MIFCO
McEnglevan Industrial Furnace Company, Inc.

Dear MIFCO Customer:

We would like to thank and congratulate you on the purchase of the McEnglevan machine and accessories, and to share with you our confidence in the quality and reliability of our equipment.

The enclosed Operating Manual and Warranty Registration Card are important to both of us for two reasons:

1. Your Registration Card, with proper serial number, will be documented in our files and your written warranty will be forwarded to you upon the receipt of this card. Please complete and mail the return card now.

2. Proper instruction on the maintenance of your machine is very important. Please read your instruction manual completely for best results and maximum machine tool life.

Should you ever need service, it is available through the distributors, our factory representatives or directly from the factory. It is the obligation of our franchised distributor who sells you this equipment to conduct field service where possible. Please contact your local distributor first and they will assist you in resolving any problems you may encounter.

We take pride along with you in your purchase of this equipment. We will be happy to assist you in any way possible to receive optimum results in its operation and use.

Sincerely yours,

Matt Walter
CEO

DO NOT REMOVE THIS PAGE

In accordance with the National Electric Code, A.G.A., Canadian Standard Association, O.S.H.A., N.F.P.A., and the F.I.A. recommendations, this specification sheet must remain a part of this manual. Most of the components are U.L. and A.G.A. listed. The wiring and Ultra-Violet Combustion Safeguard Systems, designed to conform to Illinois O.S.P.I. Circular 156 as amended, are in compliance per approval letter received from the Office of Public Instruction dated November 20,1974.

This manual contains the Electrical Wiring schematic applicable to this particular equipment. If there are any questions, contact your distributor or the factory. Only licensed electricians or qualified factory representatives should trouble shoot the electrical system of this equipment.

The electrical portion of this equipment is built in compliance with the National Electric Code in effect as of this date.

Purchased from _____ Date _____

City _____ State _____ Zip Code _____

Model Number _____ Serial Number _____

Electrical Service Specifications

_____ Volts _____ Phase _____ Hertz

Note: Schematic drawings showing different voltages, phase and hertz data are included in the manual.

The Drawing Number for this furnace is: _____

Note:

Maximum incoming gas pressure: 7 psi.
HIGHER PRESSURE WILL DAMAGE REGULATOR AND MODULAR VALVE SYSTEM.

MIFCO PROPORTIONING BURNER FURNACES

When your furnace was ordered, your company was contacted to determine the gas pressure that would be available at your furnace installation. The gas regulator that is part of this burner system was sized accordingly. The unit was test fired as close to this pressure as was possible. Only minor adjustments should be necessary, if at all.

If the gas pressure at the incoming side of the DMV - Solenoid needs to be adjusted to factory settings, you will have to turn the adjusting screw in the gas regulator. **(7lb. maximum incoming pressure to the FRI 510/10 Regulator to prevent damage.)** Please refer to the pressure setting at the bottom of this page and adjust the regulator, while watching a monometer attached to the taps on both sides of the orifice plate, until the correct pressure is reached. This operation must be performed while the furnace is running.

If there are any problems with the set-up, please call the factory before attempting any further adjustments.

DATE TESTED: _____

FURNACE MODEL: _____

SERIAL NO: _____

VOLTAGE: _____ PHASE: _____

GAS TYPE: NATURAL _____ PROPANE _____

GAS PRESSURE SETTING ACROSS LIMITING ORIFICE PLATE: _____ IN. / W.C. - High Fire

ROOTS METER - LOW FIRE _____ BTU/HR.

ROOTS METER - HIGH FIRE _____ BTU/HR.

Average High Fire Settings for Gas Pressure

DO-600A - 5î w.c. across taps on both sides of limiting orifice plate.
DO-1000A - 7î to 9î w.c. across taps on both sides of limiting orifice plate.

Operations Page Parameter Record

Make a photocopy of this page and enter your settings on that copy.

Name DIP-OUT Melter Parameters

Date 9 - 01 - 2001

PID Set Chan 1 Menu	PID Set 1
Proportional Band A	138° F
IntegralA / ResetA	.19 / min.
DerivativeA / RateA	.13 min.
Dead Band A	
Hysteresis A	
Proportional Band B	
IntegralB / ResetB	
DerivativeB / RateB	
Dead Band B	
Hysteresis B	

PID Set Chan 2 Menu	PID Set 6
Proportional Band A	
IntegralA / ResetA	
DerivativeA / RateA	
Dead Band A	
Hysteresis A	
Proportional Band B	
IntegralB / ResetB	
DerivativeB / RateB	
Dead Band B	
Hysteresis B	

PID Set Ch 1 Outer Loop	PID Set 1
Proportional Band A	60° F
IntegralA / ResetA	.15 / min.
DerivativeA / RateA	2.00 min.
Dead Band A	
Proportional Band B	
IntegralB / ResetB	
DerivativeB / RateB	
Dead Band B	

Alarm Set Point Menu	Alarm 1	Alarm 2
Low Set Point		
High Set Point		
Lo Deviation		
Hi Deviation		

Setup Page Parameter Record

Make a photocopy of this page and enter your settings on that copy.

