Type FD68 NYC-DAR Approved
Gas and Air Atomizing Oil Burners

Installation, Operation, and Maintenance Instruction Manual

NOTICE: This manual is provided to supply general information on the installation, operation and maintenance of the FD68 burner system. The burner must be installed and operated by trained personnel, guided by generally accepted industry practice. Do not attempt to operate the burner without familiarizing yourself with these instructions and the manufacturer's instructions for all components provided as part of the burner system. Failure to do so can result in personal injury, loss of life and damage to property. S.T. Johnson shall not be liable for any loss or injury to persons or property caused by the negligence of the Customer, its employees, contractors, suppliers, agents or sub-contractors.

Specifications and procedures are subject to change without notice. Please consult factory for older unit specifications, or whenever the equipment supplied does not match descriptions in this manual.

S.T. Johnson Company
925 Stanford Avenue
Oakland, CA 94608

Tel (510) 652-6000
Fax (510) 652-4302
www.johnsonburners.com

TABLE OF CONTENTS: PAGE

GENERAL INFORMATION 1
MODEL DESIGNATIONS 1
GENERAL MODEL DESCRIPTION 2
INSTALLATION INSTRUCTIONS 3
BURNER ASSEMBLY 3
BURNER MOUNTING DIMENSIONS 3
REFRACTORY INSTALLATION 4
REFRACTORY TILE CURING INSTRUCTIONS 4
SWING CYLINDER HINGE AND LATCH ADJUSTMENT 4
CONTROL PANEL & SAFETY CONTROLS INSTALLATION 5
STANDARD CONTROL PANEL MOUNTING DIMENSIONS 5
REQUIRED SAFETY LIMIT CONTROLS FOR ALL MODELS 6
GENERAL STARTUP PROCEDURE 7
PRE-FIRING CHECKOUT 7
COMBUSTION AIR ADJUSTMENT 8
INTEGRAL FAN BURNERS 8
REMOTE FAN BURNERS 8
IGNITION SYSTEM ADJUSTMENT PROCEDURE 9
STANDARD GAS-ELECTRIC PILOT SYSTEMS 9
OPTIONAL DIESEL/ELECTRIC IGNITION SYSTEMS 9
FIRING HEAD ADJUSTMENT PROCEDURE 10
AIR DIFFUSER SPECIFICATIONS 10
AIR ROTATION BLADE SETTINGS 11
FAN WHEEL SPECIFICATIONS FOR 60HZ INSTALLATIONS 12
MAINTENANCE RECOMMENDATIONS FOR ALL BURNERS 13
ROUTINE (OPERATIONAL) BURNER CHECKS 13
ROUTINE (OPERATIONAL) SAFETY CONTROL CHECKS 13
NON-OPERATIONAL CHECKS 13
LUBRICATION 13
REPLACEMENT PARTS 13
TROUBLESHOOTING GUIDE 14
GAS SYSTEMS STARTUP 15
GAS TRAIN INSTALLATION 15
SELECTION & SIZING 15
LOCATION 15
FIELD PIPING 15
VENT CONNECTIONS 15
MAIN GAS ADJUSTMENT 16
GAS PRESSURE SETTINGS: SIZE 50 TO 625 17
GAS PRESSURE SETTINGS: SIZE 1000 ONLY 18
GAS VALVE LINKAGE ADJUSTMENT 18
AIR ROTATION BLADE & AIR BAND SETTINGS 19
SIZE 1000 GAS FIRING HEAD CONFIGURATION 19
AIR ROTATION BLADE SETTINGS 19
PRIMARY AIR SLEEVE 19
AIR DISTRIBUTION SLEEVE 20
LE94 FIRING HEAD CONFIGURATION 20
GAS SPUD ROTATION 20
PRIMARY/SECONDARY GAS SPUD ORIFICES 20
OIL SYSTEM STARTUP: AIR ATOMIZED OIL SYSTEMS MODELS A-LM, A-MM, A-HM 21
INITIAL MAIN BURNER ADJUSTMENTS 21
HAUCK FIXED GRADIENT OIL METERING VALVES 22
“SAM” ELECTRONIC OIL METERING SYSTEM 23
AIR ATOMIZING OIL NOZZLE SPECIFICATIONS 24
NOZZLE POSITIONING 24
NOZZLE PIN SETTING 24
MODEL ( )L-LM OIL SYSTEM SETTINGS: BAR CRITERIA DATA SHEET #37 25
OIL PIPING SCHEMATIC: CRITERIA #37 SYSTEMS WITH OIL METERING VALVE 26
AIR ATOMIZED BURNERS WITH ELECTRONIC OIL METERING SYSTEM (EMS) 27
MODEL A-LM #2 OIL EMS SETTINGS 27
MODEL A-HM #6 OIL EMS SETTINGS 28
ELECTRONIC OIL METERING SYSTEM PIPING SCHEMATIC 29
MODEL A-LM #2 OIL SYSTEMS 29
MODEL A-HM #6 OIL SYSTEMS 29
ATOMIZING AIR COMPRESSOR INSTALLATION & ADJUSTMENT PROCEDURE 30
INSTALLATION 30

DIMENSIONS: ATLAS COPCO MODELS LE2, -3, -5 30
PIPING 31
START-UP 31
ADJUSTMENT 31
MAINTENANCE 31
OIL PUMP INSTALLATION 32
DIRECT-DRIVE OIL PUMP SET 32
60Hz OPERATION 32
ELECTRONIC OIL METERING PUMP INSTALLATION 33

APPENDIX A: SAM ELECTRONIC OIL METERING SYSTEM INSTALLATION, OPERATING AND MAINTENANCE SECTION 1
"SAM" ELECTRONIC OIL METERING SYSTEM DESCRIPTION 1
STANDARD FEATURES 1
OPERATING LIMITATIONS 1
PUMP MOUNTING & PIPING 2
SPECIAL WIRING CONSIDERATIONS 2
INITIALSETUP AND ADJUSTMENT 3
FIELD ADJUSTMENTS: 4
CAM ADJUSTMENTS: 4
FIRING RATE INDICATION: 5
DC DRIVE (CONTROL BOARD) REPLACEMENT & ADJUSTMENT: 6
SENSOR ADJUSTMENTS 7
RESPONSE TIME 7
NULL & SPAN 7
DIGITAL FLOW READOUT 8
UPGRADE/ REPLACEMENT OF OLDER VERSION: 8
INSTALLATION AND ADJUSTMENT: 8
TROUBLESHOOTING: 9

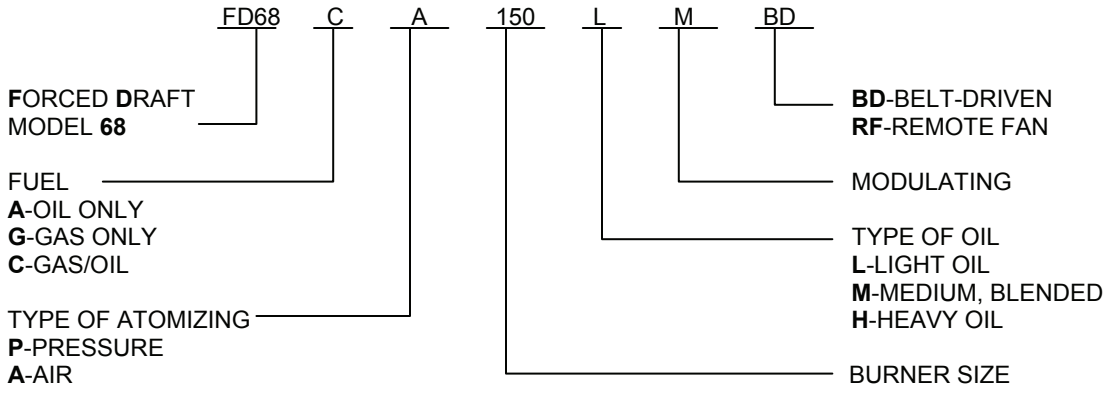
APPENDIX B: NEW YORK CITY METHODS OF LIMITATIONS 1
ELECTRONIC OIL METERING METHOD OF LIMITATION 1
CRITERIA DATA SHEET 37: METHOD OF LIMITATION 3

APPENDIX C: COMPONENT ID DRAWINGS 1

APPENDIX D: TYPICAL ELECTRICAL SCHEMATICS 1

GENERAL INFORMATION

MODEL DESIGNATIONS



Model **-LM**: Designed for use with grade #2 oil or lighter. No provision for pre-heating oil is incorporated on the burner itself. Standard design includes an oil supply back pressure regulating valve for recirculating oil from the oil inlet on the burner. Pressure atomization is available up to size 300. Air atomization is available for all sizes.

Model **-MM**: Designed for use with blended fuel oils up through grade #5. A single oil pre-heater is incorporated into the burner design to raise the oil to atomizing temperature. Standard design includes an oil supply back pressure regulating valve for recirculating oil from the discharge of the oil heater. Pre and post firing nozzle purge system is available as an option.

Model **-HM**: Designed for use with the heaviest grades of fuel oil. Oil is heated to atomizing temperature with a single heater on sizes 50 - 125 and dual heaters on sizes 150 - 1000. Standard design includes a triple-pass oil manifold to continually keep all oil piping hot up to the nozzle, an oil supply back pressure regulating valve for recirculating the oil from the burner inlet, a relief valve for recirculating oil from the oil heater discharge, and a pre and post firing nozzle purge system.

GENERAL MODEL DESCRIPTION

A flange mounted windbox assembly, a firing head assembly, a stainless steel encased refractory burner tile, a gas/electric ignition system, modulating motor with a jackshaft and linkage assembly, a wiring junction box, a flame scanner, and an observation port.

Size 50 to 1000-SP packaged burners include an integral forced draft, axial-flow, backward-inclined, blower assembly hinge mounted to the windbox incorporating a triple-disc air shutter assembly with a jackshaft and linkage connected to the windbox jackshaft with a swivel linkage, an air proving switch, and a latch switch. All sizes also include a silencer on the blower inlet.

Burner models with a **-BD** suffix are constructed with an integral FD fan, as described above, but with a belt drive arrangement. These models are intended for use with 50Hz power sources only. Burner models with an -**RF** suffix are for use with a separate FD fan. They are designed for applications involving very high furnace pressures, 50Hz power sources, and/or high elevations.

A separate NEMA 1 control panel for remote mounting, incorporating a full-modulating flame safeguard programmer, a motor starter and overload relay for the blower motor, on-off switch, a manual/auto firing rate selector switch, a manual firing rate limiting potentiometer, and (4) indicating lights for: "POWER ON", "IGNITION", "FUEL" AND "SAFETY". Numerous other control features are available as options.

GAS FIRED SYSTEMS:

Standard gas train components include a gas butterfly control valve mounted on the burner, automatic gas shut-off valves, pressure switches, pressure regulators, and manual gas cocks shipped loose. Gas train assemblies are available to meet any local or national codes required. Optional factory pre-piped gas trains are available as an option.

Standard systems are designed for use with natural gas and/or propane gas. Applications involving the use of other fuel gases are reviewed on an individual basis after receiving details regarding the fuel analysis.

AIR ATOMIZED OIL FIRED SYSTEMS:

Three different models are available for use with #2 oil, blended medium grade oil, and #6 oil. The model designations for these fuels are -LM, -MM, -HM respectively.

An oil supply pump on a separate mounting base is provided to supply oil to the burner system. The burner mounted oil pipe train includes a solenoid shut-off valve, oil supply pressure gauge, oil nozzle pressure gauge, oil metering valve, oil nozzle, and an oil back pressure regulating/relief valve.

A compressor set on a separate mounting base is provided to supply atomizing air to the system. The burner mounted atomizing air train includes an atomizing air pressure switch and an air pressure gauge.

Systems designed to fire with #4 oil also include one electric oil heater. A post-firing nozzle purge system is available as an option. Systems designed to fire with #6 oil include either one or two electric oil heaters, depending on the burner size, a post-firing nozzle purge system, and a oil recirculating system to maintain heated oil piping up to the oil nozzle at all times.

INSTALLATION INSTRUCTIONS

BURNER ASSEMBLY

If unsure of component identification refer to the component I.D. drawings included in the installation/operation manual furnished for each specific job:

The burner system is shipped with the refractory tile separate from the burner assembly to prevent damage in transit. The refractory tile should be bolted to the windbox mounting flange prior to mounting the assembly to the furnace mounting plate.

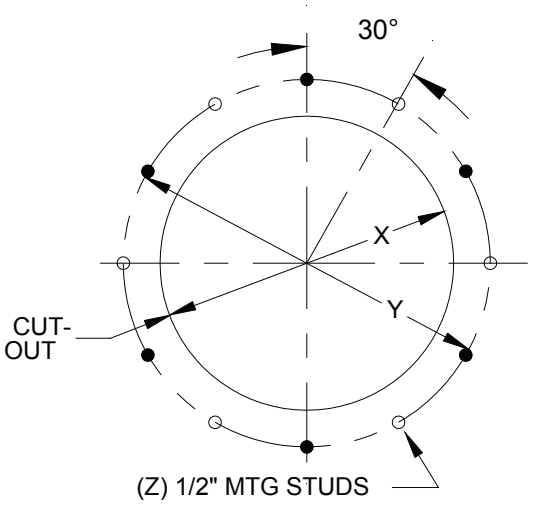
The firing head assembly can be installed inside the windbox after the burner has been mounted on the furnace. The adjustable firing head mounting brackets have been factory set for proper positioning of the head relative to the refractory burner throat. Because the refractory throat may not be positioned exactly the same at the installation as it was in the factory, a slight adjustment to the mounting brackets may be necessary to position the head concentric with the ID of the throat.

WARNING:
Both the windbox and the swing-away FD fan assembly have provision for installing a lifting lug, however the entire burner assembly should only be lifted using a lifting lug on the windbox. The weight of the burner should not be supported by using a lifting lug on the swing-away blower assembly. A lifting lug should only be used on the blower assembly should it become necessary to remove the blower assembly from the windbox.

BURNER MOUNTING DIMENSIONS

Burner Size	X	Y	Z
50-125	18	21 ¼	6
150-250	21	25 ¼	6
300	22	30 ¼	6
400	24	30 ¼	6
500-625	25	35 ¼	6
800	25	39 ½	12
1000	30	39 ½	12

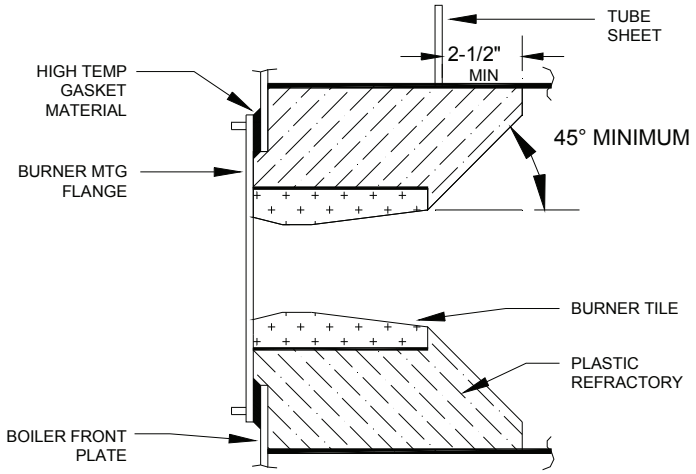
All dimensions in inches.



(SOLID LOCATIONS for SIZE 800 & UP ONLY)

REFRACTORY INSTALLATION

Plastic refractory must be “rammed" into the area between the O.D. of the burner tile and the I.D. of the furnace. This refractory must extend a minimum of 2-1/2" beyond the tube sheet of water wall of the boiler. Refractory which extends beyond the end of the burner tile should be formed from the I.D. of the tile at a minimum angle of 45 degrees.



REFRACTORY TILE CURING INSTRUCTIONS

A gradual refractory heat up schedule must be followed to ensure proper curing of the burner tile and any plastic refractory used during installation. Improperly cured refractory can blister, crack, or explode due to too rapid heating and excessive vaporization of moisture in the material. Excessive steam issuing from the refractory indicates that temperature is increasing too rapidly. Hold temperature until steaming subsides.

The following schedule does not supersede the manufacturer’s schedule, but should be viewed as a minimum requirement. Always follow the plastic refractory manufacturer’s instructions for proper curing and longest refractory service life.

1. Initially fire the burner at low fire for 30 minutes.
2. Shutdown for 30 minutes.
3. Repeat steps 1 and 2 for 6 to 8 hours. This will incrementally, but gradually raise the refractory to proper curing temperature. Do not take the firing rate past minimum until the refractory is fully cured.

Fine surface cracks are normal in a properly cured refractory and do not indicate defect or failure. Large penetrating cracks or missing pieces indicate the refractory was improperly installed or cured too rapidly. All damaged refractory should be repair or replaced immediately to avoid damage to the burner.

SWING CYLINDER HINGE AND LATCH ADJUSTMENT

Jarring during shipment can cause misalignment of the swing-away blower assembly to the windbox, or of the latch lug to the latch lock. The blower assembly is aligned to the windbox with adjusting bolts on the hinges; the weight of the blower assembly must be supported should it become necessary to loosen the fastening bolts for readjustment.

The latch assembly can be readjusted in both the horizontal and vertical directions after loosening the mounting screws. The latch lug can also be adjusted to insure tight closure of the blower assembly to the windbox by loosening the jam nut behind the lug and threading the lug closer to, or farther away from the latch lock.

