



AC HORN MANUFACTURING

**MODEL #333  
BATCH ROASTER**

INSTALLATION,  
OPERATION  
&  
MAINTENANCE  
MANUAL

**L005201K**

## **MOST IMPORTANT**

Your machine was designed and built to perform properly under a certain fixed set of conditions. Therefore, your products and processes will benefit most by maintaining your AC Horn equipment in first-class working condition. We highly recommend the use of original AC Horn parts, or AC Horn specified parts, for use in your equipment.

Your equipment has been assembled in accordance with the wiring diagrams contained in the instructions. Any changes, either electrical or mechanical, will void your warranty unless the changes carry a written opinion and approval from an executive of AC Horn Manufacturing home office in Dallas, Texas.

This machine is NOT marketed to the general public. It is a complex piece of equipment, designed and built with specific needs, to produce product. It is assumed that the customer has installed this machine (as well as auxiliary items) in accordance with all verbal and written instructions. It is also assumed that an AC Horn Manufacturing representative is available to assist with start-up, commissioning, and training.

Do not allow any changes to be made to your equipment without first determining if the change could be hazardous to either personnel or equipment. Some machines have built-in safety devices, safety doors, limit switches, etc. These are for your protection and should be maintained in good working condition.

To obtain the most efficient operation, please request or refer to the equipment serial # SN-xxxxxx or the quotation covering a list of recommended replacement parts which are applicable to your model #333 Batch Roaster. These parts will enable you to keep your machine operating at all times, thus minimizing costly downtime.

## **MACHINE DESCRIPTION**

The AC Horn Manufacturing #333 is a completely automated, radiant ray, gas-fired roaster designed to process approximately 2000 lbs. per hour of shelled peanuts, almonds, filberts and similar nuts and seeds.

(**NOTE:** 2000 pounds per hour is an approximation. With proper operations, about 660 lbs of shelled peanuts – at about 32 lbs/cuft density – can be batch roasted in 20 minutes. If efficient, the system can do almost 3 full batches in an hour, for about 1980 pounds per hour capacity. Other products will yield different capacities, typically smaller.)

The control panel provides product uniformity with maximum quality assurance. This unit provides consistent, precision temperature control from batch-to-batch, eliminating production waste and quality variation due to human error.

Nuts roasted by the radiant energy process have a comparatively dry surface and a very uniform penetration of color. This is produced by a special multiple arrangement of Selas ceramics to suit the type of gas B.T.U. content. The units are adaptable to natural, manufactured, mixed, carbureted and compressed gases, such as propane and a special air-fuel mixer provides wide range of heats. Heat loss is held to an absolute minimum by blanket type insulation.

The roaster is compact, saves floor space and can be charged from bulk storage or conveyor. Completely automatic charging and discharging is controlled by the control panel with no time loss between the charges, roast and discharge cycles. The design features improved production, eliminates safety hazards and reduces cost by providing continuous, automatic, controlled roasting on a batch basis.

## **MACHINE FUNCTION**

The roaster drum is driven by a 2 HP electric motor through a #80 chain to the drum and normally turns at 12.5 RPM in a clockwise direction (as viewed from the hopper end of the roaster). The bilateral flighting vanes welded to the cylinder walls of the drum constantly stir the peanuts. The majority of the load remains in the lower left-hand quadrant of the roaster as the drum turns. The radiant heaters are offset from the horizontal plane 45 degrees in a clockwise direction (as viewed from the hopper end of the roaster) so that the full radiation of the heaters is directed at the load during the roasting.

The gas-air mixture is carbureted by a mixer and fed to the heaters under pressure by a Pre-mix blower, which is driven by a 1/2 HP motor. Flame intensity is selected from 8 preset burner heats.

Each roaster supplied is designed and constructed to be compatible with the customer's electric requirements and available service.

## **GENERAL SAFETY**

SAFETY GUARDS have been installed on your AC Horn machine for your protection during operation. It is the responsibility of the user to create safe operating conditions on and around the machine. Operating and maintenance personnel must be familiar with the potential hazards and the precautions required to operate and maintain the equipment safely.

Practice safety when operating and working on your machine by:

- (1) Turn off electrical power to equipment (lock-out and tag-out) while doing non-running adjustments, maintenance and changing over for the different products.
- (2) Never place hands near rotating parts.
- (3) Keep machine guards in place.
- (4) Remove all tools and foreign material from equipment before starting operations.
- (5) Make certain that people are clear of equipment before starting operations.
- (6) Avoid contact with hot ingredients, products, and equipment.
- (7) Keep equipment clean and in good working order.

# **INSTALLATION**

## **LOCATING EQUIPMENT**

Plan your equipment location with sufficient clearance allowance for removal of items for maintenance and cleaning. Particular attention should be given to electrical, liquid and drain connections. Ample room should be reserved for auxiliary feeder, conveying or other similar equipment. Do not neglect overhead clearances. A clearance of approximately four feet all around is recommended for working space. Make sure all cabinet doors (control cabinet storage, etc.) have adequate opening space.

## **FOUNDATION**

The ideal foundation for equipment is a solid and level surface. For heavy industrial designed equipment designed for fixed location, mounting pads are furnished for securing on level concrete surface.

## **LEVELING & ALIGNMENT**

Proper alignment will aid in maximum equipment life. The larger the equipment the more critical alignment becomes. These points of support must be in a single level plane. While absolute levelness is not required for satisfactory operation, it is desirable. To level equipment, place a builders level (at least 36" long when possible) on a flat surface or mounting plate on which equipment is mounted. Shim equipment base to obtain a level equipment plane.

Caution: Secure all shims from possible movement.

All multi-piece equipment installed which requires common axis should be aligned per special instructions on outline or assembly drawings.

## **ELECTRICAL CONNECTIONS**

Care in making electrical connections is essential to assure proper operations.

AC Horn ships all types of electrical equipment with the original manufacturer's instructions for installation, operation, lubrication and maintenance. These instructions are included in the installation manual.

Refer to the AC Horn wiring diagram and make all necessary electrical connections. After all equipment has been wired check all drives for correct rotation.

A good electrical ground is essential as required by local code and/or the National Electric Code. All electrical equipment should be grounded.

**Caution:** Some control instruments are protected during shipment by shunt wire, which is tagged for your attention and must be removed before the instrument will operate properly.

Customer must furnish electrical disconnect on main line just prior to equipment.

Do not change power connections to individual electrical equipment until AC Horn Manufacturing has determined proper relationship. If equipment is removed or replaced, care should be taken to reconnect them in exact manner in which they were originally installed.

# UTILITIES

## ELECTRICAL

Only a certified electrician should do any wiring for the listed components. The motor control will require 9.5 amps (4.4KW) of three phase 50 or 60 hertz at 460 volt AC service. The service inlet will protrude through the topside of the electrical box.

### IMPORTANT:

A good EARTH GROUND is highly recommended. AC Horn Manufacturing suggest using a 6' to 8' long conductor driven at least 80% into the ground.

Then run electrical panel ground to the Earth ground. Also run a ground from the Earth ground to a solid metal non-moving part on the roaster.

## PILOT AIR SUPPLY

The pilot gas mixing tube requires a constant stream of regulated air to the pilot flame while trying to light. The pilot air solenoid requires 115 VAC, 50 or 60-cycle electrical service. The incoming air supply will also require that an air source having a pressure of 80 PSI be available. A Filter/Regulator will step down this air to no more than 20 PSI to the regulator supplying air to the mixing tube.

## ROASTER VENT FAN

The roaster rear vent must be connected to an exhauster sized to vent at least 700 CFM. (**NOTE:** AC Horn highly recommends sizing the system for 1000 – 1500 CFM with an air valve between the fan and the roaster exhaust to regulate the airflow between 500 – 1000 CFM.) A cyclone or other type collector should be used to collect red skins and dust aspirated from the roaster. The fan selected should be designed to handle hot exhaust. (Depending on the burner setting this exhaust temperature can be at least 800 degrees F.)

## **GAS (NATURAL STD OR PROPANE OPTIONAL)**

The gas supply line should be large enough to maintain a pressure of 3 oz. (5 inch water column) at the ratio valve while the roaster is operating at maximum heat.

As a rule-of-thumb, when the fuel is low-pressure natural gas the supply line should be one pipe size larger than the ratio valve inlet connection.

Wherever low-pressure manufactured gas is the fuel (or where the gas is supplied at a pressure less than 6" WC through a gas line more than 30 ft. in length), the supply line should be twice the pipe size of the gas inlet of the ratio valve. For specific recommendations based on local conditions, consult the gas company supplying the fuel.

The gas requirement cannot be less than 8" WC but no greater than 5 LBS of pressure. The customer may need to obtain a regulator upstream to reach these requirements; this will be the responsibility of the customer. The gas consumption will vary between unit to unit; this will be because of the gas used and the amount of BTU/HR that the customer will require. The Maximum rate of gas consumption is 1 million BTU/HR.

If the customer is using natural gas then the volume of gas used at maximum firing rate will be 1000 Cu.Ft./Hr (calorific value natural gas = 1000 BTU/Cu.Ft.).

If the customer is using propane gas then the volume of gas used at maximum firing rate will be 400 Cu.Ft./Hr (calorific value natural gas = 2500 BTU/Cu.Ft.).

Connect and/or open valve to allow natural or propane gas to enter the piping for the gas train. Check for gas leaks. Insure that the low gas pressure switch is set at 3" WC and the high gas pressure switch is set at 10" WC. The Gas ration valve located on the combustion blower has been factory set, however further adjustments may be required for your gas supply. Please consult the manufacturer's bulletin for help in setting the ration valve.

# OPERATION

## **PRESSURE REGULATOR (KDI FRI 710/6)**

Check gas supply pressure into pressure regulator. This should read between 1 and 4 (no greater than 5 PSI) on the incoming side of the regulator. Check gas pressure on roaster or outlet side of pressure regulator. This reading should be between 6 to 8 inches of water for Natural Gas and 11 to 12 inches of water for LP Gas to the minimixer. Remove the top cap of the regulator and adjust as needed. Clockwise for more gas, Counter-Clockwise for less gas.

## **LOW GAS PRESSURE SWITCH (DUNGS GAO-A2-4-5)**

Check setting of gas pressure switch. Remove switch cover and place continuity meter test leads across terminals "3" and "2". With the gas pressure off, the meter should show the switch is open. Now open the gas supply valve. The meter should show that the switch is closed. In case the switch does not close, adjust the pointer down scale until the switch closes. Note this setting on the "2-20" scale when the switch closes, continue adjustment down for one (1) graduation (1 in. of water).

## **HIGH GAS PRESSURE SWITCH (DUNGS GAO-A2-4-5)**

Check setting of gas pressure switch. Remove switch cover and place continuity meter test leads across terminals "3" and "1". With the gas pressure off, the meter should show the switch is closed. Since we recommend not running over 6 to 8 inches of water for Natural Gas and 11 to 12 inches of water for LP Gas, this setting should be 11 inches for Natural gas and 15 inches for LP Gas.

## **AIR PRESSURE SWITCH (DUNGS AA-A2-6-2)**

Make sure gas supply valve is closed. Start roaster drum and premix blower motors. Start roaster vent fan motor. Connect continuity test leads to terminals "3" and "2" on switch. Open the vent up more to allow more air to pass by sliding gate out to a maximum setting. Set the premix adjustment lever to the No. 8 position. Note this setting on the "0.16-1.2" scale when the switch closes and continue adjustment down for one (1) graduation. Test this setting by moving the vent damper in and out and moving the premix adjustment from 1 through 8 setting. Switch should remain closed with any combination of premix and damper setting. Shut off the premix blower and roasters drum and leave roaster vent fan on. The Switch should show "open" on the continuity meter.

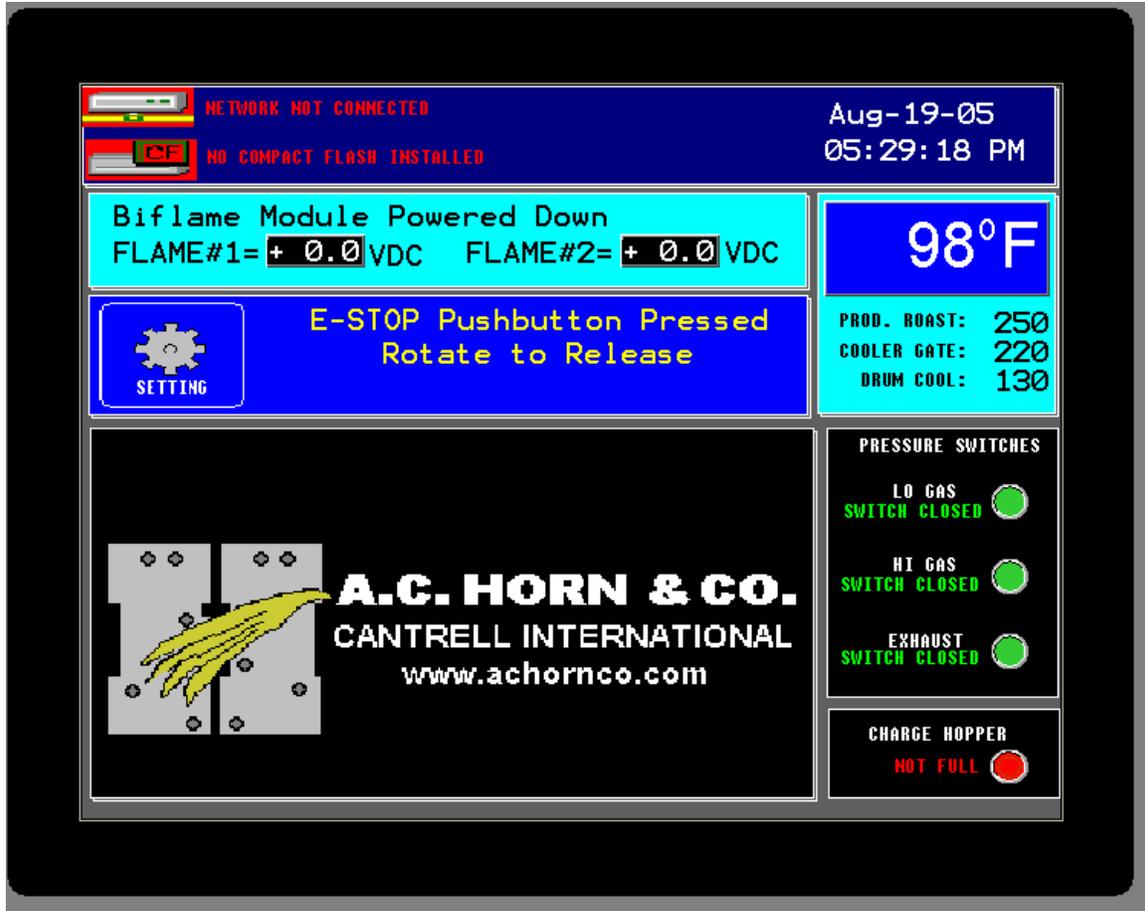
## **PILOT ASSEMBLY AND REGULATOR**

Make sure that the filter/ regulator for the air supply to the pilot assembly has a minimum of 20-PSI incoming air. Set the filter/ regulator so that the regulator after the filter/ regulator has a maximum of 20-PSI. The regulator has a green spring, which gives 6" to 14" of water outgoing pressure. This regulator has been set at the factory and should not need adjusted. If adjustment is required; remove the cap to the regulator to access the adjustment of outgoing pressure; rotating the adjustment clockwise for more gas pressure and counter-clockwise for less gas pressure.

The gas regulator is located on the side the roaster and has been factory; however depending on the type of gas supplied (LP or Natural Gas) and pressure coming in to the regulator (1 to 4 PSI Max) this will need to be reset at start up. Remove the cap to the regulator to access the adjustment of outgoing pressure; rotating the adjustment clockwise for more gas pressure and counter-clockwise for less gas pressure.

The pilot assembly has a needle valve, which acts as the mixer for the gas and the air; it is located at the 90-degree elbow. Adjust all of the settings as noted above until the operator achieves a flame that is nice and blue with a length of approximately 2-3 inches in length.

# MAIN SCREEN



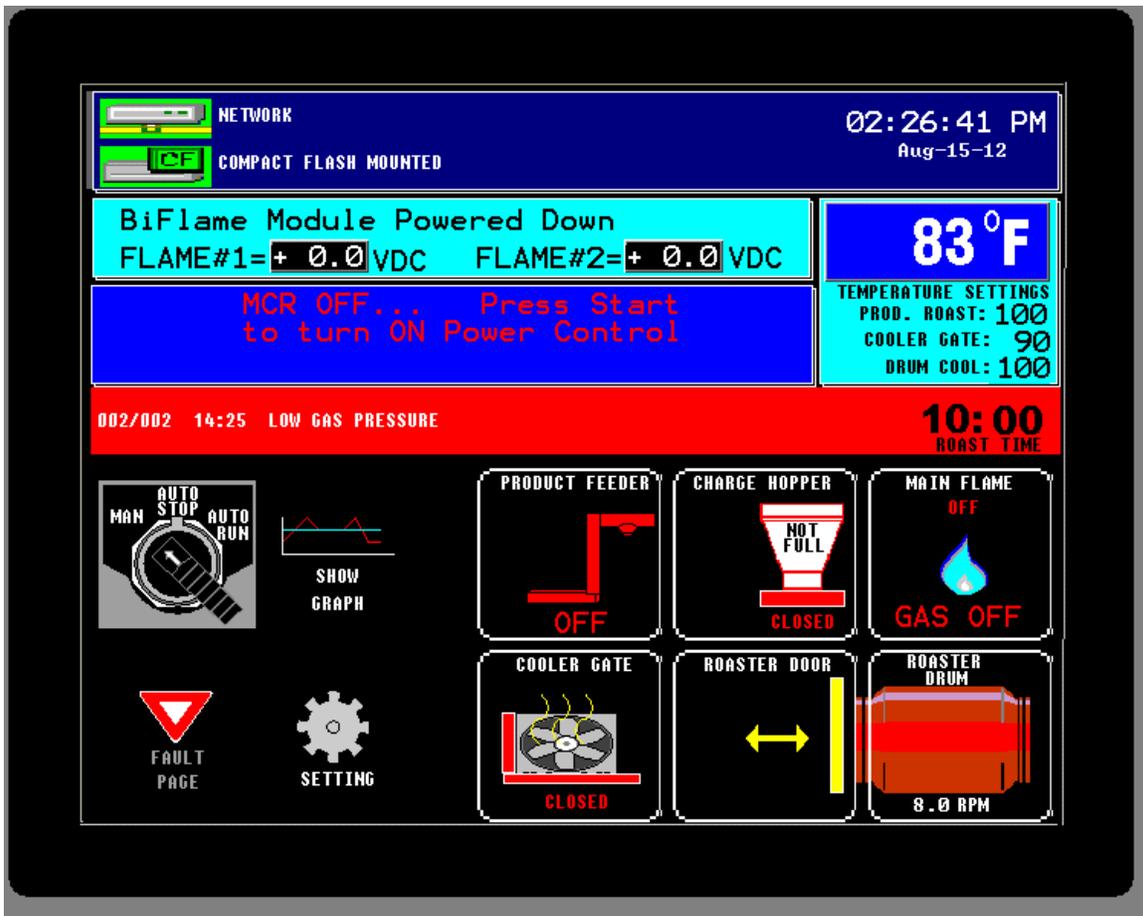
When the E-Stop Pushbutton is pressed, the E-Stop Screen is displayed. Also, the output control power for the valve solenoids, including the Eclipse biflame module, are powered down. Only the power for the PLC (Programmable Logic Controller) and the touch screen will remain on.

# Network Address and Compact Flash Status



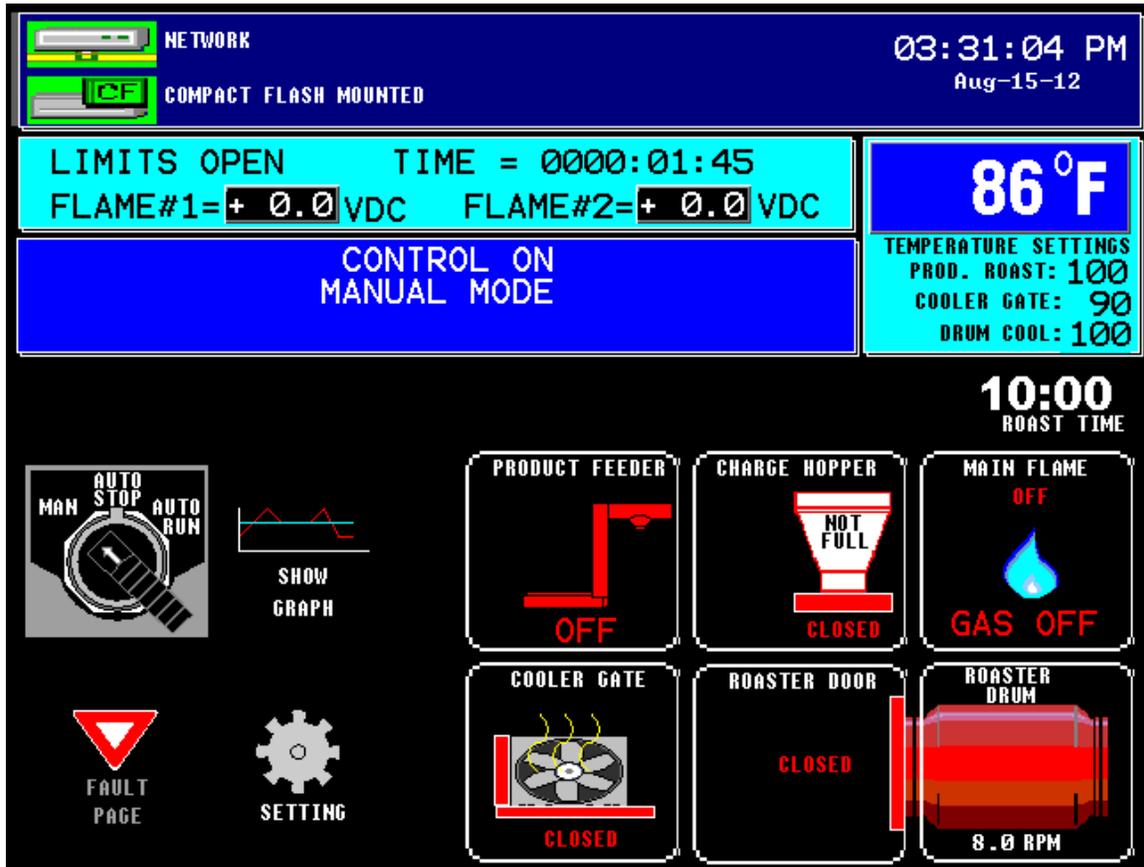
When the Network/Compact Flash icon in the upper left corner of the display is touched, the Network Address and Compact Flash Status will pop up. The IP Address is programmed for DHCP mode. When the touch screen Ethernet port is connected to the network, the touch screen will obtain an IP address and associated parameters from a DHCP server on the local network.

# MCR Off Screen



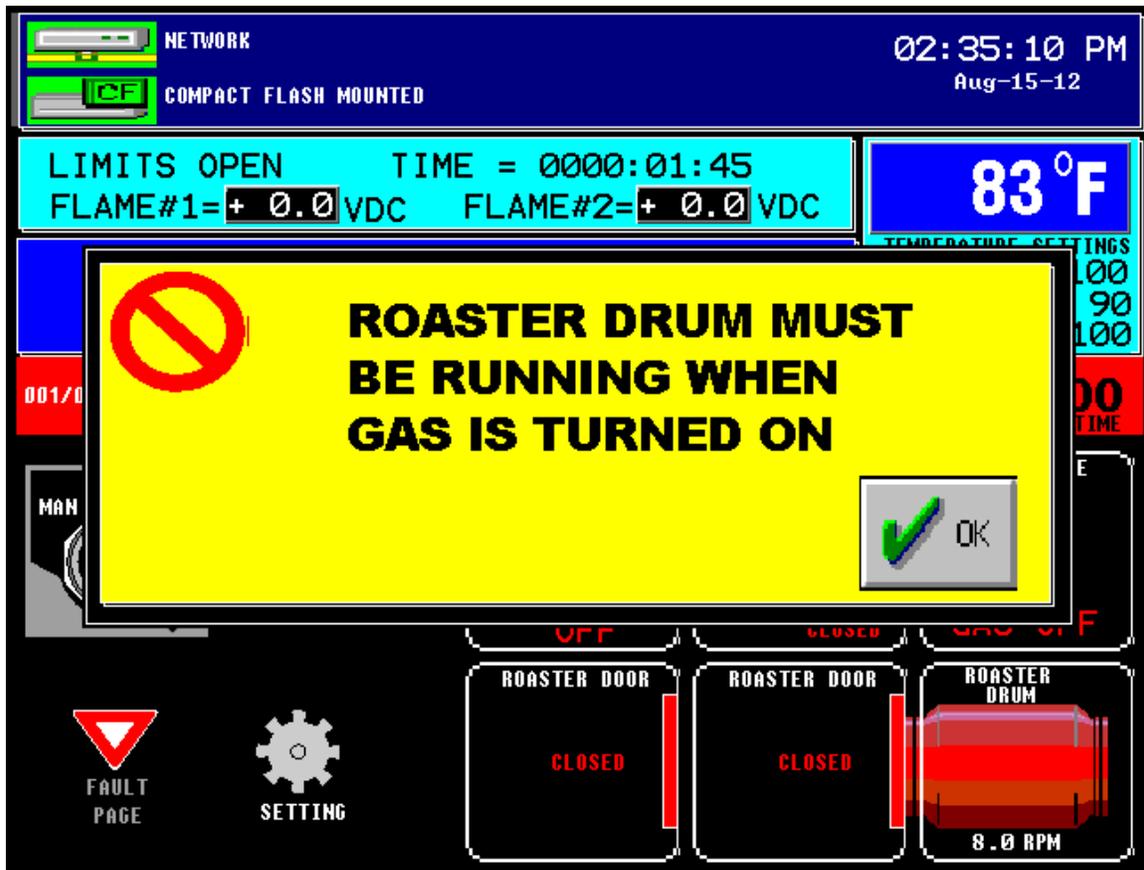
When the E-Stop is released, but the start button has not been pressed, the screen will display the selector switches. Any selector switch when touched will display a Pop-up “MCR off. Press Start” wording in the central window. The Reset Fault Pushbutton when gray is not operational. If there is a resettable fault, the Reset Fault pushbutton will cycle red/yellow and will start to flash. Pressing the button during this fault condition will reset the fault.

# Manual Mode Screen



When the “Start” button on the panel (below the E-Stop pushbutton) is pressed, the Roaster starts in Manual mode. Initially, all the pushbuttons will be in the “off” or “closed” position except for the Roaster Door. If the roaster door is in the open position when the E-Stop is reset, the door will remain in the open position until the switch is set to close position. The Mode switch selector is used to switch the roaster from Manual to Auto Run or Auto Stop Mode.

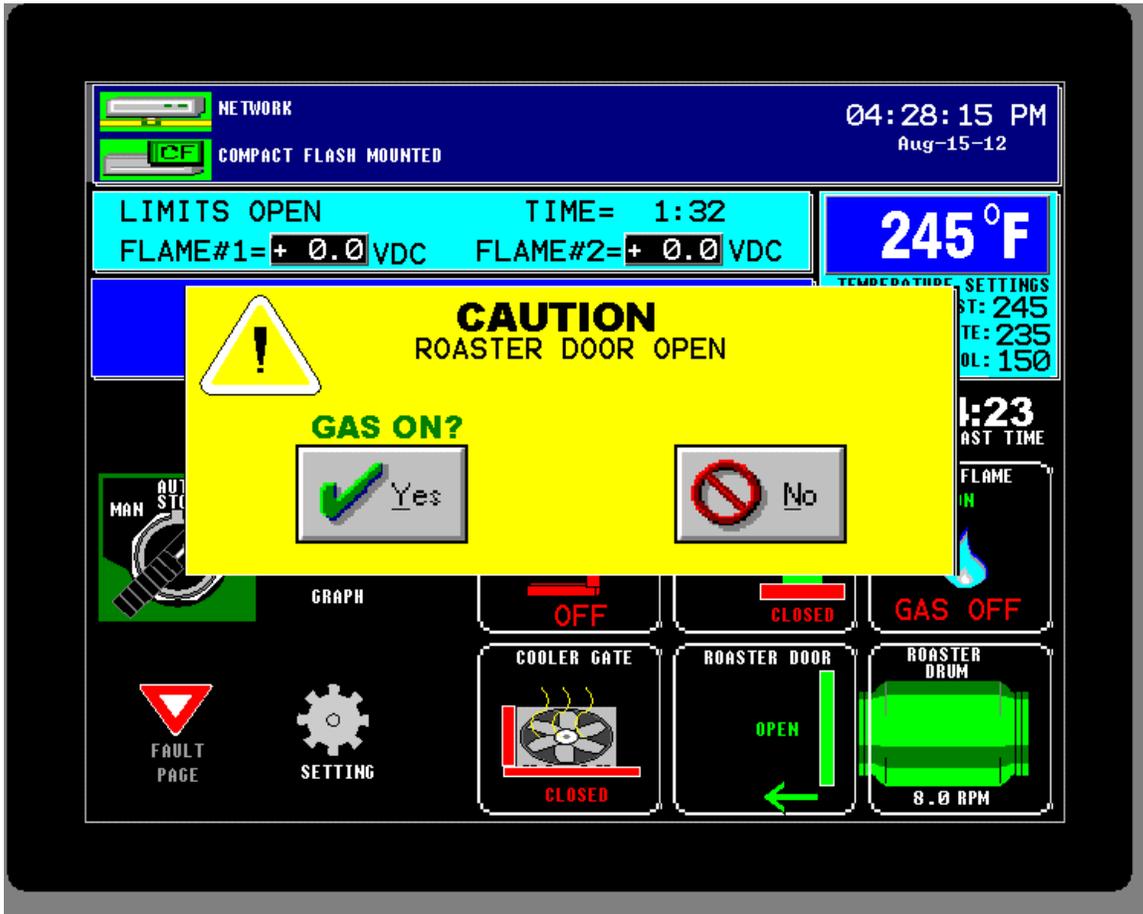
# Manual Mode Not Allowed Operation



Some keys cannot be operated in manual mode:

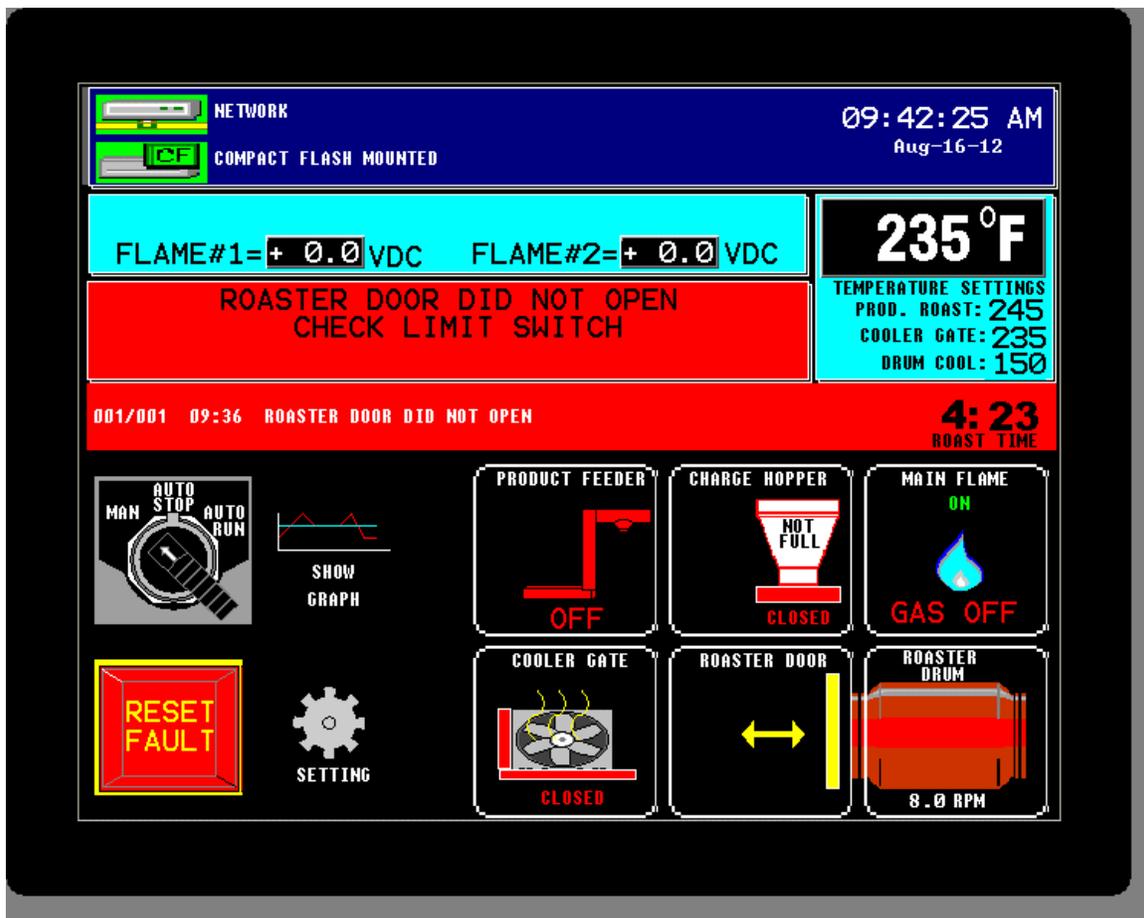
1. Gas: When the roaster drum is not running, the gas switch cannot be turned on to prevent burning one side of the drum.
2. Product Feeder: The feeder cannot be turned on when the charge hopper is full to prevent product from spilling.
3. Charge Hopper Gate: Charge hopper cannot be opened if the drum door is not closed to prevent the product from discharging from the roaster when it is being filled.

# Manual Mode Caution Popup



Some switches when operated will popup a caution sign to alert an operator of a possible problem.

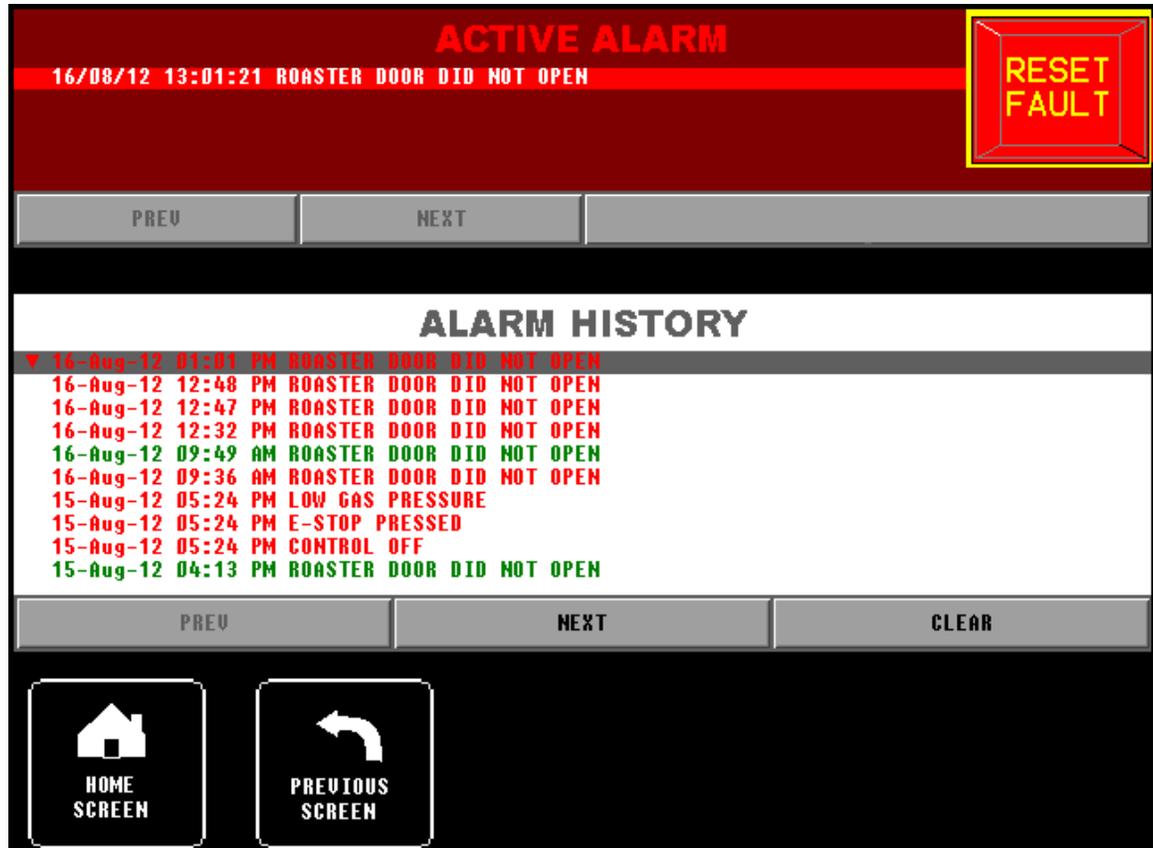
# Fault Display



If there is a fault, the status message display color turns from the color cyan to the color red to alert an operator of the fault condition.

The Reset Fault Pushbutton with flashing red/yellow will be displayed on top of the Fault Page Pushbutton. Pressing the Reset Pushbutton will reset the fault.

# ALARM SCREEN



Pressing the FAULT PAGE Pushbutton (located on the MAIN Menu or SETTING Screen Page 1) will display Active Alarm and Alarm History.

If an alarm is tripped, the alarm can be reset by pressing the ALARM RESET button. If the alarm still exist like for example the Gas Pressure is still low, pressing the ALARM RESET button will not clear or accept this alarm.

The alarm history can be cleared by pressing the CLEAR button.

# ALARMS

The following are the different kinds of alarm and the actions to help clear the condition.

## CONTROL OFF

- Press the reset pushbutton (Located on the main control box)

## E-STOP Pushbutton Pressed

- Pull the E-stop pushbutton out (Located on the main control box)

## COMBUSTION AIR PRESSURE LOW

- Make sure that the minimixer motor is operational
  - Is the power supply wired up and tight
  - Correct voltage
- Make sure the fan is spinning in the correct direction
  - Swap leads on the motor to change rotation
- Make sure that the pressure switch is operational
  - Check that all wires are in there place and tight
  - Check that the pressure setting is appropriately set
    - If the setting is set to 2 then change the setting to 8 and see if the switch changes state. If this corrects the problem then continue to change the setting to smaller and smaller until it is in alarm state again. At this point make the number greater then the trip point and move on.
  - Check and make sure that the negative air pressure plastic tube did not come off.

## COMBUSTION PRESSURE SWITCH SHORTED

- Air pressure switch has been made without the minimixer motor fan being on
  - Check for a short between the contacts on the switch
- External air source giving combustion air pressure switch a false reading

## COMBUSTION FAN STARTER OVERLOAD TRIPPED

- Check overload setting for being set to low for the motor load amp rating on the combustion air motor
- Check for something jamming the combustion air motor in place

## BI-FLAME CONTROLLER ALARM ACTIVE

- Sensor failure
- Purge air out of gas line
- Check BI-FLAME bulletin for more information

## HIGH GAS PRESSURE

- Check incoming gas supply, it should be no greater than 5 PSI
- Check that all wires are in there place and tight
- Check that the pressure setting is appropriately set
  - If the setting is set to 8 then change the setting to 2 and see if the switch changes state. If this corrects the problem then continue to change the setting to bigger and bigger until it is in alarm state again. At this point make the number smaller then the trip point and move on.

## LOW GAS PRESSURE

- Check incoming gas supply, it should be no less than 8" WC
- Check that all wires are in there place and tight
- Check that the pressure setting is appropriately set
  - If the setting is set to 2 then change the setting to 6 and see if the switch changes state. If this corrects the problem then continue to change the setting to smaller and smaller until it is in alarm state again. At this point make the number bigger then the trip point and move on.

## DRUM DRIVE WILL NOT RUN

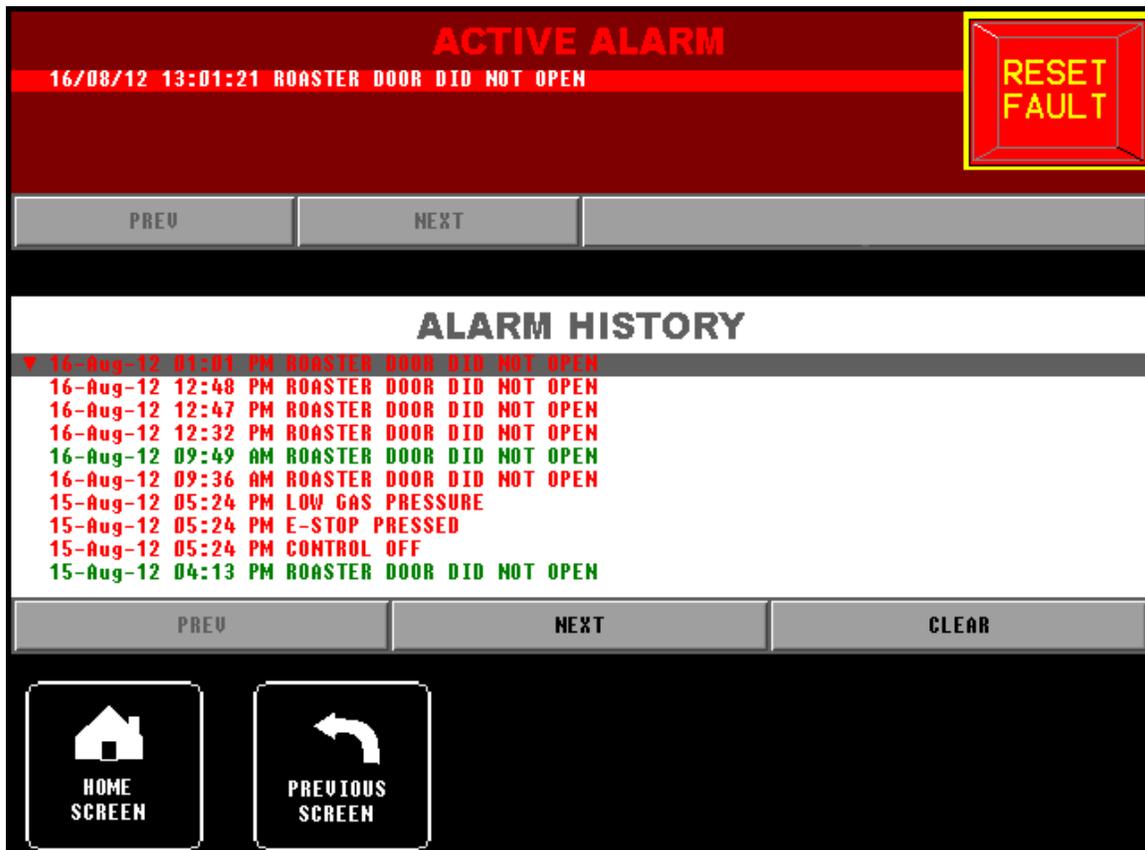
- There is no physical motion detector on the machine so all motion detection is done with electrical signals
  - The drum drive is to alarm if the variable speed drive has not got to 5 Hz in an allotted time span.
- Check drum drive motor for wires and motion
  - Check the motor overload setting, reset overload if necessary
- Check the drum drive gear box for movement

## ROASTER THERMOCOUPLE OPEN

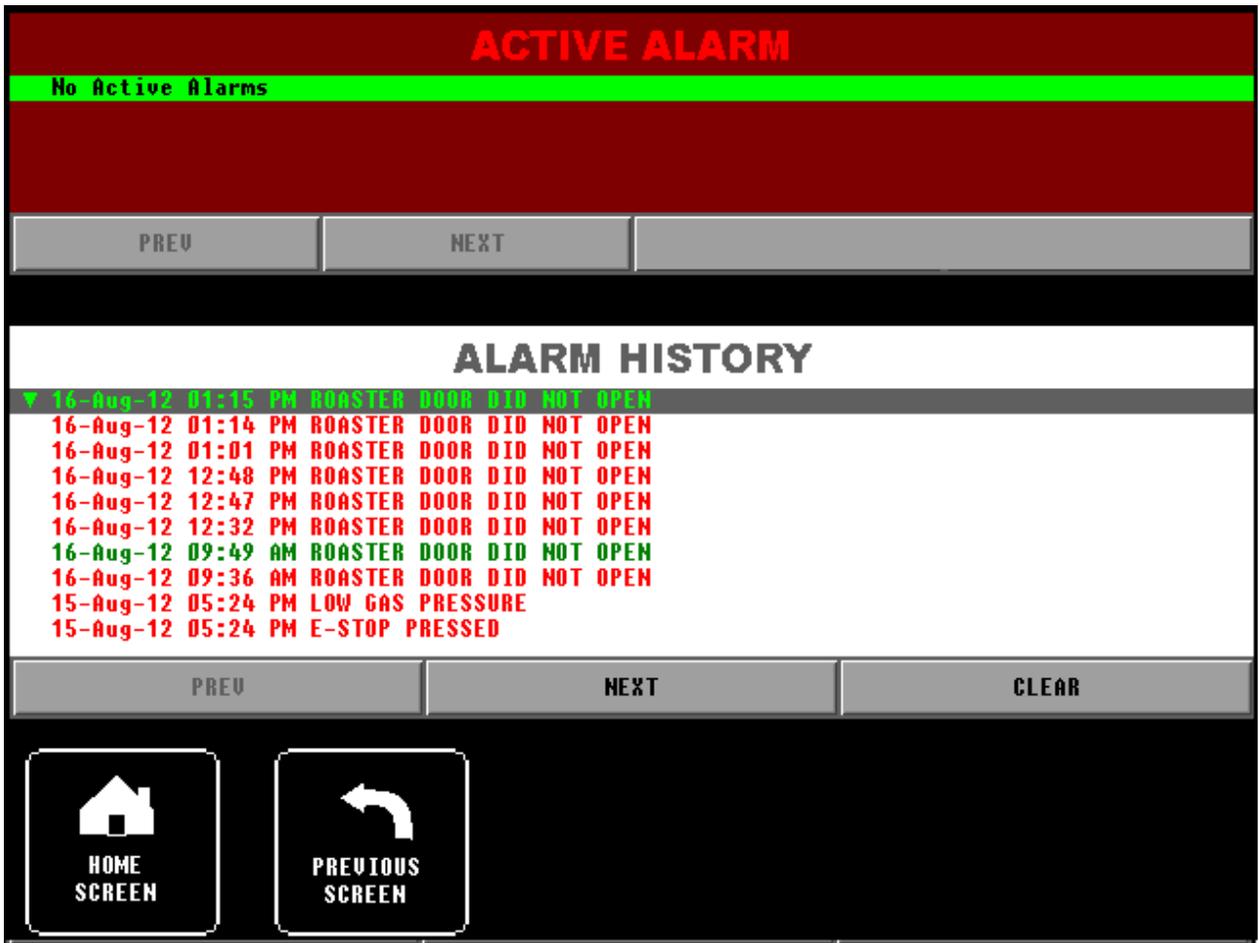
- Wires are not connected to the thermocouple
- Wires are in the incorrect place
- Thermocouple is not working and needs to be replaced

## TEMPERATURE NO READINGE

- Check CJC jumper
- Thermocouple Module maybe bad. Replace the Thermocouple Module



If an alarm exist, and the alarm can be reset, the “RESET FAULT” pushbutton will be displayed. Pressing this button will reset the fault.



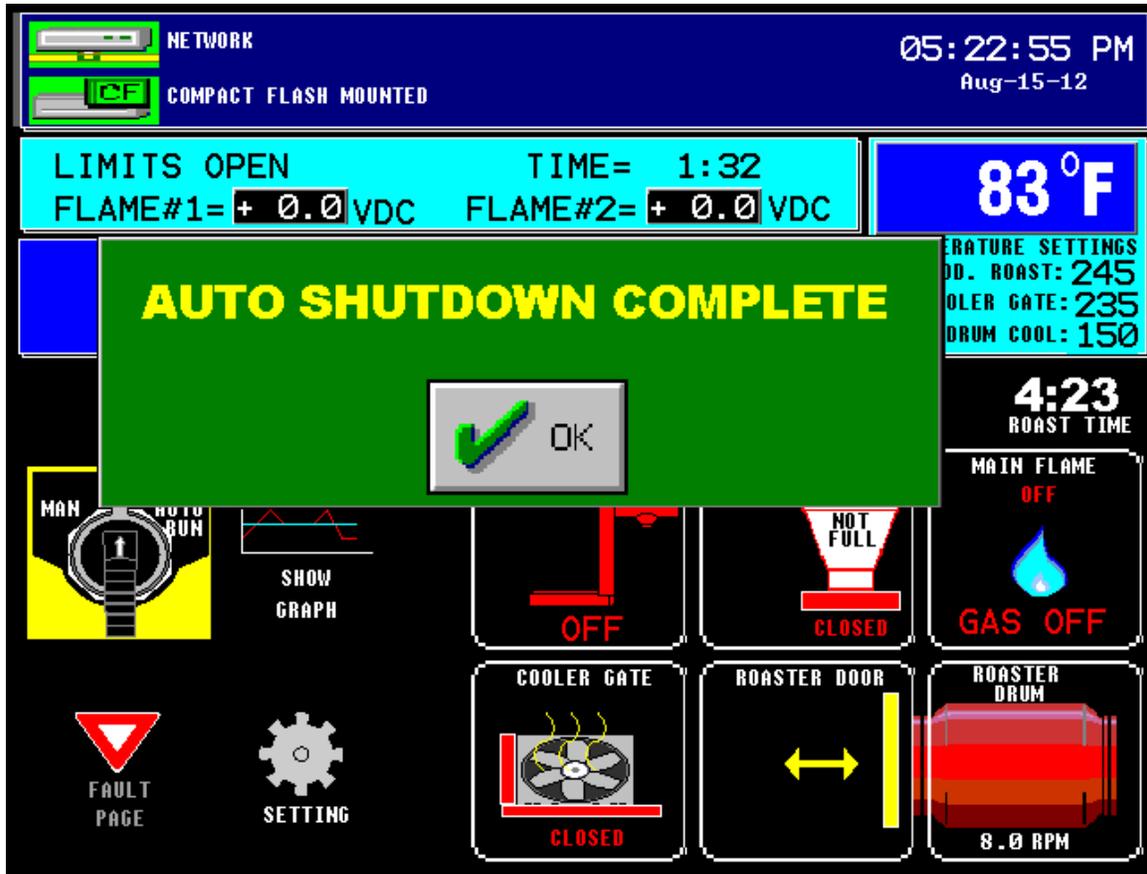
If alarm has been reset and no alarm exist, the ACTIVE ALARM Screen will show you “No Active Alarms” banner.

# Auto Mode Screen



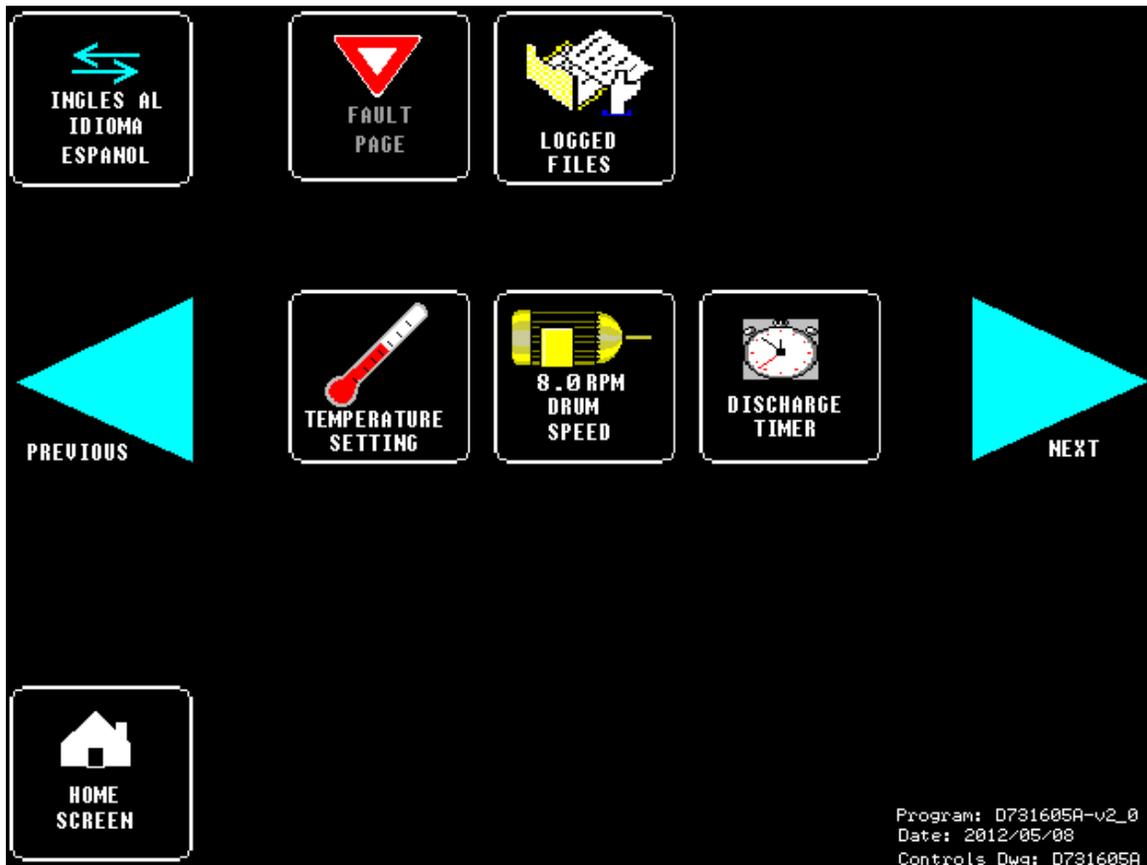
When the Roaster is running in auto mode, the switches will be just indicators. Any switch when touched will popup a message “Switches work only in Manual Mode”.

# Auto Stop/Shutdown



When the Mode Switch is set to Auto Stop, the feeder will stop. The roaster will complete the cycle when the charge hopper is not full. If the roaster drum has just discharged the roasted product and the charge hopper is still full, the charge hopper will discharge the last batch to the roaster. The roaster will complete this roasting cycle. When the set drum temperature is reached, the drum will auto stop and the popup message “AUTO SHUTDOWN COMPLETE” will be displayed.

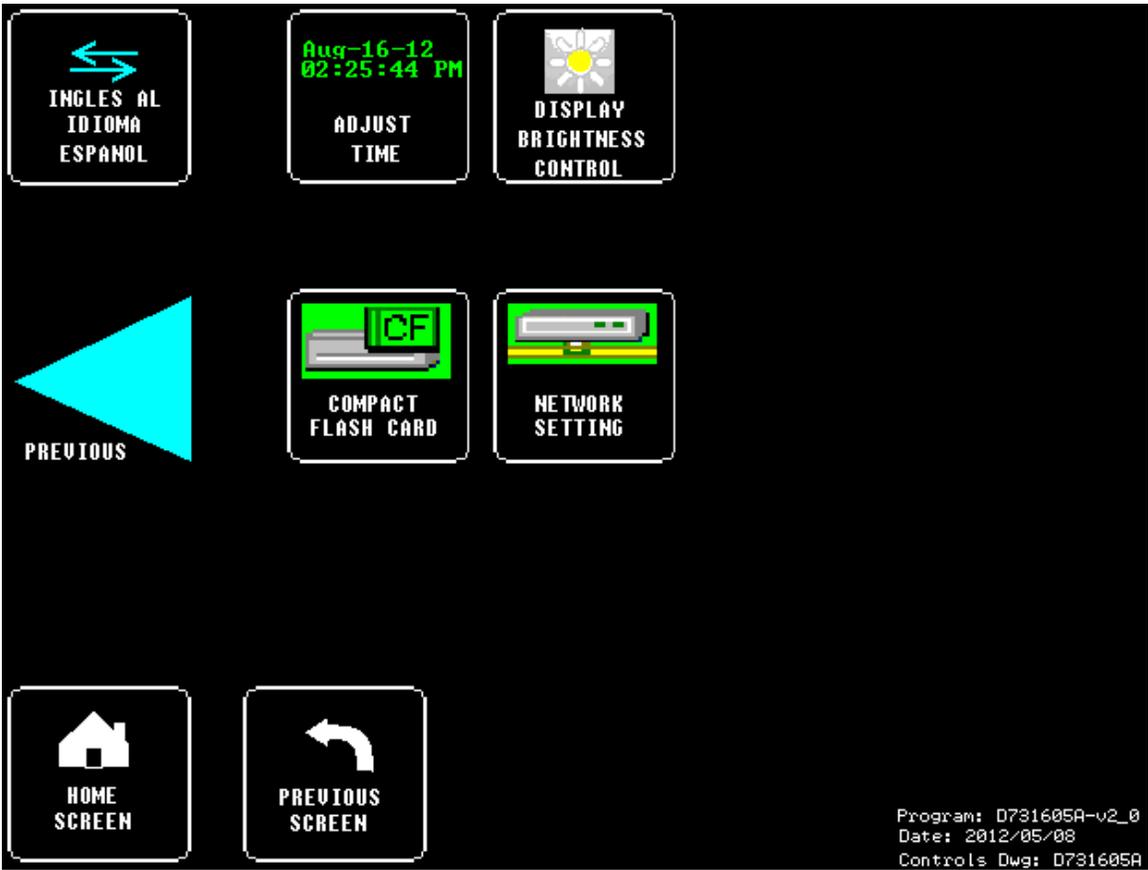
# Menu Screen



Pressing the SETTING pushbutton at the MAIN Menu Screen will display the Setting Screen Page 1.

- ENGLISH SPANISH LANGUAGE
- FAULT PAGE
- LOGGED FILES
- TEMPERATURE SETPOINT SETTING
- DRUM SPEED SETTING
- DISCHARGE TIMER

# Setting



Pressing the NEXT pushbutton will display the Setting Screen Page 2.

# Temperature Setting



The temperature set point is set on this screen.

PRODUCT ROAST TEMPERATURE is the product temperature set point. When this temperature is reached, the gas turns off, the cooler gate will close, and the roaster drum door will open to discharge the roasted product when in auto mode.

The COOLER GATE TEMPERATURE is the difference from the product roast temperature. In auto mode, when this temperature is reached when the drum temperature is going up, the cooler gate will close.

When the roaster is in auto stop mode and the drum cool temperature set point is reached, the roaster drum will automatically turn off to complete the auto shutdown sequence.

To change the values, touch the temperature (for example, touch the 30 on the COOLER GATE TEMPERATURE window) and a new prompt will open that allows you to adjust the value up or down.

# Product Discharge Timer



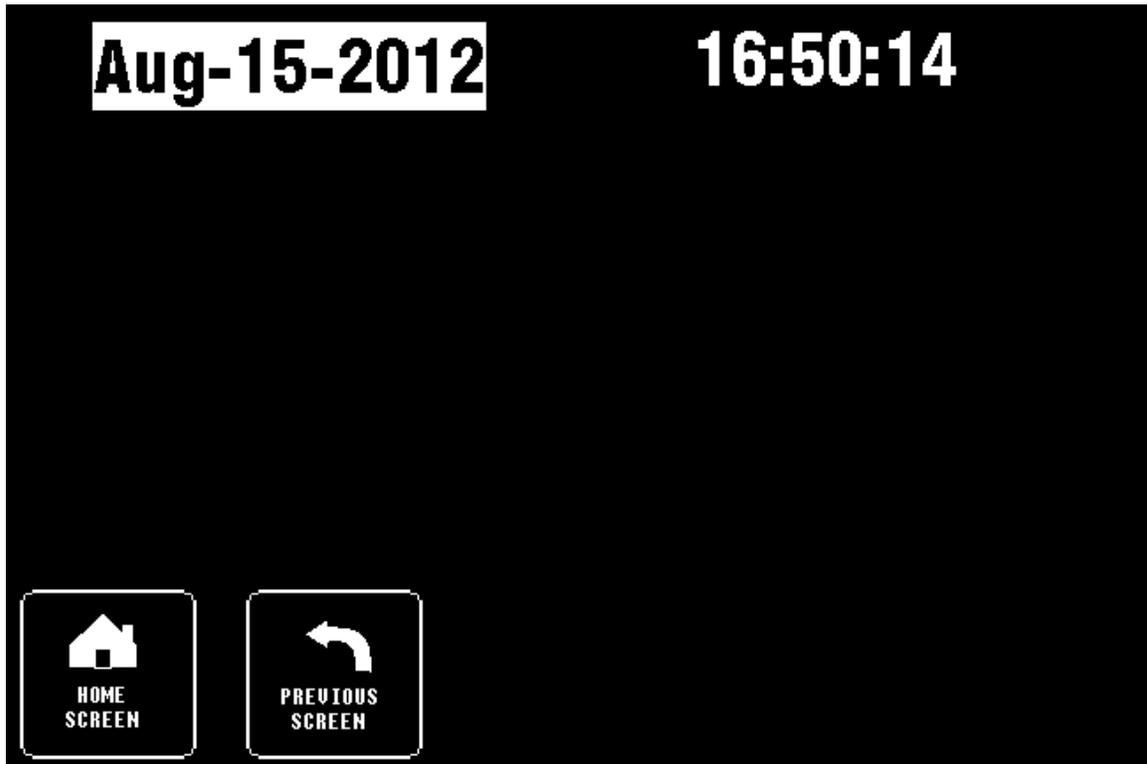
Pressing the Discharge Timer will display the Discharge Timer Setting.

In Auto Run mode:

The CHARGE HOPPER DISCHARGE TIME is the time the charge hopper will remain open to discharge the raw product into the roaster drum.

The ROASTER DOOR DISCHARGE TIME is the time the roaster door will remain open to discharge the roasted product out of the roaster.

## Time Setting



The current time and date can be changed by pressing either the Date or time.

**Aug-15-2012**

**16:51:13**



After pressing the time and it becomes highlighted, pressing it again will popup the keypad.

Press RAISE or DOWN arrow to increase or decrease the time.

Press PREV or NEXT to change hour, Minutes ,or Seconds.

Press ENTER on the keypad to accept changes.

# Logged Files

Aug-15-12		DATA FILES		04:37:58 PM								
File 12081516.CSV (1 of 2)												
0001	Date, Time	RPM	Entry	CHARGE	GATE	BIFLAME	PILOT	MAIN GAS	FLAME1	FLAME2	ROAST Temp	Setpt,
0002	2012/08/15, 16:00:00	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0003	2012/08/15, 16:00:06	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0004	2012/08/15, 16:00:12	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	86	00000
0005	2012/08/15, 16:00:18	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0006	2012/08/15, 16:00:24	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	86	00000
0007	2012/08/15, 16:00:30	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	86	00000
0008	2012/08/15, 16:00:36	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0009	2012/08/15, 16:00:42	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0010	2012/08/15, 16:00:48	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0011	2012/08/15, 16:00:54	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0012	2012/08/15, 16:01:00	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0013	2012/08/15, 16:01:06	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0014	2012/08/15, 16:01:12	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0015	2012/08/15, 16:01:18	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0016	2012/08/15, 16:01:24	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0017	2012/08/15, 16:01:30	8.0	CLOSED	ON	OFF	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0018	2012/08/15, 16:01:36	8.0	CLOSED	ON	ON	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0019	2012/08/15, 16:01:42	8.0	CLOSED	ON	ON	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0020	2012/08/15, 16:01:48	8.0	CLOSED	ON	ON	OFF	OFF	+ 0.0	+ 0.0	100	87	00000
0021	2012/08/15, 16:01:54	8.0	CLOSED	ON	ON	OFF	OFF	+ 0.0	+ 0.0	100	87	00000

The Log File screen displays the log files in the log directory of the compact flash.

The temperature is being logged every six seconds when the flame is on or if the roaster temperature is above 99 °F or 37 °C

Each log file holds 14400 samples (24 hours).

Each compact flash holds 1024 log files.

The 1<sup>st</sup> 2 numbers of the file is the file number logged that day,

The 2<sup>nd</sup> 2 numbers is the day of the month,

The 3<sup>rd</sup> 2 numbers is the month,

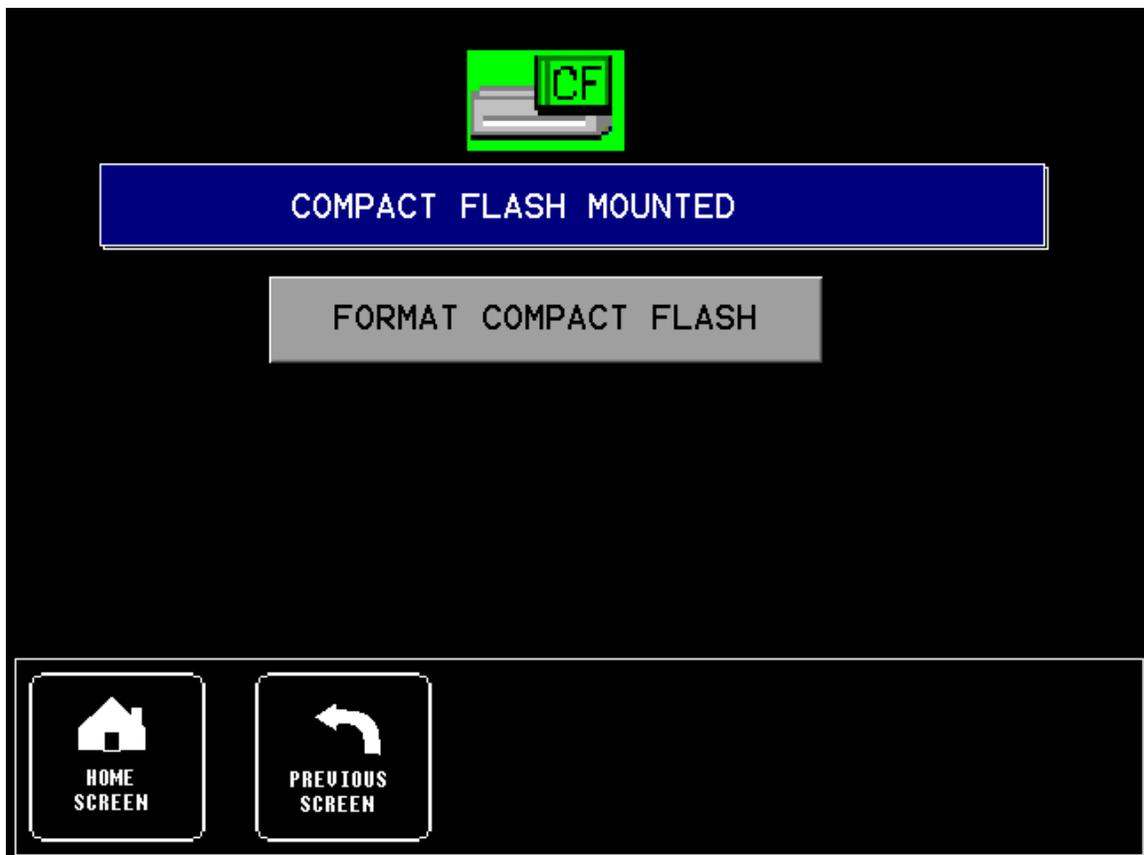
The 4<sup>th</sup> 2 numbers is the year.

These files are in CSV format that can easily be imported to a spreadsheet application like Microsoft Excel. They can be accessed and saved by swapping out the compact flash card or by accessing them via the network using the Ethernet port.

LEFT / RIGHT Arrow - Pressing the Left or Right Arrow will display the next or previous file.

UP / DOWN Arrow – Pressing the Up or Down Arrow will highlight one line of data.

## Compact Flash Card



Some compact flash may have to be formatted in order for the Touch Screen to access the compact flash card.

