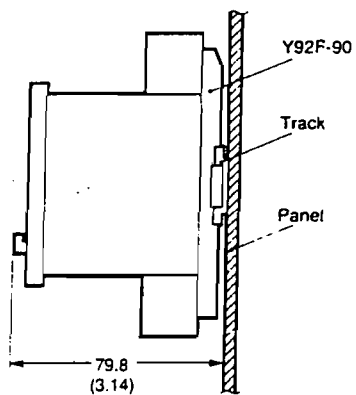
## ■ PRECAUTIONS

## Ordinary Timer Operation

The earlier ON time takes precedence.

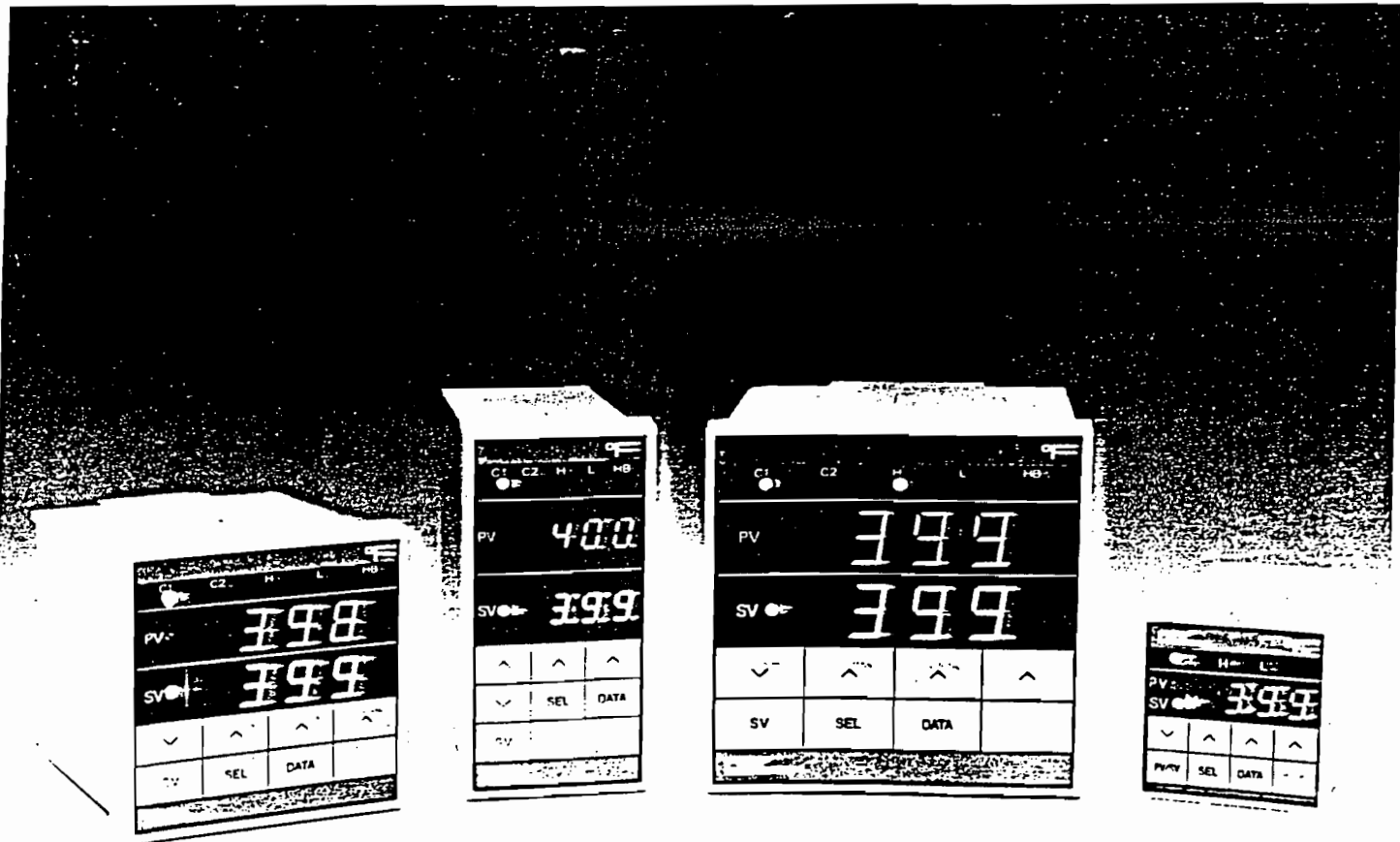


If both settings 1 and 2 are for an ON/OFF or pulse operation, the output is continuously produced without being interrupted. For example, if setting 1 is for cyclic operation, and 2 is set for an ON/OFF operation, the cyclic operation is performed during period of a to b, and the ON/OFF operation is performed from b to c.

**■ TRACK MOUNTING H5S-FB****Use Y92F-90 Track Mounting Base**

**NOTE: ALL DIMENSIONS ARE IN MILLIMETERS. To convert millimeters into inches divide by 25.4.**

**Electronic  
Temperature  
Controllers**



## PYZ SERIES

**T**HE Fuji PYZ Series process/temperature controller is one of the most technically advanced instruments in the industrial market today; it is also one of the least expensive controllers of its' kind. Through the use of a specially designed Fuji Electric micro-processor, the PYZ Series controller incorporates the latest SMT technology in controlling your application as never before. With simple finger-tip programming from the front panel, the operator can tailor the operation of the controller quickly and easily. By automatically setting Proportional band, Integral (reset) time, and Derivative (rate) time by means of the autotuning function, control parameter guesswork is eliminated forever. All this capability would normally be very expensive, however the PYZ Series controller is priced lower than many analog controllers. The PYZ Series opens the door to the next generation of control instrumentation.

The PYZ Series includes: 1/16, 1/8 and 1/4 DIN, as well as 72mm instruments, sized to fit standard panel cut-outs. Bright, easy-to-read, 4-digit LED displays indicate process and, or setpoint temperature, depending on the model. All function setting is performed on the front panel using tactile dome keys. By means of a user friendly, menu driven format, the operator can program main and sub-control setpoints and lock the data in memory to prevent possible tampering. In the secondary menu, the operator can program such items as control action, input type, digital filtering, range, alarm type, decimal point position, offsets and scale. All this to configure your controller

to your particular process. You may never need to change a single factory setting, but it is nice to know you can if you need to.

Outputs on the PYZ Series controller include: relay, 24Vdc pulsed for a SSR, 4-20 mA, and a .3A triac driver. Options include: sub-control (alarms), second output (cooling), programmable ramp-to-setpoint, and heater break alarm, depending on the model. All options except the ramp-to-setpoint

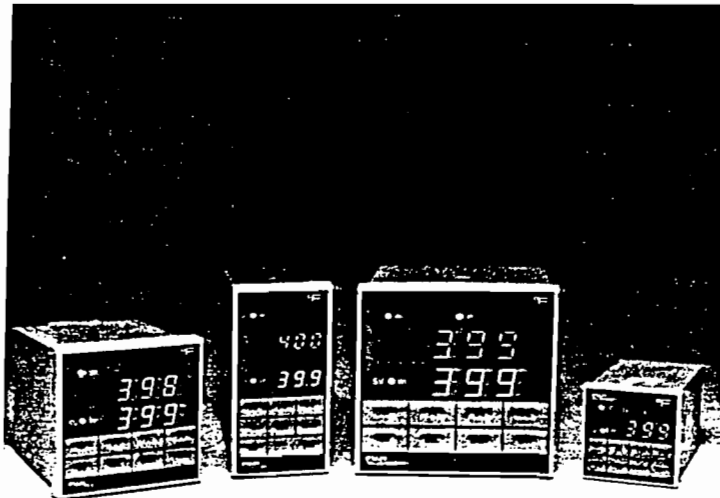
option are controlled by the same microprocessor and are just card changes, making the controller very universal. The following pages include detailed specifications for each model of the PYZ Series. After reviewing the information, we at TTI believe you will want to install PYZ controllers in all your control applications.

With an accuracy rating of  $\pm .5\%$  full Scale, The Fuji PYZ Series controller is all you need

to control process/temperature easily, precisely, and cost effectively.

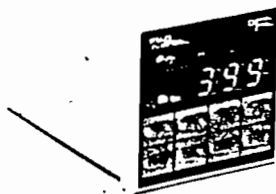
We, at Total Temperature Instrumentation, the exclusive agent for Fuji controllers in North America, stand behind the PYZ product line and to prove it offer you, the customer, a 2 year warranty against defects in manufacturing.

The PYZ SERIES . . . the new wave in control instrumentation.





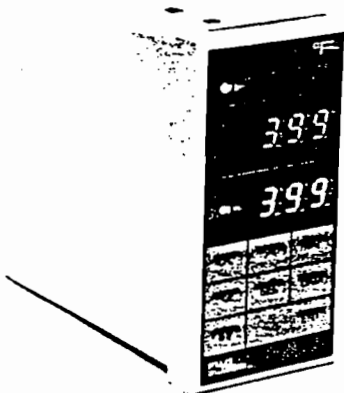
**PYZ4**



**Dimensions:**  
48(H) × 48(W) × 87(D)mm  
(measurements without socket)

**Weight:**  
150 gr.  
5.3 oz.

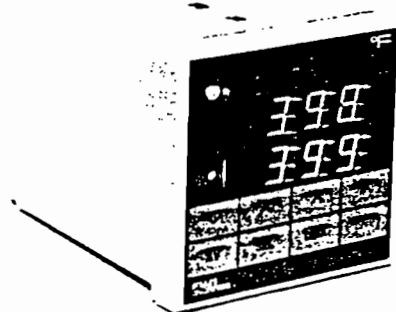
**PYZ5**



**Dimensions:**  
96(H) × 48(W) × 100(D)mm  
3.78(H) × 1.88(W) × 3.94(D) in.

**Weight:**  
300 gr.  
10.6 oz.

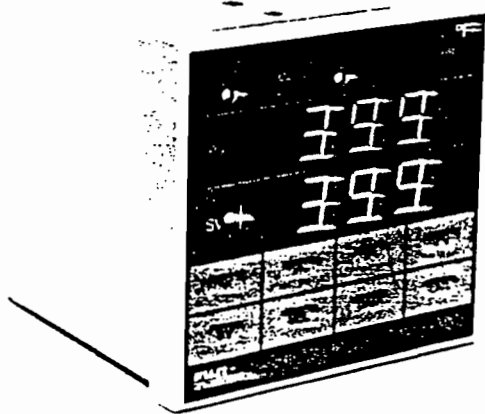
**PYZ6**



**Dimensions:**  
72(H) × 72(W) × 100(D)mm  
2.83(H) × 2.83(W) × 3.94(D) in.

**Weight:**  
300 gr.  
10.6 oz.

**PYZ9**



**Dimensions:**  
96(H) × 96(W) × 100(D)mm  
3.78(H) × 3.78(W) × 3.94(D) in.

**Weight:**  
400 gr.  
14.1 oz.

**FEATURES**

- PID Autotune with Manual Override—Heating or Cooling
- Programmable Control Action—Reverse or Direct
- Programmable Cycle Time
- 4-Digit, LED Indication
- Output Status Indication
- Fault Indication
- Selectable Indication Resolution
- Digital Filtering (to Suppress Factory Noise)
- Setting—Tactile Dome Keys
- Menu Driven Format
- Programmable Input Type
- Sensor Break Protection:
 

Direction	Display	Output
Upscale	UUUU	H/ Alarm
Downscale	LLLL	L/ Alarm
- Range Limiter
- Selectable °C and °F
- Offset Adjustments
- Programming Lock-Up Feature
- Non-Volatile Memory
- Outputs: Relay, 24V dc pulsed, 4–20mA, and 0.3A Triac Driver ac pulse
- 1/8, 1/6, 1/4 DIN or 72mm Panel Mount Package
- Termination—Screw-Down Type (PYZ5, PYZ7, PYZ9)  
Socket with Screw-Down Terminals (PYZ4)
- ABS Plastic Housing
- Metal Mounting Bracket
- Drip and Dust Proof Front Panel
- Optional—High/Low Alarm Outputs
- Optional—Secondary Output (Cooling)
- Optional—Ramp-to-Setpoint (Adjustable)
- Optional—Heater Break Alarm
- 85 to 265V ac Free Voltage Power Supply
- 2 Year Warranty
- Excellent Price



# SPECIFICATIONS

<b>Indicating Accuracy</b>	±0.5% Full Scale + 1 digit	<b>Input Range:</b>	
<b>Setting Accuracy</b>	±0.5% Full Scale + 1 digit	<b>(RTD)</b>	-150 to -100 . 400°C    -238 to -148 . 752°F
<b>Temperature Stability</b>	5 µV/°C	<b>(4-20mA dc)</b>	-1999 . . . . . 3000 Engineering Units
<b>Repeatability</b>	.83°C	<b>(1-5V dc)</b>	-1999 . . . . . 3000 Engineering Units
<b>Sampling Time</b>	0.5 sec.	<b>Output 1:</b>	
<b>Indication:</b>		<b>Relay</b>	3A, 220V ac; SPDT (Resistive Load) Electrical Life: 10 <sup>5</sup> Operations Mechanical Life: 10 <sup>7</sup> Operations
<b>(PYZ4)</b>	Process/ Setting Variable: Changeable (PV/SV) Red, 4-digit, 7 segment LEDs	<b>Voltage (Pulsed)</b>	24V dc (DC drive for a SSR) ON: 24V dc typical, 60V dc max. OFF: 0.3V dc max.
<b>(PYZ5, PYZ7, PYZ9)</b>	Process/ Setting Variable: Independent (PV): Red, 4-digit, 7 segment LEDs (SV): Green, 4-digit, 7 segment LEDs	<b>Current</b>	4-20mA dc (Resistive Load) Impedance: 600 ohms or less Ripple Effect: 1.5% FS/2 Hz.
<b>Status Indicators</b>	Control Outputs, Alarm Outputs, Heater Break Alarm	<b>Triac Driver (Pulsed)</b>	0.3A, 240V ac (AC drive for a Triac) Current Leakage: 1.5mA ac max.
<b>Span of Display</b>	DC: -1999 to 3000 max. (Programmable) Thermocouple: Temp. Range (Programmable) RTD: Temperature Range (Programmable) (Display Over-range: 30% of Range) (Display Under-range: 30% of Range)	<b>Output 2:</b>	(Optional) Same Choices as for (Output 1)
<b>Setting:</b>	Tactile Dome Keys on Front Panel	<b>Sub-Control (Alarms)</b>	(Optional) Deviation, Absolute, and Combination
<b>Control Mode (output 1):</b>		<b>Setting Type</b>	
<b>Proportional Band</b>	0 to 999.9% (Autotunable)	<b>Alarm Type</b>	High Low Low with Hold High/Low High/Low with Hold
<b>Integral Time</b>	0 to 9999 sec. (Autotunable)	<b>Output</b>	Relay: 1A, 220V ac: SPST (Resistive Load) (1) Contact: PYZ4 (2) Contacts: PYZ5, PYZ7, and PYZ9
<b>Derivative Time</b>	0 to 3600 sec. (Autotunable)	<b>Heater Break Alarm</b>	(Optional and not available on the PYZ4 or with the Ramp-to-Setpoint Option) Input: 1 to 50A 50/60 Hz. (Current Sensing Transformer) Output: Relay: 1A, 220V ac: SPST (Resistive Load)
<b>Cycle Time</b>	1 to 150 sec. (Relay, 24Vdc, and Triac Driver)	<b>Memory</b>	Non-Volatile
<b>Anti-Reset Wind-Up</b>	Standard (Fixed)	<b>Diagnostics</b>	Monitored by Watchdog Timer
<b>Hysteresis</b>	0.0 to 20.0% (for On/Off Control)	<b>Mounting</b>	Flush, Panel Mount
<b>Control Mode (output 2)</b>	(Not available on the PYZ4)	<b>Enclosure</b>	ABS Plastic (Color: off-white)
<b>Proportional Band</b>	0.1 to 99.9 (Programmable)	<b>Termination</b>	Screw-Down Type Terminals (PYZ5, PYZ7, PYZ9) 8 or 11-Pin Socket with Screw-Down or Solder Terminals (PYZ4)
<b>Coefficient for Cooling</b>		<b>Front Panel</b>	Lexan Drip and Dust Proof (IEC IP65 Standard)
<b>Integral Time</b>	Same as for Control Mode (Output 1)	<b>Power Supply</b>	85 to 265V ac
<b>Derivative Time</b>	Same as for Control Mode (Output 1)	<b>Power Consumption</b>	10 watts
<b>Cycle Time</b>	1 to 150 sec. (Relay, 24Vdc, and Triac Driver)	<b>Dielectric Strength</b>	Input: 500V ac Power Supply: 1500V ac
<b>Dead Band/Overlap</b>	-50.0 to +50.0% (Control Output Full Scale)	<b>Insulation Resistance</b>	50M ohm or more
<b>Input:</b>	(Programmable)	<b>Noise Rejection</b>	Common Mode: 110 db typical Normal Mode: 50 db typical
<b>Thermocouple</b>	J, K, R, B, S, T, E Cold Junction Compensation Thermocouple Break Protection (Upscale: Downscale) Lead Wire Effect: 0.5 µV/ ohm	<b>Ambient Temperature</b>	-10 to 50°C
<b>RTD</b>	(PT 100) IEC RTD Break Protection (Upscale: Downscale) Lead Wire Effect: 0.015%/ ohm	<b>Storage Temperature</b>	-20 to 60°C
<b>Current</b>	4-20mA dc Impedance: 250 ohm	<b>Ambient Humidity</b>	90% RH or less
<b>Voltage</b>	1-5V dc Impedance: 400K ohm		
<b>Input Range: (Thermocouple)</b>	J 0 to 200 . . . 1000°C    32 to 392 . . . . 1832°F K 0 to 200 . . . 1200°C    32 to 392 . . . . 2192°F R 0 to 1000 . . 1600°C    32 to 1832 . . . . 2912°F B 0 to 1500 . . 1800°C    32 to 2732 . . . . 3272°F S 0 to 1000 . . 1600°C    32 to 1832 . . . . 2912°F T -200 to 0 . . 400°C    -328 to 32 . . . . 752°F E 0 to 200 . . . 800°C    32 to 392 . . . . 1472°F		

# PROGRAMMING

## PRIMARY (SETPOINT) MENU

Parameter	Item	Meaning	Description
SV	SV	Main Setpoint	Settable within the Input Range
P	P	Proportional Band	Setting Range: 0.0 to 999.9% for On/Off Control Set to "0"
I	I	Integral Time (Reset)	Setting Range: 0 to 9999 sec. Integral Action is off when set to "0"
D	D	Derivative Time (Rate)	Setting Range: 0 to 3600 sec. Derivative Action is off when set to "0"
AL	AL	Low Alarm Setpoint	Settable within the Input Range Not Indicated without the Alarm Output Option
AH	AH	High Alarm Setpoint	Settable within the Input Range Not Indicated without the Alarm Output Option
TC	TC	Cycle Time (Output 1)	Setting Range: 0 to 150 sec. Not Indicated with Current Output For ON/OFF Control Set to "0" "0" = 0.5 sec.
HYS	HYS	Hysteresis (Output 1)	Setting Range: 0.0 to 20.0%
Hb	Hb	Heater Break Alarm	Setting Range: 0 to 50.0A Not Indicated without the Heater Break Alarm Output Option Not Available with the Ramp-to-Setpoint Option Alarm is off when set to "0"
Srr	Srr	Setpoint Ramp Rate	Setting Range: .1 to 999°/min. Not Indicated without the Ramp-to-Setpoint Option. Not Available with the Heater Break Alarm Output Option Function is off when set to "0"
AT	AT	Autotuning	Sets PID Parameters Internally (Reverse or Direct) 0—Autotuning off 1—Standard Autotuning 2—Below Setpoint Autotuning (10% FS Below Setpoint)
TC2	TC2	Cycle Time (Output 2)	Setting Range: 0 to 150 sec. Not Indicated without Control Output 2 Option Not Indicated with Current Output "0" = 0.5 sec.
CoOL	CoOL	Proportional Band Coefficient for Cooling	Setting Range: 0.1 to 100.0 Not Indicated without Control Output 2 Option For On/Off Control set to "0"
db	db	Dead Band/Overlap	Setting Range: - 50.0 to 50.0 Not Indicated without Control Output 2 Option
LoC	LoC	Lock-Up	Program Data Lock-Up: (Code) 0—All Data is Selectable 1—All Data is Locked-Up 2—All Data Except for Main Setpoint is Locked-Up

## SECONDARY (SYSTEM) MENU

Parameter	Item	Meaning	Description
P-n1	P-n1	Control Action	Setting Control Action: (Code) Reverse or Direct Setting Sensor Break Protection: (Code) Upscale or Downscale
P-n2	P-n2	Input Type	Setting Input Type: Thermocouple or RTD Current or Voltage
P-dF	P-dF	Digital Filter	Setting: (Code) 0 to 201 ½ of Setting = 63% Response Time
P-SL	P-SL	Lower Limit of Input Range	Setting Range: - 1999 to 3000
P-SU	P-SU	Upper Limit of Input Range	Setting Range: - 1999 to 3000
P-Ab	P-Ab	Alarm Type	Setting: (Code) Choices of Deviation, Absolute, and Combination Type Alarm Configurations
P-An	P-An	Alarm Hysteresis	Setting Range: 0-255°
P-dP	P-dP	Decimal Point Position (Resolution)	Setting: (Code) 0—Integers 2—Tenths of a Degree 4—Hundredths of a Degree 8—Thousandths of a Degree
P-48	P-48		Not to be Changed
P-CT	P-CT	Load (Heater) Voltage	Setting: Voltage used for Heater For the Heater Break Alarm Option Only Not Available with the Ramp-to-Setpoint Option
rS	rS	Ramp-to-Setpoint	Setting: (Code) 0—Non-Ramping 1—Ramp-to-Setpoint Not Available with the Heater Break Alarm Output Option
PVOF	PVOF	Process Variable Offset	Setting Range: - 1999 to 2000 Indicated Process Variable is Changed Measured Process Variable is Unchanged
SVOF	SVOF	Setpoint Variable Offset	Setting Range: - 1999 to 2000 Indicated Setpoint Variable is Unchanged Measured Setpoint Variable is Changed
P-F	P-F	C/F Selection	Setting: (Code) 0—°C 1—°F