Name DIP-OUT Melter Parameters Date 9 - 01 - 2001

System Menu	Setting
Guar. Soak Band 1	50
Guar. Soak Band 2	50
Current Time	Set
Current Date	Set
PID Units	U.S.
F or C	F
Show F or C	Yes - Up
Ch1 Autotune SP	95%
Ch2 Autotune SP	95%
Input 1 Fail	0%
Input 2 Fail	0%
Open Loop Ch1	Off
Open Loop Ch2	Off
Power-Out Time	10 sec.
Power-Out Action	Reset

Input Menu	Analog In 1	Analog In 2	Analog In 3
Sensor	TC		TC
Type	K		K
Decimal	0		0
Altitude	—		—
Units	—		—
Scale Low			
Scale High			
SP Low Limit	50° F		50° F
SP High Limit	2000° F		1800° F
Calibration Offset	0° F		0° F
Filter Time	0		0
Error Latch	Self Clear		Self Clear
Cascade	—		Process
Name			
Function			
Condition			

Control Output Menu	Output 1A	Output 1B	Output 2A
Function	Heat		
Cycle Time	—		
Process Type	4 - 20mA		
Hi Power Limit	100%		
Lo Power Limit	0%		
Alarm Name			
Alarm Type			
Alarm Source			
Latching			
Silencing			
Alarm Hysteresis			
Alarm Sides			
Alarm Logic			
Alarm Messages			
Retransmit Source			
Analog Range			
Low Scale			
High Scale			
Scale Offset			

Digital Output Menu	Digit Out 1	Digit Out 2	Digit Out 3
Name			
Function			
Boost % Power			
Boost Delay			
Compressor On % Power			
Compressor Off % Power			
Compressor On Delay			
Compressor Off Delay			

Communications Menu	Setting
Baud Rate	
Address	

Custom Main Page Parameter Record

Make a photocopy of this page and enter your settings on that copy.

Name _____ Date _____

Will always appear if active:	Main Page Input 1 Error Input 2 Error Input 3 Error	
Will appear if active and set up to appear:	Alarm 1 Condition Alarm 2 Condition Autotuning Channel 1 Autotuning Channel 2	
Choose from the column at the far right the information you want to appear on the Main Page (in any order):	**(Position on Main Page)** P1 Input 3 P2 Input 1 P3 Setpoint 1 P4 % Power 1A P5 Inner Setpoint P6 Current Step P7 Time Remaining P8 Time P9 None P10 None P11 None P12 None P13 None P14 None P15 None P16 None	**(Possible parameters)** None Input 1 Value Input 2 Value Input 3 Value Set Point 1 Set Point 2 % Power 1 % Power 2 Tune status 1 Tune status 2 Time Date Digital Inputs Digital Outputs Time Remaining Current File Current Step Active Ch1 PID Set Active Ch2 PID Set Last Jump Step Jump Count WaitFor Status Step Type Target SP1 Target SP2 Inner Set Point Custom Message 1 Custom Message 2 Custom Message 3 Custom Message 4 Input1 Cal. Offset Input2 Cal. Offset Input3 Cal. Offset
Will always appear:	Go to Operations Go to Profiles Go to Setup Go to Factory	

Series 97 Fold-out Software Map

Home Page

97 Process Value
SAFE Limit Status

Operations Page

L IM Limit Menu
OPEr Operations Page
L Lo Low Limit Set Point
L h, High Limit Set Point 2050° F
CAL I Calibration Offset 0

MAn Monitor Menu
OPEr Operations Page
Pr 1 Process 1 Chamber Temp.
L SE Limit Status SAFE
AL 2 Alarm 2 Status
AL 3 Alarm 3 Status
AL 4 Alarm 4 Status
E SE Event Input Status

ALM Alarm Menu
OPEr Operations Page
A2Lo Alarm 2 Low
A2h, Alarm 2 High
A3Lo Alarm 3 Low
A3h, Alarm 3 High
A4Lo Alarm 4 Low
A4h, Alarm 4 High

Enter your settings on a photocopy of this page.

Setup Page

InP 1 Input 1 Menu
SEt Setup Page
SEn 1 Sensor Type 1 TC
In 1 Input 1 H
rL 1 Range Low 1 50° F
rh 1 Range High 1 2050° F
dEC 1 Decimal 1 0
Ftr 1 Input Software Filter 1 0

InP2 Input 2 Menu
SEt Setup Page
In 2 Input 2
E Fo Event Function
E co Event Condition

Out 1 Ouput 1 Menu
SEt Setup Page
LS id Set Limit Active Sides HI
Lhys Limit Hysteresis 3

Out2 Ouput 2 Menu
SEt Setup Page
Ot 2 Output 2
hYS2 Alarm Hysteresis 2
LAt2 Latching 2
S iL2 Silencing 2
S id2 Alarm Active Sides 2
L9c2 Alarm Logic 2
Anu2 Alarm Annunciation 2

Out 3 Ouput 3 Menu
SEt Setup Page
Ot 3 Output 3
hYS3 Alarm Hysteresis 3
LAt3 Latching 3
S iL3 Silencing 3
S id3 Alarm Active Sides 3
L9c3 Alarm Logic 3
Anu3 Alarm Annunciation 3

Out 4 Ouput 4 Menu
SEt Setup Page
Ot 4 Output 4
hYS4 Alarm Hysteresis 4
LAt4 Latching 4
S iL4 Silencing 4
S id4 Alarm Active Sides 4
L9c4 Alarm Logic 4
Anu4 Alarm Annunciation 4
Aout Analog Output 4
Prc4 Process 4 Type
A h, Analog Output High
A Lo Analog Output Low
ACAL Analog Output Offset
bAUd Baud Rate
Addr Address

d iSP Display Menu
SEt Setup Page
UdSP Upper Display PR 1
UP L Upper Display User Limit Message
LdSP Lower Display USER
Lo S Lower Display User Safe Message SAFE
Lo L Lower Display User Limit Message OUCH