The position of the latch handle relative to the latch lug can be changed by pulling out on the handle while pushing in on the end of the latch shaft and rotating the handle to the desired position.

CONTROL PANEL & SAFETY CONTROLS INSTALLATION

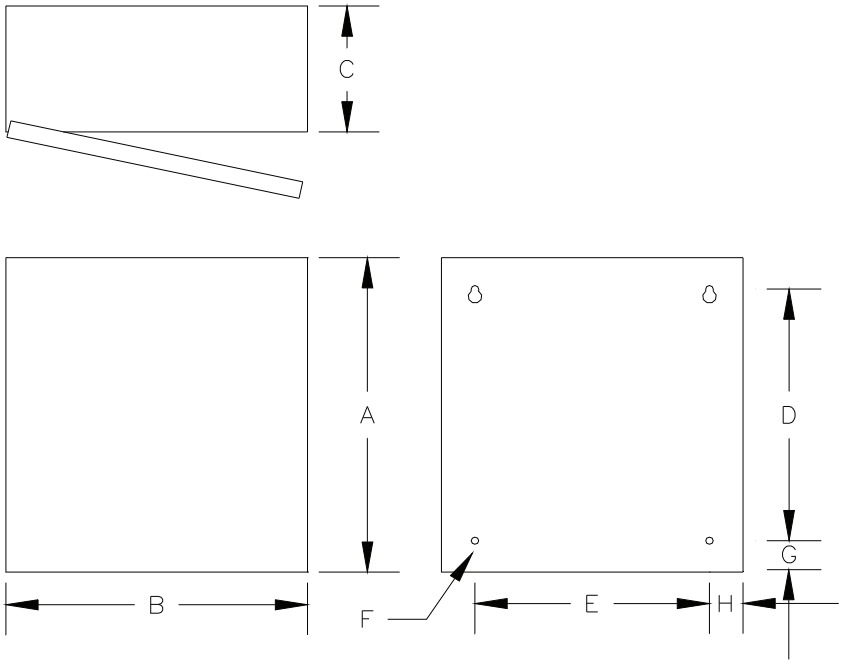
The control panel is furnished as a separate item and should be installed in a location other that immediately next to, or in line with the burner. It should be mounted on an adjacent wall or the side of the appliance. All wiring must comply with, and all branch circuits must be protected according to the national electrical code. Flame detector wiring between the burner and the control panel should be run in separate conduit from high voltage conductors.

All safety controls indicated on the wiring schematic furnished with the burner must be installed and wired in the control system as shown. Any discrepancies, or changes, must be approved by the S.T. JOHNSON CO. prior to initial firing of the burner system.

All signal wiring should be run in separate conduit and shielded according to the wiring schematic supplied with the equipment.

STANDARD CONTROL PANEL MOUNTING DIMENSIONS

The installation dimensions for standard NEMA 1 control panel enclosures follow. Specifications for other than NEMA 1 enclosures, and/or the inclusion of optional control equipment, may result in different installation dimensions. If mounting dimensions are critical, check with the factory for information on specific jobs.



DESIGNATION	A	B	C	D	E	F	G	H
FD68 STD	21.375	21.375	7.25	19	14.875	.38	1.125	1.875
FD68 LARGE	27.5	21.5	7.25	25	14.75	.38	1.25	3.25
FD68 X-LARGE	27.5	21.5	12	25	14.75	.38	1.25	3.25

All dimensions in inches.

REQUIRED SAFETY LIMIT CONTROLS FOR ALL MODELS

All burner systems must be installed with a pressure or temperature operating control and high limit control. These controls must be installed on the appliance in a location where they can accurately sense the pressure of the vapor, or temperature of the liquid being heated. Contact the appliance manufacturer if unsure of the correct mounting location. The electrical wiring schematic furnished with the burner indicates where these controls need to be wired into the control system.

The operating control functions to limit the firing of the burner to those pressures, or temperatures, below the set point of the control. Its N.C. contacts break upon rise of the pressure, or temperature. Typical operating controls are:

Honeywell L404A for pressure Honeywell L4006A for temperature

The high limit control functions to shut off the burner system at a pressure, or temperature slightly above the set point of the operating control. The set point of the high limit control must be less than the maximum pressure, or temperature, or the appliance the burner is applied to. The N.C. contacts of this control break on a rise in pressure, or temperature, and must result in manual reset of the control to resume operation of the burner system. Typical high limit controls are:

Honeywell L404C for pressure Honeywell L6006E for temperature

If safety limit controls were not furnished with the burner system, or with the appliance on which the burner is being installed, contact S.T. JOHNSON CO. or the appliance manufacturer to obtain the proper controls for installation prior to initial firing of the system.
DO NOT attempt to fire any appliance, whether boiler or furnace without the necessary safety limit controls.

GENERAL STARTUP PROCEDURE

PRE-FIRING CHECKOUT

WARNING!
The initial firing, and/or adjustment of these combustion systems must be performed by authorized and properly trained personnel. Lack of extensive knowledge of these systems and/or the failure to explicitly follow these instructions, and the manufacturer's instructions provided for all components in the system, can result in personal injury or property damage.

Qualified personnel must follow the instructions before proceeding with the initial firing of this equipment.

Unqualified personnel must not proceed with initial firing; contact S.T. JOHNSON CO for recommendations for qualified personnel to initially fire the burner system.

This equipment must not be started up, or run at any time, without all guards, cover plates, and enclosures properly secured in place. Guards and cover plates must only be removed for maintenance and service.

The entire combustion system must be checked prior to attempting the initial operation. These checks must include, but are not limited to:

1. All piping must be checked against the provided piping drawings to insure proper installation. Tightness of all fittings should also be checked.

2. All wiring must be checked against the provided wiring drawings to insure completeness and accuracy. Check for loose connections or short circuits prior to applying power to the system.

3. The electrical power supply must be checked to insure the voltage coincides with the motor and control voltages listed on the equipment nameplates.

4. Check gas supply pressure to insure it is compatible with the pressure regulators installed on the gas train.

5. Check oil supply to verify the grade of oil corresponds to that specified on the burner nameplate. Also insure that transfer pumps, if used, do not supply oil to the burner pump at a pressure higher than the manufacturer's specification, generally 3 PSIG.

6. Check linkages to all fuel control valves and the air shutter to insure proper operation without binding or slippage.

7. Insure all pumps have been properly primed with oil and that the compressor has been filled with the proper grade of compressor oil.

8. Check for proper rotation of all motors by momentarily closing the motor starter contacts.

9. Referring to the manufacturer's instructions included in the operating manual furnished, check for the proper setting and operation of all safety related controls; this could include but is not limited to:

- Boiler operating and high pressure limit controls
- Boiler pressure safety relief valves
- Boiler low water cutouts
- Burner gas pressure switches
- Burner blower air pressure switch
- Burner atomizing air pressure switch
- Burner oil pressure switch
- Low & high oil temperature switch (-MM, -HM models)

COMBUSTION AIR ADJUSTMENT

INTEGRAL FAN BURNERS

Burners with an integral, swing-away, blower assembly should have the air shutter completely closed at low fire for proper pilot performance and maximum turndown of the main flame. On applications involving a positive furnace pressure the air shutter should be adjusted for full opening at high fire to obtain the maximum catalog capacity. On applications involving a negative furnace pressure the opening of the air shutter should be limited to a point where the fan motor will not draw more current than 115% of the nameplate amperage.

To insure complete closure of the air shutter at low fire the linkage between the main jackshaft and the air jackshaft should be adjusted to provide a slight amount of over-travel of the linkage into the overtravel or swivel assembly when the air shutter is closed.

On applications where a very high draft, or a changing draft, such as boiler conversions with high stacks or where multiple boilers utilize a common stack, serious consideration must be given to control the draft through the combustion chamber/burner. Uncontrolled draft can cause low efficiency, noisy combustion and instability.

REMOTE FAN BURNERS

Remote fan burners (-RF model designation) can be furnished with a multi-blade air damper on the inlet of the burner, or with an inlet vortex damper on the remote fan. Remote fans and associated air ducting must be sized to provide the following differential windbox air pressures (over & above the furnace pressure):

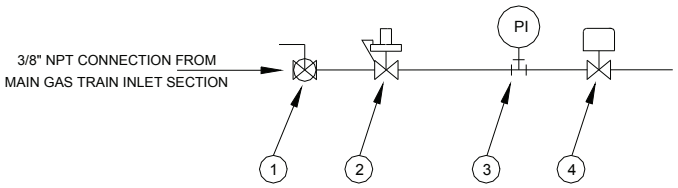
BURNER SIZE	CAPACITY (MBH)	DIFFUSER LOSS (Inches w.c.)	DAMPER LOSS (Inches w.c.)	TOTAL LOSS (Inches w.c.)
50	2,100	0.6	0.1	0.7
75	3,570	1.5	0.3	1.8
100	4,620	2.5	0.5	3.0
125	5,600	3.6	0.7	4.3
150	7,350	2.5	0.3	2.8
200	10,050	4.7	0.5	5.2
250	11,200	5.8	0.6	6.4
300	14,280	6.1	0.4	6.5
400	20,160	6.2	0.7	6.9
500	24,150	7.3	0.4	7.7
625	31,500	10.0	0.7	10.7
625	33,600	11.7	0.8	12.5
1000	42,000	12.5	0.7	13.2

IGNITION SYSTEM ADJUSTMENT PROCEDURE

Note: The "TEST/RUN" switch on the flame safeguard programmer may be used to provide additional time for adjustment; refer to the programmer instructions furnished with the burner.

STANDARD GAS-ELECTRIC PILOT SYSTEMS

Standard piloting arrangements are designed for use with natural gas or propane and include a pilot solenoid valve, pressure gauge, ball valve, ignition transformer and regulator rated for 10 PSIG max inlet pressure. The regulator should be adjusted to provide an outlet pressure of 3 to 6" w.c. The internal orifice in the pilot assembly may be drilled out to 1/8" maximum in applications where a larger pilot flame may be desired.

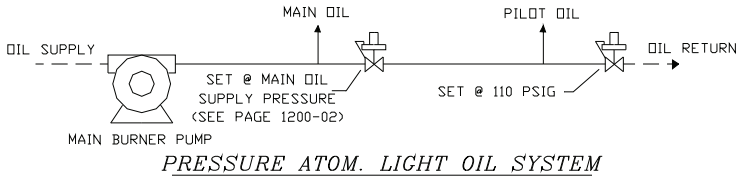


COMPONENT IDENTIFICATION

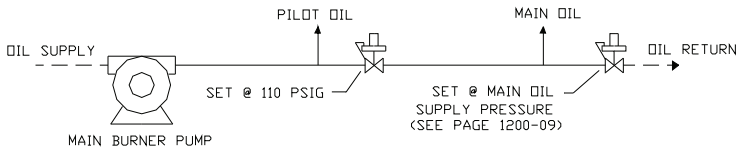
1. 3/8" BALL VALVE
2. 3/8" MAXITROL 325-3 REGULATOR
3. 0 - 35"W.C. PRESSURE GAUGE
4. 1/4" ASCO 8262G13 SHUTOFF VALVE

OPTIONAL DIESEL/ELECTRIC IGNITION SYSTEMS

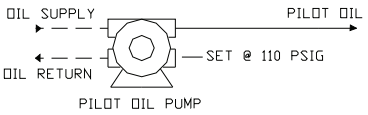
Diesel oil pilot systems are designed to operate with 100 to 110 PSIG oil pressure on the pilot nozzle. The exact piping configuration and adjustment procedure differs according to the burner model. Heavy oil burners include a separate pilot oil pump and a time delay relay in the control system to interrupt the pilot pump after establishment of the main flame. Standard arrangements for pressure or air atomized light oil burners utilize the main oil pump for the pilot, however a separate pilot oil pump can be furnished as an option.



PRESSURE ATOM. LIGHT OIL SYSTEM



AIR ATOM. LIGHT OIL SYSTEM

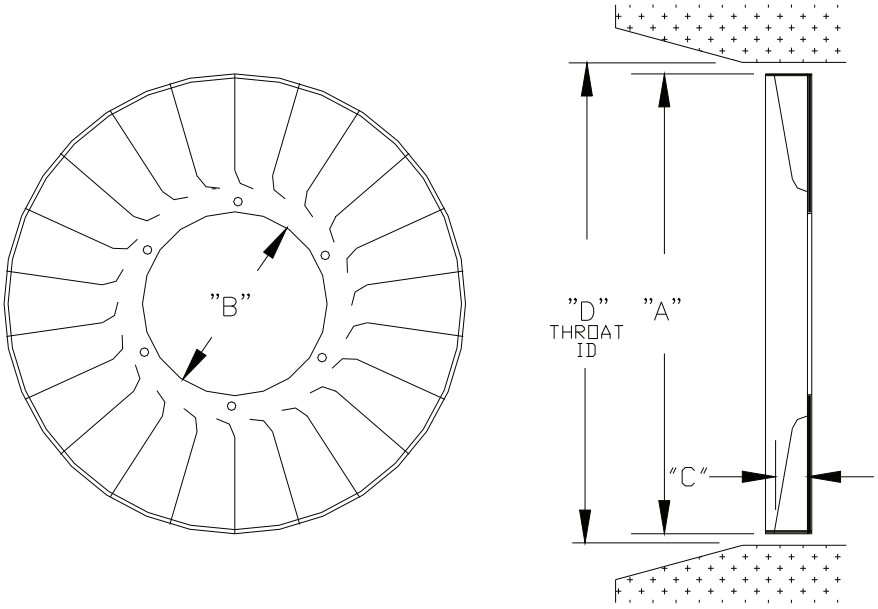


AIR ATOM. HEAVY OIL SYSTEM

FIRING HEAD ADJUSTMENT PROCEDURE

AIR DIFFUSER SPECIFICATIONS

The air diffuser is a critical component in the burner design. A damaged or deteriorated air diffuser will adversely affect combustion performance. The following dimensional information is furnished as a maintenance guide especially for checking for proper louver openings. Although these dimensions are the factory standard, certain special applications may have required opening the outside of the diffuser louvers further.

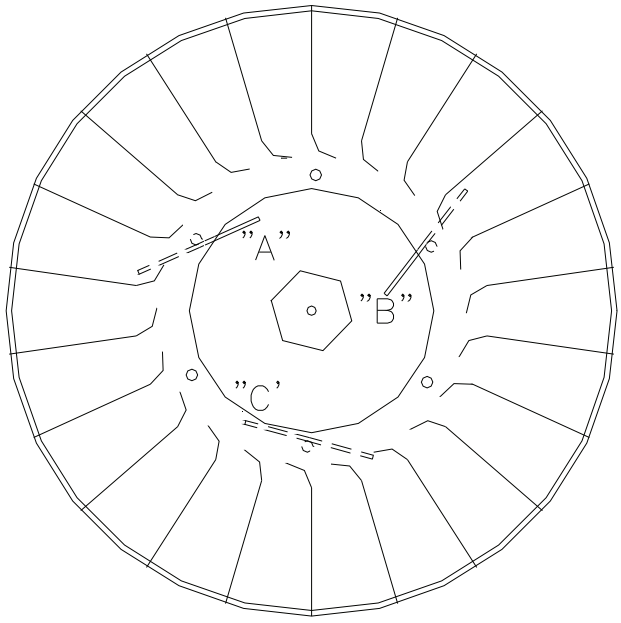


Burner Size	A	B	C	D
50, 75, 100	9.69"/246mm	4"/102mm	.31"/7.9mm	9.81"/249mm
125	9.69"/246mm	5"/127mm	.56"/14.3mm	9.81"/249mm
150, 200	12.63"/321mm	5.63"/143mm	.38"/9.5mm	12.75"/324mm
250	12.63"/321mm	6"/152mm	.50"/13mm	12.75"/324mm
300	13.63"/346mm	6.25"/159mm	.38"/9.5mm	13.75"/349mm
400	15.63"/397mm	6.25"/159mm	.50"/13mm	15.75"/400mm
500	16.38"/416mm	7.5"/191mm	.50"/13mm	16.50"/419mm
625, 800	17.38"/441mm	7.88"/454mm	.50"/13mm	17.50"/445mm
900, 1000	20.31"/517mm	9.25"/235mm	.50"/13mm	20.50"/521mm

AIR ROTATION BLADE SETTINGS

The air rotation blades serve to control the amount of, and swirl of, the combustion air flowing through the center of the air diffuser. This air has a rotation opposite to that of the air flowing through the outer diffuser louvers. The rate of fuel/air mixing and flame geometry can also be changed by the rotation blade setting especially when firing oil. Closing the blades more will result in a higher degree of swirl to the flame carrying the fuel/air mixture further out toward the furnace walls.

Oil only burners, especially those firing heavy oil, typically should have the rotation blades open further as indicated by position "B" below. Burners designed to fire on gas, or gas/oil, would typically have the blades set in the normal position "A". The closed position "C" is almost never recommended



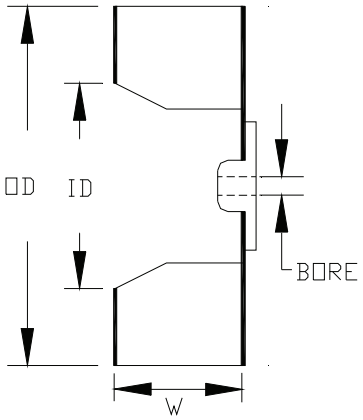
Positioning the blades so the stem is on the outward side will result in lower emissions on those installations where NOx control is incorporated.