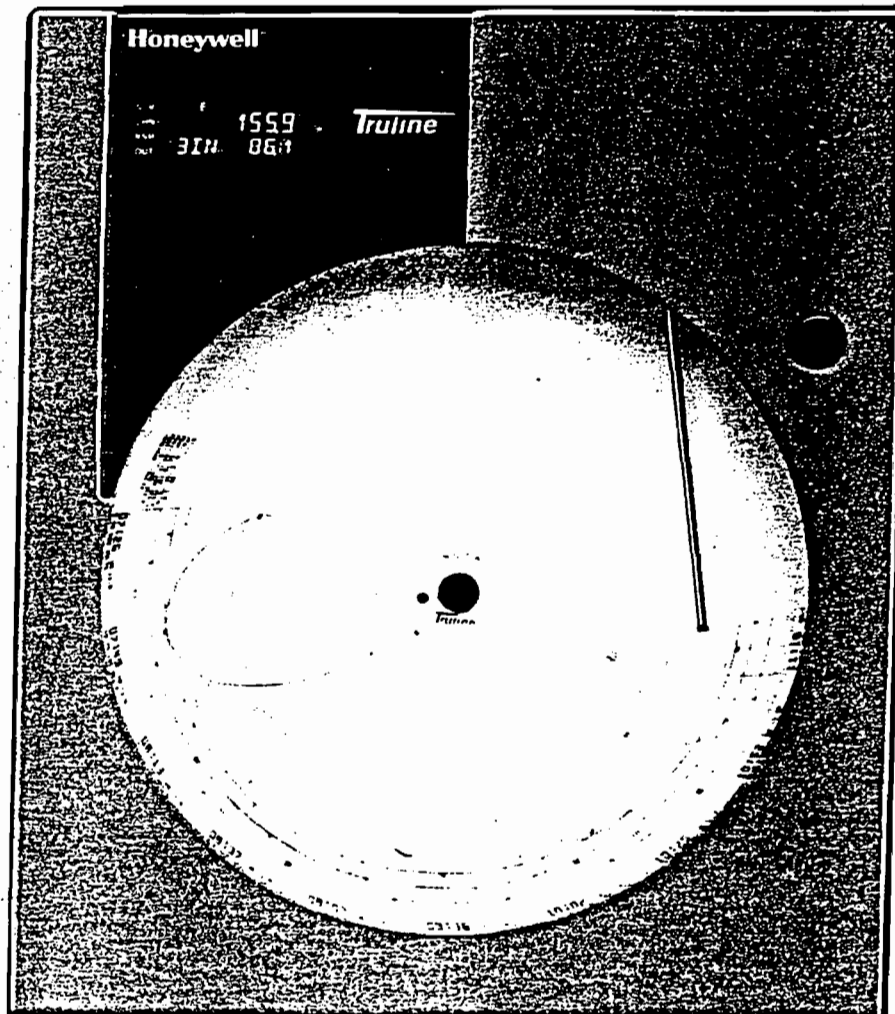
Chart Recorder

Honeywell

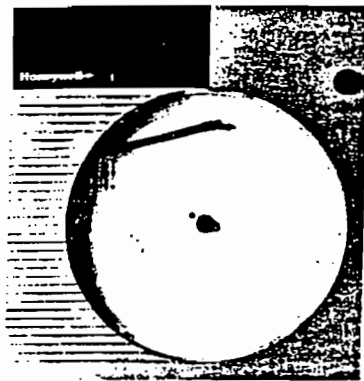
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DR 4500 Truline  
Circular Chart Recorder  
With or Without Control

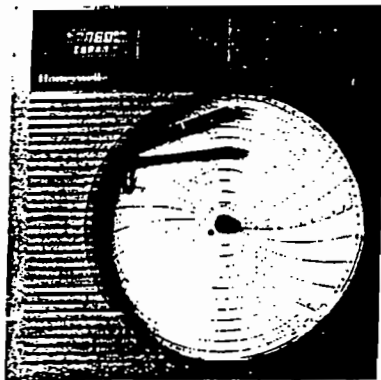
Product  
Manual



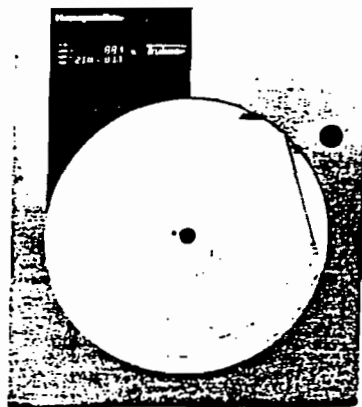
Industrial Automation and Control Division, 1100 Virginia Drive, Fort Washington, PA 19034  
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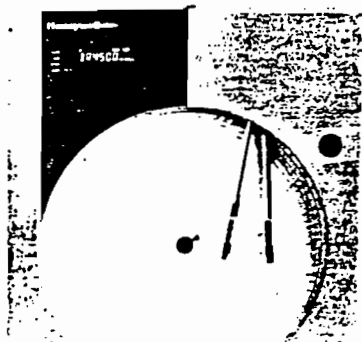
DR 4200 Digital Recorder GP



DR 4200 Digital Recorder EV



DR 4500 Truline Recorder



DR 4500 Classic Recorder

**BEST AVAILABLE COPY**

**Case Dimensions**

Blue gasketed door, meets NEMA 3 enclosure requirements. Measures 14" (w) x 14" (h) x 3.07" behind panel.

**Condensed Specifications**

	DR 4200 GP	DR 4200 EV
Accuracy	0.50% of span	0.25% of span
Inputs	Thermocouple types J, K, T; 100 ohms RTD; linear actuators, 4-20 mA, 0-20 mV, 0-50 mV, 0-5 VDC, and 1-5 VDC	DR 4200 GP actuators plus thermocouple types S, G, E, W5W26, and Ni Ni Moly; 0-10 mA, 0-100 mV, 0-200 mV, 0-1 VDC, 0-10 VDC
Pen	One or two pens	One or two pens
Control	On/Off control on each pen. High limit on one pen	On/Off, proportional with manual reset, and PID. 4-20 mA current output.
Display	None	Digital
Configuration	Switch selectable chart speed, chart range, actuation, burnout protection, control settings.	Configuration keypad

**DR 4500 Digital Recorder**

Use this recorder whenever you need to document process variables on a single chart. The DR 4500 records temperature, pressure, flow, liquid level and other process variables in industries such as:

- Food
- Pharmaceuticals
- Environmental testing
- Metalworking
- Any environment where process variables must be documented on a single circular chart, that can be retrieved easily on industry or customer demand.

The DR 4500 Digital Recorder accepts:

- milliamp
- millivolt
- volt signals
- thermocouple signals
- RTD signals

from:

- pressure transmitters
- other process variable detectors that produce electrical or resistance signals.

The DR 4500 Truline uses a heated stylus and heat-sensitive blank paper to tailor the chart and record to your process. The DR 4500 Classic uses disposable fiber-tip ink cartridges and standard charts (selectable from an inventory of over 5000 different charts). Both models use a large, easy-to-read 12" diameter chart, enabling you to view a complete process cycle on a single chart.

## Features/Benefits

Industrially hardened for plant use, the DR 4500 has a wide range of standard features, including the ability on the Truline to record as many as four process variables on the same time line. Optional features like communications and universal control outputs further extend its capabilities. The DR 4500 can also be equipped with an integral universal digital controller that can handle most control functions. The Truline can be equipped with two controllers; the Classic with one.

## Case Dimensions

Blue gasketed door meets NEMA 3 enclosure requirements; 14" (w) X 16.5" (h) X 4.2" (behind panel).

## Condensed Specifications

- **Accuracy** — Typically less than  $\pm 1^{\circ}\text{F}$  for the usable thermocouple ranges;  $\pm 0.1\%$  for voltage inputs.
- **Actuations** — Accepts ten thermocouple types, 100, 200, and 500 ohm RTDs, 0-10 mV, 0-50 mV, 0-5 V, 0-10 V, 4-20 mA. Depending on model.
- **Inputs** — One or two pens on Classic, one to four inputs on Truline.
- **Control** — Universal control option; includes On/Off, PID A or B, PID with manual reset; 1 or 2 controllers available, depending on model.
- **Charts** — 12" circular charts. Over 5000 pre-printed types for Classic.
- **Chart Illumination** — Available as an option.
- **Alarms** — As many as six optional alarms, depending on model.
- **Totalization** — Optional 1 to 4 Totalizers, depending on model. Prints on Truline Chart.
- **Setpoint Program** — Each controller may optionally include a setpoint programming capability on the Truline recorder.
- **Enclosures** — NEMA 3 standard and NEMA 4X enclosure optional.

See Specification Sheets 44-45-03-07 and 44-45-03-08 for complete specifications.

# Set-Up Tasks and Model Number Decoding

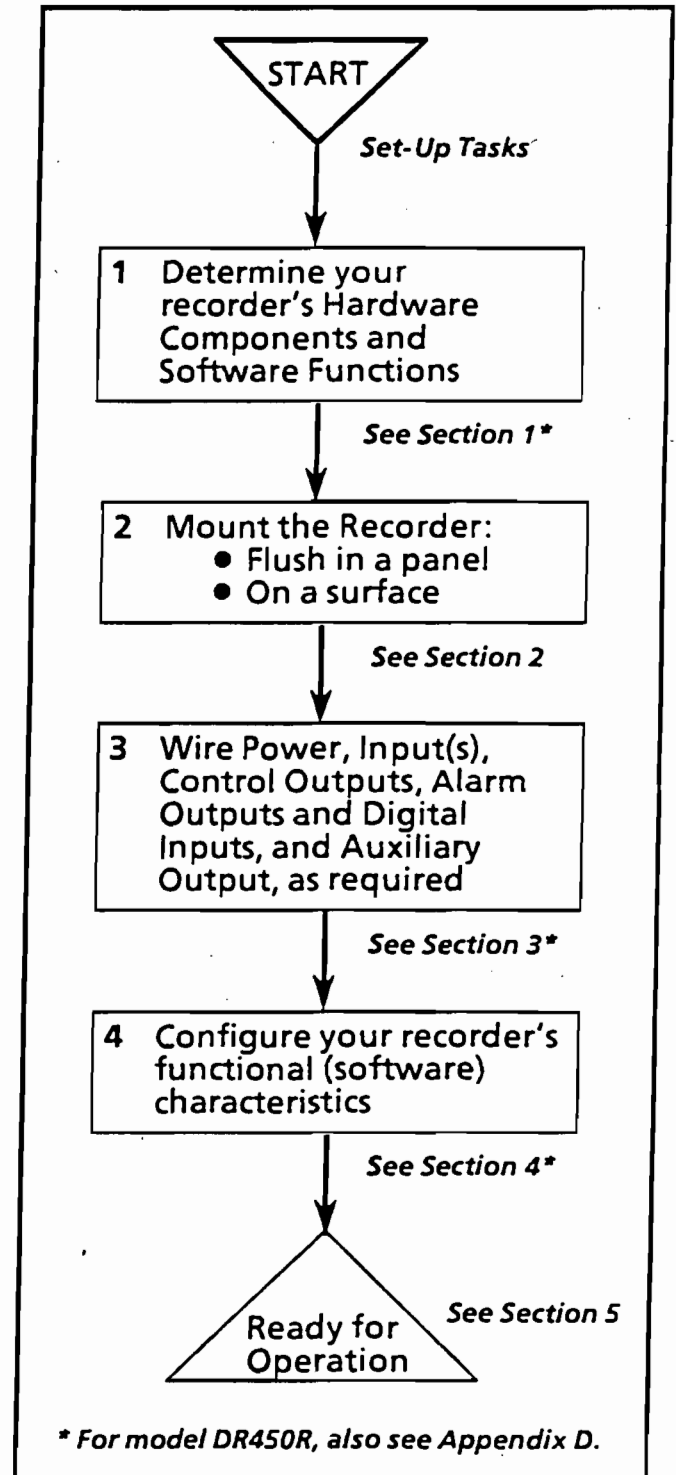
## Section 1

### Major Set-Up Tasks For DR 4500 Recorder

As shown in the flow diagram, there are four major tasks that you must complete to "Set-Up" the DR 4500 recorder for operation:

- 1 Decode your recorder's model number to verify its hardware components and software functions.
- 2 Mount the recorder flush in a panel, or on the surface of panel or a wall.
- 3 Connect power and input/output wiring.
- 4 Follow simple keystroke sequences and English language prompts to "configure" the functional characteristics of your recorder.

For easy reference, the following section numbers match the given set-up task number. Thus, proceed to the next page to decode your recorder's model number.



## 1 Decoding the Recorder's Model Number – Continued

*EXAMPLE: Assume that the model number on the label is DR 450T-1200-44-001-A-PW,66,CL-XXXX. Using the table code definitions from the previous diagram, this recorder is a 2-input type with thermocouple, RTD, mV, or 0-5Vdc input for channel 1, 4-20mA input for channel 2, two controllers with set point programming capability, alarm output/digital input capability, totalization for input 1, and plastic window, door lock, and chart illumination.*

2. After you decode your recorder's model number, use the following figures to match "table" selections with location of actual recorder hardware components. This will help you determine applicable input/output wiring needs as well as identify appropriate software functions to be configured later. To view actual components inside your recorder:
  - (1) Push in button on recorder door and swing door open.
  - (2) Loosen captive screw in right-hand side of chart plate and swing chart plate out.
  - (3) Reverse steps to close chart plate and door.

NEXT: Go to "Section 2 Mounting the Recorder."

# 1 Decoding the Recorder's Model Number – Continued

## VIEW B -- Key Number: DR 450T\* With Two to Four Inputs.

\* If Key Number is DR 450R, see Appendix D for internal views

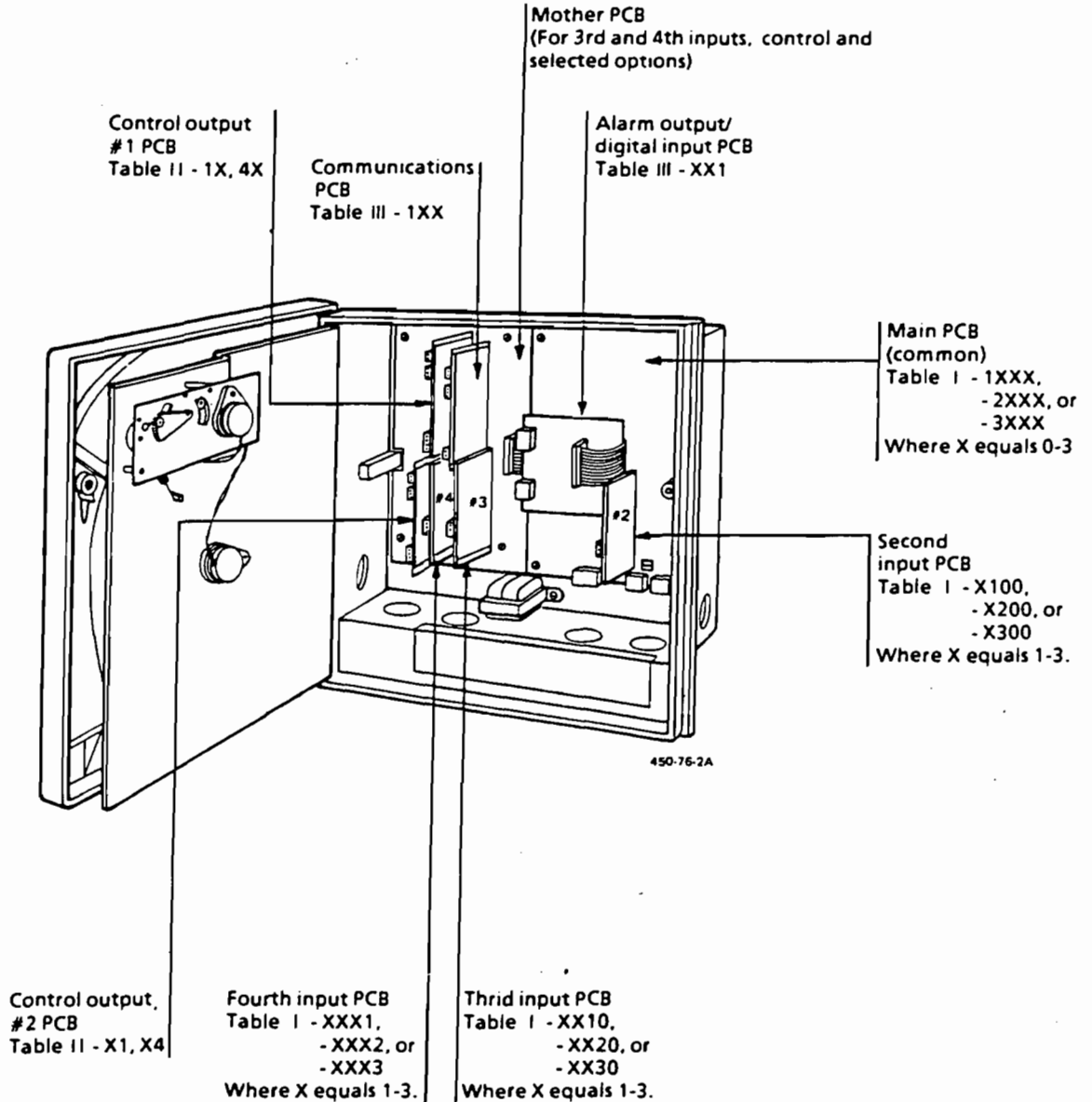


Figure 1-1 -- DR 450 Recorder hardware components versus "Table" selections -- Continued.

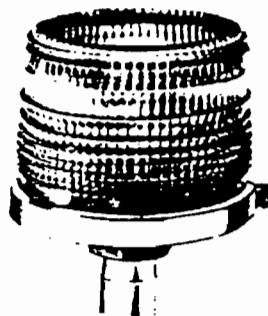


# Edwards® AdaptaBeacon® Strobe Lights

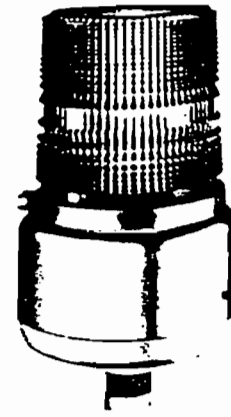
- AC or DC MODELS
- WEATHERPROOF INSTALLATION
- DOUBLE FLASH STROBE TECHNOLOGY
- DIRECT OR PIPE MOUNTING



No. 56 Series  
Strobe Beacon



No. 56P Series  
Strobe Beacon



No. 57 Series  
Strobe Beacon

## DESCRIPTION

Edwards strobe lights are used to command immediate attention. The unique patented double flash strobe increases the effective illumination and extends the time on without increasing the power consumption. The flash tube pulsates twice in such a rapid manner that the tube appears not to extinguish before it lights a second time.

## FEATURES

Edwards strobe lights have no moving parts and therefore are not subject to mechanical wear and are virtually immune to shock and vibration. The transistorized power supply and xenon flash tube flashes a 360° beam of light of tremendous intensity through a shatter-resistant Lexan®\*\* optic lens. Available in four colors: clear, red, amber and blue.

## 56 Series — Low Intensity Strobe — Direct or Pipe Mount — 12VDC

Self-contained power supply providing 80 double flashes per minute. Two means of mounting installations available: (A) flange mounting on 1" pipe and (B) direct surface mounting as on industrial vehicles. Hi/low intensity adjustment switch provides for optimum light level.

\*ADAPTABEACON is a registered trademark of the Edwards Company  
\*\*Lexan is a registered trademark of the General Electric Company.

## 57 Series — High Intensity Strobe — Pipe Mount — 120 or 240VAC

Self-contained power supply provides 80 double flashes per minute. Mounting on 1" pipe or conduit.

## APPLICATIONS

Edwards 50 series strobe lights are effective "attention getters" in any environment where personnel must be alerted to a change in building or equipment status, moving vehicles, intrusion or in the event of a hazardous condition or emergency.

**56 Series** — For use on industrial vehicles, such as forklifts, overhead cranes, security, emergency, repair and fire trucks.

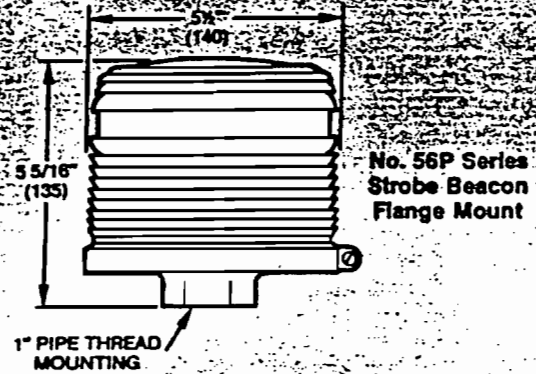
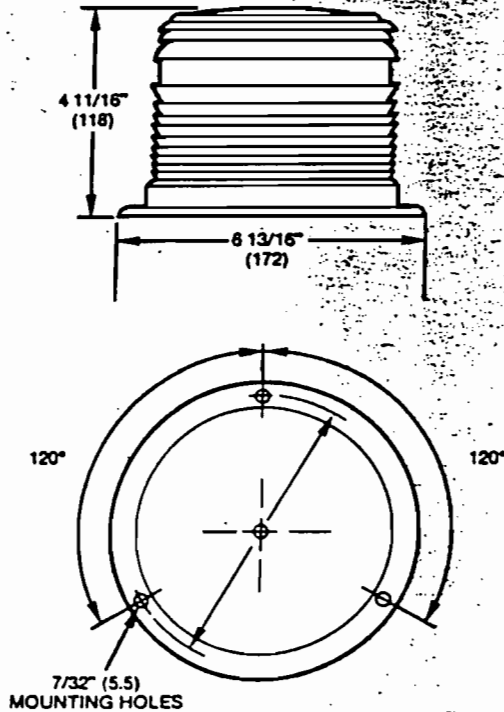
**57 Series** — To advise personnel in manufacturing and process areas when an operation is starting or stopping. To indicate malfunctions in equipment, such as an assembly line jam, a chemical spill, a gas line leak, or a blocked ventilator. To warn personnel that they are entering a hazardous area or area of high danger. To pinpoint areas of intrusion in security systems. For use on railroad locomotives, cabooses, yards and switching areas. As navigational aid on drawbridges, docks, vessels and fire boats.

A UNIT OF GENERAL SIGNAL

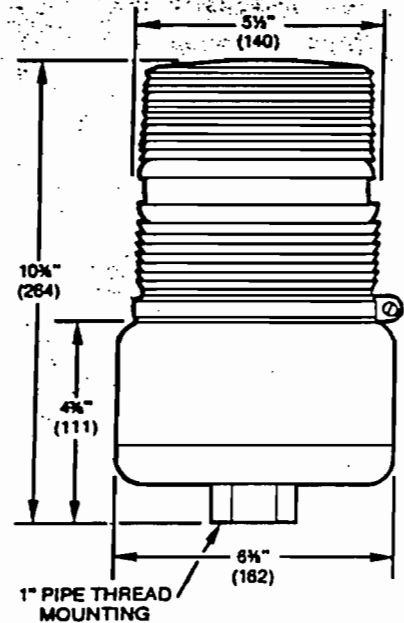
**EDWARDS**

**AdaptaBeacon Strobe Lights SPECIFICATIONS**

**No. 56 Series  
Strobe Beacon  
Direct Mount**



**No. 57 Series  
Strobe Beacon  
Flange Mount**



Description	Lens Cat. No.	Cat. No.* Color	Replacement Lens	Flash Rate	Voltage	Mounting	Lamp
Strobe Beacon Direct Mounting	56R-E1	Red	P-047549-0013	80 FPM	12V DC 2 amps	Direct 3 holes 120° apart on 5.937" bolt circle	Xenon Type Cat. No. 56-ST
	56A-E1	Amber	P-047549-0011				
	56B-E1	Blue	P-047549-0012				
	56C-E1	Clear	P-047549-0014				
Strobe Beacon Pipe Flange Mounting	56PR-E1	Red	P-047549-0013	80 FPM	12V DC 2 amps	Flange Type for mounting on 1" pipe	Xenon Type Cat. No. 56-ST
	56PA-E1	Amber	P-047549-0011				
	56PB-E1	Blue	P-047549-0012				
	56PC-E1	Clear	P-047549-0014				
AC Only Strobe Beacon Pipe Flange Mounting	57R-AY	Red	P-047549-0009	80 FPM	120V AC .40 amps	Flange Type for mounting on 1" pipe	Xenon Type Cat. No. 57-ST
	57A-AY	Amber	P-047549-0007				
	57B-AY	Blue	P-047549-0008				
	57C-AY	Clear	P-047549-0010	80 FPM	240V AC .20 amps	Flange Type for mounting on 1" pipe	Xenon Type Cat. No. 57-ST
	57R-AZ	Red	P-047549-0009				
	57A-AZ	Amber	P-047549-0007				
57B-AZ	Blue	P-047549-0008					
57C-AZ	Clear	P-047549-0010					

NOTE: Dimensions are in inches and millimeters. Specifications subject to change without notice.

GFK-0356

Series 90-30 CPU Capacities

The capacities of each model of CPU for the Series 90-30 PLC are listed in the following table.