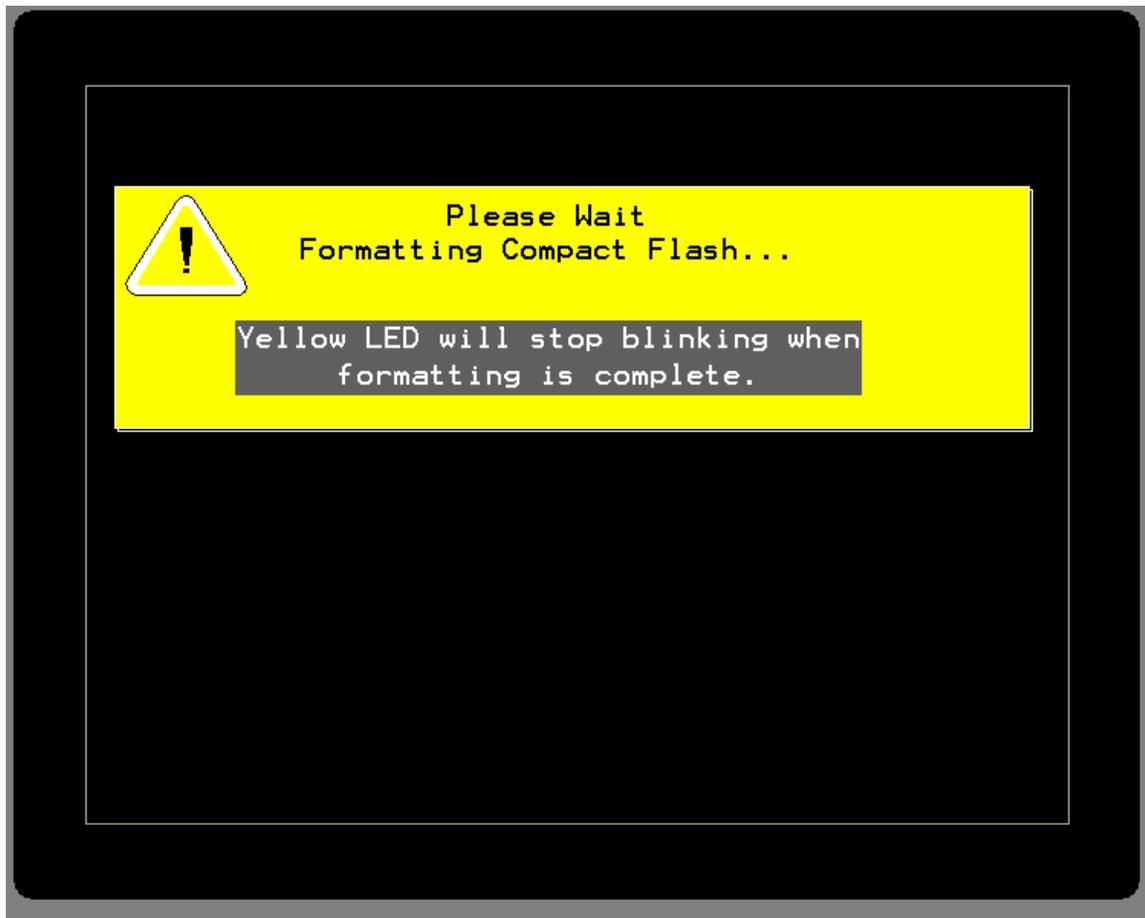
**WARNING:** formatting the compact flash will erase all the files saved in the compact flash. Make sure that all files are saved in a separate flash card or hard disk.

## WARNING Message



Before a compact flash card is formatted, a warning message is displayed to alert an operator.

## Formatting Compact Flash



When a compact flash is being formatted or accessed, the Yellow LED will start to flash. After the compact flash has been formatted, the screen goes back to Compact Flash Screen.

## LIGHTING BURNER AND ADJUSTING PREMIX BLOWER

- A. Turn roaster exhaust fan on
- B. Turn the main gas valve to the roaster on
- C. Turn air valve on. (For pilot and UV sensors)
- E. Turn the electrical panel disconnect switch on
- F. Rotate and pull out the E-stop
- G. Press the start button (MCR)
- H. Turn roaster drum on
- I. Turn gas on

## START UP AND OPERATION

By this step, you should have pilot and main burner (As observed through the front inspection door). After one minute turn the premix adjustment lever slowly to high (No. 8) and back to low (No. 1) and observe if main burner remains fired. The following procedure is used at the factory for preliminary adjustment and should be followed when starting up in the field.

1. With the ratio valve in position No. 1, turn No. 1 adjusting screw in until main burner stays lit and maintains the desired flame. Turn all the higher numbered screws in until they are all the same depth, as No. 1.
2. Now, with your screwdriver engaging No. 2 screw, turn the ratio valve very slowly toward position No. 2 and, while turning, adjust the No. 2 screw to maintain the type of flame desired. With the ratio valve set at exactly position No. 2, complete the adjustment of No. 2 screw to the flame character desired.

**CAUTION:** If, during this initial setting of the screws, the valve is shifted too rapidly from one screw to the next, without carefully adjusting as you go, the flame on the main burner may be extinguished. After allowing roaster to go through its pre-purge of gas vapors turn back to No. 1 position. Then proceed with premix adjustments.

3. With the ratio valve still at position No. 2, turn all the higher numbered screws in until they are all the same depth as the No. 2 screw just set. Then turn the No. 3 screw in one full turn.
4. Turn the ratio valve slowly toward position No. 3, adjusting the No.3 screw as you go.
5. Repeat the above procedure for all the remaining screws, each time turning all the higher numbered screws in until they are the same depth as the screw previously set, before moving the ratio valve toward the next position.

If the proceeding adjustments takes more than 5 minutes or the controls shut off the gas due to high temperature, turn gas switch to "off" on the control panel and leave roaster drum, premix blower and vent fan running with inspection door open to cool down roaster before further adjustments are made.

You are now ready for the first roast. Charge the roaster with the proper amount of nuts, turn gas switch to "on". The burner should ignite regardless of where the premix ratio valve is set. It is suggested the premix ratio valve be set on No. 3 or No. 4 setting.

As the roaster raises to operation temperature, the premix ratio valve setting established during cold roaster start up may require adjustment at full operating temperature to optimize efficiency.

**NOTE:**

Burners should be radiant and no flame should be visible.

If so, readjust each screw slightly to give the exact roaster atmosphere desired. Always adjust only the screw corresponding to the position at which the ratio valve is set. (If you wish to readjust No. 5 etc.). Turning the adjusting screws in (clockwise) for more gas, out (counter-clockwise) for less gas.

After final setting has been made, replace the quadrant cover. The premix blower-mixer combustion system is now ready for operation without further adjustment. The premix adjustment lever can now be set for the desired heat input.

## CHARGING HOPPER LEVEL CONTROL

The charging hopper is equipped with a level control (level switch). This level control serves the dual purpose of:

- A. Automatically stopping the elevator or conveyor that feeds the charging hopper when the desired batch quantity is reached, and
- B. Preventing the charging gate from opening if the charging hopper is empty or contains less than the desired batch quantity.

You are now ready for the first roast. Charge the roaster with the proper amount of nuts, turn gas switch to "on". The burner should ignite regardless of where the premix ratio valve is set. It is suggested the premix ratio valve be set on No. 3 or No. 4 setting.

As the roaster raises to operation temperature, the premix ratio valve setting established during cold roaster start up may require adjustment at full operating temperature to optimize efficiency.

**NOTE:** Burners should be radiant and no flame should be visible.

If so, readjust each screw slightly to give the exact roaster atmosphere desired. Always adjust only the screw corresponding to the position at which the ratio valve is set. (If you wish to readjust No. 5 etc.). Turning the adjusting screws in (clockwise) for more gas, out (counter-clockwise) for less gas.

After final setting has been made, replace the quadrant cover. The premix blower-mixer combustion system is now ready for operation without further adjustment. The premix adjustment lever can now be set for the desired heat input.

# THINGS TO OBSERVE ABOUT BURNERS

## CAUTION:

If at any time in adjusting or operating the roaster, one or more burner baffles are observed glowing red hot, shut gas off immediately. This condition indicates the flame has flashed back into the burner and manifold. Study the following adjustment conditions carefully.

1. Burner baffle gets red hot - The gas mixture is burning inside the burner manifold. Shut gas off immediately and cool down roaster before making further adjustment. Correct this condition by increasing velocity at all burners either by increasing gas pressure or replacing tip.
2. Burners fail to light - The mixture is too lean. Correct by adjusting premix for more gas.
3. Extremely yellow flame - The mixture is too rich. Correct by decreasing gas.
4. Extremely blue flame - The mixture is too lean. Correct by increasing gas.
5. Refractory doesn't get hot enough - Not burning enough gas or mixture isn't right; correct the mixture per above.

**NOTE:** Optimum combustion for ceramic burners occurs when the flame heats the ceramic base to an orange glow, and there is little or no flame extending out past the ceramic base.

## AIR FLOW SWITCH

The purpose of the airflow switch is to prove the roaster vent system is on and functioning properly. It is tied electrically into the gas circuit to prevent the burner from igniting without the vent system on.

The switch must be mounted in an upright position, topside up. Make sure the vane (Swing Disc) is free to swing without binding and the counter weight is screwed all the way in finger tight. (See Manufacturer instruction sheets for further information.)

# **AUTO START and SHUTDOWN PROCEDURE**

## **AT THE START OF THE DAY**

Start of production

- Turn cooler fan on.
- Turn roaster exhaust fan on.
- Turn the main gas valve to the roaster on.
- Turn air valve on (For pilot and UV sensors)
- Turn the electrical panel disconnect switch on.
- Rotate and pull out the E-Stop.
- Press the start button. (MCR)

At this stage you are ready for auto start.

## **AUTO START SEQUENCE OF OPERATION**

1: Turn the Mode switch to Auto Start.

- 1: Cooler gate closes.  
(1 Second Time Delay)
- 2: Charge hopper gate closes.  
(1 Second Time Delay)
- 3: Roaster drum turns on.  
(1 Second Time Delay)
- 4: Roaster door closes.  
(1 Second Time Delay)
- 5: Product feed turns on.  
(1 Second Time Delay)

2: Gas turns on, after charge hopper is full of product.

**Note:** When the gas is turned on the Eclipse burner control has a 1 to 2 minute pre purge before TFI (Trial For Ignition).

- 3: When roast temperature is reached.
  - 1: Gas turns off, Cooler gate closes.  
(3 Second Time Delay)
  - 2: Roaster door opens.  
(10 to 60 Second Time Delay)
  - 3: Roaster door closes.  
(1 Second Time Delay)
  - 4: Charge hopper opens, only if full of product.  
(10 to 60 Second Time Delay)

5: Gas turns on, when temperature drops below roast set point.

6: Charge hopper closes.  
(3 Second Time Delay)

7: Product feed turns on.

At this stage the cycle continues until the mode switch is turned to auto stop.

### **When do you turn the mode switch to AUTO STOP?**

When the last batch of the day to be roasted is in the charge hopper.

### **AUTO STOP SEQUENCE OF OPERATION**

- 1: Turn mode switch to auto stop.
  - 1: Product feed gate is turned off.
- 2: When roast temperature is reached.
  - 1: Gas turns off.
  - 2: Roaster door opens.  
(10 to 60 Second Time Delay)
  - 3: Roaster door closes.  
(1 Second Time Delay)
  - 4: Charge hopper opens, only if full of product, dropping the last batch into roaster.  
(10 to 60 Second Time Delay)

3: Gas turns on, when temperature drops below roast set point.

4: Charge hopper closes.

5: When roast temperature is reached.

1: Gas turns off.

2: Roaster door opens.

**Note:** At this stage the door will remain open to aid in the cooling of the drum.

6: When the temperature inside the roaster reaches the cool drum set point, the drum will then turn off automatically.

## **END OF THE DAY**

End of production

Push the E-Stop.

Turn the electrical panel disconnect switch off.

Turn the main gas valve to the roaster off.

Turn air valve off. (For pilot and UV sensors)

Turn roaster exhaust fan off.

Turn cooler fan off.

# **MANUAL START and SHUTDOWN PROCEDURE**

When operating the roaster manually you follow the same sequence of operation as in auto mode. You have to turn all switches on and off manually; the only operation that changes automatically is when roast temperature is reached (the gas will turn off).

## **AT THE START OF THE DAY**

Start of production

Turn Cooler fan on.

Turn roaster exhaust fan on.

Turn the main gas valve to the roaster on.

Turn air valve on. (For pilot and UV sensors)

Turn the electrical panel disconnect switch on.

Rotate and pull out the E-Stop.

Press the start button. (MCR)

At this stage you are ready to start roasting.

## **MANUAL START UP SEQUENCE OF OPERATION**

1: Close charge hopper gate (If gate is open)

2: Turn product feed on (Fills the charge hopper)

Product feed turns off automatically when the charge hopper is full.

3: Turn roaster drum on

4: Close roaster door (If door is open)

5: Turn gas on (If you are preheating the oven)

**Note:** If preheating the oven when the roast temperature is reached the gas will turn off automatically.

6: Turn product feed off (When charge hopper is full)

7: Open charge hopper gate

8: Close charge hopper gate (After all product is in the roaster)

9: Turn product feed on (Fills the charge hopper)

Product feed turns off automatically when the charge hopper is full.

10: Turn gas on

**Note:** When the first set point is reached (Cooler Gate) the cooler car must be empty and moved to home position (In front of the roaster) in preparation to accept the roast. You only have a minute before the batch in the roaster is ready.

When product roast temperature is reached the gas will turn off automatically.

11: Open roaster door (To discharge product)

12: Spread the product evenly in the cooler (For even cooling of product)

13: Close the roaster door

14: Open charge hopper gate

Repeat steps 8 thru 15 to continue the roasting process.

## **MANUAL SHUT DOWN SEQUENCE OF OPERATION**

When the last batch of the day is in the charge hopper follow the same procedure as steps 8 thru 12 omitting step 9 (Product Feed). When the last batch is in the Cooler Car the cooler fan must remain on to cool the product. The roaster drum will not turn off until the temperature inside the roaster drops to the same as or below the drum cool set point. Leave the roaster door open and the roaster exhaust on to aid in the cooling. Once the cool drum temperature is reached turn the drum off.

## **END OF THE DAY**

End of production

- Push the E-Stop.

- Turn the electrical panel disconnect switch off.

- Turn the main gas valve to the roaster off.

- Turn air valve off. (For pilot and UV sensors)

- Turn roaster exhaust fan off.

- Turn cooler fan off.

# MAINTENANCE

## POSSIBLE CAUSES OF IGNITION FAILURE

### 1. NO GAS

- a. Check main gas shut-off valve to see if in proper position.
- b. Main gas electric shut-off valves possibly sticking closed, coil burned out or not being energized. Check visual indicators when the main valves are energized to be open Red-valve is open, White the valve is closed. (Consult manufacturer's bulletin for more information.)
- c. The Bi-flame controller reads a fault. Fault message will read out on the Eclipse display located on the control panel. (Consult manufacturer's bulletin for more information.)

### 2. MIXTURE TOO RICH (Long Lazy flame)

- a. Reduce gas entrained at mixer or increasing air input at mixer if the adjustable type. Cold burners when first lit should have approximately 1 inch of blue flame fringe above edge of burner. When burner becomes radiant the flame is barely visible, if at all.
- b. Check mixer interior for build-up of accumulated dirt, etc., which would reduce the volume of air.
- c. Too rich a mixture reduces efficiency of burner and does not increase effectiveness. A slightly rich mixture may be necessary to attain highest temperature, or to improve lighting on ignition tube system.

### 3. MIXTURE TOO LEAN (low harsh flame)

- a. Ignition failure between burners.
- b. Burner does not become radiant as rapidly.
- c. Burners will possibly go out when throttled to low fire, because flame is not sufficient to satisfy the flame rod or insufficient supply of gas to maintain combustion. Increase gas inlet at mixer by opening gas adjustment and/or decrease air input at mixer if air adjustable mixer is used.

## DOOR OPERATION

During factory assembly every attempt is made in the light of past experience to ensure trouble-free operation. However, due to shipping and protracted operation some problems do arise which are usually a matter of systematic solution as follows.

- 1) Problem: Door doesn't open when required.
  - A) Door should only be open while drum is turning.
  - B) Check the connection between both the handle and the drive sprocket to the shaft.
  - C) Check for wear or possible replacement of Teflon Pull Pads.
  
- 2) Problem: Door does not close when required.
  - A) Door should only be closed while drum is turning.
  - B) Check the connection between both the handle and the drive sprocket to the shaft.
  - C) Check return spring, if broken or fatigued-replace.
  - D) Check door pin, if bent or damaged-replace.
  
- 3) Problem: Door does not stay closed; "creeps" open.
  - A) Check return spring, if broken or fatigued-replace.
  - B) Check door pin, if bent or damaged-replace.
  
- 4) Problem: Door does not stay open; "creeps" closed.
  - A) Check return spring, if broken or fatigued-replace.
  - B) Check door pin, if bent or damaged-replace.
  
- 5) Problem: Door opens up but not uniform or wobbles open.
  - A) Door should only be moved while drum is turning.
    - a) If the drum is not turning while the operator is trying to close the door, the door will not close correctly. The door will be put into an unnecessary bind and may damage the pins holding the door in position.

## **TRUNNION BEARING REPLACEMENT**

To replace the rear grunion bearings, the weight of the drum **MUST** be removed from the bearings. With the weight of the drum supported remove the two setscrews from the grunion support. Remove the shaft and grunion bearing assembly.

Reassembly is essentially the reverse of disassembly.

To replace the discharge grunion bearings start the same as above. Then, from the inside of the frame, remove the cap washer. Then the whole assembly may be removed. Remove the shaft and grunion bearing assembly from the discharge side out, while catching the wheel while it gets removed.

## **TO SERVICE SELAS BURNERS**

If the tip has to be serviced, remove the tip lock and unscrew the tip with a large sized screwdriver. Make sure to replace the tip lock when you have replaced the tip.

When the cup has to be replaced, it is best if the whole individual burner is removed from the manifold by unscrewing unit using a 1 1/8" wrench. The whole burner then has to be disassembled. Remove tip and tip lock. Unscrew the retaining screws and nuts holding the retaining plates together. When these are sufficiently loose, to clear the cup shoulders, the cup can be slid up off the tip holder. The whole burner assembly can be reassembled and returned to the manifold.

## **PILOT ASSEMBLY**

A setscrew on the tube that it runs through holds the pilot assembly in. To replace the pilot assembly, loosen the setscrew and remove the copper lines running to the air and gas. When all of these connections have been done, remove the pilot assembly from its home and replace with a new one.

## ROASTING UNSHELLED PEANUTS

The goal in a successful operation of roasting unshelled peanuts is to thoroughly dry and toast the kernels (nut meats). For maximum flavor development, leave the shell surface clean and free of carbon caused by scorching. This operation can be obtained on your Roaster by the controlling:

1. **HEAT INPUT (BTU's/HR)** Controlled by the Maxon Premix Valve. A low heat input (setting #2 or #3) is required. The shell and the air space between the kernels and the shell act as an excellent insulator to heat transfer. Too high of a heat input will cause the shell to dry out and scorch before the kernel is done.
2. **TEMPERATURE (F degree)** Controlled by the high set-point on the controls Unit. This set point should be set below the temperature, which "scorches" the shell (established by closely observing the initial batch of nuts). Start sampling the nuts when the temperature approaches 200 F, while observing the actual temperature on the Control Unit. As soon as the very first signs of scorching appear, note the temperature, shut the gas off and dump the peanuts into the cooler. Adjust the high temperature set-point a few degrees (2 F -4 F) lower than the scorching temperature, which you have now established.
3. **TIME (minutes and seconds)** Controlled by the PLC in the Control panel. After the high temperature set point is reached, the gas will automatically cut off. However, you can maintain the peanuts inside the hot roaster for up to 15 minutes (maximum) more time, which will allow the kernels inside the shell to finish roasting. After the delay relay has cycled through your time setting (try 600 seconds or 10 min.) the touch screen display will read "Roaster Door" which will turn on the alarm and signal the operator to open the Roaster Door.

4. **CONCLUSION:** The above three variables of heat input, temperature and time are all interrelated in that if you change one, one or both of the remaining variables must also be changed in order to maintain a quality product. Once you have established what each parameter needs to be to give you your desired quality, the Roaster will automatically maintain this quality from batch to batch, every day of operation.

Please bear in mind that the gases inside the roaster are very hot (400 F to 800 F), which will cause the temperature to continue to rise slightly even when the gas is off. If this small temperature rise scorches the shell, lower the high set point temperature a few degrees more.

In order to increase the overall capacity of the roasting system, some operators by-pass the time delay feature and simply discharge the hot nuts (when the high temperature set point is reached) into a hopper without any cooling air. Although this practice simulates the time delay feature, your quality control over the flavor development of the complete batch may suffer because of non-uniform cooling.

Note: The unshelled peanuts should be cleaned of loose shale, jute bag fibers and other foreign matter before entering the roaster.

# REPAIR PARTS LIST

## SPARE PARTS ORDERING & REPAIR PARTS LIST

Whenever it becomes necessary to recondition your AC Horn equipment, it will be necessary for you to correctly describe those replacement parts or units, which you desire to purchase. To avoid delay, and so that we may furnish you with the parts you need as quickly as possible, it is necessary that you supply us with the following information every time you order parts:

- (1) Serial Number and Model Number of equipment for which parts are required.
- (2) Part Number.
- (3) Item number and the drawing number that appears on the catalog sheets from which the parts were selected.

By including this information with your order, your potential downtime can be held to a minimum. It will also assure that when you receive your parts, they will be correct parts to serve your immediate needs.

The following will provide you with a **Repair Parts List and Drawing**.

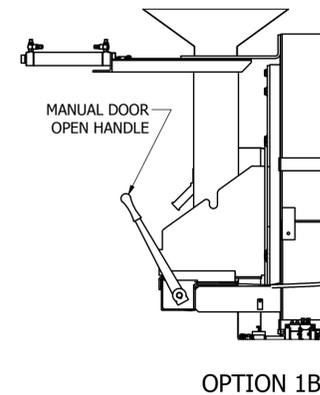
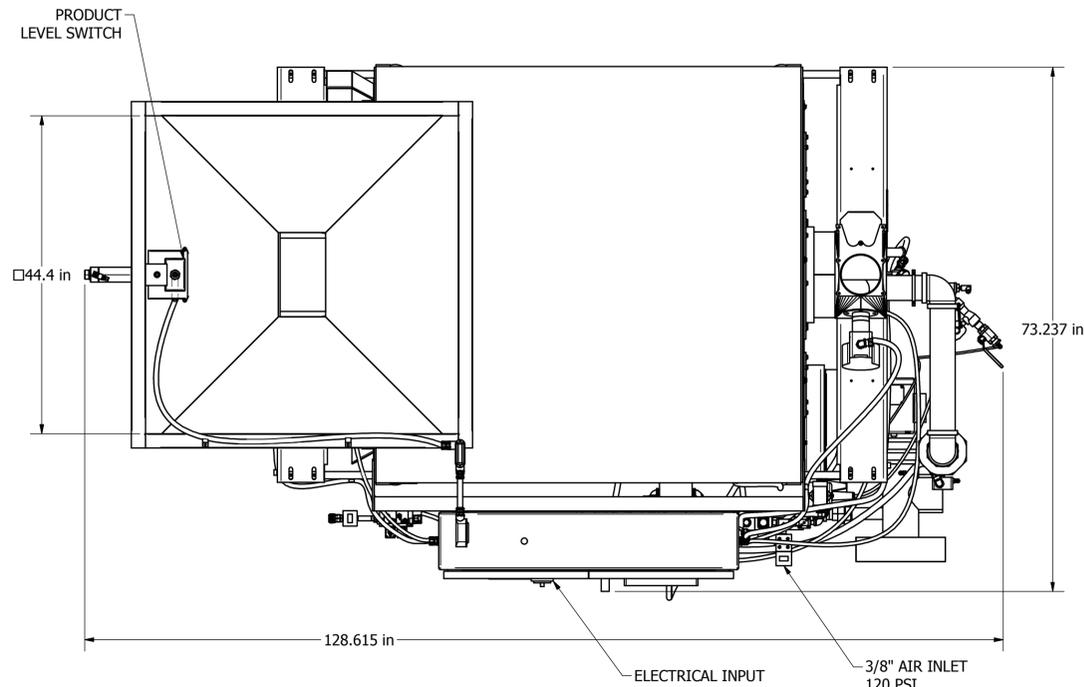
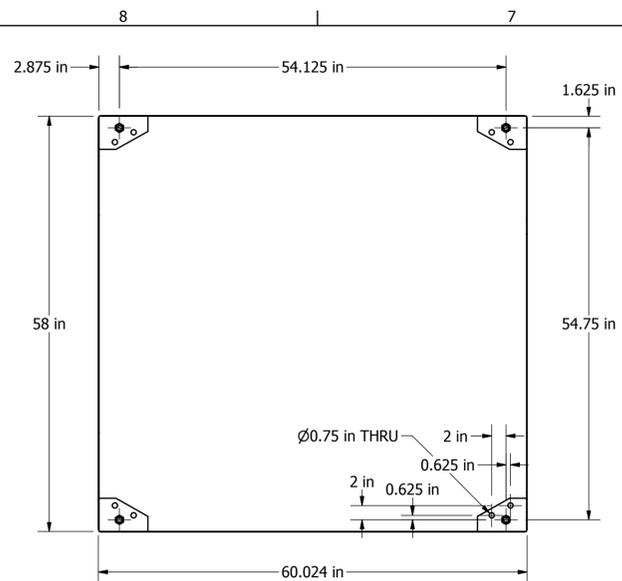


AC HORN MANUFACTURING

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**ROASTER SPECIFICATIONS:**

- MILD STEEL FRAME
- 304 STAINLESS STEEL CONTACT PARTS
- BATCH TIME ~ 20 MINUTES
- TOUCH SCREEN UL CONTROLS
- BLANKET INSULATED DRUM
- FRONT AND REAR SAMPLE ACCESS POINTS
- CERAMIC RADIANT BURNER ASSY.
- MANUALLY CONTROLLED FLAME ADJUSTMENT

**FUEL REQUIREMENTS:**

**INITIALS**

TYPE OF FUEL: NATURAL GAS OR PROPANE  
 INLET GAS PRESSURE: 12" W.C. MIN. - 5 PSI (MAX)  
 MAXIMUM HEAT INPUT: 1 MILLION BTU/HR

**FUEL INPUT (CHECK ONLY ONE):**

- NATURAL GAS  
 INLET GAS VOLUME (1 MILLION BTU/HR MAX):  
 1,000 CU. FT./HR (MAX)
- PROPANE  
 INLET GAS VOLUME (1 MILLION BTU/HR MAX):  
 400 CU. FT./HR (MAX)

**ELECTRICAL REQUIREMENTS:**

**INITIALS**

**ELECTRICAL INPUT (PLEASE CHOOSE ONE):**

- 3 PH / 60 HERTZ / 460 VOLTS
- 3 PH / 60 HERTZ / 230 VOLTS
- 3 PH / 50 HERTZ / 360 VOLTS

**OPTIONS:**

**INITIALS**

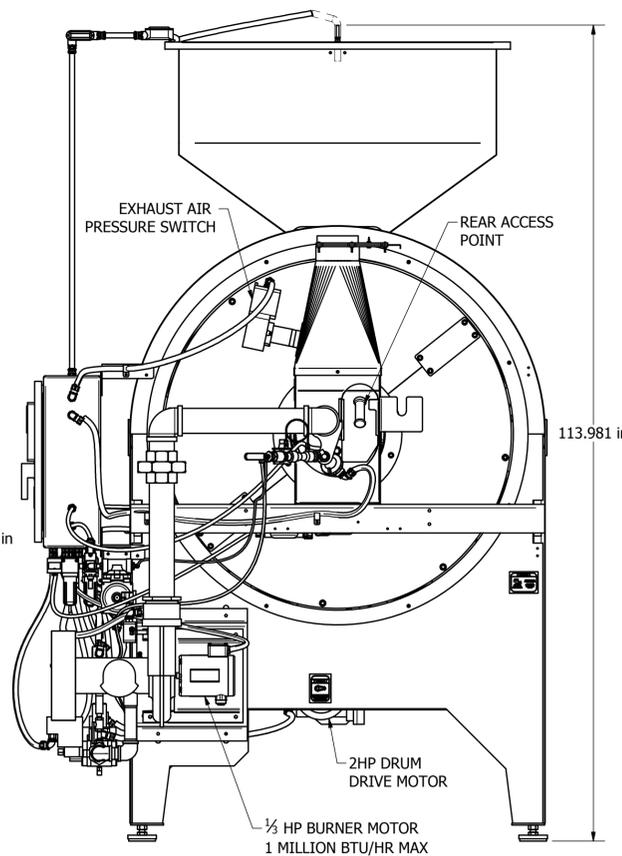
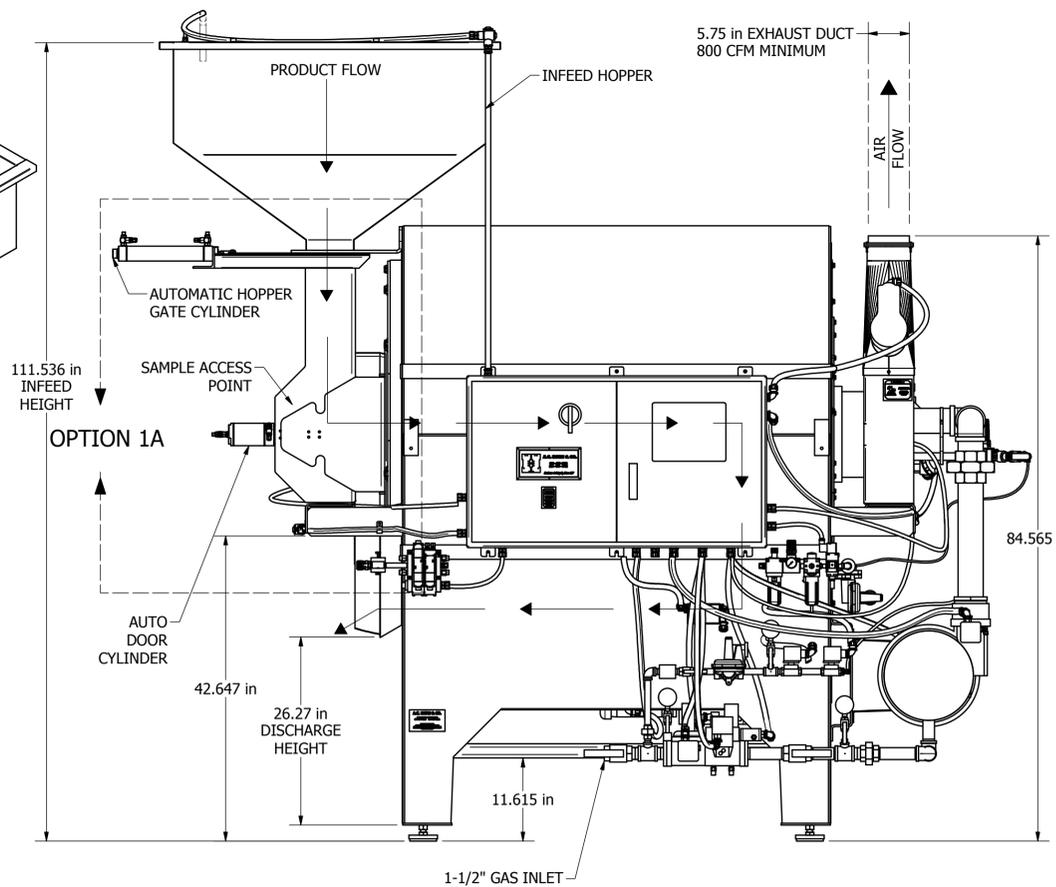
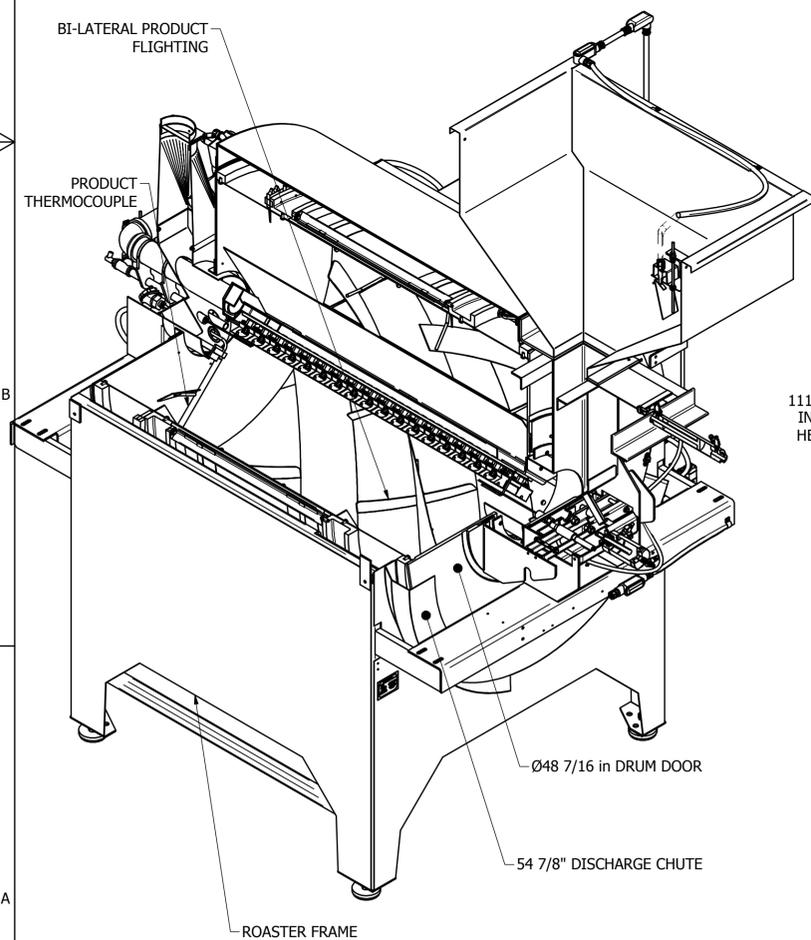
**ROASTER OPERATION**

- 1A AUTOMATIC
- 1B MANUAL

**COMMENTS:**

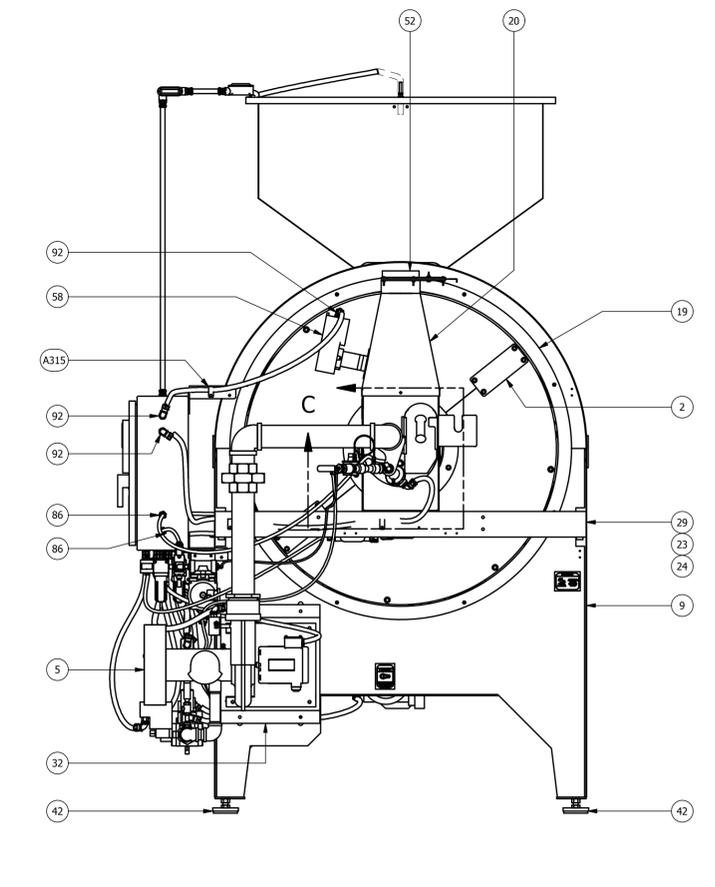
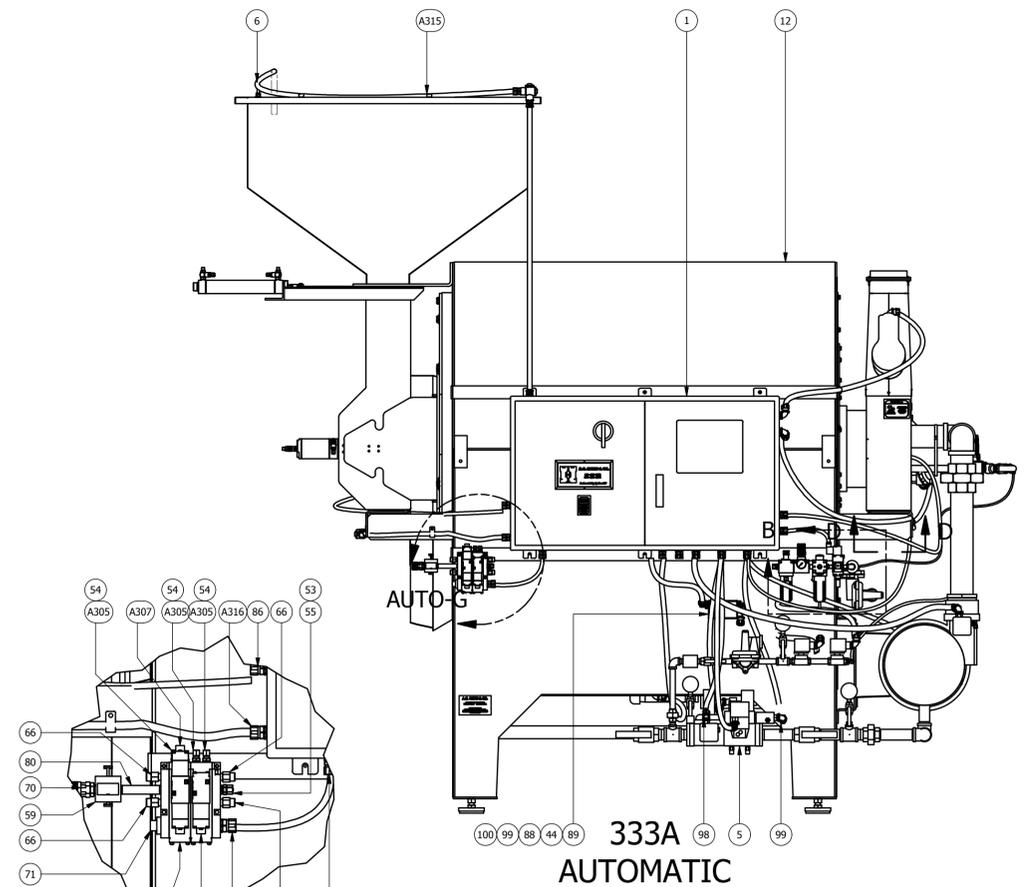
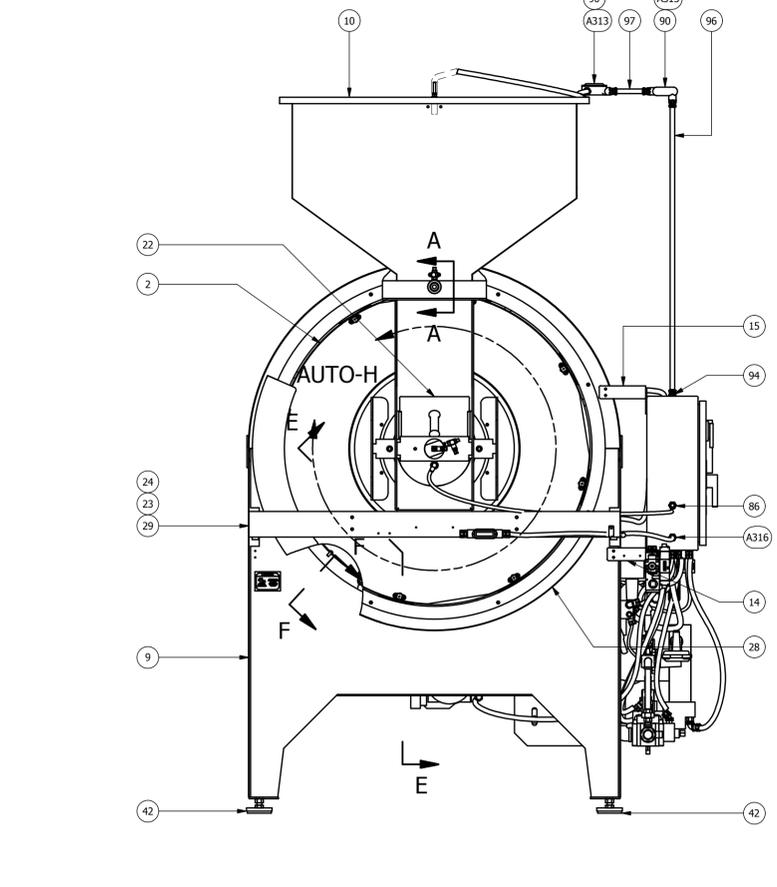
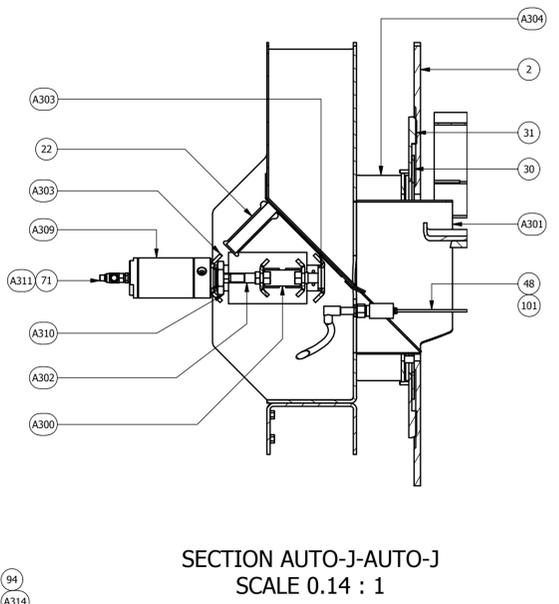
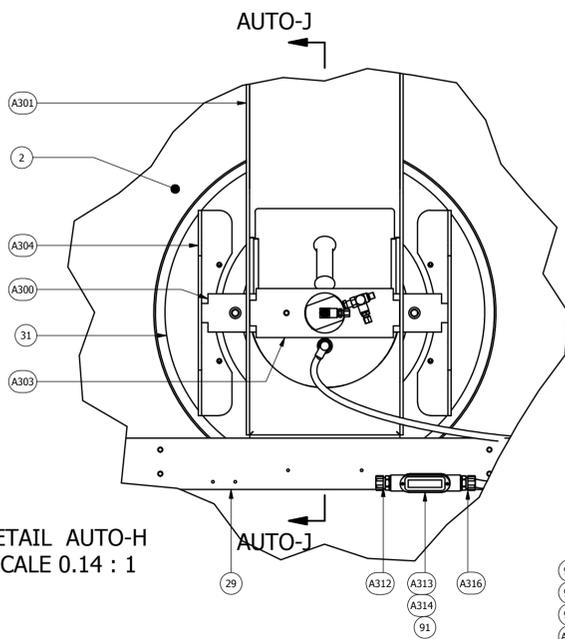
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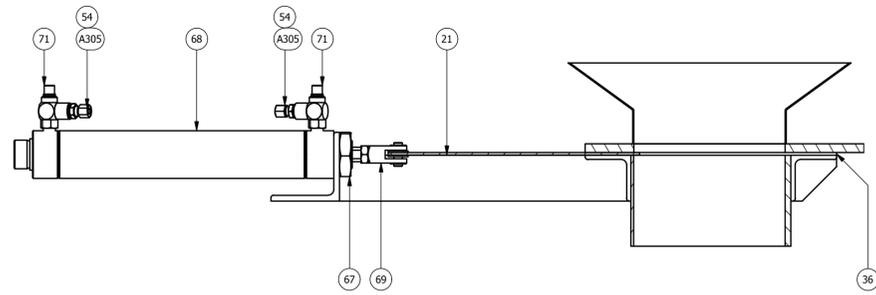
TOLERANCES, UNLESS OTHERWISE NOTED ARE TO BE: FOR ANGULAR: +/-.12° FOR DECIMAL: +/-.015 FOR DECIMAL: .XXX: +/-.0030 FOR FRACTIONAL: +/-.015" BE NON-CUMULATIVE - DO NOT APPLY TO HOLE DIA.	PART #: 333		T: 401.1415	
THIS DRAWING RELATES TO PROPRIETARY SUBJECT MATTER. ANY PARTY ASSUMING COSTLY COPIES SO WITH THE EXPRESS UNDERSTANDING AND AGREEMENT THAT NEITHER THE RECEIPT NOR POSSESSION THEREOF CONVEYS OR TRANSFERS ANY RIGHT TO USE, REPRODUCE OR DISCLOSE ITS CONTENTS, OR ANY PART THEREOF, IN ANY MANNER AND FOR ANY PURPOSE WHATSOEVER.	DRAWN BY: A. CARLISLE		DATE: 7/15/2013	REV:
	TITLE: APPROVAL DRAWING		DWG #: DB05200	
	PARENT: 333 BATCH ROASTER			

PARTS LIST					PARTS LIST					PARTS LIST					PARTS LIST								
ITEM	QTY	USAGE	MATERIAL	NUMBER	Lbs	ITEM	QTY	USAGE	MATERIAL	NUMBER	Lbs	ITEM	QTY	USAGE	MATERIAL	NUMBER	Lbs	ITEM	QTY	USAGE	MATERIAL	NUMBER	Lbs
116	4		Hexagon Socket Flat Countersunk Head Cap Screw		0	90	2		KILLARK #0LR-1 CONDUIT BODY	234-4016	0.1	49	1		103156, PILOT, EXTENDED	282-1805	2.8	1	1		M333 CONTROL PANEL	D731600	101
A306	1		BIMBA REED SWITCH	281-5157	0	A313	4		KILLARK #0L-10 BLANK COVER	234-4006	0.1	50	1		300558, MIXER, PILOT 131 COMPLETE	282-1804	3.9	3	1		EXHAUST ASSEMBLY	D501484 (SS)	31
2	1		DRUM ASSEMBLY	D501741 (SS)	1749.6	A314	4		KILLARK #0LK-1-RG GASKET	234-4005	0	51	1		GAS REG 043-180-1/2"	282-1304	15.4	4	1		BURNER ASSEMBLY	D501482 (SS)	355.3
2A	0		DRUM ASSEMBLY	D501741 (SS)	1741.8	92	4		ARMORED CONDUIT FTG, 3/8 90 ELBOW	234-3151	0	52	1		6" ALUM. BLAST GATE MCM#1788K14	281-9003	4.6	5	1		GAS TRAIN ASSEMBLY	D501480	614.5
						93	1		ARMORED CONDUIT FTG, 3/8 STRAIGHT	234-3150	0	53	1		TUBING, COPPER 3/8"	281-8610C	1.8	6	1		LEVEL CONTROL ASSEMBLY	D500059 (SS)	5.6
						94	4		EMT COMPRESSION CONNECTOR, 1/2"	234-3099	0	54	1		COPPER TUBING 1/4" O.D.	281-8604C	0.7	A301	1		INLET WELDMENT	D402895 (SS)	109
						95	1		FLEXIBLE ARMORED CONDUIT, 3/8"	234-3050	0	55	2		BRASS MALE CONN, 3/8T X 3/8NPT	281-8516	0	8	1		SAMPLE SCOOP	D402881	2.2
						97	1	5.000 in	EMT THINWALL CONDUIT, 1/2" GALV	234-3000	0.1	56	1		BRASS MALE ELBOW, 3/8T X 3/8NPT	281-8513	0	9	1		FRAME WELDMENT	D402880	928.4
						96	1	45.000 in	EMT THINWALL CONDUIT, 1/2" GALV	234-3000	1.2	57	2		BRASS MALE ELBOW, 1/4T X 1/4NPT	281-8512B	0	10	1		HOPPER	D402302 (SS)	100.6
						A315	7		1-HOLE EMT STRAP, 3/8, EFCOR 2595T	234-2080	0	A305	8		BRASS MALE CONN, 1/4T X 1/4NPT	281-8512B	0	11	1		CAM MOUNT	D403574	6.1
						98	1		ELBOW FITTING, LIQ-TITE 3/8" X 45	234-2063	0	58	1		SWITCH, AIR FLOW MODEL 955-R	281-5010	6.7	12	1		COVER	D401978	239.6
						A316	13		LIQ-TITE STRAIGHT CONNECTOR 3/8"	234-2062	0	59	2		MANUAL SHUT OFF VALVE #VS22-03	281-4045	0.2	13	1		THERMOCOUPLE SHEATH	D401228 (SS)	1.1
						99	11		ELBOW FITTING, LIQ-TITE 3/8" X 90	234-2061	0	60	1		PARTICULATE FILTER #F22B-03	281-4044	0.8	14	1		BOTTOM BOX MOUNT	D190130	17.8
						100	1		SEALTITE CONDUIT, 3/8"	234-2060	0	61	1		LUBRICATOR #L22L-03	281-4043	0.8	15	1		TOP BOX MOUNT	D190129	18.1
						101	1		PACKARD WIRE #440	234-1010	0	62	1		REGULATOR WITH GUAGE R22R-03G	281-4042	0.5	16	1		REGULATOR MOUNTING BRKT	D130497	0.8
						102	1		(J) T-COUPLE WIRE SHIELDED, 20GA	234-10055	0	63	1		MK8 SINGLE ACTING VALVES #0825A415K019M30	281-4041	0.3	19	1		BACK COVER	D121967	7.2
						103	1		SO CORD 18/3 AWG 300 VAC 0.29 OD	234-0991	0	64	1		MK8 AK ASSEMBLY KIT #AK0HB0003NSTD	281-4040	1.9	20	1		EXHAUST	D121821	5.1
						105	1		BRG,CAM FOLLOWER MCGILL 3 1/2	231-3247	4	65	1		SOLENOID 3WAY VALVE #S14E-Q2BELM	281-4022	0.4	21	1		HOPPER GATE	D121820 (SS)	4.5
						107	1		REDUCER, 1LH482, 140TC 17.55 TO 1	219-2201	14.1	80	1	3.500 in	PIPE NIPPLE, 3/8" X 3-1/2" LG.	272-1044	0.2	22	1		SAMPLE DOOR	D121807 (SS)	5
						108	1		2-HP 1725-RPM FR-145TC TEFC 230V	216-7301	13	66	4		3/8" MUFFLER/FILTER MCM# 4450K3	281-2023	0	23	4		SPACER	D121687 (60)	0.2
						A300	1		PULL ARM ASSEMBLY	D501531	9.4	67	1		MOUNTING NUT, BIMBA #D-508	281-1193	0.3	24	4		SPACER	D121687 (60)	0.1
						A302	2	8.3750 in	GUIDE ROD	D130639	1	68	1		BIMBA, 2"BORECYL,DLB ACT. 317-DXP	281-1174	0.7	25	1		DOOR	D121665	2.7
						A303	2		MOUNTING PLATE	D121574	3.7	69	1		BIMBA PISTON ROD CLEVIS D-231-3	281-1141	0	26	2		PILOT MOUNT	D121665	1.3
						A304	2		PULL PLATE	D121493	13.5	70	1		QUICK DISC. HOSE SOCKET, 3/8" MMC	281-1010	0.1	27	2		PILOT STRAP	D121664	0.1
						A307	1		MK8 DOUBLE ACTING VALVES #0825S515K019M30	281-4046	0.4	71	1		PIPE PLUG, 1" SQHD BLK	273-1100	0.4	28	1		DISCHARGE CHUTE	D121594 (MK1)	20.5
						A309	1		BIMBA, 3" BORE CYL. DBL ACT W/O TRACKS	281-1207	0	72	1		BUSHING REDUC. 1 X 1/2 NPT	273-0100B	0.2	29	2		MIDDLE SUPPORT	D121490	56.5
						A310	1		MOUNTING NUT, BIMBA #D-5379	281-1196	0	73	1		BUSHING, RED. HEX 1" X 1/2"	273-0100	0.2	30	2		PULL SUPPORT	D121489	3.6
						A311	2		BUSHING, REDUC. HEX 3/8" X 1/4" 304SS	273-0040 SS	0	74	1		BUSHING, RED. HEX 3/4 X 1/4	273-0081	0.1	31	2		PULL PAD	D121488	3.2
						71	4		BIMBA AIR FLOW CNTRL. VLV.#FCP4	281-2037	0	75	2		BUSHING, REDUC. HEX 1/2 X 1/4	273-0064	0.1	32	1		MIXER MOUNT	D121486	25.4
						A312	1		CORD GRIP, 2-HOLE CORD MCM# 7807K33	234-6144	0	76	1		BUSHING, REDUC. HEX 3/8" X 1/4"	273-0040	0	35	2		GROUND ROD	D110492	0.2
						110	4		NARROW IDLER TRUNNION - MACHINE	LA1514-MCH-1 (MK1)	20.9	77	1		PIPE TEE, 3/8 X 3/8 X 3/8 NPT	272-6080	0.2	36	2	11.000 in	HOPPER SPACER	D110487 (SS)	0.8
						109	4	1.0000 in	CAP, TRUNNION	LA6501-MCH-1	1.8	79	1		PIPE ELBOW, 1/4" X 90D	272-3020	0.1	37	1		OFFSET LINK, #80 CHAIN	294-7122	0
						41	4		GREASE FITTING, #1610, 1/8" NPT	287-8506	0	81	2	1.089 in	PIPE NIPPLE, 3/4 X CLOSE	272-1079	0.1	38	1		CONNECTING LINK, #80 CHAIN	294-7121	0
						34	2		SHAFT TRUNNION	D110625	3.9	82	3	1.068 in	PIPE NIPPLE, 1/4" X CLOSE	272-1041	0.1	39	1		ROLLER CHAIN NO. 80 SINGLE, 10'	294-7120	68.1
						18	4		THRUST BEARING SPACER	D125828	1.3	84	1		PIPE NIPPLE, 1/4" X CLOSE	272-1020	0	40	1		SPROCKET, B/Ts, 80BS20 X 1-1/4"	291-1515	8.1
						106	4		BEARING SKF REF: 22308 E	231-1961	0.3	85	1		COMPACT FLASH XGB	236-8041A	0	42	4		VIBR ISOLATION MT, MCM #6221K63	287-0158	3.6
						83	4		STRETCH FIT ROTARY SHAFT RING SEALS	265-4218	0	86	4		J-THERMOCOUPLE 5"COLD 18"HOT	236-1016	4.4	43	1		IGNITION CABLE, RESISTOR TYPE (39.4 in)	282-6049	0.1
									MCMMASTER REF: 9562K49					HUBBEL CONNECTOR, SHC-1017	234-6024	0	44	1		SNUBBER, RC, ELECTROCUBE #RG1983-6-12	282-6047	0	
									NEEDLE ROLLER THRUST BRG	231-5115	0.3	88	1		HUBBEL CONNECTOR SHC-1016	234-6023A	0	45	1		EMI SUPPRESSION FILTER #10005353	282-6038	0
						17	4	3.000 in	WHEEL BLOCKS	D125853	3.4	91	2		RED DOT 1-GANG SILVER DRY-TITE #IH5-1	234-4049	1.4	46	2		XFRMR MNT BRACKET ECLIPSE #20580	282-6033	0.1
						15	4	3.000 in	RUBBER PLATE	D130798	0	89	1		LEVITON 84014 1G SS BLANK PLATE	234-4019	0.5	47	1		IGNITION XFRMR ECLIPSE #22967	282-6032	7.2
						33	4	0.1875 in	CLAMP WASHER	D110626	0.2				KILLARK #OC-1 CONDUIT BODY	234-4009	0.2	48	2		FLAME ROD ASSEMBLY #R-1218	282-6016	0.7

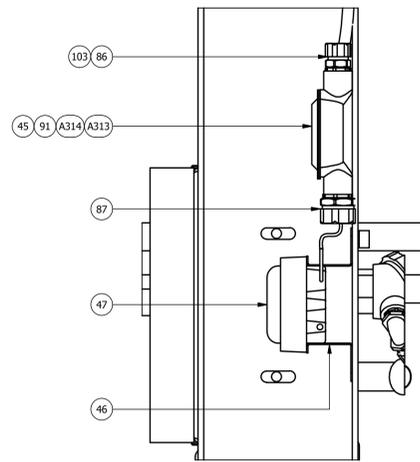


TOLERANCES, UNLESS OTHERWISE NOTED ARE TO BE: FOR ANGULAR: ± 1/2° FOR DECIMAL: ± 0.03 FOR DIMENSION: ± 0.001 FOR FRACTIONAL: ± 1/16" BE NON-CUMULATIVE - DO NOT APPLY TO HOLE DIA.		PART #:	D705200		SHEET 1 OF 3 REV: C								
THIS DRAWING RELATES TO PROPRIETARY SUBJECT MATTER. ANY PARTY ASSUMING COSTLY DUES SO WITH THE EXPRESS UNDERSTANDING AND AGREEMENT THAT NEITHER THE RECIPIENT NOR POSSESSION THEREOF CONVEYS OR TRANSFERS ANY RIGHT TO USE, REPRODUCE OR DISCLOSE ITS CONTENTS, OR ANY PART THEREOF, IN ANY MANNER AND FOR ANY PURPOSE WHATSOEVER.		DRAWN BY:	AWF			DATE:	1/6/2012						
ZONE		REV	DATE	AUTHOR	DESCRIPTION	TITLE:	REPAIR PARTS DWG	PARENT:	#333 BATCH ROASTER	DWG #:	D705200	REV:	C

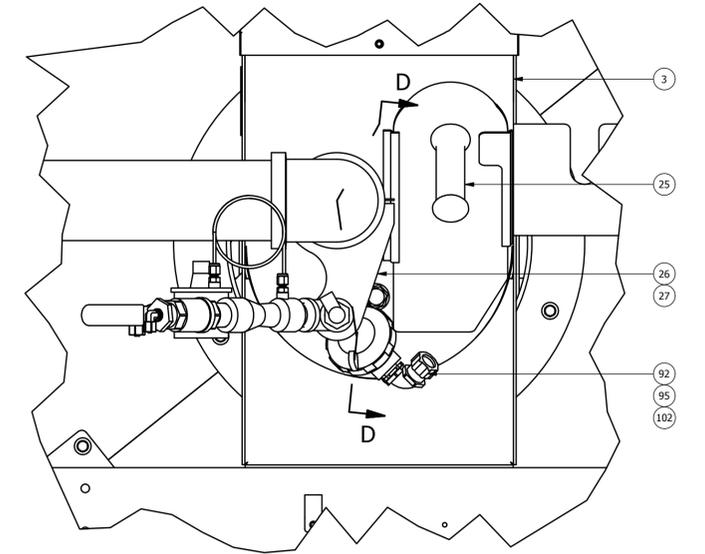




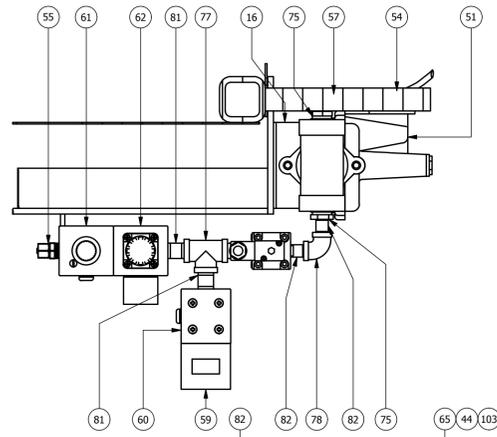
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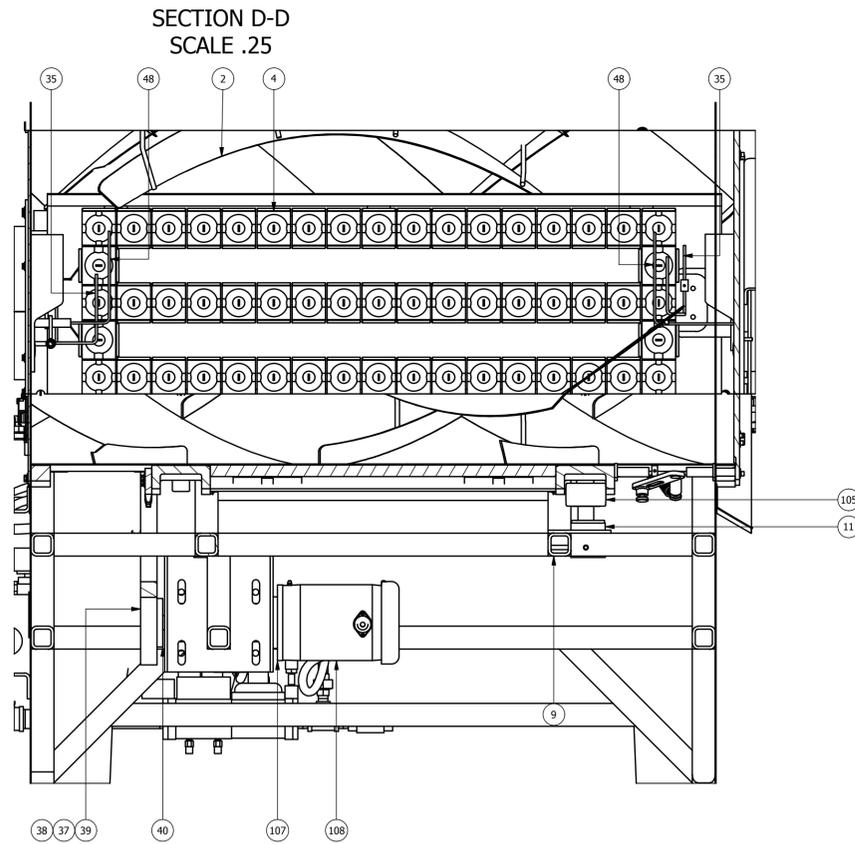
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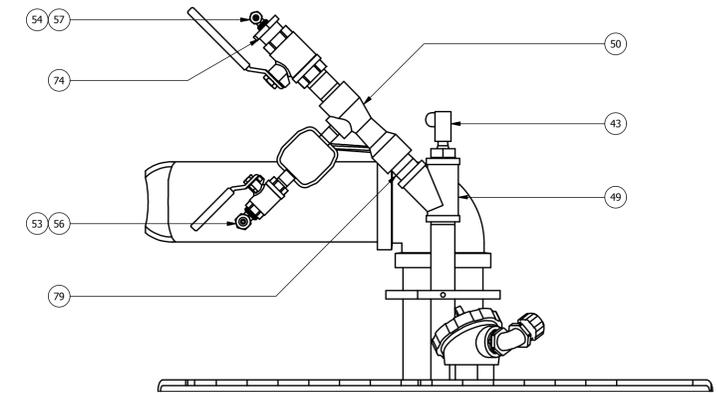
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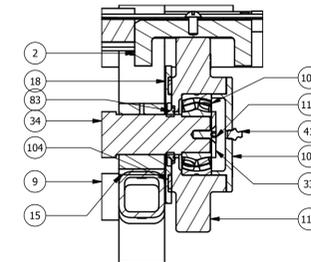
DETAIL B  
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SECTION E-E  
SCALE .125



SECTION F-F  
SCALE .25

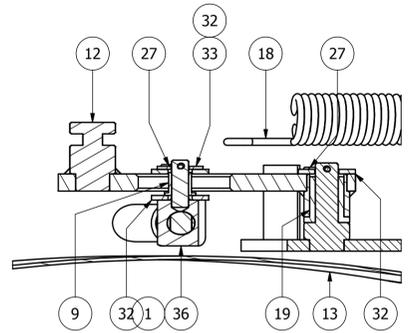


TOLERANCES, UNLESS OTHERWISE NOTED ARE TO BE:  
 FOR ANGULAR:  $\pm 1/2^\circ$   
 FOR DECIMAL XX:  $\pm 0.03$   
 FOR DECIMAL XXX:  $\pm 0.008$   
 FOR FRACTIONAL:  $\pm 1/16"$   
 BE NON-CUMULATIVE - DO NOT APPLY TO HOLE DIA.  
 THIS DRAWING RELATES TO PROPRIETARY SUBJECT MATTER. ANY PARTY ASSUMING CUSTOMY DOES SO WITH THE EXPRESS UNDERSTANDING AND AGREEMENT THAT NEITHER THE RECIPIENT NOR POSSESSION THEREOF CONVEYS OR TRANSFERS ANY RIGHT TO USE, REPRODUCE OR DISCLOSE ITS CONTENTS, OR ANY PART THEREOF, IN ANY MANNER AND FOR ANY PURPOSE WHATSOEVER.