Gas systems designed with gas spuds located behind the air diffuser can incur combustion behind the diffuser on initial light-off if the blades are open further than position "A" and the system is adjusted for maximum turndown. This condition should be checked for after initial commissioning and the blades closed further if the problem exists.

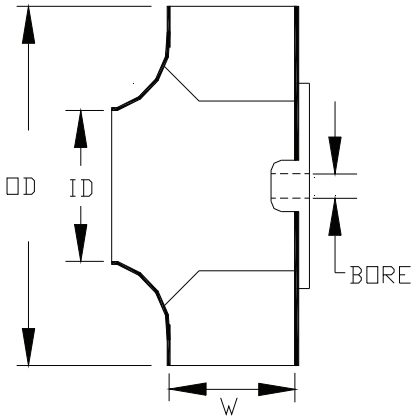
After initial setup the air rotation blades should only need to be checked, or re-set, if and when the air diffuser is replaced.

FAN WHEEL SPECIFICATIONS FOR 60HZ INSTALLATIONS

The following fan wheel dimensions are those for burners fabricated for 60Hz installations utilizing standard ODP motors. Burners built with special motors may have a different hub size.



SIZE 50 - 100



SIZE 125 - 1040

All dimensions are expressed as (Inches/mm).

Burner Size	W	OD	ID	Bore
50	2.06 / 52	8.63 / 219	5.00 / 127	0.63 / 16
75	2.50 / 63	10.50 / 267	6.00 / 152	0.63 / 16
100	2.91 / 74	12.25 / 311	7.00 / 178	0.63 / 16
125-150	4.81 / 122	12.25 / 311	7.19 / 183	0.63 / 16
200	5.53 / 140	14.00 / 356	8.19 / 208	1.13 / 29
250-300	6.22 / 158	15.63 / 397	9.19 / 233	1.13 / 29
400	6.84 / 174	17.38 / 441	10.19 / 259	1.38 / 35
500	7.56 / 192	19.13 / 486	11.19 / 284	1.63 / 41
625	8.28 / 210	20.88 / 530	12.19 / 310	1.63 / 41
800	8.28 / 210	19.13 / 486	13.00 / 330	1.63 / 41
1000	8.28 / 210	20.88 / 530	14.50 / 368	1.63 / 41
1000-SP	7.50 / 190	22.63 / 575	15.5 / 394	1.88 / 48

MAINTENANCE RECOMMENDATIONS FOR ALL BURNERS

ROUTINE (OPERATIONAL) BURNER CHECKS

1. Check visual appearance of flame (no impingement on furnace, etc)
2. Check for gas or oil leaks in fuel piping system
3. Check for abnormal bearing noise from motors
4. Inspect for loose or bent control linkage
5. Inspect for deteriorating refractory (broken pieces in furnace)

ROUTINE (OPERATIONAL) SAFETY CONTROL CHECKS

Note: The following procedures will result in a burner shut-down for a short period; if the burner does not shut down during any of the following steps, the control being tested must be replaced before placing the equipment back into service. Refer to the manufacturer's literature for check-out instructions for each specific control.

1. Manually shut off the source of fuel; the burner system should shut down within 4 seconds. If not the flame detector and/or the amplifier portion of the primary safety control must be replaced.
2. Reduce the set point of the operating limit control below the existing pressure, or temperature, condition. The burner should shut down immediately.
3. Reduce the set point of the high limit control below the existing pressure, or temperature, condition. The burner should shut down immediately requiring a manual reset to restart.
4. Reduce the set point of the low pressure switch for the fuel being used, either gas or oil, to a point below the operating pressure. The burner should shut down requiring a manual reset.

NON-OPERATIONAL CHECKS

1. Check for cleanliness of flame scanner lens.
2. Check for deterioration of pilot, ignition electrode & firing head components.
3. Check for dirt build-up on ignition electrode insulator and ignition cable.
4. Check for dirt build-up on fan blades.
5. Check for proper and safe operation of flame safeguard programmer according to the manufacturer's instructions provided in the manual furnished with the burner.
6. Leak test all fuel safety shut-off valves according to the manufacturer's instructions provided in the operating manual furnished with the burner.

LUBRICATION

Fan motors should be lubricated every 6 months under normal operating conditions, or more often with high ambient temperatures. For motors up through 10 HP use #2 consistency lithium based grease. For 15 HP and larger motors use #2 consistency, polyurea grease.

REPLACEMENT PARTS

When ordering parts, or requesting information on equipment, always include the nameplate data including shop order number.

TROUBLESHOOTING GUIDE

SYMPTOM	PROBABLE CAUSE
Call for heat but burner will not start.	• High limit control "LOCKED OUT". • Low water cut-out "LOCKED OUT". • Flame safeguard programmer "LOCKED OUT". • Blower motor overload relay tripped. • Blower motor circuit protection tripped. • Blower motor defective.
Burner starts but will not complete the prepurge cycle.	• Blower air pressure switch is not making. • Fuel pressure switch is not making. • Aux contact on blower starter is open. • Aux contact on pump or compressor starter is open. • Defective flame safeguard programmer module.
Purge complete but ignition is unsuccessful.	• Low fire start switch in mod motor not making.
Ignition is attempted but unsuccessful.	• Pilot gas cock is closed. • Pilot gas pressure is insufficient. • Ignition transformer is defective. • Pilot solenoid valve is defective. • Incorrect flame scanner sighting. • Flame scanner is defective.
Pilot established but main flame ignition is unsuccessful.	• Main fuel valve is closed. • High fuel pressure switch is tripping when main fuel valve opens. • Main gas control valve completely closed @ low fire. • Improper fuel-air ratio @ low fire.
Main flame established but burner shuts down when modulating to high fire.	• Improper fuel-air ratio @ mid-firing range. • Insufficient gas pressure from regulator. • Low fuel pressure switch set too high. • High limit control set too low or defective.
Burner remains @ low fire with increasing load demand.	• Modulating controller set too low or defective. • Modulating motor is defective. • Control system in "MANUAL, LOW FIRE" mode.
Lack of flame retention when firing on oil.	• Oil nozzle needs cleaning. • Improper atomizing air pressure. • Heavy oil temperature too high.
Creation of soot in furnace when firing on oil.	• Oil nozzle needs cleaning. • Fuel-air ratio is set too fuel rich. • Atomizing air pressure too low. • Spray angle of nozzle not correct for furnace.
Oil pressure is uncontrollably high @ light-off	• Cold oil is plugging oil nozzle. Check for proper operation of the nozzle purge solenoid and check valves.

GAS SYSTEMS STARTUP

GAS TRAIN INSTALLATION

SELECTION & SIZING

Gas trains are selected according to local code & insurance requirements. Components are sized according to available gas supply pressure, burner capacity, and furnace pressure. As a guide standard sizes are listed in the catalog bulletin along with the required outlet pressure of the main pressure regulator. Installation manuals for each job include drawings of the gas train furnished with the burner system.

LOCATION

Gas trains should be located as close to the burner assembly as possible, preferably on the left side of the burner to facilitate easy connection to the gas control valve. Temperature limitations of all the components should be taken into account when mounting directly on the heating appliance. (Refer to the specifications and installation instructions furnished with the operating manual).

FIELD PIPING

The piping should contain as few direction changes as possible between the main pressure regulator and the burner inlet to minimize the pressure drop. Proper sizing of components often results in a main pressure regulator with a smaller pipe size than the shut-off valves; this transition in pipe size should be made with a "bell type" reducer at least 4 pipe diameters downstream of the regulator outlet. Gas shut-off valves and regulators are all uni-directional and must be installed accordingly. Gas train assembly drawings are provided in the installation & operating manual with each system.

VENT CONNECTIONS

Gas train assemblies to meet IRI code, and all gas trains for capacities greater than 12500 MBTU/HR, include a N.O. vent valve for installation between the (2) shut-off valves. This valve should be installed in a horizontal run of piping with the solenoid coil on the top. The pipe size of the vent line must be no smaller than the valve furnished with the burner system. Vent connections from all pressure regulators and pressure switches should also be vented to the outside of the building using 1/4" OD tubing as a minimum and may be manifolded together but the size of the common vent line must be at least equal in area to the largest vent plus 50% of the area of the remaining vent lines. The vent line from the N.O. vent valve must be run separately.

WARNING: All piping and gas train components must be leak tested prior to the initial start up of the burner system. The manual gas cock installed downstream of the shut-off valves is provided for this testing. Gas shut-off valves should be leak tested periodically to insure there is no leakage through the valve seats. It is recommended this leak testing be performed monthly.

MAIN GAS ADJUSTMENT

WARNING: Before proceeding with the main fuel/air adjustment, all appropriate PREFIRING CHECKOUTS must be performed. Also insure that all linkages move smoothly without binding and are properly set to provide for the minimum positions of both the air shutter and fuel valve at low fire. Make sure all connectors are tight.

A pilot turndown test must be performed according to the flame safeguard manufacturer's instructions provided with this burner system. This test must ensure that the main burner flame can be smoothly ignited with the smallest flame that can be detected by the flame detector. The orientation of the flame detector can be changed if necessary by readjusting its swivel mount. A spark pickup test should also be conducted to ensure that UV radiation from the ignition spark is not being detected whenever a UV flame detector is in use. Please refer the manufacturer's instructions.

The use of the "test/run" switch on the flame safeguard programmer, and the manual firing rate potentiometer, is recommended to facilitate main fuel/air adjustment. Before attempting main fuel/air adjustment insure that the system is in the low-fire, manual mode.

Flue gas constituents should be analyzed at all firing rates to optimize the levels of O2 & CO2 and insure that the level of CO is not excessive. The exact percentage of these constituents can vary according to the application but O2 levels will typically be 6-8% @ low fire and gradually decrease to 3-4% @ high fire. The required low fire adjustment is often affected by the combustion chamber size, with smaller chambers requiring more air to achieve proper flame geometry. If precise fuel/air ratios are required, or if acceptable levels are difficult to achieve due to application variables, a gas control valve with an adjustable characteristic cam must be considered.

If an adjustable characteristic cam is not used, the fuel/air ratio is determined merely by the low and high fire setting of the gas butterfly valve and the position of the valve crankarm relative to the position of the jackshaft crankarm. The effect of changing these relative positions is shown under GAS VALVE LINKAGE ADJUSTMENT.

Manifold gas pressure should be measured and recorders using a manometer connected to the test port located between the gas control valve and the burner inlet. The gas pressure at minimum fire will be negligible and difficult to read; for this reason the fuel/air adjustment is best accomplished by sight and flue product analysis. High fire manifold pressures to achieve the nominal burner capacity (i.e. 250HP for size 250), and the maximum cataloged capacities are listed under GAS PRESSURE SETTINGS in the proceeding section.

Burners designed to burn fuel other than natural gas will typically be constructed with different gas jet porting and will require manifold pressures similar to those previously listed for natural gas. All burners with special configurations will have the proper high fire manifold pressure stamped on the burner nameplate.

Gas combustion in a confined combustion chamber with a small cross-sectional area can result in combustion harmonics especially if the length to diameter ratio of the chamber is large. Model FD68 burners are designed to eliminate this problem for most applications, however if this problem occurs the following corrective steps should be attempted in the order listed:

1. An adjustable characteristic gas valve cam should be used.
2. The fuel/air ratio must be changed to compensate.
3. The jackshaft and valve crank positions must be changed.
4. The position of the air rotation blades on the firing head must be changed.
5. The position of the air band around the gas jet plenum should be changed.
6. Some of the inner gas jets should be plugged and the manifold pressure increased.

GAS PRESSURE SETTINGS: SIZE 50 TO 625

The following tables should be used as a guide to setting the high fire gas manifold pressure for sea level operation. The pressures listed for the nominal burner capacity are those required when firing against the furnace pressure listed. The maximum capacities & manifold pressures listed are for firing against a balanced furnace pressure. Manifold pressures for firing into higher furnace pressures can be closely estimated by adding 60 to 65% of the additional furnace pressure to the manifold pressure listed.

Final fuel/air adjustments should be made by flue gas analysis.

NATURAL GAS MANIFOLD PRESSURE:

TABLE A: STANDARD MODELS OPERATING @ 60 HZ

BURNER SIZE	50	75	100	125	150	200	250	300	400	500	625
Nominal MBTU/Hr	2,100	3,150	4,200	5,250	6,300	8,400	10,500	12,600	16,800	21,000	26,250
Manifold Pressure Inches w.c.	2.7	4.5	6.8	8.0	7.8	8.5	11.1	7.7	8.7	10.9	12.8
Furnace Pressure Inches w.c.	.75	.75	1.0	1.0	1.5	2.0	2.0	3.0	4.0	4.0	4.0
Maximum MBTU/Hr	2,500	3,750	5,100	5,600	7,500	10,050	11,200	15,000	20,250	25,200	31,500
Manifold Pressure Inches w.c.	3.0	5.1	7.5	8.4	9.2	10.4	11.3	7.6	9.0	11.3	15.0

GAS PRESSURE SETTINGS: SIZE 1000 ONLY

The following tables should be used as a guide to setting the high fire gas manifold pressure for sea level operation. The manifold pressures and capacities listed are the maximum obtainable for the corresponding furnace pressure. Manifold pressures for firing into higher furnace pressures can be closely estimated by adding 60-65% of the additional furnace pressure to the manifold pressure listed.

Final fuel/air adjustments should be made by flue gas analysis.

NAT GAS MANIFOLD PRESSURE

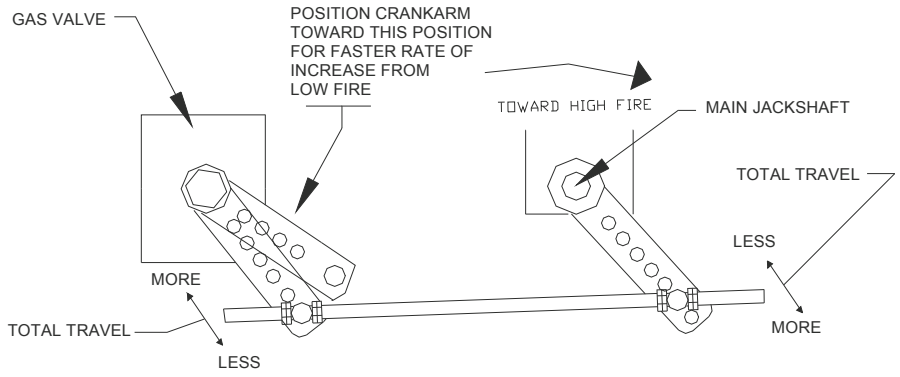
TABLE A: STANDARD MODELS OPERATING @ 60 HZ

Furnace Pressure Inches w.c.	0.0	1.0	2.0	3.0	4.0	5.0	7.0
Max Capacity MBTU/Hr	42,000	39,350	37,255	35,700	33,900	32,200	29,800
Manifold Pressure Inches w.c.	13.0	13.6	14.2	14.9	15.5	16.2	17.4

Burners ordered specifically for firing with a fuel gas other than natural gas can be furnished with special orifices in the gas spuds which will result in manifold pressures different from those listed above.

GAS VALVE LINKAGE ADJUSTMENT

The following changes can be made to increase or decrease the rate of gas valve travel at low or high fire:

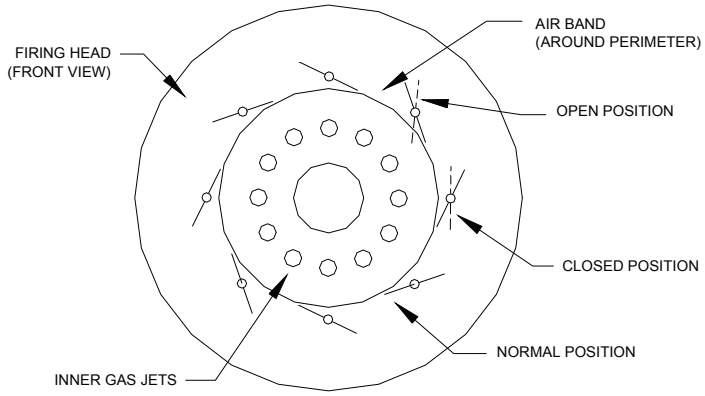


SIZE 50 - 250 SHOWN @ LOW FIRE

(JACKSHAFT ON LARGER SIZES ROTATES IN OPPOSITE DIRECTION)

AIR ROTATION BLADE & AIR BAND SETTINGS

The air rotation blades may be changed as shown. It must be kept in mind that combination gas/oil burners will probably require a normal to open setting of these blades for oil firing. The air band (if supplied) may also be repositioned to change the amount of air introduced to the gas jet plenum.