GLbL Global Menu
SEt Setup Page
C-F C or F F
Ecc Input Error Latching NON

Factory Page

LOC Lockout Menu
FctY Factory Page
OPEr Operations Page Mode
SEt Setup Page Lock
CAL Calibration Menu Lock

d IAG Diagnostics Menu
FctY Factory Page
MdL Model Number
dAtE Date of Manufacture
Sn 1 Serial Number 1
Sn2 Serial Number 2
SoFt Software ID Number
rEv Software Revision
it42 Input 2 Hardware Enabled
Ot41 Output 1 Hardware
Ot42 Output 2 Hardware
Ot43 Output 3 Hardware
Ot44 Output 4 Hardware
tout Test Output
d ISP Test Displays
hrES High Resolution
AtMb Ambient Temperature
Acnt Ambient A-D Counts
cnt 1 Channel 1 A-D Counts
cnt2 Channel 2 A-D Counts
L inE Line Frequency

The Factory Page also includes calibration parameters that are not necessary for everyday use of the controller. Calibration parameters and procedures are explained in the Appendix.

Dip-Out Furnace Installation

Furnace Set-up - Standard FM Burner

Set the furnace in a permanent location. Locate the 1î conduit coming from the 6î x 6î junction box on burner valve train. Attach conduit to the control cabinet throught the conduit fitting provided and connect all wires to terminal strip in control cabinet according to wire markers. (Skip down to paragraph 3, below.)

Furnace Set-up - IRI Burner Option

Set the furnace in a permanent location and connect the blower/burner system to the burner on the furnace by connecting the unions on the gas and air lines. Connect the scanner to the 1/2" heat sink fitting coming out of the side of the burner. Connect the spark wire to the spark electrode.

Locate melt thermocouple with right angle pipe inside crucible and fasten in holder. Insert the firing chamber thermocouple and the high limit thermocouple into the holes in the side of the furnace shell, above the burner box. Do not allow the thermocouples to touch the crucible. The control cabinet should then be powered by bringing incoming wires to the fuseable disconnect in the side of the cabinet. The control cabinet must be grounded for safety and to make control instruments work properly. Momentarily push start button to check blower impeller rotation. If the rotation is wrong, reverse any two incoming power leads. (3 phase power only)

Installing the Crucible

1. Remove the top plate with the drip shield.
2. Remove the 4" thick insulating ring. This insulating board is fragile and should be handled by at least 2 people.
3. Place the crucible rest in the bottom of the furnace chamber and in the center.
4. Place a thin layer of ceramic fiber blanket on top of the crucible rest.
5. Place the bowl crucible in the furnace in the exact center.
6. Place strips of the 1/2 in. thick ceramic fiber blanket insulation around the top of the crucible and the top of the ceramic fiber bats to form a seal 1/2 in. thick.
7. Place the insulating board ring in the furnace around the top of the crucible.
8. Put on the top plate in the same position it was when you removed it and pull down the draw clamps until they lock down.

Gas Supply and Piping

The gas service line must be at least large enough to deliver 2,000 cubic feet an hour at 2 lbs. of pressure at the furnace when it is running on high fire. Consult your gas company for proper sizing of the pipe. A gas regulator of the appropriate size has been included on this unit - per your company specifications. Low gas pressure, fluctuations, or inadequate gas volume will cause the burners to fluctuate and burn improperly. For this reason we have high and low gas pressure switches in the gas line. The furnace is also supplied a dual electric gas valve. BE SURE TO PIPE THE VENT LINE BETWEEN THE GAS VALVES, AND THE VENTS ON THE VALVES THEMSELVES, TO THE OUTSIDE OF THE BUILDING. **(I.R.I. units only.)**

Furnace Preparation Prior to Start-up

DO NOT OBSTRUCT THE EXHAUST PORT IN ANY MANNER WHILE IN OPERATION.

If the crucible breaks while in the furnace, the molten metal will flow out the drain on the floor of the furnace. Be sure the drain hole remains unobstructed by checking it regularly.

A layer of high temperature refractory insulation is cast between the pre-burned high alumina lining and the steel furnace shell. This increases melting efficiency and reduces heat loss through the furnace walls to a minimum. Because the insulation is a castable material, a certain amount of moisture is absorbed by the furnace lining. It is recommended that the initial firing periods should not exceed fifteen minutes, to allow the lining to expel the moisture slowly. The moisture may appear as steam or drops of water. Two or three short firing periods will be sufficient to remove the excess moisture. To dry the insulation, fire at about 1/3 of the firing rate until the steaming stops and moisture stops coming out of the furnace. After the furnace has been fired at low temperature, up to 1000° F for a day's time using several firing periods, it will be ready to fire at full fire.

Instructions in the Use and Care of Crucibles should be followed as closely as possible. This practice is routine in the foundry trade, and will increase crucible life and prevent failure due to cracking and spalling.

Standard FM Burner System - Sequence of Operation

1. Depress the start button. Power is applied to the Honeywell Control Module.

2. The system goes through a self diagnostic check. During this segment, the Control Module tests all circuits for continuity, makes sure that all valves are in their proper positions and analyzes the Temperature Control Instrument as well. At the same time, the Temperature Control Instrument is performing its own internal diagnostics.