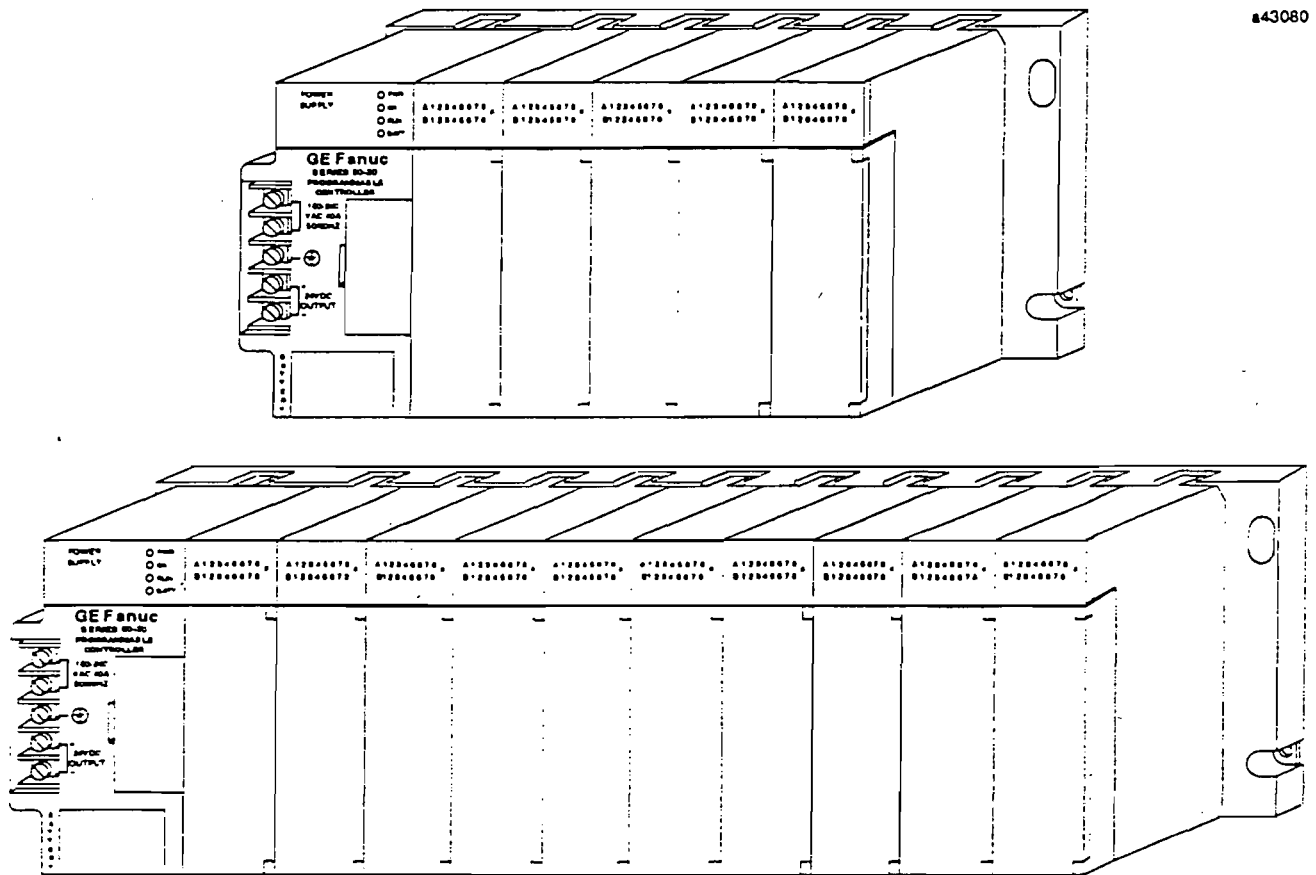
Table 1-1. CPU Capacities

PLC	Speed (MHz)	Processor	Input Points †	Output Points †	Maximum User Program Memory
Model 331 CPU	8	80188	512	512	8K (Words)
Model 311 CPU	8	80188	192	160	3K (Words)

† Model 331 CPU: total of 512 I/O points per system (any mix of I/O).  
 Model 311 CPU: total of 160 I/O points per system (any mix of I/O).

Series 90-30 PLC with Model 311 CPU

The following figure is an illustration of a 5-slot and a 10-slot Series 90-30 PLC Model 311.



a43080

Figure 1-1. Series 90-30 PLC Model 311 (5-Slot and 10-Slot)

GFK-0356

## General Specifications

General specifications for the Series 90-30 PLC are given in the following table.

Operating Temperature	0° to 60°C (32° to 140°F), (inlet air at bottom of rack)		
Storage Temperature	-40° to 85°C (-40° to 185°F)		
Humidity	5% to 95% (non-condensing)		
Vibration	0.2" 5-10Hz, 1G 10-200 Hz		
<b>AC Power Source</b>			
120 VAC Nominal Input	90 to 132 VAC		
240 VAC Nominal Input	180 to 264 VAC		
Frequency	47 to 63 Hz		
Output Power (maximum)	30 watts (total of all outputs combined)		
5V	15 watts		
24V Relay	15 watts		
24V Isolated	15 watts		
<b>Rack Weight (approximate, filled)</b>			
Model 331, 10 slot	10.5 pounds (4.7 kg)		
Model 311, 10 slot	10.9 pounds (4.9 kg)		
Model 311, 5 slot	6.2 pounds (2.8 kg)		
<b>Rack Dimensions</b>	Height	Width	Depth
Model 331 10 slot, CPU and expansion	5.1" (130mm)	17.4" (443mm)	5.6" (142mm)
Model 311 10 slot	5.1" (130mm)	17.4" (443mm)	5.6" (142mm)
Model 311 5 slot	5.1" (130mm)	9.65" (245mm)	5.6" (142mm)
<b>Back-up Battery Type</b>	Lithium, long-life		
<b>Typical Battery Life, Loaded</b>	About 6 months (depending on temperature)		
<b>Battery Shelf Life, No Load</b>	8 to 10 years		
<b>Typical Scan Rate</b>			
Model 331	0.4 ms/1K of logic (boolean contacts)		
Model 311	21.0 ms/1K of logic (boolean contacts)		
<b>Maximum number of Discrete I/O Points</b>			
Model 331	512 (any mix)		
Model 311	160 (any mix)		

## Configuration and Programming

Configuration and Programming of the Series 90-30 PLC can be accomplished through two different methods. Application programs and system configuration can be done using Logicmaster™ 90 Programming software on a Workmaster® II or Cimstar™ I computer or an IBM® PC or compatible Personal Computer, or they can be done using a convenient Hand-Held Programmer (HHP). Both configuration and programming can be done with the programmer off-line (Logicmaster 90) from the PLC. Although configuration can be done after programming, *it is recommended that configuration be done before programming*, so that the programming software can check memory constraints. Configuration and programming with the HHP must be done with the HHP attached to and interfacing with the PLC.

## Baseplates

Series 90-30 PLC hardware modules are contained in baseplates. Baseplates containing a power supply and configured with modules are referred to as racks.

### Series 90-30 Model 311 Baseplates

Series 90-30 PLC Model 311 hardware is available in two versions, a 5-slot baseplate (IC693CPU311) and a 10-slot baseplate (IC693CPU321). Both versions contain the Model 311 CPU, which is physically located on the same circuit board as is the backplane. The power supply for the PLC is mounted on the left side of the baseplate. This scheme allows all of the 5 or 10 slots to be available for I/O or other modules. There are no switches or jumpers on the Series 90-30 PLC Model 311 baseplates requiring configuration. Both the 5 and 10-slot baseplates must be panel mounted. The following figure is an illustration of a Model 311 5-slot and a Model 311 10-slot baseplate.

#43048

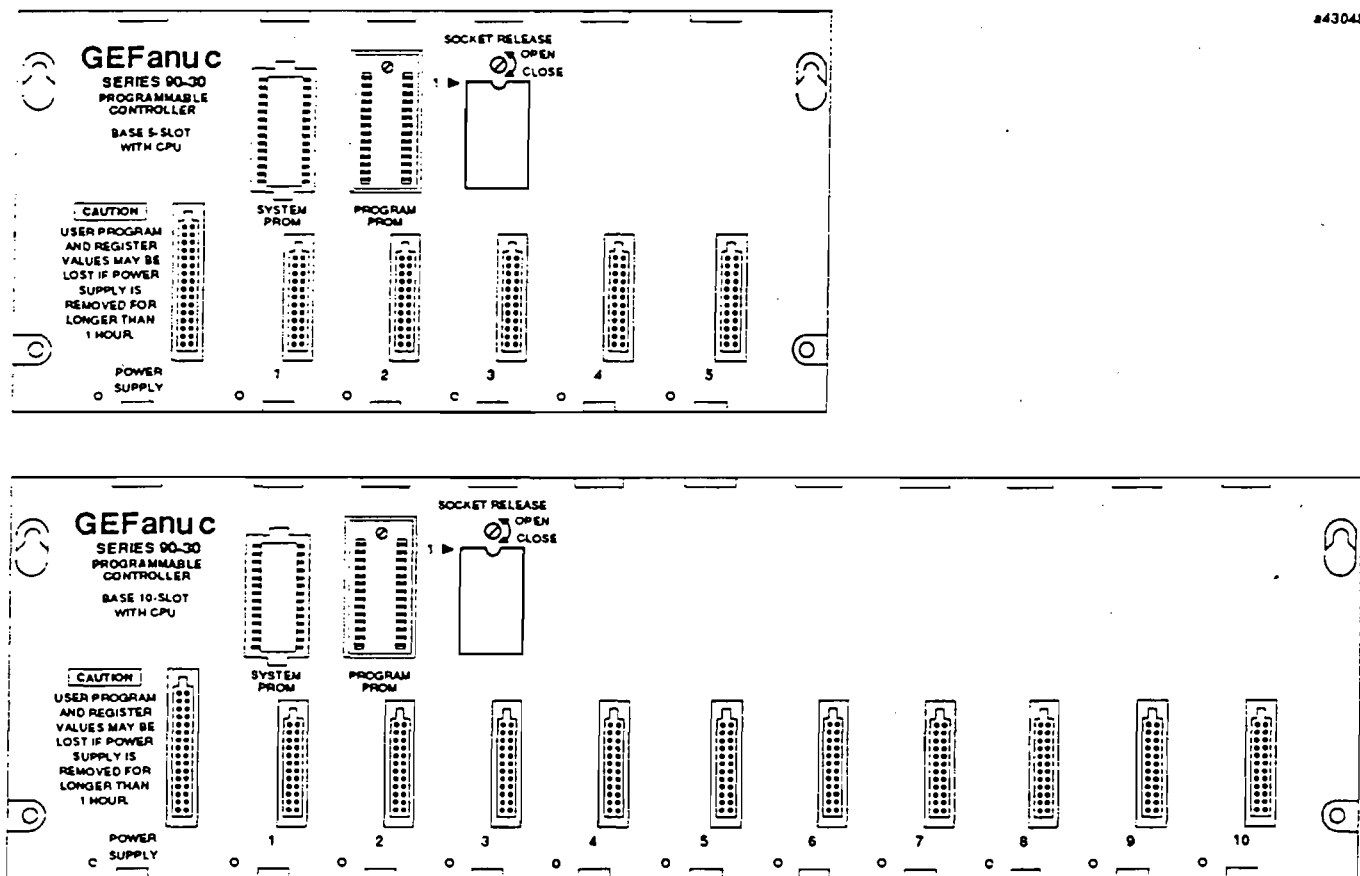


Figure 2-1. Series 90-30 PLC Model 311 Baseplates

### Universal Terminal Boards

All Model 30 I/O modules have, as a standard feature, detachable terminal boards for field wiring connections to and from user supplied input or output devices. This convenient feature makes it easy to prewire field wiring to the user supplied input and output devices, and to replace modules in the field without disturbing existing field wiring. All I/O connectors have 20 terminals and will accept up to one AWG #14 wire or two AWG #16 wires using ring or lug type terminals. Two terminals on the connector are for connection to a +24 volt DC supply for input modules requiring a 24 volt DC power source. Wires to and from field devices are routed out of the bottom of the terminal board cavity.

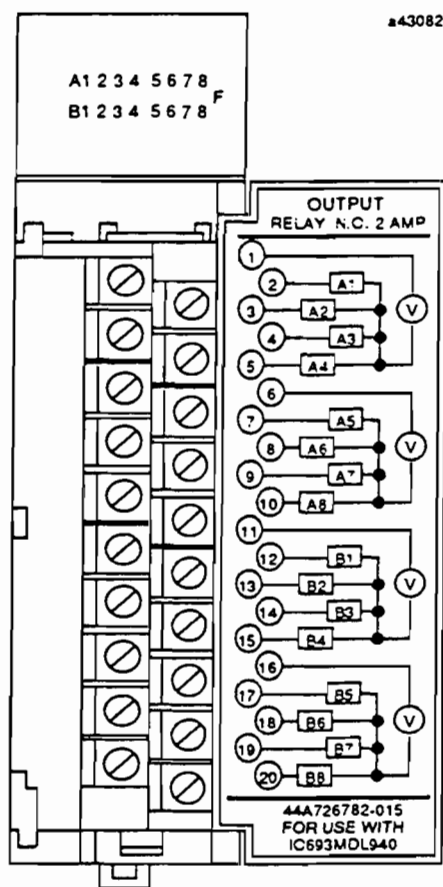


Figure 1-7. Model 30 I/O Module

### I/O Module Addressing

Module addressing is determined by the position (slot number) in the rack in which it is installed. *There are no jumpers or DIP switch settings required to address modules.* Actual reference addresses for each module are assigned by the user with the Configuration portion of the Logicmaster 90 Programming Software package, or with the Hand-Held Programmer. The configurator function of Logicmaster 90 allows the user to assign reference addresses to the I/O modules on a slot-by-slot basis.

### Option Modules for the Series 90-30 PLC

In addition to discrete and analog I/O modules, option modules are available for use in a Series 90-30 PLC system. Currently available option modules which can be used with both the Model 311 and 331

### 120 Volt AC Input, 16 Point IC693MDL240

The *120 volt AC input* module for the Series 90-30 Programmable Logic Controller provides 16 input points with one common power input terminal. The input circuits are reactive (resistor/capacitor) inputs. Current into an input point results in a logic 1 in the input status table (%I). Input characteristics are compatible with a wide range of user-supplied input devices, such as: pushbuttons, limit switches, and electronic proximity switches. Power to operate the field devices must be supplied by the user. This module requires an AC power source, it can not be used with a DC power source.

LED indicators which provide the ON/OFF status of each point are located at the top of the module. This LED block has two horizontal rows with eight green LEDs in each row: the top row labeled A1 through 8 (points 1 through 8) and the bottom row labeled B1 through 8 (points 9 through 16). An insert goes between the inside and outside surface of the hinged door. The surface towards the inside of the module (when the hinged door is closed) has circuit wiring information, and circuit identification information can be recorded on the outside surface. The outside left edge of the insert is color-coded red to indicate a high-voltage module.

This module can be installed in any slot of a 5 or 10-slot baseplate in a Model 311 system, or slots 2 through 10 of a CPU baseplate or any slot of an expansion baseplate in a Model 331 system.

Table 6-3. Specifications for 120 Volt AC Input Module

Rated Voltage	120 volts AC
Input Voltage Range	0 to 132 volts AC
Inputs per Module †	16 (one group with a single common)
Isolation	1500 volts RMS between field side and logic side
Input Current	14.5 mA (typical) at rated voltage
Input Characteristics:	
On-state Voltage	74 to 132 volts AC
Off-state Voltage	0 to 20 volts AC
On-state Current	6 mA minimum
Off-state Current	2.2 mA maximum
On response Time	30 ms maximum
Off response Time	45 ms maximum
Internal Power Consumption	90 mA (all inputs on) from 5-volt bus on backplane
Operating Temperature	0 to 60°C (32 to 140°F)
Storage Temperature	-40 to +85°C (-40 to +185°F)
Humidity	5 to 95% non-condensing

† Number of inputs on is dependent upon ambient temperature as shown in figure 6-2.

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Field Wiring Information

The following figure provides wiring information for connecting user supplied input devices and power source to the 120 volt AC input module.

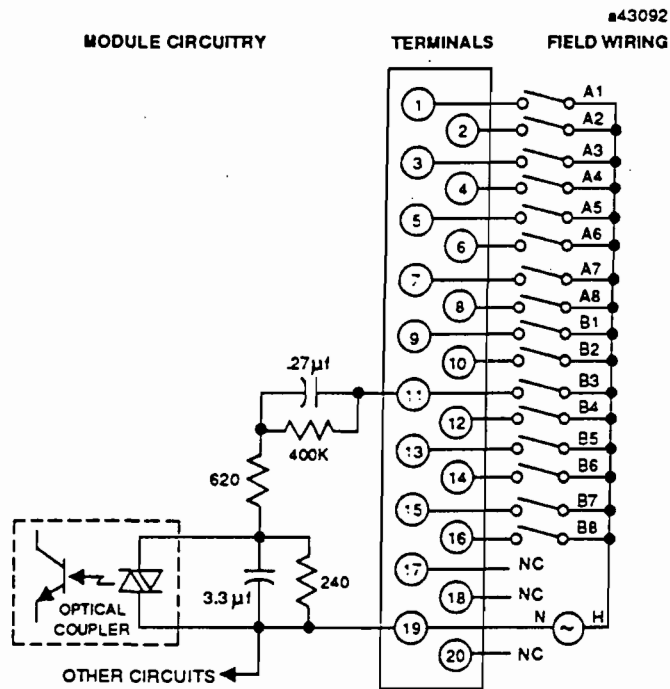


Figure 6-1. Field Wiring - 120 Volt AC Input Module

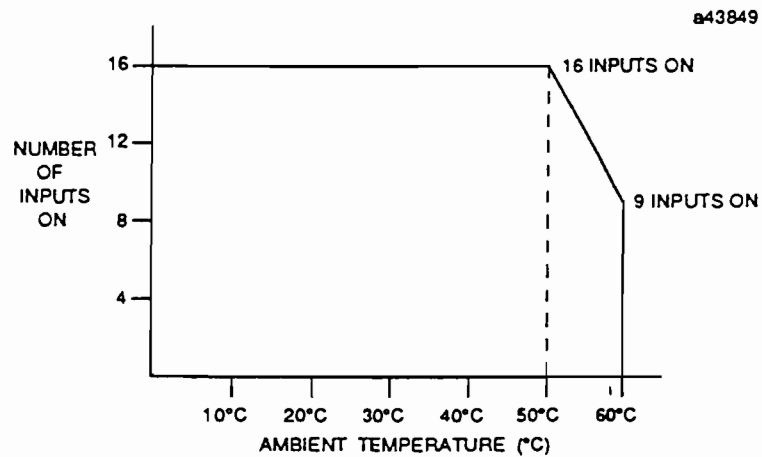


Figure 6-2. Input Points vs. Temperature for IC693MDL240



### 120 Volt AC Output - 0.5 Amp, 12 Point IC693MDL310

The *120 volt, 0.5 Amp AC output* module for the Series 90-30 Programmable Logic Controller provides 12 output points in two isolated groups with six points in each group. Each group has a separate common associated with it. The two commons are not tied together inside the module. This allows each group to be used on different phases of the AC supply, or they can be powered from the same supply. Each group is protected with a 3.2 amp fuse and an RC snubber is provided for each output to protect against transient electrical noise on the power line. This module provides a high-degree of inrush current (10x the rated current) which makes the outputs suitable for controlling a wide range of inductive and incandescent loads. AC Power to operate loads connected to outputs must be user supplied. This module requires an AC power source, it can not be used with a DC power source.

LED indicators which provide the ON/OFF status of each point are located at the top of the module. This LED block has two horizontal rows with eight green LEDs in each row and a red LED centered between and to the right of the two rows. This module uses the first six LEDs, labeled A1 through 6 in the top row and the first six LEDs, labeled B1 through 6, in the bottom row, for output status. The red LED functions as a blown fuse indicator that turns ON if any of the fuses should blow. An insert goes between the inside and outside surface of the hinged door. The surface towards the inside of the module (when the hinged door is closed) has circuit wiring information, and circuit identification information can be recorded on the outside surface. The outside left edge of the insert is color-coded red to indicate a high-voltage module.

This module can be installed in any I/O slot of a Model 311 or a Model 331 system.

Table 6-7. Specifications for 120 Volt AC Output, 0.5 Amp Module

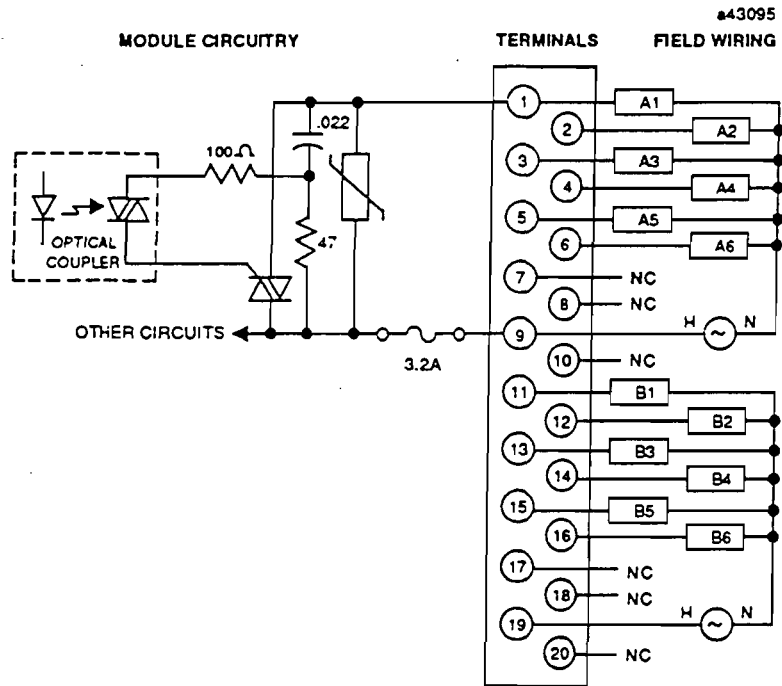
Rated Voltage	120 volts AC
Output Voltage Range	85 to 132 volts AC, 50/60 Hz
Outputs per Module	12 (two groups of six outputs each)
Isolation	1500 volts RMS between field side and logic side 500 volts RMS between each group
Output Current †	0.5 amp maximum per point 1 amp maximum per group at 60°C 2 amps maximum per group at 50°C
Output Characteristics	
Inrush Current	5 amps maximum for one cycle
Minimum Load Current	50 mA
Output Voltage Drop	1.5 volts maximum
Output Leakage Current	3 mA maximum at 120 volts AC
On Response Time	1 ms maximum
Off Response Time	1/2 cycle maximum
Internal Power Consumption	210 mA (all outputs on) from 5-volt bus on backplane
Operating Temperature	0 to 60°C (32 to 140°F)
Storage Temperature	-40 to +85°C (-40 to +185°F)
Humidity	5 to 95% non-condensing

† Maximum load current is dependent upon ambient temperature as shown in figure 6-9.

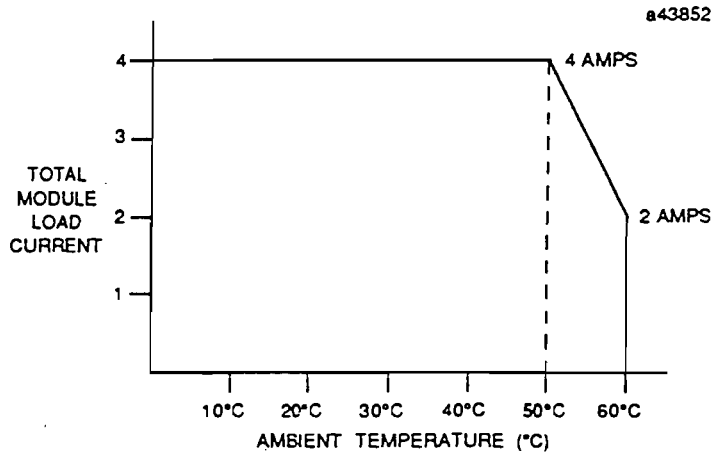
GFK-0356

**Field Wiring Information**

The following figure provides wiring information for connecting user supplied input devices and power source to the 120 volt AC output module.