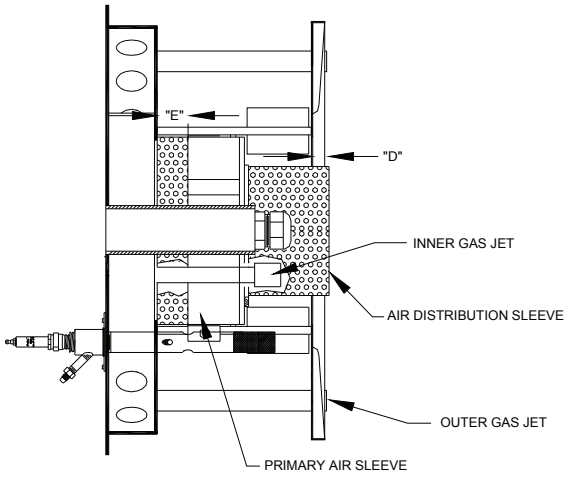
SIZE 1000 GAS FIRING HEAD CONFIGURATION

AIR ROTATION BLADE SETTINGS

The air rotation blades are factory set so that a straight edge place on the blades will be tangent with the primary sleeve on the firing head. Rotating the blades further open will result in more air being delivered into the center of the flame. Closing the blades will force more air toward the outside of the flame and will result in more rotation to the flame. Oil fired systems will generally require the blades to be open at least as far as the factory setting. The shaft of the blades should be facing toward the center of the firing head for lowest emissions.

PRIMARY AIR SLEEVE

The percentage of laminar air flow through the center of the air diffuser can be controlled with the setting of the primary air sleeve. The primary air opening "E" is factory set at the maximum opening. In general the primary air opening should be set for its maximum value particularly on oil fired systems.



AIR DISTRIBUTION SLEEVE

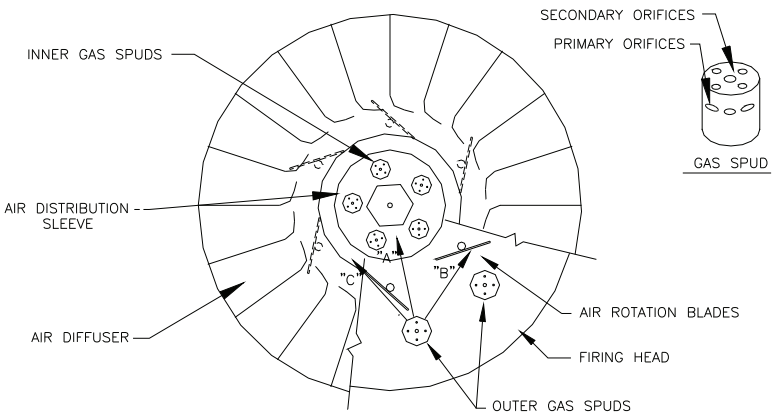
The air distribution sleeve is only furnished with gas only, LE-series firing heads. It controls the flow of air through the center of the diffuser. The dimension "D" is factory set at 5/8" but this dimension can be increased if lower NOx levels are required. The sleeve will result in a slower mixing flame when firing with oil and can be removed if a faster mixing oil fire, with more rotation, is required when firing in relatively small combustion chambers.

LE94 FIRING HEAD CONFIGURATION

The Series LE firing head design incorporates several features which enable field adjustment to change the rate of fuel/air mixing, flame geometry, and emission levels. Most installations will not require any changes from the factory settings as described below. In general NOx levels will decrease as more fuel is added to the outside of the flame. More gas can be directed to the outside of the flame until an unstable non-combustible, mixture is obtained in the center of the flame. Instability is usually only a limiting factor when firing into small diameter firetube boilers.

GAS SPUD ROTATION

The flame geometry and emission levels are affected by the direction at which the primary fuel gas is injected into the combustion air stream. The direction of the gas flow from the primary gas orifices of the outer spuds can be changed by rotating the spuds. The center orifice is factory set in position "A", directed toward the center of the firing head. Rotating in the direction of position "B" will result in more fuel being delivered to the outside of the flame. Rotating toward position "C", against the flow of air through the diffuser louvers, will also result in faster mixing but generally is not recommended because of the generation of higher levels of CO and NOx.



FRONT VIEW

PRIMARY/SECONDARY GAS SPUD ORIFICES

For natural gas, two of the three primary gas orifices are plugged at the factory. If more fuel is desired in the center of the flame, one or both of the primary orifice plugs can be removed. The center secondary orifice, on the face of the spud, may also be plugged resulting in less fuel being delivered to the outside of the flame. Lower NOx emissions are generally achieved with two of the primary orifices open, and all five of the secondary orifices open. Orifice configuration will vary for fuels other than natural gas.

OIL SYSTEM STARTUP: AIR ATOMIZED OIL SYSTEMS MODELS A-LM, A-MM, A-HM

Refer to pre-firing check-out.

Refer to air shutter & pilot adjustment.

Refer to all manufactures' component instruction manuals.

Final air and oil adjustments should be made by analyzing the flue gas. Optimum CO2 readings will vary according to oil being burned, but O2 readings should be approximately 3-4% @ high fire and 5-7% @ low fire. These settings generally will result in a turndown ratio of 5:1; a larger turndown can be achieved with higher O2 readings @ low fire.

After adjustments are completed all safety related controls, including the flame safeguard programmer, temperature or pressure limit controls, and blower air & atomizing air pressure switches must be tested for proper operation by deliberately simulating component failure and/or changing the setting of the temperature and pressure limit controls to force safety shut-down of the burner system.

INITIAL MAIN BURNER ADJUSTMENTS

Refer to the PIPING DIAGRAM for -LM, -MM, or -HM burners respectively.

Preliminary settings should include:

Atomizing air pressure setting:	8 - 10 psig (at low fire).
Oil pressure switch setting	10 psig less than oil supply pressure.
Oil backpressure valve (A-HM burners):	10 - 12 psig (at low fire).
Low oil temp. switch (A-MM &-HM burners):	10 degrees less than proper atom. temp.
Oil heater thermostat (A-MM & -HM burners):	Set for proper oil atomizing temp.

Optimum atomizing temperature for the oil can very considerably but the following recommendations can be used as a guide to obtain the required 100 - 150 SSU viscosity at the nozzle:

Grade of Oil	Oil Atomizing Temperature (Degrees F)		
	Minimum	Typical	Max
#4	70 F	110 F	135 F
#5	130 F	150 F	175 F
#6	185 F	210 F	240 F

Improper atomization and high smoke readings will result if the oil temperature is too low and unstable, pulsating combustion will result from too high of an atomizing temperature. Model A-HM burners with (2) oil heaters should have the thermostats set at slightly different temperatures to avoid having both heaters cycle simultaneously causing wide swings in temperature.

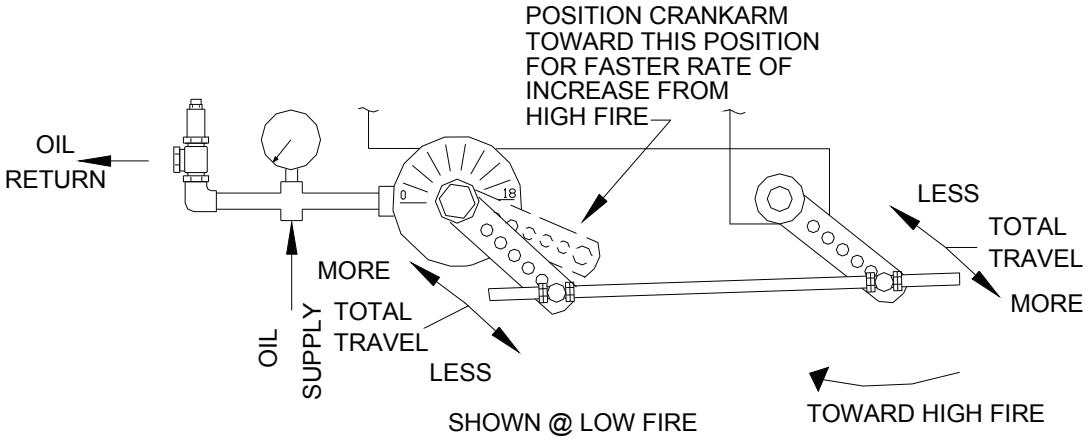
The oil delivery rate to the burner is determined by the oil metering valve position and the oil supply pressure to the inlet of the metering valve. Higher numbered positions on the metering valve and/or a higher supply pressure will result in a greater oil delivery rate.

The oil supply pressure is set by adjusting the backpressure regulating valve, which is located on the left-front of the burner assembly (right rear on sizes 800 and larger) between the oil supply and oil return connections. The optimum oil supply pressure setting will depend on the viscosity of oil at the burner inlet and other operating parameters such as furnace pressure, altitude, and desired firing rates.

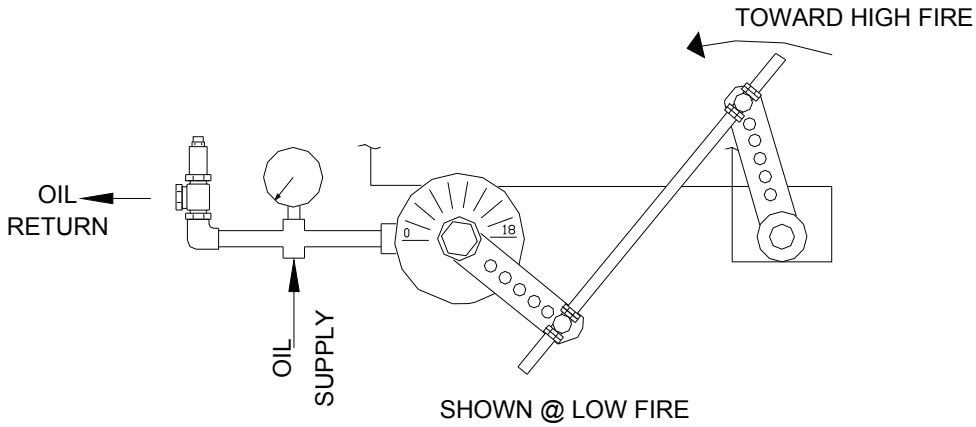
HAUCK FIXED GRADIENT OIL METERING VALVES

Oil metering valves are factory set to travel between the minimum and maximum positions indicated on the OIL SYSTEMS SETTING page for the respective burner model. The linkage to the metering valve can be adjusted to change the minimum or maximum firing rate, or to change the rate of increase of the oil flow from minimum to maximum.

Typical linkage and crank arm arrangements for the oil metering valve are shown below for the different sizes of air atomized oil burners when the optional adjustable characteristic cam is not used. The alternate positions of the crank arm, and the different locations of the linkage connectors, are shown as an aid to properly set the rate of fuel increase to match the rate of air increase when the burner modulates between low & high fire. The alternate positions apply to all burner sizes.



SIZE 50 – 250



SIZE 300 & UP

"SAM" ELECTRONIC OIL METERING SYSTEM

Refer to OIL, AIR AND PUMP ARMATURE VOLTAGE SETTINGS for -LM, or -HM respectively.

Refer to the OIL PIPING DIAGRAM for -LM, or -HM with ELECTRONIC OIL METERING SYSTEM respectively.

The oil return line on the right side of the burner includes a backpressure regulating valve which should initially be set to provide 10 to 11 psig oil pressure at the nozzle pressure gauge in the low fire position during pre-purge. After final burner adjustment this pressure should be set to equal the low fire oil pressure.

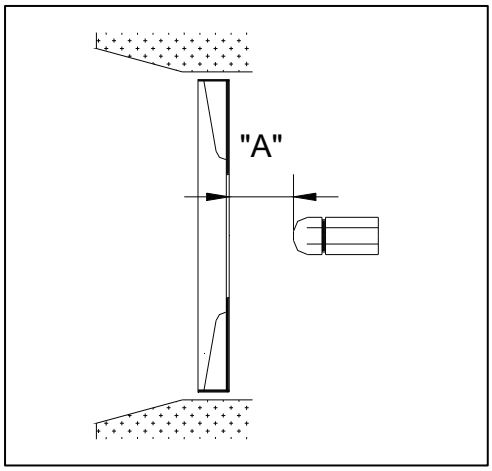
Initial temperature & pressure switch settings should be made as indicated for the oil metering valve system. All other adjustments should be made according to the ELECTRONIC OIL METERING SYSTEM INSTRUCTIONS in the proceeding section.

AIR ATOMIZING OIL NOZZLE SPECIFICATIONS

Note: The C169WA nozzle supplied with the burner is specially designed for S.T. Johnson Co. Other C169WA variants can cause smoke, sooting and carbon formation. Replacement nozzles can be purchased from any S.T. Johnson dealer.

NOZZLE POSITIONING

The position of the oil nozzle relative to the air diffuser is shown below.



Burner Size	A
50 - 125	1.125” / 29mm
150 - 250	1.25” / 32mm
300 - 1000	1.5” / 38mm

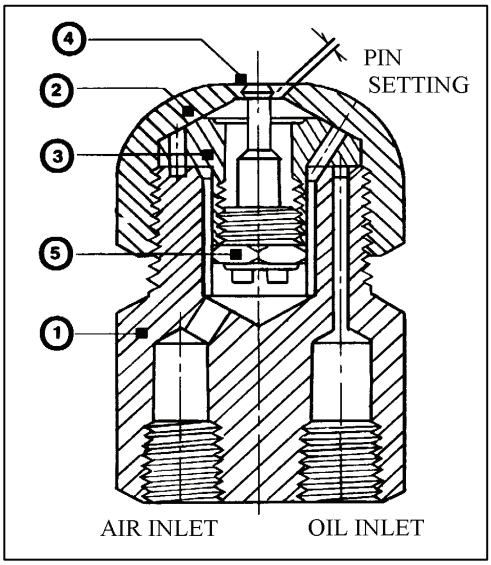
NOZZLE PIN SETTING

Proper nozzle pin setting is critical to obtaining proper atomization. Correct settings for each nozzle size are shown below.

NOZZLE COMPONENTS

1. Body
2. Tip
3. Disc
4. Metering pin
5. Locknut

NOZZLE SIZE	PIN SETTING
30, 40	0.030” (0.762 mm)
50, 60, 80	0.040” (1.016 mm)
100	0.050” (1.270 mm)
125, 150, 200, 250, 300, 350	0.062” (1.575 mm)



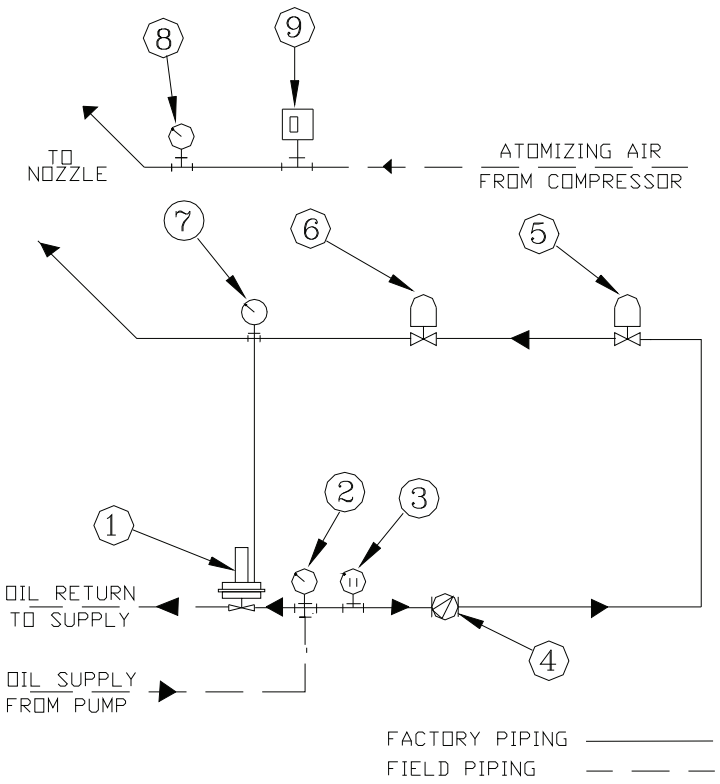
MODEL ( )L-LM OIL SYSTEM SETTINGS: BAR CRITERIA DATA SHEET #37

BURNER SIZE			50	75	100	125	150	200	250	300	400	500	625
FIRING RATE	MAX	GPH*	17.0	25.0	34.0	38.0	50.0	67.0	80.0	100.0	135.0	168.0	210.0
	NOM	GPH*	15.0	22.5	30.0	37.5	45.0	60.0	75.0	90.0	120.0	150.0	188.0
	FURN. PRESS. "W.C.		.75	.75	1.0	1.0	1.5	2.0	2.0	3.0	4.0	4.0	4.0
	MIN	GPH	7.0	7.0	8.0	9.0	9.0	12.0	15.0	18.0	24.0	30.0	37.0
NOZZLE SIZE		GPH	30	30	40	40	60	60	80	100	150	200	250
C169WA		ANGLE	50	50	50	50	70	70	70	70	70	70	70
NOZZLE PRESSURE @ HIGH FIRE	AIR	MAX	17	20	20	22	21	21	20	27	22	21	22
		NOM	17	22	21	22	20	20	20	22	19	19	21
	OIL	MAX	18	26	27	32	28	34	30	33	26	27	28
		NOM	17	26	26	30	26	30	29	30	25	24	26
CONTROL VALVE SIZE			S3-5	S3-5	S3-7	S3-7	S3-7	S3-9	S3-11	S3-13	S3-13	S3-13	S3-13
CONTROL VALVE SETTING		MAXIMUM	18	18	18	18	18	18	18	18	18	18	18
		NOMINAL	14 3/4	16 1/4	15	17	16 1/4	16	17	16 1/4	16 1/4	16	16
		MIN	12	9	6	4.5	4.5	3.6	3.6	3.6	3.6	3.6	3.6
DIFFERENTIAL PRESSURE SETTING** PSI		MAX	18	39	16	19	34	23	14	18	30	44	68
OIL SUPPLY PRESSURE PSI		MAX	36	65	43	51	62	57	44	51	56	71	96
		NOM	35	65	42	49	60	53	43	48	55	68	94
ATOMIZING AIR VOLUME		SCFM	7.3	7.3	10	10	12	10	10	10	16	16	16
OIL PUMP	SIZE		00LE	00LE	00LE	00LE	00LE	00LE	1LE	1LE	2LE	2LE	2LE
	RATING GPH		78	78	78	78	78	78	144	144	276	276	276
	RPM		1725	1725	1725	1725	1725	1725	1725	1725	1725	1725	1725

*The max firing rate listed is the maximum recommended with a balanced, or negative, furnace pressure. The nominal firing rate listed is the maximum recommended when firing against the furnace pressure listed. Reduced firing rates will result in reduced air and oil supply pressure settings. Rates based on grade #2 fuel oil @ 140,000 btu/gal.