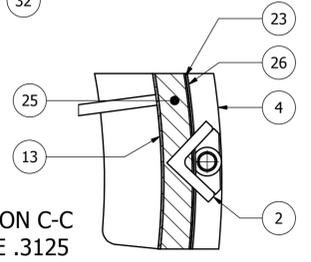
PART #: D705200  
 DRAWN BY: AWF  
 DATE: 1/6/2012  
 TITLE: REPAIR PARTS DWG  
 PARENT: #333 BATCH ROASTER

**F. CHORN & CO.**  
 EST. 1950  
 Excellence & Integrity  
 DWG #: D705200  
 REV: C

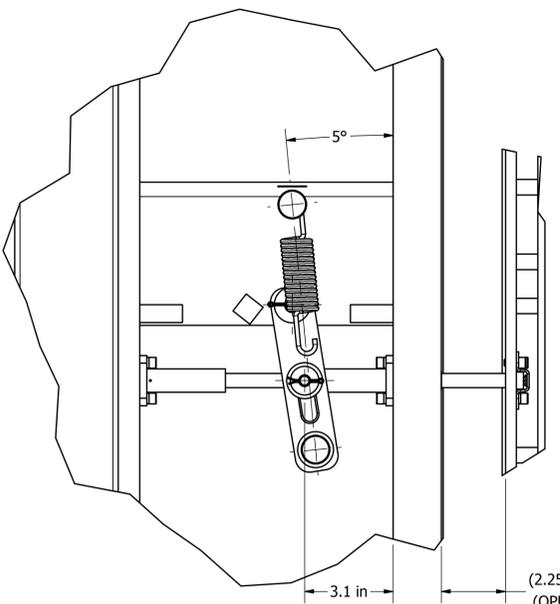
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ITEM	QTY	USAGE	MATERIAL	NUMBER	Lbs
1	8			D403421	0.1
2	12			D402486 (MS)	12.2
3	1			D402485	342.9
4	1			D402472	349.7
5	1			D402056 (SS)	5.4
6	1			D402055 (SS)	11.1
7	1			D350019	11.9
8	1			D220167 (*)	221.1
9	8			D200020	0
10	8	3.0000 in		D150046	0.4
11	8	4.2500 in		D150045	0.5
12	8			D130654	1.1
13	1			D122264 (SS)	188
14	2			D121962 (MS)	63
15	8			D121714 (SS)	0
16	2			D121573 (SS)	2.2
17	8			D110624 (SS)	0.7
18	8			287-0312	0.3
19	8			249-0806	0.1
20	2			M2301021	6.4
21	16			M2301021	0.9
22	4			M2301021	0.7
23	2			M2100161	15.4
24	10			M1303002	0.3
25	1			M0008000	206.3
26	2			SHIPPING STRAPS	2.6
27	16	3/32 X 1		H186A2120	0
28	24	3/8		H183-3400	0
29	18	5/16		H183-3100	0
30	48	1/4		H183-2801	0
31	16	1/4		H183-2800	0
32	24	1/2		H182-4000	0
33	32	3/8		H182-3400	0
34	18	5/16		H182-3100	0
35	16	1/4		H182-2800	0
36	16	1/4-20 X 0.25		H174-2602	0
37	6	1/2-20 X 1.5		H172F2612 SS	0
38	32	3/8-16 X 0.75		H172-2606 SS	0
39	32	1/4-20 X 1		H171S2608 SS	0
40	16	1/4-20 X 0.5		H171S2604 SS	0
41	24	3/8-16 X 1		H171-3208 SS	0
42	17	5/16-18 X 1		H171-2908 SS	0
43	18	1/4-20 X 0.5		H171-2604 SS	0



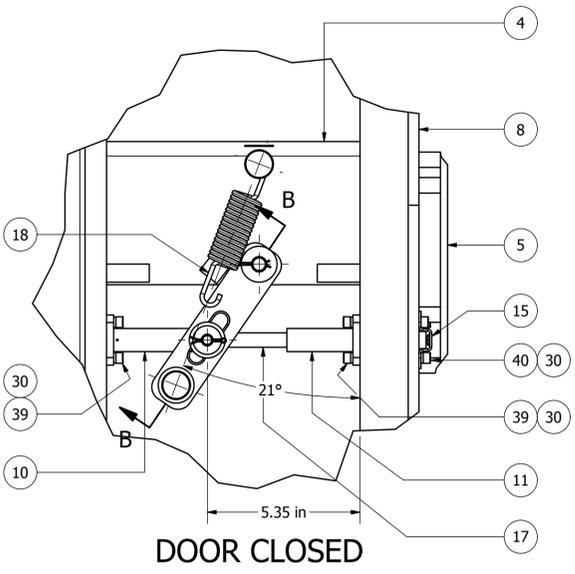
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SCALE .5



SECTION C-C  
SCALE .3125

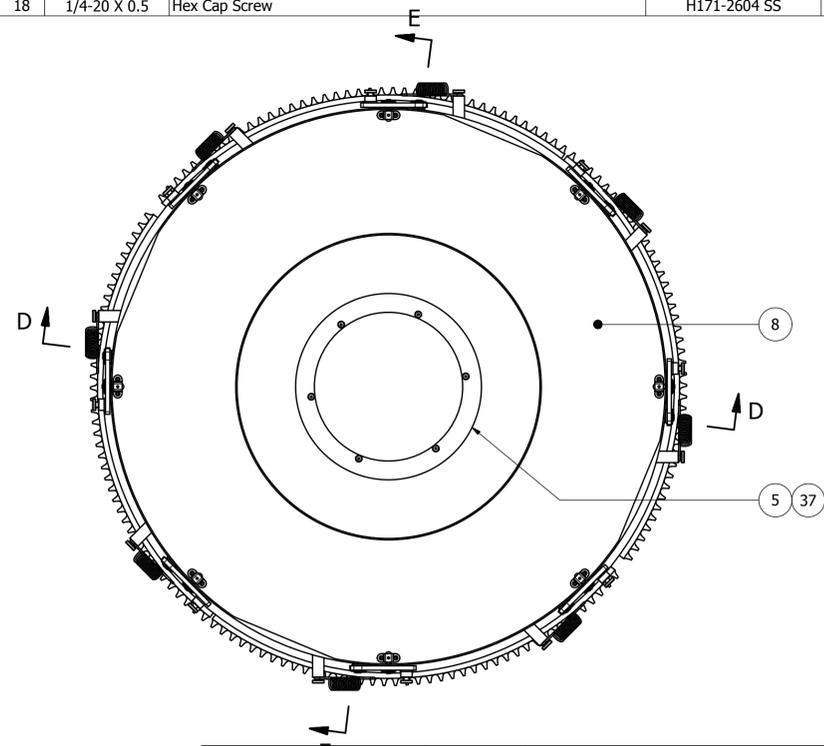
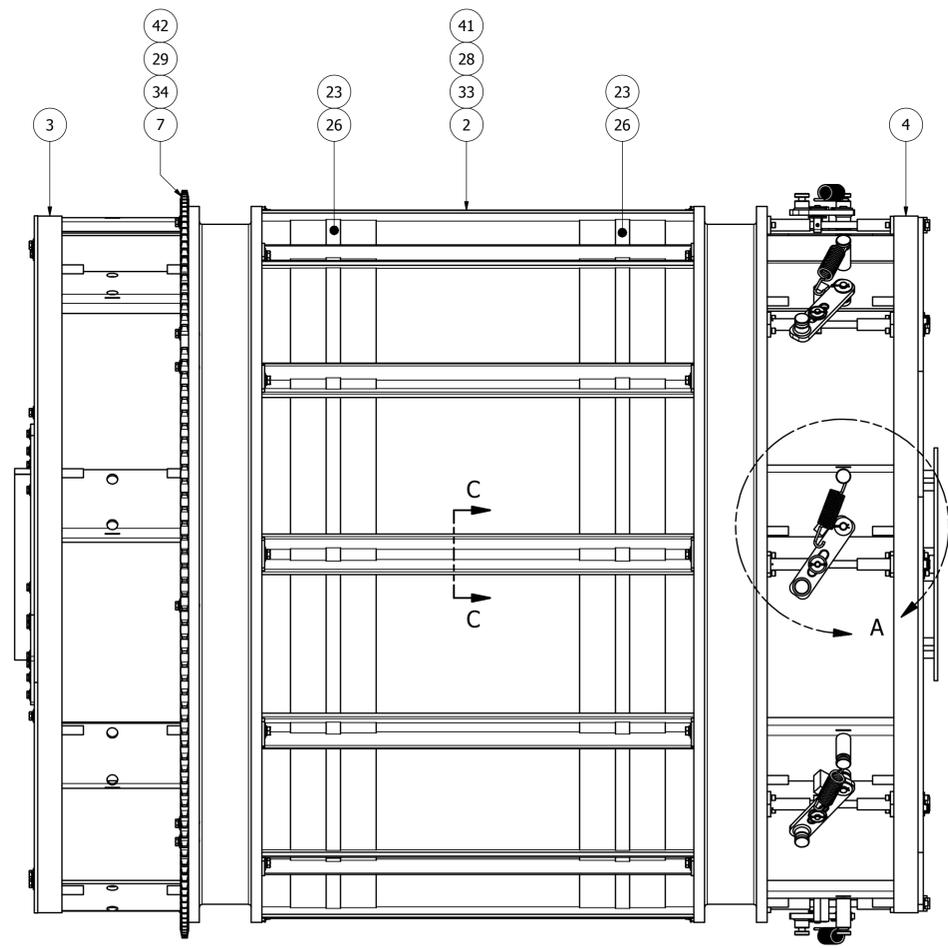
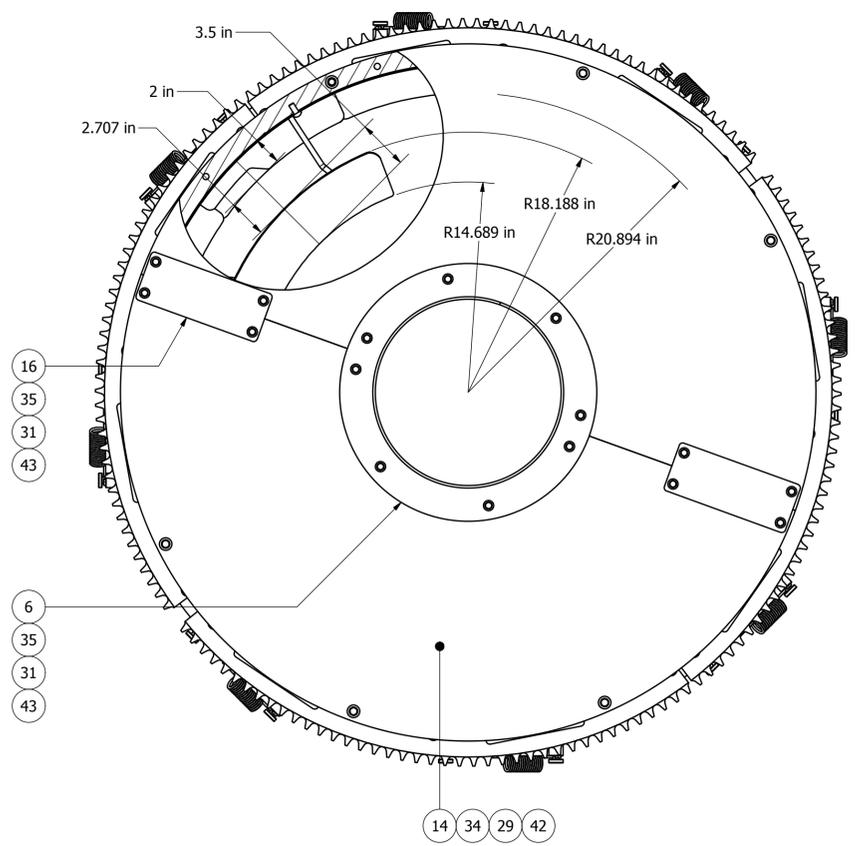


DOOR OPEN  
(2.25 in)



DOOR CLOSED

DETAIL A  
SCALE .3125



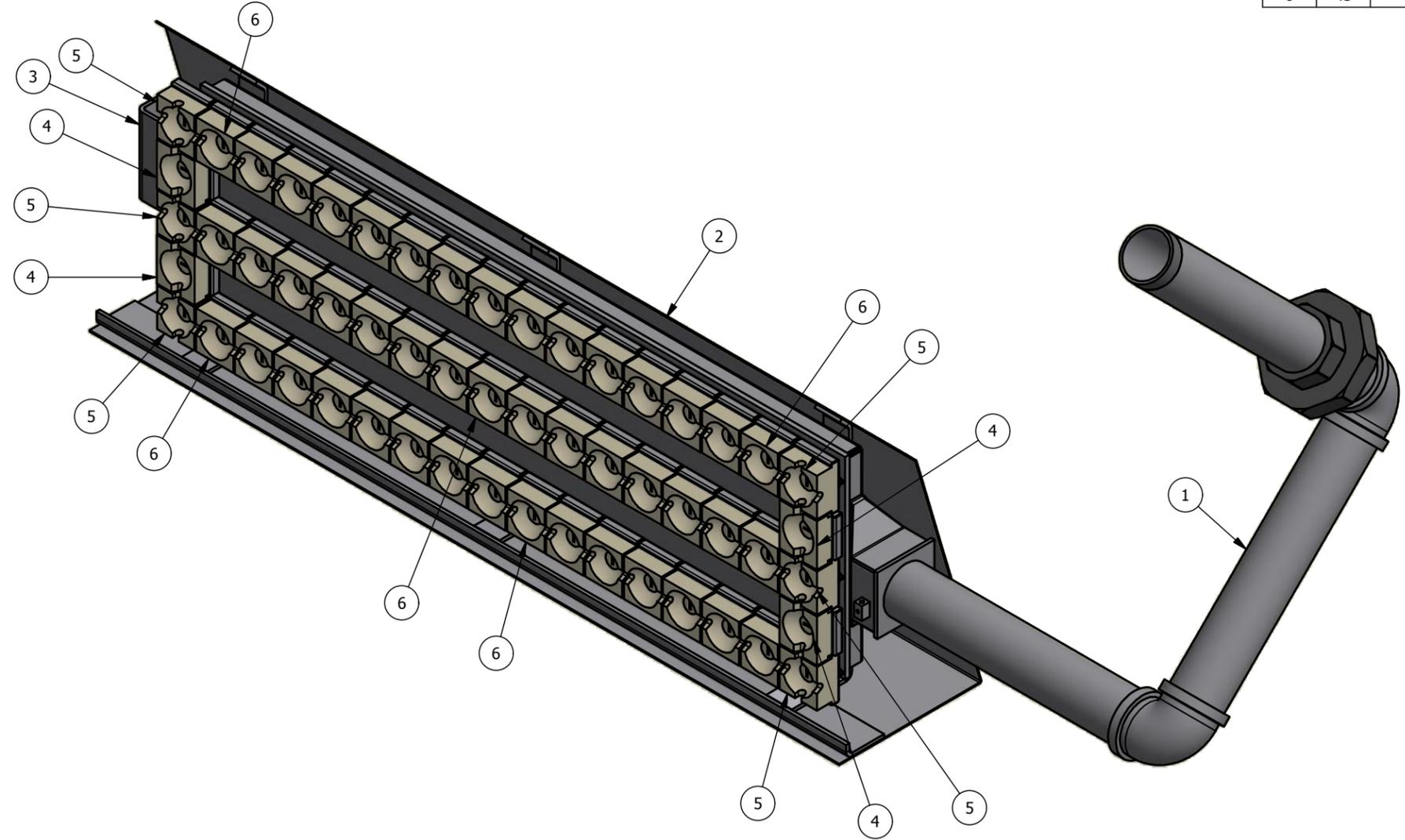
ZONE	REV	DATE	AUTHOR	DESCRIPTION
E	2/6/2014	AWF		CENSCO REVISION
D	12/19/2013	ADC		REPLACED FLIGHTS W/ NOTCHED FLIGHTS ON BURNER SIDE
C	11/13/2013	RC		ADDED FLATWASHERS, REPLACED 249-0604 W/ D200020
B	8/10/2013	CEN		REDESIGN SPRING MECHANISM
A	10/15/12	AWF		CHANGED F10498-30 FOR 287-0312

PART NO. D501741 (SS)	DATE 6/8/2010		TITLE DRUM ASSEMBLY #333 BATCH ROASTER	DRAWN BY A. CARLISLE DWG NO. D501741-SS	REV. E
TOLERANCES, UNLESS OTHERWISE NOTED ARE TO BE: FOR ANGULAR: +/- .12° FOR DECIMAL: +/- 0.03 FOR DECIMAL: +/- 0.010 FOR FRACTIONAL: +/- .004" BE NON-CUMULATIVE - DO NOT APPLY TO HOLE DIA.					

SHEET 1 OF 2

4 | 3 | 2 | 1

PARTS LIST					
ITEM	QTY	USAGE	MATERIAL	NUMBER	Lbs
1	1		GAS MANIFOLD	D401983	234.3
2	1		BURNER GUARD	D121492 (SS)	53.2
3	1		BURNER MOUNT	D121810	3.3
4	4		DOUBLE SHOULDER ASSEMBLY W/#52 TIP	118697-05	1.2
5	6		CROSS BURNER ASSY. W/#52 TIP	118697-03	1.1
6	45		STRAIGHT BURNER ASSEMBLY W/#52 TIP	118697-01	1.1



B

B

A

A

TOLERANCES, UNLESS OTHERWISE NOTED ARE TO BE  
 FOR ANGULAR +/- 1/2°  
 FOR DECIMAL XX +/- 0.03  
 FOR DECIMAL XXX +/- 0.010  
 FOR FRACTIONAL +/- 1/16"  
 BE NON-CUMULATIVE - DO NOT APPLY TO HOLE DIA.

THIS DRAWING RELATES TO PROPRIETARY SUBJECT MATTER. ANY PARTY ASSUMING CUSTODY DOES SO WITH THE EXPRESS UNDERSTANDING AND AGREEMENT THAT NEITHER THE RECEIPT NOR POSSESSION THEREOF CONFERS OR TRANSFERS ANY RIGHT TO USE, REPRODUCE OR DISCLOSE ITS CONTENTS, OR ANY PART THEREOF, IN ANY MANNER AND FOR ANY PURPOSE WHATSOEVER.

PART #: D501482 (SS)

DRAWN BY: A. FRITZ      DATE: 12/23/2008

TITLE: BURNER ASSEMBLY

PARENT: #333 BATCH ROASTER

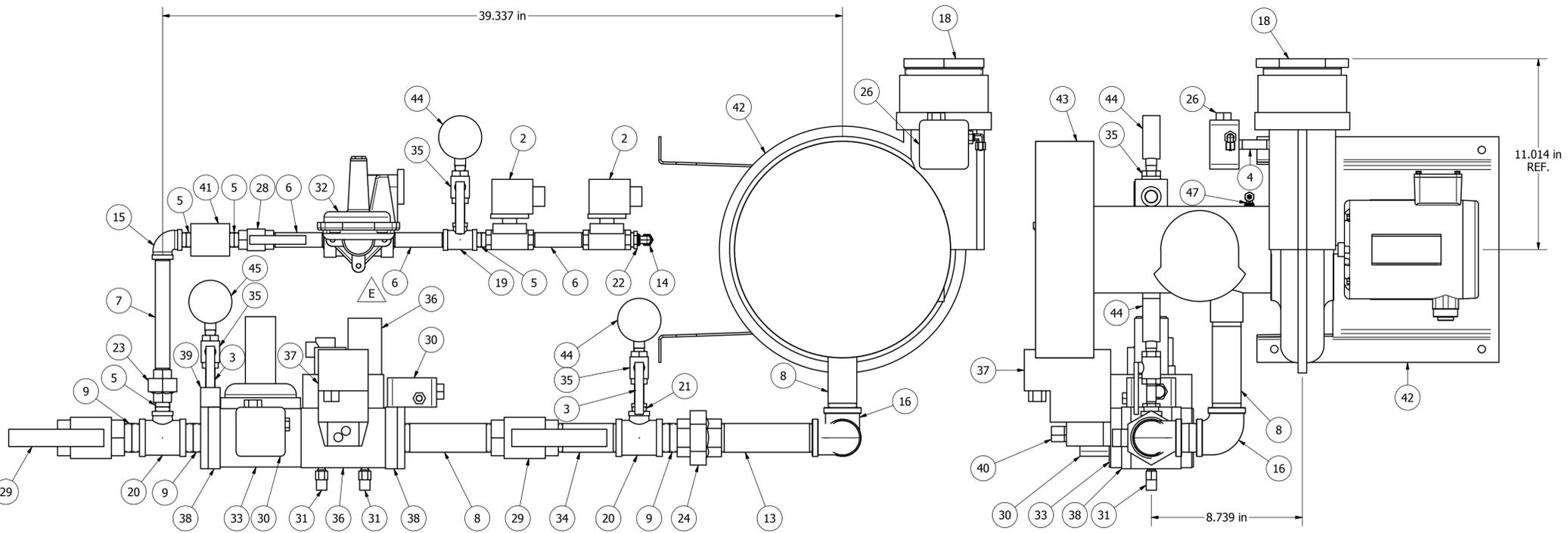
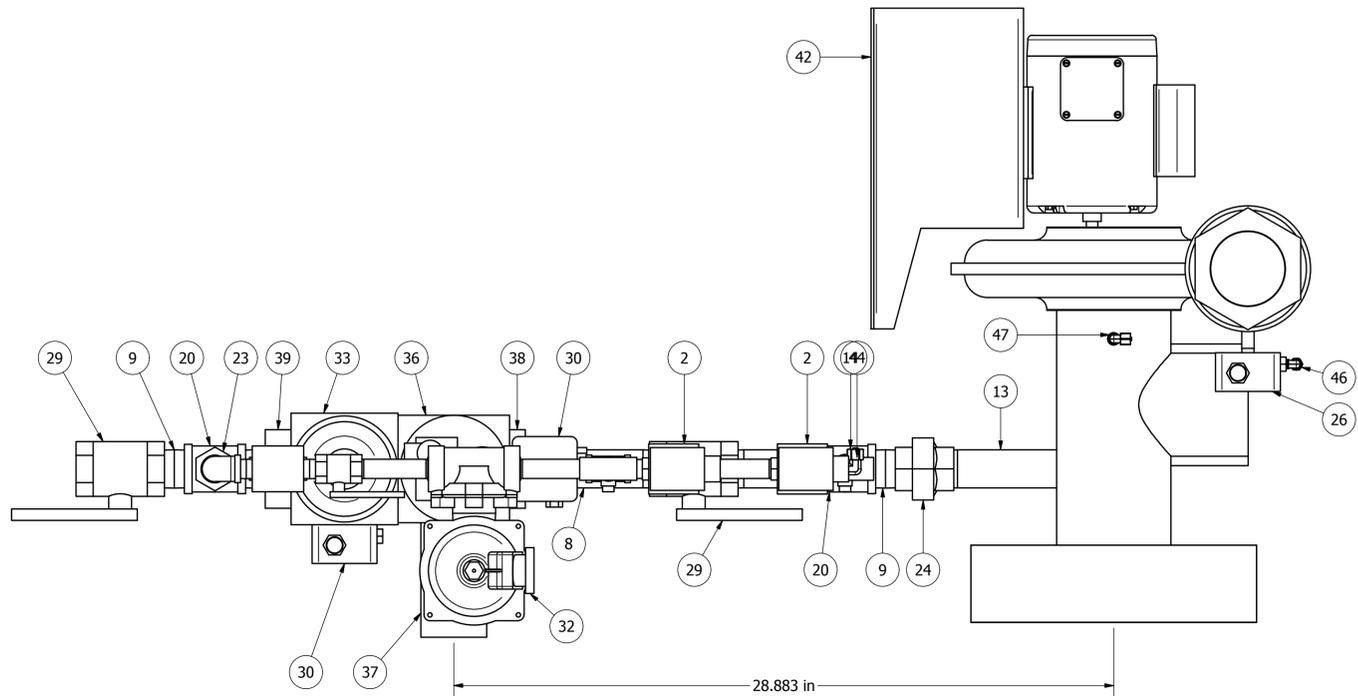


SHT 1 OF 1

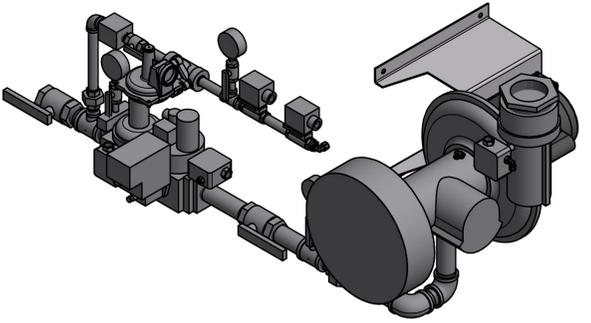
DWG #: D501482      REV: B

ZONE	REV	DATE	AUTHOR	DESCRIPTION
	B	10/2/2009	AWF	ADDED GROUND ROD
	A	2/24/2009	AWF	ADDED PILOT NOZZLES

4 | 3 | 2 | 1

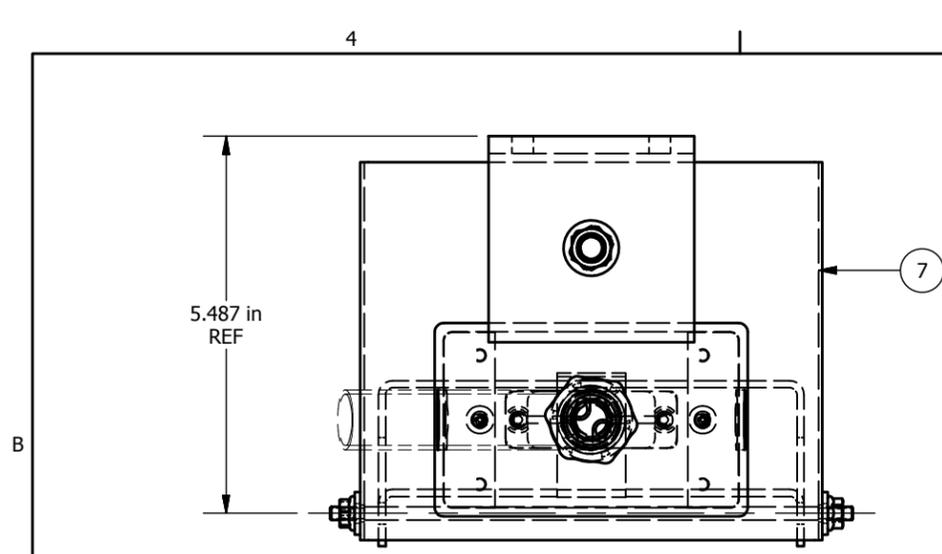


PARTS LIST					
ITEM	QTY	USAGE	MATERIAL	NUMBER	Lbs
1			BLANK		
2	2		1/2" PILOT SOLENOID ECL #20171	282-1305	3.7
3	3	1.500 in	PIPE NIPPLE, 1/4 X 1-1/2	272-1021	0.1
4	1	2.000 in	PIPE NIPPLE, 1/4 X 2	272-1022	0.1
5	4		PIPE NIPPLE, 1/2 X CLOSE	272-1060	0.1
6	3	3.500 in	PIPE NIPPLE, 1/2 X 3-1/2 LG	272-1065	0.3
7	1	7.000 in	PIPE NIPPLE, 1/2 X 7" LG	272-1059	0.5
8	2	5.500 in	PIPE NIPPLE, 1-1/4 X 5-1/2 LG	272-1125	1.1
9	4		PIPE NIPPLE, 1-1/4 X CLOSE	272-1120	0.3
10			BLANK		
11			BLANK		
12			BLANK		
13	1	6.000 in	PIPE NIPPLE, 1-1/4" X 6" LG	272-1114	1.2
14	1		BRASS MALE ELBOW, 3/8T X 3/8NPT	281-8513	0
15	1		PIPE ELBOW, 1/2" X 90D	272-3060	0.2
16	2		PIPE ELBOW, 1-1/4 X 90D	272-3120	0.1
17			BLANK		
18	1		BUSHING REDUCER 4" X 3"	273-0200	4.1
19	1		PIPE TEE, 1/2 X 1/2 X 1/4 NPT	272-6082	0.3
20	2		PIPE TEE, 1-1/4 X 1-1/4 X 1/2 NPT	272-6124	0.9
21	1		BUSHING, REDU HEX 1/2 X 1/4	273-0064	0.1
22	1		BUSHING, REDU HEX 1/2" X 3/8"	273-0066	0.1
23	1		PIPE UNION, 1/2" BLK IRON	273-3060	0.5
24	1		PIPE UNION, 1 1/4" BLK IRON	273-3120	1.7
25			BLANK		
26	1		AIR PSI SWITCH ECLIPSE AA-A2-6-2	281-5019	3.7
27			BLANK		
28	1		BALL VALVE, KDI #D240890 1/2"	282-0304	0.6
29	2		BALL VALVE, KDI #D240893 1-1/4"	282-0309	3.6
30	2		GAO-A2-4-5 HI/LO GASWTCH D217087	282-1013	3.7
31	2		VISUAL INDICATOR KDI#46000-6	282-1014	0.1
32	1		GAS REG 043-180-1/2"	282-1304	15.4
33	1		GAS REGULATOR FRI-710/6 #D230474	282-1324	26.1
34	1	4.000 in	PIPE NIPPLE, 1-1/4 X 4 LG	272-1124	0.8
35	3		BALL VALVE, 1/4" NPT D240887	282-1339	0.5
36	1		MULTI-VALVE DMV-D KDI#D224843	282-1352	32
37	1		PROVING SYSTEM VPS504, #D221073	282-1353	16.8
38	2		1.25" NPT/FLANGE, KDI# D222370	282-1355	2.8
39	1		.25" NPT PORT ADAPTER, KDI #D225047	282-1356	1.2
40	2		TEST NIPPLE KDI #D219008	282-1365	0.1
41	1		1/2" NPT GAS FILTER #GF 40-1-44	282-1374	2.2
42	1	OPTION	PREMIX BURNER, PL1000 230/460	BURNER	349.1
43	1		FILTER ASSEMBLY MAXON #17412	282-1829	117.6
44	2		GUAGE, 0-15" WC, ECLIPSE 14655	282-1900	1.5
45	1		GUAGE, 0-400 INCHES OF WATER #PR255IA4P66	282-1922	1.5
46	1		BRASS MALE ELBOW, 1/4T X 1/8NPT	281-8502	0
47	1		BRASS MALE ELBOW, 1/4T X 1/4NPT	281-8512B	0
48	1		COPPER TUBING 1/4" OD	281-8604C	0

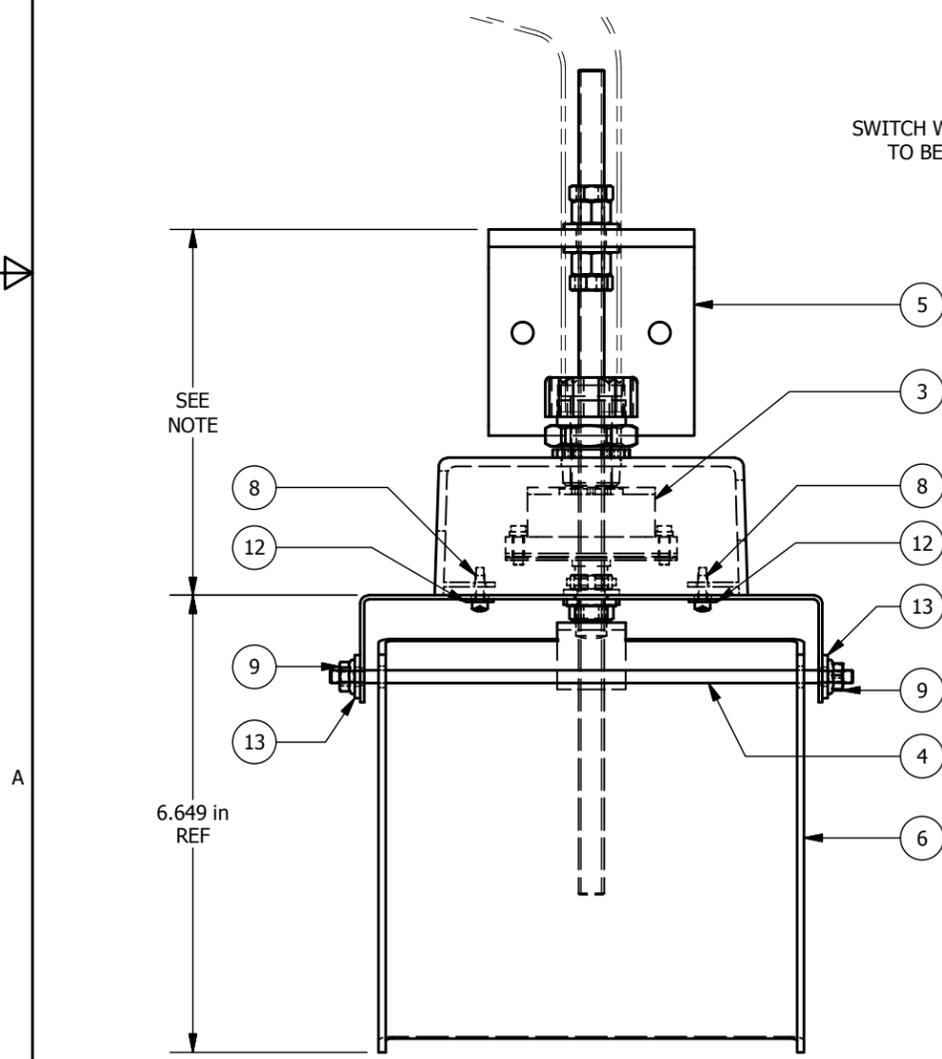


E	9/14/2011	AWF	MADE NIPPLE LONGER
D	7/13/2011	A. CARLISLE	CHANGED ITEM 45 FROM 282-1906 TO 282-1922
C	8/27/2009	A. CARLISLE	ADDED PIPES
B			
A	8/12/2008	J. DUNBAR	CHANGED #7 AND FLIPED LOWER PART OF GAS TRAIN TO FIT ON TOP
ZONE	REV	DATE	AUTHOR
			DESCRIPTION

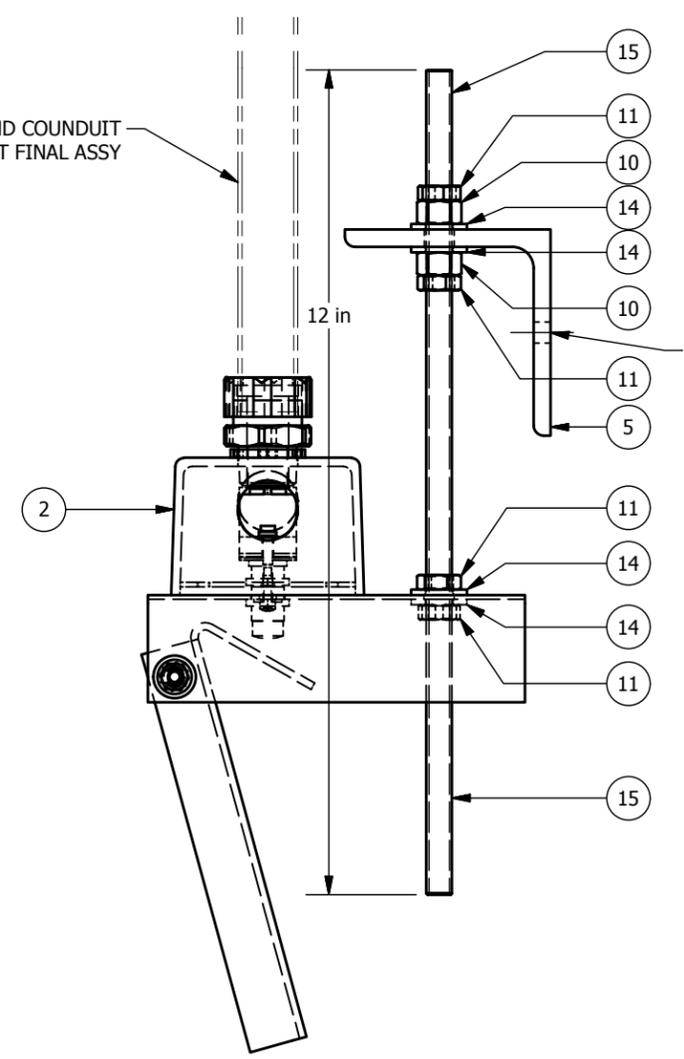
PART NO. D501480	DATE 8/21/2009	<b>A.C. HORN &amp; CO.</b> Cantrell International <i>Excellence and Integrity Since 1907</i>	SHEET 1 OF 1 REV. E
<small>           TOLERANCES, UNLESS OTHERWISE NOTED ARE TO BE:            FOR ANGULAR: +/- .12°            FOR DECIMAL: XX +/- .003            FOR DECIMAL: XXX +/- .010            FOR FRACTIONAL: +/- .125°            BE NON-CUMULATIVE - DO NOT APPLY TO HOLE DIA.         </small>	SCALE PROPORTIONAL		
<small>           THIS DRAWING RELATES TO PROPRIETARY SUBJECT MATTER. ANY PARTY ASSUMING CUSTODY DOES SO WITH THE EXPRESS UNDERSTANDING AND AGREEMENT THAT NEITHER THE RECEIPT NOR POSSESSION THEREOF CONVEYS OR TRANSFERS ANY RIGHT TO USE, REPRODUCE OR DISCLOSE ITS CONTENTS, OR ANY PART THEREOF, IN ANY MANNER AND FOR ANY PURPOSE WHATSOEVER.         </small>		# 333	DWG NO. D501480



D500059					
ITEM	QTY	USAGE	MATERIAL	NUMBER	Lbs
1	1		STRAIGHT FITTING, LIQ-TITE, 1/2"	234-2068	0
2	1		SWITCH BOX, PERFECT LINE T-11	234-4003	1.4
3	1		SWITCH, LIMIT GE #CR115B402	234-9004	0.1
4	1	7.6250 in	PIVOT ROD	D110009 (SS)	0.1
5	1	3.000 in	MOUNTING BRACKET	D190009 (SS)	1.2
6	1		SWINGING BAFFLE ASSEMBLY	D330106 (SS)	1.4
7	1		BASE PLATE	D330107 (SS)	0.9
8	2	#6-32 X 1/2"	Cross Recessed Fillister Head Tapping Screw - Type C - Type I	H172-1704 SS	0
9	2	#10-32	Hex Flange Nut	H180-2400 SS	0
10	2	3/8"	Unified hexagon bolts, screws and nuts (UNC and UNF threads)	H180-3200 SS	0
11	4	3/8"-16	Hex Nuts (Inch Series) Hex Jam Nut	H180C3200 SS	0
12	2	#6	Plain Washer (Inch )Type A and B	H182-2100 SS	0
13	2	#10	Washer A	H182-2300 SS	0
14	4	3/8"	Washer A	H182-3400 SS	0
15	1	12.0000 in	ALL THREAD, MILD STEEL, 0.375-16, UNC	M1203005	0.4



D500059-SS					
ITEM	QTY	USAGE	MATERIAL	NUMBER	Lbs
1	1		STRAIGHT FITTING, LIQ-TITE, 1/2"	234-2068	0
2	1		SWITCH BOX, PERFECT LINE T-11	234-4003	1.4
3	1		SWITCH, LIMIT GE #CR115B402	234-9004	0.1
4	1	7.625 in	PIVOT ROD	D110009 (SS)	0.1
5	1	3.000 in	MOUNTING BRACKET	D190009 (SS)	1.2
6	1		SWINGING BAFFLE ASSEMBLY	D330106 (SS)	1.4
7	1		BASE PLATE	D330107 (SS)	0.9
8	2	#6-32 X 1/2"	Cross Recessed Fillister Head Tapping Screw - Type C - Type I	H172-1704 SS	0
9	2	#10-32	Hex Flange Nut	H180-2400 SS	0
10	2	3/8"	Unified hexagon bolts, screws and nuts (UNC and UNF threads)	H180-3200 SS	0
11	4	3/8"-16	Hex Nuts (Inch Series) Hex Jam Nut	H180C3200 SS	0
12	2	#6	Plain Washer (Inch )Type A and B	H182-2100 SS	0
13	2	#10	Washer A	H182-2300 SS	0
14	4	3/8"	Washer A	H182-3400 SS	0
15	1	12.000 in	ALL THREAD, STAINLESS, 0.375-16, UNC, 304	M1303001	0.4



SWITCH WIRING AND COUNDUIT TO BE ADDED AT FINAL ASSY

TO BE MOUNTED ON INSIDE OF ROASTER HOPPER WITH 1/4-20 BOLTS

NOTE  
ADJUST TO APPROX 6 7/8"  
FOR PEANUTS (BASE ON 38° ANGLE  
OF REPOSE FROM SURFACE HOPPER GATE)

ZONE	REV	DATE	AUTHOR	DESCRIPTION
A		4-13-07	AWF	CORRECTED ITEM #'S

TOLERANCES, UNLESS OTHERWISE NOTED ARE TO BE  
FOR ANGULAR +/- 1/2°  
FOR DECIMAL XX +/- 0.03  
FOR DECIMAL XXX +/- 0.010  
FOR FRACTIONAL +/- 1/16"  
BE NON-CUMULATIVE - DO NOT APPLY TO HOLE DIA.

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PART #: D500059 (SS)	
DRAWN BY: D. WATERS	DATE: 12/27/1989
TITLE: LEVEL CONTROL ASSEMBLY	
PARENT: #333 BATCH ROASTER	

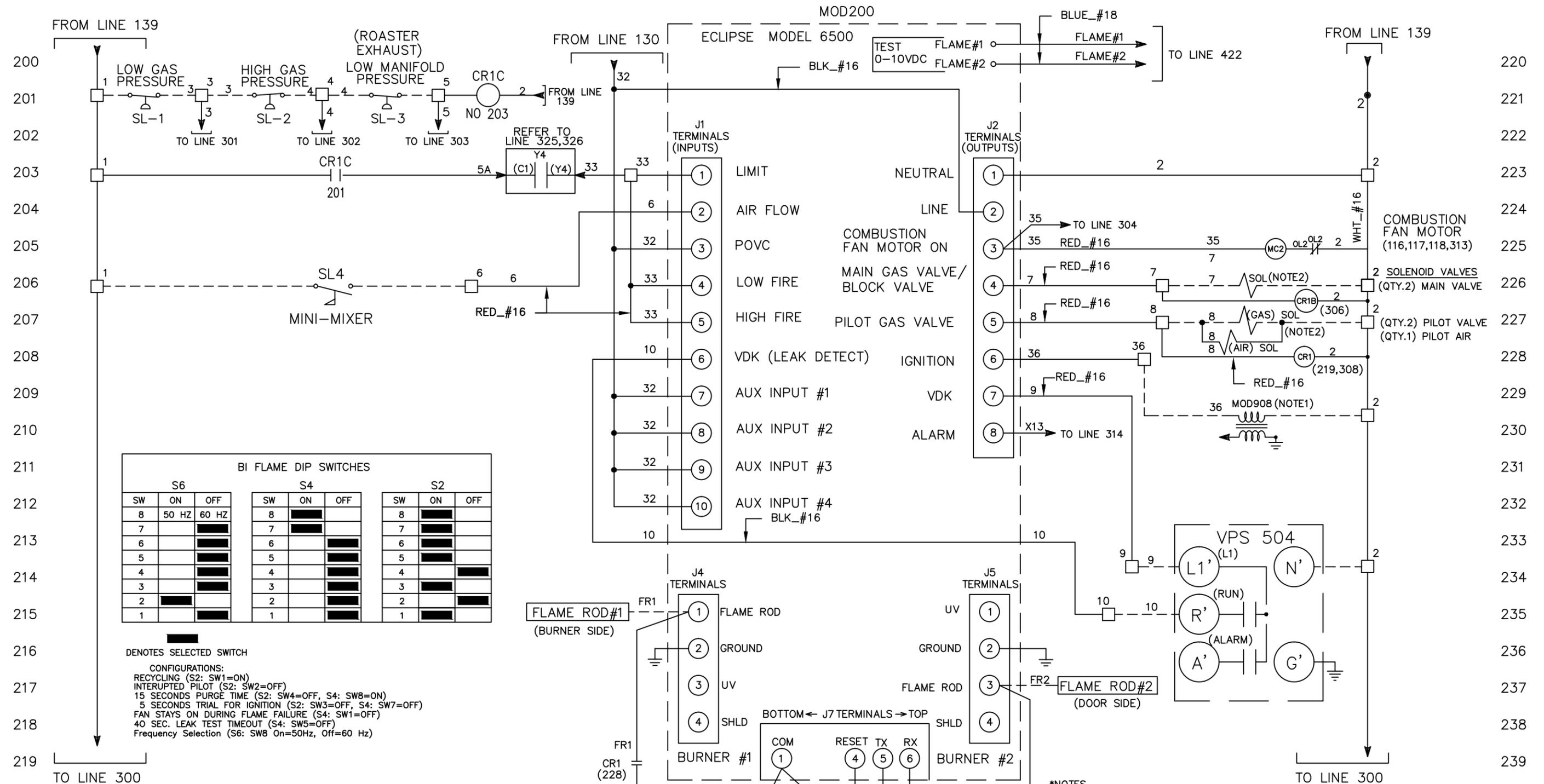
**A C HORN & CO**  
SINCE 1907  
Excellence & Integrity

DWG #:  
D500059

REV:  
A

SHT 1 OF 1





BI FLAME DIP SWITCHES

S6			S4			S2		
SW	ON	OFF	SW	ON	OFF	SW	ON	OFF
8	50 HZ	60 HZ	8	■		8	■	
7		■	7		■	7		■
6		■	6		■	6		■
5		■	5		■	5		■
4		■	4		■	4		■
3		■	3		■	3		■
2	■		2	■		2	■	
1		■	1		■	1		■

■ DENOTES SELECTED SWITCH

CONFIGURATIONS:

- RECYCLING (S2: SW1=ON)
- INTERUPTED PILOT (S2: SW2=OFF)
- 15 SECONDS PURGE TIME (S2: SW4=OFF, S4: SW8=ON)
- 5 SECONDS TRIAL FOR IGNITION (S2: SW3=OFF, S4: SW7=OFF)
- FAN STAYS ON DURING FLAME FAILURE (S4: SW1=OFF)
- 40 SEC. LEAK TEST TIMEOUT (S4: SW5=OFF)
- Frequency Selection (S6: SW8 On=50Hz, Off=60 Hz)

X TERMINAL

TORQUE 5LB/IN

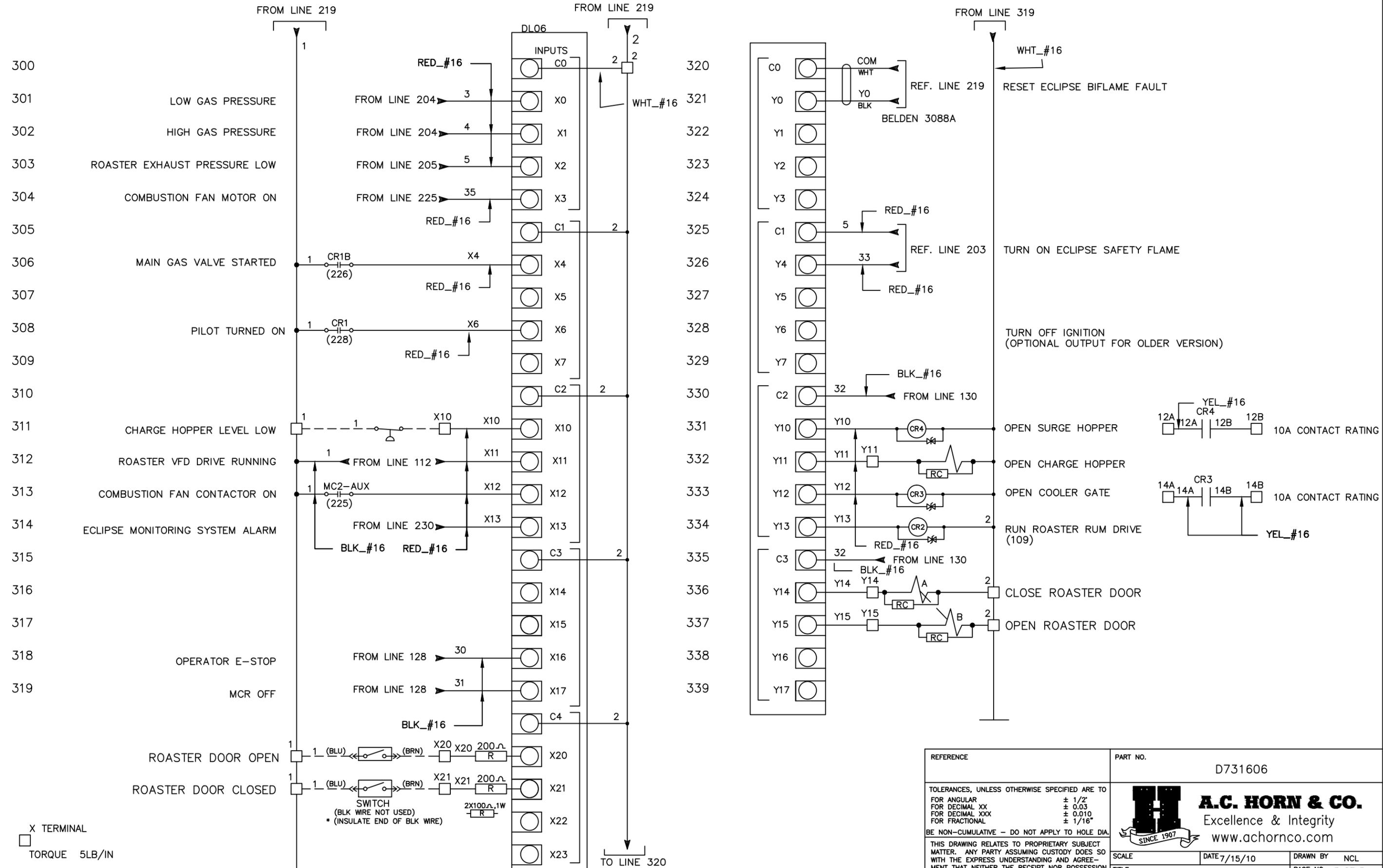
REFER TO FIGURE 6.2 ECLIPSE WIRING DIAGRAM  
PAGE 26, INSTRUCTION MANUAL NO. 826, 05/03

ECLIPSE COMBUSTION  
BI-FLAME DUAL BURNER MONITORING SYSTEM  
MODEL 6500 VERSION 1.8

- \*NOTES
- CONNECT EMI FILTER (#232-6038) AT MOD908 IGNITION TRANSFORMER
  - CONNECT SNUBBER (#282-6047 OR 282-6039) ON PILOT & MAIN GAS SOLENOIDS

REFERENCE	PART NO.
	D731606
TOLERANCES, UNLESS OTHERWISE SPECIFIED ARE TO	
FOR ANGULAR	± 1/2°
FOR DECIMAL XX	± 0.03
FOR DECIMAL XXX	± 0.010
FOR FRACTIONAL	± 1/16"
BE NON-CUMULATIVE - DO NOT APPLY TO HOLE DIA.	
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SCALE	DATE 7/15/10
TITLE	DRAWN BY NCL
M333-J ROASTER ELECTRICAL SCHEMATIC	PAGE NO. 2 OF 5
	DRAWING NUMBER D731606A

SYM	DATE	BY	DESCRIPTION
			SEE SHEET #1 FOR REVISIONS
REVISIONS			



300 FROM LINE 219 1

301 LOW GAS PRESSURE 3

302 HIGH GAS PRESSURE 4

303 ROASTER EXHAUST PRESSURE LOW 5

304 COMBUSTION FAN MOTOR ON 35

305 RED\_#16

306 MAIN GAS VALVE STARTED 1 CR1B (226) X4

307 RED\_#16

308 PILOT TURNED ON 1 CR1 (228) X6

309 RED\_#16

310

311 CHARGE HOPPER LEVEL LOW 1 X10

312 ROASTER VFD DRIVE RUNNING 1 FROM LINE 112 X11

313 COMBUSTION FAN CONTACTOR ON 1 MC2-AUX (225) X12

314 ECLIPSE MONITORING SYSTEM ALARM FROM LINE 230 X13

315 BLK\_#16 RED\_#16

316

317

318 OPERATOR E-STOP 30 FROM LINE 128 X16

319 MCR OFF 31 FROM LINE 128 X17

ROASTER DOOR OPEN 1 (BLU) (BRN) X20 200Ω R

ROASTER DOOR CLOSED 1 (BLU) (BRN) X21 200Ω R

320 FROM LINE 219 2 2 WHT\_#16

321 COM WHT REF. LINE 219

322 Y0 BLK BELDEN 3088A

323

324

325 RED\_#16

326 Y4 5 33 REF. LINE 203

327 RED\_#16

328

329

330 BLK\_#16

331 Y10 32 FROM LINE 130

332

333

334 Y13 32 FROM LINE 130

335 BLK\_#16

336 Y14 Y14 A 2 RC

337 Y15 Y15 B 2 RC

338

339

WHT\_#16

RESET ECLIPSE BIFLAME FAULT

TURN ON ECLIPSE SAFETY FLAME

TURN OFF IGNITION (OPTIONAL OUTPUT FOR OLDER VERSION)

OPEN SURGE HOPPER

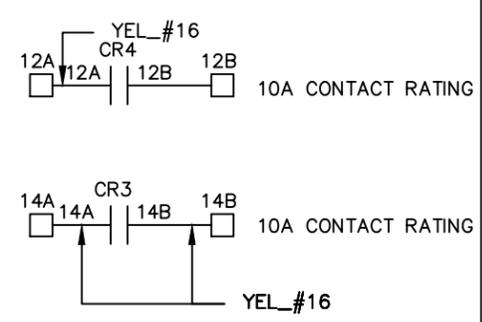
OPEN CHARGE HOPPER

OPEN COOLER GATE

RUN ROASTER RUM DRIVE (109)

CLOSE ROASTER DOOR

OPEN ROASTER DOOR



X TERMINAL  
TORQUE 5LB/IN

SWITCH  
(BLK WIRE NOT USED)  
\* (INSULATE END OF BLK WIRE)

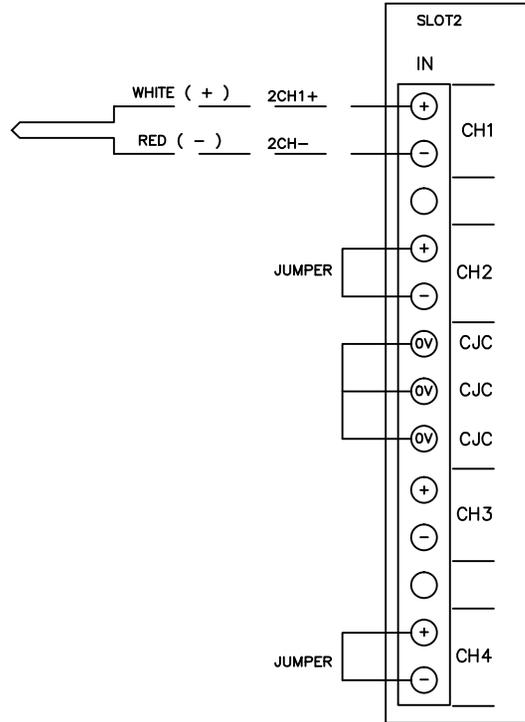
TO LINE 320

REFERENCE	PART NO. D731606	
TOLERANCES, UNLESS OTHERWISE SPECIFIED ARE TO FOR ANGULAR ± 1/2° FOR DECIMAL XX ± 0.03 FOR DECIMAL XXX ± 0.010 FOR FRACTIONAL ± 1/16"	 <b>A.C. HORN &amp; CO.</b> Excellence & Integrity www.achornco.com	
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SEE SHEET #1 FOR REVISIONS			
SYM	DATE	BY	DESCRIPTION
REVISIONS			

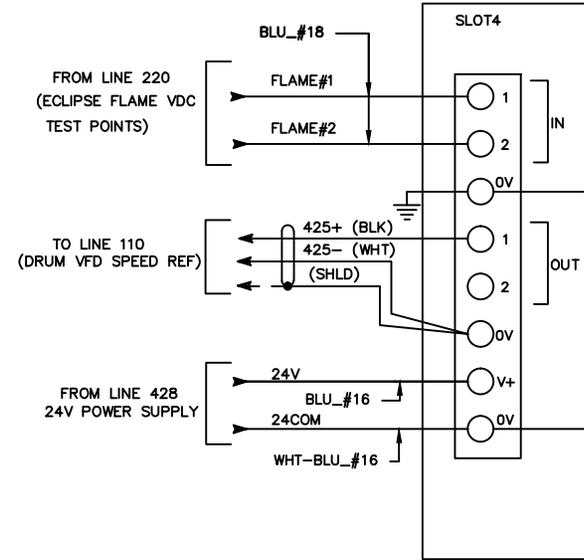
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THERMOCOUPLE MODULE  
FO-04THM

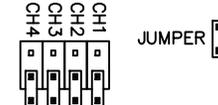


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ANALOG INPUT MODULE  
FO-2AD2DA-2



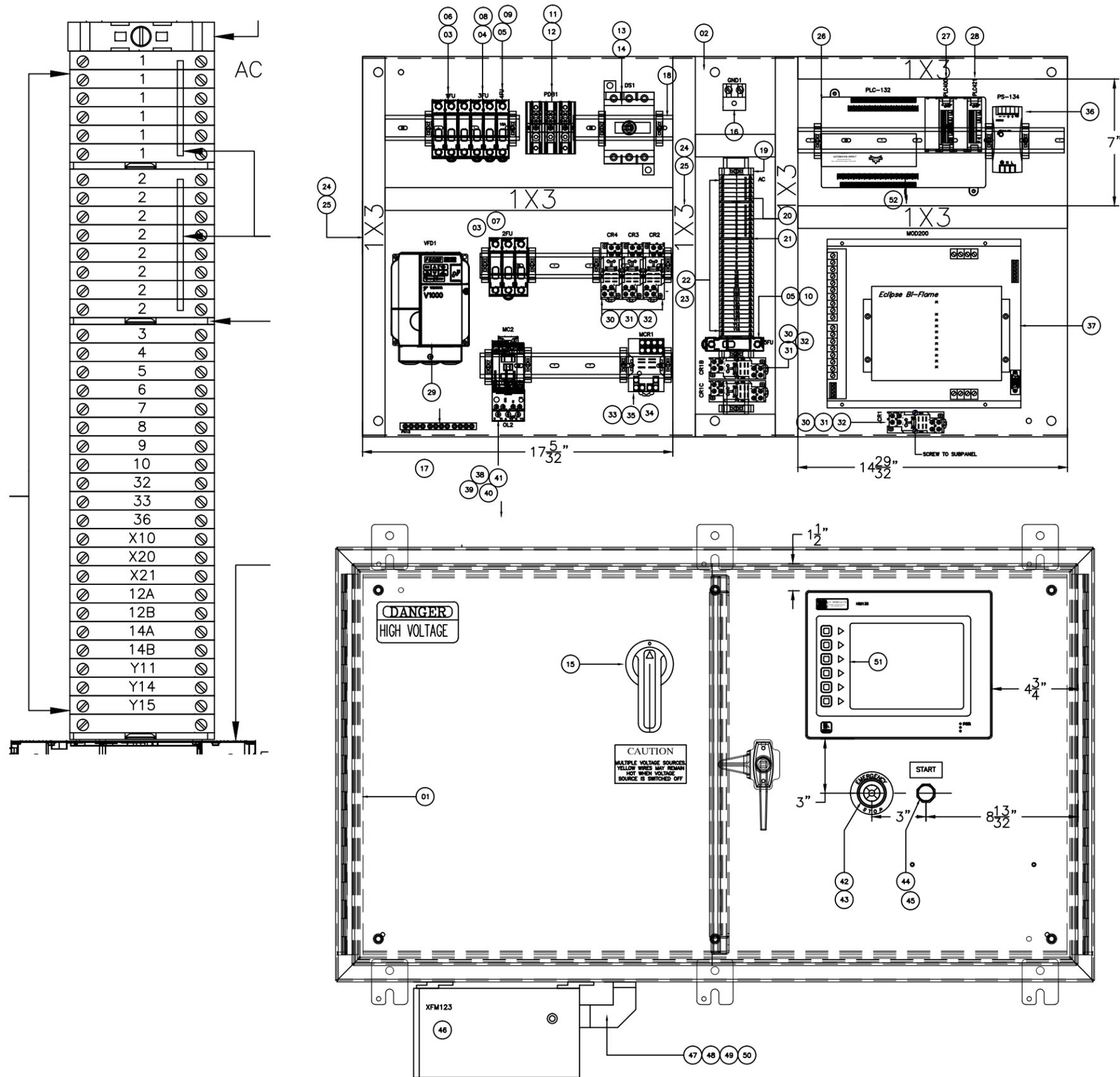
NOTE:  
FOR SHIELDED CABLE  
USE BELDEN 3088A OR  
EQUIVALENT



SYM	DATE	BY	DESCRIPTION
			SEE SHEET #1 FOR REVISIONS
REVISIONS			

REFERENCE	PART NO. D731606		
TOLERANCES, UNLESS OTHERWISE SPECIFIED ARE TO FOR ANGULAR ± 1/2° FOR DECIMAL XX ± 0.05 FOR DECIMAL XXX ± 0.010 FOR FRACTIONAL ± 1/16"	 <b>A.C. HORN &amp; CO.</b> Excellence & Integrity www.achornco.com		
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	TITLE M333-J ROASTER ELECTRICAL SCHEMATIC		PAGE NO. 4 OF 5 DRAWING NUMBER D731606A

D731606A BILL OF MATERIALS



ITEM#	QTY	PART#	DESCRIPTION
1	1	235-6077	ENCL, TYPE 12, 2-DOOR WALL-MOUNT, WIEGMANN WA244208WF
2	1	235-6078	INNER PANEL 21" X 39" WIEGMANN #NP4224
3	2	235-8263	FUSE HOLDER, 3POLE, 30A #CHCC3DI / #USCC3DI
4	1	235-8254	FUSE HOLDER, 2 POLE, 30A #CHCC2DI / #USCC2DI
5	2	235-8259	FUSE HOLDER, 1 POLE, 30A #CHCC1D1 / #USCC2DI
6	3	235-8111	FUSE CLASS CC FNQ-R-10
7	3	235-8119	FUSE CLASS CC LP-CC-2
8	2	235-8070	FUSE CLASS CC FNQ-R-5
9	1	235-8073	FUSE CLASS CC KTKR-8
10	1	235-8124	FUSE CLASS CC KTKR-5
11	1	234-7110	POWER DISTRIBUTION BLOCK, 1492-PD3141, 3P, (1) 2/0 - #14 x (4) #4-14 AWG
12	1	234-7111	DISTRIBUTION BLOCK COVER, 1492-PBC1, 2.75"x2.88"
13	1	234-8990	DISC. SWITCH 60A 3 POLE #CDNF60A3
14	1	234-9182	DISCONNECT SHAFT, 6.7"L, 7.2-8.1" DEPTH, #BDS170
15	1	234-8989	DISCONNECT. 2.6" HANDLE, IP65, RED/YEL #BDH59
16	1	234-7103	GROUND TERMINAL LUG, #AU-2/0
17	1	234-7029	GROUND BAR, 12P, #PK12GTA
18	2	236-0009	DIN RAIL, SLOTTED, 35MM
19	14	234-7050	TERMINAL BLOCK RETAINING CLIP, 35MM
20	2	234-7095	TERMINAL BLOCK PH 10P JUMPER, FBS 10-6 BRIDGE, #3030271
21	3	234-7100	TERMINAL BLOCK PH END COVER PH #3047028
22	36	234-7102	TERMINAL BLOCK PH 2-CONDUCT UT4, 26-10AWG, #3044102
23	8	234-7124	TERMINAL BLOCK PH BLANK LABELS, #5060935
24	3	234-7108	WIRE DUCT, 1"X3", TY 1X3NPG6
25	3	234-7109	WIRE DUCT COVER, 1", TYCPG6
26	1	236-7016	PLC DIRECT DL06, 20IN, 16 OUT #D0-06AR
27	1	234-7041	PLC DIRECT, 4-CHAN THERM #F0-04THM
28	1	236-7057	PLC DIRECT, 2CH IN, 2CH OUT, 0-10VDC, #F0-2AD2DA-2
29	1	281-1083	2HP, 3PHASE VFD DRIVE, CIMR-VU4A0005FAA
30	6	235-0051	RELAY, 2PDT, 120VDC COIL, 782-2C-120A
31	6	235-0052	RELAY SOCKET, 2PDT, #782-2C-SKT
32	6	235-0053	RELAY MOV, 120VAC PLUG-IN FOR 782-SKT, AD-BSMM-120
33	1	235-0084	RELAY, 4PDT, 120VAC COIL, 784-4C-120A
34	1	235-0085	RELAY SOCKET, 4PDT, #784-4C-SKT-1
35	1	235-0086	RELAY MOV, 120VAC PLUG-IN FOR 784-SKT, AD-ASMM-120
36	1	236-1013	POWER SUPPLY, 24VDC, 60W, DIN MNT, #DRA60-24
37	1	282-6035	BURNER BIFLAME CONTROLLER, #BF22P1211
38	1	235-3112	CONTACTOR, SC-E03-110VAC, 12A
39	1	235-0064	STARTER SUPPRESSOR RC, 100-250 VAC/DC, SZ-Z5
40	1	235-3120	AUXILIARY CONTACT #SZ-A20T
41	1	235-3044	OVERLOAD RELAY #TK-E02-96, .64 - .96A
42	1	235-1033	E-STOP, TWST RELEASE, ZB4BS54
43	1	235-5013	N.C. CONTACT BLOCK W/BASE, ZB4BZ102
44	1	235-1037	PUSHBUTTON MOMENTARY, FLUSH (W, BK, G, R, Y, BL CAPS), ZB4BA9
45	1	235-5014	N.O. CONTACT BLOCK W/BASE, ZB4BZ101
46	1	235-2022	TRANSFORMER, WALLMOUNT, 1KVA, 240/380/480, 1PH, 50-60HZ, T-2-79260-S
47	1	234-2041	CONDUIT 1/2" NPT BOX ADAPTER
48	1	234-2131	CONDUIT 1/2" NPT METAL CLAD SEALING O'RING
49	1	234-2072	CONDUIT 1/2" NPT PULLING ELBOW 1/2" X 90 #CL-1
50	1	272-9051	CONDUIT 1/2"NPT THRD CONDUIT COUPLING
51	1	236-8036	TOUCH SCREEN, 8" DISPLAY G308C000
52	2	285-3033	RESISTOR, 200-OHMS, 1/2W, OHMITE #OL2015E, Allied Part# 296-6417

REFERENCE	PART NO. D731606	
TOLERANCES, UNLESS OTHERWISE SPECIFIED ARE TO FOR ANGULAR ± 1/2" FOR DECIMAL XX ± 0.03 FOR DECIMAL XXX ± 0.010 FOR FRACTIONAL ± 1/16"	 <b>A.C. HORN &amp; CO.</b> Excellence & Integrity www.achornco.com	
BE NON-CUMULATIVE - DO NOT APPLY TO HOLE DIA.	SCALE	DATE 7/15/10
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SEE SHEET #1 FOR REVISIONS			
SYM	DATE	BY	DESCRIPTION
REVISIONS			

**BALDOR • RELIANCE**

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**Integral Horsepower  
AC Induction Motors  
ODP, WPI, WPII Enclosure  
TEFC Enclosure  
Explosion Proof**

**Installation & Operating Manual**



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# Section 1

## General Information

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**Overview** This manual contains general procedures that apply to Baldor Motor products. Be sure to read and understand the Safety Notice statements in this manual. For your protection, do not install, operate or attempt to perform maintenance procedures until you understand the Warning and Caution statements. A Warning statement indicates a possible unsafe condition that can cause harm to personnel. A Caution statement indicates a condition that can cause damage to equipment.

**Important:** **This instruction manual is not intended to include a comprehensive listing of all details for all procedures required for installation, operation and maintenance. This manual describes general guidelines that apply to most of the motor products shipped by Baldor. If you have a question about a procedure or are uncertain about any detail, Do Not Proceed. Please contact your Baldor distributor for more information or clarification.**

Before you install, operate or perform maintenance, become familiar with the following:

- NEMA Publication MG-2, Safety Standard for Construction and guide for Selection, Installation and Use of Electric Motors and Generators.
- The National Electrical Code
- Local codes and Practices

### Limited Warranty

1. Most Baldor products are warranted for 18 months from the date of shipment to Baldor's customer from Baldor's district warehouse or, if applicable, from Baldor's factory. Baldor Standard-E® standard efficient motors are warranted for 24 months. Standard-E is limited to three phase, general purpose, 1-200 HP ratings that fall under the Energy Policy Act (EPAAct). Baldor Super-E® premium efficient motors are warranted for 36 months. Baldor IEEEE841 motors are warranted for 60 months. All warranty claims must be submitted to a Baldor Service Center prior to the expiration of the warranty period.
2. Baldor will, at its option repair or replace a motor which fails due to defects in material or workmanship during the warranty period if:
  - a. the purchaser presents the defective motor at or ships it prepaid to, the Baldor plant in Fort Smith, Arkansas or one of the Baldor Authorized Service Centers and
  - b. the purchaser gives written notification concerning the motor and the claimed defect including the date purchased, the task performed by the Baldor motor and the problem encountered.
3. Baldor will not pay the cost of removal of any electric motor from any equipment, the cost of delivery to Fort Smith, Arkansas or a Baldor Authorized Service Center, or the cost of any incidental or consequential damages resulting from the claimed defects. (Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply to you.) Any implied warranty given by laws shall be limited to the duration of the warranty period hereunder. (Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.)
4. Baldor Authorized Service Centers, when convinced to their satisfaction that a Baldor motor developed defects in material or workmanship within the warranty period, are authorized to proceed with the required repairs to fulfill Baldor's warranty when the cost of such repairs to be paid by Baldor does not exceed Baldor's warranty repair allowance. Baldor will not pay overtime premium repair charges without prior written authorization.
5. The cost of warranty repairs made by centers other than Baldor Authorized Service Centers **WILL NOT** be paid unless first authorized in writing by Baldor.
6. Claims by a purchaser that a motor is defective even when a failure results within one hour after being placed into service are not always justified. Therefore, Baldor Authorized Service Centers must determine from the condition of the motor as delivered to the center whether or not the motor is defective. If in the opinion of a Baldor Authorized Service Center, a motor did not fail as a result of defects in material or workmanship, the center is to proceed with repairs only if the purchaser agrees to pay for such repairs. If the decision is in dispute, the purchaser should still pay for the repairs and submit the paid invoice and the Authorized Service Center's signed service report to Baldor for further consideration.
7. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

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**Safety Notice:**

This equipment contains high voltage! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt installation, operation and maintenance of electrical equipment.