3. Once everything is checked out and is in proper position, the Control Module powers the blower and the system then goes through a 60 second pre-purge to insure that there are no combustible gases present in the firing chamber. After this pre-purge, the system undergoes a 15 second purge hold. After the purge hold, there is a 10 second pilot ignition period during which the low fire is established. Once low fire is established and proven, the unit goes to a run mode. At this point the safety system is done with its tests and control is taken over by the Temperature Control Instrument.

6. Enter a set point in the Temperature Control Instrument and the furnace will travel to that setpoint and remain there until a change is made. For further information about the Temperature Control Instrument, see the page entitled: Programming the Control Instrument.

I.R.I. Burner System - Sequence of Operation

1. Depress the start button. Power is applied to the Honeywell Control Module.

2. The system goes through a self diagnostic check. During this segment, the Control Module tests all circuits for continuity, makes sure that all valves are in their proper positions and analyzes the Temperature Control Instrument as well. At the same time, the Temperature Control Instrument is performing its own internal diagnostics.

3. Once everything is checked out and is in proper position, the Control Module powers the blower and opens the air modulating motor to the High Air position. The system then goes through a 60 second High Air Purge to insure that there are no combustible gases present in the firing chamber. After this purge, the air modulating motor is driven closed and the Low Fire Interlock Switch is made.

4. At this point the spark ignition and bypass pilot come on. After a 10 second trial ignition period, the spark ignition turns off and the bypass pilot stays on. When the Control Module has a good flame signal, it turns on the Main Gas.

5. When the Main Gas comes on, the Control Module checks again to be sure that there is a good flame signal, then the bypass pilot takes over. At this point the safety system is done with its tests and control is taken over by the Temperature Control Instrument.

6. Enter a set point in the Temperature Control Instrument and the furnace will travel to that setpoint and remain there until a change is made. For further information about the Temperature Control Instrument, see the page entitled: Programming the UDC-3300

Re-ignition After Flame Failure

1. When there is a flame failure, the Flame Failure light on the control panel will be lit. Reset the UV Safety System by depressing the reset button on the Honeywell Flame Safety control box. The Safety System will not reset until the motor is at a complete stop.

2. If the Honeywell control will not reset after flame failure refer to the Diagnostic Keypad. The Honeywell Flame Safety system is equipped with a diagnostic read-out. If the furnace cannot be restarted please refer to the Keyboard Display Module section of this manual for a listing of the error codes. This will help determine which component has failed.

Maintenance

All McEnglevan furnaces are constructed with hard, pre-burned sectional refractory shapes. Each brick is made by air ramming the granular refractory particles into a steel mold, forming the desired shape. The shape is removed from the mold, dried to remove all moisture, then fired. Defective bricks fail during the final burning and are discarded. This assures controlled quality refractory for all McEnglevan furnaces
before assembly into a furnace lining.

We can control quality through the point of manufacture of the furnace, but preventative maintenance is necessary for maximum productive life of the furnace lining. The exposed surfaces of the refractory lining should be resealed when scuffing and wear takes place.

Minro Wash Refractory Sealer for Furnace Lining

Minro Wash is a dry, air setting bonding mortar that gives an exceptionally strong bond at all temperatures. Minro Wash sealer, unlike most dry mortars, is ready to use immediately after mixing with water. When mixing is completed, its fine workability has already been developed and the bonding agent is completely dissolved, ready to put on the brick surface. The sealer forms a mechanical bond with the refractory wall and in order for it to form a ceramic bond the furnace should be taken to 2000° F. The mechanical bond in the sealer will burn away by 1500∞ and the sealer will fall off unless the 2000∞ F+ temperature is reached. The maximum temperature rating of the sealer is 3000∞F.

Refractory Plastic Patching Material

If the refractory lining has been chipped or broken, and the damaged areas are too large to be filled with refractory sealer, they should be filled with patching material. The plastic patching material is a similar material as the sealer except that it is pre-mixed and has a putty consistency.

Application of Sealer and Patching Material

Remove all loose scale and foreign material from the surface to be sealed. Wire brush to remove flux and old loose sealer. Excessive flux and spilled metal are detrimental to refractory and should be removed prior to resealing. Prepare the surface by priming with a saturated solution of sodium silicate (water glass). This material is available from drug supply houses. Brush or sponge the solution liberally on the refractory.

The refractory patching material should be used at this point to fill larger holes. Saturate damaged areas with primer or water. Work a thin layer of plastic into the damaged section. This forms a strong bond between the refractory and patching plastic. Place a layer of patching plastic with a maximum thickness of 1/8î into the area being filled.
The thin patch should be allowed to dry for one hour, then the area heated to a red temperature by using the furnace. When the furnace has cooled, add another thin layer, not exceeding 1/8î thick until the patch conforms to the original contour of the furnace lining. If the procedure of applying and 'burning in" the successive thin layers is not followed and a heavy patch is used to fill the damaged area, the moisture retained in the center of the heavy patch will generate sufficient steam to cause it to rupture and peel.

After the primer has been applied, and any severely damaged sections have been repaired with plastic patching, prepare the sealer as follows:

Application of Sealer and Patching Material (cont.)

Step 1 Use one pint of warm water in a metal container.

Step 2 Sift the refractory into the water while stirring constantly.

Step 3 Remove the lid from the furnace so both the bottom and top surfaces can be sealed. With the use of a sponge, saturate exposed refractory with water and immediately brush the prepared sealer into the surface of the refractory lining and lid. Unless the refractory is presaturated with water, it will draw the moisture from the sealer, preventing a tight bonding action and the seal coating will peel. (Light coatings applied often, are more satisfactory than one heavy application).