**Differential pressure setting is the pressure drop across the oil metering valve and the two oil shutoff valves.

OIL PIPING SCHEMATIC: CRITERIA #37 SYSTEMS WITH OIL METERING VALVE



Components:

1. Differential back pressure regulating valve
2. Oil supply pressure gauge
3. Oil pressure switch
4. Oil metering valve
5. Oil solenoid valve
6. 2nd oil valve
7. Oil nozzle pressure gauge
8. Atomizing air pressure gauge
9. Atomizing air pressure switch

AIR ATOMIZED BURNERS WITH ELECTRONIC OIL METERING SYSTEM (EMS)

MODEL A-LM #2 OIL EMS SETTINGS

BURNER SIZE			50	75	100	125	150	200	250	300	350	400	450	500	625
FIRING RATE	MAX	GPH*	18.2	26.6	36.4	40.0	53.5	72	80	107	119	144	155	180	224
	NOM	GPH*	15.0	22.5	30.0	37.5	45.0	60	75	90	105	120	135	150	188
	FURN. PRESS. "W.C.		.75	.75	1.0	1.0	1.5	2.0	2.0	3.0	3.0	4.0	4.0	4.0	4.0
	MIN	GPH	7	7	8	9	9	12	15	18	18	24	24	30	37
NOZZLE SIZE		GPH	30	30	40	40	60	60	80	100	125	150	150	200	250
C169WA		ANGLE	50	50	50	50	70	70	70	70	70	70	70	70	70
NOZZLE PRESSURE, @ HIGH FIRE	AIR	MAX	20	22	21	22	20	23	20	22	17	20	24	21	23
		NOM	17	22	21	22	20	20	20	22	16	19	21	19	21
	OIL	MAX	22	28	28	32	28	36	30	33	25	31	37	28	29
		NOM	17	26	26	30	26	30	29	30	21	25	28	24	26
STD PUMP SETTINGS	SIZE		30LE	30LE	00LE	00LE	00LE	00LE	0LE	0LE	1LE	1LE	1LE	1LE	2LE
	Varm@MAX		65	93	73	80	79	ALT	83	ALT	60	73	78	ALT	63
	Varm@NOM		55	80	60	75	67	95	78	84	53	61	70	80	53
ALT PUMP SETTINGS	SIZE							0LE		1LE				2LE	
	Varm@MAX							68		58				53	
	Varm@NOM							55		49				45	

*The max firing rate listed is the maximum recommended with a balanced, or negative, furnace pressure. The nominal firing rate listed is the maximum recommended when firing against the furnace pressure listed. Reduced firing rates will result in reduced air and oil supply pressure settings. Rates based on grade #2 fuel oil @ 140,000 BTU/GAL.

The nozzle pressures listed are those recommended for most applications. The same firing rates can be obtained by either raising or lowering both the air & oil pressures. The flame geometry will be affected by the nozzle pressure with slower mixing, wider flames resulting from lower pressures.

The alternate pumps may be used on sizes 200, 300 & 500 for obtaining nominal capacity @ the Varm indicated. The alternate pumps must be used on sizes 300, 300 & 500 to obtain the maximum capacity @ the Varm indicated.

MODEL A-HM #6 OIL EMS SETTINGS

BURNER SIZE			50	75	100	125	150	200	250	300	400	500	625
FIRING RATE	MAX	GPH*	17.0	24.8	34.0	37.3	49.9	67.2	74.6	100	135	168	210
	NOM	GPH*	14.0	21.0	28.0	35.0	42.0	56.0	70.0	90.0	84.0	140	175
	FURN. PRESS. "W.C.		.75	.75	1.0	1.0	1.5	2.0	2.0	3.0	4.0	4.0	4.0
	MIN	GPH	7	7	7	9	9	11	13	17	22	28	34
NOZZLE SIZE		GPH	30	30	40	40	60	60	80	125	150	200	250
C169WA		ANGLE	50	50	50	50	70	70	70	70	70	70	70
NOZZLE PRESSURE, @ HIGH FIRE	AIR	MAX	22	22	20	21	21	20	22	17	21	22	26
		NOM	20	22	20	20	21	18	22	15	18	21	23
	OIL	MAX	28	36	30	33	28	34	33	30	40	47	59
		NOM	23	30	27	30	25	29	32	24	31	39	46
STD PUMP SETTINGS	SIZE		30LE	30LE	00LE	00LE	00LE	00LE	0LE	0LE	1LE	1LE	2LE
	Varm@MAX		62	90	53	64	81	ALT	72	ALT	73	ALT	63
	Varm@NOM		51	76	43	68	68	95	67	87	61	76	53
ALT PUMP SETTINGS	SIZE							0LE		1LE		2LE	
	Varm@MAX							65		58		52	
	Varm@NOM							54		49		43	

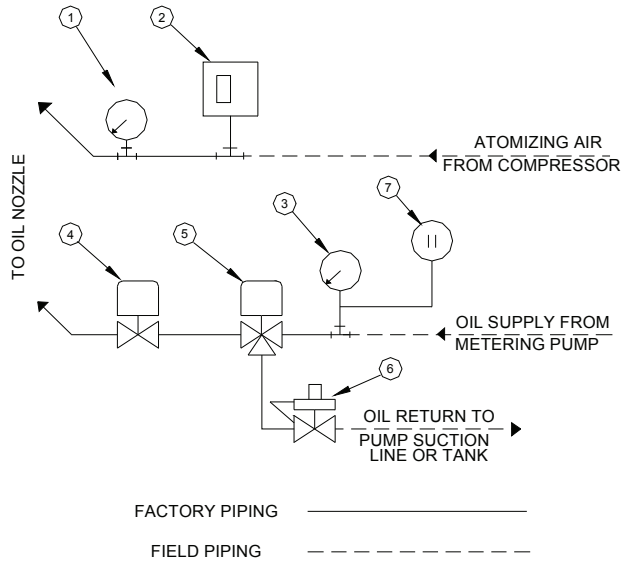
*The max firing rate listed is the maximum recommended with a balanced, or negative, furnace pressure. The nominal firing rate listed is the maximum recommended when firing against the furnace pressure listed. Reduced firing rates will result in reduced air and oil supply pressure settings. Rates based on grade #6 fuel oil @ 150,000 BTU/GAL.

The nozzle pressures listed are those recommended for most applications. The same firing rates can be obtained by either raising or lowering both the air & oil pressures. The flame geometry will be affected by the nozzle pressure with slower mixing, wider flames resulting from lower pressures.

The alternate pumps may be used on sizes 200, 300 & 500 for obtaining nominal capacity @ the Varm indicated. The alternate pumps must be used on sizes 300, 300 & 500 to obtain the maximum capacity @ the Varm indicated.

ELECTRONIC OIL METERING SYSTEM PIPING SCHEMATIC

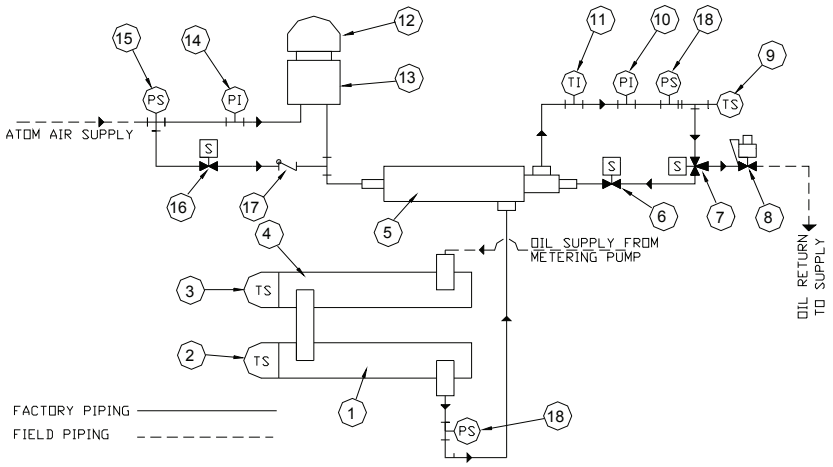
MODEL A-LM #2 OIL SYSTEMS



COMPONENTS:

1 ATOMIZING AIR PRESSURE GAUGE
2 ATOMIZING AIR PRESSURE SWITCH
3 NOZZLE OIL PRESSURE GAUGE
4 2-WAY OIL SOLENOID VALVE
5 3-WAY OIL SOLENOID VALVE
6 ANTI-SURGE VALVE
7 LOW OIL PRESSURE SWITCH

MODEL A-HM #6 OIL SYSTEMS



COMPONENTS:

1 OIL HEATER #1
2 OIL HEATER THERMOSTAT #1
3 OIL HEATER THERMOSTAT #2
4 OIL HEATER #2 (BURNER SIZE 150-625)
5 TRIPLE-PASS OIL MANIFOLD
6 2nd OIL VALVE
7 3-WAY OIL SOLENOID VALVE
8 ANTI-SURGE VALVE
9 LOW OIL TEMPERATURE SWITCH
10 OIL NOZZLE PRESSURE GAUGE
11 OIL TEMPERATURE GAUGE
12 OIL NOZZLE TIP & SPINNER
13 OIL NOZZLE BODY
14 ATOMIZING AIR PRESSURE GAUGE
15 ATOMIZING AIR PRESSURE SWITCH
16 N.O. NOZZLE PURGE SOLENOID VALVE
17 NOZZLE PURGE CHECK VALVE
18 LOW OIL PRESSURE SWITCH

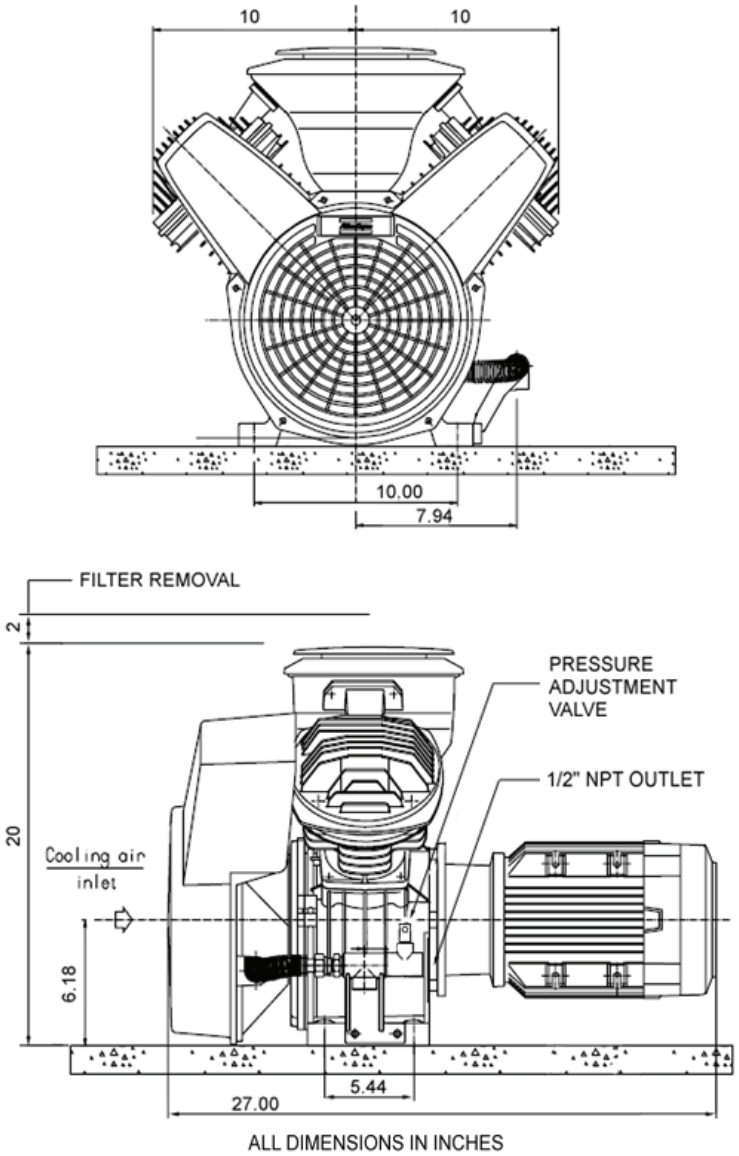
ATOMIZING AIR COMPRESSOR INSTALLATION & ADJUSTMENT PROCEDURE

INSTALLATION

All compressor sets furnished with series FD68 air atomized burners are mounted on steel bases for mounting separately from the burner. The base must be firmly anchored as close to the burner as possible to avoid excessive pressure drop in the atomizing air piping. Vibration isolators are not required, but may be used.

If remote mounting is necessary good piping design must be utilized to ensure sufficient atomizing air pressure at the burner nozzle.

DIMENSIONS: ATLAS COPCO MODELS LE2, -3, -5



PIPING

Compressors are not furnished with reservoir tanks as the output is closely matched to the air requirement of the burner. To eliminate the possibility of pressure fluctuations at the burner nozzle it is good practice to install a short run of oversized piping at the compressor outlet to act as a small accumulator.

START-UP

In general, compressors are shipped without oil in the crankcase. Follow the manufacturer's instructions for filling with the proper grade of oil prior to starting. Because most installations involve prolonged periods of operation it is recommended to use 500 SUS napthenic base compressor oil for lubrication. SAE 30, non-detergent, automotive grade oil can be substituted but it is not recommended for continuous operation.

ADJUSTMENT

Compressors are furnished with a bypass line and adjusting valve from the discharge to the inlet to enable adjustment of the air volume delivered to the burner nozzle. If adjustment is required refer to the burner adjusting instructions for proper setting of the atomizing air pressure.

In general, too little atomizing air pressure will result in poor atomization while too high a pressure can result in a pulsating flame and even combustion harmonics especially in restricted combustion chambers.

MAINTENANCE

Compressor oil level must be checked at least twice a week during periods of continuous operation. Compressors installed in areas of high ambient temperatures and/or little ventilation will run hotter and may consume some oil. Refer to the manufacturer's manual for complete recommendations.

OIL PUMP INSTALLATION

DIRECT-DRIVE OIL PUMP SET

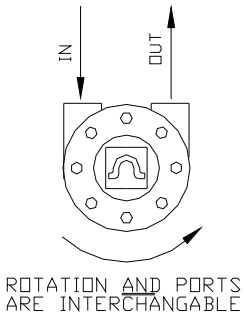
60Hz OPERATION

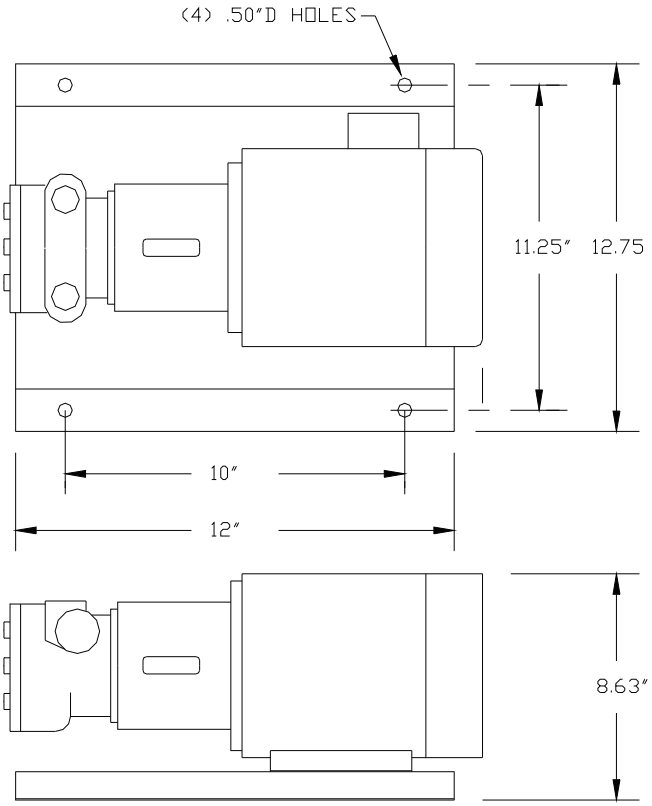
Standard direct-drive burner oil pumps furnished with series FD68 burners should be floor or boiler base mounted in close vicinity to the burner with no valving installed between the pump set and the burner inlet.

The following chart may be used as a suction line sizing guide considering a suction lift of 10 feet. The return line from the burner may be one pipe size smaller than the recommended suction line size.