**Figure 6-8. Field Wiring - 120 Volt AC Output, 0.5 Amp Module**



**Figure 6-9. Load Current vs. Temperature for IC693MDL310**

### Isolated Relay Output, N.O., 4 Amp - 8 Point IC693MDL930

The *4 Amp Relay Isolated Output* module for the Series 90-30 Programmable Logic Controller provides 8 normally-open relay circuits for controlling output loads provided by the user. The output switching capacity of this module is 4 amps. Each output point is isolated from the other points, and each point has a separate common power output terminal. The relay outputs can control a wide range of user-supplied load devices, such as: motor starters, solenoids, and indicators. The user must supply the AC or DC power to operate the field devices connected to this module. There are no fuses on this module.

LED indicators which provide the ON/OFF status of each point are located at the top of the module. The LEDs are arranged in two horizontal rows with eight green LEDs in each row. This module uses the top row labeled A1 through 8 (points 1 through 8); the bottom row is not used. An insert goes between the inside and outside surface of the hinged door. The surface towards the inside of the module (when the hinged door is closed) has circuit wiring information, and circuit identification information can be recorded on the outside surface. The outside left edge of the insert is color-coded red to indicate a high-voltage module.

This module can be installed in any slot of a 5 or 10-slot baseplate in a Model 311 system, or slots 2 through 10 of a CPU baseplate or any slot of an expansion baseplate in a Model 331 system.

**Table 6-15. Specifications for Relay Output, 4 Amp Module**

<b>Operating Voltage</b>	5 to 30 volts DC 5 to 250 volts AC
<b>Outputs per Module</b> <b>Isolation</b>	8 isolated outputs 1500 volts RMS between field side and logic side 500 volts RMS between groups
<b>Maximum Load †</b> <b>Minimum Load</b>	4 amps resistive maximum per output 10 mA
<b>Maximum Inrush</b> <b>On Response Time</b> <b>Off Response Time</b>	5 amps 15 ms maximum 15 ms maximum
<b>Internal Power Consumption</b>	6 mA (all outputs on) from 5-volt bus on backplane 70 mA (all outputs on) from relay 24V bus on backplane
<b>Operating Temperature</b> <b>Storage Temperature</b>	0 to 60°C (32 to 140°F) -40 to +85°C (-40 to +185°F)
<b>Humidity</b>	5 to 95% non-condensing

† Maximum load current is dependent upon ambient temperature as shown in figure 6-22.

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**Field Wiring Information**

The following figure provides wiring information for connecting user supplied load devices and power source to the 4 amp Relay Output module.

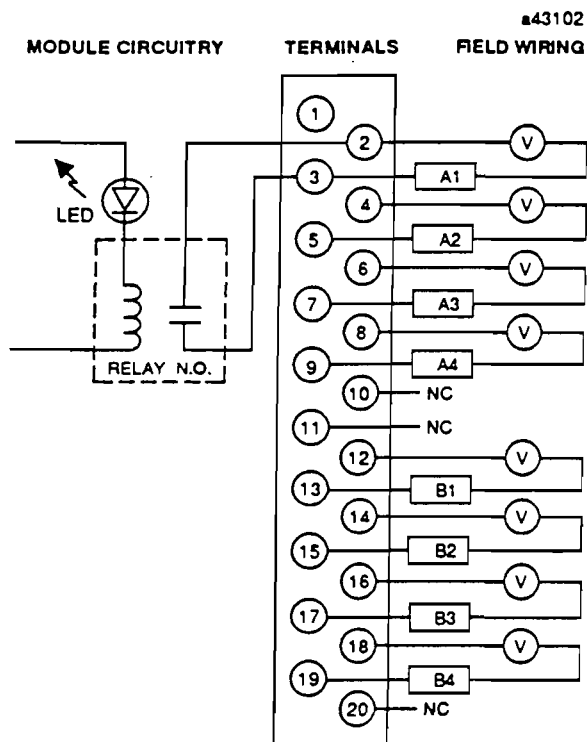


Figure 6-20. Field Wiring - Relay Output, 4 Amp Module

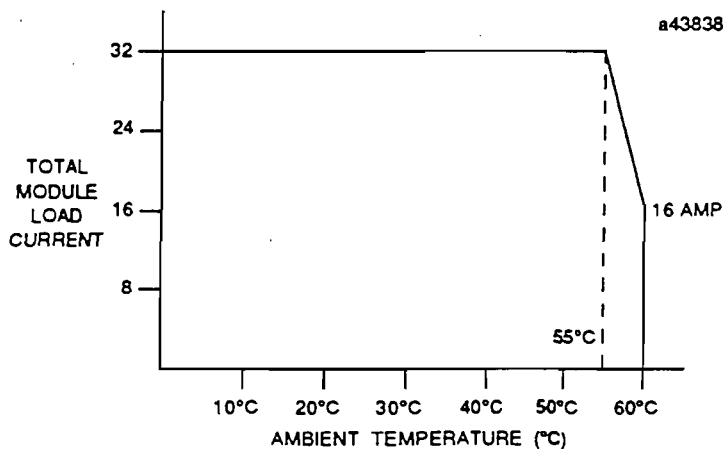


Figure 6-21. Load Current vs. Temperature for IC693MDL930

**Relay Output, N.O., 2 Amp - 16 Point**  
**IC693MDL940**

The *2 Amp Relay Output* module for the Series 90-30 Programmable Logic Controller provides 16 normally-open relay circuits for controlling output loads provided by the user. The output switching capacity of this module is 2 amps. The output points are arranged in four groups of four points each. Each group has a common power output terminal. The relay outputs can control a wide range of user-supplied load devices, such as: motor starters, solenoids, and indicators. Power for the internal relay circuits is provided by the +24 volt DC bus on the backplane. The user must supply the AC or DC power to operate field devices. There are no fuses on this module.

LED indicators which provide the ON/OFF status of each point are located at the top of the module. The LEDs are arranged in two horizontal rows with eight green LEDs in each row; the top row labeled A1 through 8 (points 1 through 8) and the bottom row labeled B1 through 8 (points 9 through 16). An insert goes between the inside and outside surface of the hinged door. The surface towards the inside of the module (when the hinged door is closed) has circuit wiring information, and circuit identification information can be recorded on the outside surface. The outside left edge of the insert is color-coded red to indicate a high-voltage module.

This module can be installed in any slot of a 5 or 10-slot baseplate in a Model 311 system, or slots 2 through 10 of a CPU baseplate or any slot of an expansion baseplate in a Model 331 system.

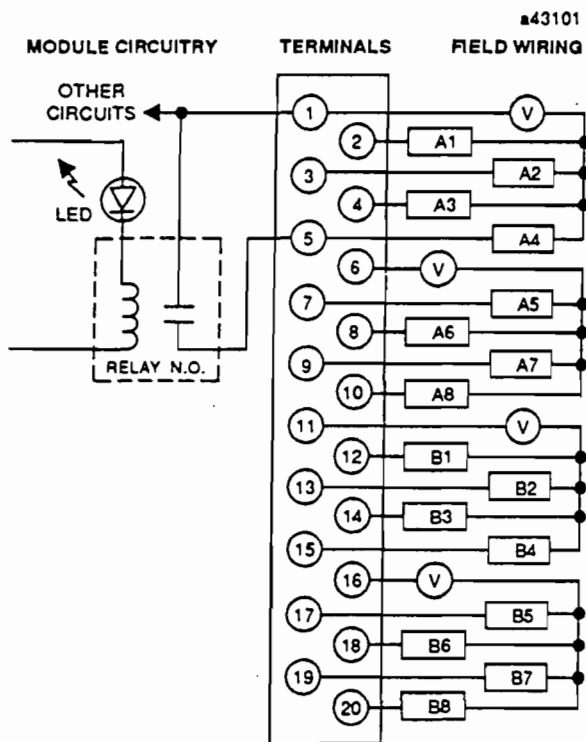
**Table 6-14. Specifications for Relay Output, 2 Amp Module**

<b>Operating Voltage</b>	5 to 30 volts DC 5 to 250 volts AC
<b>Outputs per Module</b>	16 (four groups of four outputs each)
<b>Isolation</b>	1500 volts RMS between field side and logic side 500 volts RMS between groups
<b>Maximum Load</b>	2 amps resistive maximum per output 4 amps maximum per common
<b>Minimum Load</b>	10 mA
<b>Maximum Inrush</b>	5 amps
<b>On Response Time</b>	15 ms maximum
<b>Off Response Time</b>	15 ms maximum
<b>Internal Power Consumption</b>	7 mA (all outputs on) from 5-volt bus on backplane 135 mA (all outputs on) from relay 24V bus on backplane
<b>Operating Temperature</b>	0 to 60°C (32 to 140°F)
<b>Storage Temperature</b>	-40 to +85°C (-40 to +185°F)
<b>Humidity</b>	5 to 95% non-condensing

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**Field Wiring Information**

The following figure provides wiring information for connecting user supplied load devices and power source to the 2 amp Relay output module.



**Figure 6-19. Field Wiring - Relay Output, 2 Amp Module**

# Honeywell

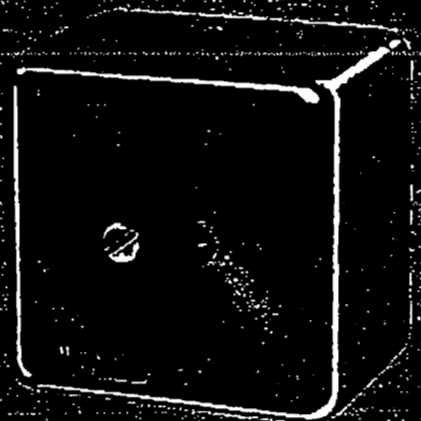
THE RA890G PROTECTORELAY CONTROL PROVIDES SOLID STATE ELECTRONIC SAFEGUARD PROTECTION FOR INDUSTRIAL AND COMMERCIAL GAS, OIL, OR COMBINATION GAS-OIL BURNERS.

- Designed for interrupted ignition with intermittent pilot for gas burners, and for interrupted or intermittent ignition on oil burners.
- Used only with a C7027, C7035, or C7044 Minipeeper Ultraviolet Flame Detector.
- Either a line voltage or low voltage controller may be used.
- Solid state circuitry eliminates warmup and increases resistance to vibration.
- Push-to-reset safety switch button is in dust-resistant enclosure.
- Safe start check prevents start if flame or flame simulating failure is present.
- Automatic safety switch lockout if flame fails on start or if flame is not re-established after a flame failure.
- When limit control opens, control will de-energize ignition and fuel valves, but safety switch lockout will not occur.
- Test jack permits reading of the flame signal.
- Easy mounting and removal through use of captive mounting screws. Mounting base is made of durable thermoplastic.
- Minus 40 F [minus 40 C] approved model available.

P.G.  
REV. 6-89

Form Number 60-2035—8  
©Honeywell Inc. 1989

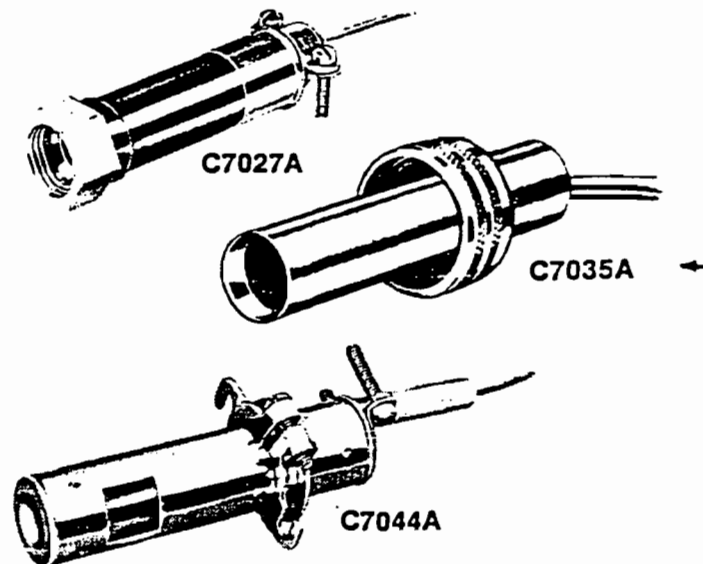
## PROTECTORELAY PRIMARY CONTROL



### RA890G

# C7027A, C7035, C7044A Minipeeper Ultraviolet Flame Detectors

The C7027A, C7035A and C7044A detect the ultraviolet radiation emitted by combustion flames. The flame detectors are used with Honeywell flame safeguard controls to provide flame supervision for gas, oil, or combination gas-oil burners.



■ C7027A, C7035A, and C7044A Flame Detectors are used with R7249A, R7290A, R7749B and R7849A,B amplifiers and the appropriate Honeywell controls.

■ C7044A may also be used with the following 50 Hz Honeywell combustion controls/amplifiers:  
R4341/R7323  
R4343/R7323  
R4344/R7323

■ C7027A has an integral collar threaded (internal 1/2-14 NPSM) for mounting on a 1/2-inch sight pipe.

→ ■ C7035A has an integral collar threaded (internal 1-11-1/2 NPSM) for mounting on a one inch sight pipe.

→ ■ C7035A housing meets Underwriters Laboratories Inc. requirements for raintightness and complies with NEMA enclosure standards, types 4 and 4X.

■ C7044A mounts with a two screw bracket. The UV sensor tube is enclosed in a stainless steel housing.

■ C7044A has the capability of side or end viewing in flame monitoring applications.

■ Because of their compact size, the C7027A and C7044A are particularly suitable for blast tube mounting.

■ Properly installed the C7027A and C7035A are pressure rated for 5 psi.

■ C7035A ultraviolet radiation sensor tube is field replaceable.

■ Two C7027A, C7035A, or C7044A flame detectors can be wired in parallel for difficult flame sighting installations.

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Troubleshooting .....	10
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# Specifications

## SUPER TRADELINE MODELS

SUPER TRADELINE models offer features not available on TRADELINE or standard models, and are designed to replace a wide range of Honeywell and competitive controls. SUPER TRADELINE models are selected and packaged to provide ease of stocking, ease of handling, and maximum replacement value. Specifications of SUPER TRADELINE models are the same as those of standard models except as noted below.

### SUPER TRADELINE MODEL AVAILABLE:

C7027A1080—includes C7027A1023 Detector, 136733 Heat Block, and 390427B Bushing.

### SUPER TRADELINE FEATURES:

- Heat block for insulating the detector from sight pipe temperatures above 215° F [102° C] up to 266° F [130° C].
- Bushing for mounting the detector on a 3/8 in. sight pipe.
- SUPER TRADELINE pack with cross reference label and Instructions, form 60-0638.

## STANDARD MODELS

### C7027A MINIPEEPER ULTRA VIOLET FLAME DETECTOR

AMBIENT OPERATING TEMPERATURE RATINGS:  
0° F to 215° F [-18° C to 102° C], or -40° F to 215° F  
[-40° C to +102° C], depending on model.

MAXIMUM PRESSURE RATING: 5 psi [34.5 kPa].

MOUNTING: Collar with 1/2-14 NPSM internal threads for mounting on a 1/2 in. sight pipe.

WIRING CONNECTIONS: Two 6 ft [1.83 m], color-coded, NEC Class 1 leadwires. (One model is available with 24 ft [7.32 m] leadwires.) Rear of detector has a clamp type connector for 1/2 in. flexible metallic conduit. (Models are available with 1/2 in. internally threaded spud connector instead of the clamp.)

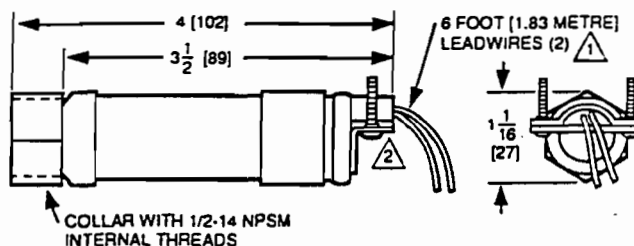
DIMENSIONS: See Fig. 1.

REPLACEMENT PART: 129685 Flange Gasket.

NOTE: The ultraviolet radiation sensing tube is not field replaceable.

ACCESSORY: 136733 Heat Block, laminated plastic, for insulating the flame detector from sight pipe temperatures up to 266° F [130° C], 1/2-14 NPSM external threads on one end and 1/2-14 NPSM internal threads on the other end (see Fig. 5).

Fig. 1—Installation dimensions of C7027A, in in. [mm in brackets].



1 MODEL AVAILABLE WITH 24 FOOT [7.32 METRE] LEADWIRES.

2 MODELS AVAILABLE WITH SPUD CONNECTOR (1/2-14 NPSM INTERNAL THREADS) INSTEAD OF CLAMP TYPE CONNECTOR.

M1943

## Ordering Information

When purchasing replacement and modernization products from your Flame Safeguard Authorized Distributor, refer to the TRADELINE® catalog or price sheets for complete ordering number, and specify:

1. Order number.
2. Operating temperature range.

### ORDER SEPARATELY:

1. Replacement parts, if desired.
2. Accessories, if desired.

If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Honeywell Residential and Building Controls Division Sales Office (check white pages of phone directory).
2. Residential and Building Controls Division Customer Satisfaction  
Honeywell Inc., 1885 Douglas Drive North  
Minneapolis, Minnesota 55422-4386 (612) 542-7500

(In Canada—Honeywell Limited/Honeywell Limitee, 740 Ellesmere Road, Scarborough, Ontario M1P 2V9) International Sales and Service offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.

→ C7035A MINIPEEPER ULTRAVIOLET FLAME DETECTOR

FLAME DETECTION: End viewing.

AMBIENT OPERATING TEMPERATURE RATINGS:  
0° F to 250° F [-18° C to 121° C], or -40° F to 250° F  
[-40° C to 121° C], depending on model.

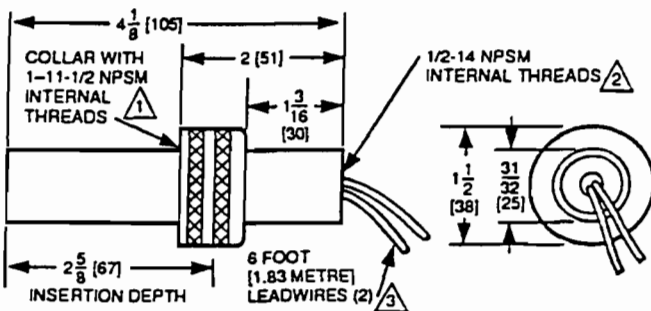
MAXIMUM PRESSURE RATING: 5 psi [34.5 kPa].

MOUNTING: Collar with 1-11-1/2 NPSM internal threads for mounting on a 1 in. sight pipe. (The DIN approved C7035A1064 has 1-11 BSP.P1 threads.)

WIRING CONNECTIONS: Two 6 ft. [1.83 m], color-coded NEC Class 1 leadwires rated for 600° F [204° C]. One model is available with 12 ft. [3.66 m] leadwires. Rear of detector has 1/2-14 NPSM internal threads for connecting to a conduit. The DIN approved C7035A1064 has 1/2-14 BSP-F threads.

DIMENSIONS: See Fig. 2.

Fig. 2—Installation dimensions of C7035A, in in. [mm in brackets].



- 1 DIN APPROVED C7035A1064 HAS 1-11 BSP.P1 INTERNAL THREADS.
- 2 DIN APPROVED C7035A1064 HAS 1/2-14 BSP-F INTERNAL THREADS.
- 3 MODEL AVAILABLE WITH 12 FOOT [3.66 METRE] LEADWIRES. M1945

REPLACEMENT PARTS:

- 129808 Flange Gasket.
- 129464M Ultraviolet Sensing Tube, 0° F to 250° F [-18° C to 121° C].
- 129464N Ultraviolet Sensing Tube, -40° F to 250° F [-40° C to 121° C].

C7027A AND C7035A

APPROVALS:

- Underwriters Laboratories Inc. listed: File No. MP268.
- Canadian Standards Association certified: Master Report LR 95329-1.
- Factory Mutual approved.
- Industrial Risk Insurers acceptable.
- DIN approved models: C7027A1056, C7035A1049, C7035A1064.

ACCESSORIES:

- 118367A Swivel Mount; provides adjustable positioning of the C7027A or C7035A.

C7044A MINIPEEPER ULTRAVIOLET FLAME DETECTOR

DETECTION: Housing has two openings to permit either side or end viewing. Side viewing is 1/8 as sensitive as end viewing.

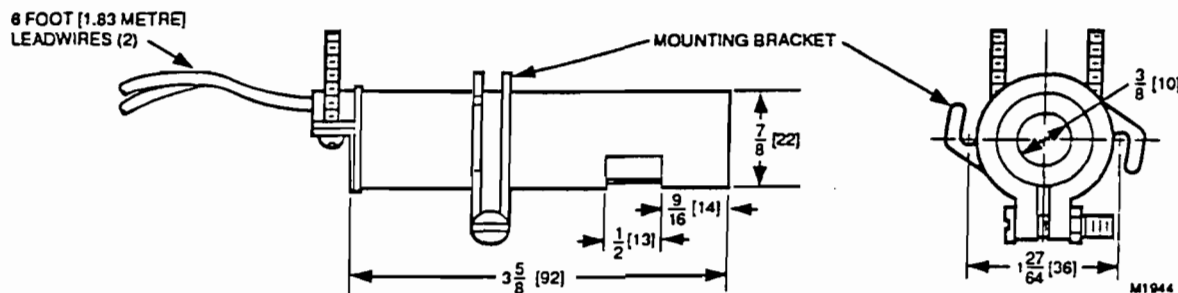
AMBIENT OPERATING TEMPERATURE RATINGS:  
0° F to 215° F [-18° C to 102° C].

MOUNTING: Bracket (included in 4074 BVK Bag Assembly), secured by two 8-32 RHIS (European M-4) screws (not included).

WIRING CONNECTIONS: Two 6 ft. [1.83 m], color-coded, NEC Class 1 leadwires. Rear of detector has a clamp type connector for 1/2 inch flexible metallic conduit.

DIMENSIONS: See Fig. 3.

Fig. 3—Installation dimensions of C7044A, in in. [mm in brackets].





## CAUTION

Ultraviolet radiation sensing tubes have a life expectancy of 40,000 hours of continuous use within the flame detector's specified ambient temperature and voltage ratings. Wearout of an ultraviolet radiation sensing tube results in failure of the UV sensor to properly discriminate between flame conditions.

The C7027A, C7035A and C7044 flame detectors should only be used on burners that cycle on-off at least once every 24 hours. Appliances with burners that remain on continuously for 24 hours or longer should use the C7012E Dynamic Self-Check Flame Detector with R7247C, R7747C or R7847C amplifiers and the appropriate Honeywell flame safeguard control. For highest sensitivity requirements, the C7076A,D Flame Detectors with the R7476A or R7886A Dynamic Self-Check Amplifiers and the appropriate Honeywell flame safeguard control should be used.

### WHEN INSTALLING THIS PRODUCT...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced, flame safeguard control technician.
4. After installation is complete, check out product operation as provided in these instructions.



## CAUTION

1. The C7027A, C7035A and C7044A Flame Detectors must be used with Honeywell flame safeguard controls (primaries, programmers, multiburner systems, and burner management systems). Using with controls not manufactured by Honeywell could result in unsafe conditions.
2. Disconnect power supply before beginning installation to prevent electrical shock or equipment damage, more than one disconnect may be involved.
3. Read the installation instructions before starting the installation.
4. All wiring must be NEC Class 1 (line voltage).
5. The flame detector must be positioned so that it sights the flame and does not respond to the UV radiation emitted by sparks generated by a spark ignitor. The Q624A solid-state ignitor may be useful in difficult installations.