Step 4 Allow the furnace to dry for a period of at least two hours.

Step 5 Light furnace and fire slowly for about five minutes, then shut furnace down. (This provides heat to expel moisture from the patching plastic).

Step 6 Allow the furnace to dry an additional one hour, then light furnace and increase heat slowly to red heat. The furnace chamber should be inspected and cleaned of any accumulation of slag or spilled metal prior to start up. Proper cleaning and the use of sealer should triple the life of the refractory in your furnace.

The Use and Care of Foundry Crucibles

Composition - Types of Material

Crucibles are manufactured in two basic compositions; the clay graphite ceramic bonded and the silicon carbide carbon bonded types. Both types utilize the refractory materials, graphite and silicon, as conductors of heat and for structural strength. Graphite is predominant in the composition of the clay graphite crucible while silicon carbide predominates in the silicon carbide crucible. Due to its higher heat conductivity and greater strength, the silicon carbide crucible is more popular in industry. The less expensive clay graphite crucible is generally used in the school shop. Crucible failure in school shops is generally due to mishandling by inexperienced students, so the benefits of the more expensive silicon carbide crucible would not be realized.

Either type crucible can be used for melting aluminum, brass, or grey iron. However, different metals should not be melted in the same crucible. This practice will cause contamination of each melt and it will be very difficult to get good castings. Different crucibles should be used for each type of metal melted. If grey iron is to be melted in appreciable quantity, a special clay lined silicon carbide crucible is recommended. Do not use just ìany sizesî crucible in your furnace. Use the size for which the furnace was designed. To prevent oxidation of the crucible wall, always melt with a full charge in the crucible. Half full crucible melts will shorten crucible life considerably.

Tilting Crucibles

Tilting crucibles are available in both clay graphite and silicon carbide composition. Instructions supplied by the crucible manufacturer should be followed closely. Be sure there is proper clearance between the pouring lip and the lip channel of the furnace wall. The crucible should rest lightly against the four wedges of brick located in the slots on each side of the lip channel of the furnace wall. Placing any undue strain on the crucible will cause premature failure. It is also advisable on high temperature operations to support the lip with ceramic fiber blanket at the end of the lip. We also recommend 2" fiber blanket underneath at the back of the pour spout to keep the flame from coming out of the front. The lip should not be restricted though to allow for expansion.

Receiving and Storage

A great deal of emphasis has been put on the proper care of graphite crucibles for maximum service life and safety. Several factors are important and should be carefully considered.

DO NOT STORE crucibles as received in their original container. Examine the container, unpack crucibles immediately, and inspect each crucible for cracks or damage.

If the shipment contains damaged pieces, have the delivering carrier acknowledge the damage on your delivery receipt, or notify the carrier of hidden damage and call for immediate inspection.

After inspecting crucibles, they should be stored in a warm, dry place. If it is necessary to store the crucibles in an exposed, unheated location, they should be moved to a warm area for two or three days prior to using. EXCESSIVE MOISTURE SHOULD BE REMOVED PRIOR TO TEMPERING. Some shops use the top of core ovens, or build drying racks near the melting furnaces for drying. This is an acceptable practice providing the crucibles are not subjected to direct furnace exhaust to force the drying. Forced drying usually results in uneven heating and sets up strains which will eventually cause cracking and premature failure.

Charging the Crucible with Metal

The part of the charge consisting of gates and risers, or of clean scrap of equivalent size, is charged first. Ingots and bars are charged last. Turnings or very light scrap should be added into the crucible after the initial charge has become molten. Otherwise, the turnings and light sections will be attacked by the furnace atmosphere, and will be oxidized excessively before melting temperature is reached. These oxides and impurities are carried into the casting metal, resulting in porous and unsound castings. Heat is transmitted to light scrap more rapidly by the molten metal with a minimum of oxidation. Always be positive that any metal added to a molten bath is dry, otherwise an explosion will occur, because of steam generation in the molten bath. Ingots should be thoroughly dry, and added to the molten charge with long handled pick up tongs.

Adding Ingot or Pig to Crucible

Heavy sections of charge should not protrude above the lip of the crucible or they will be subjected to furnace atmosphere and excessive oxidation. The ingots and bars should be cut to a length shorter than inside diameter of the crucible. This is particularly true when adding bars or pig to crucibles of molten metal. Long pieces when added, will sink and come to rest in a horizontal position. They then expand before melting and press out the sides of the crucible, causing cracks and premature failure.

Preheating Charge Metal

It is very poor practice to preheat scrap or bars by placing them across the exhaust port in the lid of the furnace. Such practice causes excessive oxidation of the metal and will result in poor castings. For the same reason, long bars should not protrude through the exhaust port into the crucible. In extreme cases, some of the bars will reach melting temperature, allowing the molten metal to run down inside the furnace lid and walls. This molten metal is oxidized very rapidly and attacks the refractory lining, causing premature replacement of the lid and lining. Ingots can be placed around the lid, well away from the exhaust port.

Programming the Control Instrument

First of all, the Watlow Control Instrument is pre-programmed here at the factory and has tuning parameters entered into it that have been arrived at by extensive testing. Everyoneís needs are different and the control parameters chosen were decided on for a mixture of speed, to get the metal up to temperature as fast as possible and to recover additional metal to pouring temperature quickly, and to minimize overshoot of the setpoint. You may decide to tune the instrument to suit your needs more closely. This is a relatively easy process, but it is strongly suggested that you read the accompanying book on your particular Watlow Controller FIRST.