BURNER SIZE	PUMP MODEL	MOTOR HP	PORT SIZE	GPH	SUCTION LINE LENGTH			
					25'	50'	75'	100'
50-200	0LE	1/3	½"	78	½"	½"	½"	½"
250-300	1LE	1/2	½"	144	½"	½"	¾"	¾"
400-800	2LE	3/4	½"	276	¾"	1"	1"	1"
1000	5LE	1	1"	360	¾"	1"	1"	1"

5LE RPM = 1150, ALL OTHERS RPM = 1725



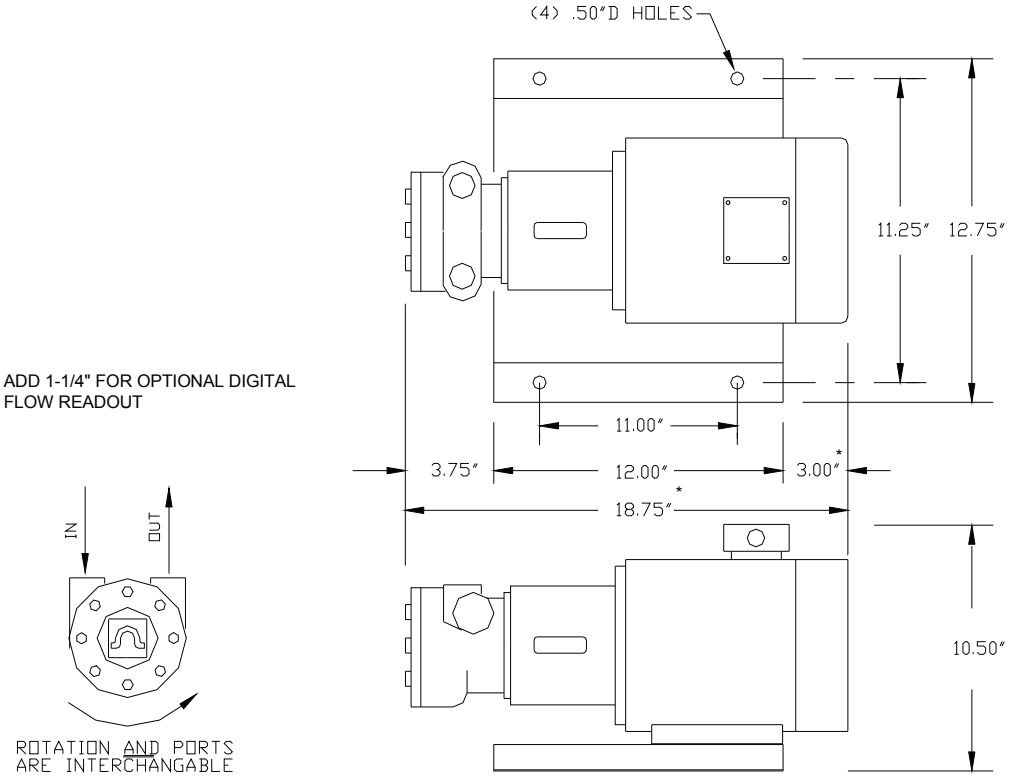


ELECTRONIC OIL METERING PUMP INSTALLATION

Variable speed oil metering pumps furnished with series FD68 burners should be floor or boiler base mounted in close vicinity to the burner with no valving installed between the pump set and the burner inlet.

The following chart may be used as a suction line sizing guide considering a suction lift of 10 feet. The return line from the burner may be one pipe size smaller than the recommended suction line size.

BURNER SIZE	STD PUMP MODEL	MOTOR HP	PORT SIZE	MAX GPH	SUCTION LINE LENGTH			
					25'	50'	75'	100'
50-75	30LE	1/3	½"	28	½"	½"	½"	½"
100-200	00LE	1/3	½"	60	½"	½"	½"	½"
250-300	0LE	1/3	½"	112	½"	½"	½"	½"
400-500	1LE	1/3	½"	180	½"	½"	¾"	¾"
625-800	2LE	1/2	½"	300	¾"	1"	1"	1"



APPENDIX A: SAM ELECTRONIC OIL METERING SYSTEM INSTALLATION, OPERATING AND MAINTENANCE SECTION

"SAM" ELECTRONIC OIL METERING SYSTEM DESCRIPTION

The electronic oil metering system controls the delivery rate of fuel oil to the burner system in relation to the delivery of combustion air by utilizing a positive displacement pump and a variable speed dc motor drive. The pump speed, and hence oil flow, is governed by a 0-10 VDC control signal generated by sensing the distance between a factory set cam on the shaft of the firing rate actuator and a proximity sensor. The settings for maximum and minimum fuel delivery rates are factory set and sealed to prevent tampering. The complete oil metering system is designed to deliver consistent flow with varying oil viscosity.

Electronic oil metering systems consist of three major components: a control circuit board, a base mounted pump and DC motor set, and a cam/proximity sensor assembly. These components come in three configurations:

1. Factory assembled and calibrated as part of a new S.T. Johnson burner system.

2. Factory assembled and calibrated conversion system (Assembly #B-8896-4) with a separate pump motor control panel enclosure, base mounted pump set, and the cam and proximity sensor assembly mounted on a new burner modulating motor.

3. Conversion kit (Assembly #B-8896-2): the cam, proximity sensor and electrical enclosure are furnished loose for installation on the existing burner modulating motor. The factory-set pump control circuitry is furnished in a separate electrical enclosure. Cam adjustments and sensor calibration are conducted in the field.

STANDARD FEATURES

Input power: 115-50/60 Hz
Control power: Integral transformer provides 24VAC for control power.
Voltage transient protection provided by MOV.
Factory set maximum pump speed: 50-110% of base pump speed.
Factory set minimum pump speed: 0-25% of base pump speed.
Factory set load compensation.
Factory set motor armature current limitation.
Factory set motor horsepower matching circuit.
Panel mounted digital readout of fuel delivery rate.

OPERATING LIMITATIONS

Line voltage variation: +10%
Line frequency variation: 48 - 62 HZ
Ambient temperature range: 32 - 131 F (0 - 55 C)
Relative humidity range: 5 - 95% (NON-CONDENSING)

PUMP MOUNTING & PIPING

The pump set should be installed in the vicinity of the burner and at an elevation lower than the burner oil inlet. The pump discharge should be piped to the burner inlet using tubing of the following recommended size:

Max Flow, GPH	Size
35	3/8”
100	½”
220	¾”
500	1”

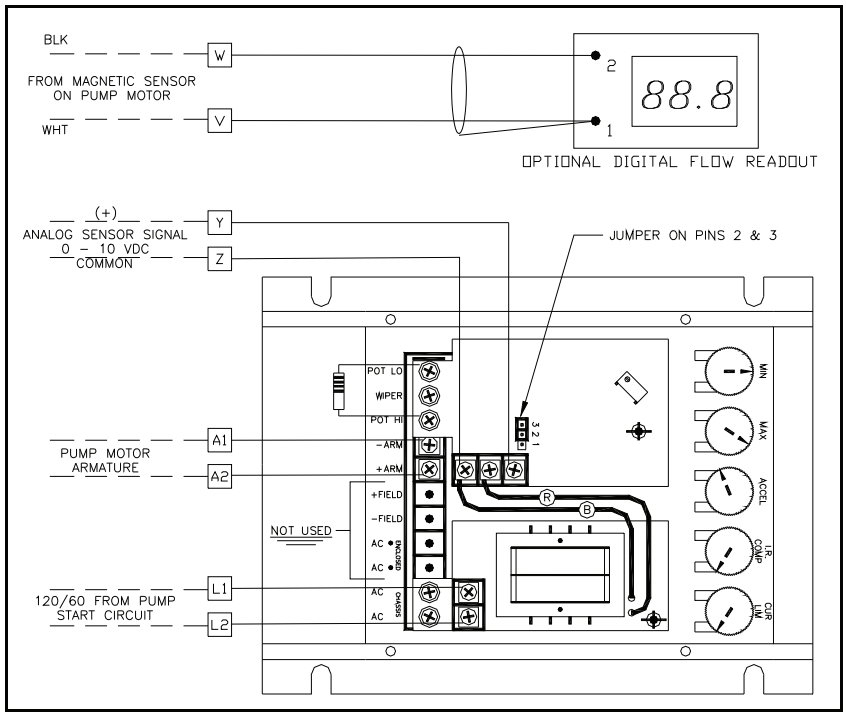
It is imperative that no valving be installed between the pump outlet and the burner inlet.

Suction line piping should be sized for a maximum suction head of 15" hg. An additional oil transfer pump located near the storage tank must be considered on installations involving long suction lines and/or underground storage tanks. The main oil circulating loop from the transfer pump should include a regulating/relief valve to limit the inlet pressure to the metering pump to 5 psig.

Standard pumps are furnished without integral relief valves. Installation with the inlet or outlet on either side of the pump body is possible, as long as the pump rotation corresponds to the piping; refer to the pump manual.

SPECIAL WIRING CONSIDERATIONS

Caution! Care must be taken to avoid inducing AC voltage in the field wiring of the 0-10 VDC control circuit from the burner to the control panel (terminals Y & Z). Shielded cable must be used and running in separate conduit is highly recommended. Avoid runs with ignition wiring, motor and electric oil heater wiring.



Pump motor armature wiring should be run from the pump motor to terminals A1 and A2 on the control circuit board located in the burner control panel. Armature conductors should be sized as follows:

Max HP	No. AWG
½	14
¾	12
1	12

Two-conductor shielded cable, 20 ga minimum, must be run in separate conduit from terminals y & z on the burner to terminals y & z in the control panel. The shield on the cable must be grounded to the control panel enclosure ground lug. The control panel must also be connected to an earth ground. The shield on the sensor end of the cable must be cut off and insulated. Do not ground this end of the shield.

Systems furnished with the optional digital oil flow readout also require a 20 ga.(min) 2-conductor shielded cable run from the magnetic sensor mounted on the pump motor to the digital flow readout in the control panel. The shield of this cable must be connected to the tachometer terminal #1 according to the wiring schematic furnished for the system. Do not ground the sensor end of the shield; it must be cut off and insulated.

A check should be made for motor armature circuit grounding before applying power to the system. Connect an ohmmeter to ground and check the resistance from ground to each of terminals ARM+ and ARM- on the control circuit board. A reading less than 100,000 ohms indicates a ground condition that must be corrected before energizing the control system.

Caution: do not use a meggar for this test, as the control circuit board will be damaged.

INITIALSETUP AND ADJUSTMENT

The control circuit board potentiometers are factory set according to the burner and pump size furnished. The following settings (referred to as % clockwise rotation) are standard:

HP	MIN	MAX	ACCEL	I.R.	C.L.
1/4	*	*	30% CW	60% CW	20% CW
1/3	*	*	30% CW	50% CW	30% CW
1/2	*	*	30% CW	40% CW	40% CW
3/4	*	*	30% CW	30% CW	60% CW
1	*	*	30% CW	20% CW	70% CW

MIN:	* Set for nominal rating of burner
MAX:	* Set for nominal rating of burner
ACCEL:	Turning CW increases acceleration & decceleration time.
IR COMP:	Setting too far CCW can cause the pump motor to slow down under extremely high load conditions.
C.L. (CURRENT LIMIT):	Factory set to match pump motor horsepower

The MIN and MAX potentiometers on the DC drive are factory set for the nominal burner rating. The adjustable cam is factory set to give a non-linear fuel flow curve approximating typical firing conditions. Field adjustments may be required depending on application conditions.

FIELD ADJUSTMENTS:

The adjustments made on the cam enable the oil delivery rates to be set on a curve which is determined by the desired fuel/air ratio at any intermediate firing rate. The minimum and maximum rates are set using the potentiometers on the DC drive. The “MIN” and “MAX” are adjusted at the factory to set the lower and upper limits of fuel delivery rate to the burner. All delivery rates in between these limits are determined by the setting of the cam adjusting screws #2 through #9.

CAM ADJUSTMENTS:

Tools required:

1. Tamper-proof, pin-in torx wrench
2. 1/16” Allen wrench, preferably 5” long.
3. Multimeter, VDC scale

Remove the side plate from the sensor/cam enclosure located on the modulating motor to gain access to the cam (refer to Fig. 1). With the system powered on the sensor beam can be seen on the white spring; this represents the current firing position which is the only position at which adjustments should be made. The position can be changed using the manual firing rate potentiometer.

Cam adjustments can be made with a standard length Allen wrench, but if an extended Allen wrench is available remove the adjustment access plug on the left side of the enclosure to allow for easier adjustment (refer to Fig 1). Turning the adjusting screw in, clockwise, will decrease the oil delivery rate. Turning the screw out, counter clockwise, will increase the oil delivery rate. It is important to note that only very small changes are required and that adjacent screws can affect each other if anything other than minor setting changes are made.

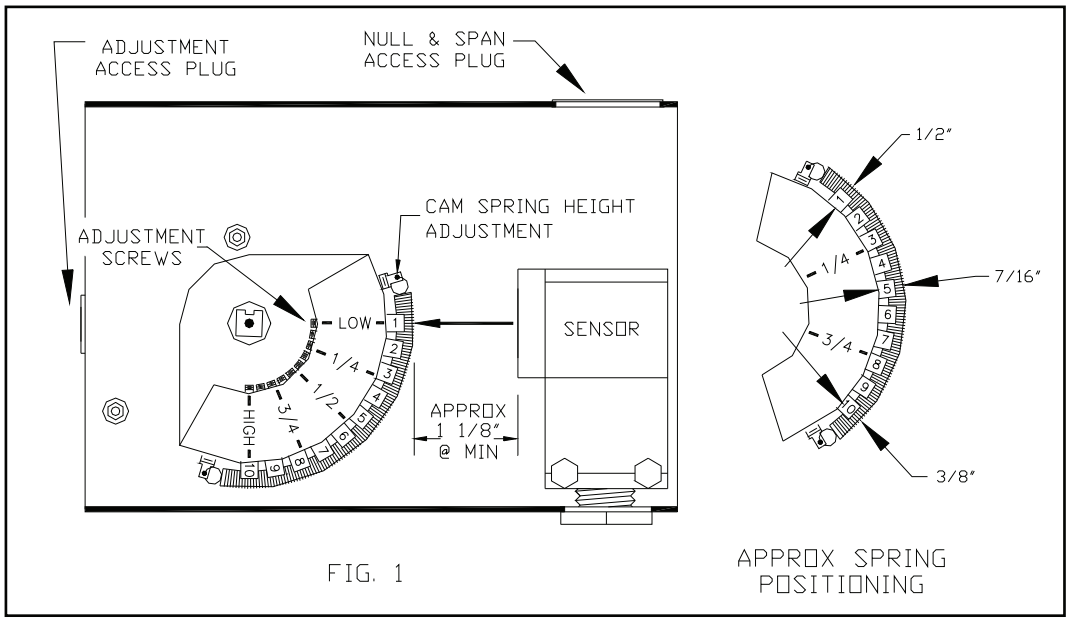


FIG. 1

The dimensions from the outer surface of the spring to the cam face will be close to those shown above. The dimensions do not have to be exact because the null & span adjustments to the sensor will compensate for any differences.

After making any desired adjustments the burner should be modulated throughout the firing range several times to insure proper operation.

The adjustment access plug and the side plate & gasket must be put back into place after final adjustments to insure that dirt, oil, water, etc will not adversely affect the proper operation of the sensor.

It is recommended that the settings of the potentiometers on the circuit board be marked for future reference, or that the adjusting wheels on the pots be locked in place with epoxy.

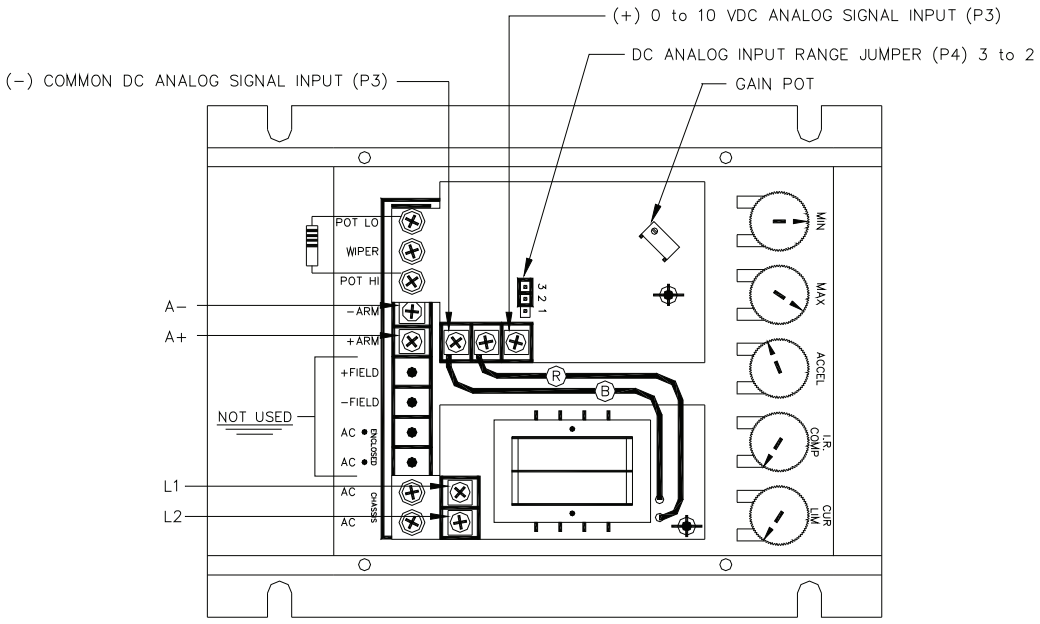
FIRING RATE INDICATION:

The relative firing rate of the burner is indicated by a scale on the adjustable cam, which is visible through a window on the cam/sensor enclosure.