### DETECTOR INSTALLATIONS

All flames emit ultraviolet radiation, invisible to the human eye but detected by the UV sensing tube. There are two important factors in UV detector installation:

1. The detector must have a line-of-sight view of the flame.
2. The detector must not be exposed to other sources of ultraviolet radiation, the most common being ignition spark. Other sources are listed in the next section.

Because it is necessary for the detector to actually *see* the flame, it is desirable to locate the detector as close to the flame as physical arrangement and temperature restrictions permit.

Sighting requirements for different types of flame supervision are:

1. Pilot flame only—Sighting must be along the axis of the pilot flame. The smallest pilot flame that can be sighted must be capable of igniting the main burner (see Pilot Turndown Test, page 9).
2. Main flame only—Sighting must be at the most stable part of the flame for all firing rates.
3. Pilot and main flame—Sighting must be at the junction of both flames.

### OTHER RADIATION SOURCES SENSED BY THE UV DETECTOR

Examples of radiation sources (other than flame) that could actuate the detection system are:

#### Ultraviolet Sources:

Hot refractory above 2800° F [1371° C].

#### Spark:

- ignition transformers.
- welding arcs.
- lightning.

Gas lasers.

Sun lamps.

Germicidal lamps.

#### Gamma Ray and X-ray Sources:

Diffraction analyzers.

Electron microscopes.

Radiographic X-ray machines.

High voltage vacuum switches.

High voltage condensers.

Radioscopes.

Except under unusual circumstances, none of these sources except hot refractory and ignition spark would be present in or near the combustion chamber.

The detector *may* respond to hot refractory above 2800° F [1371° C] if the refractory surface represents a significant percentage of the field of view of the detector. If the temperature of the hot refractory causes the flame relay (in the flame safeguard control) to pull in, re-position the sight pipe so the detector views a cooler area of the refractory.

Ignition spark is a source of ultraviolet radiation. When installing the C70217A, C7035A, or C7044A Flame Detector, make sure it does not respond to ignition spark (see *Ultraviolet Response Test*, page 9.) If the installation is such that response to the ignition sparks cannot be avoided, the Q624A solid-state ignition transformer may eliminate the ignition spark response. The Q624A, when properly installed, prevents C7027A, C7035A, and C7044A ignition spark response by alternately activating the spark generator and the UV sensing tube.

#### MOUNTING A C7027A OR C7035A LOCATE THE SIGHT PIPE

The location of the sight pipe is the most critical part of the installation. A black iron pipe is recommended. Do *not* use a stainless steel or galvanized pipe because its internal surface blackens with use as deposits from the combustion chamber settle on it. Initially, its shiny internal surface reflects ultraviolet radiation, which could result in a satisfactory flame signal, even though the pipe may be improperly located. As it blackens, less ultraviolet radiation is reflected and the flame signal may become marginal.

Under optimum sighting conditions, the C7027A and C7035A Flame Detectors can detect most common gas and oil combustion flames at a distance of six feet. The critical factors in determining the flame-detector distance separation are the optimized flame signal (current or voltage) and the flame detector temperature. Other factors may be influential and are associated with the specific installation. For minimum flame signals, see Table 1 and for ambient operating temperatures, refer to Specifications, page 2.

Use 1/2 in. pipe for a C7027 and 1 in. pipe for a C7035. Since no two situations are likely to be the same, length and sighting angle of the pipe must be determined at the time and place of installation. Generally, it is desirable to have the sight pipe tilting downward to prevent soot or dirt buildup.

If a C7027A is to be used for a blast tube installation, its location should be determined by the burner manufacturer; contact the manufacturer before making any modifications to the installation.

In locations where water is usually sprayed on the body of the detector, use a C7035A. Internal threads in its base permit the use of waterproof flexible conduit for this type of application.

#### PREPARE HOLE IN WALL OF COMBUSTION CHAMBER

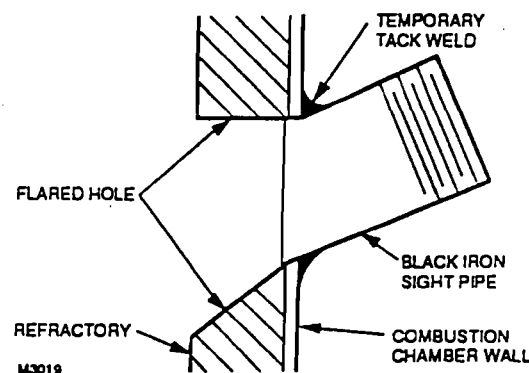
Cut a hole of the proper diameter for the sight pipe in the wall of the combustion chamber at the selected location. Flare the hole to leave room for small adjustments of the sighting angle. The taper of the hole should be about 1 in. for every 3 in. [25 mm for every 76 mm] of wall thickness.

#### MOUNTING THE SIGHT PIPE (FIG. 4)

Thread one end of the pipe to fit the mounting collar on the detector. Cut the pipe to the desired length (as short as practicable), and at an angle so it fits flush with the wall of the combustion chamber. Tack weld the pipe to the wall in a trial position. Do *not* permanently weld the sight pipe in place until after completing the Adjustments and Checkout beginning on page 7.

NOTE: If you use a swivel mount (part no. 118367A) and you are positive about the location and sighting angle, you can permanently weld the pipe.

Fig. 4—Mounting sight pipe.



#### SIGHT PIPE VENTILATION

It may be necessary to ventilate the sight pipe to cool the flame detector or to clear the sight pipe of UV radiation absorbing substances such as smoke, excessive moisture or, in some instances, unburned fuel.

For a negative pressure combustion chamber, drilling a few holes in the section of the sight pipe outside of the combustion chamber will allow air at atmospheric pressure to flow through the sight pipe into the chamber. A perforated pipe nipple between the sight pipe and the detector can also be used (see Fig. 5).

Fig. 5—Mounting a C7027A on a combustion chamber (viewed from above). C7035A mounting is similar.

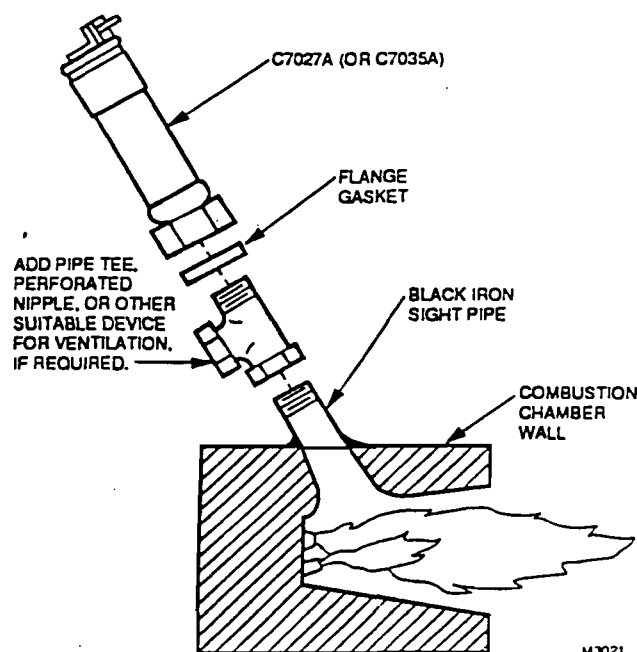
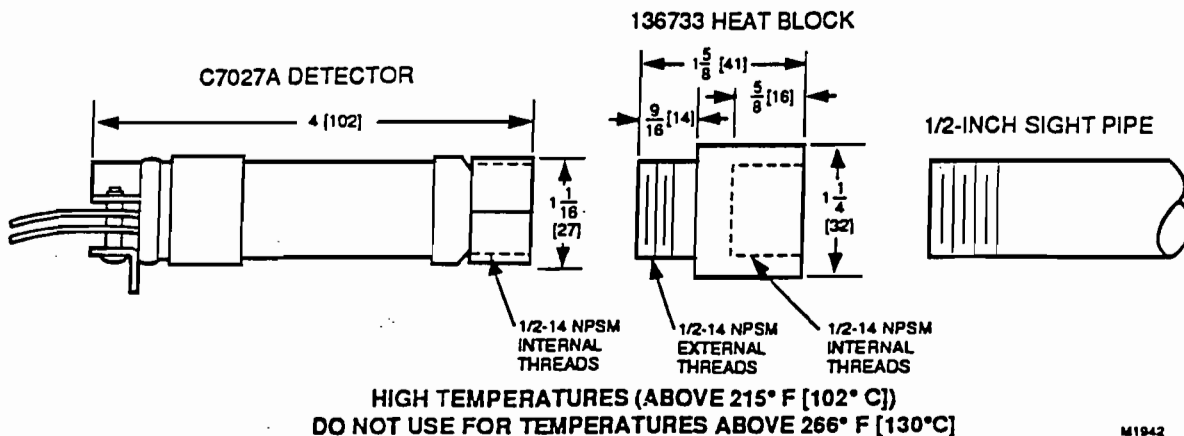


Fig. 6—Mounting dimensions of 136733 heat block, in in. [mm in brackets].



For a positive pressure combustion chamber, connect a supply of pressurized air from the burner blower through the sight pipe into the chamber. The supply air pressure must be greater than the chamber pressure.

**SWIVEL MOUNT**

To facilitate proper sighting of the flame, a swivel mount (part no. 118367A) is available. The swivel mount will require a 3/4 to 1/2 in. reducer and a 1/2 in. close nipple to mount a C7027A, or a 1 in. pipe at least 2-1/2 in. [63.5 mm] long to mount a C7035A. For mounting details, refer to form 60-0361 for the 118367A Swivel Mount.

**USING A HEAT BLOCK WITH A C7027 (Fig. 6)**

If the temperature of the sight pipe will become high enough to cause the C7027A to overheat (above 215° F [102° C] up to 266° F [130° C], screw a 136733 Heat block (order separately) onto the sight pipe before mounting the detector.

**MOUNT THE DETECTOR (Fig. 5)**

Mount the detector onto the sight pipe, pipe tee, nipple, or other fitting. Make sure the flange gasket is in place inside the mounting collar on the detector, and then screw the collar onto the sight pipe or fitting.

NOTE: If a window is installed between the UV detector and the flame, it must be fabricated from quartz or fused silica. Ordinary glass filters out ultraviolet radiation.

**MOUNTING A C7044A ON A BLAST TUBE (Fig. 7)**

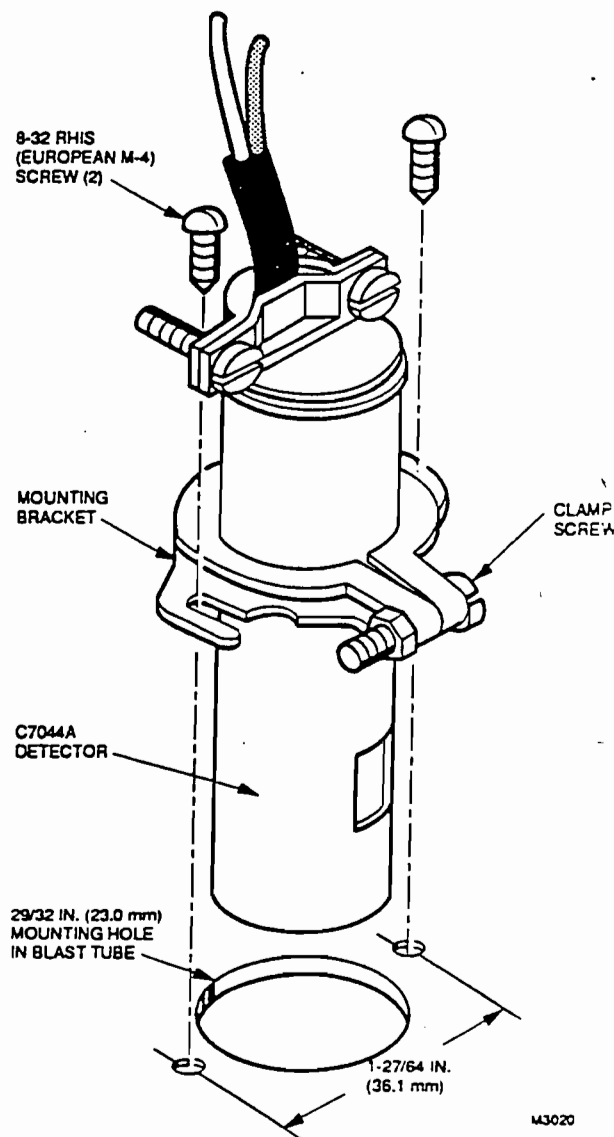
The C7044 is designed to be mounted on the blast tube of a burner. The exact location should be determined by the burner manufacturer. Contact the manufacturer before making any modifications to the installation.



**CAUTION**

The C7044 will allow air leakage through its housing. It should not be located in an atmosphere of fuel vapors under positive pressure. The C7027 or C7035 should be used if internal pressure sealoff is required.

Fig. 7—Mounting C7044A on blast tube.



The C7044 is mounted in a 29/32 in. [23.0 mm] hole in the blast tube. The mounting bracket is fastened to the blast tube with 2 screws on 1-27/64 in. [36.1 mm] centers.

The mounting bracket is designed so that the detector can be removed from the blast tube for cleaning and then replaced without disturbing the sighting angle. Loosen the 2 screws holding the bracket to the blast tube, but do not loosen the clamp screw on the bracket. Twist both the bracket and detector to remove them.

#### WIRING (All Models—Fig. 8)



### CAUTION

The *blue* (tan with blue tracer with C7035A1080) leadwire must be connected to the F terminal of the flame safeguard control subbase or terminal strip and the *white* (tan leadwire without blue tracer with C7035A1080) to the G terminal (see Fig. 8). Failure to observe the circuit polarity by reversing the leadwires (even momentarily) may cause the flame detector to improperly supervise the combustion flame.

1. Disconnect power supply before beginning installation to prevent electrical shock and equipment damage. All wiring must comply with applicable electrical codes, ordinances, and regulations. Use NEC Class 1 wiring.

2. If the leadwires are not long enough to reach the terminal strip or wiring subbase, make the required splices in a junction box.

3. If splicing is necessary, use moisture-resistant wire suitable for at least 167° F [75° C] if the detector is used with a flame safeguard *primary* control, or at least 194° F [90° C] if used with a flame safeguard *programming* control.

4. For high temperature installations, use Honeywell Specification no. R1298020 or equivalent for the F leadwire. (This wire is rated up to 400° F [204° C] for continuous duty. It is tested for operation up to 600V and breakdown up to 7500V.) For the other leadwires, use moisture-resistant wire selected for a temperature rating above the maximum operating temperature.

**IMPORTANT:** Do not run the flame detector wiring in the same conduit with high voltage ignition transformer wires.

#### CONNECTING DETECTORS IN PARALLEL

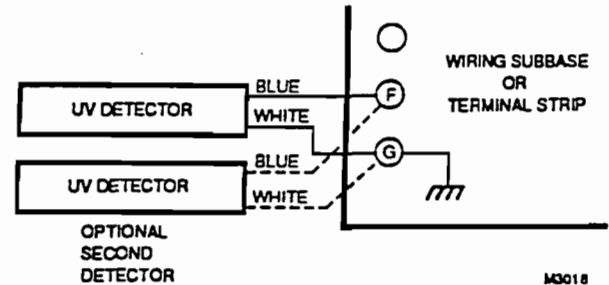
For a flame that is difficult to sight, using two flame detectors connected in parallel will reduce the occurrence of nuisance shutdowns. If only one of the parallel detectors loses the flame signal, the other will continue to indicate the presence of the flame and keep the burner in operation.

When the flame detectors are connected in parallel, the low level background signals are additive. Therefore, no more than two C7027A, C7035A, or C7044A flame detectors should be paralleled. Furthermore, the background signal increases as temperature decreases. Because of this, the minimum ambient operating temperature must be increased when the C7027A, C7035A or C7044A flame detectors are paralleled.

When using detectors rated for a minimum of 0° F [-18° C], limit the minimum ambient temperature at the detectors to 32° F [0° C]. When using detectors rated for a minimum of -40° F [-40° C], limit the minimum ambient temperature at the detectors to -10° F [-23° C].

Connect the *blue* leadwires of both detectors to the F terminal of the wiring subbase or terminal strip, and the *white* leadwires of both detectors to the G terminal, as shown in Fig. 8.

Fig. 8—Wiring C7027A, C7035A, and C7044A flame detectors in parallel.



#### EARTH GROUND

The detector and the flame safeguard control must be connected to earth ground. A convenient method of accomplishing this is to connect the detector to the flame safeguard control with a flexible conduit, or ensure a good ground connection at the mounting bracket.

## Adjustments and Checkout

Before welding the C7027A or C7035A sight pipe in its final location, or before tightening the C7044A clamp screw, complete both the adjustments and checkout tests that follow and any required by the burner manufacturer.

#### UV SENSOR TUBE TEST

**NOTE:** For initial burner lightoff, consult the burner manufacturer instructions or the instructions for the flame safeguard control.

During the initial burner lightoff, make sure the flame safeguard control starts (i.e., the load relay, usually 1K, pulls in). If it does not start, visually check the sensing tube in the C7027A, C7035A, or C7044A flame detector. If the tube continues to glow when no flame is present, replace the sensing tube (C7035A), or replace the detector (C7027A or C7044A).

**ADJUST DETECTOR SIGHTING POSITION**

With the flame detector installed and burners running, adjust the position of the flame detector for optimum flame signal. The flame signal will be read in microamps or voltage (Vdc) depending on the Honeywell flame safeguard combustion control used.

Most existing Honeywell flame safeguard controls incorporate a flame current jack on the flame amplifier or on the control itself. The flame signal can be measured with a volt-ohmmeter such as the Honeywell W136A. To measure the flame current (signal), use a cable connector (part number 196146, included with the W136A) must be used in conjunction with the meter. With the W136A (or equivalent) positioned at the zero to 25 microampere scale, make connections from the meter probes to the two ends of the cable connector plug (red to red, black to black). Make these connections before inserting the plug end of the connector plug into the flame jack of the control or control amplifier (see Fig. 9a). Read the flame signal in microamperes directly from the W136A meter. Refer to Table 1 for the minimum acceptable flame currents.

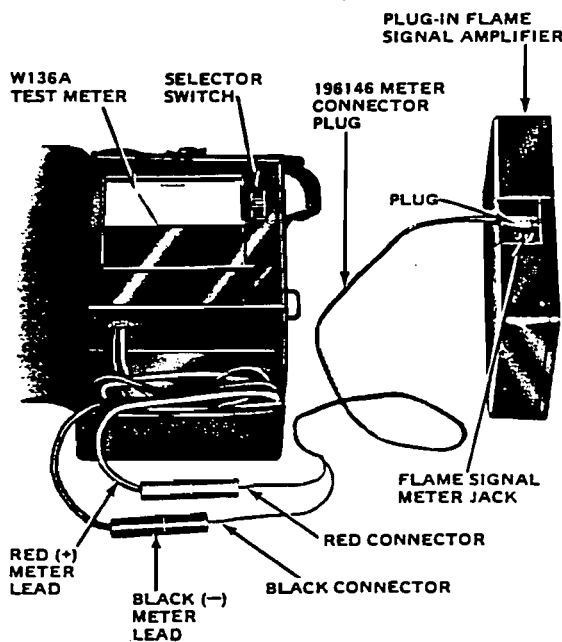
The R7749B and R7849A,B amplifiers used with the Honeywell, BCS 7700 and 7800 SERIES controls, respectively, have a dc voltage flame signal output.

For the R7749B amplifier, a volt-ohmmeter with a zero to 5 or 10 Vdc scale and a minimum sensitivity of 20,000 volts/ohm is suggested.

For the R7849A,B amplifiers used with the 7800 SERIES controls, a volt-ohmmeter with a zero to 5 or 10 Vdc scale and a minimum sensitivity of one megohm/volt is recommended, (see Fig. 9c).

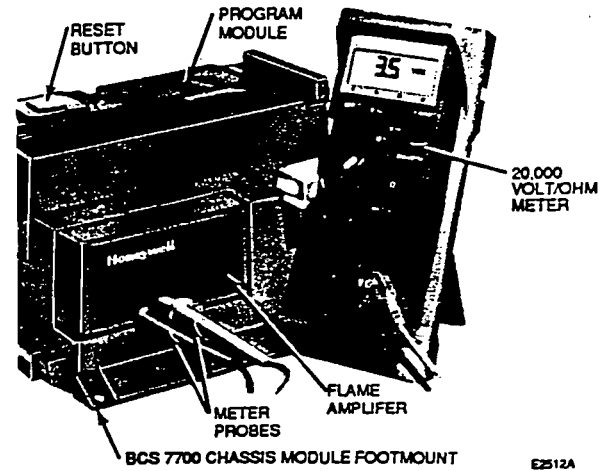
Make the flame signal voltage measurements as illustrated in Figs. 9b and 9c. Care is to be taken in that the positive meter lead is to be connected to the positive (+) amplifier jack and the negative meter lead connected to the negative (-)

**Fig. 9a—Measuring microamp flame signal.**

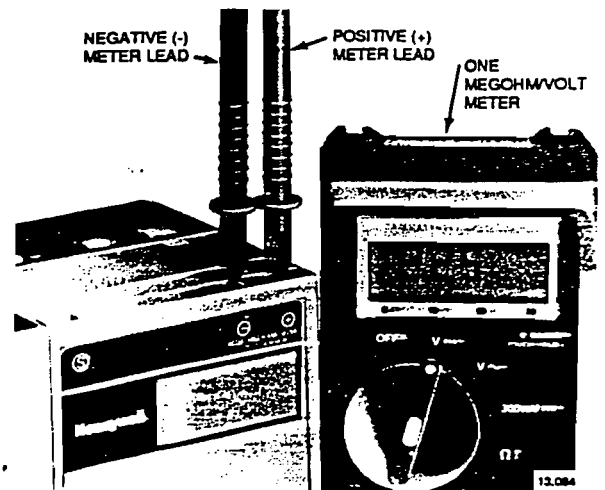


amplifier jack (BCS 7700) or the (-Com) jack in the case of a 7800 SERIES control. If the BCS 7700 and SERIES 7800 controls have the optional Keyboard Display Module, a zero to five Vdc reading will be displayed on the module.

**Fig. 9b—Measuring the BCS 7700 flame signal voltage.**



**Fig. 9c—Measuring flame signal voltage of 7800 SERIES controls.**



Move the flame detector and sight pipe (if not permanently attached to the burner/boiler) to view the flame from various positions. Allow a few seconds for the meter reading to stabilize. A maximum steady microamp or voltage reading is desirable. The flame signal must be above the minimum acceptable level for the flame safeguard control and associated amplifier as indicated in Table 1.

Measure the flame signal for the pilot alone, the main burner flame along, and both together (unless monitoring pilot only when using an intermittent pilot or supervising the main flame only when using direct spark ignition). Also, measure the flame signal at low and high firing rates and while modulating (if applicable).

With the flame detector in its final position, all flame signals must be steady with a current/voltage value as indicated in Table 1. If the minimum signal cannot be obtained or is unstable, refer to Troubleshooting, page 10

**PILOT TURNDOWN TEST**

If the detector is used to prove a pilot flame before the main fuel valve can be opened, perform a Pilot Turndown Test. Follow both the procedures in the Instructions for the appropriate flame safeguard control, and in the burner manufacturer's instructions.