Be sure that you are completely familiar with NEMA publication MG-2, safety standards for construction and guide for selection, installation and use of electric motors and generators, the National Electrical Code and local codes and practices. Unsafe installation or use can cause conditions that lead to serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.

- WARNING:** Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.
- WARNING:** Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury. National Electrical Code and Local codes must be carefully followed.
- WARNING:** Avoid extended exposure to machinery with high noise levels. Be sure to wear ear protective devices to reduce harmful effects to your hearing.
- WARNING:** This equipment may be connected to other machinery that has rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt to install operate or maintain this equipment.
- WARNING:** Do not by-pass or disable protective devices or safety guards. Safety features are designed to prevent damage to personnel or equipment. These devices can only provide protection if they remain operative.
- WARNING:** Avoid the use of automatic reset devices if the automatic restarting of equipment can be hazardous to personnel or equipment.
- WARNING:** Be sure the load is properly coupled to the motor shaft before applying power. The shaft key must be fully captive by the load device. Improper coupling can cause harm to personnel or equipment if the load decouples from the shaft during operation.
- WARNING:** Use proper care and procedures that are safe during handling, lifting, installing, operating and maintaining operations. Improper methods may cause muscle strain or other harm.
- WARNING:** Before performing any motor maintenance procedure, be sure that the equipment connected to the motor shaft cannot cause shaft rotation. If the load can cause shaft rotation, disconnect the load from the motor shaft before maintenance is performed. Unexpected mechanical rotation of the motor parts can cause injury or motor damage.
- WARNING:** Disconnect all electrical power from the motor windings and accessory devices before disassembly of the motor. Electrical shock can cause serious or fatal injury.
- WARNING:** Do not use non UL/CSA listed explosion proof motors in the presence of flammable or combustible vapors or dust. These motors are not designed for atmospheric conditions that require explosion proof operation.

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**Safety Notice** Continued

**WARNING:** Motors that are to be used in flammable and/or explosive atmospheres must display the UL label on the nameplate along with CSA listed logo.

Specific service conditions for these motors are defined in NFPA 70 (NEC) Article 500.

**WARNING:** UL Listed motors must only be serviced by UL Approved Authorized Baldor Service Centers if these motors are to be returned to a hazardous and/or explosive atmosphere.

**Caution:** To prevent premature equipment failure or damage, only qualified maintenance personnel should perform maintenance.

**Caution:** Do not over-lubricate motor as this may cause premature bearing failure.

**Caution:** Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load from the motor shaft before moving the motor.

**Caution:** If eye bolts are used for lifting a motor, be sure they are securely tightened. The lifting direction should not exceed a 20° angle from the shank of the eye bolt or lifting lug. Excessive lifting angles can cause damage.

**Caution:** To prevent equipment damage, be sure that the electrical service is not capable of delivering more than the maximum motor rated amps listed on the rating plate.

**Caution:** If a HI POT test (High Potential Insulation test) must be performed, follow the precautions and procedure in NEMA MG1 and MG2 standards to avoid equipment damage.

If you have any questions or are uncertain about any statement or procedure, or if you require additional information please contact your Baldor distributor or an Authorized Baldor Service Center.

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## **Receiving**

Each Baldor Electric Motor is thoroughly tested at the factory and carefully packaged for shipment. When you receive your motor, there are several things you should do immediately.

1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your motor.
2. Verify that the part number of the motor you received is the same as the part number listed on your purchase order.

## **Storage**

If the motor is not put into service immediately, the motor must be stored in a clean, dry and warm location. Several precautionary steps must be performed to avoid motor damage during storage.

1. Use a "Megger" periodically to ensure that the integrity of the winding insulation has been maintained. Record the Megger readings. Immediately investigate any significant drop in insulation resistance.
2. Do not lubricate bearings during storage. Motor bearings are packed with grease at the factory. Excessive grease can damage insulation quality.
3. Rotate motor shaft at least 10 turns every two months during storage (more frequently if possible). This will prevent bearing damage due to storage.
4. If the storage location is damp or humid, the motor windings must be protected from moisture. This can be done by applying power to the motors' space heater (if available) while the motor is in storage.

## **Unpacking**

Each Baldor motor is packaged for ease of handling and to prevent entry of contaminants.

1. To avoid condensation inside the motor, do not unpack until the motor has reached room temperature. (Room temperature is the temperature of the room in which it will be installed). The packing provides insulation from temperature changes during transportation.
2. When the motor has reached room temperature, remove all protective wrapping material from the motor.

## **Handling**

The motor should be lifted using the lifting lugs or eye bolts provided.

1. Use the lugs or eye bolts provided to lift the motor. Never attempt to lift the motor and additional equipment connected to the motor by this method. The lugs or eye bolts provided are designed to lift only the motor. Never lift the motor by the motor shaft or the hood of a WP11 motor.
2. When lifting a WP11 (Weather Proof Type 2) motor, do not lift the motor by inserting lifting lugs into holes on top of the cooling hood. These lugs are to be used for hood removal only. A spreader bar should be used to lift the motor by the cast lifting lugs located on the motor frame.
3. If the motor must be mounted to a plate with the driven equipment such as pump, compressor etc., it may not be possible to lift the motor alone. For this case, the assembly should be lifted by a sling around the mounting base. The entire assembly can be lifted as an assembly for installation. Do not lift using the motor lugs or eye bolts provided.

If the load is unbalanced (as with couplings or additional attachments) additional slings or other means must be used to prevent tipping. In any event, the load must be secure before lifting.

## Section 2 Installation & Operation

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### Overview

Installation should conform to the National Electrical Code as well as local codes and practices. When other devices are coupled to the motor shaft, be sure to install protective devices to prevent future accidents. Some protective devices include, coupling, belt guard, chain guard, shaft covers etc. These protect against accidental contact with moving parts. Machinery that is accessible to personnel should provide further protection in the form of guard rails, screening, warning signs etc.

### Location

It is important that motors be installed in locations that are compatible with motor enclosure and ambient conditions. Improper selection of the motor enclosure and ambient conditions can lead to reduced operating life of the motor.

Proper ventilation for the motor must be provided. Obstructed airflow can lead to reduction of motor life.

1. **Open Drip-Proof/WPI** motors are intended for use indoors where atmosphere is relatively clean, dry, well ventilated and non-corrosive.
2. **Totally Enclosed and WPII** motors may be installed where dirt, moisture or dust are present and in outdoor locations.

Severe Duty, IEEE 841 and Washdown Duty enclosed motors are designed for installations with high corrosion or excessive moisture conditions. These motors should not be placed into an environment where there is the presence of flammable or combustible vapors, dust or any combustible material, unless specifically designed for this type of service.

### Mounting

The motor must be securely installed to a rigid foundation or mounting surface to minimize vibration and maintain alignment between the motor and shaft load. Failure to provide a proper mounting surface may cause vibration, misalignment and bearing damage.

Foundation caps and sole plates are designed to act as spacers for the equipment they support. If these devices are used, be sure that they are evenly supported by the foundation or mounting surface.

After installation is complete and accurate alignment of the motor and load is accomplished, the base should be grouted to the foundation to maintain this alignment.

The standard motor base is designed for horizontal or vertical mounting. Adjustable or sliding rails are designed for horizontal mounting only. Consult your Baldor distributor or authorized Baldor Service Center for further information.

### Alignment

Accurate alignment of the motor with the driven equipment is extremely important.

1. **Direct Coupling**  
For direct drive, use flexible couplings if possible. Consult the drive or equipment manufacturer for more information. Mechanical vibration and roughness during operation may indicate poor alignment. Use dial indicators to check alignment. The space between coupling hubs should be maintained as recommended by the coupling manufacturer.
2. **End-Play Adjustment**  
The axial position of the motor frame with respect to its load is also extremely important. The motor bearings are not designed for excessive external axial thrust loads. Improper adjustment will cause failure.
3. **Pulley Ratio**  
The pulley ratio should not exceed 8:1.
4. **Belt Drive**  
Align sheaves carefully to minimize belt wear and axial bearing loads (see End-Play Adjustment). Belt tension should be sufficient to prevent belt slippage at rated speed and load. However, belt slippage may occur during starting.

**Caution: Do not over tension belts.**

5. Sleeve bearing motors are only suitable for coupled loads.

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## Doweling & Bolting

After proper alignment is verified, dowel pins should be inserted through the motor feet into the foundation. This will maintain the correct motor position should motor removal be required. (Baldor motors are designed for doweling.)

1. Drill dowel holes in diagonally opposite motor feet in the locations provided.
2. Drill corresponding holes in the foundation.
3. Ream all holes.
4. Install proper fitting dowels.
5. Mounting bolts must be carefully tightened to prevent changes in alignment. Use a flat washer and lock washer under each nut or bolt head to hold the motor feet secure. Flanged nuts or bolts may be used as an alternative to washers.

## Power Connection

### **Conduit Box**

Motor and control wiring, overload protection, disconnects, accessories and grounding should conform to the National Electrical Code and local codes and practices.

For ease of making connections, an oversize conduit box is provided. The box can be rotated 360° in 90° increments. Auxiliary conduit boxes are provided on some motors for accessories such as space heaters, RTD's etc.

### **AC Power**

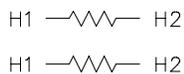
Connect the motor leads as shown on the connection diagram located on the name plate or inside the cover on the conduit box. Be sure the following guidelines are met:

1. AC power is within  $\pm 10\%$  of rated voltage with rated frequency. (See motor name plate for ratings).  
**OR**
2. AC power is within  $\pm 5\%$  of rated frequency with rated voltage.  
**OR**
3. A combined variation in voltage and frequency of  $\pm 10\%$  (sum of absolute values) of rated values, provided the frequency variation does not exceed  $\pm 5\%$  of rated frequency.

Performance within these voltage and frequency variations are shown in Figure 2-2.

### **Figure 2-1 Accessory Connections**

#### HEATERS



One heater is installed in each end of motor.  
Leads for each heater are labeled H1 & H2.  
(Like numbers should be tied together).

#### THERMISTERS



Three thermistors are installed in windings and tied in series.  
Leads are labeled T1 & T2.

#### WINDING RTDS



Winding RTDs are installed in windings (2) per phase.  
Each set of leads is labeled W1, W2, W3, W4, W5, & W6.

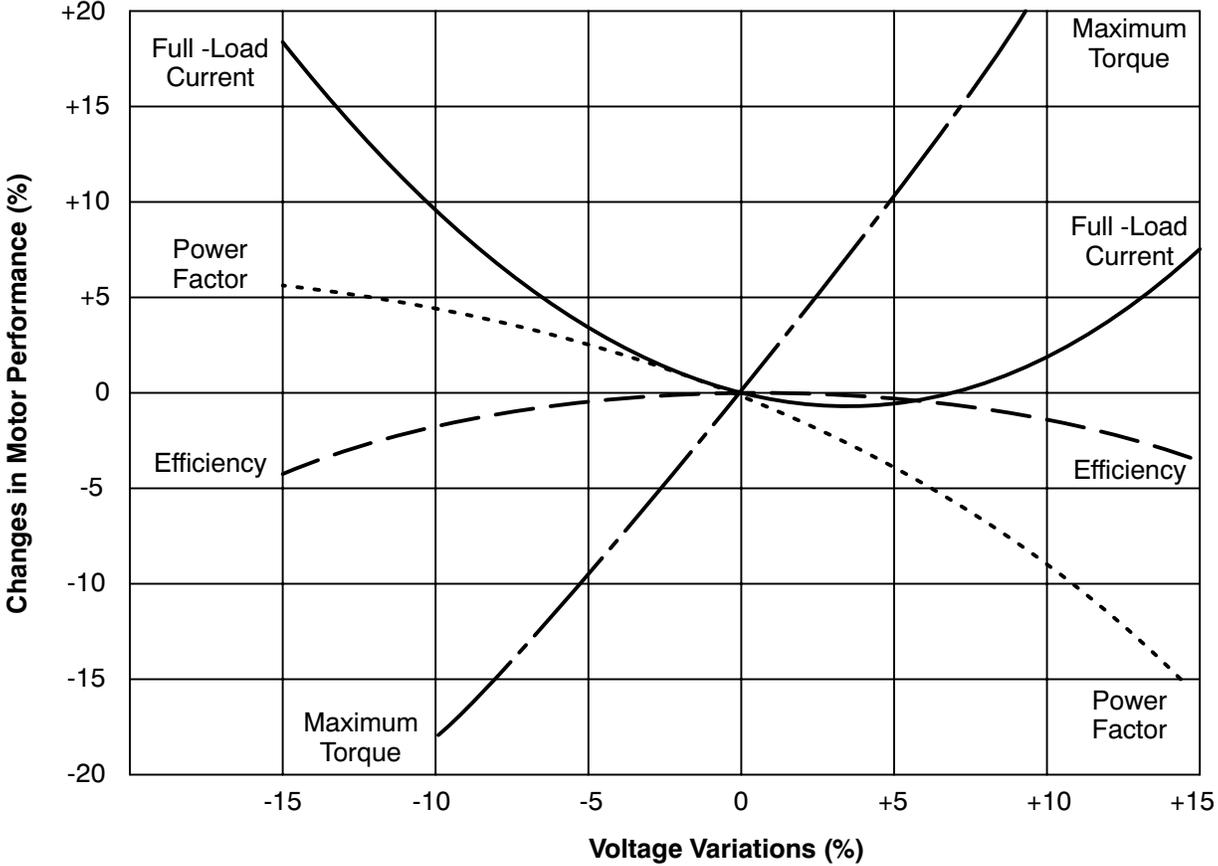
#### BEARING RTD



- \* One bearing RTD is installed in Drive endplate (PUEP), leads are labeled RTDDE.
- \* One bearing RTD is installed in Opposite Drive endplate (FREP), leads are labeled RTDODE.

\* Note RTD may have 2-Red/1-White leads; or 2-White/1-Red Lead.

**Figure 2-2 Typical Motor Performance VS Voltage Variations**



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## **First Time Start Up**

Be sure that all power to motor and accessories is off. Be sure the motor shaft is disconnected from the load and will not cause mechanical rotation of the motor shaft.

1. Make sure that the mechanical installation is secure. All bolts and nuts are tightened etc.
2. If motor has been in storage or idle for some time, check winding insulation integrity with a Megger.
3. Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity.
4. Be sure all shipping materials and braces (if used) are removed from motor shaft.
5. Manually rotate the motor shaft to ensure that it rotates freely.
6. Replace all panels and covers that were removed during installation.
7. Momentarily apply power and check the direction of rotation of the motor shaft.
8. If motor rotation is wrong, be sure power is off and change the motor lead connections. Verify rotation direction before you continue.
9. Start the motor and ensure operation is smooth without excessive vibration or noise. If so, run the motor for 1 hour with no load connected.
10. After 1 hour of operation, disconnect power and connect the load to the motor shaft. Verify all coupling guards and protective devices are installed. Ensure motor is properly ventilated.

## **Coupled Start Up**

This procedure assumes a coupled start up. Also, that the first time start up procedure was successful.

1. Check the coupling and ensure that all guards and protective devices are installed.
2. Check that the coupling is properly aligned and not binding.
3. The first coupled start up should be with no load. Apply power and verify that the load is not transmitting excessive vibration back to the motor through the coupling or the foundation. Vibration should be at an acceptable level.
4. Run for approximately 1 hour with the driven equipment in an unloaded condition.

The equipment can now be loaded and operated within specified limits. Do not exceed the name plate ratings for amperes for steady continuous loads.

**Jogging and Repeated Starts** Repeated starts and/or jogs of induction motors generally reduce the life of the motor winding insulation. A much greater amount of heat is produced by each acceleration or jog than by the same motor under full load. If it is necessary to repeatedly start or jog the motor, it is advisable to check the application with your local Baldor distributor or Baldor Service Center.

Heating - Duty rating and maximum ambient temperature are stated on the motor name plate. Do not exceed these values. If there is any question regarding safe operation, contact your local Baldor distributor or Baldor Service Center.

## Section 3 Maintenance & Troubleshooting

**WARNING:** UL Listed motors must only be serviced by UL Approved Authorized Baldor Service Centers if these motors are to be returned to a hazardous and/or explosive atmosphere.

### General Inspection

Inspect the motor at regular intervals, approximately every 500 hours of operation or every 3 months, whichever occurs first. Keep the motor clean and the ventilation openings clear. The following steps should be performed at each inspection:

**WARNING:** Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.

1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Use a "Megger" periodically to ensure that the integrity of the winding insulation has been maintained. Record the Megger readings. Immediately investigate any significant drop in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.

### Relubrication & Bearings

Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a grease (over time) depends primarily on the type of grease, the size of the bearing, the speed at which the bearing operates and the severity of the operating conditions. Good results can be obtained if the following recommendations are used in your maintenance program.

#### **Type of Grease**

A high grade ball or roller bearing grease should be used. Recommended grease for standard service conditions is Polyrex EM (Exxon Mobil).

Equivalent and compatible greases include:

Texaco Polystar, Rykon Premium #2, Pennzoil Pen 2 Lube and Chevron SRI.

#### **Relubrication Intervals**

Recommended relubrication intervals are shown in Table 3-1. It is important to realize that the recommended intervals of Table 3-1 are based on average use.

Refer to additional information contained in Tables 3-2, 3-3 and 3-4.

**Table 3-1 Relubrication Intervals \***

NEMA / (IEC) Frame Size	Rated Speed - RPM					
	10000	6000	3600	1800	1200	900
Up to 210 incl. (132)	**	2700 Hrs.	5500 Hrs.	12000 Hrs.	18000 Hrs.	22000 Hrs.
Over 210 to 280 incl. (180)		**	3600 Hrs.	9500 Hrs.	15000 Hrs.	18000 Hrs.
Over 280 to 360 incl. (225)		**	* 2200 Hrs.	7400 Hrs.	12000 Hrs.	15000 Hrs.
Over 360 to 5800 incl. (300)		**	*2200 Hrs.	3500 Hrs.	7400 Hrs.	10500 Hrs.

\* Relubrication intervals are for ball bearings.

For vertically mounted motors and roller bearings, divide the relubrication interval by 2.

\*\* For motors operating at speeds greater than 3600 RPM, contact Baldor for relubrication recommendations.

**Table 3-2 Service Conditions**

Severity of Service	Hours per day of Operation	Ambient Temperature Maximum	Atmospheric Contamination
Standard	8	40° C	Clean, Little Corrosion
Severe	16 Plus	50° C	Moderate dirt, Corrosion
Extreme	16 Plus	>50° C* or Class H Insulation	Severe dirt, Abrasive dust, Corrosion, Heavy Shock or Vibration
Low Temperature		<-29° C **	

\* Special high temperature grease is recommended (Dow Corning DC44). Note that Dow Corning DC44 grease does not mix with other grease types. Thoroughly clean bearing & cavity before adding grease.

\*\* Special low temperature grease is recommended (Aeroshell 7).

**Table 3-3 Relubrication Interval Multiplier**

Severity of Service	Multiplier
Standard	1.0
Severe	0.5
Extreme	0.1
Low Temperature	1.0

Some motor designs use different bearings on each motor end. This is normally indicated on the motor nameplate. In this case, the larger bearing is installed on the motor Drive endplate. For best relubrication results, only use the appropriate amount of grease for each bearing size (not the same for both).

**Table 3-4 Bearings Sizes and Types**

Frame Size NEMA (IEC)	Bearing Description (These are the "Large" bearings (Shaft End) in each frame size)			
	Bearing	Weight of Grease to add * oz (Grams)	Volume of grease to be added	
			in <sup>3</sup>	teaspoon
56 to 140 (90)	6203	0.08 (2.4)	0.15	0.5
140 (90)	6205	0.15 (3.9)	0.2	0.8
180 (100-112)	6206	0.19 (5.0)	0.3	1.0
210 (132)	6307	0.30 (8.4)	0.6	2.0
250 (160)	6309	0.47 (12.5)	0.7	2.5
280 (180)	6311	0.61 (17)	1.2	3.9
320 (200)	6312	0.76 (20.1)	1.2	4.0
360 (225)	6313	0.81 (23)	1.5	5.2
400 (250)	6316	1.25 (33)	2.0	6.6
440 (280)	6319	2.12 (60)	4.1	13.4
5000 to 5800 (315-450)	6328	4.70 (130)	9.2	30.0
5000 to 5800 (315-450)	NU328	4.70 (130)	9.2	30.0
360 to 449 (225-280)	NU319	2.12 (60)	4.1	13.4
<b>AC Induction Servo</b>				
76 Frame 180 (112)	6207	0.22 (6.1)	0.44	1.4
77 Frame 210 (132)	6210	0.32 (9.0)	0.64	2.1
80 Frame 250(160)	6213	0.49 (14.0)	0.99	3.3

\* Weight in grams = .005 DB of grease to be added

Note: Not all bearing sizes are listed. For intermediate bearing sizes, use the grease volume for the next larger size bearing.

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**Caution:** To avoid damage to motor bearings, grease must be kept free of dirt. For an extremely dirty environment, contact your Baldor distributor or an authorized Baldor Service Center for additional information.

**Relubrication Procedure** Be sure that the grease you are adding to the motor is compatible with the grease already in the motor. Consult your Baldor distributor or an authorized service center if a grease other than the recommended type is to be used.

**Caution:** Do not over-lubricate motor as this may cause premature bearing failure.

**With Grease Outlet Plug**

1. With the motor stopped, clean all grease fittings with a clean cloth.
2. Remove grease outlet plug.

**Caution:** Over-lubricating can cause excessive bearing temperatures, premature lubrication breakdown and bearing failure.

3. Add the recommended amount of grease.
4. Operate the motor for 15 minutes with grease plug removed. This allows excess grease to purge.
5. Re-install grease outlet plug.

**Without Grease Provisions**

**Note:** Only a Baldor authorized and UL or CSA certified service center can disassemble a UL/CSA listed explosion proof motor to maintain it's UL/CSA listing.

1. Disassemble the motor.
2. Add recommended amount of grease to bearing and bearing cavity. (Bearing should be about 1/3 full of grease and outboard bearing cavity should be about 1/2 full of grease.)
3. Assemble the motor.

**Sample Relubrication Determination**

Assume - NEMA 286T (IEC 180), 1750 RPM motor driving an exhaust fan in an ambient temperature of 43° C and the atmosphere is moderately corrosive.

1. Table 3-1 list 9500 hours for standard conditions.
2. Table 3-2 classifies severity of service as "Severe".
3. Table 3-4 shows that 1.2 in<sup>3</sup> or 3.9 teaspoon of grease is to be added.

Note: Smaller bearings in size category may require reduced amounts of grease.

**Table 3-5 Troubleshooting Chart**

<b>Symptom</b>	<b>Possible Causes</b>	<b>Possible Solutions</b>
Motor will not start	Usually caused by line trouble, such as, single phasing at the starter.	Check source of power. Check overloads, fuses, controls, etc.
Excessive humming	High Voltage.	Check input line connections.
	Eccentric air gap.	Have motor serviced at local Baldor service center.
Motor Over Heating	Overload. Compare actual amps (measured) with nameplate rating.	Locate and remove source of excessive friction in motor or load. Reduce load or replace with motor of greater capacity.
	Single Phasing.	Check current at all phases (should be approximately equal) to isolate and correct the problem.
	Improper ventilation.	Check external cooling fan to be sure air is moving properly across cooling fins. Excessive dirt build-up on motor. Clean motor.
	Unbalanced voltage.	Check voltage at all phases (should be approximately equal) to isolate and correct the problem.
	Rotor rubbing on stator.	Check air gap clearance and bearings.
		Tighten "Thru Bolts".
	Over voltage or under voltage.	Check input voltage at each phase to motor.
	Open stator winding.	Check stator resistance at all three phases for balance.
	Grounded winding.	Perform dielectric test and repair as required.
	Improper connections.	Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity. Refer to motor lead connection diagram.
Bearing Over Heating	Misalignment.	Check and align motor and driven equipment.
	Excessive belt tension.	Reduce belt tension to proper point for load.
	Excessive end thrust.	Reduce the end thrust from driven machine.
	Excessive grease in bearing.	Remove grease until cavity is approximately $\frac{3}{4}$ filled.
	Insufficient grease in bearing.	Add grease until cavity is approximately $\frac{3}{4}$ filled.
	Dirt in bearing.	Clean bearing cavity and bearing. Repack with correct grease until cavity is approximately $\frac{3}{4}$ filled.
Vibration	Misalignment.	Check and align motor and driven equipment.
	Rubbing between rotating parts and stationary parts.	Isolate and eliminate cause of rubbing.
	Rotor out of balance.	Have rotor balance checked and repaired at your Baldor Service Center.
	Resonance.	Tune system or contact your Baldor Service Center for assistance.
Noise	Foreign material in air gap or ventilation openings.	Remove rotor and foreign material. Reinstall rotor. Check insulation integrity. Clean ventilation openings.
Growling or whining	Bad bearing.	Replace bearing. Clean all grease from cavity and new bearing. Repack with correct grease until cavity is approximately $\frac{3}{4}$ filled.

## Suggested bearing and winding RTD setting guidelines

Most large frame AC Baldor motors with a 1.15 service factor are designed to operate below a Class B (80°C) temperature rise at rated load and are built with a Class H winding insulation system. Based on this low temperature rise, RTD (Resistance Temperature Detectors) settings for Class B rise should be used as a starting point. Some motors with 1.0 service factor have Class F temperature rise.

The following tables show the suggested alarm and trip settings for RTDs. Proper bearing and winding RTD alarm and trip settings should be selected based on these tables unless otherwise specified for specific applications.

If the driven load is found to operate well below the initial temperature settings under normal conditions, the alarm and trip settings may be reduced so that an abnormal machine load will be identified.

The temperature limits are based on the installation of the winding RTDs imbedded in the winding as specified by NEMA. Bearing RTDs should be installed so they are in contact with the outer race on ball or roller bearings or in direct contact with the sleeve bearing shell.

**Winding RTDs - Temperature Limit In °C (40°C Maximum Ambient)**

Motor Load	Class B Temp Rise ≤ 80°C (Typical Design)		Class F Temp Rise ≤ 105°C		Class H Temp Rise ≤ 125°C	
	Alarm	Trip	Alarm	Trip	Alarm	Trip
≤ Rated Load	130	140	155	165	175	185
Rated Load to 1.15 S.F.	140	150	160	165	180	185

Note: • Winding RTDs are factory production installed, not from Mod-Express.

• When Class H temperatures are used, consider bearing temperatures and relubrication requirements.

**Bearing RTDs - Temperature Limit In °C (40°C Maximum Ambient)**

Bearing Type Oil or Grease	Anti-Friction		Sleeve	
	Alarm	Trip	Alarm	Trip
Standard*	95	100	85	95
High Temperature**	110	115	105	110

Note: \* Bearing temperature limits are for standard design motors operating at Class B temperature rise.

\*\* High temperature lubricants include some special synthetic oils and greases.

Greases that may be substituted that are compatible with Polyrex EM (but considered as "standard" lubricants) include the following:

- Texaco Polystar
- Mobilith SHC-100
- Darmex 707
- Rykon Premium #2
- Pennzoil Pennzlube EM-2
- Darmex 711
- Chevron SRI #2
- Chevron Black Pearl
- Petro-Canada Peerless LLG

See the motor nameplate for replacement grease or oil recommendation.

Contact Baldor application engineering for special lubricants or further clarifications.



## Baldor District Offices Baldor District Offices Baldor District Offices

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# INSTRUCTION MANUAL FOR DODGE® SETSCREW, ECCENTRIC COLLAR, D-LOK, H, H-E SERIES & EZ-KLEEN MOUNTED BALL BEARINGS

## INSTALLATION

### WARNING

To ensure that drive is not unexpectedly started, turn off and lock out or tag power source before proceeding. Failure to observe these precautions could result in bodily injury.

**Under certain operating conditions it is possible for a static electric charge to build-up on E-Z KLEEN® Polymer Housings. Do not operate these bearings in any environment where a sudden static discharge may cause either an operating hazard or personnel discomfort.**

1. Clean shaft and bearing bore thoroughly. Measure and confirm shaft size and tolerance. File flats on shaft at setscrew locations to permit easy removal of bearing.
2. Slip bearing into position. Be sure that bearing is not on a worn section of the shaft. For tighter fits, tap inner ring face only with soft driver. **DO NOT HAMMER ON HOUSING.**
3. The bearing outer ring OD is spherical and swivels in the housing to accommodate misalignment. Snug hold-down bolts and use shaft to swivel each bearing until its final position is in the center of free movement top to bottom as well as side to side. Pass shaft through both bearings without forcing. This will prevent preloading of the bearings. Housing slippage depends on the mounting hold-down bolt tightening torque, number of bolts and friction characteristics between mounting surfaces. Auxiliary load carrying devices such as shear bars are advisable for side or end loading of pillow blocks and radial loads for flange units where normal to heavy loading or shock loading is encountered.

**NOTE:** On coated and non-metallic housings, hold-down bolts should be tightened carefully with flat washers to prevent damage to the coating. Coated housings have reduced friction characteristics, so auxiliary load carrying devices are even more important in those applications.

4. Tighten hold-down bolts to proper torque (Table 1). Turn shaft by hand. Resistance to turning should be the same as before full tightening of hold-down bolts.
5. For setscrew mounted bearings: **After final alignment of the shaft, tighten both setscrews hand tight**, then the setscrews should be tightened alternately and in small increments to the torque specified in Table 1. After 24 hours operation, the setscrews should be retightened to the torque in Table 1 to assure full locking of the inner race to the shaft. Care should be taken that the socket key or driver is in good condition with no rounded corners and the key is fully engaged in the setscrew and held square with the setscrew to prevent rounding out of the setscrew socket when applying maximum torque. Do not drill through the setscrew holes for spot drilling of the shaft. (Some inner rings have tempered setscrew threads and can be damaged by a drill.) If spot drilling is required, locate bearings on the shaft and center punch through the setscrew hole. Remove bearing and spot drill the shaft, then reassemble over the spot drilled position and assemble as above. Milled or filed flats are preferable to spot drilling.

**NOTE:** On all SC Product the setscrews can be re-torqued many times without damage to the bearing system. To achieve maximum shaft holding power it is highly recommended that setscrews be replaced with new hardware after any disassembly operation.

6. For eccentric collar mounted bearings, slide collar against cam end of inner race. Use a punch in the hole provided in the collar, tap collar smartly in the direction of shaft rotation. Tighten setscrews to proper torque (Table 1). To remove bearings, loosen setscrew and tap collar in the direction opposite of shaft rotation.
7. For D-LOK mounted bearings, be sure collar is square and tight against shoulder on inner ring. Tighten cap screw to recommended torque shown in Table 1.
8. For expansion bearings (H-E Series), locate inner unit in housing to allow expansion in the desired direction before locking to the shaft.

**WARNING:** Because of the possible danger to persons(s) or property from accidents which may result from the improper use of products, it is important that correct procedures be followed: Products must be used in accordance with the engineering information specified in the catalog. Proper installation, maintenance and operation procedures must be observed. The instructions in the instruction manuals must be followed. Inspections should be made as necessary to assure safe operation under prevailing conditions. Proper guards and other suitable safety devices or procedures as may be desirable or as may be specified in safety codes should be provided, and are neither provided by Rockwell Automation nor are the responsibility of Rockwell Automation. This unit and its associated equipment must be installed, adjusted and maintained by qualified personnel who are familiar with the construction and operation of all equipment in the system and the potential hazards involved. When risk to persons or property may be involved, a holding device or shear bars must be an integral part of the driven equipment.

SETSCREWS					D-LOK			MOUNTING BOLTS						
Setscrew Size	Key Hex Across Flats	Recommended Torque			Cap Screw Size	Recommended Torque	E-Z Kleen Recommended Torque	Metal Housings		EZ-KLEEN Housed Bearings				
		Standard Ball Bearing Insert		Corrosion Resistant-Stainless Steel				Bolt Size	Recommended Dry Torque (Grade 2)	2-Bolt PB, 2 & 4-Bolt Fig. And Fig. Brackets		Tapped-Base PB		
		Min	Max							Bolt Size	Torque*	Bolt Size	Torque**	
(in.)	(in.)	(in-lbs.)	(in-lbs.)	(in-lbs.)	(in.)	(in-lbs.)	(in-lbs.)	(in.)	(in-lbs.)	(in.)	(in-lbs.)	(in.)	(in-lbs.)	
#10	3/32	28	33	25	#8-32	58	46	3/8-16	240	3/8-16	225	3/8-16	175	
1/4	1/8	66	80	60	#10-32	90	72	7/16-14	384	7/16-14	350	7/16-14	350	
5/16	5/32	126	156	117	1/4-28	180	144	1/2-13	600	1/2-13	500	1/2-13	400	
3/8	3/16	228	275	206	5/16-24	400	320	5/8-11	1200	9/16-12	650			
7/16	7/32	342	428	321	3/8-24	750	600	3/4-10	1950	5/8-11	1000			
								7/8-9	2890					
(mm)	(mm)	(N-m)	(N-m)	(N-m)	(mm)	(N-m)	(N-m)	(mm)	(N-m)	(mm)	(N-m)	(mm)	(N-m)	
M5	2.5	3.2	3.7	2.8	M4	5.85	4.68	M10	29	MB	15			
M6	3	6.2	7.7	5.8	M5	10.75	8.6	M12	50	M10	25			
M8	4	14.2	17.8	13.4	M6	20.5	16.4	M16	124	M12	50			
M10	5	26	31	23	MB	45	36	M20	238	M14	75			
M12	6	46	57	43				M22	322	M16	125			

### LUBRICATION

High Speed Operation — In the higher speed ranges, too much grease will cause over-heating. The amount of grease that the bearing will take for a particular high speed application can only be determined by experience. If excess grease in the bearing causes overheating, it will be necessary to remove grease fitting to permit excess grease to escape. The bearing has been greased at the factory and is ready to run. When establishing a relubrication schedule, note that a small amount of grease at frequent intervals is preferable to a large amount at infrequent intervals.

#### Lubrication Guide

Use a No. 2 Lithium complex base grease or equivalent.\*

Hours Run per Day	Suggested Lubrication Period in Weeks							
	1 to 250 RPM	251 to 500 RPM	501 to 750 RPM	751 to 1000 RPM	1001 to 1500 RPM	1501 to 2000 RPM	2001 to 2500 RPM	2501 to 3000 RPM
8	12	12	10	7	5	4	3	2
16	12	7	5	4	2	2	1	1
24	10	5	3	2	1	1	1	1

\* For H and H-E series bearings, use Exxon Unirex N3 or equivalent suitable to 300° F.

Lubrication recommendations are intended for standard products applied in general operating conditions. For modified products, high temperature applications, and other anomalous applications contact product engineering at 864-284-5700

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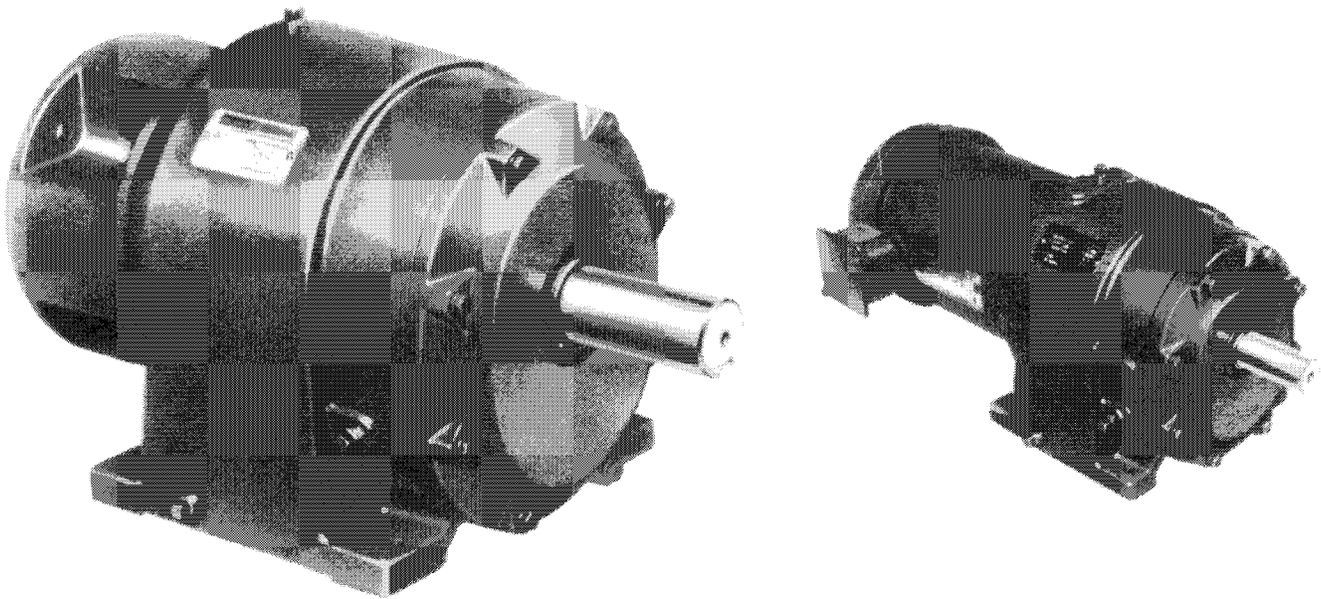
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# MASTER<sup>®</sup> XL PARALLEL GEARMOTORS AND C-FACE REDUCERS

## SERVICE AND REPAIR

FOR SIZES 16, 21, 28



**WARNING:** Because of the possible danger to person(s) or property from accidents which may result from the improper use of products, it is important that correct procedures be followed: Products must be used in accordance with the engineering information specified in the catalog. Proper installation, maintenance and operation procedures must be observed. The instructions in the instruction manuals must be followed. Inspections should be made as necessary to assure safe operation under prevailing conditions. Proper guards and other suitable safety devices or procedures as may be desirable or as may be specified in safety codes should be provided, and are neither provided by Rockwell Automation nor are the responsibility of Rockwell Automation. This unit and its associated equipment must be installed, adjusted and maintained by qualified personnel who are familiar with the construction and operation of all equipment in the system and the potential hazards involved. When risk to persons or property may be involved, a failsafe device must be an integral part of the driven equipment beyond the speed reducer output shaft.

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# MOUNTING, LUBRICATION, AND MAINTENANCE INFORMATION

## GEARCASE MOUNTING

### GENERAL

The MASTER Parallel Gear line is composed of one basic reducer. This reducer is used to make up two types of motor and gear reduction packages.

1. THE GEARMOTOR — is a compact integral power package. Partial motor is directly connected to the reducer input shaft by means of a semi-rigid coupling.

2. THE C-FACE REDUCER — is also a compact power package utilizing a standard “C” Face motor, adapter, and flexible coupling connecting to the reducer.

The MASTER Parallel gearing is Helical design with ball bearings on input shaft and taper roller bearings on intermediate and output shafts.

### ROTATION

To reverse the direction of rotation of a 3-phase A-C Gearmotor, interchange any two of the lines going to the motor. If it is a 2-phase gearmotor, interchange the wires of one phase. Four wire 2-phase gearmotors have lead marking conforming to NEMA standards.

D-C Gearmotors may be reversed by interchanging the armature leads (A1 and A2). In all cases, the connection diagrams furnished with the motors must be consulted to insure that proper polarity of series fields is retained.

### GEARCASE MOUNTING

This gearcase has been lubricated at the factory for only one mounting position. Before starting, check the following mounting position diagrams to make sure that the oil level plug and oil level are in the correct location for which the unit is to be operated. This is extremely important as insufficient lubricant will damage gears and bearings in a very short time. When the unit is to be mounted in a position other than those shown in the diagrams, consult factory.

### OPERATING TEMPERATURES

Heating is a natural characteristic of high speed gears and a maximum gearcase sump temperature approaching 200°F. is not uncommon for units operating in normal ambient temperatures. When operated at rated capacity, no damage will result from this temperature as this was taken into consideration in the design of the gearcase and the selection of the lubricants.

### INSTALLATION

The gear unit must be mounted on a sturdy base of sufficient strength to prevent distortion due to applied loads. To prevent the introduction of additional stresses in the gear unit, the base must be flat and any unevenness must be compensated for by the insertion of shims between the base and the feet of the gearcase. Hex head bolts of proper diameter, together with flat washers, should be used to mount the gear unit to its base.

### MAINTENANCE

Gearmotors and gear reducers are accurately adjusted and tested at the factory. Care must be taken when the gearcase is

disassembled and reassembled. This should be done by an authorized service station as damage to internal parts may result if done improperly.

Whenever a partial motor is assembled to the gearcase of a gearmotor-type unit, the spline on the reducer input shaft must be lubricated with a molydisulfide type lubricant, preferably Mobiltemp No. 78 grease.

Whenever a C-face motor is assembled to a C-face-type reducer, care must be taken to ensure that the flexible coupling hub on the motor shaft is spaced properly from the end of the motor shaft. See diagram on page 8 of this manual.

### SERVICE CLASSES OR SERVICE FACTORS

Load conditions must be in accordance with service class or service factor as listed on the name plate. Parallel gearmotors have service classes, while parallel reducers have service factors. Refer to the Reliance Electric catalog or AGMA published ratings for definition of service conditions.

### LUBRICATION INFORMATION

Lubrication is extremely important for satisfactory operation. Proper oil level must be maintained in the gearcase at all times. The correct level is indicated by the red pipe plug. Frequent inspections with the unit not running, (preferably when warm), should be made by removing this plug to see that the level is being maintained. If low, (without replacing oil level plug), add lubricant through one of the upper holes until it comes out the oil level hole. Replace the oil level plug securely.

The satisfactory performance of gears and bearings in gear motors and reducers depends on clean lubricant, free from dust, grit, sludge, and moisture. Depending on operating conditions, the lubricant will eventually become contaminated and should be drained periodically. When first put into operation, the lubricant in a new gearcase becomes contaminated with grit and metal particles unavoidably left in the unit as a result of machining and from tooth surfaces during run-in periods.

Lubricant should be drained, the gearcase flushed with mineral spirits, and refilled after the first 250 hours of operation; then every 1500 hours or six months thereafter, whichever occurs first. (Normal operation is running 16 hours per day in 80°F. ambient.) More frequent oil changes may be required when running continuously at high temperatures. Use only recommended lubricants as listed in the following table.

All bearings above the the operating oil level that are provided with a pipe plug should be lubricated with a good grade of ball bearing grease when changing gear lubricant. (Replace the pipe plug with a zerk fitting at this time.) Do not overlubricate grease packed bearings.

Master XL parallel gear units are factory filled to the proper oil level for position 1 mounting and an ambient condition of +60°F. to +110°F. and 13.5 to 500 RPM output speed (SAE 40 oil).

## RECOMMENDED LUBRICANTS

It is impossible to select one gear lubricant of petroleum origin which is usable over a wide range of temperatures, such as minus (-) 65°F. to plus (+) 165°F., as is required for some installations. When such conditions are encountered it is necessary to change lubricants depending on the ambient (surrounding air) temperature at the time of operation. Use lubricants of the proper group as outlined in the following table.

### APPROVED LUBRICANTS VS. AMBIENT CONDITIONS:

Ambient Temperature	Lubricant Viscosity Grade vs. Outputshaft Speed			
	13.5 to 500 RPM	501 to 1000 RPM	1001 to 3000 RPM	Over 3000 RPM
-65°F. to -20°F.	Note (C)			
*-30°F. to +10°F.	Note (B)	Note (C)		
*-10°F. to +20°F.	SAE 10W	Note (B)		
*+10°F. to +40°F.	SAE 20W	SAE 10W	SAE 10W	
*+35°F. to +70°F.	SAE 30	SAE 20W	SAE 10W	SAE 10W
*+60°F. to +110°F.	SAE 40	SAE 30	SAE 20W	SAE 10W
*+110°F. to +165°F.	SAE 50 (A)	SAE 40	SAE 30	SAE 20W

\*Mobil SHC 629 is suitable for all speeds in these temperatures.

Note (A) Use automotive heavy duty oil, SAE 50 grade with oxidation inhibitor.

Note (B) Use Gulf Paramount No. 22 which is a naphenic base oil with a low pour point and viscosities of 109.8 SUS at 100°F. or 39.1 SUS at 210°F. Any other oil meeting these specifications would be a suitable substitute.

Note (C) Use Mobil Oil Corp. Avrex 904 oil.

Use only the best grades of automotive engine lubricants unless otherwise specified. When gear units are used out-of-doors, seasonal changes may be necessary.

Do not operate gear unit in ambient temperatures below -65°F. nor above +165°F. For temperatures below +10°F. special oil seals are required.

When changing oil from one viscosity grade to another, flush the gearcase with mineral spirits before installing the new oil.

If a USDA-H1 food grade lubricant is desired, Chevron FM Lubricating Oil 460X may be used in ambient temperatures of +15°F. to +110°F. If Chevron FM Lubricating Oil 460X is installed in the field by draining a gearcase which contains our standard non food grade lubricant, the gearcase must be flushed thoroughly with mineral spirits before installing the new lubricant.

## WARRANTY

This equipment is warranted under Reliance's published "Standard Terms and Conditions of Sale of Electrical Apparatus."

Parts, service, and repairs, in or out of warranty may be arranged through any Reliance Authorized Service Shop, Distributor, or District Sales Office.

Damage in shipment, abuse, misuse, applicable maintenance and repair and periodic adjustments, as required, are not part of this warranty.

## STANDARD TERMS & CONDITIONS OF SALE

Company expressly warrants the equipment manufactured by it as set forth herein. Company makes no other warranties, either express or implied (including without limitation warranties as to merchantability or fitness for a particular purpose).

### WARRANTY

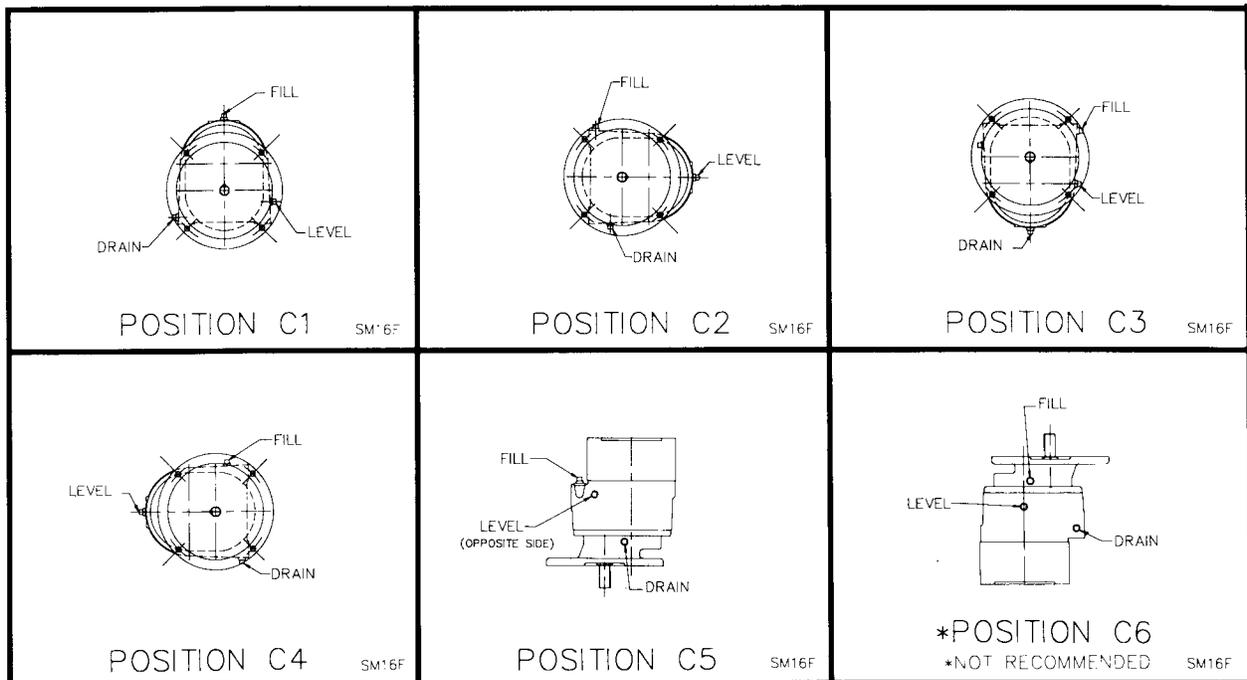
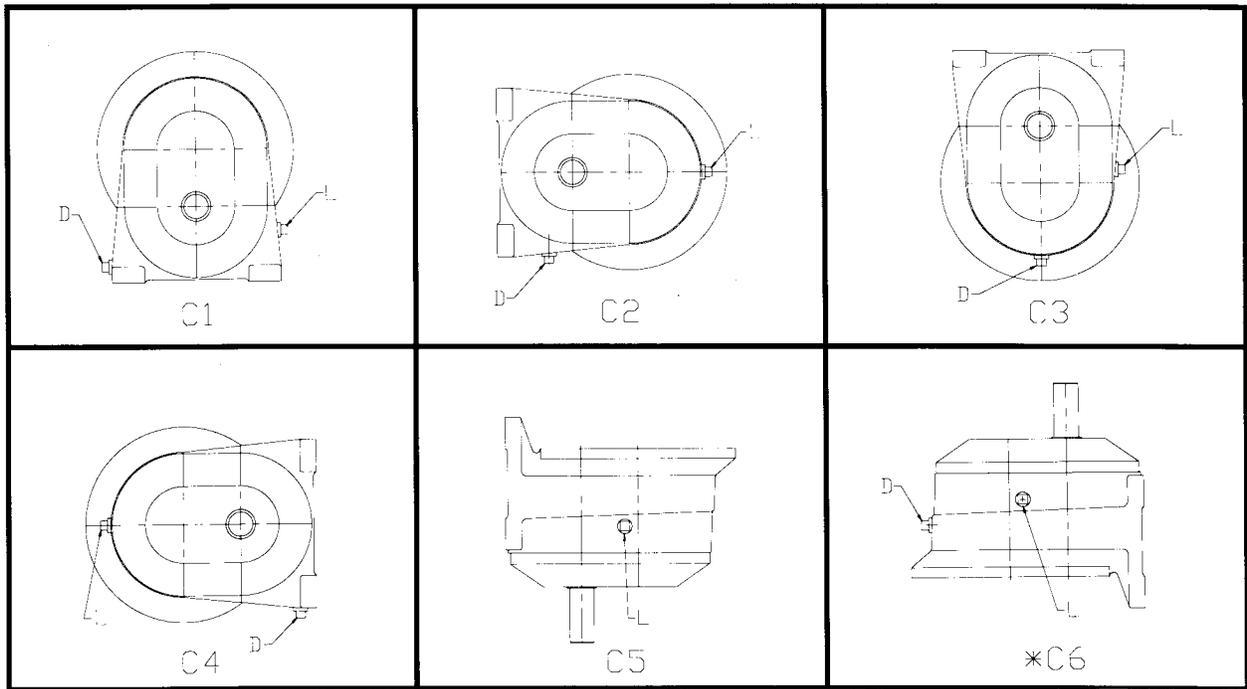
**CAUTION: SERVICE AND REPAIR UNDER WARRANTY SHOULD BE PERFORMED ONLY BY A DODGE AUTHORIZED SERVICE SHOP. CALL WARRANTY ADMINISTRATION AT 812-376-1100 FOR THE NEAREST LOCATION.**

MASTER XL gear units are warranted under the DODGE "Standard Conditions for Sale."

Warranty claims on any such apparatus must be submitted to the company within one year from date of installation or within three years from date of manufacture, whichever comes first. The Seller's warranty applies insofar as the equipment is operated within the rating and service conditions for which it was specifically sold. The warranty does not extend to failures induced by misuse, improper storage or handling, abuse or misapplication.

For warranty service, contact the nearest DODGE Sales Office or Authorized Distributor or call Warranty Administration at 812-376-1100.

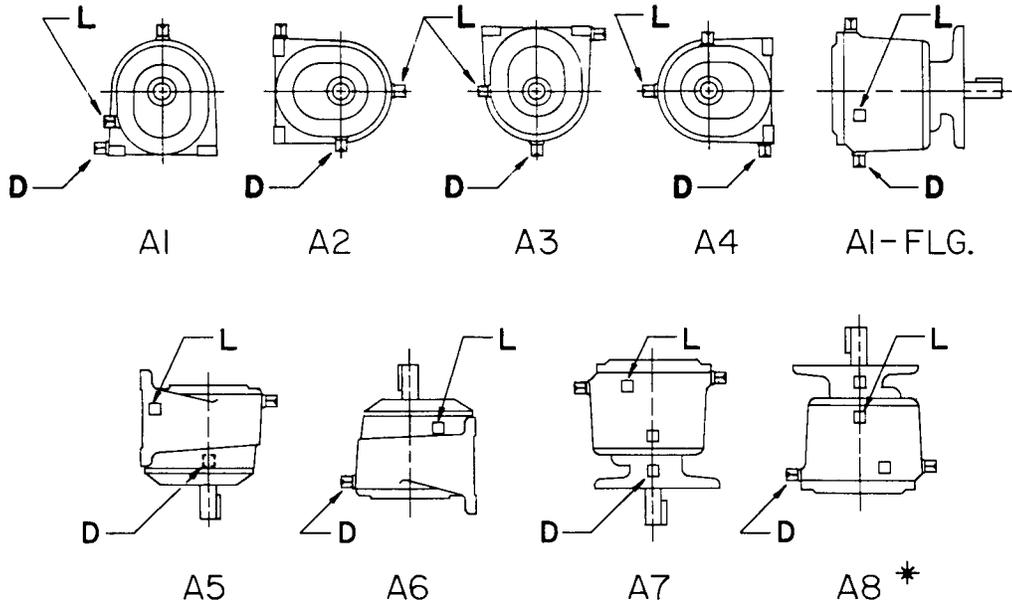
## MOUNTING POSITIONS SINGLE PARALLEL



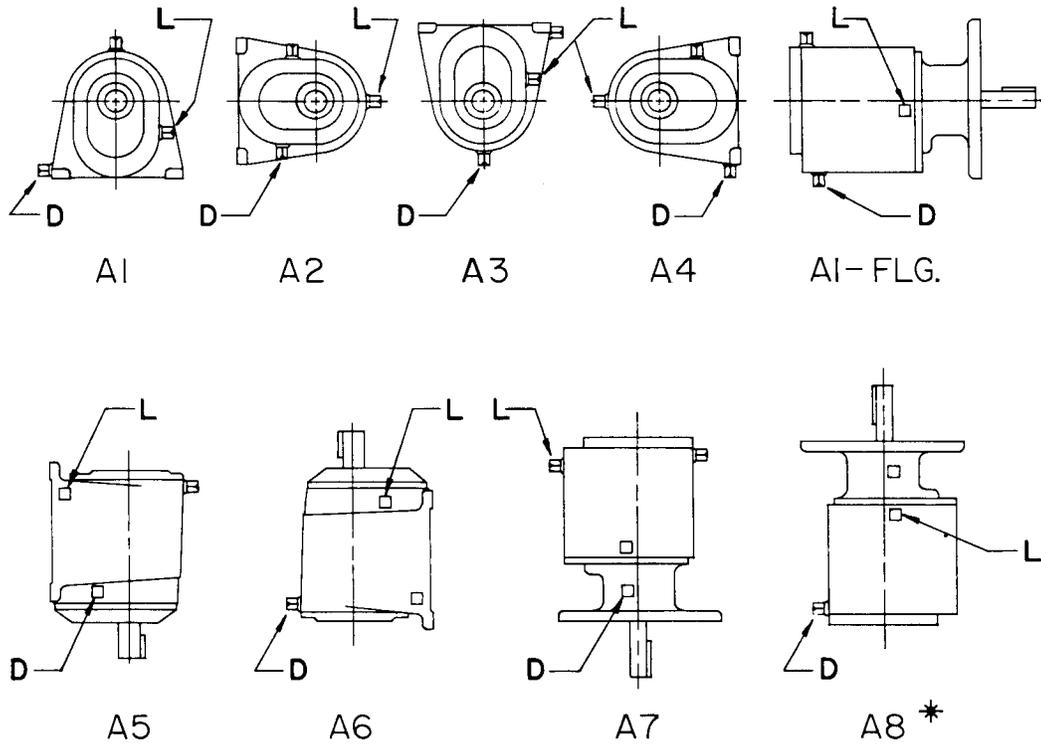
L = Oil Level Plug      D = Drain Plug

\*Mounting position not recommended. Use in this position voids the time-in-use warranty.

**MOUNTING POSITIONS  
DOUBLE PARALLEL**



**TRIPLE PARALLEL**



L = Oil Level Plug      D = Drain Plug

\*Mounting position not recommended. Use in this position voids the time-in-use warranty.

## REMOVAL OF INTEGRAL MOTOR

### WARNING

To ensure that drive is not unexpectedly started, turn off and lock out or tag power source before proceeding. Failure to observe these precautions could result in bodily injury.

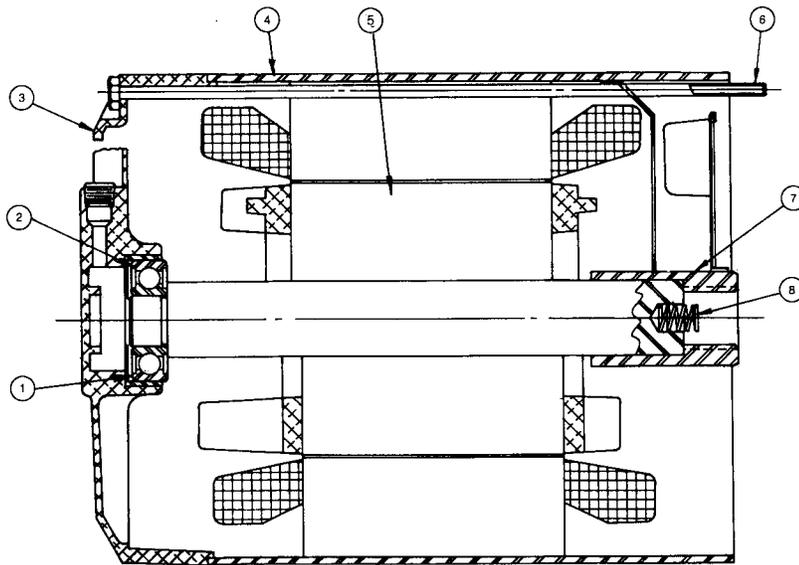
#### For the Gearmotor Configuration:

1. Disconnect all electrical wire and conduit.
2. Remove four motor bolts (6).
3. Tap the side of the end shield (3) to loosen and remove.
4. Remove stator and frame assembly (4).
5. Rotor and shaft assembly (5) will now slide off of the splined input shaft. Be careful not to lose the coupling spring (8) which is in the coupling bore.

6. After other repairs are made to the reducer the motor can be assembled in reverse order.
7. The semi-rigid coupling in gearmotors requires a small amount of Mobiltemp 78 lubricant added to the splines.

#### For the C-Face Configuration:

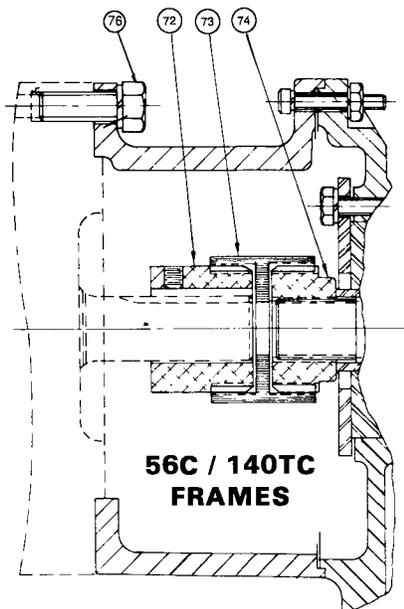
1. Disconnect all electrical wire and conduit.
2. Remove four motor mounting bolts (76).
3. Pull motor from C-face adaptor.
4. Refer to applicable motor instruction manual if further disassembly is required.



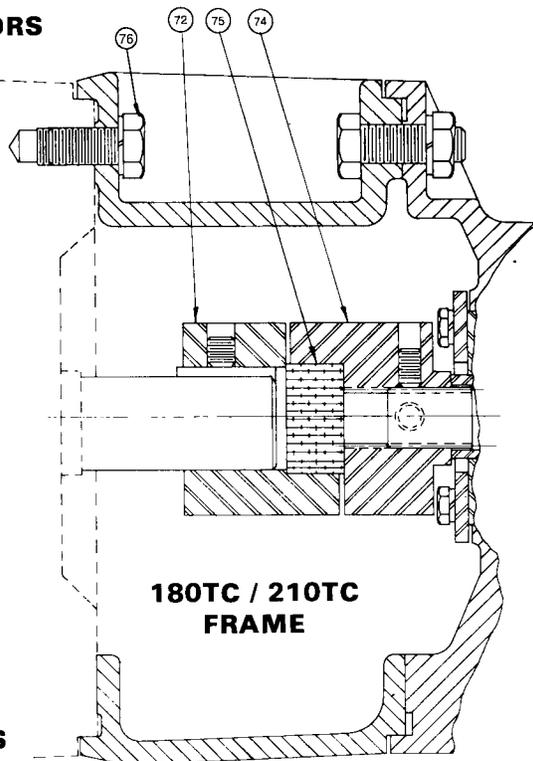
**PARTIAL MOTOR USED ON GEARMOTORS**

#### MOTOR PARTS IDENTIFICATION

1. Thrust Spring
2. Ball Bearing
3. F.E. Shield
4. Stator and Frame
5. Rotor
6. Motor Bolts
7. Motor Shaft and Semi-Rigid Coupling Assembly
8. Spring (Coupling)
72. Half Coupling for Motor Shaft
73. & 75. Coupling Sleeve or Spider
74. Half Coupling for Reducer Input Shaft
76. Motor Mounting Bolts



**56C / 140TC  
FRAMES**



**180TC / 210TC  
FRAME**

**MOTOR ADAPTER USED ON C-FACE REDUCERS**

## INSTALLATION OF MOTOR FOR THE C-FACE CONFIGURATION

### WARNING

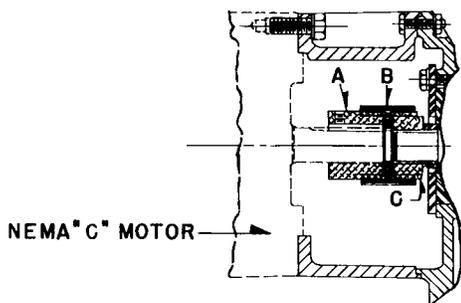
To ensure that drive is not unexpectedly started, turn off and lock out or tag power source before proceeding. Failure to observe these precautions could result in bodily injury.

When the C-face MASTER SPEED REDUCER is received the adapter is bolted to the gearcase. The flexible coupling assembly and bolts for attaching the motor to the adapter are packaged separately. To assemble the C-face motor to the C-face reducer proceed as follows:

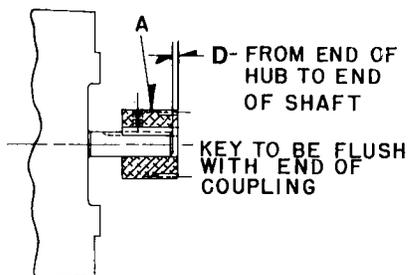
### MOTOR FRAMES 48Y, 56C AND 140TC

Shown in Figure 1 below is the C-FACE ASSEMBLY for mounting Nema C-face motor frames 48Y, 56C, and 140TC.

1. Locate motor coupling hub A on the motor shaft as shown in figure 2 below. Once located, tighten coupling hub set screw.
2. Slip reducer coupling hub C on the reducer input shaft until it shoulders on the reducer seal sleeve as shown in figure 1.
3. Slip coupling sleeve B over reducer coupling hub C until shouldered.
4. Guide motor shaft coupling hub A into the coupling sleeve as shown in figure 1.
5. Rotate motor to line up C-face tapped holes with bolt holes on the adapter; insert bolts, and tighten securely.



**FIGURE 1**

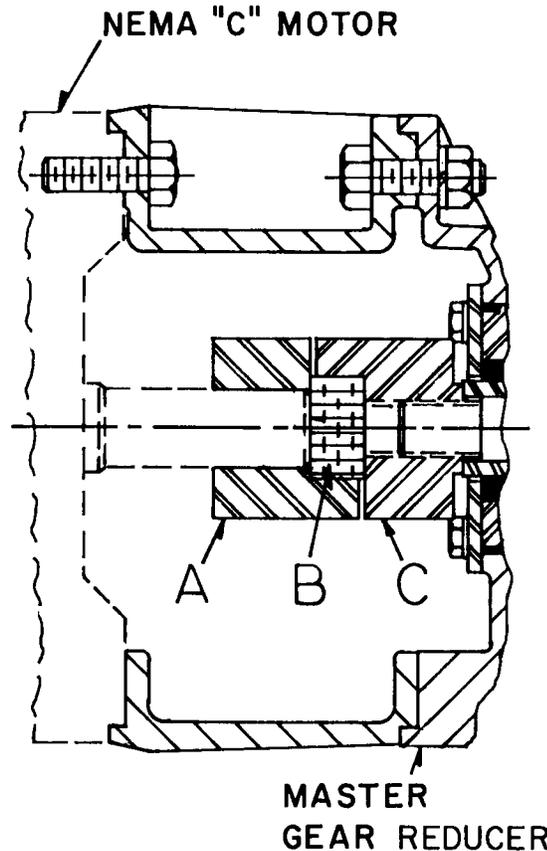


**FIGURE 2**

### MOTOR FRAMES 180TC - 210TC

Shown in the figure below is the C-FACE ASSEMBLY for mounting Nema C-face motor frames 180TC and 210TC.

1. Slip reducer coupling hub C on the reducer input shaft until it shoulders on the reducer seal sleeve. Once located, tighten set screws.
2. Slip motor coupling hub A on motor shaft until the end of the motor shaft is flush with the inner face of the coupling hub. Once located, tighten set screws.
3. Slip coupling spider onto reducing coupling hub C.
4. Guide motor shaft with coupling hub A into spider as shown below.
5. Rotate motor to line up C-face tapped holes with bolt holes on adapter, insert bolts, and tighten securely.



### LUBRICATION AND MAINTENANCE

The C-face MASTER SPEED REDUCER flexible coupling is lubrication free and requires no maintenance.

"C" FACE FRAME	D
56 FR. OR 48 FR. WITH 56 FR. "C" FACE	1/8
140TC	1/8

## INSTRUCTIONS FOR DISASSEMBLY AND REASSEMBLY OF SINGLE PARALLEL GEARMOTORS AND REDUCERS (Refer to Pages 12 & 13)

### WARNING

To ensure that drive is not unexpectedly started, turn off and lock out or tag power source before proceeding. Failure to observe these precautions could result in bodily injury.