DC DRIVE (CONTROL BOARD) REPLACEMENT & ADJUSTMENT:

After physically replacing the board, follow these steps:

1. Set the “MIN” & “IR COMP” pots fully CCW
2. Set the “MAX” pot @ 50%
3. Adjust the GAIN POT fully CCW. Note this can be one to two dozen turns.
4. Ensure that the analog input range jumper is on pins #2 & #3.
5. Establish power to the burner system and maintain the burner at the minimum position using the “test/run” switch on the programming control.
6. With a minimum analog signal to the board from the “IR” sensor on the burner (close to 0 VDC) adjust the “MIN” pot fully CW then turn CCW until the pump motor armature voltage is 0 VDC as measured on terminals ARM+ & ARM-.



7. Allow the burner to go to the high fire purge position (10 VDC signal from the “IR” sensor to the board).
8. Adjust the GAIN POT CW until no further increase in pump armature voltage is noticed. Readjust GAIN POT CCW until a 5 VDC drop from the maximum occurs.
9. Set the minimum and maximum armature voltages according to the S.T. Johnson electronic oil metering system specifications supplied with the new burner or conversion kit.
10. Return the burner to the low fire position and set the “MIN” pot to obtain the desired minimum firing rate.

SENSOR ADJUSTMENTS

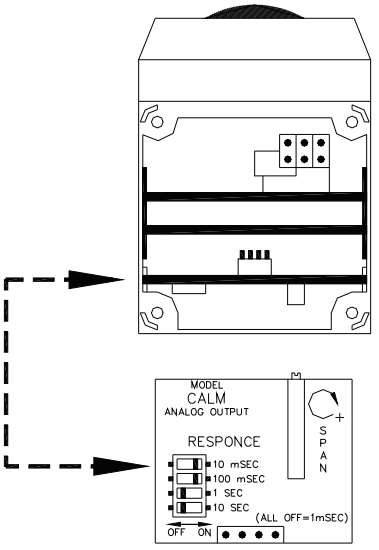
Please note: the sensor adjustments described are not necessary for new burners, or for SAM conversions ordered pre-assembled with a modulating motor. These adjustments will have been made at the factory.

RESPONSE TIME

These instructions pertain to sensor replacement or "loose" SAM conversion kits only.

The response time is factory set on systems included with new burners. If the sensor is replaced the response time must be set at 110 mSEC using the dip switches on the back circuit board prior to installing the sensor in the enclosure.

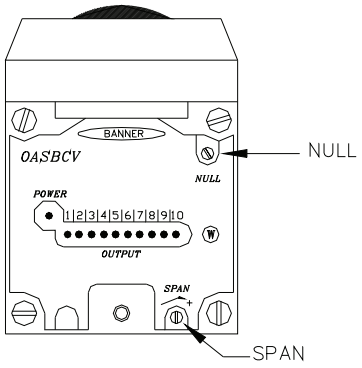
The sensor must be separated from the power block and the circuit board pulled out to gain access to the dipswitches.



NULL & SPAN

These adjustments are made on the top of the sensor after it is mounted in the enclosure and the beam is centered on the cam spring.

1. Remove the top cover from the sensor.
2. With the system powered set both the null and span adjustments fully CCW.
3. Modulate the cam to the high fire position and adjust the null for a 10VDC, or slightly less than 10VDC output.
4. Modulate the cam to the low fire position and adjust the span for approximately 0VDC (+.03 to +.04 VDC)
5. Modulate the cam between low and high positions to check for the appropriate output at low and high fire. Repeat steps 3 and 4 until low and high outputs are proven repeatable.



DIGITAL FLOW READOUT

The digital flow readout consists of a programmable digital rate meter, a power supply for the meter, a magnetic sensor, a cast aluminum sensor yoke, and a sensing gear. The meter receives a pulse each time a tooth on the gear passes the sensor. The meter is programmed with a scaling factor to give the desired reading in gallons per hour based on actual RPM. When furnished as part of a new S.T. Johnson burner system the meter is factory installed in the burner control panel and the sensor, yoke, and sensing gear are factory installed on the metering pump. No adjustment will be required.

UPGRADE/ REPLACEMENT OF OLDER VERSION:

Previous versions of the digital flow readout used an adjustable digital tachometer that is no longer being manufactured. If this is being used to replace an older version, the main difference is a two wire 120v supply to the power terminals on the meter.

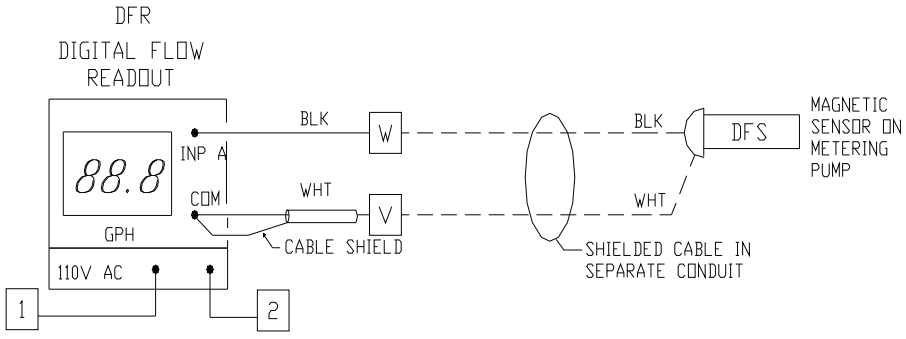
When ordered from the factory, the meter should come preprogrammed for your size burner. If there are any problems consult an S.T. Johnson technician.

Sensor wiring and installation is the same and no changes will need to be made.

INSTALLATION AND ADJUSTMENT:

The sensor must be wired to the meter with 16 ga. 2 conductor shielded cable. The shield must be connected to the INP COM terminal of the meter, with the white wire. The black wire must be hooked to INP A. The sensor end of the shield must be cut off and insulated. Never run this cable in conduit with other power carrying conductors.

The power supply mounts directly to the back of the meter, to the power inputs, and requires a 120v power supply from the main power source.



TROUBLESHOOTING:

Most problems are caused by improper wiring, or are the result of short cuts taken during installation. Please take the time to re-check wiring and re-read all sections of this manual before spending too much time troubleshooting and readjusting the system.

Every possible troubleshooting item can be checked with an inexpensive Multimeter. Do not attempt to commission or troubleshoot a unit without one.

PUMP MOTOR DOESN'T RUN.	1. AC power not applied to circuit board terminals L1 & L2. Check wiring and pump control relay (if used) 2. Blown AC power fuse on circuit board. Check for cause and replace. 3. No DC voltage on board terminals A1 & A2 with AC input on L1 & L2. Replace circuit board. 4. Pump motor brushes need to be replaced.
PUMP SPEED DOESN'T CHANGE WITH CHANGE IN FIRING RATE.	1. Open circuit in control signal wiring. 2. Cam spring is the same distance from the sensor @ all positions. Spring must be closer to sensor @ higher firing rates. 3. IR sensor is defective; replace. 4. Check DC control wiring. DC input wires may be reversed.
POOR REPEATABILITY, PUMP SPEED VARIES AT A CONSTANT FIRING RATE.	1. AC voltage interference with DC control signal wiring between burner and control panel. Signal wiring must be shielded cable, grounded at one end only. 2. Ensure 1.8 kohm (or closest) resistor is installed between “pot hi” and “pot lo” terminals on DC control board. 3. Check ground.
PUMP SPEED INCREASES INTERMITTENTLY.	1. AC interference from contactors such as oil heater contactors. Do not run DC control wires with power wiring. 2. Check ground.
ABLE TO SET MIN, BUT PUMP SPEED “MAXES” OUT TO QUICKLY	1. Check DC control wiring. DC input wires may be reversed. 2. Check alignment of sensor beam. 3. Compare cam and sensor distances to Fig. 1 and make corrections if necessary. Remember to reset null and span afterwards.
FLOW DISPLAY READS "0" ALL FIRING RATES.	1. Open circuit between magnetic sensor & display. 2. Battery is dead, replace unit. 3. Sensor/sensing gear gap is too large; Set at .005 - .007". 4. Magnetic sensor is faulty; Replace.
DISPLAY VARIES RADICALLY@ LOW FIRE.	Sensor/sensing gear gap is too large; Set @ 0.005-0.007".

APPENDIX B: NEW YORK CITY METHODS OF LIMITATIONS

ELECTRONIC OIL METERING METHOD OF LIMITATION

The oil delivery rate of the metering pump system is determined solely by the armature voltage delivered to the pump motor by the control circuit board. The maximum allowable armature voltage, VARM, for a specific burner size is factory set by adjustment of potentiometer "MAX" on the control circuit board. After setting, the potentiometer thumbwheel is epoxied in place to prevent further adjustment. This factory setting will not allow VARM, or the maximum oil delivery rate, to exceed those values shown on chart EMSTUT.DAR. The low fire delivery rate is factory set by adjustment of potentiometer "MIN" on the control circuit board. After setting, the potentiometer thumbwheel is epoxied in place to prevent further adjustment. This low fire oil delivery rate will insure the turndown ratio indicated on chart EMSTUT.DAR.

Three other potentiometers on the circuit board, which do not affect oil delivery rate, are factory set and epoxied prior to shipment. These potentiometers merely match the control circuitry to the pump motor and limit armature current to a safe level.

The oil delivery rate in GPH can be directly read on the LCD display on the burner control panel. The relative firing rate indicator, from MIN to MAX, can be viewed through a window on the enclosure mounted on the modulating motor.

The maximum allowable firing rate for each size burner is stamped on the burner nameplate, and the factory set maximum firing rate for each specific job is stamped on the nameplate of the control circuit board located in the panel enclosure.

Fig. 1 S.T.JOHNSON EMS SYSTEM w/ TUTHILL PUMPS

BURNER SIZE		**50**	**75**	**100**	**125**	**150**	**200**	**250**	**300**	**400**	**500**	**625**
HIGH FIRE, GPH <1>	MAX	18.4	28.2	37.5	46.9	56.2	75.0	93.7	112.5	150.0	180.0	234.0
	NOM	15.0	22.5	30.0	37.5	45.0	60.0	75.0	90.0	120.0	150.0	187.5
MIN FIRE, GPH		9.0	9.0	10.0	11.0	11.0	12.0	15.0	18.0	24.0	30.0	37.0
TURNDOWN RATIO		3:2	2:1	3:1	3.3:1	4:1	5:1	5:1	5:1	5:1	5:1	5:1
OIL NOZZLE, C169WA SIZE(GPH) x SPRAY ANGLE(DEGREES)		30 x 50	30 x 50	40 x 50	40 x 50	60 x 70	60 x 70	80 x 70	125 x 70	150 x 70	200 x 70	250 x 70
NOZZLE PRESSURE	AIR	15	18	18	20	17	19	20	18	21	22	25
	OIL	20	30	28	33	24	26	30	28	33	33	37
STD PUMP <2><3>	SIZE (MODEL#)	30LE	30LE	00LE	00LE	00LE	00LE	0LE	0LE	1LE	1LE	2LE
	Varm @ MAX	65	93	58	79.5	85.5	(SEE ALT PUMP)	89.5	(SEE ALT PUMP)	82	(SEE ALT PUMP)	71.5
	Varm @ NOM	55	80	46.5	60	70.5	90	73	86	64	82	57.5
ALT PUMP <2><3><4>	SIZE						0LE		1LE		2LE	
	Varm @ MAX						73		60		54	
	Varm @ NOM						58.4		48		45	

<1> MAX GPH LISTED IS MAXIMUM CAPACITY FIRING INTO A FURNACE WHICH IS BALANCED OR NEGATIVE. NOM GPH IS THE NOMINAL RATING OF THE BURNER, (e.g. SIZE 100 FIRING @ 100HP).
<2> PUMP MODEL NUMBERS MAY HAVE A SUFFIX, SUCH AS (-7) INDICATING THE TYPE OF SHAFT SEAL.
<3> Varm IS THE PUMP MOTOR ARMATURE VOLTAGE. Varm @ MAX GPH IS THE ARMATURE VOLTAGE WHICH CORRESPONDS TO THE MAXIMUM FIRING RATE OF THE BURNER. Varm @ NOM GPH IS THE ARMATURE

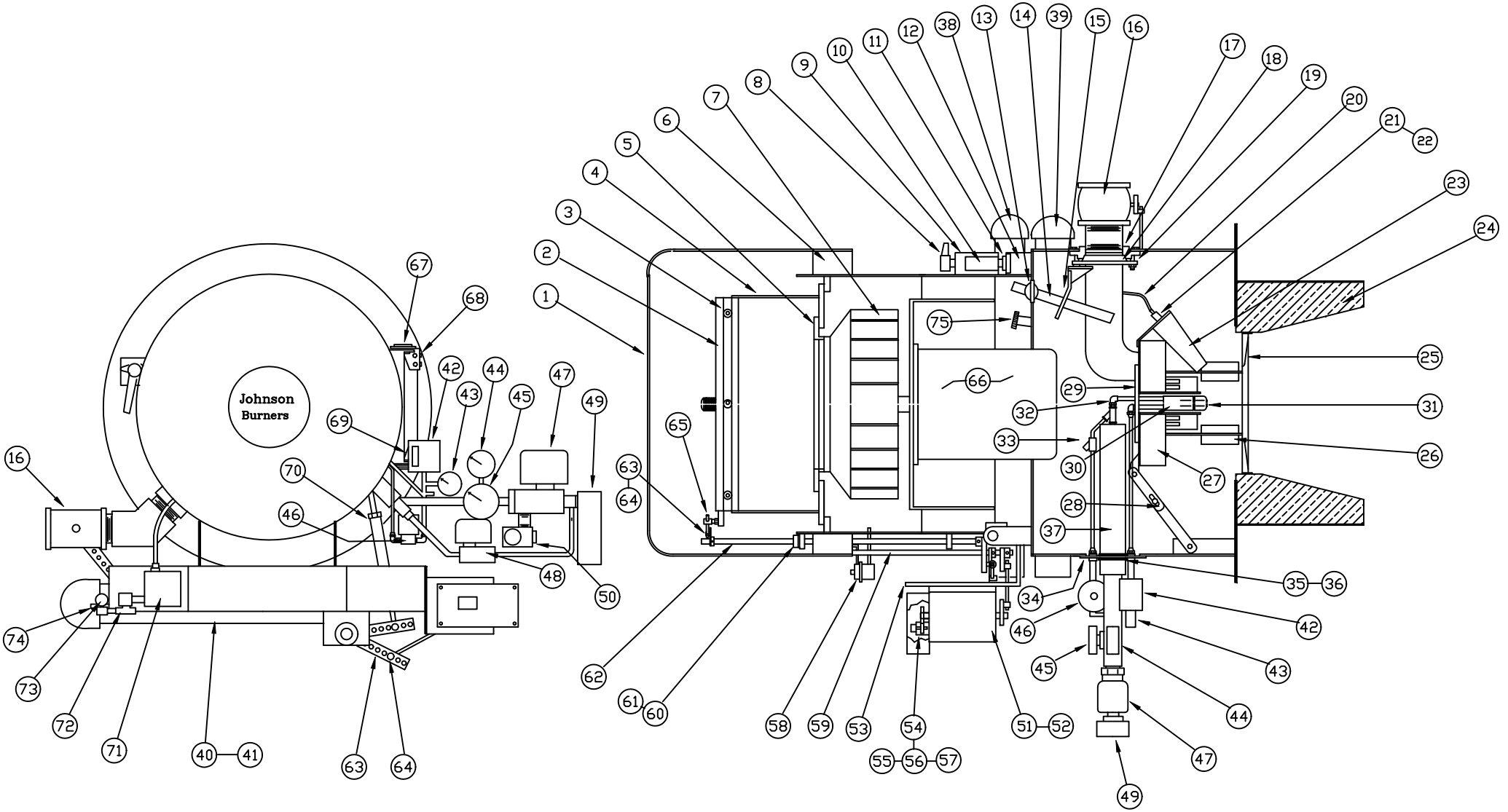
VOLTAGE WHICH CORRESPONDS TO THE NOMINAL RATING OF THE BURNER, i.e. BURNER SIZE 100 FIRING @ 100HP. ALL PUMP MOTORS ARE 90VDC, 1725 RPM.
<4> THE ALTERNATE PUMP SIZE MAY BE USED FOR BURNER SIZES 200, 300 & 500 WITH THE Varm INDICATED WHEN THE MAX GPH CAPACITY OF THE BURNER IS REQUIRED.

CRITERIA DATA SHEET 37: METHOD OF LIMITATION

The model FD68( )AL-LM utilizes a direct drive oil pump, a differential pressure regulating valve, and a Hauck oil metering valve to regulate oil to the nozzle.

Combination gas and #2 oil unit are designated as model FD68CAL-LM.