TABLE 1—FLAME SIGNAL

Flame Detector	Plug-in Amplifier	Honeywell Flame Safeguard Control	Minimum Acceptable Steady Current (microamps)	Maximum Current Expected (microamps)	Minimum Acceptable Voltage (Vdc)	Maximum Voltage (Vdc)
	R7249A	BC7000 + PM720	3.5	7.5		
	R7749B (AMPLI-CHECK™)	BCS7700A			2.2	4.98
	R7249A	R4075C,D,E	3.5	7.5		
		R4138C,D	3.5	7.5		
		R4140G,L,M	3.5	7.5		
	R7290A	R4795A,D	1.5	2.25		
	None	R7023C,	1.5	2.25		
		R7795A,C,E,G	1.5	2.25		
	R7849A or R7849B (AMPLI-CHECK™)	RM7800E,G,L,M			1.25	5.0
		RM7823A			1.25	5.0
		RM7838A,B			1.25	5.0
		RM7840E,G,L,M			1.25	5.0
		RM7885A			1.25	5.0
		RM7890A,B			1.25	5.0
	None	RA890G	1.5	2.25		

**ULTRAVIOLET RESPONSE TESTS  
IGNITION SPARK RESPONSE TEST**

Test to be sure that ignition spark is not actuating the flame relay (usually 2K) in the flame safeguard control.

1. Close the pilot and main burner manual fuel shutoff valves.
2. Connect the appropriate meter to the flame safeguard control amplifier. Start the burner and run through the ignition period. Ignition spark should occur, but the flame relay must not pull in. The flame signal should not be more than 0.25 microamp.
3. If the flame relay does pull in, reposition the flame detector to increase the distance between the flame detector and the ignition spark. If the flame detector is not in the line of sight of the ignition spark but appears to respond to the spark, it may be responding to reflected spark generated UV radiation. If so, relocate the flame detector so it does not receive the reflected UV radiation. It may be necessary to construct a barrier to block the UV radiation generated by the spark from the flame detector view.
4. Continue making the adjustments until the flame signal due to ignition spark is less than 0.25 microamp or 1.25 Vdc.
5. The use of the Q624A solid-state ignition transformer may also provide a method to eliminate the C7027A, C7035A, or C7044A flame detector response to UV radiation generated by ignition spark. The Q624A prevents flame detector response to ignition spark by providing alternating periods of

spark generation and UV sensor activation.

**RESPONSE TO OTHER ULTRAVIOLET SOURCES**

Some sources of artificial light produce small amounts of ultraviolet radiation. Under certain conditions, an ultraviolet detector will respond to them as if it is sensing a flame. *DO NOT USE AN ARTIFICIAL LIGHT SOURCE TO CHECK THE RESPONSE OF AN ULTRAVIOLET DETECTOR.* To check for proper flame detector operation, test for flame failure response under all operating conditions.

**WELD THE SIGHT PIPE (or Tighten the C7044A Clamp Screw)**

When the flame signal is acceptable after all adjustments are made, remove the flame detector and weld the sight pipe in its final position. If you are using a swivel mount, the pipe may already be welded. Then reinstall the flame detector.

NOTE: If using a C7044A detector with no sight pipe, do not remove the detector; tighten the clamp screw securely.

**FINAL CHECKOUT**

Before putting the burner into service, check out the installation using the procedures in the Checkout section of the Instructions for the appropriate flame safeguard control. After completing the checkout, run the burner through at least one complete cycle to verify correct operation.



# Troubleshooting



## CAUTION

1. Be extremely careful while troubleshooting the detector; line voltage is present on some of the terminals when power is on.
2. Open the master switch to disconnect power before removing or installing the detector.

### INADEQUATE FLAME SIGNAL

If a satisfactory flame signal cannot be obtained while adjusting the sighting position of the detector, perform the procedures indicated in steps 1 through 7. If other difficulties are encountered in the system, refer to *Troubleshooting in the Instructions for the appropriate Honeywell flame safeguard control*.

1. Check for proper line voltage. Make sure the master switch is closed, connections are correct, and power supply is the correct voltage and frequency.
2. Check the detector wiring for defects, including:
  - incorrect connections.
  - wiring type or size of wire.
  - deteriorated wire.
  - open circuits.
  - short circuits.
  - leakage paths caused by moisture, soot, or dirt.

3. With the burner running, check the temperature at the detector, when it exceeds 215° F [102° C] for a C7027 or C7044, or 250° F [121° C] for a C7035:

- use a heat block (part no. 136733) if using a C7027A Flame Detector.
- add the additional insulation between the wall of the combustion chamber and the detector.
- add a shield or screen to reflect radiated heat away from the detector, or
- add cooling (refer to SIGHT PIPE VENTILATION, page 5).

4. Remove the detector and clean the viewing window with a soft, clean cloth.

5. Clean the inside of the sight pipe (if one is used) before reinstalling the detector.

6. If the flame signal continues to be too low, replace the plug-in amplifier (if the control has one).

7. If you still cannot obtain a proper flame signal, replace flame detector (C7027A, C7044A) or UV radiation sensing tube (C7035A).

**IMPORTANT:** At the completion of troubleshooting, be sure to perform the Adjustments and Checkout beginning on page 7.

# Maintenance

### PERIODIC MAINTENANCE

1. Clean the viewing window and sight pipe (if used) when necessary. Remove the detector and use a soft, clean cloth to remove accumulated contaminants from the UV radiation sensor tube glass envelope.

3. Ultraviolet sensing tubes have a life expectancy of 40,000 hours of continuous use within the ambient temperature and voltage ratings. Replace the sensing tube in the C7035, or replace the C7027 or C7044 Detector, at appropriate intervals.

3. Keep the flame detection system adjusted for the smoothest, most reliable operation as recommended by the burner manufacturer.

### CLEANING THE C7044A DETECTOR

When necessary, clean the C7044 flame detector by using the following procedure.

1. Loosen the two screws holding the C7044 mounting bracket to the blast tube. To remove, twist the bracket and detector. *Do not* loosen the clamp screw that holds the mounting bracket to the detector.

2. Clean the viewing window with a soft, clean cloth.

3. Insert the detector into the mounting hole, and to realign it, twist against the mounting screws.

4. Tighten the two mounting screws.

## Honeywell

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740 Ellesmere Road  
Scarborough, Ontario  
M1P 2V9



**SHOP TESTING**

**FLAME TROL II CONTROLLER  
SHOP TESTING PROCEDURE**

Before leaving the shop, LFG Specialties control panels must be tested and approved by the designing engineer. The sequence of events in the controller should be verified as per the following steps:

Step 1      Verify permissive for purge

- Down Timer times out or system is reset by the selector switch (Reset Button)
- Pilot temperature reading is below "BLOWER ON" temperature (300F)
- Header valve switch is in closed position
- Purge light ON

Verify Purge failure (lockout)

- Purge pressure switch did not close contact during purge cycle (5 min.)
- Purge Failure light ON

Step 2      Verify permissive on the pilot and igniter timers

- Purge timer times out and no purge failure
- Pilot light ON
- Igniter light ON

Pilot failure (lock-out)

- Pilot timer is through before "PILOT OFF" temperature is achieved
- Pilot Failure light ON

Step 3      Verify permissive for opening header valve

- "BLOWER ON" temperature is achieved during pilot ON
- Header Open light ON

Header valve closed

- Header valve should close on all shutdowns
- Header Closed light ON

Step 4 Verify permissive for starting blower

- "BLOWER ON" temperature is achieved during pilot ON cycle
- Header valve NOT closed
- Check Blower ON and Blower OFF lights for all blowers

Blower shutdown

- Header valve closed
- Header valve did not make fully open contact within 60 sec. from blower start-up
- Blower high bearing temperature switch ON (Blower Failure light ON)
- Flare shutdown

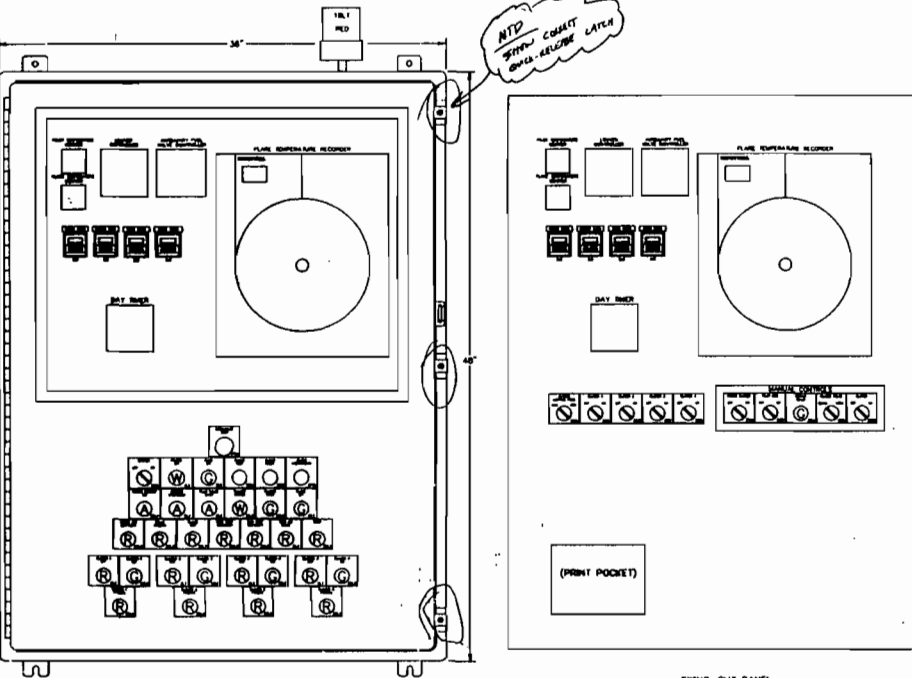
Step 5 Flare shutdown should be initiated if any of the following occurs:

- Purge failure. (Lockout, Purge Failure light)
- Pilot failure. (Lockout, Pilot Failure light)
- Header valve did not make fully open switch within 60 seconds from blower start-up. (Lockout, Flashing Header Open light )
- Flame out from ultra violet scanner which is activated 30 seconds after "BLOWER ON" temperature is achieved. U.V. scanner has 4 seconds delay to prevent flare shutdown in case of a flickering signal from U.V. sensor. (Activates down timer, Flame Out light)
- "LOW TEMP> SHUTDOWN" temperature is not achieved within 5 minutes from "BLOWER ON" on start-up. (Lockout, Low Temperature Shutdown light)

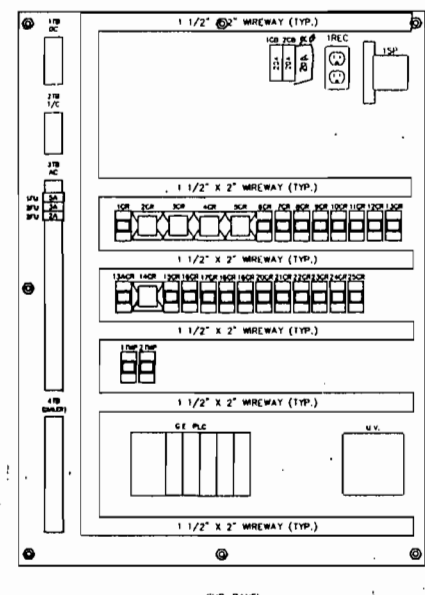
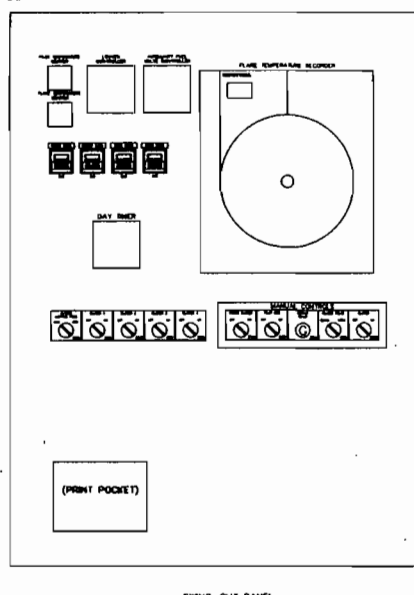
- Temperature falls below "LOW TEMP. SHUTDOWN" temperature (1400F) for any reason during normal operation. (Activates down timer, Low Temperature Shutdown light)
- Temperature rises above "HIGH TEMP. SHUTDOWN" temperature (1900F). (Safety shutdown, Lockout, High Temperature Shutdown light)
- High oxygen level switch is ON. (Lockout, High O2 Level light)
- High blower bearing temperature switch is ON. (Lockout, Blower X Failure light)
- LFG leak switch is ON. (Lockout, LFG Leak light)

Panel will be run through complete system checkouts using induced thermocouple signals and remote device switch signals to simulate accurate field conditions.

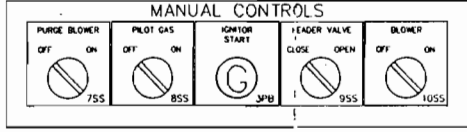
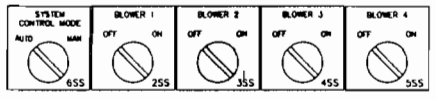
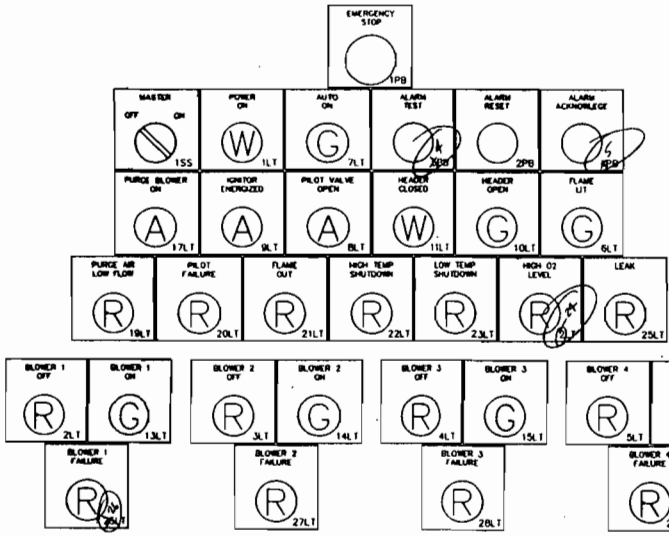
**SHOP-DRAWING PLANS**



NTD  
SWING-OUT  
COMP. - SELECTOR  
LATCH



NAME	QTY	DESCRIPTION	PART No.	MFG.
	1	ENCLOSURE	A-48H36125SP	HOFFMAN
	2	PANEL	A-48P36	HOFFMAN
	1	SWING-OUT PANEL KIT	A-NADFX	HOFFMAN
	1	WINDOW	A-PWA-2919WF	HOFFMAN
1-2CB	2	CIRCUIT BREAKER	00U120	SQ'D
1-3FU	3	FUSEBLOCK	1492-CE6	A-B
1FU	1	FUSE	FNM-5	BUSSMAN
2FU	1	FUSE	FNM-3	BUSSMAN
2FU	1	FUSE	FNM-2	BUSSMAN
8,9,17,1	3	PILOT LIGHT (AMB)	CR104PL132W	G.E.
1,11,1	2	PILOT LIGHT (WH1)	CR104PL132W	G.E.
2-5L1	4	PILOT LIGHT (RED)	CR104PL132R	G.E.
6,7,10,13-16L1	7	PILOT LIGHT (GRN)	CR104PL132G	G.E.
19-29L1	11	PILOT LIGHT (RED)	CR104PLG32R	G.E.
1BL1	1	BEACON (RED)	57R-Y	EDWARDS
155	1	KEY LOCK (2 POS)	CR104PS2182W	G.E.
2-655	5	SEL SW OPERATOR (2 POS)	CR104PS2182	G.E.
3-655	4	SELECTOR SWITCH (2 POS)	CR104PS21891	G.E.
1PB	1	PUSHBUTTON (OPERATOR)	CR104PB296	G.E.
1PB	1	PUSH-PULL (NIT)	CR104PB12	G.E.
2,4,5PB	3	PUSHBUTTON	CR104PB91B1	G.E.
3PB	1	PUSHBUTTON	CR104PB91G1	G.E.
2-5,14CR	5	RELAY	2703CA120-01	EAGLE
2-5,14CR	5	SOCKET	SR3P-06	IDEC
14-13,15-25CR	22	RELAY	RT45-UR-AC120	IDEC
14-13,15-25CR	22	SOCKET	SY45-05	IDEC
1-4TR	4	TIMER ON-DELAY	H3CA-08-120AC	OMRON
1-4TR	4	SOCKET	P3C-06	OMRON
	1	WEEKLY TIMER	HSL-A	OMRON
FUEL ENRICH	2	ELECTRIC ACTUATOR	MA06-6	BARBER-COLMAN
LOUVER TEMP	2	TEMPERATURE CONTROLLER	PI24R4Y1-5V	FUJ
	2	SOCKET	AT12P5B-UL	FUJ
	1	STRIP CHART	DR-4200	HONEYWELL
1REC	1	DUPLEX RECEPTACLE	5252	HUBBELL
1REC	1	DUPLEX COVER	LCD	RED DOT
	1	PLC (RACK & CPU)	IC693CPU311	G.E.
	2	120VAC INPUT	IC693MDL240	G.E.
	2	120VAC OUTPUT	IC693MDL34B	G.E.
	1	POWER SUPPLY	IC693PWR321	G.E.
1HTR	8 FT.	HEAT TAPE	12 WATT	BARP-ON CORP.
UV	1	UV	R4890C-1260	HONEYWELL
UV	1	REMOTE RESET	118702C	HONEYWELL
UV	1	UNIVERSAL BASE	Q270A	HONEYWELL
1SP	1	SURGE SUPPRESSOR	SP1175	SQ'D
1SP	1	MTG BRACKET (FOR ABOVE)	00-SAMK	SQ'D
2TB	1	TERMINAL STRIP (1/C) TYPE	65-2141-K-5	MARLIN
2TB	10	SPADE LUG (CHROME)	SL-2141-CH	MARLIN
2TB	10	SPADE LUG (ALUMEL)	SL-2141-AL	MARLIN
	5	FAST OPEN CLAMP ASS'Y.	A-FC41255	HOFFMAN
	1	IND. CORROSION INHIBITOR	A-HCL10E	HOFFMAN



REV	DESCRIPTION	DATE	BY

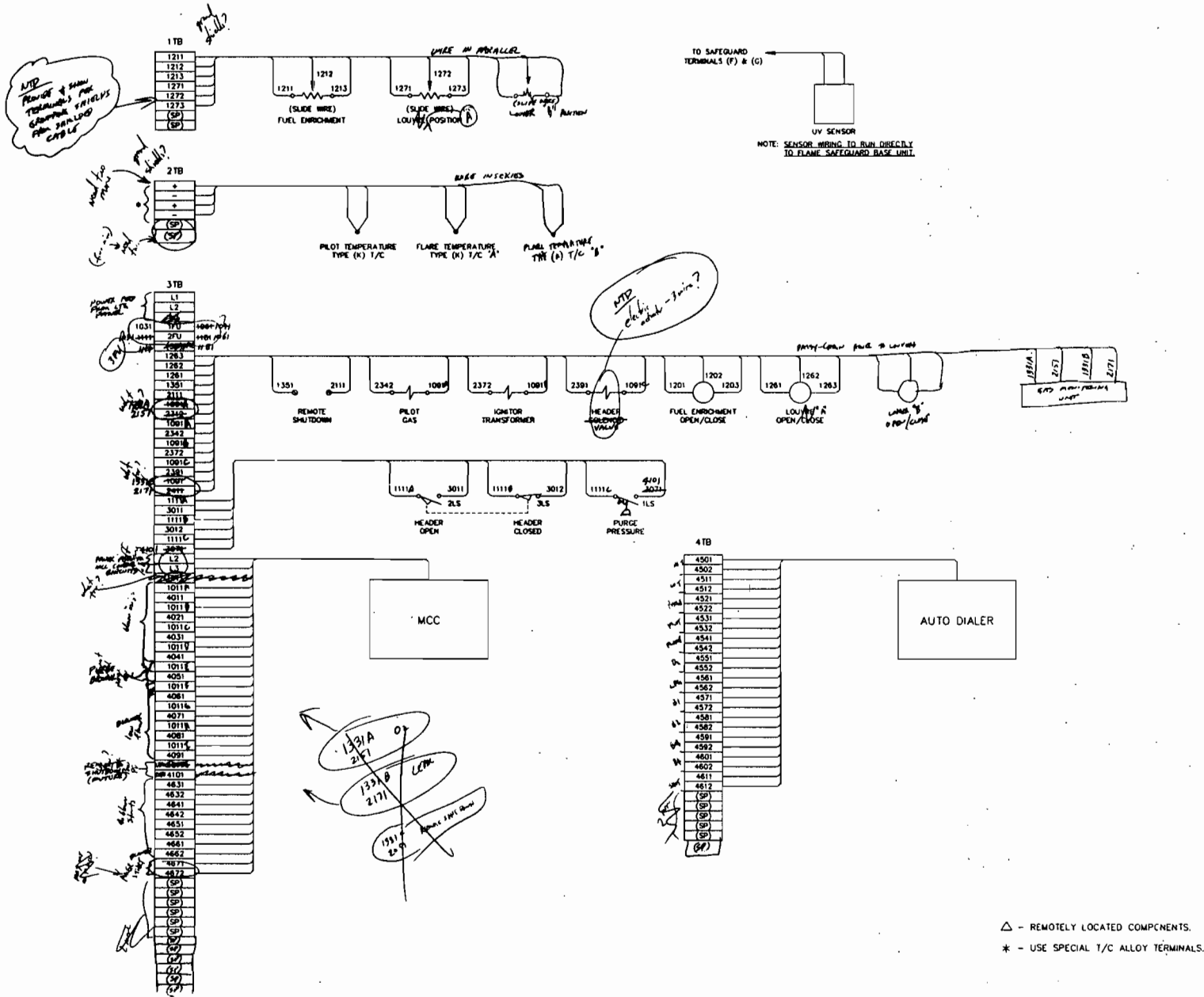
**LFC SPECIALTIES, INC.**

PLANT  
705 FRIENDSHIP DRIVE  
NEW CONCORD, OHIO 44130  
(614) 826-7472

HEAD OFFICE  
7550 LUCERNE DRIVE #110  
CLEVELAND, OHIO 44130  
(216) 891-0335

TITLE	PANEL LAYOUT, DETAILS, & BILL OF MATERIAL
PROJECT NAME	EAST DUVAL SANITARY LANDFILL
DRAWING NUMBER	
CUSTOMER	MORETRENCH AMERICAN CORP.
SCALE	2" = 1"
DATE	8/92
DESIGNER	T.P.
CHECKED BY	B.B.
PROJECT NUMBER	
SHEET	1 OF 6 C