1. Remove motor if complete disassembly is to be made.
2. Remove the drain plug and drain the oil from the reducer.
3. Remove the screws holding the bearing housing (8) in place and tap housing with a mallet to separate at the gasket joint. Remove the bearing housing from the gearcase (6) making sure that the gear is not hit or damaged in any way. Remove the output shaft (17) and driven gear-assembly (10) from the gearcase.
4. To remove the input shaft, remove the seal clamp screws and seal clamp (3). Tap the opposite end of the input shaft with a mallet in order to force out the shaft seal (4) and bearing (5a) from the gearcase. On gearmotors where a lockring is used to secure the bearing and seal in the gearcase, Tru-arc pliers can be used to remove this lockring. If bearings and gears are to be replaced, a suitable set of bearing pullers or an arbor press should be utilized to remove them.
5. To remove the driven gear (10) from the output shaft (17), place the assembly in a press with the shaft down resting on the gear. Press the shaft out of the gear (10), spacer collar (13), and bearing (31a). On S-16 reducers, a lockring (43) serves as a shoulder and care should be taken not to try and press against it. Reverse shaft in the press and press other bearing (31b) off of shaft. All parts and castings should now be washed and inspected for replacements.
6. Re-assemble in reverse order. If bearings or gears have been removed from the shafts, they should now be replaced with new ones.
7. Install spacer (44). Press the driven gear (10) on the output shaft (17) install spacer (13) and bearing (31a).
8. Install bearing (31b), grease retainer (34)\* onto the shaft.
9. Install the bearings (5a-5b) on the input shaft (1). Also press on the seal sleeve (2) applying a small amount of sealer under the sleeve.
10. The input shaft (1) should be installed in the gearcase before the output shaft (17).
11. Apply a small amount of lubricant to the input shaft seal (4) O-Ring and seal sleeve (2). This will allow the seal to slide into the gearcase bore more freely. Install the seal clamp (3) and screws and tighten.
12. If the unit is a gearmotor with a lockring, add ball bearing shims as required between the lockring and the seal housing to limit the endplay of the input shaft to the internal clearance of the ball bearing.
13. The taper roller bearing cups (31a-31b) should be placed in the bearing bore of gearcase (6) and bearing housing (8). Shim to .000-.003 endplay. Shimming of the roller bearings is done by means of bearing shims (14) of various thicknesses. These shims are placed under the bearing cup in the bearing housing (8).
14. Place the output shaft with gear in gearcase carefully. Install the bearing housing gasket with sealer, bearing housing and secure with several bolts. When shimmed properly, there should be no side movement in the bearings or final output shaft, and the bearings should not be preloaded.
15. The output shaft seal (15) should be the last part installed in the bearing housing (8). A small amount of sealer should be placed on the outside diameter of the seal. Start the seal into the bore and tap into place, using a tube of the correct diameter so as to be able to tap the seal into place flush with the face of the bearing housing. Fill the gearcase with the proper lubricant to the correct oil level for test.
16. Reinstall motor.

\*Grease Retainer (34) used only in vertical output shaft up mounting position.

## INSTRUCTIONS FOR DISASSEMBLY AND REASSEMBLY OF DOUBLE PARALLEL GEARMOTORS AND REDUCERS (Refer to pages 14 & 15)

### WARNING

To ensure that drive is not unexpectedly started, turn off and lock out or tag power source before proceeding. Failure to observe these precautions could result in bodily injury.

1. Remove motor.
  2. Remove the drain plug and drain the lubricant from the gearcase. We suggest that the disassembly of a gearmotor or a reducer begin at the input shaft of the unit.
  3. The input shaft seal (4) and bearing (5a) were locked in the coverplate (7) by a lockring in earlier designs. The present design input shaft seal and bearing are locked with a clamp (3) and screws.
  4. Remove the bolts holding the coverplate and tap the cover to loosen at the gasket fit. The coverplate (7) and input shaft (1) can be removed as an assembly, being careful not to hit or damage the gear teeth. Remove the clamp (3) and pull or tap the input shaft (1), seal (4), and bearing (5a) from the coverplate.
  5. Remove the screw (11) and washer (12) holding the first stage driven gear (10) on the second stage pinion shaft (19). This gear should come off freely.
  6. Stand gearcase on end with the output shaft vertically up. Remove the bolts holding the bearing housing (8). Tap the side of the housing to loosen at the gasket fit. Lift off the bearing housing.
  7. The final output shaft (17) assembly can now be removed. The second stage pinion shaft (19) can now also be removed.
  8. All parts and castings should now be washed and inspected for possible replacements. If parts are replaced, reshim bearings for proper fit up.
  9. Reassemble in reverse order. It is a good idea to shim the shafts separately, in that installing each shaft and checking for preloading gives the best results. Install the final output shaft assembly (17) in the gearcase. The bearing shims are placed under the bearing cup in the bearing housing (8). Shim to .000-.003 endplay. Install the gasket and bearing housing (8), and secure with several screws. Check this shaft for proper shimming to be sure that there is no side motion and that the shaft turns freely.
  10. Remove bearing housing (8) and the final output shaft assembly (17).
  11. Install the second stage pinion shaft (19). Shims (18) are placed under the bearing cup (9b) in the bearing housing (8). Place the bearing housing on the gearcase with a gasket and several screws. Check the shaft from the inside of the gearcase making sure that the shaft turns freely and that there is no side motion in the bearings (9a-9b). Shim to .000-.003 endplay.
  12. Remove the bearing housing (8) and place the final output shaft (17) back into the gearcase again. Place some sealer on the gasket surface and reinstall the bearing housing using all screws. At this time install the counter shaft oil seal (15) in the bearing housing.
  13. Place the gearcase on its feet again and install the first stage driven gear (10) on the second stage pinion shaft (19). Lock in place with washer (12) and screw (11).
  14. If new ball bearings (5a-5b) have been installed on the input shaft (1), a new seal sleeve (2) should also be installed. Apply some sealer to the shaft at the seal sleeve location.
- NOTE: On D-16 and D-21 size reducers, the pinion is cut on the input shaft. In D-28 reducers, some ratios have a shell pinion (37) on the input shaft. There are spacers (36 & 38) and a lockring (39) on this input shaft.
- \*Grease retainer (34) used only in vertical output shaft up mounting position.
15. The input shaft (1) is placed in the coverplate (7). A bit of lubricant applied to the seal sleeve (2) will make installation easier.
  16. Place the oil seal assembly (4) in the coverplate (7). A bit of lubricant applied to the seal sleeve (2) and the O-Ring of the seal will make installation easier. Install the bearing clamp and screws.
  17. Fill the reducer with the proper lubricant to the correct oil level for test. Reinstall motor.

## INSTRUCTIONS FOR DISASSEMBLY AND REASSEMBLY OF TRIPLE PARALLEL GERMOTORS AND REDUCERS (Refer to Pages 16, 17 & 18)

### WARNING

To ensure that drive is not unexpectedly started, turn off and lock out or tag power source before proceeding. Failure to observe these precautions could result in bodily injury.

1. Remove motor.
  2. Remove the drain plug and drain the lubricant from the gearcase. It is suggested that disassembly begin at the input shaft end of the reducer.
  3. Remove the bolts holding the coverplate and tap cover so as to loosen it at the gasket joint. The coverplate and the input shaft assembly can be removed as a unit. Be careful not to hit or damage the gear teeth. Remove the clamp (3) and tap or pull the pinion shaft (1) bearing (5a) and seal (4) from the coverplate (7).
  4. Remove the screw (11) and washer (12) holding the first stage driven gear (10) on the second stage pinion shaft (19). This gear and spacer (13) should slip off freely.
  5. Remove the screw (24) and washer (25) holding the second stage driven gear (20). This gear will not normally come off of the shaft until output shaft (17) and bearing housing (8) are removed.
  6. Remove the three bolts (21) holding the bearing clamp (22) on the second stage pinion shaft. By moving gear (20) on the third stage pinion shaft, the second stage pinion shaft (19) can now be removed. This shaft assembly should now be pulled out, at the same time one bearing cup and shims will also come out.
  7. Loosen all screws on bearing housing (8) and remove all except one on each side to keep output shaft in place. With bearing housing loose you can now reach into the gearcase from opposite end and slip off second stage driven gear (20) and spacer (26) from third stage pinion shaft (29).
  8. Stand gearcase on end with output shaft vertical. Remove remaining screws and lift off bearing housing. Lift out output shaft assembly (17) also the third stage pinion shaft (29).
  9. All parts and castings should be washed and inspected for possible replacement. It is our suggestion that the shimming of bearings be done to one shaft at a time, this allows for better freedom and less possibility of too much preloading or looseness of bearings.
  10. If new seals and bearings are being installed, it is a good idea to press on the new seal sleeve. Apply some sealer to the shaft at sleeve location.
  11. Install the third stage pinion shaft (29) in the gearcase. Place the shims (28) under the bearing cup (27B) in the bearing housing (8). Install the bearing housing with several bearing housing screws. Check the shaft from the inside of the gearcase for proper shimming of the roller bearings (27A-B). Shim to .000-.003 endplay. The shaft (29) should be free to turn with no side motion in the bearings.
  12. Remove the bearing housing screws, bearing housing and lift out the third stage pinion shaft.
- \*NOTE: Grease retainer (34) used only in vertical output shaft up mounting only.
13. Place the final output shaft (17) into the gearcase. The bearing shims should be placed under the bearing cup (31B) in the bearing housing (8). Shim to .000-.003 endplay. Install the bearing housing and secure with several screws. Check the output shaft to be sure that the shaft turns freely and there is no side motion in the bearings.
  14. Remove the bearing housing (8) again and re-install the third stage pinion shaft (29).  
  
NOTE: It is now necessary to place the second stage driven gear (20) and spacer (26) onto the third stage pinion shaft (29) from the input end of the gearcase. Use screw (24) and washer (25) finger tight in order to keep the gear on splined shaft while completing assembly of output shaft end. Apply silicone rubber adhesive to gasket surface and re-install bearing housing with all screws. You should now be able to turn the third stage pinion shaft freely from inside the gearcase.
  15. From the input end you can now place the second stage pinion shaft (19) into the bearing bores. You will need to loosen the screw (24) which was finger tight and slide gear (20) on spline in order for bearing on pinion shaft (19) to clear gear and go into bearing bore. To secure these shaft bearings (9A-B) the shims (18) are placed under the bearing clamp (22). Shim to .000-.003 endplay. Again shim so there is no side motion in the bearings and shaft turns freely.
  16. Secure the second stage driven gear (20) onto the third stage pinion shaft (29) with screw (24) and washer (25).
  17. The first stage driven gear (10) and spacer (13) can now be placed on the second stage pinion shaft (19). Lock this gear on the shaft with screw (11) and washer (12).
  18. If new bearings (5A-B) have been installed on the input shaft (1), a new seal sleeve (2) should also be installed. Apply some sealer to the shaft at the seal sleeve location and press the sleeve in place. The input shaft assembly should be placed in the coverplate (7).  
  
NOTE: In T-28 reducers, some ratios have a shell pinion (37) on the input shaft. There are additional spacers (36-38) and locking (39) on this input shaft.
  19. Apply silicone rubber adhesive to the gasket area. Take input shaft (1) and coverplate assembly and install on gearcase making sure that pinion meshes with driven gear and outboard bearing (5B) slides into the bearing bore properly. Install coverplate screws and secure them.
  20. The oil seal assembly (4) can now be placed in the coverplate (7). A bit of lubricant should be applied to the seal sleeves and to the O-Ring. This will allow the seal to slide into place much easier. Install the seal clamp (3) and secure with clamp screws.
  21. If the output shaft oil seal has not as yet been installed, it should now be placed in the bearing housing and a tube of proper dimensions used to tap the seal flush with the casting surface.
  22. Fill the reducer with the proper lubricant to the correct oil levels for test. Reinstall motor.

**MASTER X-L GEARMOTORS  
AND  
C-FACE SPEED REDUCERS  
SINGLE PARALLEL  
SIZES SG16, SM16, SG21, SM21, SG28, SM28**

REF. NO.	DESCRIPTION	QTY. EACH	RATIO	PART NUMBER**		
				S16	S21	S28
1	Input Shaft (Pinion)	1		SEE GEAR CHART BELOW		
2	Oil Seal Sleeve	1*	ALL	411621-07A	411621-20A	411621-20C
3	Lock Ring or Clamp	1	ALL	411625-13A	411625-04A	411637-01A
4	Oil Seal Assembly	1*	ALL	411620-21A	411620-11B	411620-13C
5a	Bearing	1*	ALL	79147-02P	79147-02AD	79147-02AL
5b	Bearing	1*	ALL	79147-02B	79147-02F	79147-02P
6	Gearcase	1	ALL	86868-04A	86856-02A	86860-04A
8	Bearing Housing	1	ALL	79070-02A	79039-02A	79045-02A
10	Driven Gear	1		SEE GEAR CHART BELOW		
13	Spacer	1	ALL	411622-08H	411622-07C	411622-11A
14	Shims — As Required	—	ALL	411623-01E	411623-01Y	411623-02A
15	Oil Seal	1*	ALL	411627-01AL	411627-01AM	411627-01A
16	Oil Seal Sleeve	1*	ALL	411621-08B	411621-10A	411621-15B
17	Output Shaft	—	ALL	602088-01N	602050-01A	602066-01R
31a	Bearing	1*	ALL	411626-01B	411626-01A	411626-01R
31b	Bearing	1*	ALL	411626-01D	411626-01W	411626-01AR
34	Grease Retainer— When Required	1	ALL	411624-01B	411624-01E	411624-01R
36	Spacer (For Shell Pinion)	1	ALL	—	—	411622-09B
38	Spacer (For Shell Pinion)	1	ALL	—	—	411622-08C
41	Spacer (S21 & S28 Only)	1	ALL	—	411622-02D	411622-07C
42	Lock Ring (S28 Only)	1	ALL	—	—	056509
43	Lock Ring (S16 Only)	—	—	411637-02C	—	—
44	Spacer	1	ALL	411622-08AG	411622-09A	411622-12C
50	Gasket-Brg. Hsg. (Not Shown)	1*	ALL	602028-14A	602028-05A	602028-09A

\* Recommended Spares

\*\* NOTE: These part numbers apply to standard catalogued units only.

**GEARING CHART**

RATIO	SIZE	PINION-DRIVER REF #1	DRIVEN GEAR REF #10
2.25	S16	602082-16	602083-16
2.25	S21	602044-16	602045-16
2.25	S28	602060-16	602061-16
2.75	S16	602082-13	602083-13
2.75	S21	602044-14	602045-14
2.75	S28	602060-14	602061-14
3.37	S16	602082-10	602083-10
3.37	S21	602044-10	602045-10
3.37	S28	602060-11	602061-11
4.13	S16	602082-07	602083-07
4.13	S21	602044-07	602045-07
4.13	S28	602060-08	602061-08
5.06	S16	602082-04	602083-04
5.06	S21	602044-05	602045-05
5.06	S28	602060-05	602061-05
6.20	S16	602082-02	602083-02
6.20	S21	602044-02	602045-02
6.20	S28	602060-02	602061-02

**REPAIR KITS**

SEAL & GASKET KIT	SIZE
079019-38AS	S16
079019-38AT	S21
079019-38AV	S28

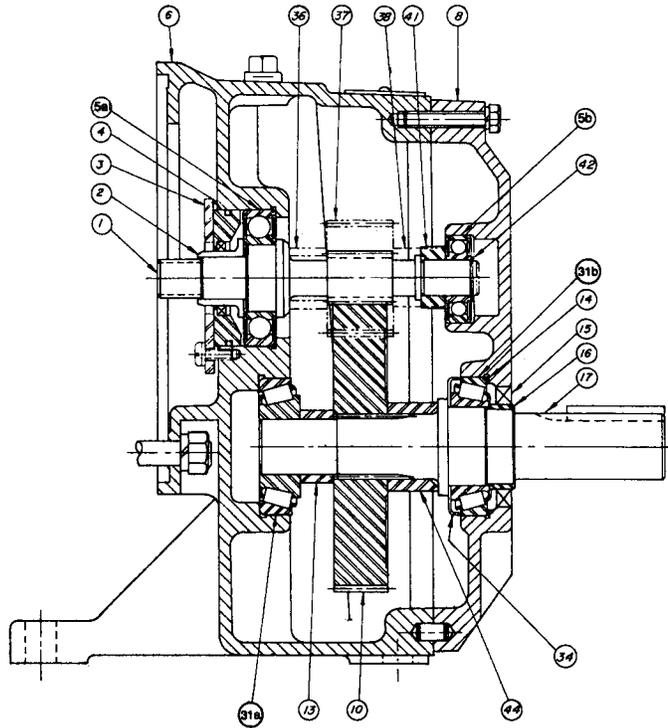
INCLUDES INPUT & OUTPUT SEALS, SLEEVES AND GASKETS.

BEARING KIT	SIZE
411642-45M	S16
411642-45N	S21
411642-45P	S28

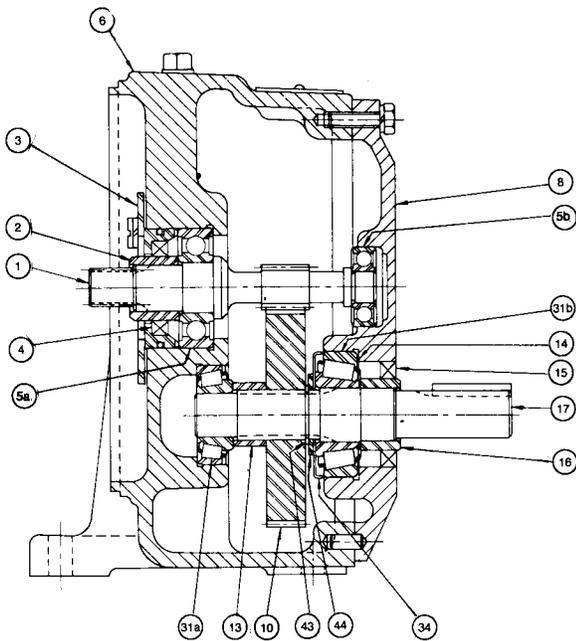
INCLUDES ALL REDUCER BEARINGS.

**SIZES S16-S21-S28**

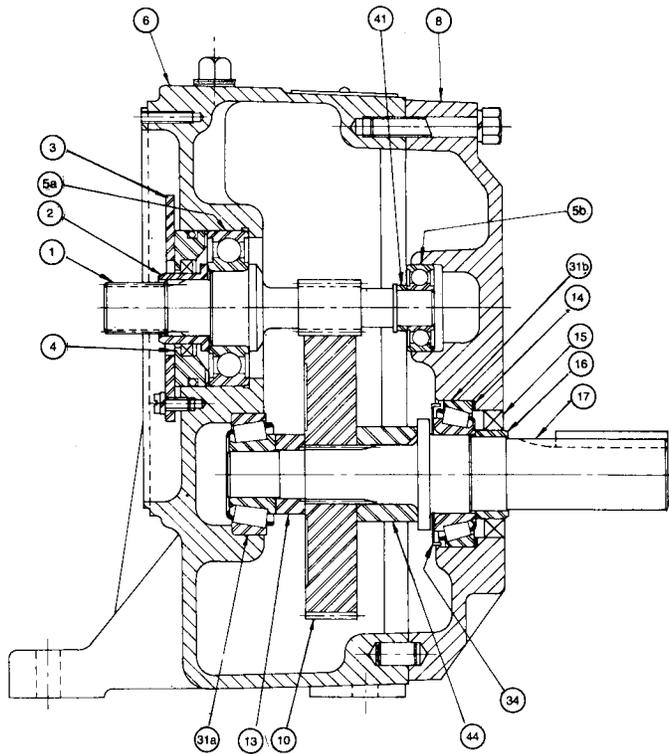
- 1. Input Shaft (driver gear)
- 2. Seal Sleeve
- 3. Lock Ring or Clamp
- 4. Oil Seal
- 5a. Ball Bearing
- 5b. Ball Bearing (input shaft)
- 6. Gearcase
- 8. Bearing Housing
- 10. 1st Stage Driven Gear
- 13. Spacer (gear)
- 14. Shims
- 15. Seal (output)
- 16. Seal Sleeve (output)
- 17. Output Shaft
- 31a. Roller Bearing
- 31b. Roller Bearing (output shaft)
- 34. Grease Retainer (shaft up mounting only)
- 36. Spacer (gear)     Shell Pinion
- 37. Shell Pinion     in some S-28
- 38. Spacer (gear)     Ratios
- 41. Spacer (bearing)
- 42. Lock Ring
- 43. Lock Ring (S-16)
- 44. Spacer (gear)



**S28**



**S16**



**S21**

**MASTER X-L GEARMOTORS  
AND  
C-FACE SPEED REDUCERS  
DOUBLE PARALLEL  
SIZES DG16, DM16, DG21, DM21, DG28, DM28**

REF. NO.	DESCRIPTION	QTY. EACH	RATIO	PART NUMBER**		
				D16	D21	D28
1	Input Shaft — 1st stg. Pinion	1		SEE GEAR CHART BELOW		
2	Oil Seal Sleeve	1*	ALL	411621-07A	411621-20A	411621-20C
3	Clamp	1	ALL	411625-13A	411625-04A	411625-04A
4	Oil Seal Assembly	1*	ALL	411620-21A	411620-11B	411620-13C
5a	Bearing (Input Shaft)	1*	ALL	79147-02P	79147-02AD	79147-02AL
5b	Bearing (Input Shaft)	1*	ALL	79147-02B	79147-02F	79147-02P
6	Gearcase	1	ALL	86870-02A	86858-02A	86862-02A
7	Cover Plate — Input 56/140 Frame	1	ALL	79073-04A	79041-02A	79047-02A
7	Cover Plate — Input 180/210 Frame	1	ALL	—	79041-02B	79047-04D
8	Bearing Housing — Output	1	ALL	79074-02A	79042-02A	79048-02A
9a	Bearing	1	ALL	411626-01B	411626-01BE	411626-01AE
9b	Bearing	1	ALL	411626-01D	411626-01AD	411626-01AW
10	Gear — 1st stg. Driven	1	ALL	SEE GEAR CHART BELOW		
14	Shims — As Required	—	ALL	411623-01Y	411623-02AD	411623-03A
15	Oil Seal	1*	ALL	411627-01AM	411627-01A	411627-01D
16	Oil Seal Sleeve	1*	ALL	411621-10C	411621-13A	411621-18B
17	Output Shaft	1	ALL	602088-02A	602050-02A	602066-02A
18	Shims — As Required	—	ALL	411623-01A	411623-02D	411623-03E
19	Pinion Shaft — 2nd stg. Driver	1		SEE GEAR CHART BELOW		
20	Gear — 2nd stg. Driven	1		SEE GEAR CHART BELOW		
31a	Bearing (Output Shaft)	1	ALL	411626-01W	411626-01X	411626-01AY
31b	Bearing (Output Shaft)	1	ALL	411626-01A	411626-01AA	411626-01AB
33	Key — Gear			050992	057500	050768
34	Grease Retainer— When Required	1	ALL	411624-01E	411624-01F	411624-01X
36	Spacer (For Shell Pinion Only)	1	—	—	—	411622-09B
37	Shell Pinion in Some T-28 Ratios	—	—	—	—	—
38	Spacer (For Shell Pinion)	1	—	—	—	411622-08B
50	Gasket-Brg. Hsg. (Not Shown)	2*	ALL	602028-08C	602028-06A	602028-10A

\* Recommended Spares

\*\* NOTE: These part numbers apply to standard catalogued units only.

**GEARING CHART**

RATIO	SIZE	REF. #1 1ST PINION	REF. #10 1ST GEAR	REF. #19 2ND PINION	REF. #20 2ND GEAR
5.06	D16	602082-19	602083-19	602084-08	602029-08
5.06	D21	602044-20	602045-20	602046-08	602030-08
5.06	D28	602019-19*	602061-19	602062-04	602039-04
6.20	D16	602082-16	602083-16	602084-08	602029-08
6.20	D21	602044-18	602045-18	602046-08	602030-08
6.20	D28	602060-17*	602061-17	602062-04	602039-04
7.60	D16	602082-19	602083-19	602084-03	602029-02
7.60	D21	602044-18	602045-18	602046-05	602030-02
7.60	D28	602060-18*	602061-18	602062-03	602039-02
9.30	D16	602082-16	602083-16	602084-03	602029-02
9.30	D21	602044-16	602045-16	602046-05	602030-02
9.30	D28	602060-16	602061-16	602062-03	602039-02
11.4	D16	602082-13	602083-13	602084-03	602029-02
11.4	D21	602044-14	602045-14	602046-05	602030-02
11.4	D28	602060-14	602061-14	602062-03	602039-02
14.1	D16	602082-10	602083-10	602084-03	602029-02
14.1	D21	602044-10	602045-10	602046-05	602030-02
14.1	D28	602060-11	602061-11	602062-03	602039-02
17.1	D16	602082-06	602083-06	602084-03	602029-02
17.1	D21	602044-07	602045-07	602046-05	602030-02
17.1	D28	602060-07	602061-07	602062-03	602039-02
20.9	D16	602082-06	602083-06	602084-02	602029-03
20.9	D21	602044-07	602045-07	602046-04	602030-04
20.9	D28	602060-07	602061-07	602062-02	602039-03
25.6	D16	602082-04	602083-04	602084-02	602029-03
25.6	D21	602044-05	602045-05	602046-04	602030-04
25.6	D28	602060-04	602061-04	602062-02	602039-03
31.4	D16	602082-02	602083-02	602084-02	602029-03
31.4	D21	602044-02	602045-02	602046-04	602030-04
31.4	D28	602060-02	602061-02	602062-02	602039-03

BEARING KIT	SIZE
41164245R	D16
41164245S	D21
41164245T	D28

INCLUDES ALL REDUCER BEARINGS.

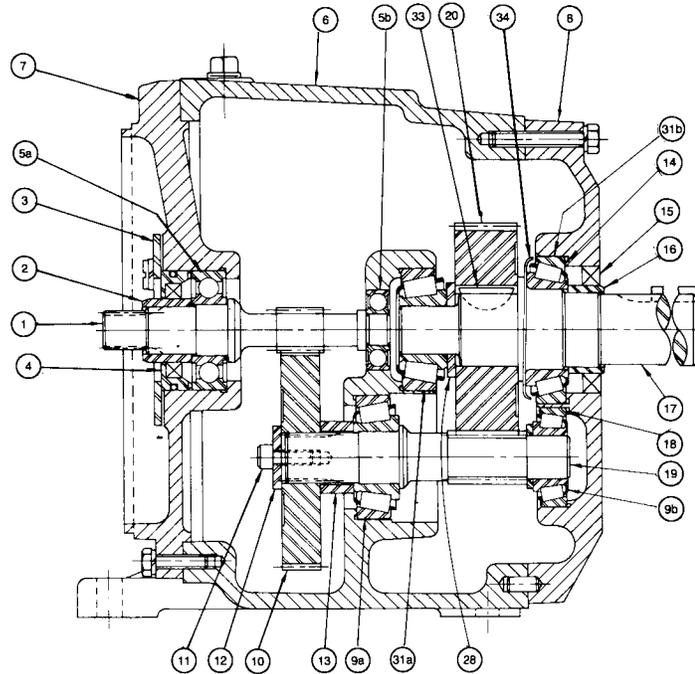
SEAL & GASKET KIT	SIZE
079019-38AW	D16
079019-38AX	D21
079019-38AY	D28

INCLUDES INPUT & OUTPUT SEALS, SLEEVES AND GASKETS.

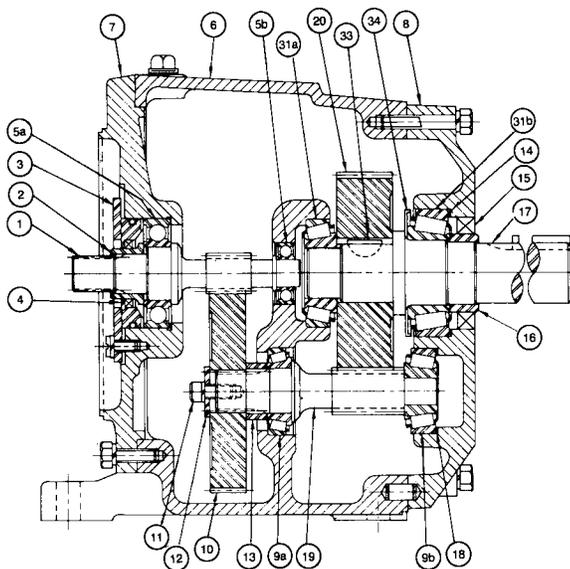
\*SHELL PINION. If input shaft is required also order part number 602060-37A.

**SIZES D16-D21-D28**

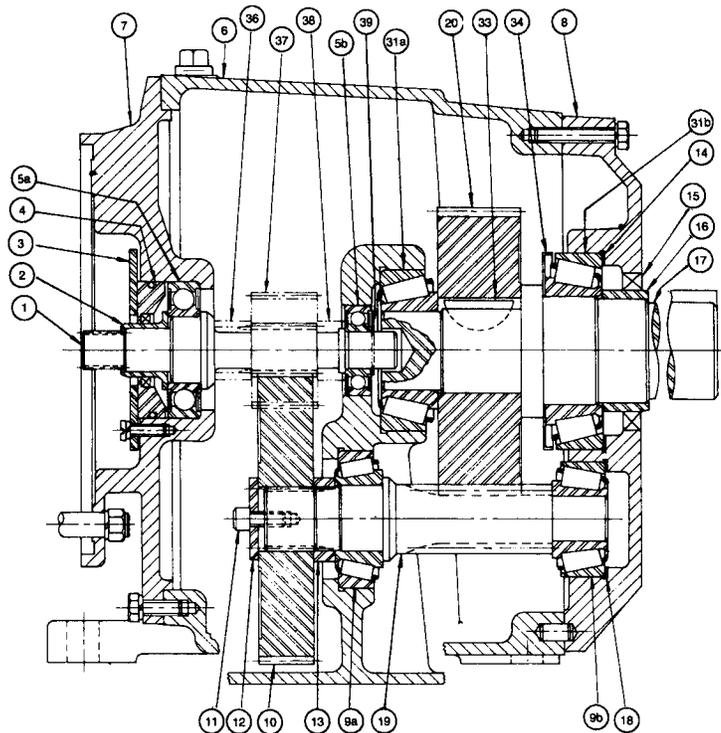
- 1. Input Shaft (driver gear)
- 2. Seal Sleeve
- 3. Clamp
- 4. Seal (input)
- 5a. Ball Bearing (input shaft)
- 5b. Ball Bearing (input shaft)
- 6. Gearcase
- 7. Cover Plate
- 8. Bearing Housing
- 9a. Roller Bearing
- 9b. Roller Bearing
- 10. 1st Stage Driven (gear)
- 11. Screw
- 12. Washer
- 13. Spacer (gear)
- 14. Shims
- 15. Seal (output)
- 16. Seal Sleeve (output)
- 17. Output Shaft
- 18. Shims
- 19. 2nd Stage Driver (gear)
- 20. 2nd Stage Driven (gear)
- 27. Key
- 28. Spacer (gear)
- 31a. Roller Bearing
- 31b. Roller Bearing
- 33. Key
- 34. Grease Retainer (shaft up mounting only)\*
- 36. Spacer } Shell pinion
- 38. Spacer } in some D-28
- 39. Lock Ring } ratios



**D21**



**D16**



**D28**

**MASTER X-L GEARMOTORS  
AND  
C-FACE SPEED REDUCERS  
TRIPLE PARALLEL  
SIZED TG16, TM16, TM21, TG28, TM28**

REF. NO.	DESCRIPTION	QTY. EACH	RATIO	PART NUMBERS**		
				T16	T21	T28
1	Input Shaft — 1st stg. Pinion	1			SEE GEARING — PAGE 17	
2	Oil Seal Sleeve	1*	ALL	411621-07A	411621-20A	411621-20C
3	Clamp	1	ALL	411625-13A	411625-04A	411625-04A
4	Oil Seal Assembly	1*	ALL	411620-21A	411620-11B	411620-13C
5a	Bearing	1*	ALL	79147-02P	79147-02AD	79147-02AL
5b	Bearing	1*	ALL	79147-02B	79147-02F	79147-02P
6	Gearcase	1	ALL	86871-02A	86859-02A	86863-02A
7	Cover Plate—Input 56/140 Frame	1	ALL	79073-04A	79041-02A	79047-02A
7	Cover Plate—Input 180/210 Frame	1	ALL	—	79041-04B	79047-04D
8	Bearing Housing — Output	1	ALL	79076-02A	79044-02A	79049-02A
9a	Bearing	1*	ALL	411626-01D	411626-01BE	411626-01AW
9b	Bearing	1*	ALL	411626-01B	411626-01AD	411626-01AE
10	Gear — 1st stg. Driven	1			SEE GEARING — PAGE 17	
11	Screw	1	ALL	411631-01A	411631-01A	411631-01D
12	Washer	1	ALL	411632-01B	411692-01B	411632-01A
13	Spacer	1	ALL	411622-08H	411622-10B	411622-12D
14	Shims — As Required	—	ALL	411623-02A	411623-03A	411623-03AD
15	Oil Seal	1*	ALL	411627-01A	411627-01D	411627-02D
16	Oil Seal Sleeve	1*	ALL	411621-15D	411621-18A	411621-19A
17	Output Shaft	1	ALL	602088-03A	602050-03A	602066-03A
18	Shims — As Required	—	ALL	411623-05A	411623-02A	411623-04E
19	Pinion Shaft — 2nd stg. Driver	1			SEE GEARING — PAGE 17	
20	Gear — 2nd stg. Driven	1			SEE GEARING — PAGE 17	
21	Screw	2	ALL	4119631-02A	411631-02A	411631-02A
22	Clamp	1	ALL	411625-09A	411625-09A	411625-06B
23	Spacer (T16 Only)	1	ALL	411622-05A	—	—
24	Screw	1	ALL	411631-01A	411631-01A	411631-03B
25	Washer	1	ALL	411632-01B	411632-01A	411632-01C
26	Spacer	1	ALL	411622-08G	411622-13A	411622-17C
27a	Bearing	1*	ALL	411626-01B	411626-01AC	411626-01AY
27b	Bearing	1*	ALL	411626-01B	411626-01AA	411626-01BB
28	Shims — As Required	—	ALL	411623-01E	411623-02Y	411623-03Y
29	Pinion Shaft — 3rd stg. Driver	1			SEE GEARING — PAGE 17	
30	Gear — 3rd stg. Driven	1			SEE GEARING — PAGE 17	
31a	Bearing	1*	ALL	411626-01R	411626-01AB	411626-01AX
31b	Bearing	1*	ALL	411626-01BC	411626-01Y	411626-01Y
32	Spacer (T16 & T28 Only)	1	ALL	411622-10E	—	411622-18A
33	Key, Gear	1	ALL	053180	051283	151985
34	Grease Retainer	1	ALL	411624-01R	411624-01X	411624-02A
35	Spacer (T21 & T28 Only)	1	ALL	—	411622-14A	411622-17B
36	Spacer (For Shell Pinion Only)	1	ALL	—	—	411622-09B
38	Spacer (For Shell Pinion Only)	1	ALL	—	—	411622-08B
39	Lock Ring (T28 Only)	1	ALL	—	—	056509
40	Lock Ring (T28 Only)	1	ALL	—	—	058256
50	Gasket—Not Shown—Input Brg. Hsg.	1*	ALL	602028-08C	602028-08C	602028-08B
50	Gasket—Not Shown—Output C. Plate	1*	ALL	602028-15A	602028-07A	602028-11A

\* Recommended Spares

\*\* NOTE: These part numbers apply to standard catalogued units only.

**REPAIR KITS**

SEAL & GASKET KIT	SIZE
07901938BA	T16
07901938BB	T21
07901938BC	T28

INCLUDES INPUT & OUTPUT  
SEALS, SLEEVES AND GASKETS

BEARING KIT	SIZE
41164245V	T16
41164245W	T21
41164245X	T28

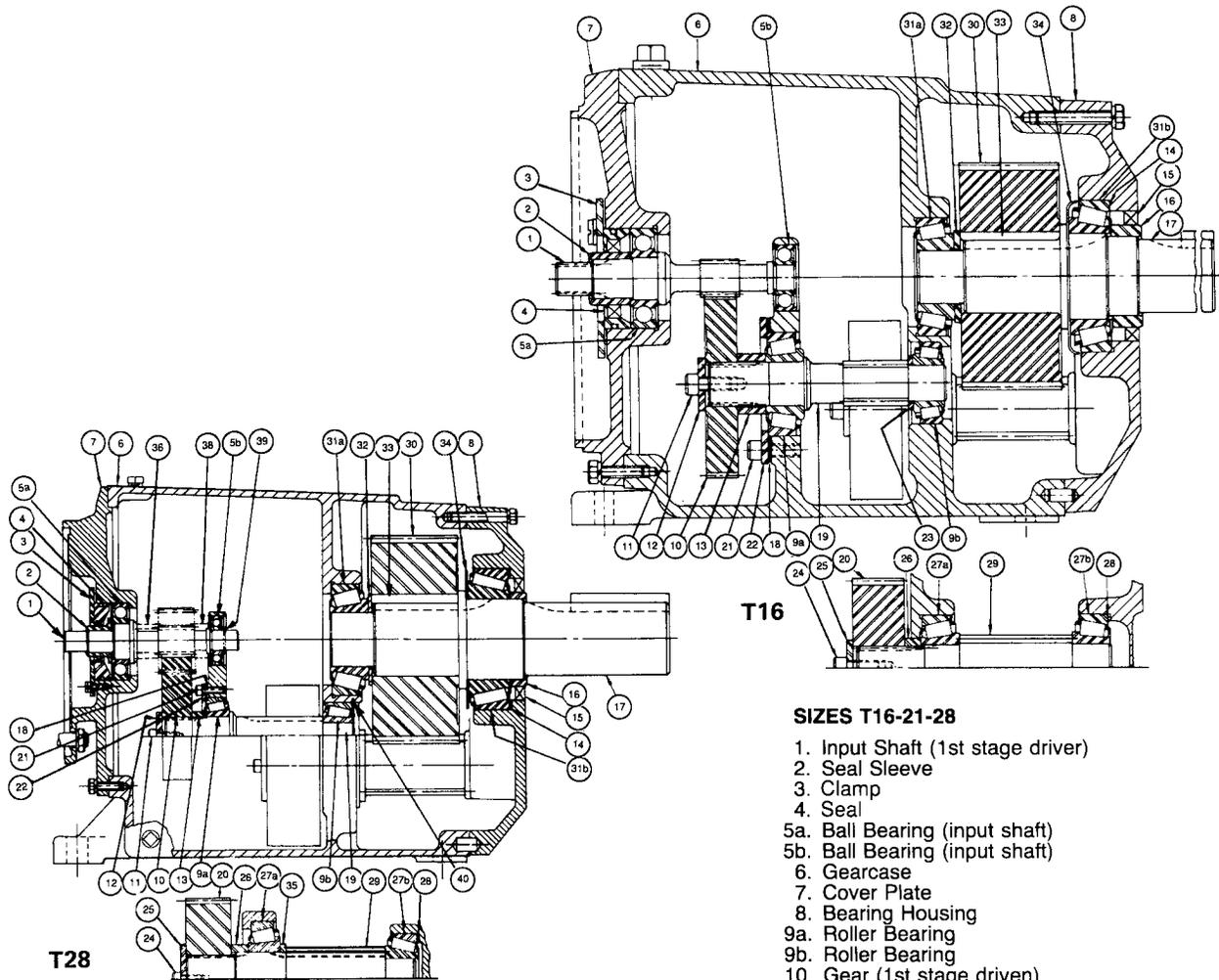
INCLUDES ALL REDUCER  
BEARINGS.

**MASTER X-L GEARMOTORS  
AND  
C-FACE SPEED REDUCERS  
TRIPLE PARALLEL  
SIZES TG16, TM16, TG21, TM21, TG28, TM28**

**GEARING CHART**

<b>RATIO</b>	<b>SIZE</b>	<b>REF. #1 1ST PINION</b>	<b>REF. #10 1ST GEAR</b>	<b>REF. #19 2ND PINION</b>	<b>REF. #20 2ND GEAR</b>	<b>REF. #29 3RD PINION</b>	<b>REF. #30 3RD GEAR</b>
20.9	T16	60208219	60208319	60208408	60208404	60208602	60208702
20.9	T21	60204420	60204520	60204608	60204704	60204802	60204902
20.9	T28	60206019*	60206119	60206204	60206207	60206404	60206502
25.6	T16	60208216	60208316	60208408	60208504	60208602	60208702
25.6	T21	60204418	60204518	60204608	60204704	60204802	60204902
25.6	T28	60206017*	60206117	60206204	60206307	60206404	60206502
31.4	T16	60208213	60208313	60208408	60208504	60208602	60208702
31.4	T21	60204418	60204518	60204605	60204703	60204802	60204902
31.4	T28	60206020	60206120	60206204	60206307	60206404	60206502
38.5	T16	60208215	60208315	60208403	60208503	60208602	60208702
38.5	T21	60204416	60204516	60204605	60204703	60204802	60204902
38.5	T28	60206015	60206115	60206203	60206306	60206404	60206502
47.5	T16	60208213	60208313	60208403	60208503	60208602	60208702
47.5	T21	60204414	60204514	60204605	60204703	60204802	60204902
47.5	T28	60206015	60206115	60206202	60206305	60206404	60206502
57.7	T16	60208209	60208309	60208403	60208503	60208602	60208702
57.7	T21	60204410	60204510	60204605	60204703	60204802	60204902
57.7	T28	60206011	60206111	60206203	60206306	60206404	60206502
70.6	T16	60208207	60208307	60208403	60208503	60208603	60208702
70.6	T21	60204407	60204507	60204605	60204703	60204802	60204902
70.6	T28	60206007	60206107	60206203	60206306	60206404	60206502
86.5	T16	60208204	60208304	60208403	60208503	60208602	60208702
86.5	T21	60204407	60204507	60204604	60204702	60204802	60204902
86.5	T28	60206004	60206104	60206203	60206306	60206404	60206502
105.9	T16	60208204	60208304	60208402	60208502	60208602	60208702
105.9	T21	60204405	60204505	60204604	60204702	60204802	60204902
105.9	T28	60206004	60206104	60206202	60206305	60206404	60206502
129.7	T16	60208202	60208302	60208402	60208502	60208602	60208702
129.7	T21	60204402	60204502	60204604	60204702	60204802	60204902
129.7	T28	60206002	60206102	60206202	60206305	60206404	60206502

\*SHELL PINION. IF INPUT SHAFT IS REQUIRED ALSO ORDER PART NUMBER 60206037A



**SIZES T16-21-28**

1. Input Shaft (1st stage driver)
2. Seal Sleeve
3. Clamp
4. Seal
- 5a. Ball Bearing (input shaft)
- 5b. Ball Bearing (input shaft)
6. Gearcase
7. Cover Plate
8. Bearing Housing
- 9a. Roller Bearing
- 9b. Roller Bearing
10. Gear (1st stage driven)
11. Screw
12. Washer
13. Spacer (gear)
14. Shims
15. Seal
16. Seal Sleeve (output)
17. Output Shaft
18. Shims
19. Gear (2nd stage driver)
20. Gear (2nd stage driven)
21. Screws (bearing clamp)
22. Clamp
23. Spacer (T-16)
24. Screw
25. Washer
26. Spacer
- 27a. Roller Bearing
- 27b. Roller Bearing
28. Shims
29. Gear (3rd stage driver)
30. Gear (3rd stage driven)
- 31a. Roller Bearings
- 31b. Roller Bearings
32. Spacer (T-16 & T-28)
33. Key
34. Grease Retainer (shaft up mounting only)\*
35. Spacer (T-21 & T-28)
36. Spacer } Shell Pinion
38. Spacer } in some T-28
39. Lock Ring ratios
40. Lock Ring

**T28**

**T16**

**T21**

## LONG-TERM STORAGE GUIDELINES FOR GEAR REDUCERS:

Care must be taken to ensure that gear reducers are placed in service in the best possible condition. During periods of long storage (six months or longer) special procedures must be followed which will protect the reducer and make certain that it will be in good condition when ready to be put into service.

By taking special precautions, problems such as seal leakage and reducer failure due to lack of lubrication, improper lubrication quantity, or contamination can be avoided. The following precautions will protect reducers during periods of long-term storage:

### A. Preparation:

1. Select a clean, dry, protected storage area free of vibration and temperature extremes. Set the drive level on its feet with no load on either the input or output shafts. Block as needed to keep weight off the motor fan shroud and motor conduit box (if unit has a motor).
2. Fill the gearbox to the highest designated oil level with a recommended lubricant blended with 2% by volume of \*Daubert Chemical Co. Nox-Rust VCI-105 oil. Do not fill the gearbox completely full of oil. Expansion space is needed to avoid pressurizing the gearbox during temperature variations. Rotate the input shaft at least 60 revolutions to ensure a full distribution of the lubricant.
3. All condensate drains and breathers (on motors so equipped) are to be fully operable to allow breathing through points other than bearing fits. Remove the condensate drain plugs located in the motor end shield. Position the motor so the drain is at the lowest point. Totally enclosed fan cooled XT motors are equipped with automatic drains which should be left in place.
4. All units equipped with heaters must have the heaters connected and operational if the storage conditions are in any way like the anticipated service conditions.
5. Motor windings are to be checked with a megohmmeter when the equipment is put into storage. The resistance must be recorded and saved for future reference. See "to put the stored unit into service" for the megohmmeter check required upon removal from storage.
6. Apply a thick coating of chassis-type grease, Cosmoline or equivalent protective coating \*(Daubert Chemical Co. Nox-Rust X-110 is a suitable coating) on all unpainted surfaces including threads, bores, keyways and shafts.
7. Apply a thick coating of chassis-type grease to all exposed shaft seals.
8. If the unit must be stored outdoors or in damp or unheated areas indoors, cover the entire exterior with a rust preventative. Seal the unit in a moisture proof container or in an envelope of heavy polyethylene film with a desiccant inside. Shade the enclosure from direct sunlight.
9. Rotate the input shaft at least 60 revolutions once a month to redistribute the lubricant and to prevent brinelling of bearings and drying of seals.
10. Instruction manuals and tags are paper and must be kept dry. Remove these documents and store them in a safe, dry place for future reference at start up.

### B. To put the stored unit into service:

1. Remove all protective coatings added for storage.

2. Drain and refill the gearbox with a recommended type and amount of lubricant. Regreasable assemblies and bearings must be purged and filled with new grease.
3. Install the oil level plug in the proper location for the mounting position to be used. Check the motor condensate drain locations to assure the motors will drain properly when mounted in the proposed position. Rotate the motor on the gearhead or rotate the motor end shields on the motor frame if necessary to get the drains in the proper positions.
4. Check all hardware for proper tightness.
5. If the gear unit has been stored for more than three years or in an area with high ambient temperatures, the oil seals must be replaced before being put into service. See the instruction manual for directions on oil seal replacement.
6. Check the motor stator insulation resistance with a megohmmeter. Resistance less than one megohm or less than 50% of the resistance reading taken when the motor was put into storage (whichever is the higher resistance), requires the motor winding to be dried in one of the two ways described below. If drying does not restore the winding insulation resistance to the values listed above, the motor must be repaired or rewound.
  - A. Remove the motor from the reducer (see instruction manual), place the motor in a ventilated oven at not more than 90 degrees celsius (194 degrees F.). Check the insulation resistance every 30 minutes. Bake until the resistance becomes constant.
  - or
  - B. Lock the motor rotor. Insert a thermocouple in the winding or set up to measure rise by resistance. Apply low voltage, gradually increase the current through the winding until the winding temperature reaches 90 degrees celsius (194 degrees F.). Do not exceed this temperature. Check the winding insulation resistance with a megohmmeter. Repeat if necessary.

After drying, briefly run the motor not connected to any load to further dry the motor and to check the bearings for noise and smooth operation.
7. When stored motors are found to be wet, a more detailed inspection should be made by removing the motor end shields and visually inspecting for water in the grease or rust on the bearings. If either is found, replace the bearings, clean the end shields thoroughly and relubricate.

\*Note: Daubert Nox-Rust VCI-105 oil and Nox-Rust X-110 protective coating can be procured in bulk quantity from:

Daubert Chemical Company, Inc.  
4700 S. Central Ave.  
Chicago, Illinois 60638  
Telephone (708) 496-7350

or in 5-gallon pails from their distributor:

Rock Island Lubricants and Chemicals  
1320 First Street  
Rock Island, Illinois 61204-5015  
Telephone (309) 788-5631

## HARDWARE TORQUES

### TORQUE FOR GEARCASE BOLTS (GRADE 5 HEX HEAD SCREWS)

CASE SIZE	BEARING HOUSING SCREWS		BEARING CLAMP SCREWS	
	SCREW SIZE	TORQUE (LB. IN.)	SCREW SIZE	TORQUE (LB. IN.)
S16 W16 C16	1/4 - 20	75	1/4 - 20	75
S21 D21 T21 S28 D28 T28	5/16 - 18	156	1/4 - 20	75

### TORQUES FOR PARTIAL GEARMOTOR MOUNTING HARDWARE

MOTOR FRAME SIZE	THREAD SIZE	TORQUE (LB. IN.)
56P 140P	#10-32 Thru Bolt	23 23
180TY 210TY	1/2 - 13 Stud	420

### TORQUE FOR NEMA C-FACE BOLTS (GRADE 5 HEX HEAD SCREWS)

MOTOR FRAME SIZE VS. CASE SIZE	C-FACE ADAPTOR TO GEARCASE		MOTOR TO C-FACE SCREWS	
	SCREW SIZE	TORQUE (LB. IN.)	SCREW SIZE	TORQUE (LB. IN.)
56C 140TC vs. 16 21-28 180TC 210TC vs. 21-28	3/8 - 16	276	#10-32	36
	1/2 - 13	660	1/2 - 13	660

### TORQUES FOR PIPE PLUGS

CASE SIZE	PLUG SIZE	TORQUE (LB. IN.)
S16 D16 T16	1/4 - 18 NPT	200
S21 D21 T21 S28 D28 T28	3/8 - 18 NPT	400

### TORQUES FOR SETSCREWS WHICH ATTACH COUPLING HUBS TO C-FACE MOTORSHAFTS AND TO SPLINED INPUT SHAFT OF GEARCASE

MOTOR FRAME SIZE VS. CASE SIZE	SCREW SIZE	TORQUE (LB. IN.)
56C & 140TC vs. 16-21-28 Motor Hub	1/4 - 20	50
180TC 21TC vs. 21-28 Motor Hub	5/16 - 18	96
180TC 210TC vs. 21-28 Splined Shaft Gearcase Hub	3/8 - 16	180

#### RENEWAL PARTS

CONTACT YOUR NEAREST RELIANCE PARTS DISTRIBUTOR IN THE YELLOW PAGES UNDER THE HEADINGS SPEED REDUCERS, POWER TRANSMISSION EQUIPMENT, OR VARIABLE SPEED DRIVES.

OR

CONTACT DODGE-MASTER-REEVES RENEWAL PARTS QUOTATIONS FOR ASSISTANCE AT PHONE NUMBER 1-803-297-4160 OR FAX NO. 1-803-281-2364. IDENTIFICATION NUMBER FROM UNIT NAMEPLATE WILL BE REQUIRED FOR PARTS ASSISTANCE.

#### SERVICE ENGINEERS

FOR RATES AND AVAILABILITY OF SERVICES CALL 1-812-378-2416.



## **DESCRIPTION AND INSTRUCTIONS**

The DRY-SYS Air-Flow Switch is a device which opens or closed an electrical circuit. It is actuated by the pressure or suction in an air duct, and is mounted directly on the duct in a convenient location (preferable close to the fan) where there is sufficient suction or pressure to operate it. The Flow Switch will operate on suction or pressure in a range of 0.12" to 10.0" water gauge.

The DRY-SYS Air-Flow Switch is generally used in connection with other safety devices to shut off the fuel supply to burners on ovens, boilers, and similar equipment in the event that the air flow in the duct stops, due to fan failure, closed dampers or other reasons.

The DRY-SYS Air-Flow Switch can be used for any application where suction or pressure in an air duct is the motivating force, and the opening or closing of an electrical contact is the required action.

The DRY-SYS Air-Flow Switch is not intended for a differential control. It switches on or off depending on whether the fan is running or stopped.

More than one Flow Switch can be used on a system. Connected in series, any one switch will perform the safety function. Used independently, each switch can operate a separate device.

Current capacity: 5 amp, -230V, 10 amp -115V, A.C.

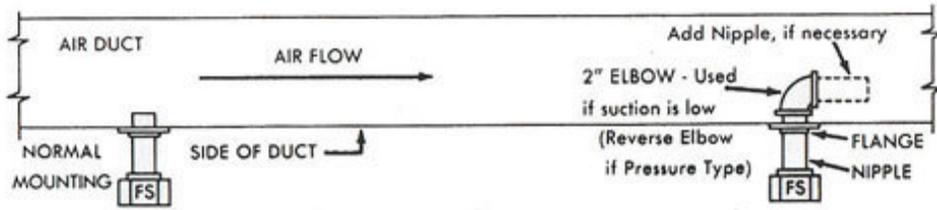
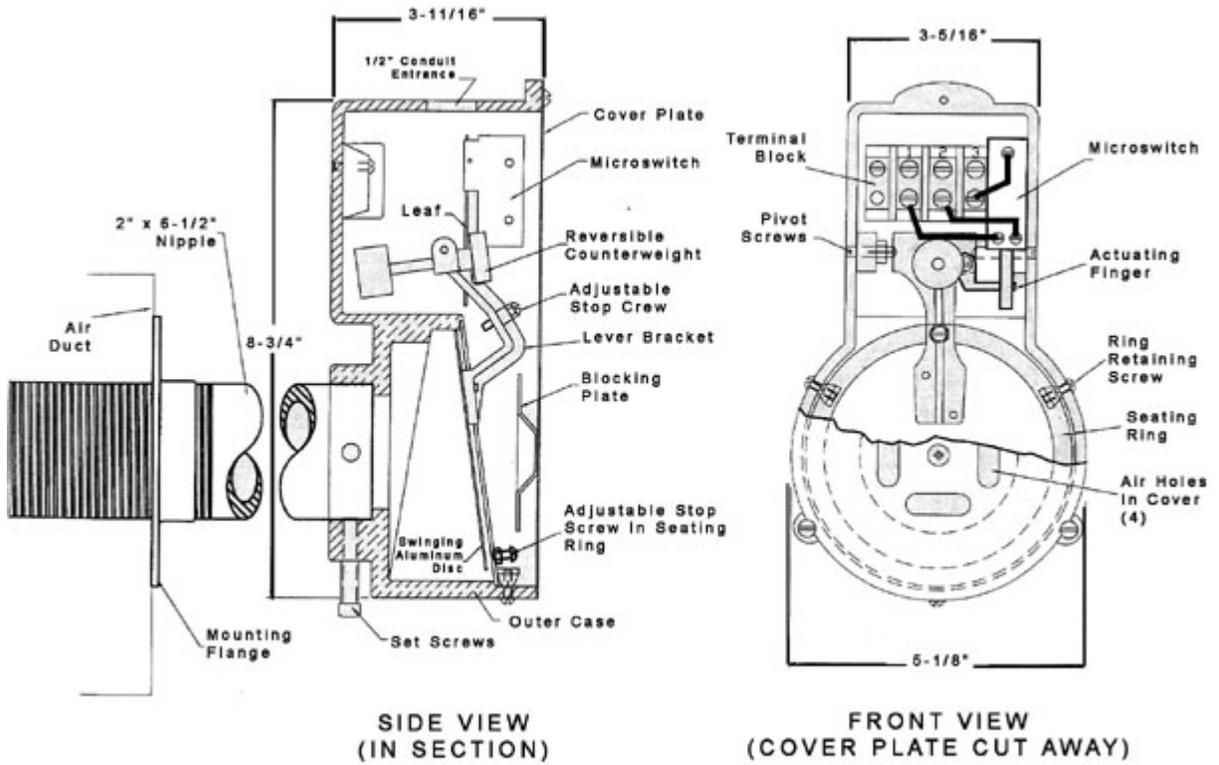


Figure 3



SIDE VIEW  
(IN SECTION)

FRONT VIEW  
(COVER PLATE CUT AWAY)

## **INSTALLATION INSTRUCTIONS**

1. Cut 2 ½" round hole in side of duct
2. Fasten 2" pipe flange to duct, over hole, preferably with bolts. Nipple should be screwed tightly into flange before fastening. Nipple should project 2" outside of any insulation on duct, and about 1" into duct.
3. Mount Flow-Switch on nipple and tighten setscrews. FLOW-SWITCH MUST BE VERTICAL and PLUMB, top side up.
4. If necessary, provide braces to keep Flow-Switch rigid.
5. Be sure swinging disc moves freely on bearings, and that wires do not interfere with movement.
6. On installations where suction is very low, or where lighting of burners may cause a momentary pressure puff, better results will be obtained by screwing a 2" - 90F elbow on the nipple inside the duct, facing the open end toward the fan, or away from the burners. Add extension nipple to bring closer to fan, if necessary. See Figure 3.
7. Do not use Flow-Switch on pressure side of fan if duct temperature is above 175F.

## **ESSENTIAL PARTS OF AIR-FLOW SWITCH**

CASE – This is cast aluminum, and contains the working parts.

TERMINAL BLOCK – Wiring connections are made here. Terminals are numbered.

MICRO SWITCH – S.P.D.T. switch, actuated by the movement of the swinging disc. See cover plate for wiring connections.

SWINGING DISC – Air suction pulls the disc toward the back. Air pressure moves it toward the front.

COUNTERWEIGHT – Position of this weight determines whether switch will operate on suction or pressure. See instructions on the switch coverplate.

STOP SCREWS - These screws are adjusted to keep the disc slightly off the seat, to prevent chattering. Top screw for suction operation. Bottom screw for pressure operation. Note: Make this adjustment only if disc chatters.

ACTUATING FINGER – This is pre-set, but can be bent slightly up or down to equalize on-off switch action with movement of vane if necessary.

## CARE OF DRY-SYS AIR-FLOW SWITCH

1. Keep interior of switch clean. Be sure that disc and seating surfaces are clean. Inspect regularly.
2. Keep bearings clean (2 cone-point bearings). Bearings should be set to allow free movement of disc, but not too "sloppy". Do not oil bearings.
3. On switches having a dust filter, clean filter in gasoline or naphtha, and re-oil with No. 20 S.A.E. oil as often as necessary.

## PARTS LIST (For Ordering)

<b>Part</b>	<b>Feco Part Number</b>
Complete Unit Without Filter	4102398
Complete Unit With Filter	4102399
Cover Plate (non-filter)	4102406
Microswitch	4102388
With Lead for Microswitch	4102393
Counterweight, Bracket and Disc Assembly	4102384
Terminal Block	4102386
Actuating Finger	4102377
<b>FOR FILTER ONLY</b>	
Cover Plate (filter)	4102401
Air Filter	4102389

# Differential pressure switch for air, flue and exhaust gases

AA...A2

**DUNGS®**



#### UL Listed

- UL 353
- File # MH 16628

#### CSA Certified

- CSA C22.2 No. LR 53222
- Certification # 201527

#### FM Approved

- Class 3510, 3530
- File # J.I. 1T7A8.AF



## Description

AA...A2 differential pressure switches are field adjustable, compact pressure switches for automatic burner controls. Available with hose or NPT threaded connections.

AA...A2-4 differential pressure switches are suitable for making and/or breaking a circuit when the medium pressure changes relative to the set point. AA...A2-4 versions feature hose connections.

AA...A2-6 differential pressure switches are suitable for making and/or breaking a circuit when the medium pressure changes relative to the set point. AA...A2-6 versions feature NPT threaded connections that also include a test button in the lower housing.

## Application

Differential pressure monitoring in firing, ventilation and air-conditioning systems. The AA...A2 can be used as a pressure, vacuum or differential pressure switch for air and non-aggressive gases. Not suitable for natural gas, propane, butane and other combustible gases.

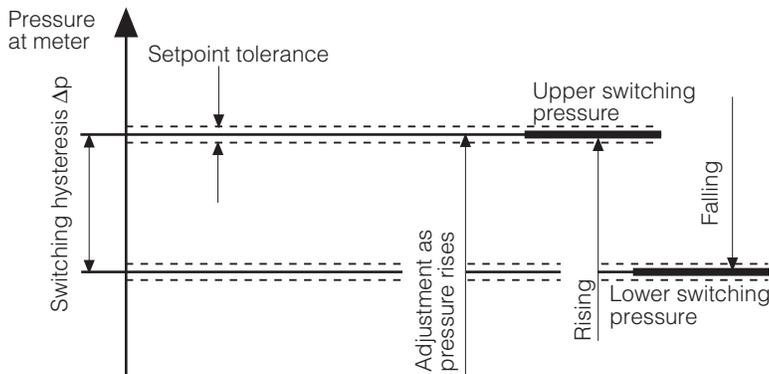
**AA...A2** SPDT differential pressure switch in pressure and vacuum ranges. The differential pressure acts via the diaphragm against the force of the setting spring on the microswitch. The pressure switch operates without any auxiliary power

<b>Specifications</b>	AA...A2-4 Hose connection	AA...A2-6 Threaded connection
Max. operating pressure	7 PSI (500 mbar)	
Pressure connection	5/32" (4.6 mm) dia. positive 5/32" (4.6 mm) dia. negative	1/4" NPT positive 1/8" NPT negative 5/32" (4.6 mm) test connection
Temperature range	Ambient temperature Medium temperature	-40 °F to +140 °F (-40 °C to +60 °C) -40 °F to +140 °F (-40 °C to +60 °C)
Materials	Housing: Switch: Diaphragms: Switching contact:	Polycarbonate Polycarbonate NBR-based rubber Silver (Ag)
Electrical ratings	AC eff. min. 24 V max. 250 V DC min. 24 V max. 48 V	
Current ratings	AC 5A resistive @ 120 Vac AC 3A inductive @ 120 Vac DC min. 20 mA @ 24 Vdc DC max. 1 A @ 48 Vdc	
Electrical connection	Screw terminals via 1/2" NPT conduit connection	
Enclosure rating	NEMA 4	
Setting tolerance	±15% switching point deviation referred to set point, adjusted as pressure rises, vertical diaphragm position	
Installation position	Multipoised	

**⚠ Installation position**  
Standard installation position is **vertical** upright diaphragm. When installed **horizontally**, the pressure switch switches at a pressure higher by approx. 0.2 in. W.C. When installed **upside down**, the pressure switch switches at a pressure lower by approx. 0.2 in. W.C. When installed in **other positions**, the pressure switch switches at pressure deviating from the set reference value by max. ± 0.2 in. W.C.

**Definition of switching hysteresis  $\Delta p$**

The pressure difference between the upper and lower switching pressures.



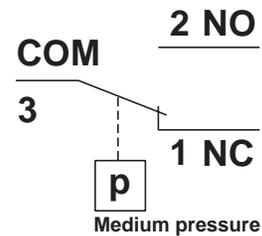
**AA...A2 switching function**

**As pressure rises:**

1 NC opens, 2 NO closes

**As pressure falls:**

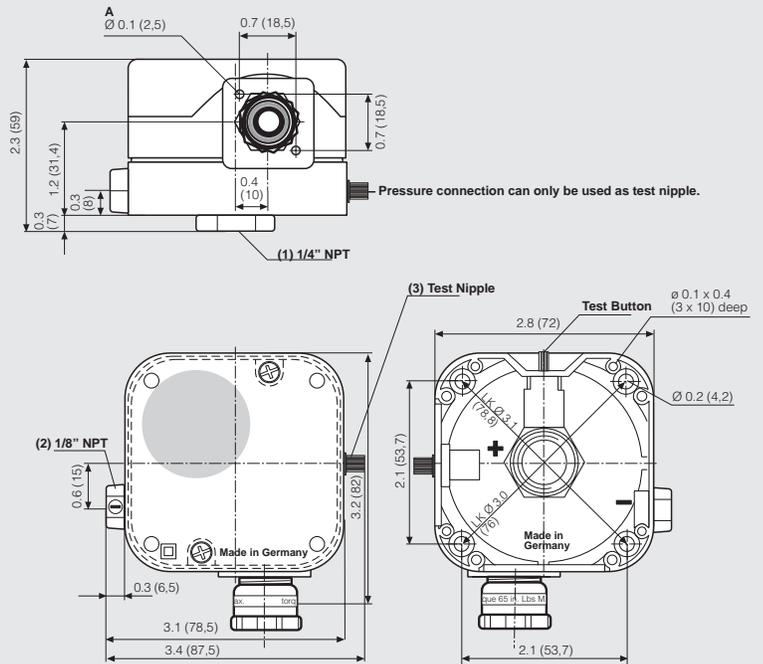
1 NC closes, 2 NO opens



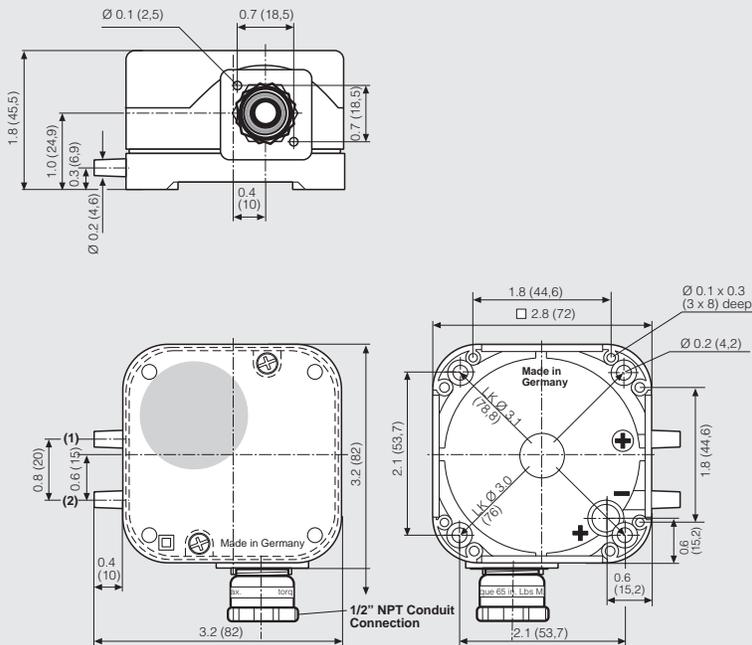
## Dimensions inch (mm)

- 1 Pressure connection (+)
- 2 Pressure connection (-)
- 3 Test nipple p (+)

## AA...A2-6 Threaded connection



## AA...A2-4 hose connection



### A2 test button

The AA...A2-6 threaded version is equipped with a test button.

When the test button is pressed, the connection to the **1/4" NPT** pressure connection is interrupted and the pressure below the diaphragm is relieved. The microswitch of the pressure switch changes the contact position from NO to NC. If the test button is released, the pressure below the diaphragm is built up again and the microswitch changes

**Differential pressure switch for air,  
flue and exhaust gases**

**AA...A2**

**DUNGS®**

Type	Version	Description	Order No.	Setting range In. W.C	Switching difference In. W.C.
<b>AA-A2-4-...</b>	AA-A2-4-2	Hose connection	46012-2	0.16 - 1.2"	≤ 0.12"
	AA-A2-4-3	Hose connection	46012-3	0.4 - 4"	≤ 0.20"
	AA-A2-4-5	Hose connection	46012-5	2 - 20"	≤ 0.40"
	AA-A2-4-6	Hose connection	46012-6	12 - 60"	≤ 1.20"
<b>AA-A2-6-...</b>	AA-A2-6-2	Threaded connection	46020-2	0.16 - 1.2"	≤ 0.12"
	AA-A2-6-3	Threaded connection	46020-3	0.4 - 4"	≤ 0.20"
	AA-A2-6-5	Threaded connection	46020-5	2 - 20"	≤ 0.40"
	AA-A2-6-6	Threaded connection	46020-6	12 - 60"	≤ 1.20"

Accessories for pressure switch	Order No.
Klima-Set (Duct mounting kit)	46000-5
Neon Light (120 Vac)	46000-7
Neon Light (24 Vac / Vdc)	D231 771
Replacement Cover	D223 798
Replacement Conduit Adapter	46000-14
Din Connector	D210 318

We reserve the right to make any changes in the interest of technical progress.

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**Lino Lakes, MN 55014, U.S.A.**  
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**Fax 651 792-8919**  
**e-mail [info@karldungsusa.com](mailto:info@karldungsusa.com)**  
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**Fax +49 (0)7181-804-166**  
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**Internet <http://www.dungs.com>**



**SPECIFICATIONS**

- DMV-D/6** Two normally closed safety shut off valves in one housing. Fast opening, fast closing. Adjustable max. flow on valve 2.
- DMV-DLE/6** Two normally closed safety shut off valves in one housing. Valve 1 fast opening, fast closing. Valve 2 slow opening, fast closing. Adjustable max. flow and initial lift on valve 2.