APPENDIX C: COMPONENT ID DRAWINGS



S.T.JOHNSON CO
OAKLAND, CA USA
TEL: 510 652 6000
FAX: 510 652 4302

TITLE COMPONENT IDENTIFICATION	ASBLY	SUB-ASBLY	MATERIAL
	SCALE NONE	DRWN BY DLW	DATE 10-4-99
FOR MODEL FD68CA-HM GAS/HEAVY OIL W/ "SAM" OIL METERING			DRWG NO. B-8879

PARTS LIST FD68CA-HM w/"SAM" OIL METERING

Ref: Drawing B-8879

ITEM	DESCRIPTION	50	75	100	125	150	200	250	300	400	500	625	ITEM
1	SILENCER END COVER	B-6770	--------	-------	--------	C-4630	--------	--------	C-4980	--------	C-4969	--------	1
2	AIR SHUTTER ASBLY	C-4619-2	--------	--------	--------	C-4619-3	--------	--------	C-5012-1	--------	C-5012-2	--------	2
3	AIR SHUTTER BEARINGS		A-7975	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------- 3
4	AIR INLET HOUSING	C-5525	--------	--------	--------	C-5526	--------	--------	C-5527	--------	C-5528	--------	4
5	AIR INLET RING	B-8429-1	B-8429-2	B-8429-3	B-8429-4	B-8430-1	B-8430-2	B-8430-3	B-8431-1	B-8431-2	B-8432-1	B-8432-2	5
6	SILENCER SUPPORT BAND	N/A	--------	--------	-------	--------	--------	--------	C-5700	--------	C-5701	--------	6
7	BLOWER WHEEL	C-5659-1	C-5659-2	C-5659-3	C-5659-4	--------	C-5659-5	C-5659-6	--------	C-5659-7	C-5659-8	C-5659-9	7
8	LATCH HANDLE	A-6845	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	8
9	LATCH SWITCH BODY	A-3964	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	9
10	LATCH SWITCH	BZ-2RL-A2	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	10
11	LATCH LUG	A-3706	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	11
12	LATCH LOCK	A-6855	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	12
13	SCANNER SWIVEL MOUNT	32612A	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	13
14	SCANNER SIGHT TUBE	A-7280-1	--------	--------	--------	A-7280-2	--------	--------	A-7280-5	--------	--------	--------	14
15	SIGHT TUBE BRACKET	A-7232	--------	--------	--------	A-7217	--------	--------	A-7869	--------	--------	--------	15
16	GAS CONTROL VALVE	A-7974-4	--------	A-7974-5	--------	A-7974-6	--------	--------	A-7974-7	--------	A-7974-8	--------	16
17	GAS INLET COUPLING	B-6761	--------	--------	--------	B-6720	--------	--------	C-4675	--------	C-4676	--------	17
18	GAS INLET GASKET	A-7976-1	--------	--------	--------	A-7976-3	--------	--------	A-7976-4	--------	A-7976-5	--------	18
19	GAS INLET FLANGE	C-5662-1	--------	--------	--------	C-5662-2	--------	--------	C-5662-3	--------	C-5661	--------	19
20	IGNITION CABLE ASBLY	A-7876-1	--------	--------	--------	A-7876-2	--------	---------	A-7876-3	--------	A-7876-4	--------	20
21	PILOT ASSEMBLY	A-7875	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	21
22	SPARK IGNITOR	A-4447	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	22
23	PILOT SLEEVE	A-7231	--------	--------	--------	A-7289	--------	--------	--------	-------	A-7311	--------	23
24	REFRACTORY TILE	A-7279	--------	--------	--------	A-7274	--------	--------	A-7271	A-7305	A-7312	A-7313	24
25	AIR DIFFUSER	B-7226	--------	--------	--------	A-7272	--------	--------	A-7872	A-7873	A-7874	C-5650	25

----- Indicates That Part # Is Identical to Number To The Left

PARTS LIST FD68CA-HM w/'SAM" OIL METERING

Ref: Drawing B-8879

ITEM	DESCRIPTION	50	75	100	125	150	200	250	300	400	500	625	ITEM
26	AIR ROTATION BLADES	A-7214	--------	--------	--------	A-7223	--------	--------	A-7245	--------	--------	--------	26
27	FIRING HEAD	C-4897	--------	--------	--------	C-4895	--------	--------	C-5658	--------	C-5657	--------	27
28	FIRING HEAD BRKTS (3)	A-6805	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	28
29	OIL NOZZLE YOKE ASBLY	B-8433-1	--------	--------	--------	B-8433-2	--------	--------	B-8433-3	--------	B-8433-4	--------	29
30	OIL NOZZLE BODY	A-7049-1	--------	--------	--------	A-7049-2	--------	--------	--------	--------	A-7049-3	-------	30
31	OIL NOZZLE TIP, C169WA	30 x 50	--------	40 x 50	--------	60 x 70	--------	80 x 70	125 x 70	150 x 70	200 x 70	250 x 70	31
32	OIL LINE UNION	¼" NPT	--------	--------	--------	--------	--------	--------	--------	--------	3/8" NPT	--------	32
33	PURGE CHECK VALVE	¼" 62T	--------	--------	--------	--------	--------	--------	--------	--------	3/8" 62T	--------	33
34	OIL LINE COVER PLATE	B-7772-1	--------	--------	--------	B-7772-2	--------	--------	B-7772-3	--------	B-7772-4	--------	34
35	TAPERED BUSHING	B7870-1	--------	--------	--------	--------	--------	--------	--------	--------	B7870-2	--------	35
36	GLAND PLATE	B-7066-11	--------	--------	--------	B-7066-12	--------	--------	B-7066-13	--------	B-7066-14	--------	36
37	TRIPLE MANIFOLD	C-4603	--------	--------	--------	--------	--------	--------	C-4807	--------	--------	--------	37
38	OIL HEATER #1 *220 VOLT	BF-3-*-18	--------	BF-5-*-20	--------	--------	--------	--------	BF-7-*-24	BF-10-*24	--------	--------	38
39	OIL HEATER #2 220 VOLT	**N/A**	--------	--------	--------	BF-3--220	BF-5-*-220	--------	BF-7-*-24	BF-10-*24	--------	--------	39
40	HEATER BODY, SINGLE	B-2916-7	--------	--------	--------	--------	--------	--------	B-2916-8	--------	--------	--------	40
41	HEATER BODY, DUAL	N/A	--------	--------	--------	C-4261-1	--------	--------	C-4261-2	--------	--------	--------	41
42	ATOM AIR PRESS SWITCH	L404F1078	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	42
43	ATOM AIR PRESS GAUGE	0-30 PSIG	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	43
44	NOZZLE OIL PRESS GAUGE	0-60 PSIG	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	44
45	OIL TEMP GAUGE	0 – 240F	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	45
46	NOZZLE PURGE VALVE	8262G262	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	46
47	3-WAY OIL VALVE	83777	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	47
48	2nd OIL SHUT-OFF VALVE		8266D77V	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------48
49	LOW/HIGH OIL TEMP SWITCH	L4081B1013	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	49
50	ANTI-SURGE VALVE	A-3890	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	50

-------- Indicates That Part # Is Identical To The Number To The Left.

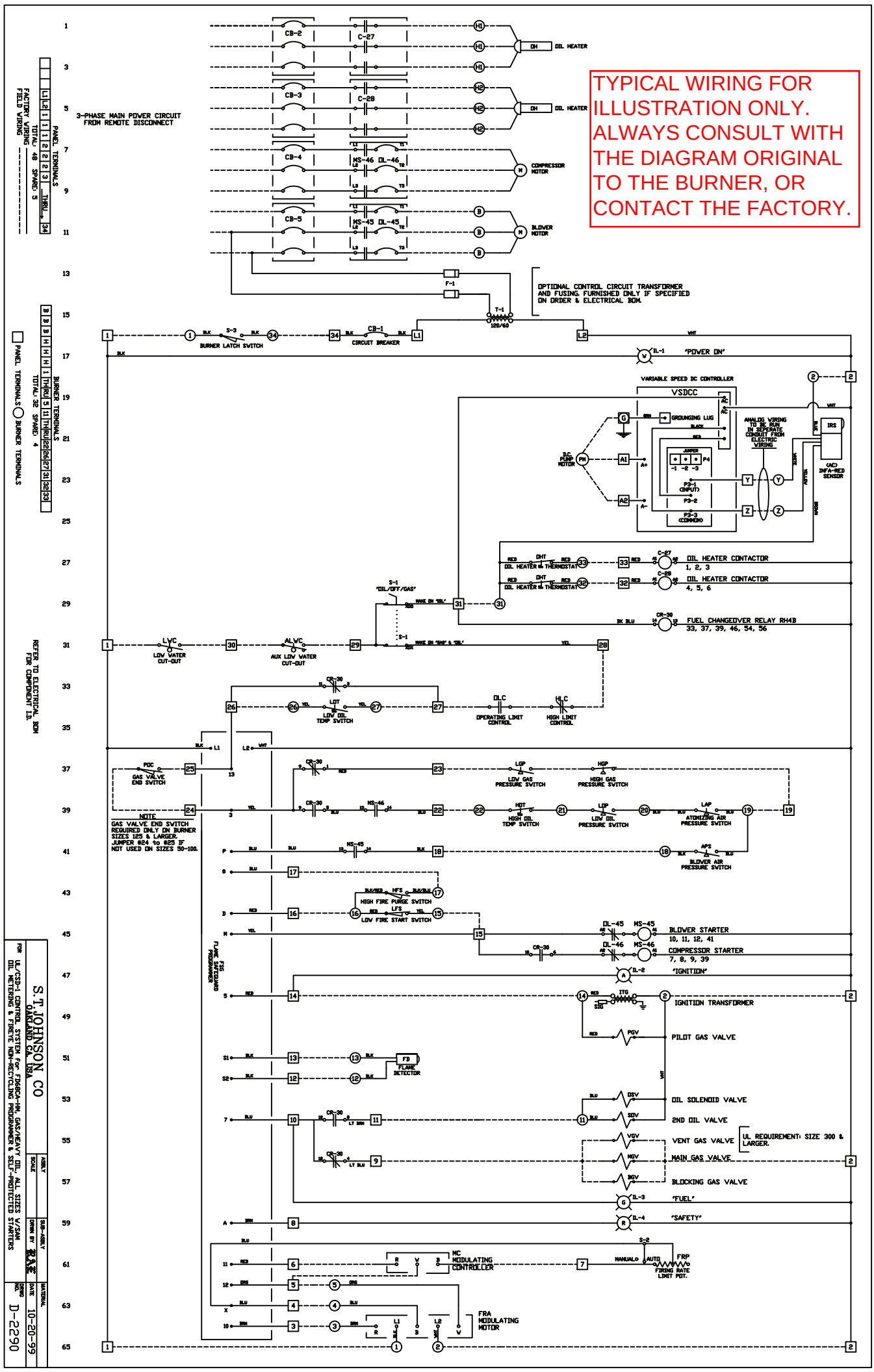
PARTS LIST FD68CA-HM w/"SAM" OIL METERING

Ref: Drawing B-8879

ITEM	DESCRIPTION	50	75	100	125	150	200	250	300	400	500	625	ITEM
51	MODULATING MOTOR	M9174C1025	--------	--------	--------	--------	--------	--------	M9484F1031	--------	--------	--------	51
52	MOD MOTOR TRANSFORMER	N/A	--------	--------	--------	--------	--------	--------	198162EA	--------	--------	--------	52
53	MOD MOTOR BRKT	B-8289-1	--------	--------	--------	--------	--------	--------	B-8289-2	--------	--------	--------	53
54	EMS CAM ASBLY	C-6032	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	54
55	EMS CAM SPRING	C-6032-1	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	55
56	EMS I.R. SENSOR	OASBCV	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	56
57	EMS I.R. POWER SUPPLY	OPBA3	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	57
58	AIR PRESSURE SWITCH	R72-2-AEV6	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	58
59	MAIN JACKSHAFT	A-6075-77	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	59
60	JACKSHAFT STOP COLLAR	CS-8-A	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	60
61	JACKSHAFT BUSHINGS	FF-600-5	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	61
62	AIR JACKSHAFT	A-6075-69	--------	--------	--------	--------	--------	--------	A-6075-77	--------	--------	--------	62
63	JACKSHAFT CRANKARMS(4)	A-7939	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	63
64	CRANKARM SWIVEL	A-7931	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	64
65	AIR SHUTTER SWIVEL	0804	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	65
66	BLOWER MOTOR,3450RPM*	1/2 HP	3/4 HP	1-1/2 HP	2 HP	--------	5 HP	7-1/2 HP	--------	15 HP	20 HP	25 HP	66
67	HINGE POST(S)	A-7878	--------	--------	--------	--------	--------	--------	--------	--------	A-7879	--------	67
68	HINGE BRACKET, UPPER	C-4578-1	--------	--------	--------	--------	--------	--------	--------	--------	C-5515-1	--------	68
69	HINGE BRACKET, LOWER	C-4578-2	--------	--------	--------	--------	--------	--------	--------	--------	C-5515-2	--------	69
70	SWIVEL LINKAGE	A-4252	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	70
71	IGNITION TRANSFORMER	1092PF	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	71
72	PILOT SOLENOID VALVE		8262G13	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------72
73	PILOT PRESS GAUGE	0-35" WC	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	73
74	PILOT SHUT-OFF VALVE	3/8" NPT	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	74
75	OBSERVATION PORT ASBLY	A-7877	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	75

-------- Indicates That Part # Is Identical To The Number To The Left

APPENDIX D: TYPICAL ELECTRICAL SCHEMATICS


TYPICAL WIRING FOR ILLUSTRATION ONLY. ALWAYS CONSULT WITH THE DIAGRAM ORIGINAL TO THE BURNER, OR CONTACT THE FACTORY.
3-PHASE MAIN POWER CIRCUIT FROM REMOTE DISCONNECT
CB-2
C-27
CB-3
C-28
CB-4
MS-46 DL-46
CB-5
MS-45 DL-45
OH OIL HEATER
OH OIL HEATER
M COMPRESSOR MOTOR
M BLOWER MOTOR
F-1
T-1
120/60
OPTIONAL CONTROL CIRCUIT TRANSFORMER AND FUSING. FURNISHED ONLY IF SPECIFIED ON ORDER & ELECTRICAL BOM.
S-3
BURNER LATCH SWITCH
CB-1
CIRCUIT BREAKER
IL-1 "POWER ON"
VARIABLE SPEED DC CONTROLLER
VSDCC
GROUNDING LUG
D.C. PUMP MOTOR
JUMPER
P3-1 (INPUT)
P3-2
P3-3 (COMMON)
ANALOG WIRING TO BE RUN IN SEPERATE CONDUIT FROM ELECTRIC WIRING
IRS
(AC) INFRA-RED SENSOR
OIL HEATER THERMOSTAT
C-27 OIL HEATER CONTACTOR 1, 2, 3
C-28 OIL HEATER CONTACTOR 4, 5, 6
S-1 "OIL/OFF/GAS"
CR-30 FUEL CHANGEOVER RELAY RH4B 33, 37, 39, 46, 54, 56
LVC LOW WATER CUT-OUT
ALWC AUX LOW WATER CUT-OUT
LOT LOW OIL TEMP SWITCH
DLC OPERATING LIMIT CONTROL
HLC HIGH LIMIT CONTROL
PDC GAS VALVE END SWITCH
NOTE GAS VALVE END SWITCH REQUIRED ONLY ON BURNER SIZES 125 & LARGER. JUMPER #24 to #23 IF NOT USED ON SIZES 50-100.
LGP LOW GAS PRESSURE SWITCH
HGP HIGH GAS PRESSURE SWITCH
HOT HIGH OIL TEMP SWITCH
LOP LOW OIL PRESSURE SWITCH
LAP ATOMIZING AIR PRESSURE SWITCH
APS BLOWER AIR PRESSURE SWITCH
HFS HIGH FIRE PURGE SWITCH
LFS LOW FIRE START SWITCH
DL-45 MS-45 BLOWER STARTER 10, 11, 12, 41
DL-46 MS-46 COMPRESSOR STARTER 7, 8, 9, 39
IL-2 "IGNITION"
FLAME SAFEGUARD PROGRAMMER
ITG IGNITION TRANSFORMER
PGV PILOT GAS VALVE
FD FLAME DETECTOR
DSV OIL SOLENOID VALVE
SOV 2ND OIL VALVE
VGV VENT GAS VALVE
MGV MAIN GAS VALVE
BGV BLOCKING GAS VALVE
UL REQUIREMENT: SIZE 300 & LARGER.
IL-3 "FUEL"
IL-4 "SAFETY"
S-2 MANUAL/AUTO
FRP FIRING RATE LIMIT POT.
MC MODULATING CONTROLLER
FRA MODULATING MOTOR
PANEL TERMINALS
FACTORY WIRING
FIELD WIRING
TOTAL 48 SPARE 5
BURNER TERMINALS
TOTAL 32 SPARE 4
REFER TO ELECTRICAL BOM FOR COMPONENT I.D.
S.T. JOHNSON CO
OAKLAND CA. USA
FOR UL/CSD-1 CONTROL SYSTEM for FD96CA-HN, GAS/HEAVY OIL, ALL SIZES W/SAM OIL METERING & FIRETE NON-RECYCLING PROGRAMMER & SELF-PROTECTED STARTERS
SCALE
DRAWN BY
DATE 10-20-99
DRWG NO. D-2290