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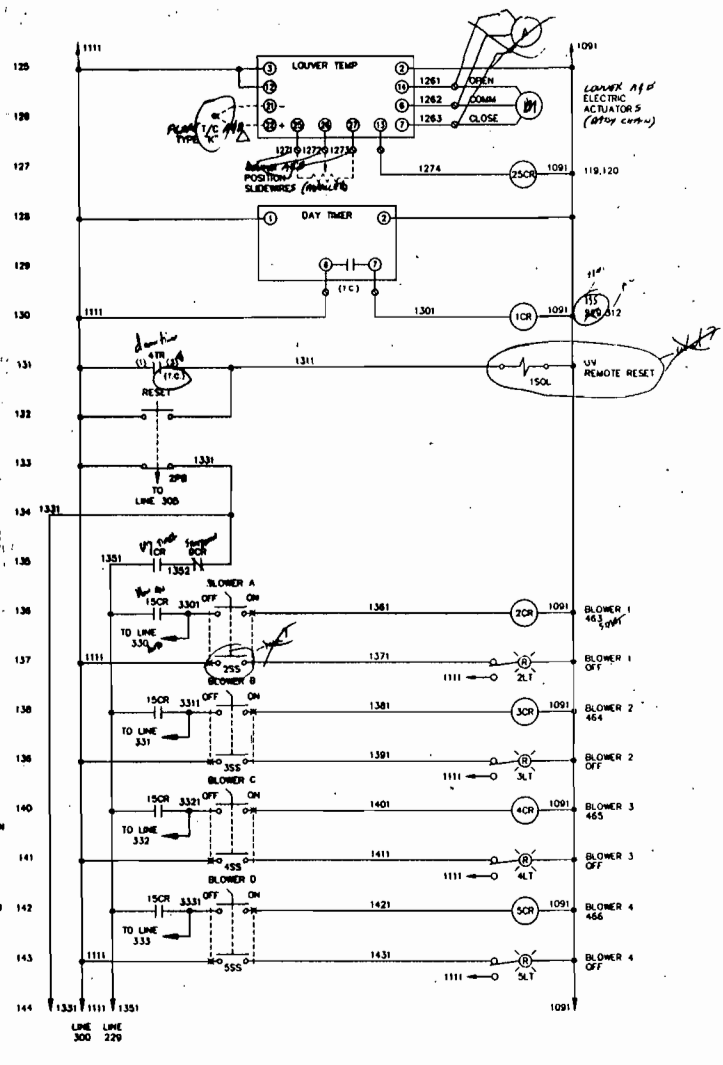
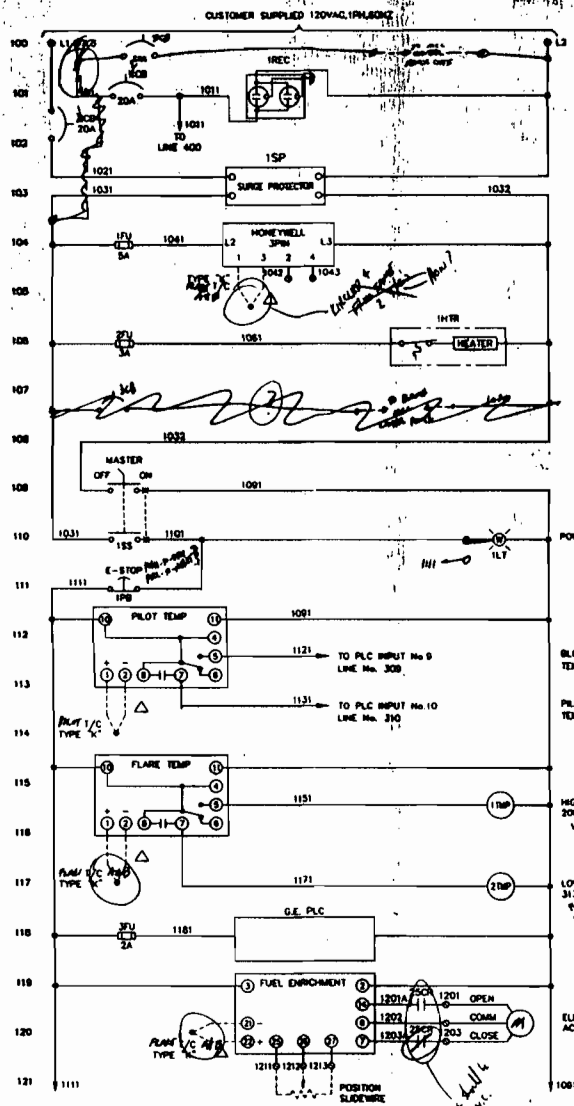
PLANT  
 HEAD OFFICE  
 7550 LUCERNE DRIVE #110  
 CLEVELAND, OHIO 44130  
 (216) 891-0305

PLANT  
 705 FRIENDSHIP DRIVE  
 NEW CONCORD, OHIO 43762  
 (614) 826-7422

SCALE	NONE
DATE	9/92
DESIGNER	T.R.
CHECKED BY	J.R.
APPROVED BY	
PROJECT NUMBER	
FILE	
PROJECT NAME	CABLING DIAGRAM
CUSTOMER	EAST DUVAL SANITARY LANDFILL
DRAWING NUMBER	
CUSTOMER #	MOORETRENCH AMERICAN CORP.

Page 2 of 6





△ - REMOTELY LOCATED COMPONENTS.

REV	DESCRIPTION	DATE	BY

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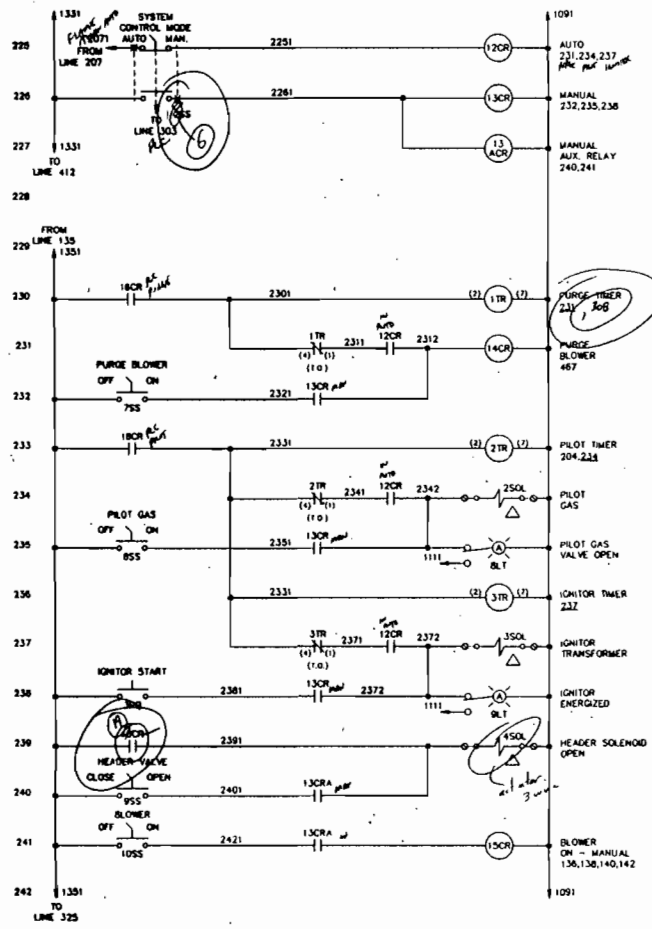
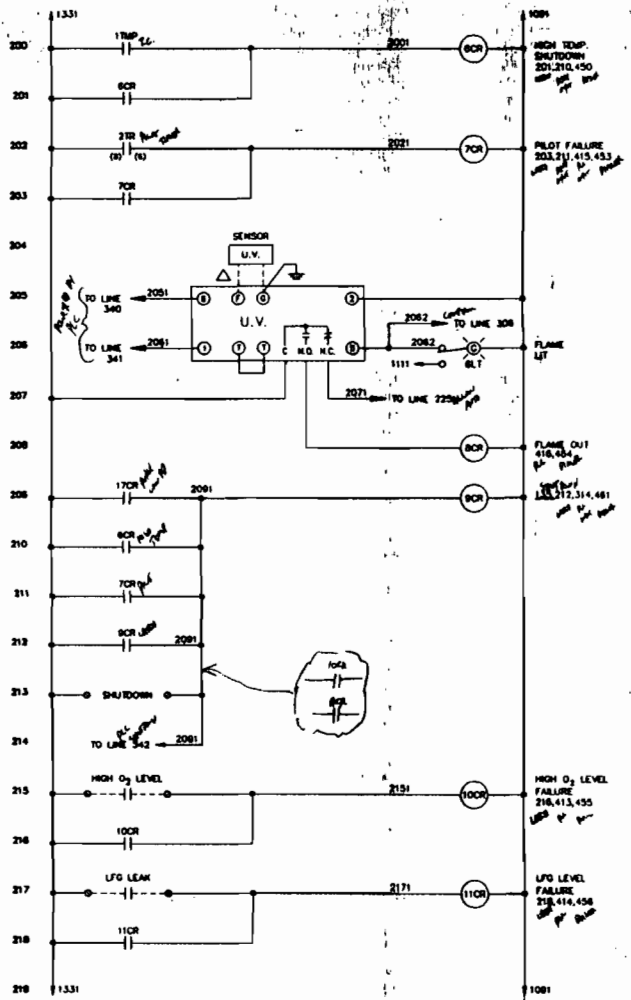
**LFG SPECIALTIES, INC.**

PLANT  
705 FRIENDSHIP DRIVE  
NEW CONCORD, OHIO 43762

HEAD OFFICE  
7550 LUCERNE DRIVE #110  
CLEVELAND, OHIO 44130  
(216) 881-0305

TITLE	ELECTRICAL SCHEMATIC
PROJECT NAME	EAST DUVAL SANITARY LANDFILL
DRAWING NUMBER	
SCALE	NONE
DATE	8/92
DRAWN BY	T.R.
CHECKED BY	
APPROVED BY	
PROJECT NUMBER	P.O. NUMBER MORETRENCH AMERICAN CORP.

SHEET 3 of 6



△ - REMOTELY LOCATED COMPONENTS.

REV.	DESCRIPTION	DATE	BY

**LFG SPECIALTIES, INC.**

PLANT

7550 LUCERNE DRIVE #110  
CLEVELAND, OHIO 44130  
(216) 891-0305

HEAD OFFICE

705 FRIENDSHIP DRIVE  
NEW CONCORD, OHIO 43762  
(614) 826-7422

SCALE	DATE	DESIGNED BY	DRAWN BY	CHECKED BY	APPROVED BY	PROJECT NUMBER
NONE	8/92	T.R.	B.B.			

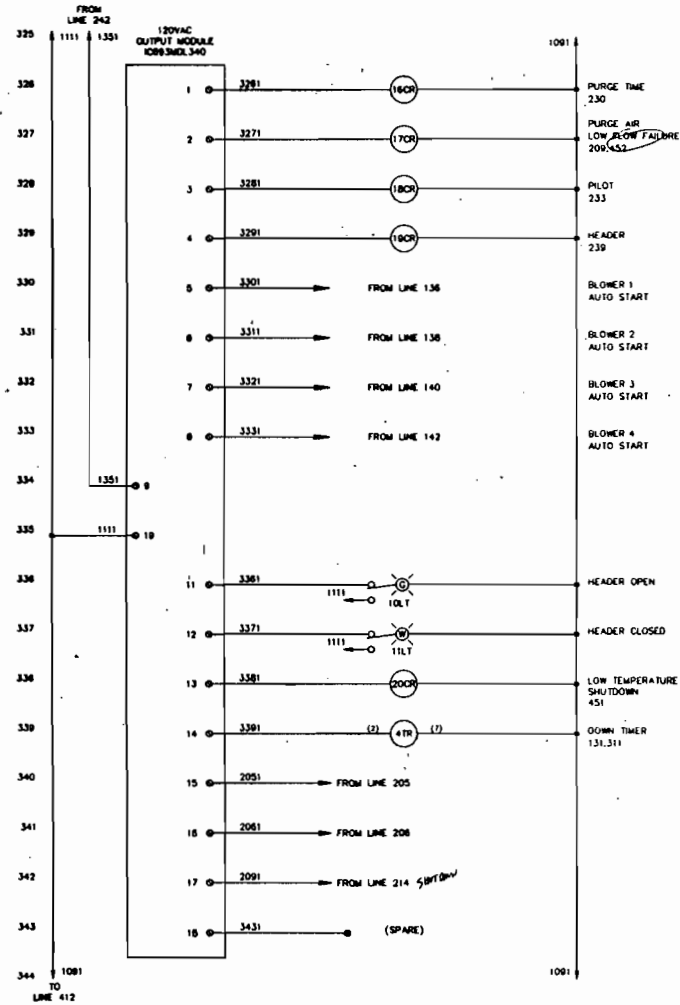
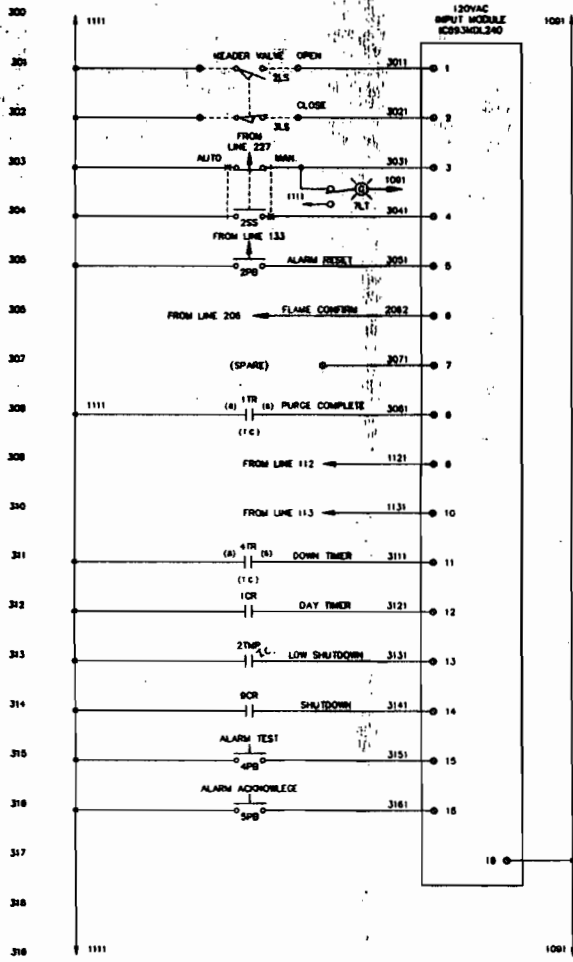
ELECTRICAL SCHEMATIC

EAST DUVAL SANITARY LANDFILL

P.O. BOX 1000  
MORETRENCH AMERICAN CORP.

SHEET 4 OF 6

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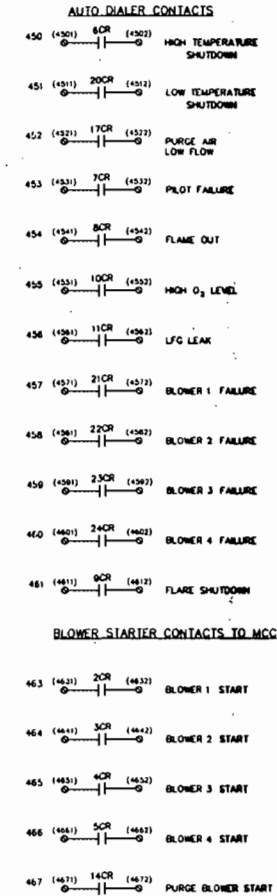
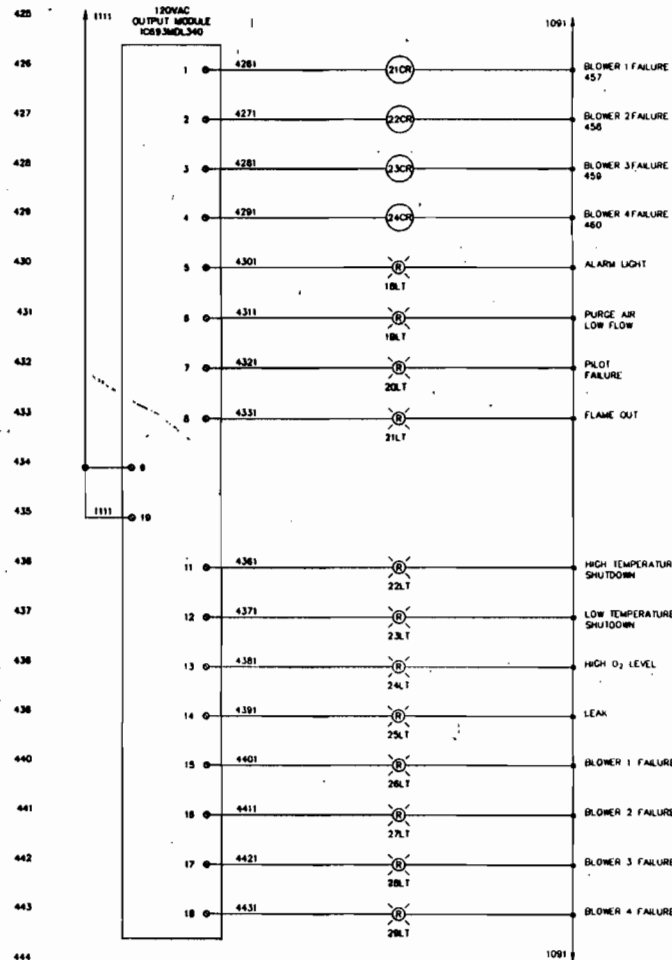
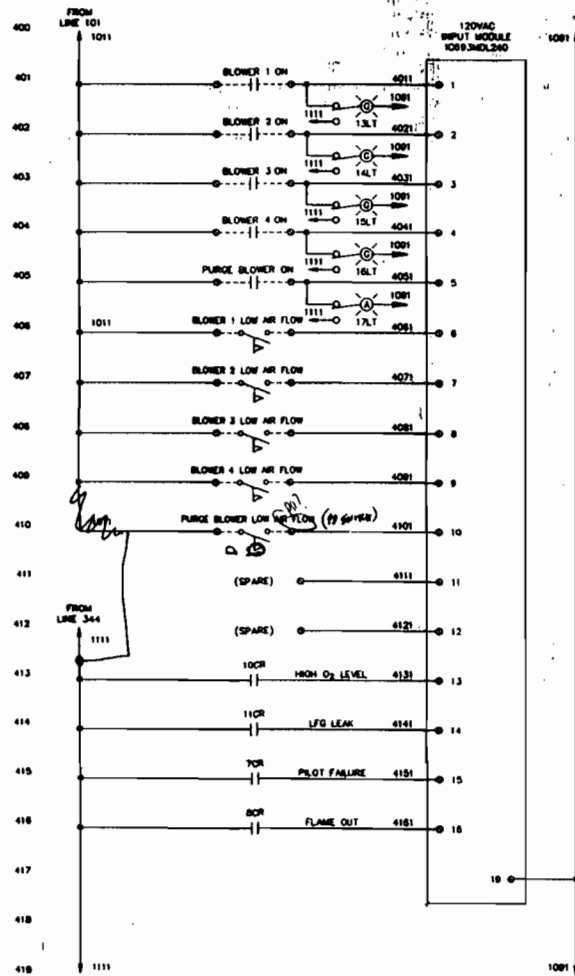
REV.	DESCRIPTION	DATE	BY
1			
2			
3			
4			

**LFG SPECIALTIES, INC.**  
 HEAD OFFICE  
 7550 LUCERNE DRIVE #110  
 CLEVELAND, OHIO 44130  
 (216) 891-0305

PLANT  
 705 FRESHSPRING DRIVE  
 NEW CONCORD, OHIO 43162  
 (614) 828-7422

TITLE: ELECTRICAL SCHEMATIC  
 DATE: 9/92  
 DRAWN BY: TR  
 CHECKED BY: JR  
 APPROVED BY: [Signature]  
 PROJECT NUMBER: [Blank]  
 SHEET: 5 of 6

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△ - REMOTELY LOCATED COMPONENTS.

REV.	DESCRIPTION	DATE	BY

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**LFG SPECIALTIES, INC.**

HEAD OFFICE  
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CLEVELAND, OHIO 44130  
(216) 891-0305

PLANT  
705 FREDERICK DRIVE  
NEW CONCORD, OHIO 43762  
(614) 826-7422

ELECTRICAL SCHEMATIC

DATE: 9/92  
DRAWN BY: JTR  
CHECKED BY: JTR  
APPROVED BY: JTR

PROJECT NAME: EAST DAVAL SANITARY LANDFILL

CUSTOMER: MORETRENCH AMERICAN CORP.

SHEET 8 OF 8

## Section 3

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*CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS*

*CITY OF JACKSONVILLE  
JACKSONVILLE, FLORIDA*

*EAST DUVAL SANITARY LANDFILL CLOSURE*

**CONFORMED**

*APRIL 1992*

*POST, BUCKLEY, SCHUH & JERNIGAN, INC.  
Consulting Engineers & Planners*

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Section 11188

LANDFILL GAS COLLECTION-FLARE SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. Furnish all labor, materials, equipment and incidentals required and install, test and make completely ready for operation one (1) enclosed type Landfill Gas Collection flare system including all appurtenances required, as shown on the Drawings and specified herein.
2. Contractor is responsible for completing pad construction in coordination with the equipment supplier prior to equipment installation.
3. All equipment and accessories shall have approved manufacturer's shop drawings prior to installation and shall be tested in conformance with these Specifications prior to acceptance and final payment by the Owner.
4. The Contractor shall be responsible for furnishing all equipment and accessories as described in this Specification and/or as noted on the mechanical and electrical drawings and as required for satisfactory operation of the system. He shall assume complete system responsibility, including warranty, for all equipment whether he is manufacturer or not.
5. The flare manufacturer shall be responsible for all wiring connection input and output from and to the flare control panel and all field devices furnished by him.

1.02 QUALITY ASSURANCE

A. Qualifications: All of the equipment specified under this Section shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the production of the equipment to be furnished.

B. Standards:

Welding - Gas Piping: ASME IX  
Welding - Burners: AWS  
Welding - Structural: AWS  
Weld Inspection: ASME V  
Drawing Dimensions: English  
Electrical Wiring: NEC  
Pipe Flanges: 150 lb. ANSI

Pipe Threads: NPT  
Structural Design: AISC A58.1

- C. Equipment Manufacturer: The flare shall be manufactured by McGill, model EGF75; or John Zink, model ZTOF, or equal.

### 1.03 SUBMITTALS

- A. Materials and Shop Drawings: Submittals shall include at least the following:

1. Certified shop drawings showing all important details of construction, dimensions, and weight.
2. Descriptive literature, bulletins, and/or catalogs of the equipment.
3. A complete total bill of materials for all equipment.
4. A list of manufacturer's recommended spare parts to be supplied, with the manufacturer's current price for each item.
5. The total weight of the equipment including the weight of the single largest item.
6. Design calculations based on data furnished herein to meet the performance and enrichment fuel requirement calculation at low methane gas concentration to sustain the flare and to maintain operating temperature.
7. Complete control panel diagrams and elevations showing all components, wires, connections, and numbered terminals.
8. Complete electrical interconnect diagram showing all wires and terminals between the control panel and external devices.

- B. Complete assembly, foundation and installation drawings complete wiring diagrams, control panel layout and control schematics, together with detailed specifications, and data covering actual materials used, parts, devices, and other accessories shall be submitted.

- C. Operating Instructions:

1. Six (6) copies of an operating and maintenance manual shall be furnished in accordance with Section 01730. The manual shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, and information necessary to instruct operating and maintenance personnel unfamiliar with such equipment.
2. A factory representative with complete knowledge of proper operation and maintenance shall be provided for a minimum of three (3) days to instruct representatives of the Owner and/or the Engineer on proper



operation and maintenance. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- B. The equipment shall be delivered on-site as fully assembled as transportation will allow. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- D. Finished surfaces of all exposed openings shall be protected by wooden blanks, strongly built and securely bolted thereto.
- E. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.05 WARRANTY AND GUARANTEES (SEE SECTION 01740)

- A. The equipment manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and material for a period of one (1) year from the date of equipment startup and acceptance. Copies of the Warranty shall be provided in accordance with Section 01740, "WARRANTIES AND BONDS" In the event that the equipment fails to perform as specified, the equipment manufacturer shall promptly repair or replace the defective equipment without any cost to the Owner (including handling and shipment costs).

PART 2 - MATERIALS

2.01 GENERAL

A. Flare:

- 1. An enclosed gas flare system shall be provided to render landfill gas pollution free for discharge in the atmosphere. The flare system shall be designed to operate with automatic temperature control. The flare system shall be capable of operating at or above a temperature of 1800°F, continuously. Landfill gas flow shall vary from 400 SCFM to 2,400 SCFM. The landfill gas is expected to have following characteristics:

	<u>Average</u>	<u>Range</u>
Gas Temperature, °F	100±	(80°-150°F)
Methane Concentration, %	52±	(40-60%)
Carbon Dioxide, %	48±	(40-60%)

2. The flare shall reduce odorous compound in LFG to a non-odorous form by combination of combustion at high temperature, combustion in excess air, and retention of the combustion products for a sufficient time to allow complete reduction prior to exhaust from the flare stack with no visible flame. Propane gas will be used as a pilot fuel. The following minimum requirements shall be maintained:

Operating Temperature/Retention time: A minimum temperature of 1500°F for 0.6 seconds after flame burner.