To enter a setpoint into the controller, look at the lower display of the instrument. You will notice that the Setpoint 1 is the third parameter displayed. Use the down arrow to get to it, then the right arrow to enter the setpoint. Use the up or down arrows to determine the setpoint and right arrow again, after the setpoint is entered. The burner should begin to go to high fire. This is all that is required.

Entering a Ramp / Soak Profile

The instrument is shipped from our factory with a sample profile that is named OVERNITE 1. It can be viewed by going down the Main Page list in the lower display to the line that says Go to Profiles. Use the right arrow to go into the group. The display will read Create Profile, Edit Profile, Delete Profile. Choose Edit Profile and use the right arrow to step through the existing profile. OVERNITE 1 is a simple 5 step profile for idling the furnace down at 5:00 pm to a setpoint of 1100°F. Step 1 has a ramp time of 1 second, the lowest setting, to immediately change the setpoint. Step 2 is a 11 hour soak period to hold the metal at the setpoint until 4:00 am. Step 3 is a 1 second ramp back up to a setpoint of 1350°F. Step 4 is a soak period of 2 hours at the setpoint and will get the metal back up to temperature for pouring by 6:00 am. Step 5 is the end segment. This tells the controller what to do at the end of the profile. In this case, we have programmed it to hold at the final setpoint. We do not employ the feature called guaranteed soak, which delays timing of steps until the process temperature is within a specified range of the setpoint, because of the nature of the process in a melting furnace.

There are other questions that have to be answered for each step when a profile is being created that tell it to perform certain functions, or to observe certain parameters. Refer to the sample profile page on the next page of this manual to see the standard settings for these steps in this furnace. It is also strongly suggested that you refer to the chapter on page 4.1, entitled Profile Programming, of the Watlow manual supplied with this operating manual for further details pertaining to creating profiles.

To run the profile, press the profile button in the lower left corner of the instrument. It will ask which profile you wish to run. Select the profile, right arrow out of the group, and the profile will start. You can confirm this by referring to the lower display. Line 6 reads out the current step, line 7 tells the time remaining for that step, and line 8 tells the actual time in 24 clock readout. To stop a profile, press the profile button again and tell the instrument to terminate the profile. Right arrow out of the group and the profile terminates. The Setpoint 1 reading will say OFF. Arrow down to the Setpoint 1 line and right arrow into it, enter a setpoint again and right arrow out of the group and a new setpoint will be entered.

User Profile Record

Copy this record and use it to plan profiles. Keep it with a Setup Page Parameter Record to document the controller's programmed settings.

Profile Name:_____

Date Programmed: _____

Programmed by: _____

Controller checked by:_____

Step Nmbr	*Step Type*	*Date/Day, Time*	*Wait for*	*Set Events* 1 2 3 4 5 6 7 8	*Time* H M S	*Rate*	*Set Pt 1*	*Set Pt 2*	*PID Set*	*Guar. Soak*	*Jump to Profile*	*Step*	*Repeats*	*End Step*
1	Ramp Time	Same	No	—	00:00:01	—	1100°F	—	1	No	—	—	1	—
2	Soak	Same	No	—	11:00:00	—	—	—	1	No	—	—	1	—
3	Ramp Time	Same	No	—	00:00:01	—	1350°F	—	1	No	—	—	1	—
4	Soak	Same	No	—	02:00:00	—	—	—	1	No	—	—	1	—
5	End	Same	No	—	—	—	—	—	1	No	—	—	—	Hold

Chamber Thermocouple for all Dip-Outs

105115 Chamber thermocouple assembly complete - includes 11 1/2î tube, thermocouple, pipe coupling and closed nipple, thermocouple head.

105116 11 1/2î mullite tube with fittings - no thermocouple.

004064 K14S-18 thermocouple - base wire with beads.

Melt Thermocouples

DO-300

104665 Melt thermocouple assembly - includes thermocouple head, 12î protection tube, elbow, connector, thermocouple, beads, 16î stainless pipe.

DO-600

105105 Melt thermocouple assembly - includes thermocouple head, 18î protection tube, elbow, connector, thermocouple, beads, 23î stainless pipe.

DO-1000, DO-1500, DO-2000

105280 Melt thermocouple assembly - includes thermocouple head, protection tube, elbow, connector, thermocouple, beads, 25î stainless pipe.

004076 All Dip-Outs - 48î bath thermocouple.

Protection Tubes

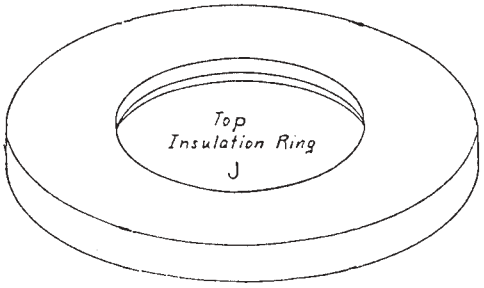
004079 DO-300 thermocouple protection tube.

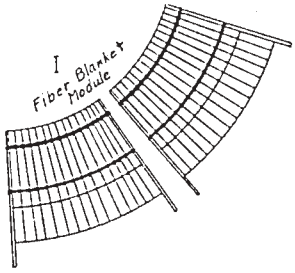
004074 All other Dip-Outs - thermocouple protection tube.