**Body size**                      **Flange Size**  
 DMV-D(LE) 701/6              1/2" - 1" NPT  
 DMV-D(LE) 702/6              1" - 2" NPT  
 DMV-D(LE) 703/6              1" - 2" NPT

**Gases**  
 Natural gas, Propane, Other Noncorrosive gases

**Maximum Operating Pressure**  
 7 PSI (500 mbar)

**Ambient / Fluid Temperature**  
 -40 °F to +150 °F ( -40 °C to +65 °C)

**Electrical Ratings (Both valves inclusive)**  
 110 to 120 Vac / 50 to 60 Hz  
 220 to 240 Vac / 50 to 60 Hz  
 24 Vdc, 24 Vac / 50 to 60 Hz

**Power Consumption**  
 DMV-D(LE) 701: 45 VA  
 DMV-D(LE) 702: 65 VA  
 DMV-D(LE) 703: 90 VA

**Electrical Connection**  
 DIN-Connector with 1/2" NPT conduit adapter

**Operating Time**  
 100 % duty cycle

**Classification of Valve V1 and V2**  
 Safety Shut Off Valve: UL 429, FM 7400  
 ANSI Z21.21 • CSA 6.5 C/I Valves

**Closing Time (Valve 1 & Valve 2)**  
 < 1 second

**Opening Time**  
 DMV-D/6: V1 & V2 < 1 sec.  
 DMV-DLE/6: V1 < 1 sec.; V2 10 to 20 sec. at 70 °F

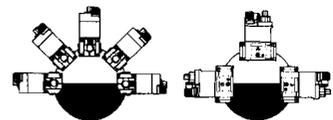
**Main Flow Setting (DMV-D/6 & DMV-DLE/6)**  
 Adjustable on V2: <10 to 100% of total flow

**Initial Lift Adjustment (DMV-DLE/6)**  
 Adjustable on V2: 0 to 70 % of total flow

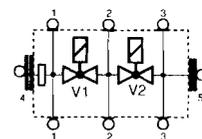
**Materials in contact with Gas**  
 Housing: Aluminum, Steel  
 Sealings on valve seats: NBR-based rubber

**Mounting Position**  
 Solenoid upright vertical  
 to solenoid horizontal

**Strainer**  
 23 Mesh, installed in the housing upstream V1



**Test Port**  
 G 1/8 ISO 228 taps available  
 on both sides; upstream of  
 V1, between V1 and V2,  
 downstream of V2, and on both flanges



**Position Indication (optional)**  
 Visual Indicator  
 CPI 400 w/ visual indication and electrical  
 switch (SPDT)

**Approvals**  
 UL Recognized Component: File No. MH16727  
 CSA: Certified File No. 157406  
 FM Approved: Report J.1.1Z6A0.AF

**CAPACITY**

Capacity in CFH at pressure drop of 1 inch water column; natural gas, sp.gr.=0.64

	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
DMV-D(LE) 701/6	345	429	457	-	-	-
DMV-D(LE) 702/6	-	-	1065	1277	1368	1430
DMV-D(LE) 703/6	-	-	1230	1532	1698	1795

DMV/6 Installation Manual - 80119 - 02/2002

**KARL DUNGS INC.**

524 Apollo Drive, Suite 10 Lino Lakes, MN 55014 U.S.A.

Phone: (651) 792-8912 Fax: (651) 792-8919 E-mail: info@karldungsusa.com

*DMV 525 flanged - 80119 gdh*

## ATTENTION

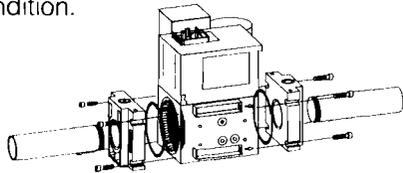
- Read these instructions carefully.
- Failure to follow them and/or improper installation may cause explosion, property damage and injuries.
- Installation must be done with the supervision of a licensed burner technician.
- The system must meet all applicable national and local code requirements.
- Check the ratings in the specifications to make sure that it is suitable for your application.
- Never perform work if gas pressure or power is applied, or in the presence of an open flame.
- Once installed, perform a complete checkout including leak testing.
- Label all wires prior to disconnection when servicing. Wiring errors can cause improper and dangerous operation.
- Verify proper operation after servicing.

## MOUNTING

- Examine the DMV-D(LE)/6 for shipping damage.
- The main gas supply must be shut off before starting the installation.
- The inside of the DMV-D(LE)/6, the flanges, and piping must be clean and free of dirt, remove all dirt and debris before installing the DMV-D(LE)/6. Failure to remove dirt/debris could result in valve damage or improper performance.

### Recommended Procedure to Mount the Flanges

- Unpack the DMV-D(LE) 701 (702/703) and remove the 8 M6 (M8) socket cap head screws using a 5 mm (6 mm) Allen wrench.
- Remove the two white protective plastic covers from the DMV-D(LE) body.
- Make sure the O-rings and the grooves are clean and in good condition.
- Install the DMV-D(LE) with the gas flow matching the direction indicated by the arrows on the casting.
- Mount the DMV-D(LE) only with the solenoid vertical upright to horizontal.
- Clean the mounting surface of the flanges. Make sure they are in good condition.



**CAUTION:** If the flow is not in the same direction of the arrows the valves will not operate properly.

- Attach the DMV-D(LE) to the flanges using the M6 (M8) socket cap screws supplied.
- Use a 5mm Allen wrench for the DMV-D(LE) 701.
- Use a 6mm Allen wrench for the DMV-D(LE) 702/703.
- Tighten the screws in a crisscross pattern
- Do not overtighten the screws. Follow the maximum torque values below.

### Recommended Torque

M6	M8	Screw Size
62	134	[lb-in]

### Recommended Piping Procedure

- Use new, properly reamed and threaded pipe free of chips.
- Apply good quality pipe sealant, putting a moderate amount on the male threads only. If pipe sealant lodges on the valve seat, it will prevent proper operation. If using LP gas, use pipe sealant rated for use with LP gas.
- Do not thread pipe too far. Valve distortion and/or mal function may result from excess pipe in the valve body.
- Apply counter pressure only a parallel jaw wrench only to the flats on the flange when screwing the pipe into the flanges.
- Do not overtighten the pipe. Follow the maximum torque values listed below.

### Recommended Torque for Piping

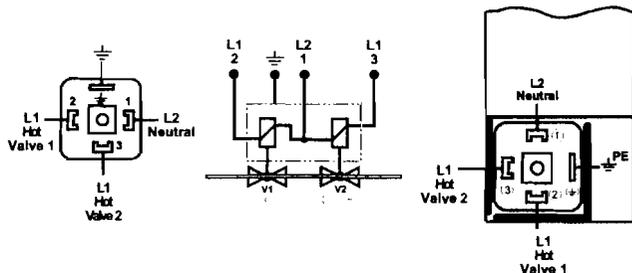
1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	NPT pipe
375	560	750	875	940	1190	[lb-in]

- After installation is complete, perform a leak test.

## WIRING

- Disconnect all power to the valves before wiring to prevent electrical shock and equipment damage.
- Do not exceed the electrical ratings given in the specifications and on the valve.
- Attach a flexible 1/2" NPT conduit to the DIN connector.
- Route the wires through the conduit and the DIN connector.
- Use 14 or 16 gauge wire for at least 75°C (167°F).
- Connect the wiring to the appropriate screw terminals in the DIN connector.
- Plug the DIN connector into the AMP terminals. Fasten the DIN connector with the screw supplied.

**CAUTION:** All wiring must comply with local electrical codes, ordinances and regulations. An ultimate electrical enclosure must be provided.

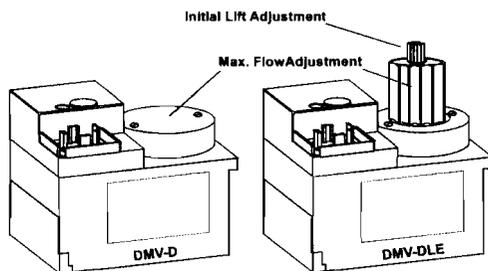


## VALVE ADJUSTMENT

### Flow Setting

- The valves are factory set with the flow adjustment fully open.
- **CAUTION:** Make sure the flow of gas does not create a hazard.
- Locate the flow adjustment on top of valve 2 on the DMV-D/6 (black knob) DMV-DLE/6 (base of the hydraulic brake). There are two screws, the holding screw is recessed and has a blue sealing compound on it, while the pan head screw protrudes from the cap.
- Loosen the pan head screw until you can freely rotate the flow adjustment.
- Turn clockwise for less gas or counterclockwise for more gas.
- Check the flow at the burner with an orifice or flow meter.
- Tighten the pan head screw on the adjustment cap.

**⚠ CAUTION:** Do not adjust or remove any screws or bolts which are sealed with a Red or Blue colored compound. Doing so will void all approvals and warranties.



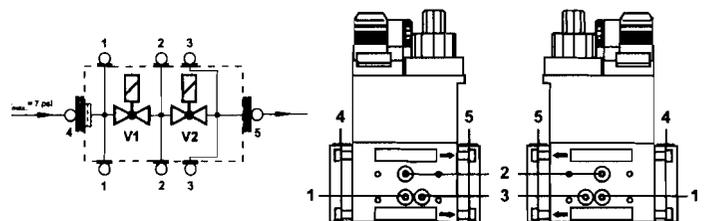
### Initial Lift Adjustment (DMV-DLE/6 only)

The initial lift adjustment varies the initial gas flow through the valve as the valve seat begins to open. This adjustment can vary the initial flow between 0 % and 70% of the total gas flow; 0 to 25% of stroke. All DMV-DLE/6 valves are factory set with no initial lift. To adjust the lift proceed as follows:

- Unscrew the small black cap on top of the flow adjustment cap to expose the initial lift adjustment knob.
- The black cap also serves as tool; turn the cap over and insert it on the slot on the adjustment knob.
- Turn the knob clockwise for a min. initial lift or counterclockwise for a max. initial lift.
- Once the desired initial fast lift has been achieved, reinstall the black cap.

### Test Ports

The G 1/8 ISO 228 taps are available on both sides upstream V1, between V1 and V2, downstream V2, and on both flanges. The G 1/8 test nipple (# D219 008) can be screwed in any of these pressure tap ports.



## VALVE LEAKAGE TEST

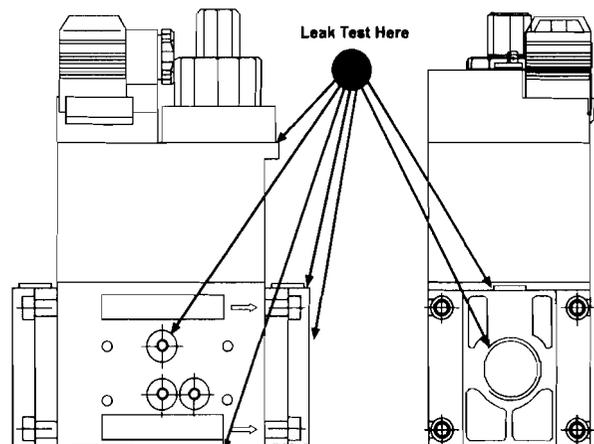
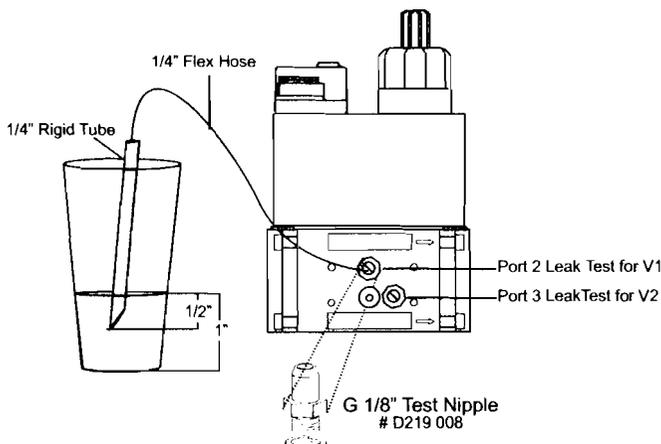
This test checks the sealing capabilities of the DMV-D(LE)/6 automatic shutoff valves. This test requires test nipples installed in the downstream accessory port of both automatic shutoff valves to make the required hose connection. (Port 2 and 3)

Only qualified personnel should perform this test at the initial burner system startup, and annually or more depending on the application, environmental parameters, and the requirements of the authority having jurisdiction.

It is recommended that this test be included in scheduled inspection and maintenance procedures.

**Use the illustration below as a reference.**

- 1) Externally leak test the valve. DUNGS recommends using an all purpose liquid leak detector solution (Snoop™ or a soapy water solution). Apply the liquid leak detector solution to the areas indicated below. The presence of bubbles indicate a leak. Be sure to test any accessories mounted to the Valve. (Continued on page 4)



- 2) De-energize valve # 1 and #2.
- 3) Close the upstream manual ball valve, and close the downstream manual ball valve.
- 4) Be sure that both test nipples are properly installed in port 2 and 3 and are leak tight.
- 5) Fill a glass of water at least 1 inch from the bottom, Connect a 1/4" flexible hose to a rigid tube. The rigid tube shall be 1/4 in. diameter and have a 45° cut at the end that is not connected to the flexible hose. The rigid tube can be made from either aluminum, copper or plastic.
- 6) Using a screwdriver, slowly open the V1 test nipple (port 2) by turning it counter clockwise to depressurize the volume between the two valves.
- 7) Connect the 1/4" flexible hose to test nipple.
- 8) Open the upstream manual ball valve.
- 9) Immerse the 1/4 in. tube vertically 1/2 in. (12.7 mm) into the glass of water.
- 10) If bubbles emerge from the rigid tube, let the rate stabilize and count the number of bubbles appearing during a 10 second period. (See chart below for leakage rates.)

- 11) Repeat the same procedure for valve V2 (port 3), except that valve #1 needs to be opened at step 7 above. (Energize only terminal 2 on the DIN connector).

**After completing the above tests:**

- 12) Close the upstream and downstream manual ball valves. De-energize the safety shutoff valves.
- 13) Remove the flexible hose, and close the test nipples.
- 14) Open the upstream manual ball valve, and energize both valves.
- 15) Use soapy water to leak test all test nipples to ensure that there are no leaks.
- 16) De-energize the safety shutoff valves.
- 17) Open the downstream manual ball valve.

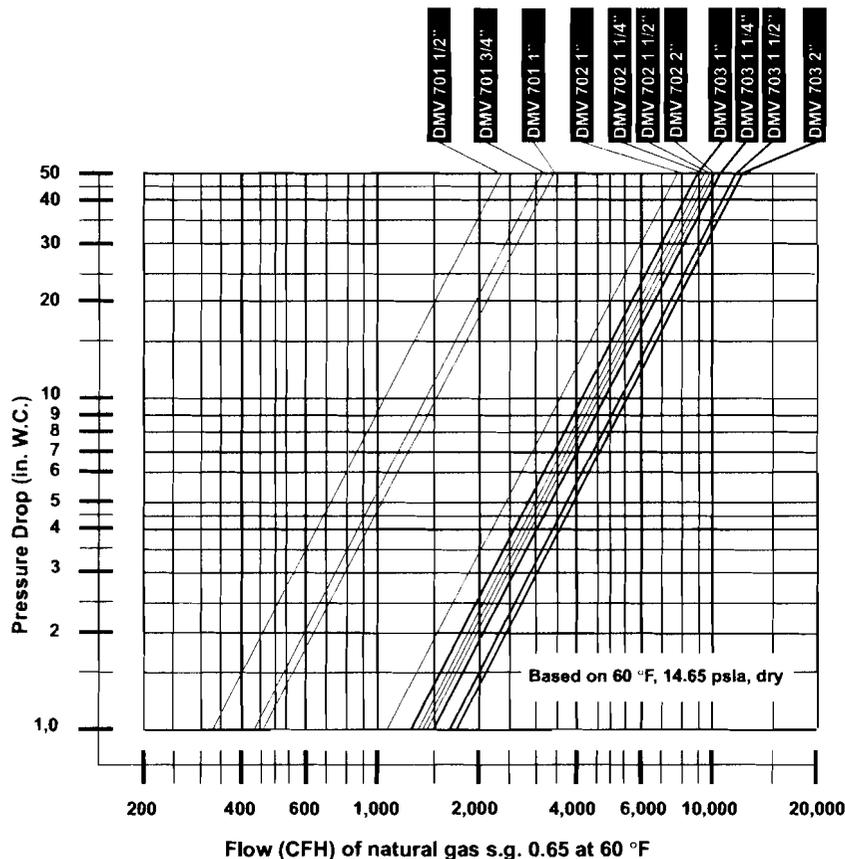


**WARNING:** If leakage values are exceeded, replace valve immediately.

Model	Allowable Leakage*	# of Bubbles in 10 sec		
		AIR	Natural Gas	LP
DMV D(LE) 701/6 (507/11) 264 cc/hr		5	6	4
DMV D(LE) 702/6 (512/11) 494 cc/hr		9	11	7
DMV D(LE) 703/6 (520/11) 494 cc/hr		9	11	7

\*Based on air, and test conditions per UL 429 Section 29. (Air or inert gas at a pressure of 1/4 psig and also at a pressure of one and one-half times maximum operating pressure differential, but not less than 1/2 psig. This test shall be applied with the valve installed in its intended position.) Volume of bubble defined in Table 2 of FCI 70-2-1998.

## FLOW CURVE



**SPECIFICATIONS**

**FRI/6** Gas pressure regulator (lock-up type) with integrated gas filter in one housing. The FRI/6 series regulator mounts directly to the DMV series valves. It is suitable for mounting in a gas train using two flanges.

**Body size**                      **Flange Size**  
 FRI 705/6 & 707/6          1/2" - 1" NPT  
 FRI 710/6 & 712/6          1" - 2" NPT

**Gases**  
 Natural gas, Propane, Butane; Other Noncorrosive gases

**Maximum Operating Pressure**  
 7 PSI (500 mbar) UL, FM, CE  
 5 PSI (350 mbar) CSA

**Ambient / Fluid Temperature**  
 +5°F to +150°F; (-15°C to +60°C)

**Materials in contact with Gas**  
 Housing: Aluminum, Steel  
 Sealings on valve seats: NBR-based rubber

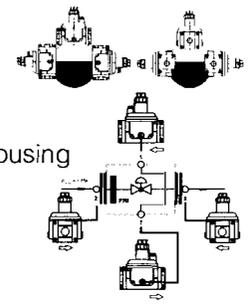
**Mounting Position**  
 Upright vertical to horizontal

**Strainer**  
 23 Mesh, installed in the housing

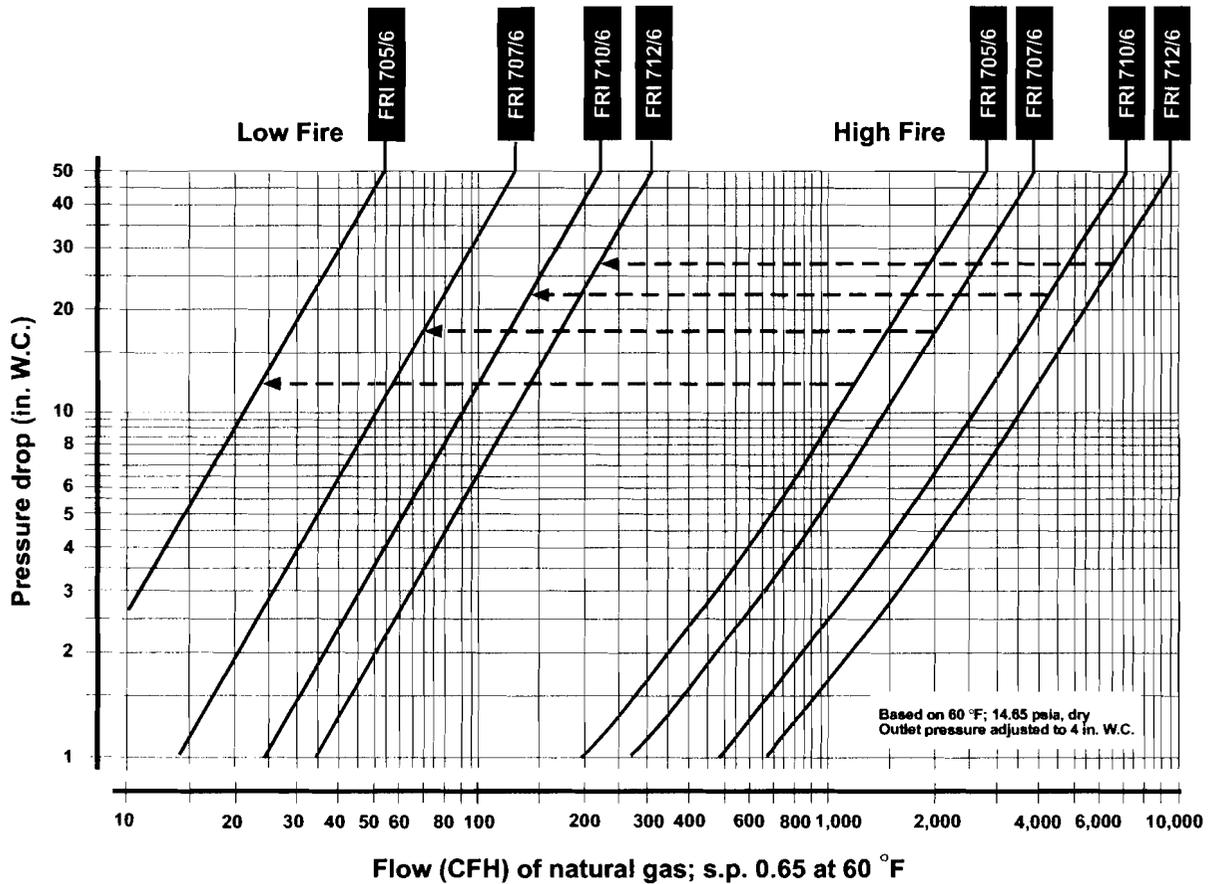
**Filter**  
 Mesh <0.05mm, installed in the housing

**Test Ports**  
 G 1/8 ISO 228 taps available on both sides downstream of regulator, and on both flanges

**Approvals**  
 UL Unlisted Component: File No. MH16727 (SP)  
 CSA Certified: File No. 157406  
 FM Approved: report J.I. 1Z6A0.AF (7411)  
 CE 0087-AU30



**CAPACITY**



FRI Installation Manual 80115 - 01/2002

## ATTENTION

- Read these instructions carefully.
- Failure to follow them and/or improper installation may cause explosion, property damage and injuries.
- Installation must be done with the supervision of a licensed burner technician.
- The system must meet all applicable national and local code requirements.
- Check the ratings in the specifications to make sure that it is suitable for your application.
- Never perform work if gas pressure or power is applied, or in the presence of an open flame.
- Once installed, perform a complete checkout including leak testing.

## INSTALLATION

### Installation

- The regulator can be mounted either upstream or downstream of the DMV/6. It can also be mounted as a stand alone regulator using two flanges and the flange mounting kit.
- The main gas supply must be shut off before starting the installation.
- Examine the regulator for shipping damages.
- The inside of the regulator and piping must be clean and free of dirt.

### Recommended Procedure to Mount the FRI/6 regulator to a DMV/6 series valve.

- Replace the O-ring in the groove on the side of the DMV/6 body with the oval O-ring supplied with the mounting kit.
- Make sure the oval O-ring and the groove are clean and in good condition.
- Install the FRI/6 regulator and DMV/6 series valve with the gas flow matching the direction indicated by the arrows on the body.
- Attach the regulator to the DMV/6 series valve body using the socket cap crews supplied in the FRI/DMV mounting kit.
- Use a 5mm Allen wrench for the FRI 705/6 & 707/6.
- Use a 6mm Allen wrench for the FRI 710/6 & 712/6.
- Tighten the screws in crisscross pattern.
- Do not overtighten the screws. Follow the maximum torque values listed below.
- After installation is completed perform a leak test to verify that no leakage occurs.

### Recommended Torque for Mounting Screws

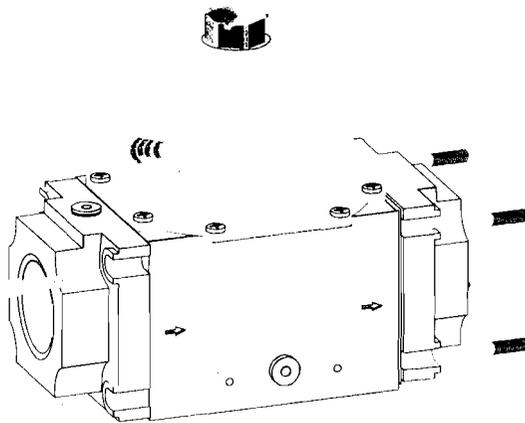
M6	M8	Screw Size
62	134	[lb-in]

### Recommended Procedure to Mount Flanges

- Make sure the O-rings and the grooves are clean and in good condition.
- Install the FRI/6 with the gas flow matching the direction indicated by the arrows on the casting.
- Mount the FRI/6 vertical upright to horizontal.
- Clean the mounting surface of the flanges. Make sure they are in good condition.
- Attach the FRI/6 to the flanges using the appropriate M6 or M8 socket cap screws supplied.
- Use a 5mm Allen wrench for the FRI 705/6 & 707/6.
- Use a 6mm Allen wrench for the FRI 710/6 & 712/6.
- Tighten the screws in a crisscross pattern
- Do not overtighten the screws. Follow the maximum torque values below.
- After installation is complete, perform a leak test.

### Recommended Torque Screws

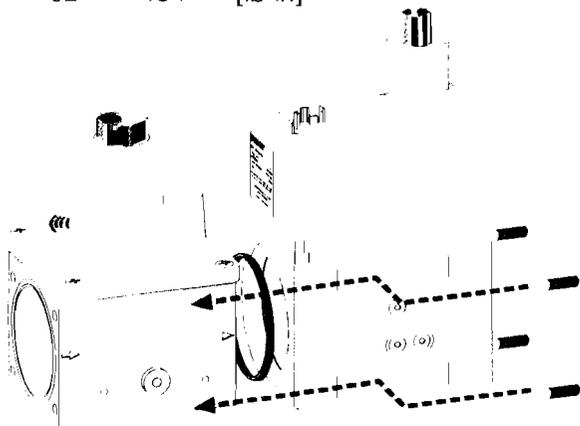
M6	M8	Screw Size
62	134	[lb-in]



**CAUTION:** If the flow is not in the same direction of the arrows the regulator will not operate properly.

### Recommended Piping Procedure

- Use new, properly reamed and threaded pipe free of chips.
- Apply good quality pipe sealant, putting a moderate amount on the male threads only. If pipe sealant lodges on the regulator seat, it will prevent proper operation. If using LP gas, use pipe sealant rated for use with LP gas.



- Do not thread pipe too far. Valve distortion and/or malfunction may result from excess pipe in the valve body.
- Apply counter pressure using a parallel jaw wrench only to the flats on the flange when screwing the pipe into the flanges.
- Do not overtighten the pipe. Follow the maximum torque values listed below.
- After installation is complete, perform a leak test.

#### Recommended Torque for Piping

1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	NPT pipe
375	560	750	875	940	1190	[lb-in]

#### Vent Line

- On indoor installations requiring venting outdoors, run the piping as short and as direct as possible.
- With natural gas or other hazardous gases, vent to an approved location.
- Screen and protect the opening outdoors to guard against any blocking of the vent line.



CAUTION: When venting is required, each regulator must be individually vented.

## OPERATION

#### Start-Up

- The inlet and outlet shut off valves should both be closed.
- Slowly and carefully open the inlet shut off valve just enough to allow inlet pressure to build up slowly in the regulator until it is fully pressurized.
- Slowly open the outlet shut off valve(s) to allow a small flow.



CAUTION: During start-up a pressure gauge must be used on the regulator outlet pressure and carefully watched. While inlet pressure builds up, outlet pressure must not exceed set point by more than 30%. If outlet pressure exceeds set point by more than 30% close the inlet shut off valve. The regulator is not closing properly. Check and make necessary corrections before proceeding with start-up.



CAUTION: Make sure the flow of gas does not create a hazard. With gas flowing, check for correct inlet and outlet pressures. Complete start-up by making sure that there are no leaks.

#### Set-Point Adjustment

- Remove the black protective cap.
- To **increase** the outlet pressure set point turn the adjustment spindle **clockwise** with a screw driver.
- To **decrease** the outlet pressure set point turn the adjustment spindle **counterclockwise** with a screw driver.
- Always use an accurate pressure gauge connected downstream from the regulator to measure the actual outlet pressure.
- Screw on protective cap.
- After adjusting the set point for normal operation check to see that the gas pressure regulator operates as intended.

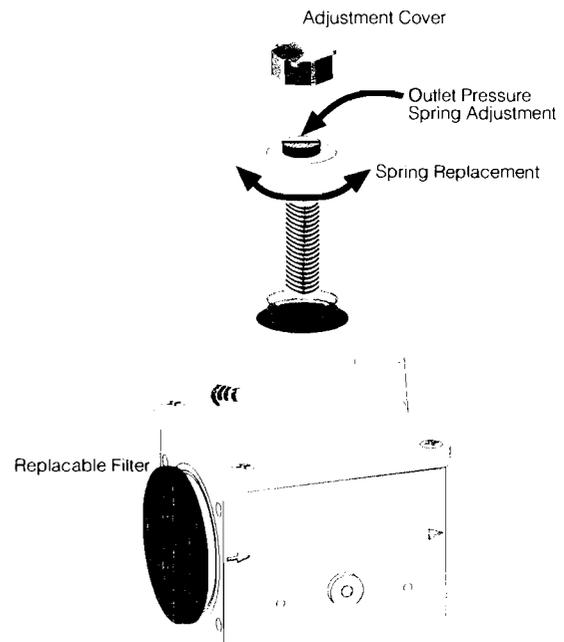
#### Outlet Pressure Spring Replacement

- Remove the black protective cap.
- Release spring by turning the adjustment spindle counterclockwise with a screw driver. Turn the spindle to the stop.
- Remove the aluminum cap.
- Remove spring.

- Insert new spring.
- Assemble complete adjustment device and adjust desired outlet pressure. Follow the set point adjustment instructions.
- Screw on protective cap.
- Apply new label provided with new outlet pressure range onto the name plate.

#### Filter

- Inspect the filter at least once a year.
- Replace the filter if the pressure drop across the filter is more than 4" W.C.
- Replace the filter if the pressure drop across the filter is more that twice as high as the first installation inspection.



#### Filter Change

- Remove the FRI/6 by following the mounting instructions in reverse order.
- Remove the support ring.
- Remove the filter insert.
- Insert a new filter insert.
- Press in the support ring.
- Re-install the FRI/6 following the mounting instructions.
- Perform a function and leak test.

## OUTLET PRESSURE RANGE

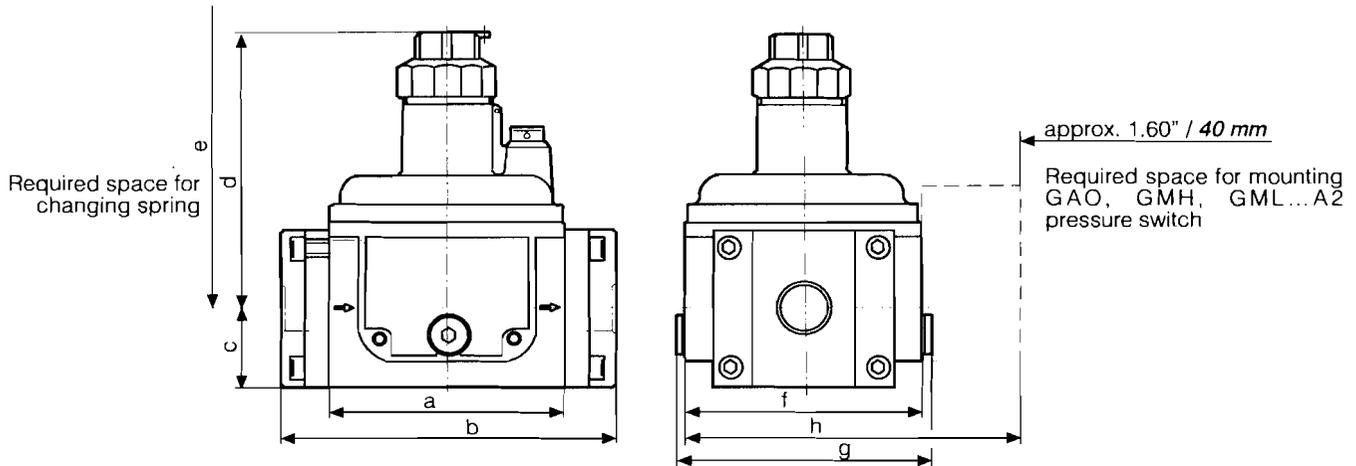
Setpoint range [in. W.C.]	1 to 3.6	2 to 5	2.8 to 8	4 to 12	10 to 22	12 to 28	24 to 40	40 to 60
	*Spring 1	Spring 2	Spring 3	Spring 4	Spring 5	Spring 6	Spring 7	Spring 8
Spring color	brown	white	orange	blue	red	yellow	black	pink

**Order No.**

FRI 705/6 - 707/6	D229 817	D229 818	D229 820	D229 821	D229 822	D229 823	D229 824	D229 825
FRI 710/6 - 712/6	D229 842	D229 843	D229 844	D229 845	D229 846	D229 847	D229 848	D229 849

\*Not AGA/CGA Certified

## DIMENSIONS



**For dimension b**  
**FRI 710/712 1, 1 1/4 in. NPT = 6.9"**  
**FRI 710/712: 1 1/2, 2 in. NPT = 8.1"**

Type	NPT	Order No.	Dimensions [inch]								Weight [lbs]
			Dimensions [mm]								
			a	b	c	d	e	f	g	h	Weight [kg]
FRI 705/6	1/2" - 1"	D230 472	3.6	5.6	1.3	6.0	7.7	3.8	4.1	5.5	2.0
			92	141	33	152	195	96	104	139	0,9
FRI 707/6	1/2" - 1"	D230 473	3.6	5.6	1.3	6.0	7.7	3.8	4.1	5.5	2.0
			92	141	33	152	195	96	104	139	0,9
FRI 710/6	1" - 2"	D230 474	4.9	6.9/8.1	1.8	6.9	9.3	5.0	5.3	6.7	3.5
			124	176/206	45	175	235	126	135	169	1,6
FRI 712/6	1" - 2"	D230 475	4.9	6.9/8.1	1.8	6.9	9.3	5.0	5.3	6.7	3.5
			124	176/206	45	175	235	126	135	169	1,6

## ACCESSORIES

Type	Flange NPT	Order No.	Kit for mounting flanges to FRI/6	Order No.
			FRI 705/707	D224 093
FRI 705/6 - FRI 707/6	1/2"	D222 371	FRI 710/712	D224 094
FRI 705/6 - FRI 707/6	3/4"	D222 368		
FRI 705/6 - FRI 707/6	1"	D221 999		
			Kit for mounting FRI/6 to DMV/6	Order No.
FRI 710/6 - FRI 712/6	1"	D222 369		
FRI 710/6 - FRI 712/6	1 1/4"	D222 370	FRI 705/707 on DMV 701/6	D219 967
FRI 710/6 - FRI 712/6	1 1/2"	D222 003	FRI 710/712 on DMV 702/6 + 703/6	D219 968
FRI 710/6 - FRI 712/6	2"	D221 997		



## SPECIFICATIONS

High/low gas pressure switch (SPDT) with automatic or manual reset and with visual indication of switch position. Mounts directly to various ports on the DMV series valves and/or FRI series regulators.

**Gases**

Natural gas, Propane, Butane; Other Noncorrosive gases

**Switch**

SPDT

**Switch action**

GAO: high/low limit, NC breaks on rise, automatic reset

GMH: high limit, NC breaks on rise, manual reset

GML: low limit, NO breaks on fall, manual reset

**Contact Rating**

10 A res., 8 FLA, 48 LRA @120 Vac

**Electrical Connection**

1/2" NPT NPT 1/2" conduit connection

**Enclosure**

NEMA Type 4

**Maximum Operating Pressure**

7 PSI (500 mbar)

**Ambient / Fluid Temperature**

-40°F/ to +140°F; (-40°C to +60°C)

**Materials in contact with Gas**

Housing: Aluminum, Steel; Seals: NBR-based rubber

**Approvals**

UL Listed: File No. MH 16628, Guide No. MFHX

FM Approved: Report J.I. 1T7A8.AF and J.I. 1Y9A9.AF

CSA Certified: LR 73925

## ATTENTION

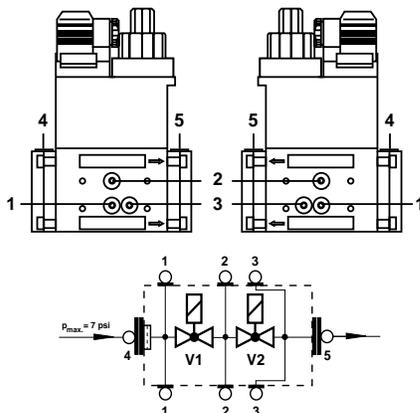
- Read these instructions carefully.
- Failure to follow them and/or improper installation may cause explosion, property damage and injuries.
- Installation must be done with the supervision of a licensed burner technician.
- The system must meet all applicable national and local code requirements.
- Check the ratings in the specifications and on the switch to make sure that it is suitable for your application.
- Never perform work if gas pressure or power is applied, or in the presence of an open flame.
- Once installed, perform a complete checkout including leak testing.
- Label all wires prior to disconnection when servicing. Wiring errors can cause improper and dangerous operation
- Verify proper operation after servicing.

## MOUNTING

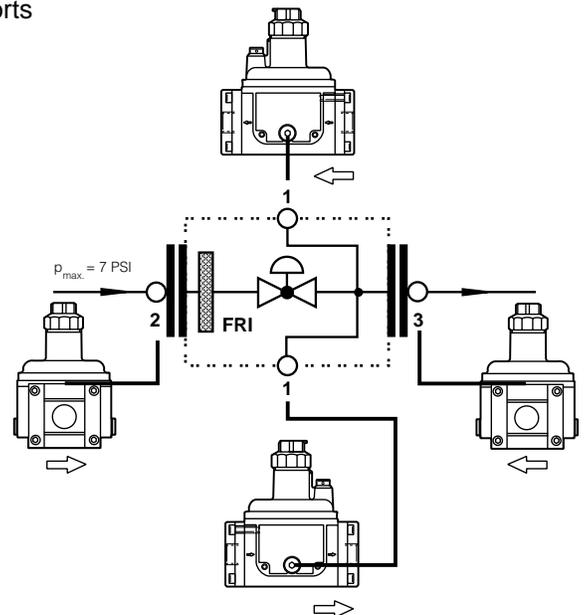
**Location**

Model GAO-A2-4, GMH-A2-4, and GML-A2-4 can be mounted directly to various ports on the DMV system. The pressure switch should be mounted in locations meeting the requirements of the applicable code. Order mounting kit D214975 for DMV port 3 mount.

**DMV ports**



**FRI ports**



**KARL DUNGS INC.**

524 Apollo Drive, Suite 10 Lino Lakes, MN 55014 U.S.A.

Phone: (651) 792-8912 Fax: (651) 792-8919 E-mail: info@karldungsusa.com

## SPECIFICATIONS

**VPS** The Valve Proving System VPS 504 S06 checks that both safety shutoff valves in a Dual Modular Valve (DMV) are closed before either a system start-up or after shutdown when wired and interlocked with a suitable flame monitoring relay. The VPS 504 S06 will halt the start-up sequence to a burner if it detects an open or damaged safety shutoff valve, thus preventing ignition under dangerous conditions.

### Gases

Natural gas, Propane, Air and Other Inert Gases.

### Maximum Operating Pressure

7 PSI (500 mbar)

### Maximum Body Pressure

15 PSI (1000 mbar)

### Ambient / Fluid Temperature

5 °F to +140 °F (-15 °C to +60 °C)

### Electrical Rating

120 Vac / 60 Hz

### Power Consumption

During pump period 60VA

Standby 17 VA

### Contact Rating

Run (Terminal 5) 4A res. 2A FLA @ 120 Vac 60 Hz

Alarm (Terminal 3) 1A res. 0.5A FLA @ 120 Vac 60 Hz

### Enclosure Rating

NEMA Type 12

### Electrical Connection

Screw terminals with 1/2" NPT conduit connection

### Operating Time

100 % duty cycle; Maximum 20 cycles per hour

### Test Volume

Less than 0.14 ft<sup>3</sup>

### Release Period

~10 sec. for test volume < 0.5 cft

>10 sec. for test volume > 0.5 cft

### Detection Limit (Worst Case Condition)

1.4 ft<sup>3</sup> Hour, Natural Gas

### Materials in Contact with Gas

Housing: Aluminum

Seals: NBR-based rubber

### Mounting Position

Vertically upright to horizontal

### Test Ports

One inlet test nipple and one outlet test nipple

### Approvals

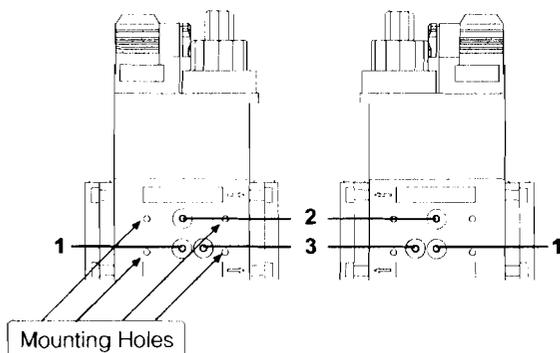
UL Recognized Component File # MN 17004

FM Approved File # J.I. 3004006 (7411)

## ATTENTION

- Read these instructions carefully.
- Failure to follow them and/or improper installation may cause explosion, property damage and injuries.
- Installation must be done with the supervision of a licensed burner technician.
- The system must meet all applicable national and local code requirements.
- Check the ratings in the specifications to make sure that it is suitable for your application.
- Never perform work if gas pressure or power is applied, or in the presence of an open flame.
- Once installed, perform a complete checkout including leak testing.
- Label all wires prior to disconnection when servicing.
- Wiring errors can cause improper and dangerous operation
- Verify proper operation after servicing.

## MOUNTING



### Location

The VPS 504 S06 is to be mounted directly to either the side of the DMV.

### Mounting

Shut off the gas supply and disconnect all power to the DMV and the VPS 504 S06 to prevent shock and equipment damage.



Do not adjust or remove any screws or bolts which are sealed with a Red or Blue colored compound. Doing so will void all approvals and warranties.

KARL DUNGS INC.

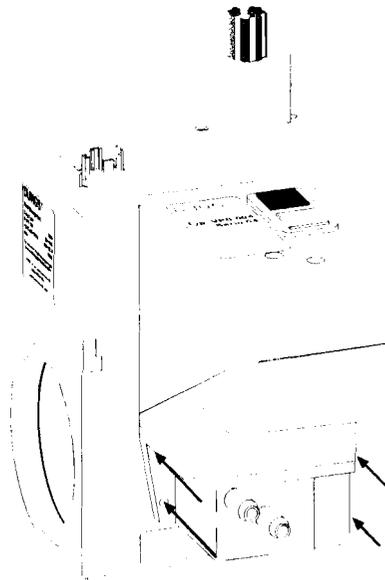
524 Apollo Drive, Suite 10 Lino Lakes, MN 55014 U.S.A. VPS Install - 80122-9/16

Phone: (651) 792-8912 Fax: (651) 792-8919 E-mail: info@karldungsusa.com

## MOUNTING

### Recommended Mounting Procedure

- Verify the 10.5 x 2.25 mm O-rings are fitted into the grooves on the back of the VPS 504 S06.
- Make sure the O-rings are clean and in good condition.
- Remove the G 1/8 plugs from port 1 and port 2 of the valve with a 3 mm hex key wrench.
- Verify that the surface is clean and in good condition. Clean if necessary.
- Use the M 4 x 15 mm self tapping hex head screws supplied to mount mounting the VPS 504 S06 to the DMV valve body. **DO NOT Exceed 22 lb-in of Torque.**
- Verify that the O-rings are located in the grooves.
- Perform a complete leak test to verify that no leakage occurs around the O-rings.



## WIRING

**NOTE:** Use 14 or 16 guage wire rated for 95°C(200°F).

- Disconnect all power to the VPS 504 S06 before beginning the wiring to prevent electrical shock and equipment damage.
  - Do not exceed the terminal ratings given in the specifications and on the VPS 504 S06.
  - Remove the black cap on top of the VPS 504 S06.
  - Loosen the screw which secures the gray cover and remove.
  - Attach 1/2" NPT conduit to the black conduit adapter.
  - Route the wires through the conduit connector.
  - Connect the wiring to the appropriate screw terminals on the terminal strip.
  - Replace the gray cover, the screw, and the black cap.
- A typical wiring diagram for operating the VPS 504 S06 on burner start-up only is shown below.

**CAUTION:** Frequency converters with insufficient shielding can cause faults in the VPS 504 S06 as the result of transients. Verify that the equipment is provided with sufficient shielding.

### Accessory: CM 100, CM 101

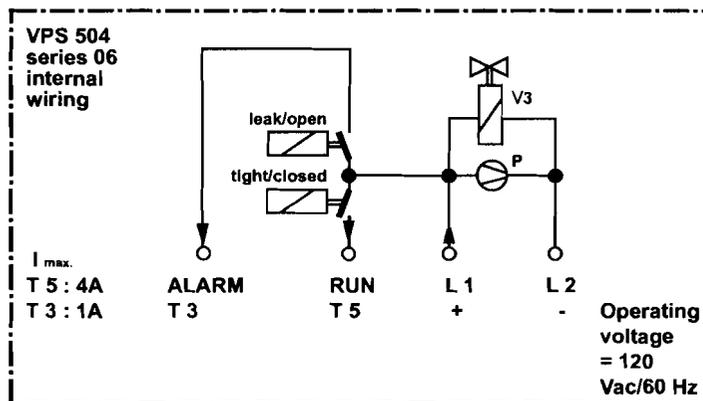
The DUNGS CM 100 and CM 101 incorporate the relays and logic necessary to operate the VPS 504 S06 on a system start up and after shutdown when wired and interlocked with a suitable flame safeguard control. (When the VPS 504 S06 is integrated with the CM 100 or CM 101, the VPS 504 S06 can be used in lieu of a vent line when accepted by the authority having jurisdiction.)



**CAUTION:** All wiring must comply with local electrical codes, ordinances and regulations.



Operating voltage 120 Vac / 60 Hz



# OPERATION

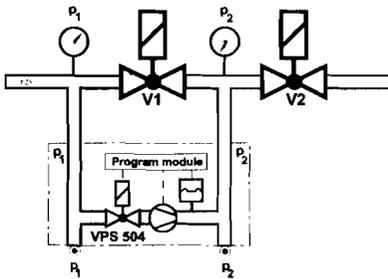
## Functional description

The VPS 504 S06 proves the integrity and the effective closure of the valve seats by pumping gas from upstream of the main safety valve to the volume between the two safety shutoff valves and detecting leakage. The VPS 504 S06 proves the valves as soon as power is applied.

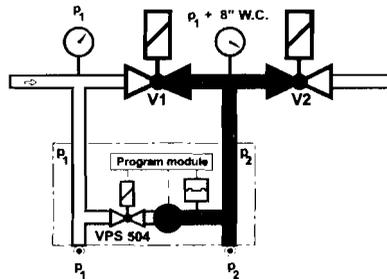
Valve proving occurs:

- Prior to each start-up, or
- After normal shut-down, or
- After safety shut-down, or
- Prior to start and after shutdown when integrated with the CM 100 or CM 101 control module. This allows the VPS 504 S06 to be used in lieu of a vent valve when accepted by the authority having jurisdiction.

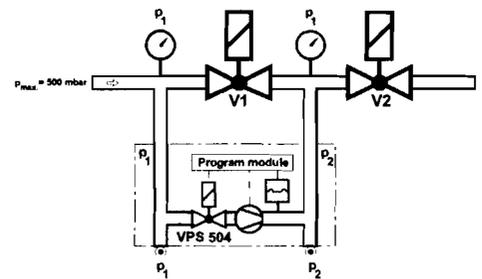
## Program sequence



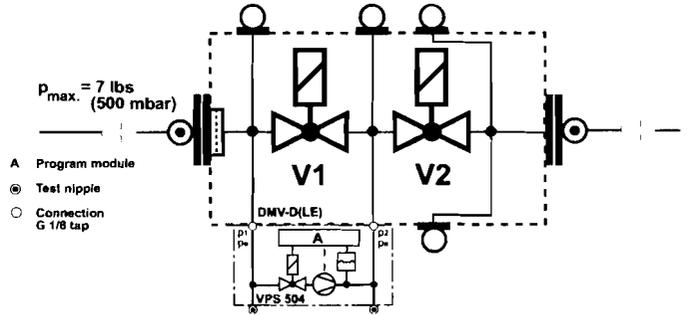
**Idle state**



**Valve Proving**



**Operation**



**Idle state:** Valves 1 and 2 are closed.

**Valve proving:** The internal pump pumps gas pressure from upstream the first safety valve,  $p_1$ , to the volume between the two safety valves. The gas pressure between the two safety shut-off valves,  $p_2$ , increases approx. 8 in. W.C. above  $p_1$ .

During the test period, the internal differential pressure switch monitors the pressure between the two safety valves.

If  $p_2$  increases approx. 8 in. W.C. above  $p_1$ , the motor pump is switched off (end of test period) indicating no leak is detected. The contact "RUN" (T5) is energized after 26 s max. and the yellow signal lamp lights continuously.

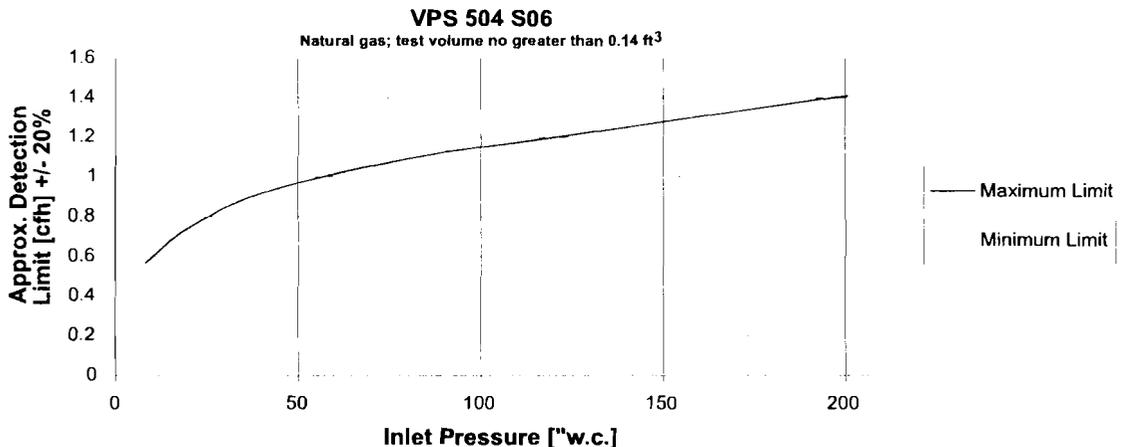
If  $p_2$  does not increase approx. 8 in. W.C. above  $p_1$ , the motor pump is switched off (end of test period) as a leak is detected. The contact "ALARM" (T3) is then energized after about 26 s, and the red signal lamp lights continuously.

The release time (10 - 20 s) depends on the test volume (max. 0.14 ft<sup>3</sup>) and input pressure (max. 200 in. W.C.) In the case of short-term voltage failure during test or burner operation, an automatic restart is performed.

## Operation

VPS pump remains off. "RUN" contact remains energized.

# LEAK DETECTION LIMIT



## MAINTENANCE

The VPS 504 S06 is a protective device. **Check it at least annually for proper operation.**

### Test Procedure

**CAUTION:** Verify that both safety shutoff valve are de-energized and closed prior testing the VPS 504 S06.

1. Loosen test nipple p2. Confirm that gas is not continuously leaking from p2 by applying soapy water to the p2 test port.

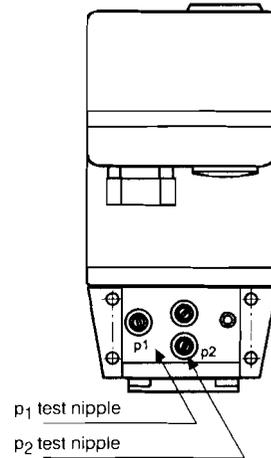
2. With power to the VPS 504 S06, reset the VPS 504 S06 by pressing the red lockout button. Confirm that after the VPS 504 S06 stops pumping that the red light illuminates and the VPS 504 S06 locks out. (Terminal T3 is energized with 120 Vac.)

**Note:** When the internal pump in the VPS 504 S06 is running, a small amount of gas will flow from p2.

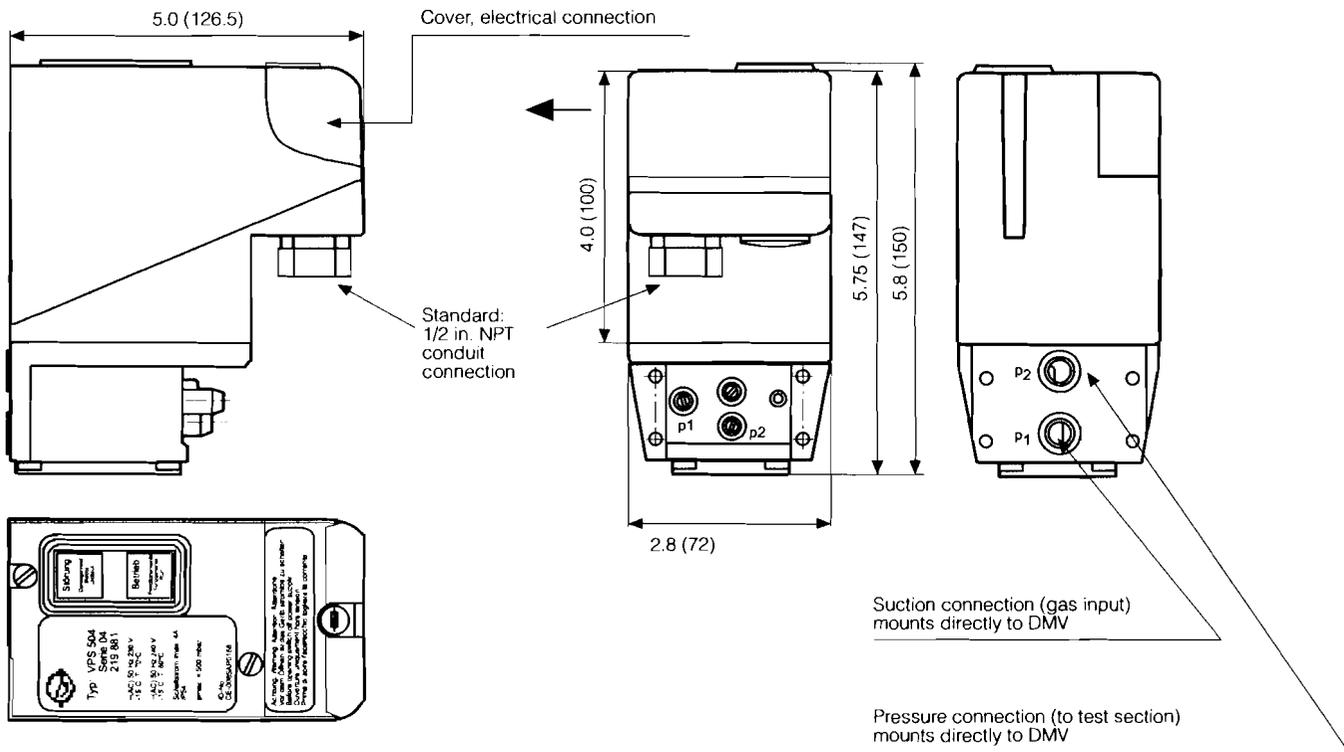
If test procedure 1 or 2 fail, immediately shut down the system, remove and replace the VPS 504 S06.

**CAUTION:** All test ports must be properly tightened before any gas is reapplied to the system.

**CAUTION:** Return the VPS 504 S06 for repair or replacement. Do not try to repair the unit by yourself. You may interfere with its normal operation and cause a fire or explosion. If you disassemble the VPS 504 S06, you will void the approvals, warranty, and exchange policies.



## DIMENSIONS



## Visual Indicator Installation Instructions

### SPECIFICATIONS

**Visual Indicator** The visual indicator (V.I.) is for use with the Karl Dungs, Inc. MV-D(LE), DMV-D(LE), DMV-ZRD(LE), and HSAV models of shut-off valves. The indicator mounts to the bottom of the valve and visually displays when the valve is open or closed.

### ATTENTION

- Read these instructions carefully.
- Failure to follow them and/or improper installation may cause explosion, property damage and injuries.
- Installation must be done with the supervision of a licensed burner technician.
- The system must meet all applicable national and local code requirements.
- Check the ratings in the specifications to make sure that it is suitable for your application.
- Never perform work if gas pressure or power is applied, or in the presence of an open flame.
- Once installed, perform a complete checkout including leak testing.
- Verify proper operation after servicing.

### FUNCTION

The valve position is indicated through the clear plastic.

Red: the valve is open

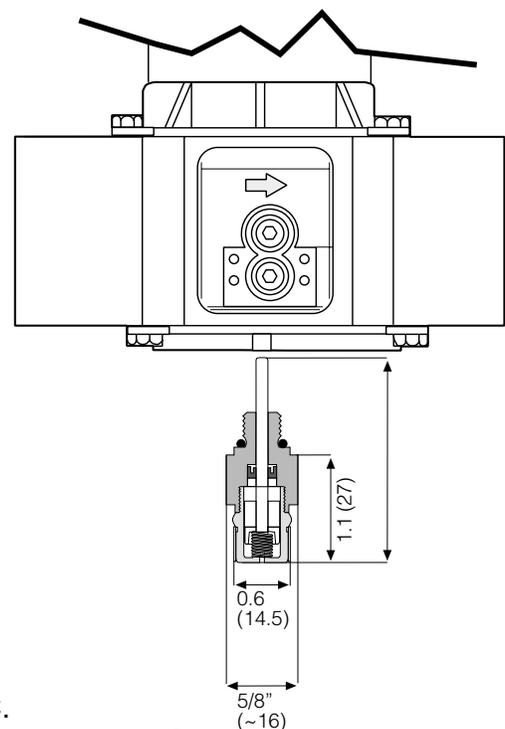
White: the valve is closed

**CAUTION:** When using the visual indicator, reduction of the main flow adjustmet may limit the ability of the V.I. to indicate the position of the valve.

### MOUNTING

1. Remove the plug and the O-ring on the bottom of the valve with a 5mm hex key wrench.
2. Insert the visual indicator and its O-ring; using a 5/8" (16mm) open end wrench, turn clockwise until the visual indicator is sufficiently tightened. DO NOT over tighten, or you will damage the O-ring.
3. Be certain that the valve area where the stickers will be placed is clean before applying the stickers. Install the two aluminum adhesive-backed stickers (one on each side) of the valve body so the operator can refer to either of them while viewing the indicator.
4. Before putting the valve into service, test the indicator by opening and closing the valve to visually verify the indicator is working properly.
5. Apply a soapy water solution between the indicator and the valve body to verify that no leakage occurs.

**CAUTION:** The shut-off valve must be de-energized and its gas supply shut off before installing the visual indicator.



**Warning:** A shut-off valve must have at least 5/32" (3.5mm) of stroke for the visual indicator to work properly. This is especially important to remember when setting the main flow adjustment.

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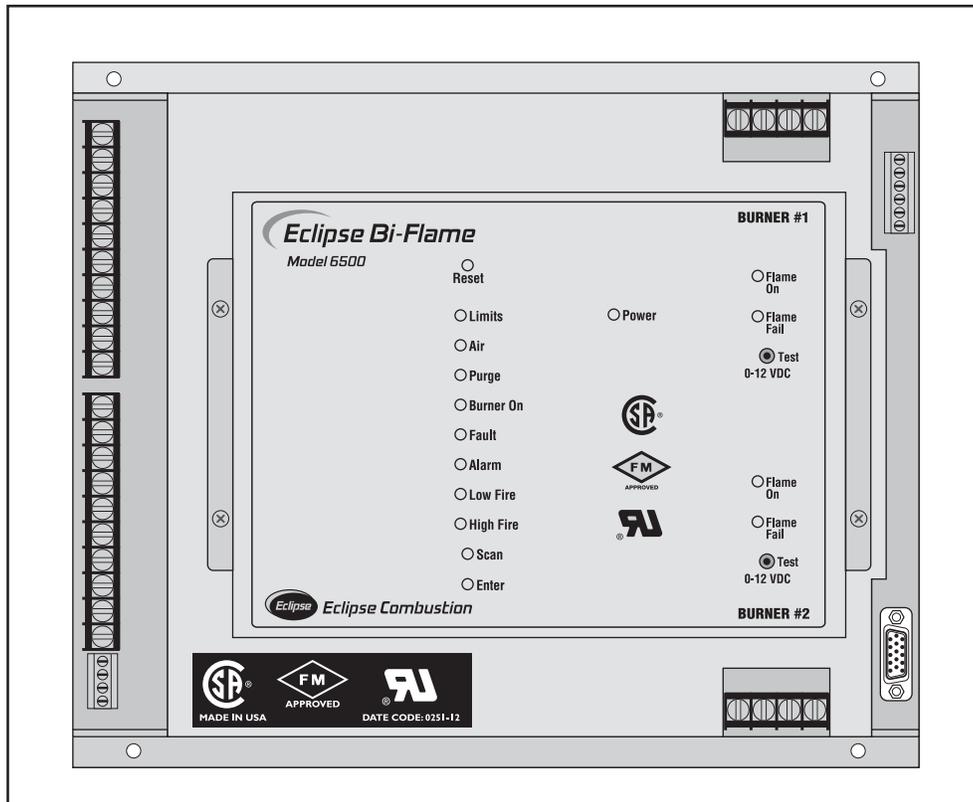


# Bi-Flame

## Dual Burner Monitoring System

Model 6500

Version 1.8



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## **DISCLAIMER NOTICE**

In accordance with the manufacturer's policy of continual product improvement, the product presented in this brochure is subject to change without notice or obligation.

The material in this manual is believed adequate for the intended use of the product. If the product is used for purposes other than those specified herein, confirmation of validity and suitability must be obtained. Eclipse Combustion warrants that the product itself does not infringe upon any United States patents. No further warranty is expressed or implied.

We have made every effort to make this manual as accurate and complete as possible. Should you find errors or omissions, please bring them to our attention so that we may correct them. In this way we hope to improve our product documentation for the benefit of our customers. Please send your corrections and comments to our Marketing Communications Manager.

## **LIABILITY AND WARRANTY**

It must be understood that Eclipse Combustion's liability for its products, whether due to breach of warranty, negligence, strict liability, or otherwise, is limited to the furnishing of burner monitoring system replacement parts and Eclipse Combustion will not be liable for any other injury, loss, damage or expenses, whether direct or consequential, including but not limited to loss of use, income of, or damage to material arising in connection with the sale, installation, use of, inability to use or the repair or replacement of Eclipse Combustion's products.

Eclipse Combustion, for a period of one year from shipment, warrants each Bi-Flame burner monitoring system to the original purchaser to be free from defects in material and workmanship under normal use as defined hereafter. Any operation expressly prohibited in this Guide, any adjustment or assembly procedures not recommended or authorized in these instructions, shall void the warranty.



# About this manual

## AUDIENCE

This manual has been written for the people who select and install the product and the technicians who work on it. They are expected to have previous experience with this kind of equipment.

## IMPORTANT NOTICES

- Read this manual carefully. Make sure that you understand the structure and contents of this manual.
- Obey all the safety instructions.
- Do not deviate from any instructions or application limits in this manual without written consent from Eclipse Combustion.
- If you do not understand any part of the information in this manual, do not continue. Contact your Eclipse sales office or Eclipse Combustion.

## DOCUMENT CONVENTIONS

There are several special symbols in this document. You must know their meaning and importance.

The explanation of these symbols follows. Please read it thoroughly.



### Danger:

Indicates hazards or unsafe practices which **WILL** result in severe personal injury or even death. Only qualified and well trained personnel are allowed to carry out these instructions or procedures.

Act with great care and follow the instructions.



### Warning:

Indicates hazards or unsafe practices which could result in severe personal injury or damage.

Act with great care and follow the instructions.



### Caution:

Indicates hazards or unsafe practices which could result in damage to the machine or minor personal injury.

Act carefully.



### Note:

Indicates an important part of the text. Read the text thoroughly.



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# Introduction

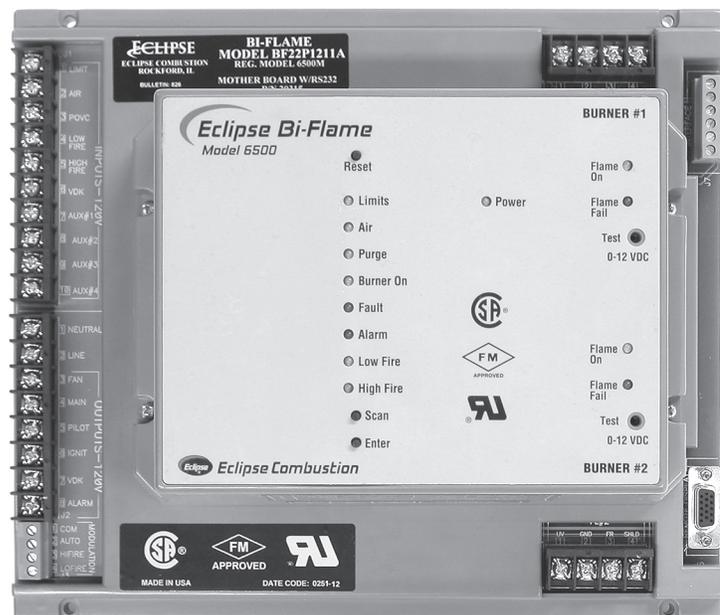
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## PRODUCT DESCRIPTION

The Eclipse Combustion Bi-Flame Burner Monitoring System controls the start-up sequence and monitors the flame of two individual gas, oil, or combination gas/oil burners connected to a common valve train. Its dynamic on-board testing checks for faulty relays, proof of valve closure, high and low fire switch interlocks, and shorted air switch.

The microcomputer based system features a plug-in modular design so any of the circuit board modules attached to the motherboard can be replaced when power is removed. Its DIP switches allow sequence and timing functions, as well as system configuration. It is also capable of modulation (high and low fire purging) and monitoring up to four auxiliary inputs, history logging, and interfacing to valve leakage detection devices. It is UL recognized, FM approved and CSA certified.