Destruction Efficiencies: 90% for Benzene, 98% for Vinyl Chloride and non-methane organic containments (NMOC)

Opacity: Less than 5%

3. The flare system shall include an anti-flashback burner, automatic valves and temperature control, pressure regulator, stack, automatic gas safety shut off valves, control panel with stainless steel stand in NEMA 4 316 SS enclosure suitable for outdoor installations and all other necessary appurtenances to have a complete operational system.
4. Flare tower should be fabricated in steel. The exterior of the outside casing of the burning zone shall be constructed with a steel cylinder with solid welded seams to provide strength and air tightness. All metal work shall be given a shop coat of heat resistant paint. The portion of the stack exposed to flame and high temperatures shall be internally insulated.
5. Noise from burner shall not exceed 80 dB when measured three (3) feet from the outer surface of flare during operation at the specified maximum gas flow rate.
6. Design loads: The flare stack and other components shall be designed to support its own dead load plus 100 mph wind load.
7. Equipment supplier shall provide lightning protection for the stack and contractor shall ground it.

## 2.02 ACCESSORIES

1. Inlet Flame Arrester: An inlet flame arrester shall be provided as shown on the drawings and described here. Flame arrester shall be designed for a maximum LFG flow of 2,400 SCFM. It shall have aluminum housing and aluminum internals. It shall be provided with a one-inch drain plug. The flame arrester shall be provided with 12-inch flanged connections.
2. Solenoid Valves: Gas solenoid valves shall be forged brass body with Teflon seat, Type 305 stainless steel core tube, Type 430F stainless steel core and plug nut, Type 302 stainless steel springs,

suitable for an inlet working pressure of 50 psig. Solenoid valves shall have an auxiliary manual operator. Solenoid valve enclosure shall be rated NEMA 4, 120-volt, single-phase, ASCO Red Hat, Magnetrol, or equal.

3. Pressure Regulator, Gas: Shall provide gas at reduced pressures, as shown, constant to within plus or minus 10 percent for flows from 0 to 10 SCFM with 50+ psi supply pressure. Unit shall have setscrew for outlet pressure adjustment. Units for air set services shall have integral filter and relief valve. Units shall be Masoneilan Series 77; Fisher Series 67 or equal.
4. Pressure Gauge, Gas: Gauges shall have a stainless steel case and Type 316 stainless steel bourdon tube and 1/4-inch connection with range as required for service. The gauge shall be capable for use with propane fuel.
5. Electric Motor Operators for Throttling Service:
  - a. Each electric operator shall be bi-directional type for throttling service with permanent split capacitor motor drive and integral mechanical brake. Provide built-in motor thermal overload protection. Operator power source shall be 115 volts ac. Each electric operator shall contain a local/remote selector switch, stop-open-close push-buttons, and open and closed indicator lights. The control housing shall be NEMA 4 construction with threaded hubs for conduit entry.
  - b. Gear operators shall be totally enclosed and factory-grease packed. Operators shall have self-lubricating bronze shaft bearings. Position switches shall be integrally geared to the operator and shall be adjustable to stop motion at the end of travel in each direction. Provide an operator space heater to operate continuously.
  - c. The operators shall have a manual override to allow operation of valve in case of power failure. Provide disengageable manual override so that the operator cannot be operated electrically while the manual override is engaged. All mechanical parts to have a safety factor of at least two with an output target of at least 1.5 times the maximum torque required.
6. Purge Air Blower: The enclosed flare system shall be equipped with a purge air blower to purge the flare prior to start up. The blower shall be equipped with necessary control and shall be sized by the flare manufacturer.

#### 2.03 FLARE SYSTEM CONTROL PANEL

The panel shall be a 316 stainless steel, rack-mounted enclosure rated NEMA 4X. The panel shall be sized to adequately dissipate heat generated by equipment mounted inside or on the panel face.

A. Finish:

1. The panel face openings for panel-mounted equipment shall be smoothly finished, cut with counterboring, and provided with trim strips as required to give a neat, finished appearance.
2. Panel Surfaces shall not be painted.
3. Provide engraved laminated plastic nameplates for each panel face-mounted device to completely describe the service of the device.

B. Access:

1. The control panel shall have a continuous piano hinge front access door. Door opening shall expose a minimum of 80% of the panel interior. Print pocket shall be provided on the door. The panel door shall be equipped with quick-release latches.
2. All components and terminals shall be accessible without removing other components except for covers. Conduit entry shall be from the bottom.
3. All indicator lights, control switches, and pushbuttons shall be mounted on the panel front face door. Group controls in a logical sequence to facilitate manual start-up and shutdown and to position like items in functional groups.
4. Locate the controllers, recorder, and annunciator behind a fully gasketed, hinged, clear Lexan window on the panel front face door to allow viewing of the devices and maintain a NEMA 4X environment for the devices.

C. Corrosion and Temperature Control: The panel shall be protected from internal corrosion by the use of corrosion - inhibiting vapor capsules, Hoffman, model A-HCI, or equal. Provide an interior panel space heater to maintain internal temperatures above dew point. Provide a combination drain/breather, Crouse-Hinds Model ECD18, or equal.

D. Construction: The panel shall be a manufactured item, Hoffman Engineering, or equal. Minimum metal thickness shall be 14-gauge. Provide stiffeners as required to prevent deflection under instrument loading and permit lifting without racking or distortion.

E. Electrical:

1. Provide a main circuit breaker and branch circuit breaker for each branch circuit as required to distribute power within the panel from the two 120V, single phase feeder circuits. Make provisions for feeder conduit entry and provide terminal board for termination of all wiring. Access to the breakers shall be provided when the panel door is open. The following rules apply for actual circuit wiring:

- a. No more than 20 devices on any single circuit
  - b. Do not group multiple units of parallel operations on the same board circuit
  - c. Do not exceed an ampacity of 12 amps for any branch circuit
  - d. Panel receptacle shall be on separate branch circuit.
2. The panel builder shall design, furnish and install all interior wiring and components within the control panel. Furnish complete wiring diagrams showing the electrical circuits inside the panel and interconnections between the panel and the external instruments and components. Interconnecting wiring between the panels and the equipment specified under other sections shall be identified and numbered on the diagram. All terminals and internal wiring shall be identified and numbered on the drawing. All panel wiring shall have numbered plastic clip-on tags attached to each wire for identification. Inside the panel, there shall be provided a copy of panel and interconnecting wiring diagrams. No power shall be applied until the Engineer has approved the installation.
3. Wiring within panels shall meet the following requirements:
- a. Power and control wiring shall be 600-volt, stranded copper, sized for the current carried but no smaller than No. 14 AWG.
  - b. Restrain wiring with plastic ties or ducts. Hinge wiring shall be secured at each end with bend area protected with a plastic sleeve.
  - c. Analog signal wiring shall be 300-volt, stranded copper in twisted shielded pairs, no smaller than No. 16 AWG.
  - d. Separate analog circuits by at least 6 inches from any AC power or control wiring.
4. All relays shall be the compact, general-purpose, plug-in type. Contacts shall be rated for not less than 10 amperes at 120V. Provide relays with neon status lights and test buttons. Time delay relays shall have integral adjustment knob and rangeability of at least 10:1. All relays shall have permanent, legible identification.
5. Terminal blocks shall meet the following requirements:
- a. Provide the greater of 20 percent of all connected terminals or four unused spare terminals.
  - b. Provide terminal blocks for 120V circuits separate from analog circuit terminal blocks.

- c. Screw-type terminal connections shall be with locking, fork-tongue or ring-tongue lugs crimped with proper sized anvil. Terminate no more than two lugs per terminal with no more than one wire per lug.
  - d. Compression clamp terminal connections shall be stripped and prepared per manufacturer's recommendations. Terminate no more than one wire per screw and yoke.
- 6. Provide the panel with a 120V, 15 amp, duplex receptacle.
  - 7. The panel shall be provided with an isolated copper grounding bus to ground all connections. Provide surge protection on the 120V, single phase feeder circuit, as manufactured by Square D, or equal. Coordinate grounding system with Division 16, Electrical.
  - 8. Analog signal transmission modes shall be electronic 4-20 mA DC. No other signal characteristics are acceptable. All electronic devices shall be solid state.
  - 9. Electrical transient protection shall be provided for all electrical elements of the system. Surge suppressors shall be located at any connection between AC power sources and electrical equipment including panels, assemblies, and field devices; and at both ends of all analog signal circuits that have any portion of the circuit extending outside of protecting buildings. Coordinate grounding requirements with Division 16, Electrical.
- F. Control System Operation: Provide the required relay logic, control devices, and field components to implement the following control operations and features:
- 1. System Start-up: System start-up shall begin with a timed air purge cycle (from the air purge blower) to evacuate any fugitive hydrocarbons from the flare enclosure. After purge is completed, the pilot shall be lit by use of propane gas, pilot gas solenoid valve, and spark plug ignition. Provide ignition transformer, pilot spark plug, and ignition timer. Upon proving the pilot flame by a self-checking flame scanner, the landfill gas valve shall be opened and the landfill gas blower(s) shall be started allowing landfill gas to flow to the flare enclosure allowing the use of the landfill gas for system warm-up. Provide suitable time delays to shutdown a blower if the flow switch alarms for that blower is activated while that blower is running.

Provide time delays (0-5 minutes) to allow sequential starting of blowers and prevent simultaneous starts. Provide suitable time delays to shutdown a blower if the flow switch alarm for that blower is activated while that blower is running. After the landfill gas valve is opened, the pilot gas solenoid valve shall then shut off to limit propane gas usage. If a flame is still sensed on the main burner, the system shall continue operation; if not, it shall shut down on flame failure.

2. Temperature Control (Air): The unit temperature shall be maintained by automatically adjusting two electric actuated air dampers, opening the dampers to reduce the flue gas temperature by adding quench air. Provide an automatic temperature controller, two compatible damper operators, and temperature element to operate the analog control loop. Provide a temperature recorder on the control panel to continuously record the flare temperature. Electric damper motor operator is described in Article 2.02. 5.
3. Temperature Control (Fuel): When landfill gas levels are low, the unit temperature may drop. Provide a temperature element and controller to modulate the enriched fuel (propane) electric actuated valve and add enriched fuel to the landfill gas to maintain system temperature (set controller set point below air damper temperature controller). Electric motor operator is described in Article 2.02.5.
4. Automatic Start/Restart: In the automatic mode, the unit shall automatically start when power is applied. If the unit shuts down for any reason except high stack temperature, the auto mode shall allow the unit to attempt to purge and restart for a specified time period. A remote signal is sent if the unit fails to restart.
5. Pressure Control: Provide a pressure regulator on the pilot gas line. Provide a pressure gauge on both the pilot gas line and enriched fuel line downstream of the automatic valves. Pressure regulator is described above in Paragraph 2.02.4 and 2.02.5.
6. Control Features:
  - a. Control switches and pushbuttons:
    - 1) Power ON/OFF switch
    - 2) Purge START pushbutton (green)
    - 3) Landfill gas valve OPEN/CLOSE/AUTO switch
    - 4) Start-up sequence MANUAL/AUTO switch
    - 5) Four (4) landfill gas blower MANUAL/OFF/AUTO switches
    - 6) RESET pushbutton for all latched alarm control relays
    - 7) Ignition START pushbutton (green)
    - 8) System emergency STOP pushbutton (red)
    - 9) Alarm beacon RESET pushbutton (black)
  - b. Indicator lights:
    - 1) Power ON (white)
    - 2) Landfill gas valve OPEN (green)
    - 3) Purge cycle ON (blue)
    - 4) Purge cycle OFF (amber)
    - 5) Pilot gas valve OPEN (green)
    - 6) Flame ON (green)
    - 7) Landfill gas blower ON (for each of four) (green)
    - 8) Landfill gas blower OFF (for each of four) (red)

c. Annunciator alarms:

- 1) Flare temperature HIGH (from temperature switch)
- 2) Flare temperature LOW (from temperature switch)
- 3) Flame OUT, flare failure (from flame scanner switch)
- 4) Landfill gas blower FAIL (for each of four blower flow switches)
- 5) Blower suction air infiltration (from O<sub>2</sub> sensor)
- 6) Landfill gas leak (from toxic gas sensor)
- 7) Purge air flow LOW, purge blower failure (from purge differential pressure switch)

d. Remote interface contacts:

- 1) 3-wire, 120-volt power supply to flare control panel
- 2) Purge air blower motor starter control contact to MCC
- 3) Purge air blower "on" contact from MCC
- 4) Purge air blower pressure differential switch contact
- 5) 2-wire signal cable to temperature switch thermocouples (for each of the two)
- 6) 2-wire signal cable to temperature controller thermocouples (for each of the two)
- 7) 5-wire signal contacts to flame scanner
- 8) Landfill gas valve closed position switch contact
- 9) Landfill gas valve 2-wire control contact to 3-way solenoid
- 10) Single wire to ignition spark plug (Taylor #357, or equal)
- 11) 2-wire 120V power to each of two air damper actuators
- 12) 2-wire signal cable to each of two air damper actuators
- 13) 2-wire 120V power to enriched fuel valve actuator
- 14) 2-wire signal cable to enriched fuel valve actuator
- 15) Pilot gas solenoid valve control contact
- 16) Landfill gas blower motor starter control contact to MCC (for each of the four)
- 17) Landfill gas blower "on" contact from MCC (for each of the four)
- 18) 20-wire signal contacts from annunciator to autodialer
- 19) 2-wire signal from oxygen sensor in gas analyzer enclosure
- 20) 2-wire signal from landfill gas sensor in gas analyzer enclosure
- 21) 2-wire signal from landfill gas blower low flow switch (for each of the four)

G. Control Components:

1. Alarm, Visual Beacon: Warning lights shall be flashing type units that produce 360-degree beams of colored light. Flashing rate shall be 60 to 80 flashes per minute. Unit shall use a solid state strobe source. Light color shall be red and unit shall have simple technique for relamping. Units shall be suitable for panel mounting and shall operate on 120V AC power. Housing shall be weatherproof, suitable for use in outdoor environments without other protection.



General purpose units shall be Benjamin Electric Manufacturing, Series KL-4000; or equal.

2. Annunciator: The annunciator panel shall consist of backlighted, individual lamp windows for indication of each fault noted. The windows shall be engraved with the inscriptions noted. At the occurrence of any fault, the visual alarm beacon and the lamp indicator shall flash on and off. The unit shall include integral TEST, ACKNOWLEDGE, and RESET pushbuttons as shown. The TEST pushbutton shall illuminate all the lamp indicators. When the ACKNOWLEDGE pushbutton is depressed, the lamp indicator shall change to steady-on. When the fault condition goes to normal, the lamp indicator shall remain steady-on until RESET. If a fault should occur at any other point after the first fault, the new fault shall flash on and off until ACKNOWLEDGED.

Individual annunciator points shall be plug-in units that are removable from the front of the panel. The annunciator box shall be rated NEMA 1 and suitable for panel mounting behind the panel front face window and furnished with integral or remote electronics. All functions shall be performed by solid state circuitry. Provide one normally open auxiliary contact at each individual point. The annunciator shall operate on 120-volt, 60 hertz power. Field contact sensing voltage shall be 120-volt AC. Terminal blocks shall be provided and be clearly identified for each fault. Each lamp indicator shall incorporate two parallel lamps with a rated life of 4500 hours minimum at the normal system voltage. The annunciator shall be Ronan X11 Series, or equal.

3. Controller, Single-Loop, Electronic: Units shall be direct or reverse acting 1/4 DIN size, electronic, single-loop, PID controllers, suitable for panel mounting behind the panel front face window, and operate on 120-volt AC power. Provide the following control modes:
  - a. Manual Mode: Controller output adjusted manually.
  - b. Automatic, Internal Set Point Mode: Feedback or feedforward controller output is derived from the process variable and the operator adjusted set point with proportional, integral, and/or derivative control action.

Units shall be Honeywell UDC 3000 Universal Digital Controller, or equal.

4. Indicating Light, Watertight: Units shall be heavy-duty, watertight, press-to-test industrial-type with integral transformer for 120-volt AC applications. The lights shall be rated for NEMA 4X service. Units shall have screwed-on prismatic lenses in colors noted and factory-engraved legend plates as noted. Units shall be Square D, Class 9001, Type SK, Allen Bradley Type 800H, or equal.

5. Switch, Maintained Contact, Watertight: Units shall be heavy-duty, watertight, industrial type selector switches with contacts rated for 120-volt AC service at 10 amperes continuous. The switches shall be rated for NEMA 4X service. Units shall have factory-engraved legend plates indicating position definition. Operators shall be black knob type. Units shall have the number of positions and contact arrangements noted. Units shall be single hole mounting in panel thicknesses of 1/16 to 1/4 inch. Units shall be Square D Class 9001, Type SK; Allen Bradley Type 800H, or equal.
6. Switch, Momentary Contact, Watertight: Units shall be heavy-duty, watertight, industrial type pushbuttons with momentary contacts rated for 120-volt AC service at 10 amperes continuous. The push-buttons shall be rated for NEMA 4X service. Units shall have factory-engraved legend plates indicating service definition. Units shall have contact arrangements and colors as noted. Units shall be single-hole mounted in panel thicknesses of 1/16 to 1/4 inch. Units shall be Square D Class 9001, Type SK, Allen Bradley Type 800H, or equal.
7. Recorder, Strip Chart, Electronic:
  - a. Unit shall be small-case, microprocessor-based, strip chart recorder. Unit enclosure shall be FM and CSA approved, mounted in corrosion resistant case, suitable for panel mounting with gasketed, hinged door and glass window for chart viewing. Nominal enclosure size shall be 8 inches wide, 8 inches high, and 12 inches deep.
  - b. Units shall accept three 4 to 20 mA dc analog input signals and record them on a 6-inch rectilinear strip chart scroll. Recorder shall provide fully isolated inputs.
  - c. Units shall mount adjacent to and be of the same manufacturer as the controllers.
  - d. Units shall operate on 120-volt, 60 hertz power. Recorder accuracy shall be 0.5 percent of full scale. Provide charr ranges of 0-100% of signal with pointer scales in engineering units.
  - e. Units shall be Honeywell Model VP131 Continuous Recorder, or equal.

#### H. SHOP TESTS

1. The control panel shall be shop tested for complete simulation of all control and communication functions. Where field devices are specified, the material will be capable of meeting standard tests and the Contractor shall submit evidence that similarly manufactured materials have been tested and they meet the minimum requirements of the tests. The tests shall be certified by the manufacturer and shall have been conducted in the United States of America.

2. The test procedures which will demonstrate conformance of the system to the Specifications and project requirements, shall be performed at the manufacturer's factory prior to shipment of the equipment. The manufacturer shall notify the Owner and the Engineer at least four weeks before the expected beginning of the test in order that the test may be witnessed if necessary.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings.
- B. The Contractor shall provide the services of an Erection Supervisor to supervise flare system installation. The Erection Supervisor shall be specifically authorized as a representative of the manufacturer for the installation of the equipment furnished hereunder, and shall be thoroughly competent and experienced for the work required.
- C. The Proposal shall include the services of the Erection Supervisor. Payment for these services shall be part of the Contractor's bid price.
- D. The equipment furnished hereunder shall be installed by the Contractor. The erection supervisor shall supervise the entire unloading and installation of each item of equipment furnished for the flare system under this contract.
- E. The duties of the Erection Supervisor shall include the following for each item of equipment furnished, subject to all limitations and requirements directed by the Engineer or specified elsewhere:
  1. Give all necessary instructions for proper unloading and first class installation of the equipment, including interpretations of the Contractor's printed instructions.
  2. Be present on the work at all times necessary for proper supervision during the unloading and installing of the equipment.
- F. The manufacturer shall provide the services of a qualified engineer or technician to place the units in operation. The Contractor shall assist the manufacturer by starting up and operating all support systems such as electric power and instrumentation. The services provided by the manufacturer shall be the start-up services detailed on the O&M Manuals which shall include at least the following:
  1. Check equipment alignment and ensure there are no internal stresses.
  2. Calibrate all instrumentation.

- G. Start-up and debugging shall be considered completed when the manufacturer and Contractor have demonstrated that the unit is operating optimally and without mechanical/electrical and instrumentation problems. Debugging and start-up of the equipment shall not be considered part of the erection or installation and, therefore, all start-up and debugging efforts will be provided at no additional cost to the Owner nor will the time count against the Erection Supervisor's required number of days. The Engineer shall be the sole judge as to whether the manufacturer and Contractor have completed start-up and debugging.
- H. The Contractor shall submit a certificate from the equipment manufacturer stating that the installation of the equipment is satisfactory, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, and care of the system.

### 3.03 INSPECTION AND TESTING

#### A. General:

- 1. A factory representative shall be provided for four (4) days and shall have complete knowledge of proper operation and maintenance to inspect the final installation and supervise the test run of the equipment.
- 2. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.
- 3. Emission testing of the inlet and outlet of the flare for concentration and mass emission rate of selected pollutants.

#### B. Field Testing:

- 1. Upon completion of all the mechanical work, the Contractor shall conduct testing as specified herein to demonstrate that the equipment performs in accordance with all specifications.
- 2. The Contractor shall perform initial testing of the equipment insuring to himself that the tests listed in the Demonstration Test paragraph below can be satisfactorily completed.
- 3. The Demonstration Test shall demonstrate that all items of these Specifications have been met by the equipment as installed and shall include, but not be limited to, the following tests:
  - a. That the unit has been properly installed and all parts are in correct alignment.
  - b. That the system satisfactorily operate for at least three days of eight continuous hours.
  - c. That there are no mechanical defects in any of the parts.

- d. That the controls perform satisfactorily as to automatic starting and stopping, and remote control of blowers and associated equipment.
4. The Contractor shall provide emissions testing of the inlet and outlet of the flare for concentration and mass emission rate of carbon monoxide, carbon dioxide, methane, hydrogen sulfide, non-methane organic contaminants (NMOC), vinyl chloride, benzene, and any other minimum requirements for stack sampling facilities, source sampling and reporting in accordance with Florida Administrative Code (F.A.C.) 17-2.620(2) and 40 CFR 60 Appendix A. Determine the destruction efficiency for NMOC, vinyl chloride and benzene. If a compound is not found at the inlet, it does not need to be tested for at the outlet. The testing and reporting is to be completed within 45 days of system start-up. The Contractor shall submit to the Engineer for approval the methods of sampling and analyses of air samples, procedures, testing laboratory, and personnel qualifications in shop drawings form, submitted sixty (60) days before start-up of the system. Five (5) copies of the draft report shall be submitted to the Engineer for review and comments. Fifteen (15) copies of the final report shall be submitted after incorporating comments from Engineer.
5. The Contractor shall provide visible emission testing in accordance with EPA Method 22 for a duration of 2 hours. Such tests shall be conducted and reported within 45 days of start-up of the system.
6. Records of testing emission information shall include at a minimum:
- the date, exact place, and time of sampling or measurements;
  - the person responsible for performing the sampling or measurements;
  - the dates analyses were performed;
  - the person responsible for performing the analyses;
  - the analytical techniques or methods used; and
  - the results of such analyses.
7. In the event that the equipment does not meet the Demonstration Test, the Contractor shall, at his own expense, make such changes and adjustments in the equipment which he deems necessary and shall conduct further tests until full satisfaction is indicated by the Engineer and written certification is received thereof.
8. The Owner will pay the salaries of the personnel selected by the Owner for operation of the equipment. Payment of all other salaries, public utility services, and operating expenses shall be borne by the Contractor for the test period and any additional test period required.

END OF SECTION

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