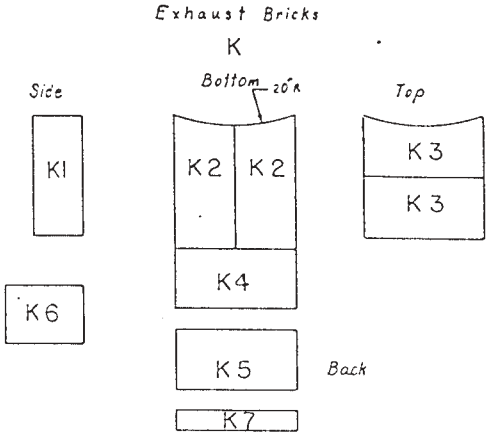
DO-300A Brick Diagram

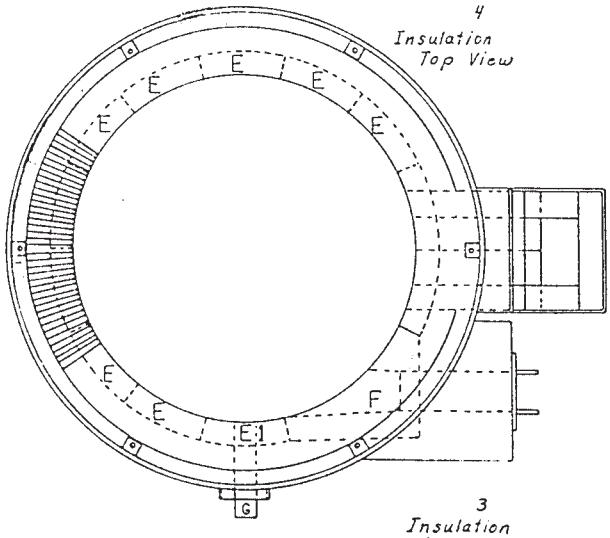
A	Bottom Brick - 2 1/2î x 6 1/2î x 13 1/2î	11
AA	Bottom Brick - 2 1/2î x 4 1/2î x 13 1/2î	2
B	Bottom Brick - 2 1/2î x 4 1/2î x 9î	4
C	Bottom Brick - 2 1/2î x 3î x 3î	4
D	Cast Insulation (set)	1
E	DO-300 Side Liner	11
E1	DO-300 Drain Liner	1

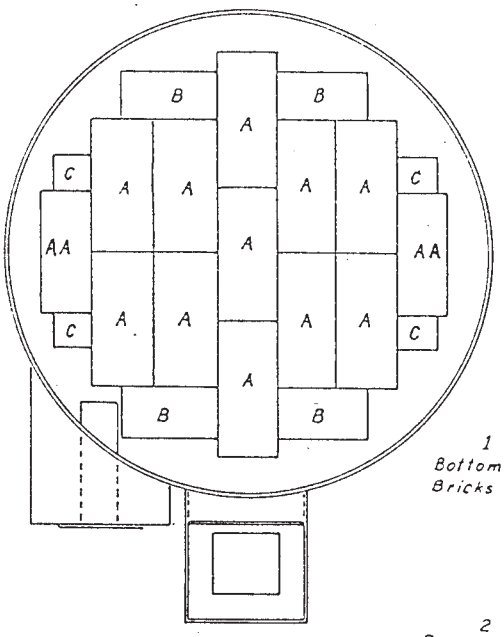
F	Burner Port (set)	1
G	Drain PLug	1
H		
I	Ceramic Fiber Blanket Wall	50
J	Top Insulating Ring	1
K	Exhaust Brick Assembly (set)	1
L	1î Ceramic Fiber Blanket Ring	1
M	1î Ceramic Fiber Blanket Rope	7ft.