**Figure 1.1** Bi-Flame Burner Monitoring System





# Specifications

# 2

## INTRODUCTION

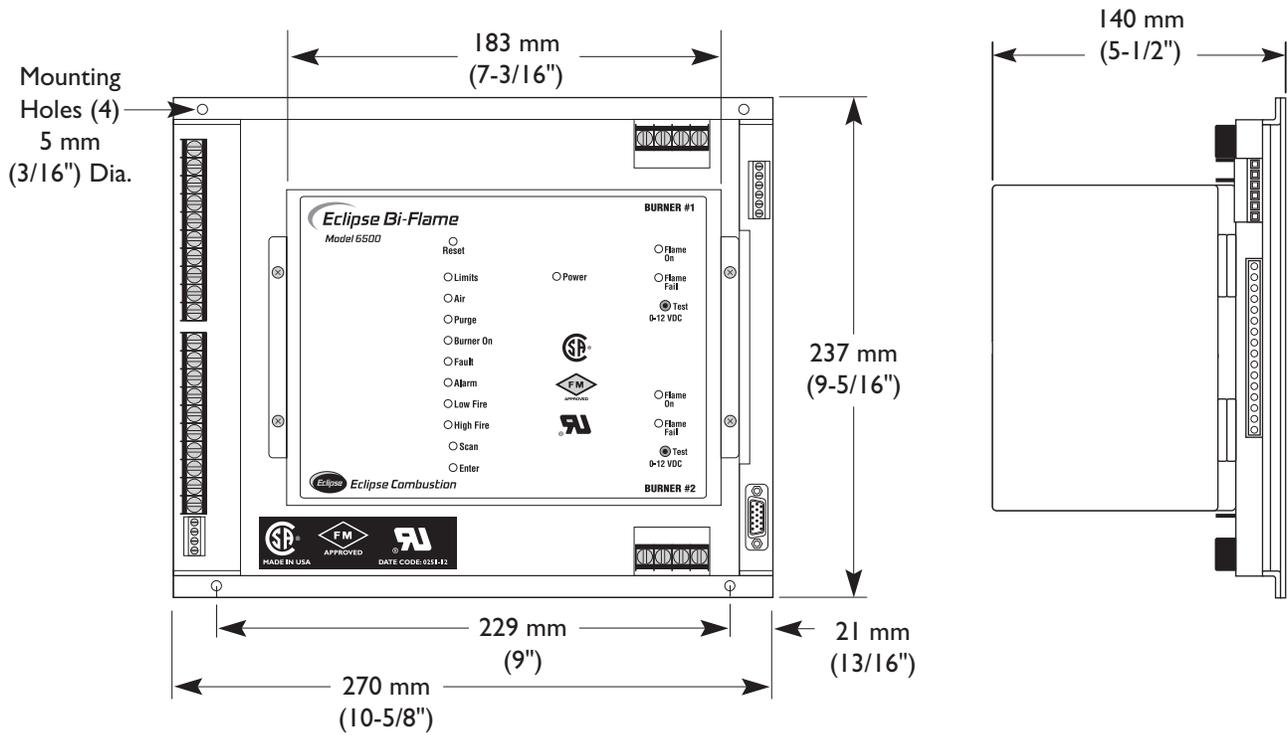
This section gives a detailed overview of Bi-Flame specifications and dimensions.

## Specifications

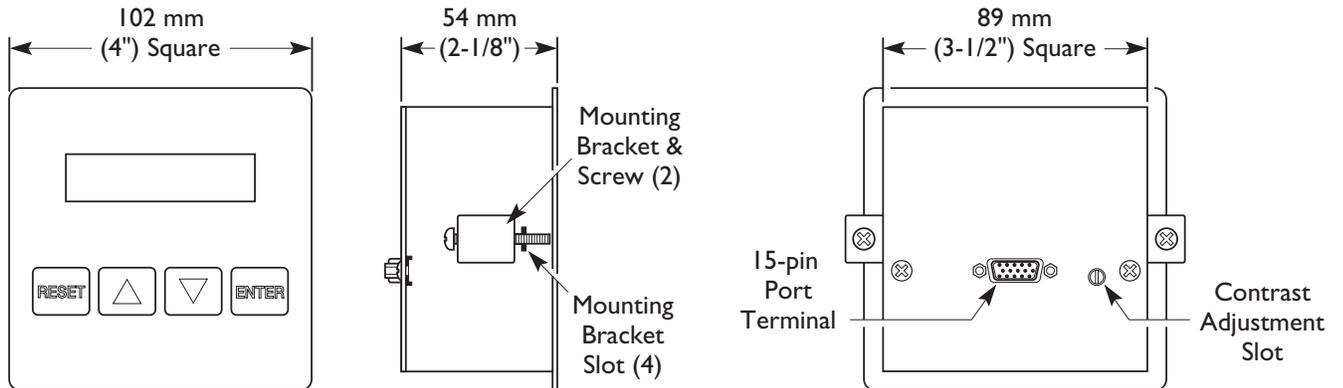
Parameter	Description			
Supply	<ul style="list-style-type: none"> <li>• 120 VAC (+10%, -15%), 50/60 Hz standard.</li> <li>Internal power consumption: 24VA</li> </ul>			
Temperature Ranges	<b>Unit</b>	<b>Model Nos.</b>	<b>Temperature Range</b>	
	Bi-Flame	6500	-40° to +60°C (-40° to +140°F)	
	90° U.V. Scanner	5600-90A	-20° to +60°C (0° to 140°F)	
	U.V. Scanner	5600-91	-40° to +125°C (-40° to +257°F)	
	NEMA4 UV Scanner	5600-91N4	-20° to +125°C (0° to 257°F)	
	Self-Check U.V.	5602-91	-40° to +60°C (-40° to +140°F)	
	Remote Display	6000D	0° to 50°C (32° to 122°F)	
Flame Failure Response	<ul style="list-style-type: none"> <li>• 3 seconds ±0.5 seconds.</li> </ul>			
TFI/Pilot Interrupt	<ul style="list-style-type: none"> <li>• 5, 10 or 15 seconds selectable.</li> </ul>			
Purge Time	<ul style="list-style-type: none"> <li>• Modulating: selectable from 0-225 seconds in 15 second increments, or 0-15 minutes in 1 minute increments</li> <li>• Process: selectable from 0-15 minutes in 1 minute increments, or 0-60 minutes in 4 minute increments.</li> </ul>			
Contact Ratings @ 120 VAC (maximum total connected load not to exceed 15 amps)	<b>Function</b>	<b>Affected Terminals</b>	<b>Inductive Load</b>	<b>Resistive Load</b>
	Output Relay	J2-4 through J2-8	1/3 HP	10 amps
	Output Relay	J2-3	1/2 HP	15 amps
	Modulation	J3-1 through J3-4	1/3 HP	10 amps
Approvals	<ul style="list-style-type: none"> <li>• UL Recognized; File MPI 537 (category MCCZ2)</li> <li>• FM Approved; J.I. 2Y3A5.AF (class 7610)</li> <li>• CSA Certified; File 007989-0-000 (class 2632-01, 2642-01)</li> </ul>			
Shipping Weight	<ul style="list-style-type: none"> <li>• 2.7 kilograms (6 lbs.)</li> </ul>			

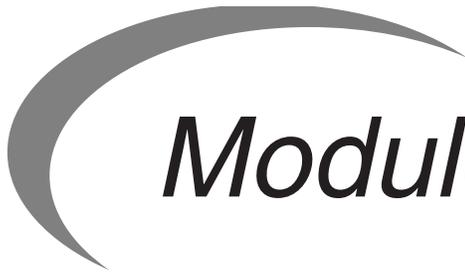
# DIMENSIONS

## Main Chassis



## Remote Display (Shown with remote keypad and reset)



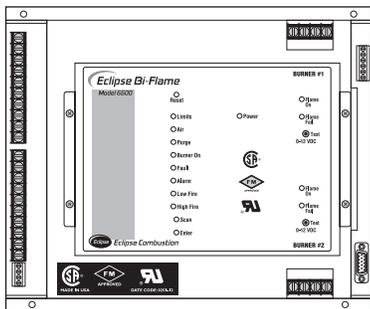


# Modules Description

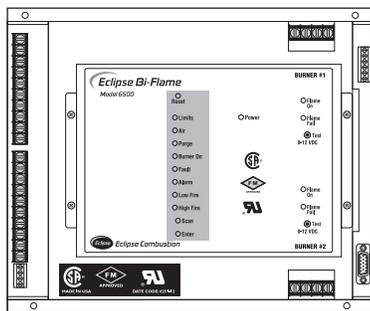
# 3

## INTRODUCTION

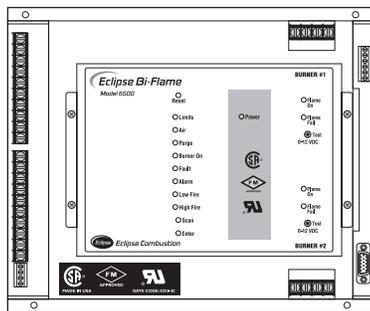
## MODULE DESCRIPTION AND IDENTIFICATION



Relay Module Location



Logic Module Location



Power Module Location

In this section, you will find descriptions of the various modules which comprise the Bi-Flame dual burner flame monitoring system, whether standard or optional items.

### Relay Module

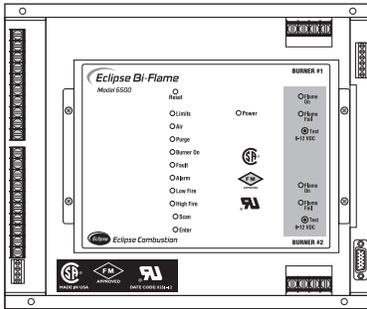
The relay module contains the output relays which provide power for operating the ignition coil, pilot valve, main valve, combustion fan and alarm. This module is mounted in the first position on the left of the motherboard closest to the output terminals.

### Logic Module

The logic module houses the microcomputer which provides all the sequential logic and safety start-up and shutdown circuitry. On the front of this module is the reset, scan and enter push-buttons, and status lights. This module is mounted in the second position from the left of the motherboard next to the relay module.

### Power Module

The power module supplies the power required for the electronic circuitry. It is mounted in the motherboard to the right of the logic module. The green LED on the front indicates that power is on to the Bi-Flame.



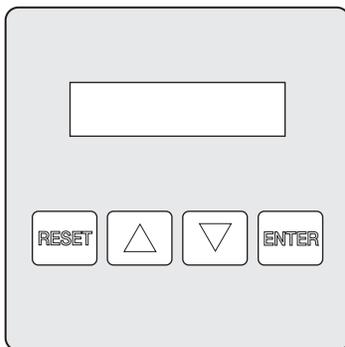
Sensor Module Location

## Sensor Module

The sensor module is the flame sensing module of the Bi-Flame. It is mounted in the furthest right position of the mother board.

On the front of the sensor module are two “Flame On” LED’s, which illuminate when a flame is detected at the corresponding burner. Directly below the “Flame ON” LED are “Flame Fail” LED’s, which energize to show the first burner to lose its signal.

The sensor module incorporates test point connection jacks in the front of the unit. Using these, the flame signal strength of each burner can be measured using a 0-15 VDC, one megohm/volt meter as explained and shown in “Flame Signal Strength” on page 30.



Remote Display

## Remote Display

The remote display provides alphanumeric messages which indicate burner status as well as annunciate lockout condition in the Bi-Flame system. It also provides remote reset, a keypad and history logging capability.

A cable connects the remote display to the motherboard; this cable is available in six and 10 feet lengths.



# DIP Switch Selection

# 4

## INTRODUCTION

This section details the location, selection and description of the Bi-Flame DIP switches, which allow for sequence and timing functions as well as system configuration.



### Caution:

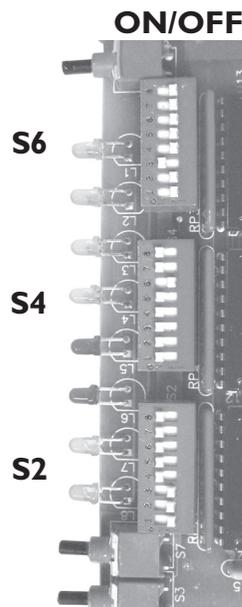
To avoid electric shock, shut off the power supply when installing any control device. Flame monitoring systems must be installed by a qualified, licensed technician.

## DIP SWITCH LOCATION

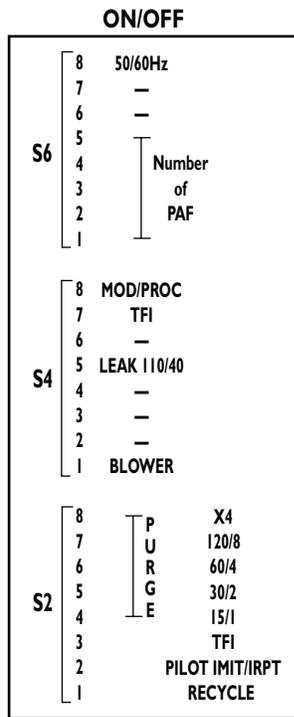
All of the DIP switches are located in the logic module, which is mounted in the second position from the left of the motherboard next to the relay module (see page 10 for logic module location).

## DIP SWITCH ACCESS

To gain access to the DIP switches, remove the circuit board cover. To do this, remove the four screws which hold the cover to the motherboard. Remove the cover by lifting up and off of the circuit boards. The logic module is the second board from the left. Gently pull the logic module with a rocking motion to disengage the terminal pins at the module base. The photo below shows the DIP switch locations.



# DIP SWITCH SETTINGS



DIP Switch Functions

	ON	OFF
S2	8	— X4
	7	Time 120 sec.
	6	Not 60 sec.
	5	Added 30 sec.
	4	15 sec.

S2 Modulation Purge Time, S4 - 8 = ON

	ON	OFF
S2	8	— X4
	7	Time 8 min.
	6	Not 4 min.
	5	Added 2 min.
	4	1 min.

S2 Process Purge Time, S4 - 8 = OFF

If the TFI needed is:	THEN SW3 of S2 DIP switch must be turned:	AND SW7 of S4 DIP Switch must be turned:
5 seconds	Off	Off
10 seconds	Off	On
15 seconds	On	Off or On

Trial-for-Ignition (TFI) Settings

## S2 DIP Switches

The S2 DIP switches permit programming of timing and sequence functions of the Bi-Flame.

**Note:**

The S2 DIP switch settings at left are for illustrative purposes only; the actual settings of any of these switches will be determined by your system conditions.

SW1: Recycling mode selection (On=Recycling; Off=Non-recycling)

SW2: Pilot selection (On = Intermittent, where pilot remains on during burner cycle; Off = Interrupted, where pilot valve closes after main burner is established).

SW3: Trial-for-ignition (TFI) range selection; used with SW7 of the S4 DIP switch. See the table at left for proper selection.

SW4 through 8: Purge time selection; switch in off position selects indicated purge time. Selected purge times are additive. See illustration at left for exact times.

## S4 DIP Switches

SW1: Fan operation on flame failure (on = fan turns off; off = fan stays on).

SW5: Leak test time (on=110 seconds; off=40 seconds).

SW7: Trial-for-ignition (TFI) range selection; used with SW3 of the S2 DIP switches. See the table at left for proper selection.

SW8: Purge mode; (on = modulation, off = process).

## S6 DIP Switches

The S6 DIP switches are factory set for two burners. DO NOT CHANGE. Any other setting will result in an "UNMATCH#" fault condition.

SW6: Off, Not used.

SW7: Off, Not used.

SW8: Frequency Selection; (On = 50Hz, Off = 60 Hz)



# Function Summary

# 5

## INTRODUCTION

This section describes the function features of the Bi-Flame that can be found on the various terminal strips and the modules of the Bi-Flame.

### **Combustion Air Flow Check Terminal**

The Bi-Flame checks that the combustion air flow switch is open before start-up, closed during operation and open again at burner shutdown, thus preventing operation with an air switch that is defective, maladjusted or jumpered.

### **Main Fuel Valve Proof-of-Closure Terminal**

The Bi-Flame checks that the main fuel valve is closed before start-up and after burner shutdown. This arrangement requires a closed position switch on the main fuel valve.

### **Low Fire Start Terminal**

The system checks for the low fire start position prior to light-off. If voltage is not present on this terminal within 15 minutes, the Bi-Flame goes to lockout and alarm.

### **High Fire Purge Check Terminal**

The system checks that the air modulation motor reached the high fire position during high fire purge. The modulation motor or air valve must be fitted with a high fire position switch, which is then connected to the high fire check terminal. An air flow or pressure switch that is set to prove sufficient purge air may be used instead of the high fire position switch. If voltage is not present on this terminal within 15 minutes, the Bi-Flame goes to lockout and alarm.

## Recycle Mode

When selected, the Bi-Flame will restart the sequence after flame or air failure. The recycle mode allows the system to re-initiate the start-up sequence automatically, once the main burners have been operating for at least 20 seconds. If the pilot flame fails to light during recycling, the system will lock out and annunciate a pilot flame fail. If the recycle is successful and the main burners are operational for at least 20 seconds, the system is ready for another recycle. At no time will the system recycle in the event of pilot flame fail.

## Pilot Test Mode

This mode is entered by pressing the “Reset” and the “Enter” buttons simultaneously then releasing the “Reset” button but holding the “Enter” button for another 10 seconds. The limits light will flash off and on, indicating that the system is in the test mode.

In the pilot test mode, the Bi-Flame operates normally with the exception that the main valves are not energized, preventing the main burners from igniting.

To exit the pilot test mode, simply press the “Reset” button and the Bi-Flame will exit the pilot test mode and restart the sequence. Entering the pilot test mode erases the history log.

## Interrupted or Intermittent Pilot

Pilot mode is selected using the DIP switch (see “S2 DIP Switch Settings” on page 13). An interrupted pilot shuts off after the main flame is established. An intermittent pilot continues during the entire main flame firing cycle.

## Spark, Pilot Flame and Main Flame Separation

During the trial for ignition period (TFI), the pilot and ignition outputs remain energized. At the end of the TFI, the pilot output remains on and the ignition output is de-energized. After a five second delay to prove the pilot flame, the main output is energized.



### Note:

*Both pilots must light within the specified TFI or a pilot flame failure will occur. If one burner experiences either a pilot or main flame failure, then both burners will shut down. The failed burner will be indicated by the red “Flame Fail” light.*

## Auxiliary Inputs

This feature provides four auxiliary inputs which are monitored by the Bi-Flame as alarm interlocks. This means that when the input voltage is interrupted, the system locks out and will annunciate on the optional remote display unit.

A voltage of 120 VAC must be present at the input for the Bi-Flame system to operate. If an auxiliary input loses its voltage for more than one second while the interlocks and limits input is powered, a lockout condition will occur. If the Bi-Flame is equipped with a remote display unit, the following message will occur:

<u>Aux. Input #1</u>	<u>Aux. Input #2</u>	<u>Aux. Input #3</u>	<u>Aux. Input #4</u>
<b>AUX.LIM.#1 FAIL</b>	<b>AUX.LIM.#2 FAIL</b>	<b>AUX.LIM.#3 FAIL</b>	<b>AUX.LIM.#4 FAIL</b>
<b>LKOUT HHHH:MM:SS</b>	<b>LKOUT HHHH:MM:SS</b>	<b>LKOUT HHHH:MM:SS</b>	<b>LKOUT HHHH:MM:SS</b>



### Note:

*Unused auxiliary inputs should be connected to 120 VAC.*

## History Log

The history log is only accessible through the remote display unit with remote reset, and when the Bi-Flame is in a “LOCKOUT” or “LIMITS OPEN” condition. The history log records the total number of operating cycles, total recycles, cause of last recycle and the last lockout messages up to a maximum of 10.

With a remote display available and the Bi-Flame in one of the two conditions described above, the history log can be accessed as follows:

- 1) Press and hold the ENTER key on the remote display unit until the following message appears:

**TOTAL OPERATING CYCLES = XXXXXX** (where X is a digit between 1 and 9).

The record number will display as long as the ENTER key is pressed. The scan button on the logic board also scrolls the history log.

- 2) If there has been a recycle, release and press the ENTER key to see: **RECYCLES TOTAL = XXXXXX** then release and press the ENTER key to see:

**LAST RECYCLE BY AIR=XXXXXX** or

**LAST RECYCLE BY FLAME=XXXXXX**

- 3) Release and press the ENTER key a second time. The record number of the lockout message will be displayed:

**RECORD #X** (where X is the number of the most recent lockout)

*(continued on next page)*

## History Log (continued)

- 4) Release the ENTER key and the most recent lockout message will display for seven seconds.
- 5) If you wish to see the next lockout message, press and release the ENTER key before the seven second time duration ends of the most recent lockout message display. This will prompt the next lockout message. If desired, continue this procedure until the maximum of ten lockout messages has been displayed (remember that the highest record number is the most recent lockout message).
- 6) Continued pressing and releasing of the ENTER key in less than seven seconds keeps the history log active and repeats the lockout message list; waiting longer than seven seconds deactivates the history log mode and the next display is the last sequence message before the history log was activated. For example, if the message "LIMITS OPEN" was displayed when the history log was activated, then that message will appear again after seven seconds.
- 7) If you wish to erase all of the lockout messages from the history log, press the RESET and ENTER keys simultaneously while the history log is active. Release the RESET key, but hold the ENTER key for another five seconds. Wait five seconds and press and release the RESET key.

## Modulation Contacts

The modulation feature incorporates "drive high", "drive low", and "automatic" contacts into the purge sequence. This feature allows the Bi-Flame to sequence internal dry contacts which can be used by the customer requiring a high fire purge of the combustion chamber before ignition.

The high fire purge time is selectable by means of S2 DIP switches on the logic board (see "S2 DIP Switch Settings" on page 13)

With this option, the modulation terminals on J3 terminal strip will sequence as follows:

<u>Sequence Step</u>	<u>Internal Contact Connections</u>
High Fire Purge	Terminal 1 (COMMON) to Terminal 3 (HI FIRE)
Low Fire Start	Terminal 1 (COMMON) to Terminal 4 (LOW FIRE)
Automatic	Terminal 1 (COMMON) to Terminal 2 (AUTO)
Post Purge	Terminal 1 (COMMON) to Terminal 4 (LOW FIRE)
Power Off	Terminal 1 (COMMON) to Terminal 2 (AUTO)
Power On/Limits Off	Terminal 1 (COMMON) to Terminal 4 (LOW FIRE)
Alarm	Terminal 1 (COMMON) to Terminal 4 (LOW FIRE)

The Automatic step occurs 20 seconds after the main output has energized (see Table 10.1 beginning on page 36) and allows the burner firing rate to be controlled by an automatic temperature controller.

## Valve Leak Sensing Device (VLSD) Interface

The Bi-Flame Valve Leak Sensing Device (VLSD or VDK) interface provides a 120 VAC output which triggers the start of the test period. An input is also provided which receives a 120 VAC signal from the VLSD. If the signal is received within the selected test period (40 or 110 seconds, see page 13), then the test has been successfully completed. This option includes the required sequential software to initiate the valve leak test on start-up and shutdown of the burners.

When the limits close to the Bi-Flame, the 120 VAC output to the VLSD is activated. If an optional remote display is connected, the following message will appear:

### **VALVE LEAKAGE**

**UNDERTEST XX** (where X is the remaining seconds of the test).

If the VLSD does not activate the VLSD 120 VAC input within the test period, an alarm lockout will occur, and the following message will appear on the optional remote display:

### **VALVE LEAK FAIL**

**LKOUT HHHH:MM:SS**

If a valve leak occurs, the fan output on the Bi-Flame will be activated to purge the combustion chamber of gases.



#### Note:

*If the VLSD input is not used, then it should be connected to 120 VAC.*

## LOGIC MODULE STATUS LIGHTS & PUSH-BUTTONS

### Remote Display Unit

The remote display with keypad allows remote reset and activation of the history log option. It is panel mountable and features a backlit liquid crystal display in a 1/4 DIN housing. It connects to the Bi-Flame by a six or ten foot cable. The display incorporates the following features:

- 1) Provides status messages for the Bi-Flame sequence. (See Section 10)
- 2) Indicates lockout conditions when they occur, as well as the amount of time into the sequence when the lockout occurred and the amount of time elapsed from lockout.
- 3) Provides continuous monitoring of each burner's flame signal strength during main burner operation. (Pressing ENTER once will lock on a particular burner's status; pressing ENTER a second time will resume scrolling).
- 4) Incorporates a remote reset key.
- 5) Provides the interface required for the History Log.
- 6) Incorporates keys for pilot test mode.

### RS232 Communication Interfaces (RS485 optional)

Terminals 1, 5, and 6 on Bi-Flame terminal strip J7 provide a serial ASCII output communication interface for remotely monitoring the system sequence and status using a terminal or a modem; refer to Section 10 for the types of messages sent by the Bi-Flame.

The communications protocol is 8 bit, no parity, 1 stop bit and 1200 baud. This feature is provided standard as a RS232 interface. The RS485 interface is optional.

Sending a carriage return (<CR> = ASCII Hex 0D) from the terminal causes the Bi-Flame to retransmit the last message. Sending a CTRL-E (<ENQ> = ASCII Hex 05) accesses the optional history log.

The logic module provides all the sequential logic, and safety start-up and shutdown circuitry. On the front of the module is the reset, scan and enter push-buttons, and status lights. This section describes the their respective functions.

### Limits

This LED illuminates when the operation limits are made. These limits are wired in series to terminal J1-1. This input becomes energized to begin the burner sequence. When in the test mode, this LED flashes (see "Pilot Test Mode" on page 15).

**Air**

This LED illuminates when the air switch is closed and power is thereby applied to the air switch input. The Bi-Flame also checks this input for an air switch short (see “Combustion Air Flow Check Terminal” on page 14).

**Purge**

This LED illuminates whenever the combustion blower is energized, including the purge period and the main burner period of the sequence. It blinks on and off while the purge is in process and remains constant when the purge process is complete.

**Burner On**

This LED illuminates when the main gas valve is energized, permitting gas flow to all the burners.

**Fault**

This LED illuminates when a system fault is detected (see “System Faults” on page 21).

**Alarm**

This LED illuminates when an alarm condition causes a system lock-out (see “System Lockout Conditions” on page 21).

**Low Fire**

This LED illuminates during the low fire period of the purge cycle.

**High Fire**

This LED illuminates during the high fire period of the purge cycle.

**Scan**

This push-button can be used to scroll the history log.

**Enter**

This push-button is used with the RESET button to enable the pilot test mode.

**Reset**

This push-button resets the control. It is also used with the ENTER button to enable the pilot test mode.

## System Faults

A system fault (illuminated by the fault LED on the logic cards) prevents gas ignition but does not lock out the system. System fault conditions are as follows:

- 1) If a flame is detected out of sequence, which may be caused by:
  - a) a faulty scanner
  - b) electrical interference on the sensor leads
  - c) a flame exists in the burner due to a gas leak or other condition.
- 2) Air flow switch closed before start-up.

## System Lockout Conditions

A system lockout will occur (illuminated by the alarm LED on the logic card) for any of the following conditions:

- 1) Air failure—loss of combustion anytime during the operational cycle.
- 2) Pilot flame fail—loss of flame during the trial for pilot ignition period.
- 3) Main flame fail—loss of flame during the main burner trial for ignition.
- 4) Main fuel valve—open after cycle shutdown or before start-up with interlocks closed.
- 5) Unmatched burners—the S6 DIP switch is not set correctly (see “S6 DIP Switch Settings” on page 13).
- 6) Relay fail—failure of Bi-Flame internal relays.
- 7) Low fire fail—low fire switch open for more than 15 minutes prior to trial for ignition.
- 8) High fire fail—high fire switch has not closed within 15 minutes of high fire purge.
- 9) Flame fail—loss of flame after main flame has been established.
- 10) Auxiliary input fail—loss of input voltage to any of the four “Aux” terminals after the limit input is made.
- 11) Valve leak fail—valve leak sensing device has detected a leak.
- 12) Wiring error which puts external voltage on any of the output terminals.
- 13) Welded internal contacts or other malfunctions in the Bi-Flame.

# System Installation

# 6

## INTRODUCTION

In this section, the necessary procedures are detailed to integrate a Bi-Flame into a burner system; Figure 6.1 (page 25) illustrates the various terminal strips mentioned.



**Note:**

*Shut off the power supply before any module is removed or replaced from the unit, including the remote display.*



**Caution:**

*Installation and maintenance must conform with the National Electrical Code and all other national and local codes and authorities having jurisdiction.*

## INTERLOCKS AND LIMIT SWITCH INPUT

Interlocks are generally pressure or temperature switches which, when activated, start the burner. Limit switches are generally pressure, temperature and other switches which, when activated, stop the burner. The interlocks and limit switches are wired in series. A break in this circuit will shut the burner down, but will not produce an alarm. This input is considered the normal operation control input to the Bi-Flame system.

## COMBUSTION AIR SWITCH INPUT

This input is for monitoring the combustion air switch separately from other interlocks and limits. When wired to this input, the air switch will be proven open before start-up and after shutdown. It will also be proven closed 10 seconds after the combustion air blower is energized.

If the air switch opens during the main firing cycle, the system will either lockout or recycle, depending on the DIP switch selection.

If this terminal is not used, place a jumper between the combustion blower output (terminal 3 on terminal strip J2) and the air switch input (terminal 2 on terminal strip J1). This jumper must not be used in place of a required air flow switch interlock.

If the combustion air blower is controlled outside of the Bi-Flame system, then the air switch must be wired between the combustion blower output and the air switch input. Connecting the air switch in this manner will prevent the open contact (air short) check on the switch.

## IGNITION WIRING

Route ignition wiring a sufficient distance from all sensors and other low voltage wiring to avoid electrical interference, which may cause erratic operation of the Bi-Flame system.



### Caution:

*Do not connect multiple ignition coils in excess of output relay contact rating*

## COMMUNICATION WIRING

Route communication wiring, using shielded cable, a sufficient distance from ignition and other high voltage wiring to avoid electrical interference.

## POWER SUPPLY

All input power must be single phase 120 VAC, 60/50 Hz selectable, see page 13. All circuits must have a common 15 amp fuse and disconnect. The neutral must be grounded. Do not use solid-state triac output devices in any of the input circuits. 120 VAC wiring must be at least 90°C 16 AWG minimum and satisfy all applicable codes.

## LOW FIRE POSITION INPUT

It is possible to wire the system for checking low fire start position prior to pilot ignition. To use this feature, the low fire start switch must be connected to the low fire start input (terminal 4 on terminal strip J1). If this feature is not used, a jumper must be placed between terminals 1 and 4 on terminal strip J1.

## MAIN VALVE PROOF-OF-CLOSURE

The system can be wired to check for the proof of valve closure (POVC) switch on the main gas valve prior to start-up and after the end of the burner cycle.

To use this feature the POVC switch must be connected to the POVC switch input (terminal 3 on terminal strip J1). If this feature is not used, a jumper must be placed between terminals 2 on terminal strip J2 and 3 on terminal strip J1.

## HIGH FIRE POSITION INPUT

The system can be wired to check for high fire position during the high fire purge portion of the sequence. To use this feature, the high fire position switch must be connected to the high fire input (terminal 5 on terminal strip J1). If this feature is not used, a jumper must be placed between terminals 1 and 5 on terminal strip J1.

## AUXILIARY INPUTS

The system can be wired to check auxiliary status conditions with the four auxiliary inputs. To use this feature, the auxiliary input switches must be wired to the auxiliary inputs (terminals 7,8,9 and 10 on terminal strip J1). If this feature is not used, these inputs must be connected to 120 VAC.

## REMOTE RESET

This feature permits remote mounting of a switch to reset the Bi-Flame. To use this feature, a normally closed remote reset switch must be wired between terminals 1 and 4 on terminal strip J7. When it is depressed or actuated, the connection between the terminals is momentarily interrupted and resets the Bi-Flame. This is a low voltage signal circuit that must be routed separately from other control voltage wiring. Use two-conductor shielded cable with the shield connected on one end only to terminal 1 of J7.



**Note:**

*If reset is required from both the display and the J7 terminals, use a normally open switch.*

## REMOTE DISPLAY

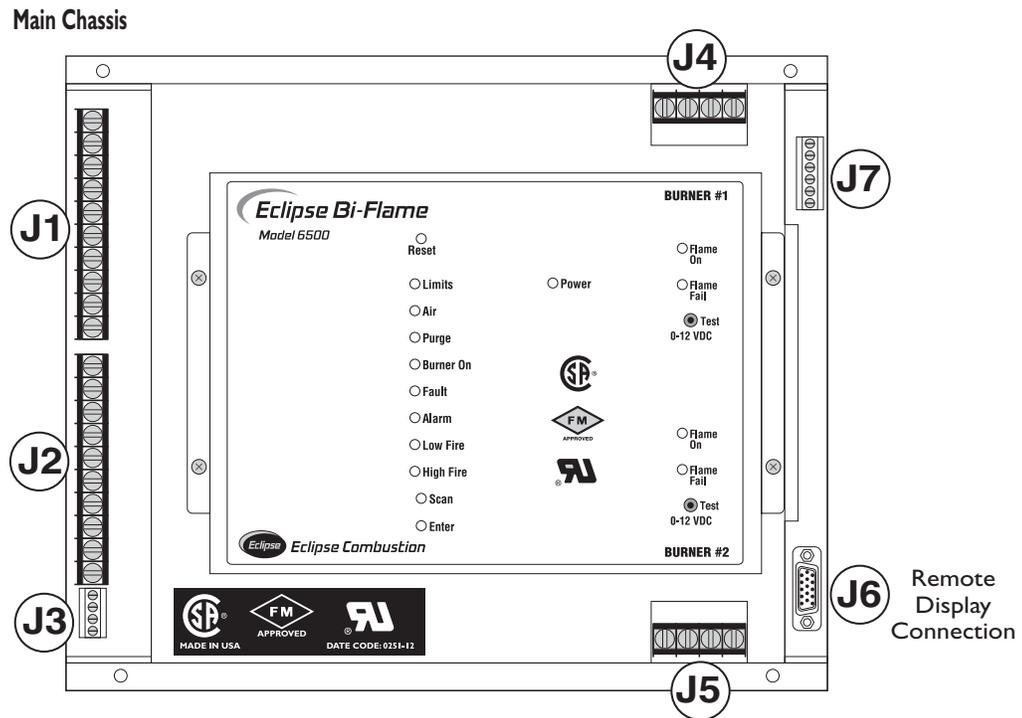
When installed, the remote display must be grounded. Panel mounting is through a 1/4 DIN cutout (see page 9). Use either the six or ten foot cable to connect it to the motherboard.



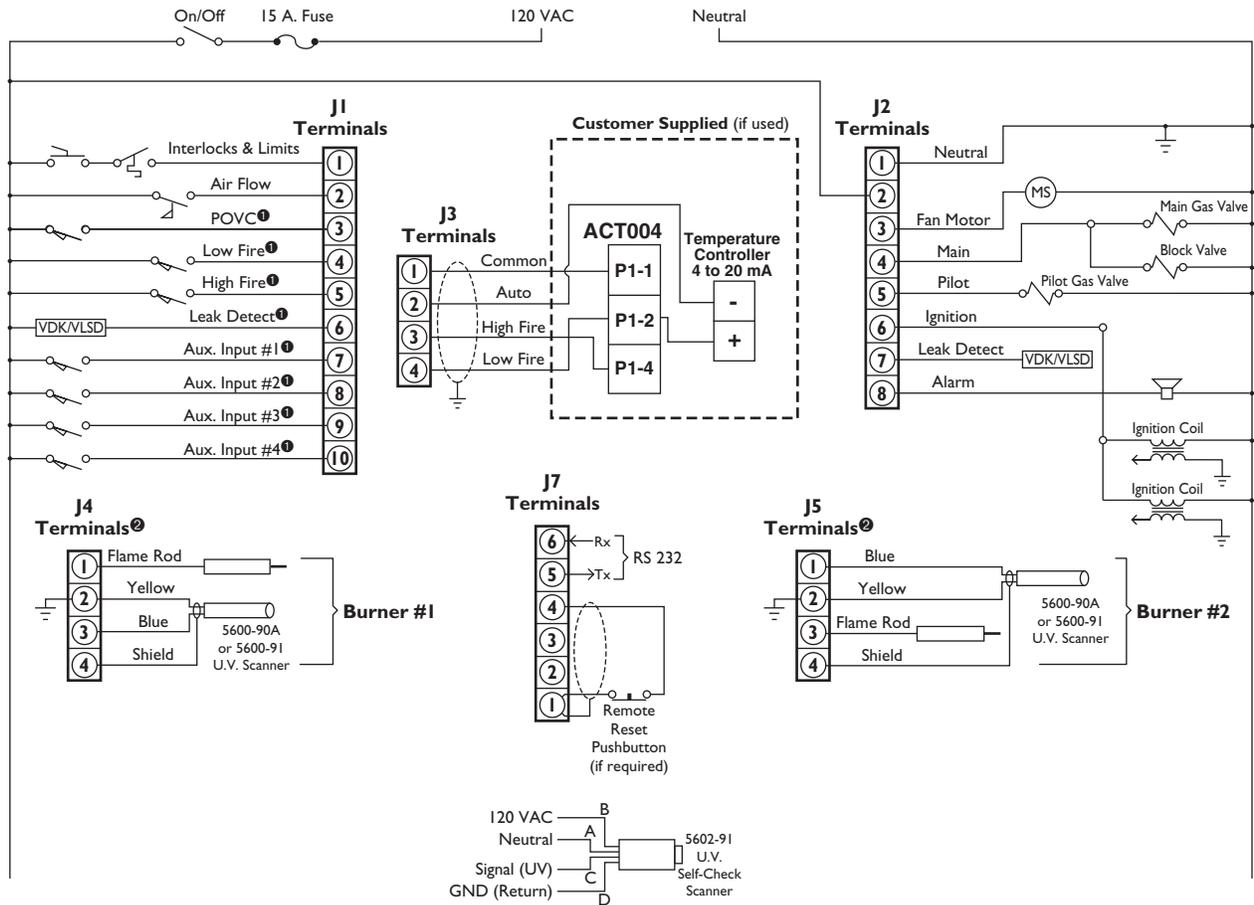
**Warning:**

**Power must be off when inserting or removing the cable.**

**Figure 6.1 Terminal Strips Identification & Location**



**Figure 6.2 Wiring Diagram & Connections—Main Chassis**



① When not used, must be tied into 120 VAC.

② Using both sensors isn't mandatory; you may use a flame rod, or a UV scanner, or both.

**J1 (Input) Terminals**

- 1 – Limits Input
  - 2 – Air Switch Input
  - 3 – POVC Switch Input<sup>①</sup>
  - 4 – Low Fire Switch Input<sup>①</sup>
  - 5 – High Fire Switch Input<sup>①</sup>
  - 6 – VDK/VLDS Input<sup>①</sup>
  - 7 – Aux. #1<sup>①</sup>
  - 8 – Aux. #2<sup>①</sup>
  - 9 – Aux. #3<sup>①</sup>
  - 10 – Aux. #4<sup>①</sup>
- Auxiliary Inputs**

**J3 (Modulation) Terminals**

- 1 – Common
  - 2 – Auto
  - 3 – Hi Fire
  - 4 – Low Fire
- Modulation Motor Connections for High Fire & Low Fire Start**

**J5 (Sensors/Burners 2 & 4) Terminals<sup>②</sup>**

- 1 – U.V. (Blue)
  - 2 – Ground (Yellow)
  - 3 – Flame Rod
  - 4 – Shield Connection
- Burner #2**

**J4 (Sensors/Burners 1 & 3) Terminals<sup>②</sup>**

- 1 – Flame Rod
  - 2 – Ground (Yellow)
  - 3 – U.V. (Blue)
  - 4 – Shield Connection
- Burner #1**

**J2 (Output) Terminals**

- 1 – Neutral
  - 2 – 120 VAC
  - 3 – Fan
  - 4 – Main Gas Valve
  - 5 – Pilot Gas Valve
  - 6 – Ignition Transformer
  - 7 – VDK/VLDS
  - 8 – Alarm
- Bi-Flame Power Inputs**  
**Outputs**

**J7 (Interface) Terminals**

- 6 – RS 232/RS 485 Interface
- 5 – RS 232/RS 485 Interface
- 4 – Reset
- 3 – Scan
- 2 – Enter
- 1 – Ground

# Sensor Installation

# 7

## INTRODUCTION

This section describes the proper wiring, installation and sighting considerations for all sensors that can be used with a Bi-Flame.



### **Warning**

**Incorrect sensor installation may cause the sensor to generate a false flame signal, causing unburned fuel to collect in the combustion chamber. The result can be explosions, injuries and property damage. Be certain that the flame sensor detects only pilot and main flames, not glowing refractory, burner or ignition parts.**

## SENSOR WIRING

Route sensor wiring a sufficient distance from ignition and other high voltage or high current wiring to avoid electrical interference. Interference from ground currents, nearby conductors, radio-frequency emitters (wireless devices), and inverter drives can induce false flame signals. Shielded cables can help reduce interference with the shield connected to ground at the control end only. The wire type and its capacitance (picofarads or microfarads) to ground may cause low signal problems, so a grounded shield may decrease the signal due to the cable's internal capacitance. Multiple U.V. tube-type sensor leads run together without shielding may interfere or "cross talk", so the shield or flexible armor must be grounded to prevent this situation. For flame rod sensor runs approximately 100 feet (30 meters) or greater, use Eclipse part number 21741 coax cable. To achieve the maximum wiring distance, the shield should not be grounded (keep in mind that an ungrounded shield provides less protection against electrical interference).

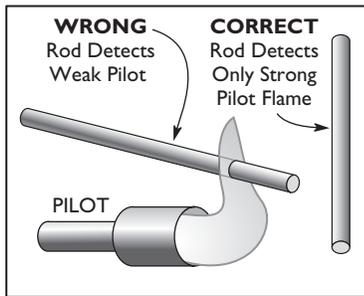
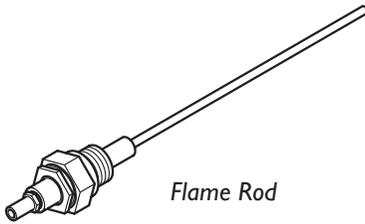
**Do not ground the shield to terminal GND.**



### **Note:**

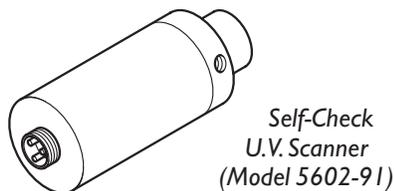
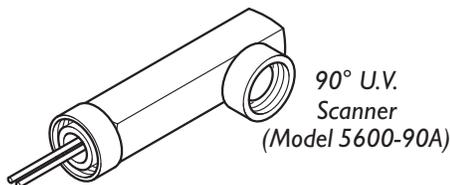
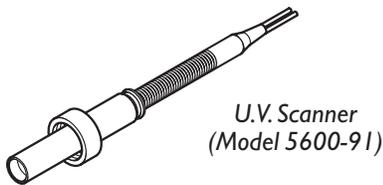
*Unshielded sensor wiring must not be run in common with other wires; it must be run in separate conduit. Multiple unshielded flame sensor wiring must not be run together in a common conduit or wireway. Use #14 to #18 AWG wire suitable for 90°C (194°F) and 600 volt insulation, or better grade if required by the application. Multiple shielded cables can be run in a common conduit.*

## FLAME RODS



Flame Rod Position

## SCANNERS



Flame rods should be used only on gas burners. They accumulate soot on oil burners, causing nuisance shutdowns and unsafe operating conditions.

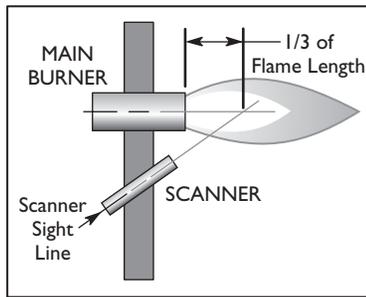
See the burner manufacturer's literature for flame rod mounting location. When installing flame rods, please consider the following:

- 1) Keep the flame rod as short as possible and at least 13 mm (1/2") away from any refractory.
- 2) Position the rod into the side of both the pilot and main flames, preferably at a descending angle to minimize drooping of the flame rod against burner parts. Flame rod position must adequately detect the pilot flame at all burner draft conditions. Extend the rod 13 mm (1/2") into nonluminous flames, such as blue flames from burning an air/gas mixture. For partially luminous flames, such as atmospheric air/gas mixtures, place the rod at the edge of the flame.
- 3) Provide a burner/flame grounding area that is at least four times greater than the flame rod area contacting the flame. The flame rod/burner ground ratio and position of the rod in the flame may need adjustment to yield maximum flame signal strength.
- 4) Ignition interference from the spark plug may increase or decrease the flame signal strength. Reversing the ignition transformer primary leads may reverse this effect. Reducing the spark gap or adding grounding area between the flame rod and spark plug may eliminate the interference.

Use only Eclipse model 5600-90A, 5600-91, 5602-91 or 5600-91N4 scanners. Consult the burner manufacturer's instructions for mounting location. When installing scanners, please consider the following:

- 1) Position the scanner within 457 mm (18") of the flame.
- 2) Bushing threads are 1/2 inch F.N.P.T. for scanner models 5600-90A, 5600-91 and 5600-91N4; model 5602-91 has 1 inch F.N.P.T. bushing threads.
- 3) The ambient temperature limits of each scanner varies, (see specifications). For higher temperatures, use Eclipse heat insulator 49099 or the Heat Block Seal, Model 23HBS, that has a purge fitting.
- 4) An optional magnifying lens (Eclipse #49600-98) may also be used to increase the flame signal strength in difficult sighting situations.

## SCANNER SIGHTING CONDITIONS



*U.V. Scanner Sighting*

Aim scanners at the third of the flame closest to the burner nozzle, as shown at left. This is especially true for oil flames which typically have less UV radiation in the outer flame. The scanner should view the intersection of the pilot and main flames. When sighting scanners, please consider the following:

- 1) Sight the scanner away from the ignition spark. Sighting the spark or its reflections from burner internals can be misinterpreted as a flame signal.
- 2) Do not allow the scanner to detect a pilot flame that is too small to ignite the main burner.
- 3) Perform a minimum pilot test when installing or adjusting any pilot or main burner system; see "Minimum Pilot Test" on page 30.

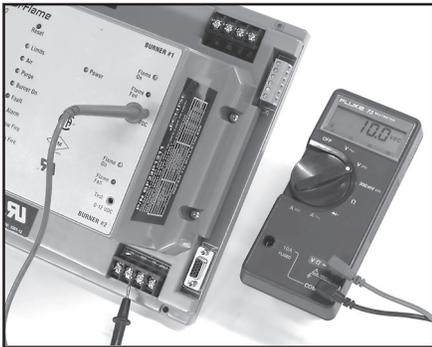
# Test Procedures

# 8

## INTRODUCTION

## FLAME SIGNAL STRENGTH

## MINIMUM PILOT TEST



Voltmeter hook-up to the Bi-Flame

This section describes the test procedures that must be performed after installation to insure that the Bi-Flame is operating properly; these procedures are mandatory.

Insert the positive probe of a 0-15 VDC, one megohm/volt meter into the test point on the front cover, as shown in the photo at left. Connect the negative probe to ground. A good flame signal strength will read between 6 and 11 VDC; anything below 4VDC is inadequate.

Run the following test procedures to ensure that the sensor will not detect a pilot flame too small to reliably light the main flame:

- 1) Manually shut off the fuel supply to the burner, but not to the pilot.
- 2) Start the system normally.
- 3) To enter the pilot test mode, press the RESET and ENTER buttons simultaneously. Then release the RESET button but keep the ENTER button depressed for another 10 seconds. The Limits LED will blink, signalling that the system is in the pilot test mode.
- 4) The control will hold the operating sequence at the pilot flame step. Measure signal strength as described above.
- 5) Reduce pilot fuel until the flame relay drops out. Increase pilot fuel until the flame signal is greater than 4VDC, and flame relay just manages to pull in. This is the minimum pilot. If you don't think this flame will be able to safely light the main burner, realign the sensor so that it requires a larger pilot flame and repeat steps 2 through 5.
- 6) Push the RESET button to exit the test mode and begin the normal start-up sequence again.
- 7) When the sequence reaches the main flame trial for ignition, smoothly restore the fuel supply to the burner. If the main burner does not light within five seconds, immediately shut off the burner supply to shut down the system. Realign the sensor so that it requires a larger pilot flame. Repeat steps 1 through 6 until the main burner lights off smoothly and reliably.

## PILOT FLAME FAILURE TEST

- 1) Manually shut off the fuel supply to one individual pilot and main burner, or all burners if the system has a single fuel supply.
- 2) Place system in pilot test mode (please refer to page 15).
- 3) Start the system normally. The controller should lock out\*; if it doesn't, then the controller is detecting a false flame signal (see Section 7). Find the problem and correct it before resuming normal operation.
- 4) Repeat steps 1 through 4 until all burners have been tested.

## MAIN FLAME FAILURE TEST *(For Interrupted Pilot Systems)*

- 1) Manually shut off the fuel supply to the main burner, or all burners if the system has a single fuel supply, but not to the pilot.
- 2) Start the system normally. This should ignite the pilot and lock out\* after pilot interruption. If the system does not lock out, the controller is detecting a false flame signal (see Section 7). Find the problem and correct it before resuming normal operation.
- 3) Repeat steps 1 through 3 until all burners have been tested.

## SPARK SIGHTING TEST

- 1) Manually shut off the fuel supply to the pilot and main burner.
- 2) Start the system normally.
- 3) Measure the flame signal as described in "Flame Signal Strength" in this section.
- 4) If a flame signal greater than 4VDC is measured for more than three seconds during the trial for ignition, the sensor is picking up a signal from the spark plug or the ignition current is interfering with the sensor wiring. If this is an abnormal condition, correct before resuming normal operation.

## LIMITS AND INTERLOCK TESTS

Periodically check all interlock and limit switches by manually tripping them during burner operation to make sure they cause the system to shut down.



### **Warning**

***Never operate a system that is improperly adjusted or has faulty interlocks or limit switches. Always replace faulty equipment with new equipment before resuming operation. Operating a system with defective safety equipment can cause explosions, injuries, and property damage.***

\* The burner at which a flame fails will be identified by the red "Flame Failure" LED on the cover.

# Maintenance and Troubleshooting

# 9

## INTRODUCTION

## MAINTENANCE

This section is divided into two parts:

- The first part describes the maintenance procedures.
- The second part helps you to identify problems that may occur, and gives advice on how to solve these problems.

Preventative maintenance is the key to a reliable, safe and efficient system. The core of any preventive maintenance program is a list of periodic tasks.

In the paragraphs that follow are suggestions for a monthly list and a yearly list.



**Note:**

*The monthly list and the yearly list are an average interval. If your environment is dirty, then the intervals may be shorter.*



**Caution:**

*Turn off power before disconnecting or installing sensors, controls or modules.*

### Monthly Checklist

1. Inspect flame-sensing devices for good condition and cleanliness. Keep the glass lens of scanners clean with a soft, damp cloth, since small amounts of dust will measurably reduce the flame signal strength. Wash the flame rod electrode and insulator with soap and water, then rinse and dry thoroughly.
2. Test all the alarm systems for proper signals.
3. Check ignition spark electrodes and check proper gap.
4. Test interlock sequence of all safety equipment as described in Test Procedures: manually make each interlock fail, noting what related equipment closes or stops as specified by the manufacturer.  
Test flame safeguard by manually shutting off gas to the burner.

## **Yearly Checklist**

- 1.** Test (leak test) safety shut-off valves for tightness of closure.
- 2.** Test pressure switch settings by checking switch movements against pressure setting and comparing with actual impulse pressure.
- 3.** Visually check ignition cable and connectors.
- 4.** Make sure that the following components are not damaged or distorted:
  - the burner nozzle
  - the spark plugs
  - the flame sensors
  - the flame tube or combustion block of the burner

## TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	SOLUTION
Cannot initiate start sequence	• Main valve is not closed.	Check proof-of-valve-closure switch.
	• Air pressure switch has not made contact.	Check air pressure switch adjustment. Check air filter. Check blower rotation. Check outlet pressure from blower.
	• High gas pressure switch has tripped.	Check incoming gas pressure; adjust gas pressure if necessary. Check pressure switch setting and operation.
	• Low gas pressure switch has tripped.	Check incoming gas pressure; adjust gas pressure if necessary. Check pressure switch setting and operation.
	• Malfunction of flame safeguard system such as a shorted-out flame sensor or electrical noise in the sensor line.	Have qualified electrician investigate and rectify.
	• Purge cycle not completed.	Check flame safeguard system, or purge timer.
	• Main power is off.	Make sure power is on to control system.
	• No power to control unit.	Call qualified electrician to investigate.
Scrambled messages on remote display.	• Improper grounding in system.	Check grounding in system.
“UNSAFE AIR SHORT” message appears on display.	• Improperly adjusted air switch. • Air switch either shorted or wired wrong.	Check air switch settings. Check wiring to air switch.
Burner flame fails but no flame failure indication occurs.	• A faulty scanner.	Check scanner as explained in checklists in “Maintenance” portion of this Section.
	• Improperly connected sensor wires.	Check wiring diagram on page 26 as well as appropriate sensor information in Section 7.
	• Electrical interference from other current carrying wires.	Check Note information on page 27 regarding sensor wiring.

# Remote Display Messages

# 10

## INTRODUCTION

This section covers how the optional remote display is used with the Bi-Flame. The remote display provides LCD messages which monitor the status of the Bi-Flame's functions as well as any lock-out conditions. This section is divided into two parts or tables:

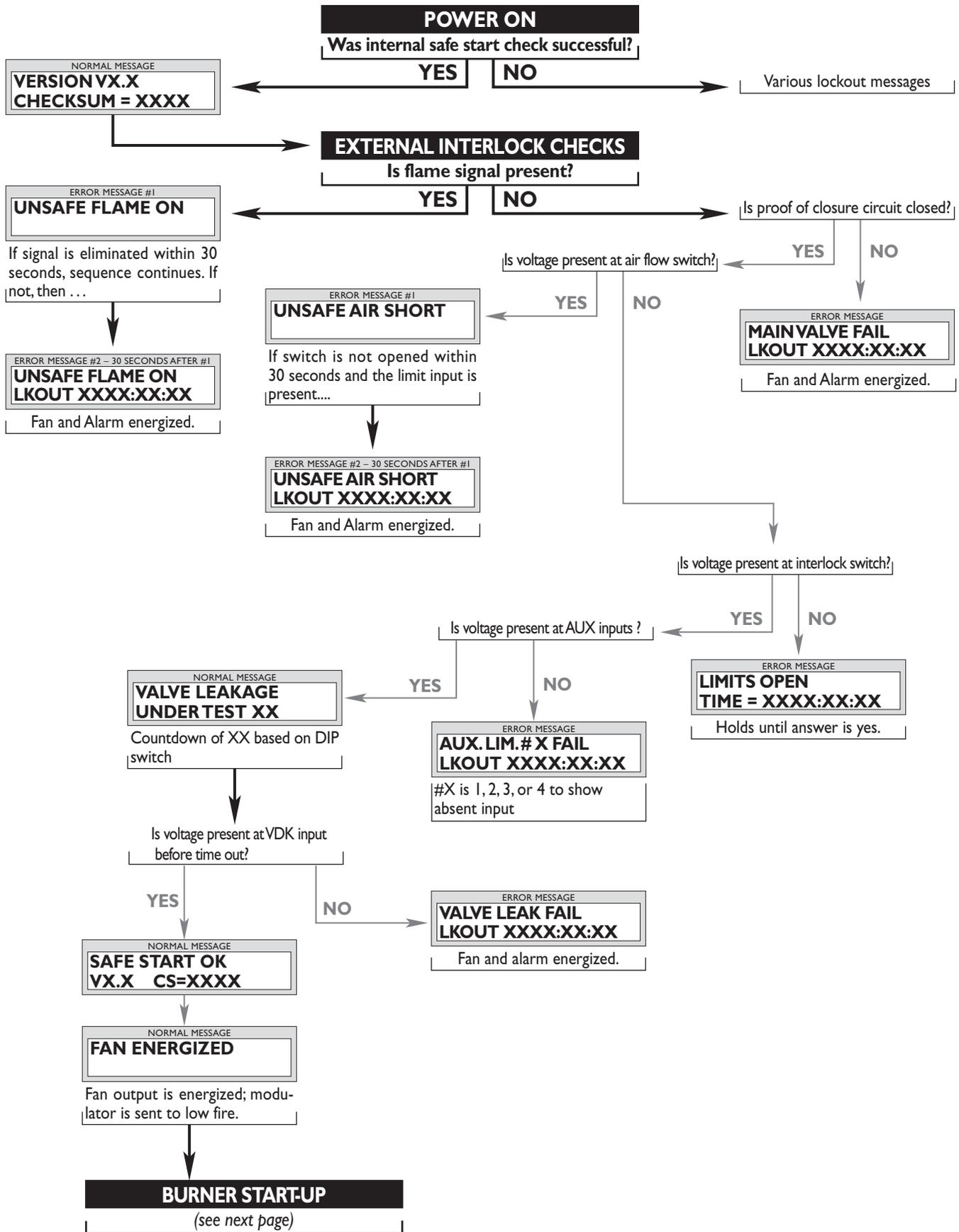
- The first table describes the start-up and shutdown monitoring sequences of the Bi-Flame and how the progress (or halt) of the sequence can be monitored by the messages on the remote display.
- The second table alphabetically lists and explains the diagnostic messages which can appear on the remote display.

Note:

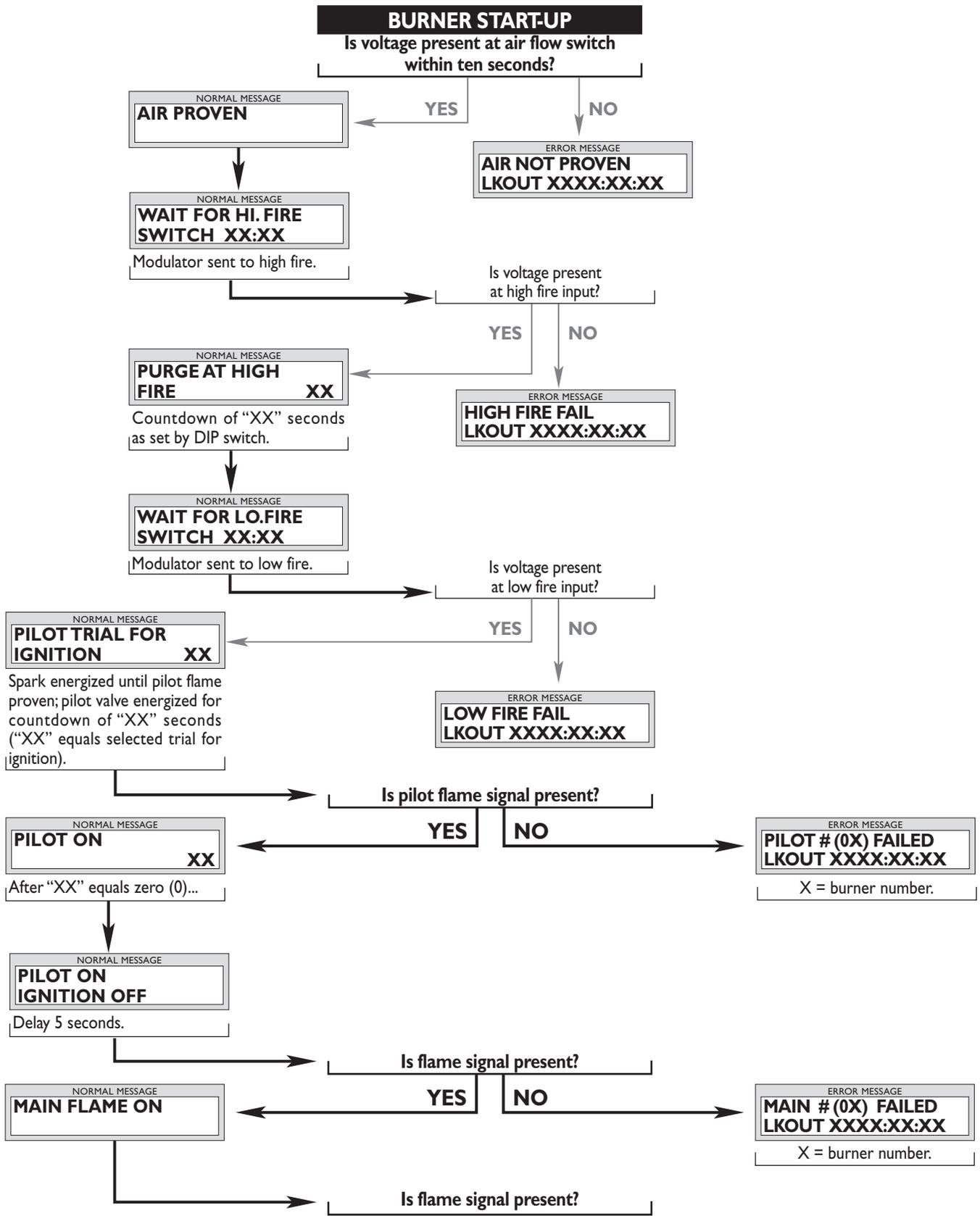


*Some of the messages which may appear with some of the options are not shown; refer to Section 5, Function Summary, for details.*

**Table 10.1 Bi-Flame Operating Sequence**

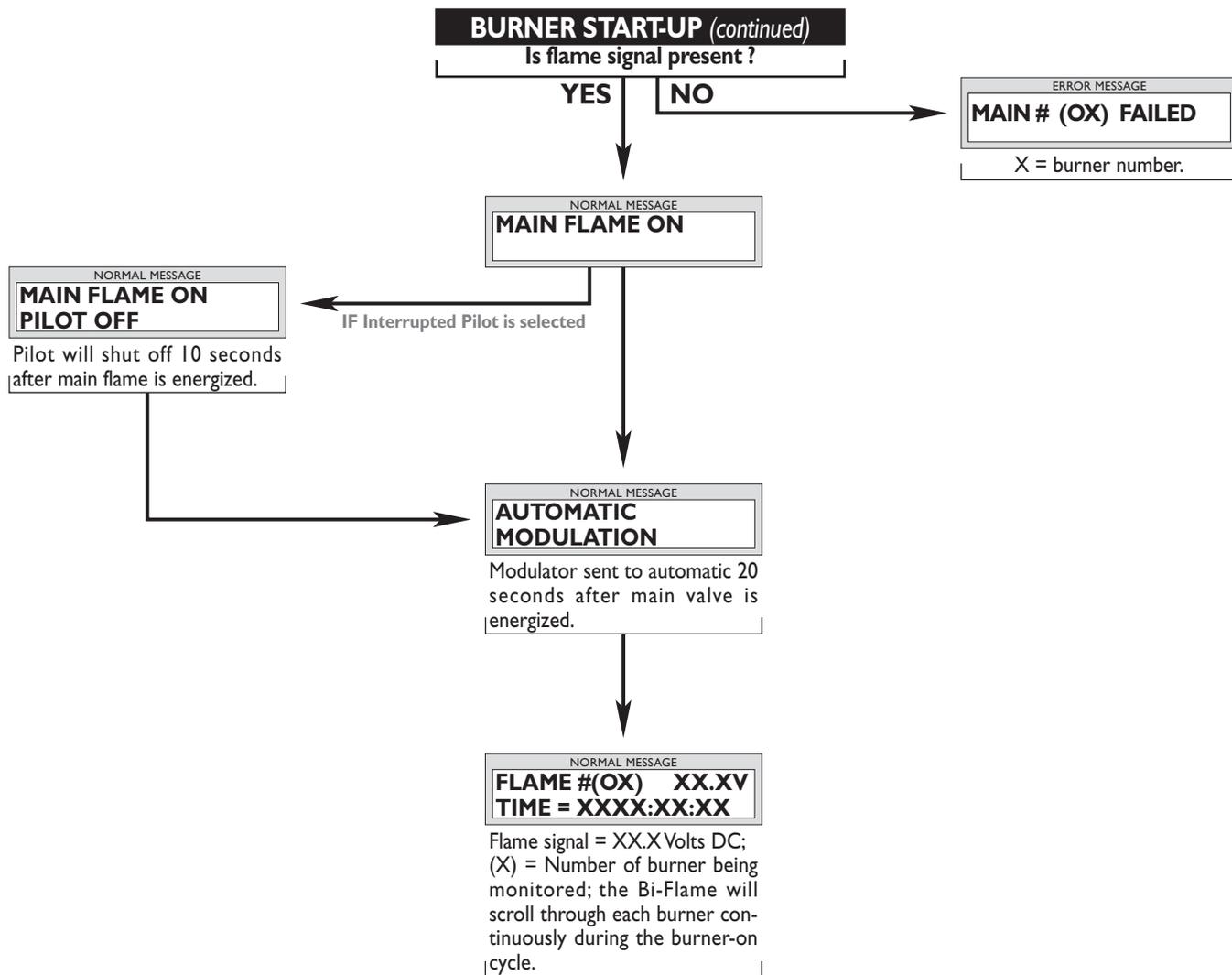


**Table 10.1 Bi-Flame Operating Sequence** (continued)

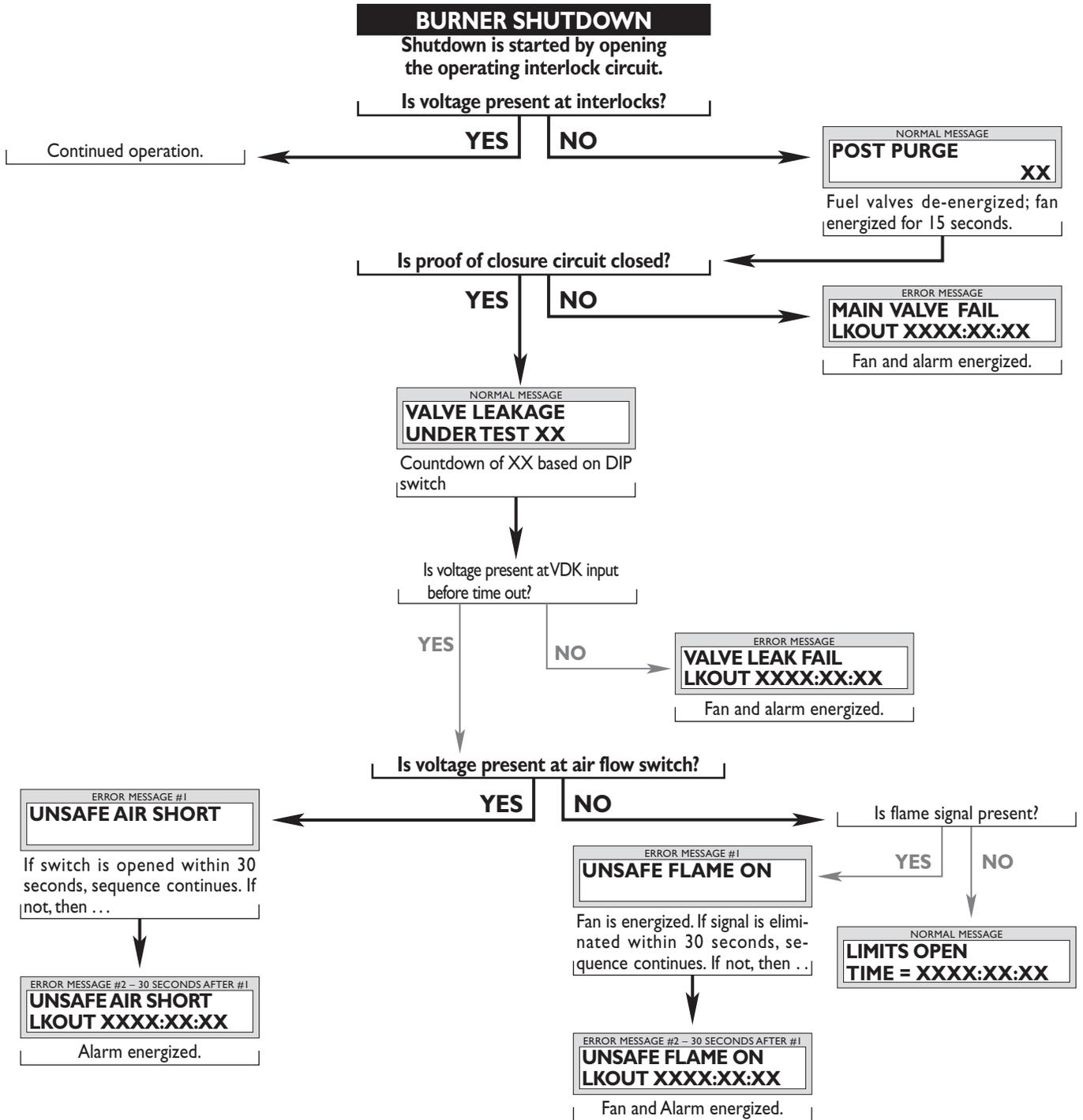


(see next page)

**Table 10.1 Bi-Flame Operating Sequence** (continued)



**Table 10.1 Bi-Flame Operating Sequence** (continued)



**Table 10.2 Remote Display Diagnostic Messages (Listed Alphabetically)**

MESSAGE	TYPE	EXPLANATION
<b>AIR FAILURE LKOUT XXXX:XX:XX</b>	Lockout	Combustion air flow limit switch (strip J1, terminal 2) opened for more than two seconds once initially proven.
<b>AIR FAILURE RECYCLING</b>	Status	Combustion air flow limit switch (strip J1, terminal 2) opened; control will recycle once if “recycle” DIP switch has been selected.
<b>AIR NOT PROVEN LKOUT XXXX:XX:XX</b>	Lockout	Combustion air flow limit switch (strip J1, terminal 2) did not make within ten seconds of fan being energized.
<b>AIR PROVEN</b>	Status	Combustion air flow limit switch (strip J1, terminal 2) closed within ten seconds of fan being energized.
<b>AUTOMATIC MODULATION</b>	Status	Modulating motor is sent to automatic operation. Terminal 1 is connected to terminal 2 on terminal strip J3.
<b>AUX.LIM.#1 FAIL LKOUT XXXX:XX:XX</b>	Lockout	Auxiliary input #1 has lost its voltage during system operation, causing a lockout at the indicated time.
<b>AUX.LIM.#2 FAIL LKOUT XXXX:XX:XX</b>	Lockout	Auxiliary input #2 has lost its voltage during system operation, causing a lockout at the indicated time.
<b>AUX.LIM.#3 FAIL LKOUT XXXX:XX:XX</b>	Lockout	Auxiliary input #3 has lost its voltage during system operation, causing a lockout at the indicated time.
<b>AUX.LIM.# 4 FAIL LKOUT XXXX:XX:XX</b>	Lockout	Auxiliary input #4 has lost its voltage during system operation, causing a lockout at the indicated time.
<b>FAN ENERGIZED</b>	Status	Blower motor (strip J2, terminal 3) is energized at the start of pre-purge.
<b>FLAME # ( ) FAIL RECYCLING</b>	Status	Main flame lost during automatic modulation; control will recycle once if “recycle” has been selected.
<b>FLAME # (X) FAILED LKOUT XXXX:XX:XX</b>	Lockout	Main flame lost during operation in the automatic modulation mode. Burner number (X) given of failed unit.
<b>FLAME # (Y) XX.XV TIME=XXXX:XX:XX</b>	Status	Main flame of burner number (Y) is proven in the automatic modulation mode; flame strength is XX.XV (volts DC). Elapsed time is shown in hours:minutes:seconds.
<b>HI FIRE FAIL</b>	Lockout	High damper or high purge rate switch did not make and hold for high pre-purgee.
<b>INTERNAL FAULT</b>	Lockout	Internal control failure; replace controller.
<b>LIMITS OPEN TIME=XXXX:XX:XX</b>	Status	The controller has completed its internal checks and is standing by for the interlocks (strip J1, terminal 1) to close.
<b>LOW FIRE FAIL LKOUT XXXX:XX:XX</b>	Lockout	Low fire switch (strip J1, terminal 4) is open just prior to pilot trial for ignition.

**Table 10.2 Remote Display Diagnostic Messages** (continued)

MESSAGE	TYPE	EXPLANATION
<b>MAIN # ( ) FAILED</b>	Lockout	Main flame was not established during the main burner trial for ignition.
<b>MAIN FLAME ON</b>	Lockout	Main valve has been energized and main flame proven during trial for ignition.
<b>MAIN FLAME ON PILOT OFF</b>	Status	Pilot valve (strip J2, terminal 5) is de-energized and main flame is on.
<b>MAIN VALVE FAIL LKOUT XXXX:XX:XX</b>	Lockout	Main valve proof-of-closure is open before startup or after burner shutdown.
<b>PILOT FLAME FAIL LKOUT XXXX:XX:XX</b>	Lockout	Pilot flame was not established during the pilot trial for ignition.
<b>PILOT ON                   XX</b>	Status	Pilot flame is proven; transformer is de-energized; remaining countdown for pilot trial for ignition is "XX".
<b>PILOT TRIAL FOR IGNITION        XX</b>	Status	Pilot valve and ignition transformer are energized; countdown for pilot trial for ignition begins at "XX".
<b>PLT/MVL ENERGIZ. XX:XX:XX LOCKOUT</b>	Lockout	An external source of voltage is present on the ignition, pilot or main output terminals.
<b>POST PURGE                   XX</b>	Status	15 second post purge is started on burner shutdown; "XX" shows countdown.
<b>PROGM SWITCH ERR LKOUT XXXX:XX:XX</b>	Lockout	DIP switch improperly set or changed during cycle.
<b>PURGE AT HIGH FIRE            XX</b>	Status	Modulating motor is sent to high fire; "XX" shows purge countdown.
<b>RECORD #X</b>	Status	Part of the optional history log which records the total number of operating cycles and the last lockout messages up to a maximum of 10.
<b>RELAY FAIL LKOUT XXXX:XX:XX</b>	Lockout	Internal relay(s) fail initial check. Check ratings. If lockout still occurs after overload is eliminated, replace control.
<b>SAFE START OK</b>	Status	Control has completed internal safe-start check.
<b>UNSAFE AIR SHORT</b>	Status	Combustion air switch is closed before start-up or after shutdown; control holds start-up until switch re-opens; if interlocks close before switch opens, alarm will energize in 30 seconds.
<b>UNSAFE AIR SHORT LKOUT XXXX:XX:XX</b>	Lockout	Same conditions as above, except the interlocks closed for 30 seconds before the switch re-opened, causing a lockout and the alarm.

**Table 10.2 Remote Display Diagnostic Messages** (continued)

MESSAGE	TYPE	EXPLANATION
<b>UNSAFE FLAME ON</b>	Hold	Flame signal—actual, induced, or faulty scanner—is detected before start-up or after shutdown. The fan is energized. If the cause is corrected within 30 seconds, as in afterburn, the control will turn off the fan and continue the sequence.
<b>UNSAFE FLAME ON LKOUT XXXX:XX:XX</b>	Lockout	Same conditions as above, except the cause has not been corrected within 30 seconds, resulting in a lockout and alarm.
<b>UNSAFE-FLM-PURGE</b>	Hold	Flame signal—actual, induced, or faulty scanner—is detected during the selected purge time period. The fan is energized. If the cause is corrected within 30 seconds, as in afterburn, the control will turn off the fan and continue the sequence.
<b>UNSAFE-FLM-PURGE LKOUT XXXX:XX:XX</b>	Lockout	Same conditions as above, except the cause has not been corrected within 30 seconds, resulting in a lockout and alarm.
<b>VALVE LEAKAGE UNDER TEST XX</b>	Status	Indicates that the optional valve leak sensing device has been activated and the test period “XX” has begun.
<b>VALVE LEAK FAIL LKOUT XXXX:XX:XX</b>	Lockout	The test period for valve leak sensing has exceeded XX seconds and failed; check the gas shut-off valves.
<b>WATCHDOG FAIL LKOUT XXXX:XX:XX</b>	Lockout	Internal control failure; replace controller.
<b>XXXXXXX XXXXXTESTXX</b>	Status	In combination with other messages, shows the control is in the minimum pilot test mode.



# Appendix

## CONVERSION FACTORS

### Metric to English.

FROM	TO	MULTIPLY BY
cubic meter (m <sup>3</sup> )	cubic foot (ft <sup>3</sup> )	35.31
cubic meter/hour (m <sup>3</sup> /h)	cubic foot/hour (cfh)	35.31
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C × 1.8) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	Btu/hr	3414
meter (m)	foot (ft)	3.28
millibar (mbar)	inches water column ("wc)	0.401
millibar (mbar)	pounds/sq in (psi)	14.5 × 10 <sup>-3</sup>
millimeter (mm)	inch (in)	3.94 × 10 <sup>-2</sup>

### Metric to Metric.

FROM	TO	MULTIPLY BY
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

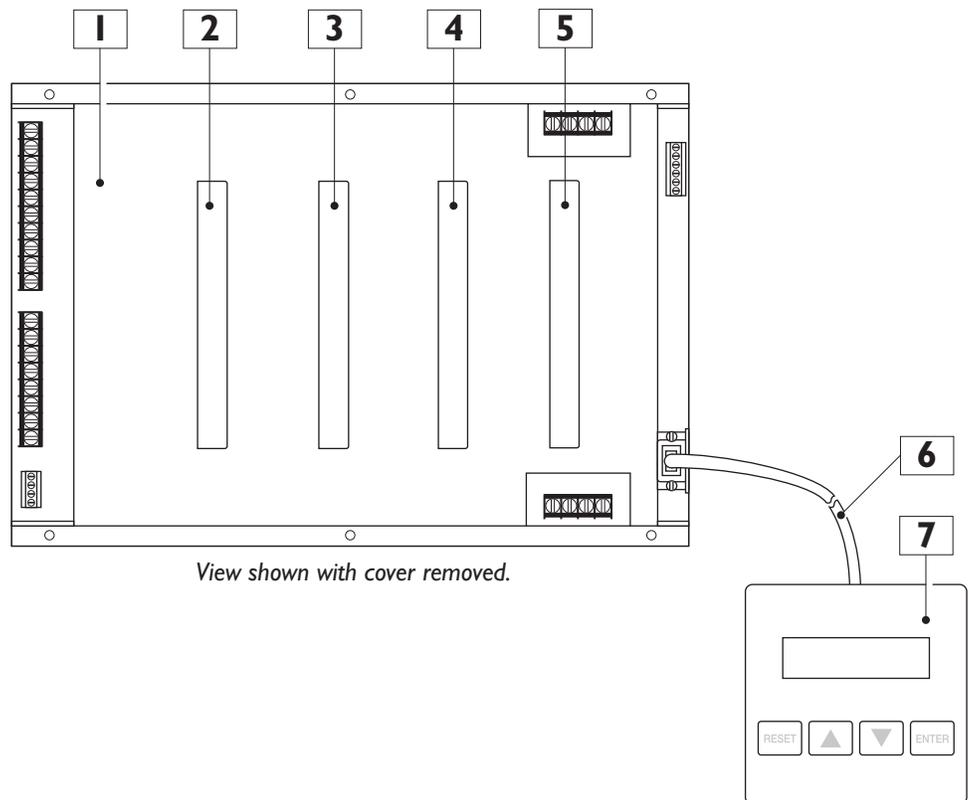
### English to Metric.

FROM	TO	MULTIPLY BY
Btu/hr	kilowatt (kW)	0.293 × 10 <sup>-3</sup>
cubic foot (ft <sup>3</sup> )	cubic meter (m <sup>3</sup> )	2.832 × 10 <sup>-2</sup>
cubic foot/hour (cfh)	cubic meter/hour (m <sup>3</sup> /h)	2.832 × 10 <sup>-2</sup>
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F - 32) ÷ 1.8
foot (ft)	meter (m)	0.3048
inches (in)	millimeter (mm)	25.4
inches water column ("wc)	millibar (mbar)	2.49
pound (lb)	kilogram (kg)	0.454
pounds/sq in (psi)	millibar (mbar)	68.95

# ILLUSTRATED PARTS LIST

Pos. No.	Qty.	Description	Eclipse Part Number
1	1	Mother Board (6500M) with RS232	20315
1	1	Mother Board (6500M) with RS485	20315-1
2	1	Relay module circuit board	22494
3	1	Logic module circuit board	22495
4	1	Power module circuit board	22496
5	1	Sensor circuit board	20314
6	1	183 cm (6ft) cable for remote display	15426
6	1	305 cm (10ft) cable for remote display	15426-1
7	1	Remote display with keypad	15422

Downtimes due to a failure can be kept to a minimum by stocking recommended spares.







# Eclipse Extended Pilots

## Series "EP"



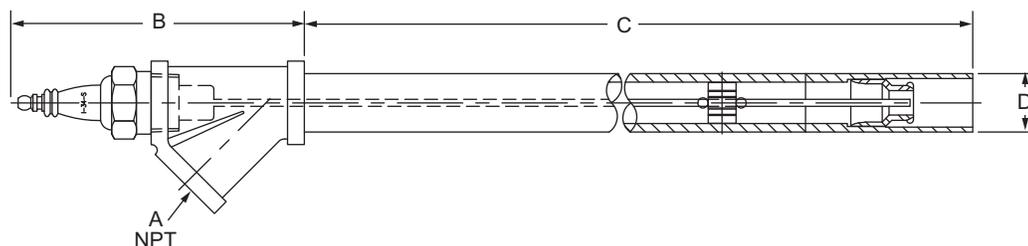
**Figure 1. Extended Pilot, 3/4"**

The Eclipse Series "EP" Extended Pilots are long, internally spark-ignited pilot burners. These pilots are primarily used to ignite gas, oil or combination gas/oil burners that are located too far inside the combustion chamber to be reached by conventional pilots.

The Eclipse Series "EP" Extended Pilots are available in 2 inlet pipe sizes: 3/4" and 1". The 3/4" pilot assembly is available in 12", 18" and 24" lengths. The 1" pilot assembly is available in 12", 18", 24", 36" and 48" lengths. The pilot assemblies consist of a "Y" casting, burner tube, spark plug with extended electrode and a steel Ferrofix pilot nozzle. Alloy Ferrofix pilot nozzles are available for high temperature applications.

Extended Pilots operate best when used as blast type pilots. For this reason Eclipse recommends the use of the following air/gas mixing equipment. Extended Pilots should be used with an Eclipse 131 PM Pilot Mixer. (See Bulletin 812.) These mixers are not included with the pilot assemblies and must be purchased separately.

### Dimensions and Specifications

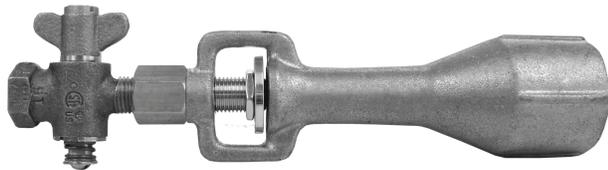


Steel Nozzles		Alloy Nozzles		Dimensions				Recommended Mixer Assy.	Recommended Air Jet
Catalog Number	Assembly Number	Catalog Number	Assembly Number	A	B	C	D		
3EP-12	103155	3EPA-12	103175	3/4	5-1/4	12	1-1/16	300558	10254-7
3EP-18	103156	3EPA-18	103176	3/4	5-1/4	18	1-1/16		
3EP-24	103157	---	---	3/4	5-1/4	24	1-1/16		
4EP-18	103159	4EPA-18	103179	1	5-13/16	18	1-5/16	300558	10254-10
4EP-24	103160	4EPA-24	103180	1	5-13/16	24	1-5/16		
4EP-36	103161	4EPA-36	103181	1	5-13/16	36	1-5/16		

NOTE: All dimensions are in inches.

# Eclipse Pilot Mixers

Series NMP-S



Low Pressure



High Pressure

Eclipse Pilot Mixers are of three different types: low pressure atmospheric, high pressure atmospheric and blast. All are designed to provide stable, accurate, air/gas mixtures for a great variety of pilot nozzles under many varying furnace conditions. These pilot mixers are available in either complete or stripped assemblies. Stripped assembly mixers are furnished less all valves and fittings.

## Eclipse Low Pressure Atmospheric Pilot Mixers

Eclipse Low Pressure Atmospheric Pilot Mixers will operate with any clean, commercially available fuel gas. It is only necessary to pipe low pressure gas (4" w.c. to 1 psig natural gas or 10" w.c. to 1 psig LP-gas) to the mixer for operation.

The energy of the gas passing through the mixer orifice is used to entrain a portion of the air required for combustion. The balance of the air is introduced as secondary air at the pilot nozzle, therefore, these pilot mixers are limited to open burner applications.

Pilot mixers are available in 1/2", 3/4" and 1" outlet sizes for all Eclipse atmospheric pilot nozzles. See Spec Sheet 810, page 1, for pilot assemblies with low pressure atmospheric pilot mixers.

## Eclipse High Pressure Atmospheric Pilot Mixers

Eclipse High Pressure Atmospheric Pilot Mixers operate on the same principle as the low pressure atmospheric pilot mixers. The kinetic energy of the high pressure gas,

however, is sufficient to entrain all the air required for combustion. This feature makes it possible to use high pressure pilot mixers on sealed burner applications as there is no requirement for secondary air at the pilot nozzle.

These mixers will operate with gas pressures ranging from 1 psig to 25 psig. High pressure pilot mixers are available in 1/2", 3/4" and 1" outlet sizes for all Eclipse High Pressure Pilot Nozzles. See Spec Sheet 810, page 2, for pilot assemblies with high pressure pilot mixers.

## Eclipse Blast Pilot Mixers

Eclipse Blast Pilot Mixers utilize low pressure gas (6" w.c. to 15" w.c.) and air from a low pressure blower (4 oz. to 32 oz.) and can be used on open or sealed burner applications.

These mixers can be used for single pilot applications (see Spec Sheet 810, pages 3 through 5) or for multiple pilot applications. When using Eclipse Blast Pilot Mixers for multiple pilot applications, refer to Selection Guide 812.

Blast Pilot Mixers are available in sizes 1/2" through 1-1/2" and will supply air/gas mixture to as many as six pilot nozzles.



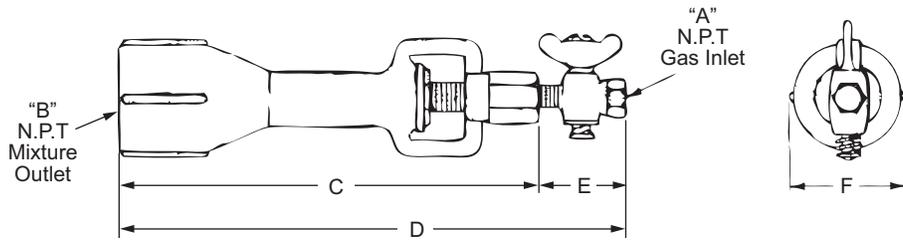
Low Pressure



High Pressure

## Dimensions

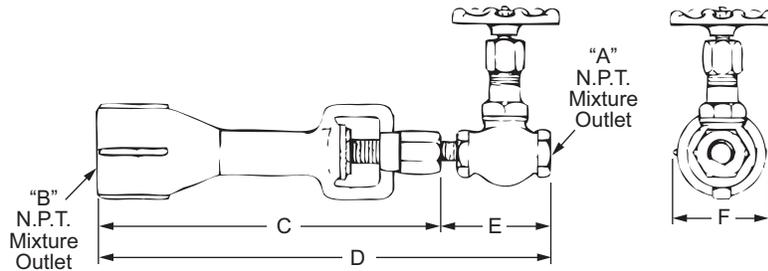
### Low Pressure Pilot Mixers



Catalog Number	Assembly Number		Dimensions					
	Complete	Stripped	A	B	C	D	E	F
TR-2	300262	300266	1/8	1/2	5-5/16	6-9/16	1-1/4	1-7/8
TR-3A	300263	300267	1/4	3/4	6-3/4	8-1/4	1-1/2	1-7/8
TR-4A	300257	300258	1/4	1	6-3/4	8-1/4	1-1/2	1-7/8

NOTE: All dimensions in inches.

### High Pressure Pilot Mixers

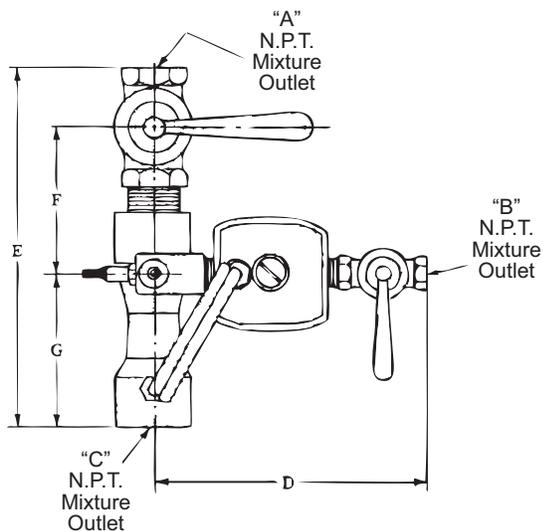


Catalog Number	Assembly Number		Dimensions					
	Complete	Stripped	A	B	C	D	E	F
TR-H2	300268	-	1/8	1/2	5-5/16	7	1-11/16	1-7/8
TR-3HA	300269	300267	1/4	3/4	6-3/4	9	2-1/4	1-7/8
TR-4HA	300259	300258	1/4	1	6-3/4	9	2-1/4	1-7/8

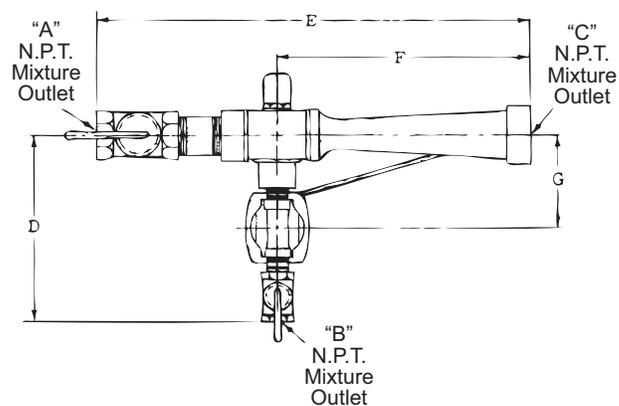
NOTE: All dimensions in inches.

## Blast Pilot Mixers

**121 and 131 PM**



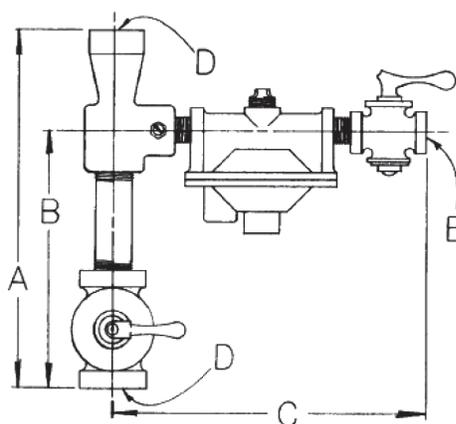
**142 and 163 PM**



Catalog Number	Assembly Number		Dimensions						
	Complete	Stripped	A	B	C	D	E	F	G
121 PM	300557	300561	1/2	3/8	1/2	5-3/4	7	2-27/32	3-1/32
131 PM	300558	300562	3/4	3/8	3/4	5-3/4	7-1/8	2-29/32	3-1/32
142 PM	300577	300579	1	1/2	1	7-13/16	19-1/8	10-1/32	3-15/16
163 PM	300578	-	1-1/2	3/4	1-1/2	8-7/8	23-13/32	12	4-3/16

NOTE: All dimensions in inches.

**32 LP**



Catalog Number	Assembly Number		Dimensions				
	Complete	Stripped	A	B	C	D	E
32 LP	300694	300675	9-1/2	6-1/2	5-7/8	3/4	1/2

NOTE: All dimensions in inches.





*Innovative Combustion Solutions Worldwide*

# *GAS PRESSURE REGULATORS*

**Eclipse offers a line of gas regulators for industrial applications of natural, mixed, manufactured and liquefied petroleum gases or LP gas-air mixture. The regulators are categorized according to design:**

## **Rubber Seat Poppet Type**

These regulators are designed primarily for main burner and pilot load applications where precise control of tiny flows is an essential operation requirement. Housings are cast aluminum.

## **Straight Thru-Flow Type**

The patented design of these low pressure regulators provides accurate, sensitive regulation. This design also allows high flow rates with minimum pressure drops.

These regulators should not be used: 1) where the inlet pressure will be ten times greater than the outlet pressure, and 2) as tight shut-off valves.

Outlet pressures may be varied by changing the diaphragm spring. Housings are aluminum for sizes through 3", and iron for the 4" size.

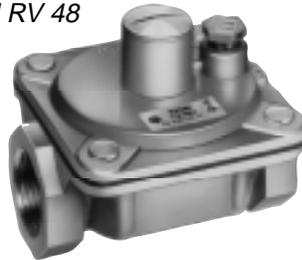
## **Double Diaphragm Type**

The RS Series is designed primarily for main burner and pilot load applications. They are ideally suited for industrial heaters and boilers. The double diaphragm balanced valve design prevents the inlet pressure from acting on the valve. Housings are aluminum.

## **Positive Shut-Off Type**

The 325-5A is a lever acting regulator with an aluminum housing. It features a high leverage valve linkage to deliver positive dead end lock-up and precise regulation control from full flow down to tiny pilot flows. The 325-5A can be ordered with various springs to accommodate outlet pressures from 4" w.c. up to 2 psi.

**Rubber Seat Poppet Type**  
*Model RV 48*



**Straight Flow-Thru Type**  
*Model RV 131*



**Double Diaphragm Type**  
*Model R400S*



**Positive Shut-Off Type**  
*Model 325-5A*



## Specifications

Model	Pipe Size, Inches	Max. Inlet, PSI	SCFH Flow at Various Pressure Drops (Natural Gas at 0.64 specific gravity)										Maximum Emergency PSI <sup>1</sup>	Temp. Limits, °F		Mounting Position	Outlet Pressure Range <sup>2</sup> ("w.c.)	
			0.3"	0.7"	0.8"	0.9"	1"	2.5"	4"	8"	16"	28"		Min.	Max.			
<b>Rubber Seat Poppet Type—CGA Listed, AGA Certified</b>																		
RV12LT	1/8	1/2	15	23	24	26							2.5	-40	275	Any	2.8 to 5.2	
RV20VL	1/4	1/2	30	46	49	52	55						2.5	+32	225	Any	2.8 to 5.2	
RV20VL	3/8	1/2	30	46	49	52	55						2.5	+32	225	Any	2.8 to 5.2	
RV48	1/2	1/2	130	199	212	225							2.5	+32	225	Any	5 to 12	
<b>Straight-Thru Flow Type—CGA Listed; AGA Certified for 1/2 PSIG</b>																		
(AGA certified for the ranges shown in bold numbers, with the outlet pressures shown as standard.)																		
RV 52	1/2	1/2	<b>262</b>	<b>400</b>	<b>427</b>	<b>453</b>	478	756	956				3	-40	205	Any	5 to 12	
	3/4	1/2	<b>262</b>	<b>400</b>	<b>427</b>	<b>453</b>	478	756	956				3	-40	205	Any	5 to 12	
RV 53	3/4	1/2	<b>375</b>	<b>573</b>	<b>612</b>	<b>650</b>	<b>684</b>	1081	1369				3	-40	205	Any	5 to 12	
	1	1/2	<b>375</b>	<b>573</b>	<b>612</b>	<b>650</b>	<b>684</b>	1081	1369				3	-40	205	Any	5 to 12	
RV 61	1	1	<b>675</b>	<b>1004</b>	<b>1073</b>	<b>1138</b>	1200	1897	2464				5	-40	205	Any	5 to 12	
	1-1/4	1	<b>675</b>	<b>1004</b>	<b>1073</b>	<b>1138</b>	1200	1897	2464				5	-40	205	Any	5 to 12	
RV 81	1-1/4	1	<b>1350</b>	<b>2062</b>	<b>2204</b>	<b>2339</b>	<b>2465</b>	3897	4929				5	-40	205	Upright	5 to 12	
	1-1/2	1	<b>1350</b>	<b>2062</b>	<b>2204</b>	<b>2339</b>	<b>2465</b>	3897	4929				5	-40	205	Upright	5 to 12	
RV 91	2	1	<b>2100</b>	<b>3208</b>	3429	3637	3834	6062	7668				5	-40	205	Upright	5 to 12	
	2-1/2	1	<b>2100</b>	<b>3208</b>	3429	3637	3834	6062	7668				5	-40	205	Upright	5 to 12	
RV 111	2-1/2	1	<b>4750</b>	<b>7256</b>	<b>7757</b>	8227	8572	13,553	17,161				5	-40	125	Upright	5 to 12	
	3	1	<b>4750</b>	<b>7256</b>	<b>7757</b>	8227	8572	13,553	17,161				5	-40	125	Upright	5 to 12	
RV 131	4	2	<b>8200</b>	<b>12,525</b>	<b>13,390</b>	14,202	14,971	23,672	29,942				15	-40	125	Upright	5 to 12	
<b>Double Diaphragm Type</b>																		
R400S	1/2	5	105	160	171	182	192	304					12.5	-40	205	Any	4 to 12	
R500S	3/4	5	240	367	392	416	438	693	876				12.5	-40	205	Any	4 to 12	
<b>Positive Shut-Off Type</b>																		
325-5A	1/2	10	70	107	114	121	128	202	255	361	509	673	65	-40	205	Any	4 to 12	
	3/4	10	70	107	114	121	128	202	255	361	509	673	65	-40	205	Any		
	1	10	70	107	114	121	128	202	255	361	509	673	65	-40	205	Any		

  = At these flows and regulator pipe sizes, velocity pressures exceed 0.5. To avoid excessive pressure drops, use larger pipe upstream and downstream of the regulator. Contact your Eclipse representative for assistance.

<sup>1</sup> Maximum inlet pressures that the regulator can contain. Depending on model, some internal parts may be damaged.

<sup>2</sup> For springs supplied as standard. See "Optional Springs" chart for availability of other springs.

### Optional Springs

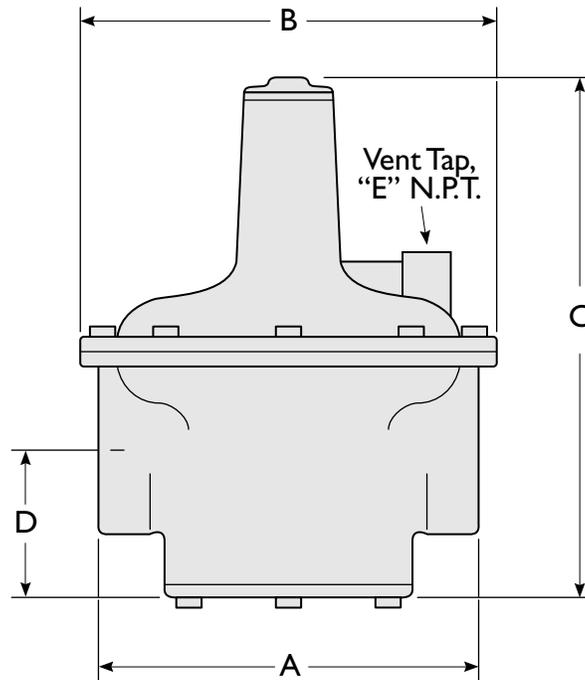
Model	Pressure Range "w.c.	Part No.	Spring Color
RV52	1 to 3.5	12295	Brown
RV53		12296	
RV61		12297	
RV81		12298	
RV91		12299	
RV111		12300	
RV131		CON	
RV61	10 to 22	14314	Red
RV81		12316	
RV91		12317	
RV111		12319	
RV131		CON	
325-5A		10928-2	
325-5A	15 to 30	10928-3	Yellow
325-5A	1 to 2psi	10928-4	Tagged

**Note:** If the outlet pressure can be provided by two different springs, select the higher outlet pressure

### Sizing and Selection

- 1) Determine the following:
  - a) Inlet pressure to regulator
  - b) Outlet pressure required from regulator
  - c) SCFH required through regulator
  - d) Desired size of regulator
- 2) Subtract outlet pressure from inlet pressure and divide by two. Use this figure as the maximum allowable pressure drop when sizing the regulator.
- 3) In the Specifications table above, find the column closest to, but not exceeding, the maximum allowable pressure drop.
- 4) Read down to find a regulator of the correct pipe size with a flow closest to, but not less than, the required SCFH.

## Dimensions



Catalog Number	Part Number	Pipe Size	Dimensions, In Inches					Approx. Ship. Wt. (Lbs.)
			A	B	C	D	E	
RV12LT	17127-1	1/8	1-11/16	1-3/8	1-11/16	3/8	—	1
RV20VL	15027	1/4	2-3/8	1-3/4	2-1/8	1/2	5/16*	1
RV20VL	17127-6	3/8	2-3/8	1-3/4	2-1/8	1/2	5/16*	1
RV 48	12271	1/2	3-3/8	3	2-3/4	3/4	1/8	1-1/4
RV 52	12274 12276	1/2 3/4	3-3/16	3-1/4	5-1/16	1-1/2	1/8	1-1/4
RV 53	12277 12278	3/4 1	3-5/8	3-7/8	5-13/16	1-5/8	1/8	1-1/2
RV 61	12279 12280	1 1-1/4	4-3/8	5-7/16	6-7/16	1-5/8	1/8	2-1/2
RV 81	12282 12284	1-1/4 1-1/2	6	7	8-5/8	2-5/8	1/4	5-1/4
RV 91	12285 12286	2 2-1/2	6-1/2 7-1/8	9-1/8 9-1/8	10-13-16 10-1/2	2-3/8 2-7/16	1/4 1/4	9 9
RV 111	12288 12290	2-1/2 3	9	13-7/16	15-1/16	3-7/16	1/4	20
RV 131	Contact Factory	4	13-7/8	18	23-1/4	5-1/16	3/4	127
R400S	17127-8	1/2	2	2	3-1/4	15/16	1/8	1/2
R500S	17127-9	3/4	3	3-1/8	4-11/16	1-3/16	1/8	1
325-5A	10866 10888 10897	1/2 3/4 1	5-7/8	5-7/16	5-1/4	15/16	3/8	2

\* 5/16"-24 THD for 1/8" O.D. tube connector, p/n 13204.



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# Ignition Transformers

- Safer, more durable insulation
- Excellent mechanical properties
- Superior electronics
- High temperature rating
- Effective heat dissipation
- Compact design
- Light weight
- Durable sealed construction
- Reliable operation
- 100% final tested



Ignition Transformer with Bracket Kit and Ignition Cable  
(See Page 2 Accessories)

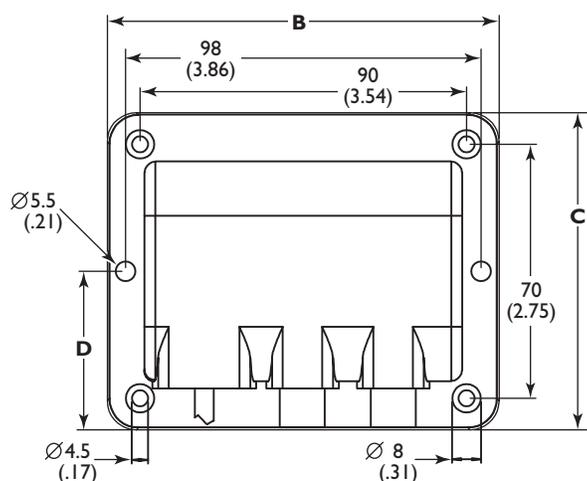
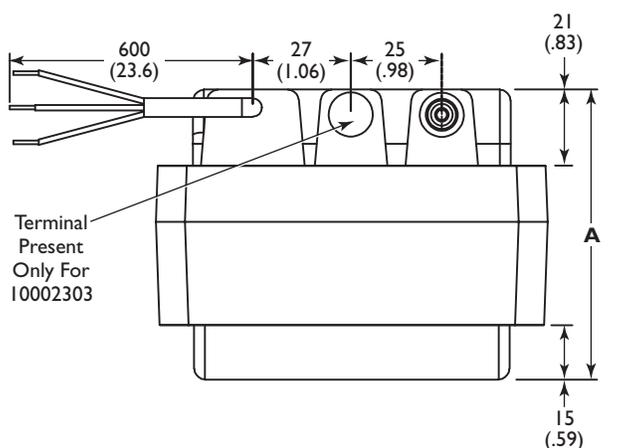
PARAMETER	22967	10002303	10002304	10005352	10012234
Primary Supply Voltage , VAC	120	120	120	220-240	110
Frequency , Hz	60	60	60	50-60	50
Primary Current, A	1.6	3.5	1.5	0.4	1.5
Power , VA	192	420	180	92	165
Secondary Voltage RMS [±10%], VAC	7000	2 x 5000	6000	6000	6000
Secondary Current RMS [±10%], mA	23	35	23	10	23
Secondary Ground Termination	End Pole	Center Tap	End Pole	End Pole	End Pole
Service Duty, % on-time /4 minutes	25%	25%	100%	100%	100%
Approvals	CE, cULus	CE, cULus	CE, cULus	CE	CE
Weight, kg (lbs)	1.9 (4.2)	2.8 (6.2)	2.8 (6.2)	1.9 (4.2)	2.8 (6.2)
Surface Material	Araldite Epoxy Resin				
Ambient Temp, °C (°F)	90 (194) Maximum -40 (-40) Minimum				

CE Standards: EN 61558/2/3, VDE 0550, SEV BA9, 73/23/EEC Low Voltage Directive, and meets 89/336/EEC Electromagnetic Compatibility, emission standards EN 50081-1 and EN 55014-1/A2 when used with suppression wire and filter p.n. 10005353.

Underwriters Laboratories listed as a recognized component, cURus, for the Canadian and USA markets.

## Dimensions & Specifications

### Dimensions mm (inches)



Part Number	Dimensions mm (inches)			
	A	B	C	D
22967	65 (2.56)	106 (4.17)	86 (3.38)	43 (1.69)
10002303	80 (3.15)	108 (4.25)	87.4 (3.44)	43.7 (1.72)
10002304	80 (3.15)	108 (4.25)	87.4 (3.44)	43.7 (1.72)
10005352	65 (2.56)	106 (4.17)	86 (3.38)	43 (1.69)
10012234	80 (3.15)	108 (4.25)	87.4 (3.44)	43.7 (1.72)

### Accessories

Part No.	Description	
20580	Kit, Bracket, Ignition Transformer, 40mm x 40mm, Consisting Of: Two Galvanized Brackets Two 5M x 50mm Iron Screw Two 5M x 4mm Iron Nut	
10013387	Cable, Ignition, 300mm Long (11.8"), Complete Cable Assembly, 7mm Dia. Silicone Suppression Wire Rated 20KV 4mm Diameter Straight Terminal Connector With Cap 6.3mm Diameter Right Angle Terminal Connector With Cover -50°C (-58°F) to 180°C (356°F)	
20581	Cable, Ignition, 1M Long (39.4"), Complete Cable Assembly, 7mm Dia. Silicone Suppression Wire Rated 20KV 4mm Diameter Straight Terminal Connector With Cap 6.3mm Diameter Right Angle Terminal Connector With Cover -50°C (-58°F) to 180°C (356°F)	
20603	Cable, Ignition, 3M Long (9.8"), Complete Cable Assembly, 7mm Dia. Silicone Suppression Wire Rated 20KV 4mm Diameter Straight Terminal Connector With Cap 6.3mm Diameter Right Angle Terminal Connector With Cover -50°C (-58°F) to 180°C (356°F)	
10005353	Suppressor, Emi Disturbance Suppression Filter for Ignition Transformer Primary	
10005354	Wire, ignition, Emi-Suppression, Silicon, -50° to 180° C, 7mm Dia., Breakdown Voltage 20kV, Iso-Spec 3808/1 Clause 5.2.3	
10002352	Connector, Wire, 90 Degree with Spring, for Spark Electrode, 6.3mm Diameter, for 4.7-5.2-7mm Diameter Cable.	
10002353	Cap, Terminal, Wire, 90 Degree, Silicone Rubber, for Spark Electrode, for 4.7-5.2-7mm Diameter Cable.	
10002349	Connector, Wire, Straight, Output for Ignition Transformer, Phosphor Bronze, 4mm Diameter, for 4.7mm Diameter Cable (32756).	
10002351	Connector, Wire, Straight, Output for Ignition Transformer, Phosphor Bronze, 4mm Diameter, for 7mm Diameter Cable (10005354, 35443).	
10002354	Cap, Terminal, Wire, Straight, Silicone Rubber, L=35mm, Output for Ignition Transformer, for 4.7- 5.2-7mm Diameter Cable.	

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# Installation Instructions

## General Instructions

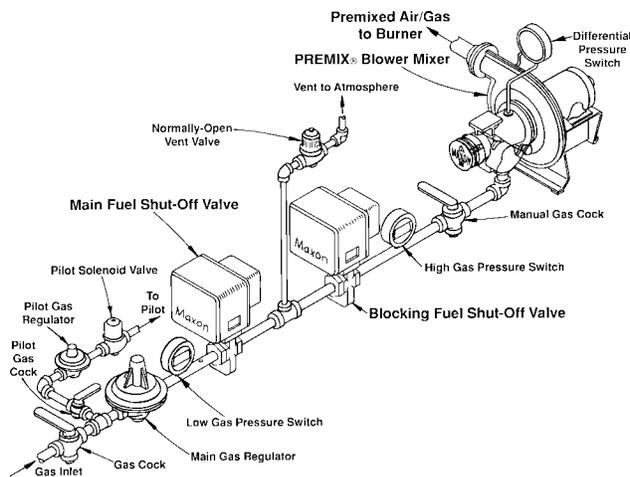
**Important: Do not discard packing materials until all loose items are accounted for.**

To prevent damage in transit, spark ignitors, flame rods, connecting linkage components, and filter housings/elements may be packed separately and shipped loose with your new Maxon PREMIX® Blower Mixer.

The blower mixer itself is normally only a part of your complete combustion system. Additional pipe train accessories and control components may be required for a complete combustion system installation.

The sketch below shows a typical gas train as might be used with a PREMIX® Blower Mixer.

## Typical Piping Layout



**Maxon assumes no responsibility for the use or misuse of the piping layouts shown. Specific piping and wiring diagrams should always be submitted to the appropriate agencies for approval on each application.**

1. **PREMIX® Blower Mixer** provides the air supply to your combustion system and is essential to the inspiration and mixing of fuel gas. It should be located in the coolest, cleanest position that you can find near the burner itself. It must not be exposed to direct radiant heat or positioned where it might draw in inert gases or hot air rising from a furnace or oven. If such conditions exist, consider filters, relocation and/or ducting of an outside air supply.

2. **Electrical service** must match the voltage, phase, and cycle of all electrical system components and be compatible with burner nameplate ratings. Insure that all normal control safeguards are satisfied. Blower mixer air should continue to run after shutdown to allow burner to cool.
3. **Gas supply piping** must be large enough to maintain required fuel pressures (approximately 2" - 8" wc) at the ratio valve inlet while burner is operating at full capacity. The use of non-standard gases or long, complicated piping may necessitate "oversizing" piping runs to keep pressure drops within acceptable ranges.
4. **Clean fuel lines** are essential to prevent blockage of pipe train components or burner gas ports. All dirt, scale and pipe dope should be blown out of any new gas line before actually connecting to the burner system.
5. **Main shut-off cock** should be upstream of both main gas regulator and pilot line take-off. Use it to shut off fuel to both pilot and main burner during shutdown periods of more than a few hours. **The ratio valve of your PREMIX® Blower Mixer is not intended for tight shut-off.**
6. **Main gas regulator** is essential to maintain a uniform system supply pressure. A separate regulator should be provided in the branch leading to each mixer if more than one is served by a common main. Size regulator for full system capacity at required pressure, including pipe train losses. Follow the instructions attached to the regulator during installation.
7. **Pilot take-off** should be upstream of the main gas regulator, but downstream of the main gas cock. It should normally include its own pilot gas regulator, a solenoid valve and shut-off cock. A pilot adjustable orifice at the pilot inlet simplifies adjustment.
8. **Pilot piping** must be large enough to provide for the full flow and pressures shown in the catalog for your particular burner size.

## Installation Instructions

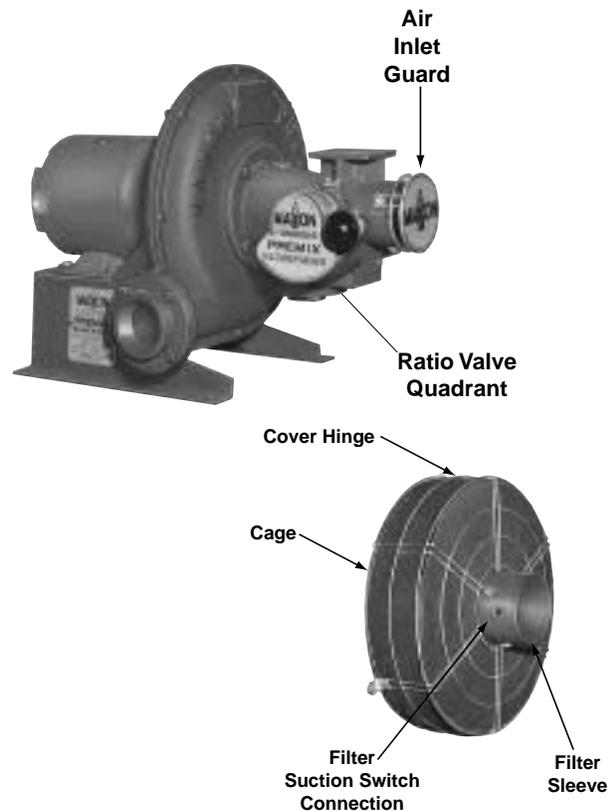
9. **Fuel shut-off valves** (when properly connected to a safety control system) are designed to shut the fuel supply off when a hazardous operating condition is sensed. **Manual reset valves** require operator attendance each time the system is started up (or restarted after a trip-out). **Motorized shut-off valves** permit automatic start/restart when used with appropriate control system.
10. **Ratio valve** (part of mixer) controls burner heat release by throttling air and gas flows. It includes provision for an adjustable minimum and throttling over a turndown range that matches burner capabilities.
11. **Downstream piping** from blower mixer to burner should be kept as short as possible.
12. **Inlet pipe leading to any burner** should be at least four pipe diameters in length. If the mixer is supplying multiple burners or multiple inlets to a single burner element, care should be taken so that air/gas mixing piping gives minimal pressure drop and maximum uniformity. **Do not install any shut-off device in the air/gas mixture line.**
13. **Test connections** are essential for burner adjustment. They should be provided (at a minimum) downstream of the mixer and at each burner inlet. Test connections in elbows or tees should be avoided. Test connections must be plugged except when readings are being taken.
14. **Vent dampers and pressure controllers** should be used to maintain balanced or slightly positive furnace or chamber pressures (0.0" to 0.5" wc) for maximum efficiency. Excessive back pressure will reduce burner capacity. Negative pressures allow infiltration of secondary air and will affect efficiency and temperature uniformity.

### New Filter Assembly Installation

To install a new filter assembly, refer to the photos below, then:

1. Remove existing air inlet guard, saving screws removed.
2. Place sleeve of new filter assembly over the open end of mixer air inlet, turning so that filter suction switch connection is opposite ratio valve quadrant.
3. Align holes in filter sleeve with those in mixer air inlet, then secure filter assembly in place with screws removed in step 1.
4. Check position of filter assembly cover hinge. If it is not at top, remove sheet metal screws holding wire cage to filter sleeve and rotate as necessary, then re-fasten. Three unused holes must be plugged with remaining sheet metal screws.

**Warning: The filter material used is approved by UL as Class II (fire retardant). Hot welding beads or direct flame can ignite filter material.**



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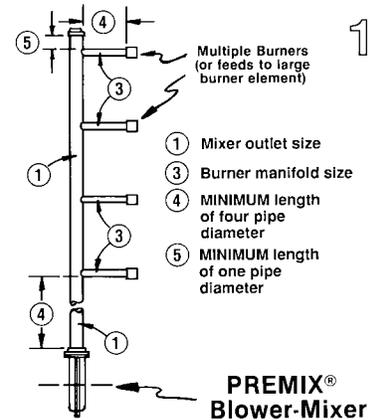
**INDUSTRIAL COMBUSTION EQUIPMENT AND VALVES**

# Installation Instructions

## Premixed Air/Gas Manifolding Suggestions

1. Always design air/gas manifold piping for **uniform** distribution to multiple-feed or multiple-burner systems. Select manifold piping sizes by starting at the burner/nozzle end and working backward to the blower mixer outlet.
2. Always make sure that any distribution header is greater in cross-sectional area than the **total** cross-sectional area(s) of any and all pipes being fed.
3. **Never** install a throttling or shut-off device in any air/gas mixture line between the blower mixer and its burner(s).
4. If necessary to have a smaller size manifold, use alternate discharge flanges available from Maxon for most PREMIX® Blower Mixers.  
The chart below gives typical pipe data for use in designing air/gas distribution manifolds.

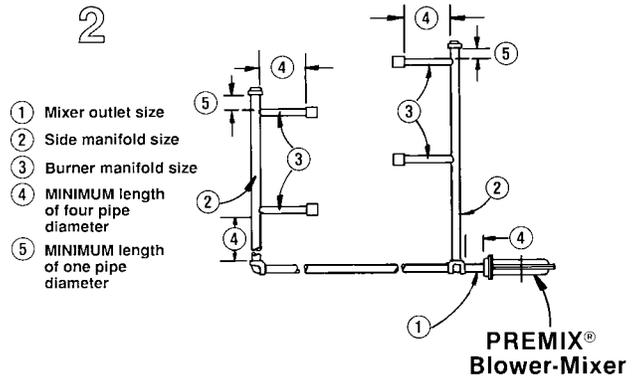
**Sketch 1** shows four burners fed from one end-fed header. Note that full mixer size is continued past all burner take-offs, and outlet extended and capped one pipe diameter length beyond last take-off. Always keep blower mixer a minimum of four pipe diameters in length from first take-off.



### General Pipe Data

Nominal Pipe Diameter	Inside Diameter (inches)	Outside Diameter (inches)	Inside Area (square inches)
1/8	0.269	0.405	0.057
1/4	0.364	0.54	0.104
3/8	0.493	0.675	0.191
1/2	0.622	0.84	0.304
3/4	0.824	1.05	0.533
1	1.049	1.315	0.864
1-1/4	1.38	1.66	1.496
1-1/2	1.61	1.9	2.036
2	2.067	2.375	3.356
2-1/2	2.469	2.875	4.788
3	3.068	3.5	7.393
3-1/2	3.548	4	9.887
4	4.026	4.5	12.73
5	5.047	5.563	20.006
6	6.065	6.625	28.89
8	7.981	8.625	50.027
10	10.02	10.75	78.854
12	12	12.75	113.097

**Sketch 2** shows a system with the two side manifolds sized so their total combined cross-sectional areas do not exceed that of blower mixer outlet. If a manifold must be center-fed, then provisions may be required to connect both ends of the side manifolds together to form a complete looped distribution header to insure uniform distribution to the multiple burners.



## Installation Instructions

### Bringing in outside combustion air to blower mixers

In exceptionally dirty locations, or where a local code or plant regulation requires external-source combustion air, a separate supply duct from outside the room or building may be necessary.

The air inlet of a PREMIX® Blower Mixer is sized to accept round sheet metal ducting for this purpose. The accompanying table lists all available PREMIX® Blower Mixers together with a suggested maximum duct run that will allow development of full-rated mixer capacity.

Two columns are shown: a **standard size** which matches the PREMIX® Blower Mixer inlet diameter, and an **oversize** column which reflects the length made possible by enlarging the entire duct one size. A sheet metal transition could reduce duct to the standard size at ratio valve air inlet.

Because of the additional friction involved in duct elbows, **treat each turn in direction as if it added an additional 10 pipe diameters in length.**

#### Outside Air Supply Duct Sizes

Blower Mixer Type			Maximum Duct Footage	
PL	PM	PH	Standard Size	Oversize
			<b>3" dia.</b>	<b>4" dia.</b>
PL-8-			30 ft.	---
PL-130	PM-200	PH-190		
PL-165	PM-260	PH-250		
PL-195		PH-330 PH-400		
	PM-350		20 ft.	30 ft.
PL-380			18 ft.	
PL-490			11 ft.	
PL-540			4-1/2 ft.	
			<b>4" dia.</b>	<b>5" dia.</b>
		PH-500	30 ft.	---
	PM-525	PH-700		
PL-630		PH-900	28 ft.	30 ft.
PL-750			20 ft.	
PL-850			16 ft.	
PL-1000			11 ft.	
PL-1350			3 ft.	10 ft.
			<b>5" dia.</b>	<b>7" dia.</b>
		PH-1220	30 ft.	---
	PM-690	PH-1400		
	PM-920	PH-1650		
	PM-1080			
	PM-1200		24 ft.	30 ft.
PL-1700			12 ft.	
		PH-2350	9-1/2 ft.	
PL-1440			9 ft.	
	PM-2000		8-1/2 ft.	25 ft.
PL-2650			5 ft.	
PL-3500			3 ft.	
PL-4250			2 ft.	
			<b>7" dia.</b>	<b>10" dia.</b>
	PM-3200		27 ft.	30 ft.
	PM-4000		18 ft.	
PL-4600			13 ft.	
	PM-4800		12 ft.	
	PM-5750		11 ft.	15 ft.
PL-8500			2-1/2 ft.	
PL-10500				



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**INDUSTRIAL COMBUSTION EQUIPMENT AND VALVES**

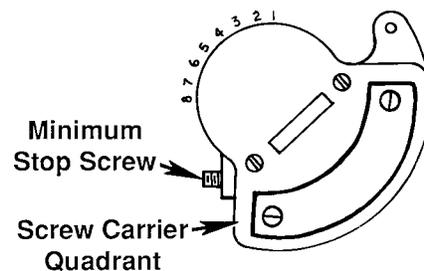
## Start-Up Instructions

Read complete instructions before proceeding, and familiarize yourself with all the system's components. Verify that your equipment has been installed in accordance with the manufacturer's current instructions.

**CAUTION: Initial adjustment and light-off should be undertaken only by trained and experienced personnel familiar with combustion systems, with control/safety circuitry, and with knowledge of the overall installation. Instructions provided by the company and/or individuals responsible for the manufacture and/or overall installation of complete system incorporating Maxon burners take precedence over these provided by Maxon. If Maxon instructions conflict with any codes or regulations, contact Maxon Corporation before attempting start-up.**

### For initial PREMIX® Blower Mixer start-up:

1. **Check all electric circuitry.** Verify that all control devices and interlocks are operable and functioning within their respective settings/ranges. Be sure all air and gas manifolds are tight and that test ports are plugged if not being used.
2. **Close all burner fuel valves and cocks.** Remove pilot and main gas regulators' adjusting screw covers. Turn adjusting screw down (clockwise) to approximately mid-position. Close pilot gas adjustable orifice screw by turning in clockwise until it stops. (Do not over-tighten.) Then back out the adjustable orifice (counter-clockwise) approximately 2-3 turns.
3. **Check that all duct and chamber dampers are properly positioned** and locked into operating positions.
4. **Disconnect the automatic control motor's linkage** from your blower mixer's screw carrier by loosening the control motor's connecting rod from the toggle linkage.  
**Initial start-up adjustment should only be accomplished during a "manual" burner control mode.**
5. **Start all system-related fans and blowers.** Check for proper motor rotation and impeller direction. Verify that all control interlocks are working. Allow air handling equipment to run for adequate purge of your manifolds and combustion chamber plenums. With main gas shut off, manually advance blower mixer's screw carrier to "high fire" position so that air only flows through burner and combustion chamber.
6. **Determine minimum differential mixture pressure.** Depending on the type of burner and its application, a method must be developed to connect a manometer between the combustion chamber static pressure and into a **straight** manifold going to the burner (at a point farthest from the PREMIX® Blower Mixer).  
 This method must take into consideration all of the frictional pressure drops in the distribution manifolding. You must maintain at least +0.25" wc differential mixture pressure (with natural gas) between the burner and the combustion chamber to avoid potential backfire conditions. (For VF LINOFLAME® Burners, differential mixture pressure should be +0.1" wc.)  
**Do not try to take a differential mixture pressure reading from a test port at or near an elbow in the piping manifolds** due to potentially erroneous readings caused by turbulence set up within the pipe by such pipe fittings. Measure in a **straight** manifold with at least four pipe diameters in length before and after the test port location.
7. **Set minimum differential mixture pressure** with minimum stop screw located on the side of the screw carrier quadrant of blower mixer ratio valve (see sketch below).



# Start-Up Instructions

This minimum stop screw creates a mechanical block which prohibits the screw carrier quadrant and its direct-connected air butterfly valve from closing completely. Thus a "minimum" volume of air is allowed in through the ratio valve to be delivered down the distribution manifold(s) to the burner(s). This air is used to establish the minimum differential pressure.

Screwing in (clockwise) on the minimum stop screw through its lock nut will open up the air butterfly and increase the minimum differential pressure.

Once your manometer readings confirm the minimum differential mixture readings, lock the minimum stop screw in that position so the ratio valve cannot be moved back below this minimum firing position. Regardless of what numerical value the indicator strip shows, this becomes the minimum firing position for your specific system in this application.

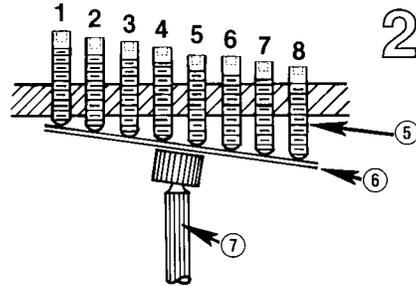
## 8. Adjusting the ratio valve of your PREMIX® Blower Mixer:

The heart of each PREMIX® Blower Mixer is its ratio valve. The description and accompanying sketches summarize its operation.

A quadrant (shown in Sketch 1) is rotated either manually or by a control operator to change firing rate as indicated by a position indicator strip ① and position pointer ②. A minimum stop screw ③ limits rotation and establishes a minimum air flow.

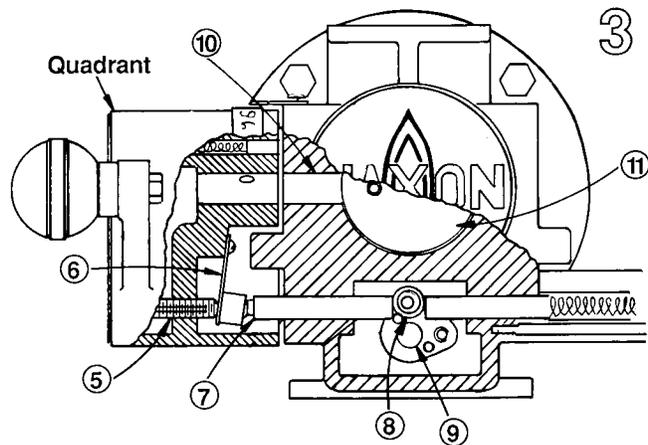
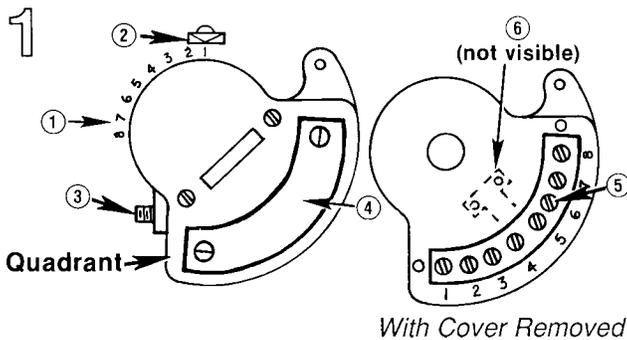
Removing a cover strip √ reveals a numbered series of adjusting screws ⑤ which bear on a set of cam strips ≈ beneath the quadrant.

Turning in the adjusting screws ⑤ (clockwise) gives a contour to flexible steel cam strips ≈ (see Sketch 2). These cam strips bear on a plunger and cap assembly Δ that determines opening of the gas butterfly valve. Cam strips serve to provide a continuous gradient.



As shown in Sketch 3, the plunger and cap assembly Δ acts upon a roller/crank ⑧ to rotate a valve shaft ⑨ to which the gas butterfly is attached.

Turning adjusting screw in until it is flush with quadrant opens gas butterfly fully. **Do not attempt to force screw further.**



Directly connected to the quadrant by a shaft ⑩ extending through its point of rotation is the air control butterfly ⑪, also shown in Sketch 3. Note that at #1 position of quadrant, air butterfly may be "closed" but deliberately undersized to provide a required minimum air flow. Air butterfly is fully open with quadrant at highest numbered position. (Number varies with mixer size.)



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INDUSTRIAL COMBUSTION EQUIPMENT AND VALVES

## Start-Up Instructions

9. **Prepare to adjust the ratio valve** by removing the cover plate from the quadrant screw carrier and turn all adjusting screws out until they are all flush with the outer surface of the screw carrier casting. (New equipment is shipped from factory with all screws already backed out to this level.)
10. **Return blower mixer quadrant to “low fire” position** when air purge of system is complete.
11. **Open main and pilot gas cocks**, then attempt to light burner pilot while slowly turning pilot gas regulator and/or adjusting orifice screw to increase fuel flow. Repeat procedure as necessary until pilot ignites as air might have to be bled out of fuel supply lines before reliable pilot flame is established. Pilot gas regulator should normally be set for as low a pressure as possible, using fuller opening of pilot gas adjustable orifice (if used.)
12. **After ignition, adjust pilot flame** for good stable flame shape. A “rule of thumb” is that any pilot over a tennis ball size is probably too large. This assumes you have visual access to the pilot flame. If this is not possible, then adjust pilot to give the strongest and most stable flame signal through your flame safety circuit. The signal strength (or range) will be determined by the specific type of flame safeguard instrument you have with your burner system.
13. **Re-check pilot ignition** by closing pilot gas cock or otherwise causing pilot outage. Re-light and refine pilot gas adjustment as necessary to get reliable ignition. The flame safeguard relays should now power your main fuel Shut-Off Valve(s).
14. **Light main burners at minimum**, as follows:  
First, make sure ratio valve is at its minimum setting (which may be at position 1 or 2 after completing step 6). With gas pilot established and flame supervision system operational, opening the main fuel Shut-Off Valve(s) will allow fuel flow to the blower mixer’s ratio valve. Turn corresponding screw in (clockwise) until flame ignites at all burner nozzles. (This may take several turns of the screw.)  
**NOTE:** At this point, it is more important to get any kind of a flame as soon as possible. The flame geometry can be adjusted and refined as needed later.  
Continue turning in slowly until flame becomes noticeably rich (usually purple or green with a slight yellow tip). Then slowly back the screw out until the flame becomes bright blue.
15. Once your flame is established and refined at this position, and without advancing the screw carrier quadrant higher, screw all remaining screws down to at least the same level as your first adjusted screws.  
**NOTE:** A preliminary setting can be established with all the remaining adjusting screws. Generally, each succeeding screw needs to be screwed in approximately one additional full turn from the preceding screw. A smooth “stair step” gradient pre-set at this point from low to high will simplify the remaining adjustment steps.
16. Without advancing the ratio valve quadrant, screw down on #2 screw (one or two turns). Then slowly advance the ratio valve quadrant to the #2 position. Adjust flame appearance at this new position #2.  
**NOTE:** If firing chamber is of refractory construction, allow your burner system to operate at this low setting for the necessary dry/cure out time period recommended by the chamber or refractory manufacturer. Then continue adjustment of ratio valve.  
Again, without moving ratio valve, bring #3 and all remaining adjusting screws down to the same level as #2 screw.  
**NOTE:** If approximate pre-set gradient was made earlier, the remaining screws will already be at or below appropriate levels.

**CAUTION: After completing steps above, re-check all interlocking safety components and circuitry to prove that they are properly installed, correctly set, and fully operational. If in doubt, shut the system down, close pilot cock and contact responsible individual before proceeding further.**

## Start-Up Instructions

Progressively work your way up through each adjusting screw position, developing a smooth progression slope from your first screw to the "maximum" position. As each is adjusted, you must turn the remaining unadjusted screws in at least that far to prevent possible damage to flexible cam strips inside the ratio valve.

**NOTE:** To adjust the flame at any position, you must move the ratio valve to the number you desire to adjust. This aligns the adjusting screw directly on top of the fuel valve plunger. A resulting adjustment of the screw is directly applied to the fuel valve plunger and its interconnected valve body linkage. **Always adjust only the screw corresponding to the position at which the ratio valve has been set.**

**CAUTION:** If flame is extinguished, immediately return ratio valve to minimum position and shut off fuel (if flame safeguard has not already done so). Turn in slightly on adjusting screw at point where ignition was lost, then return ratio valve to minimum position, re-establish pilots, open fuel valve and verify ignition.

17. **Refine main gas regulator adjustment** (if necessary) to give the required pressure. If a major adjustment is made, you may then need to re-adjust the screw(s) just set.
18. **After adjusting through the full range**, allow furnace or oven to reach operating temperature and refine adjustment as needed for hot conditions.
19. **Cycle burner from minimum to maximum** and refine adjustment, if necessary.  
**For operation with interrupted pilot** (as recommended), shut off pilots and cycle burner from minimum to maximum and back several times to verify the flame is maintained. When satisfied with adjustment, replace ratio valve cover plate.

20. **When burner performance is satisfactory** and stable throughout the firing range, reconnect linkage to control motor.

Control linkage travel must be such that burner quadrant is moved throughout its complete travel, or cataloged capacities and turndowns will not be achieved.

If less than full-rated burner capacity is required, linkage can be adjusted to limit maximum output. **With interrupted pilot**, it may be necessary to set control for somewhat higher than minimum burner setting to permit hold-in of flame detection system without pilot.

**CAUTION:** Internal drive mechanism within the control motor may be damaged if linkage is adjusted so as to cause binding with burner in high or low fire position.

21. **Plug all test connections not in use to avoid fuel leakage.** Replace equipment cover caps and tighten linkage screws.
22. **Check out overall system operation** by cycling through light-off at minimum, interrupting pilot, and allowing temperature control system to cycle burner from minimum to maximum and return.
23. **Recheck all safety system interlocks** for proper setting and operation.

**WARNING:** Test every UV installation for dangerous spark excitation from ignitors and other possible sources of direct or reflected UV radiation. Use only gas-tight scanner connections.

24. **Before system is placed into full service**, instruct operator personnel on proper start-up, operation, and shut-down of system. Establish written instructions for their future reference.



**CORPORATION**  
MUNCIE, INDIANA, USA

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**INDUSTRIAL COMBUSTION EQUIPMENT AND VALVES**

## Start-Up Instructions

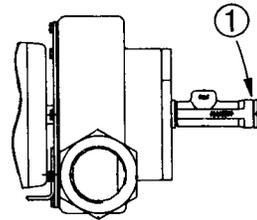
### Miniature PREMIX® Blower Mixers

Before proceeding, verify that all system equipment has been installed in accordance with the general instructions found on pages 3100-S-1 and 2.

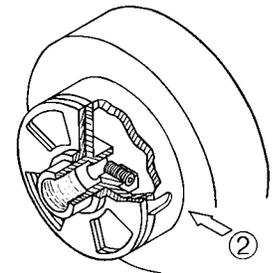
**Initial adjustment and light-off should be undertaken only by trained and experienced personnel familiar with combustion systems, control/safety circuitry, and overall installation. Instructions provided by the company or individual responsible for the overall installation of complete system take precedence over those provided by Maxon. If Maxon instructions conflict with local codes or regulations, contact us before start-up.**

#### For initial system start-up:

1. **Start blower mixer** and check for proper impeller rotation. Correct if necessary.
2. **Close mixer fuel port.** For M-100 and M-250 sizes, see illustration above, then remove cap ① and lightly turn orifice screw "in" (clockwise) until it seats.  
For the M-500, see sketch above. Insert 5/16" Allen wrench through slot ② and turn gas adjusting screw "in" (clockwise) until it bottoms.
3. **Open air shutter fully.** Verify burner differential air pressure is at least +0.25" wc. Verify that it meets required minimum for that specific burner nozzle(s).



M-100/M-100-U  
M-250



M-500

4. **Light pilot(s)** at the burner nozzle(s).
5. **Open main gas cock** and the adjustable orifice cock (where applicable).
6. **Turn gas adjusting screw** slowly "out" (counterclockwise) until ignition occurs, then refine setting as necessary. You will find most adjustment occurs within the first three turns of gas adjusting screw.

Allow time for remaining air to bleed out of gas line, but if ignition does not occur with reasonable promptness, close the gas cock and check for:

- A. Insufficient gas supply, possibly due to gas regulator incorrectly installed, closed gas cock, etc.
- B. Too much gas as a result of turning the adjusting screw too fast or too far.
- C. Improper piloting or insufficient spark.

# Notes



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