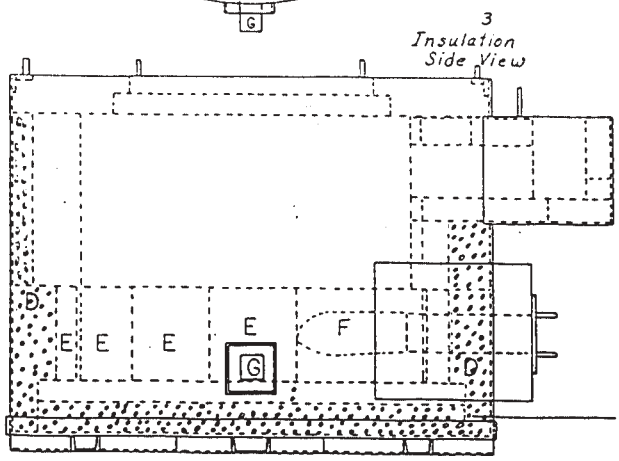


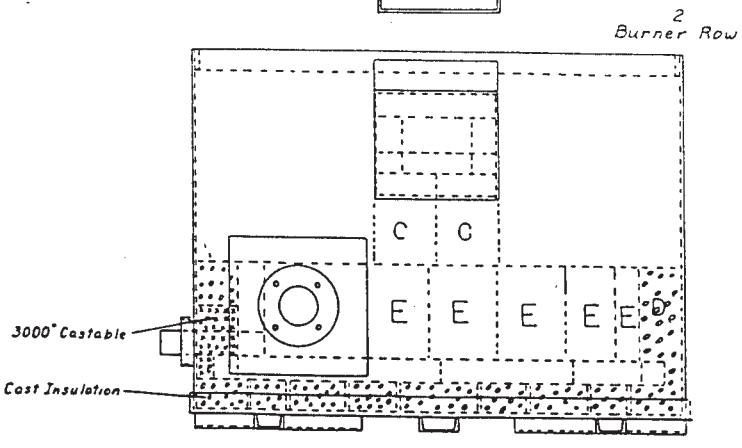






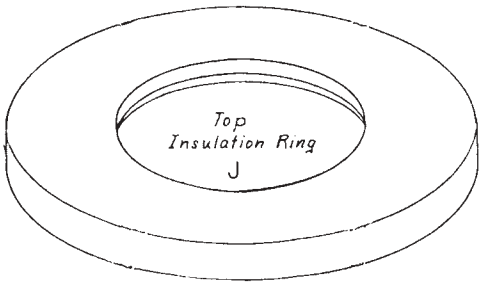


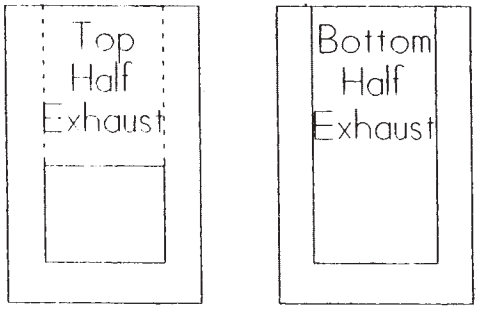




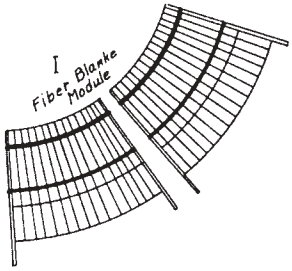
DO-600A Brick Diagram

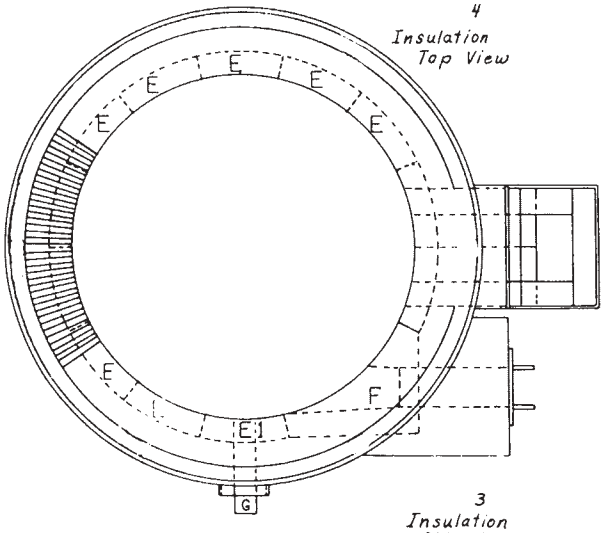
A	Bottom Brick - 2 1/2î x 6î x 13 1/2î	10	F	DO-600 Burner Brick	1
AA	Bottom Brick - 2 1/2î x 6î x 13 1/2î (cut)	4	G	Drain PLug	1
B	Bottom Brick - 2 1/2î x 6 3/4î x 9î	6	H	1î Ceramic Fiber Blanket (under top ring)	1
C	Exhaust Support - 2 1/2î x 6î x 6 1/2î	2	I	Ceramic Fiber Blanket Modules	9
D	3000° Castable Insulation		J	Top Insulation Ring	1
E	DO-600 Burner Row Side Liner	11	K1	Exhaust Liner Top Brick (cast)	1
E1	DO-600 Burner Row Side Liner Drain	1	K2	Exhaust Liner Bottom Brick (cast)	1

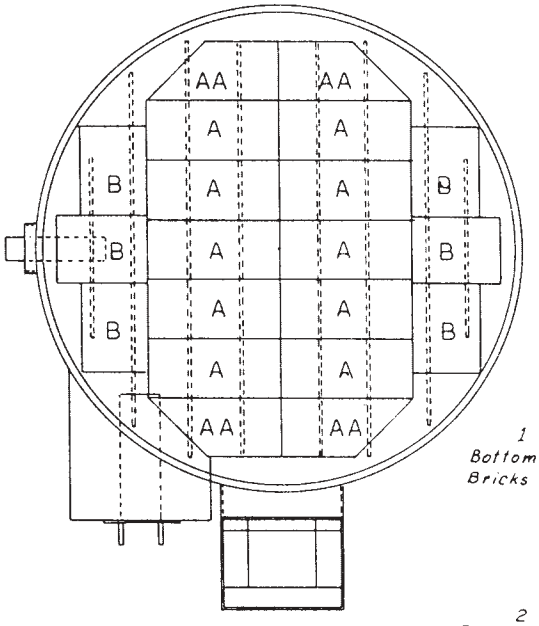


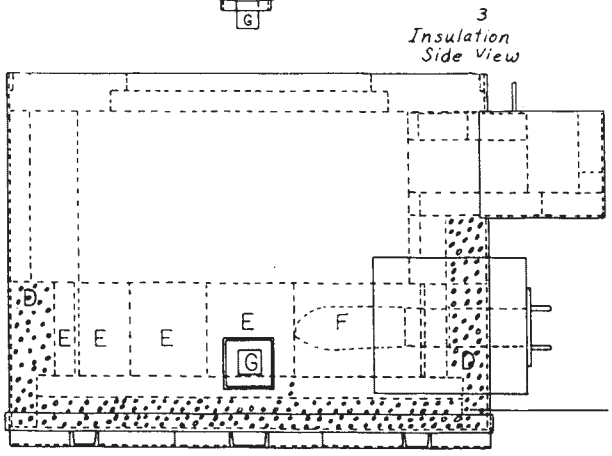


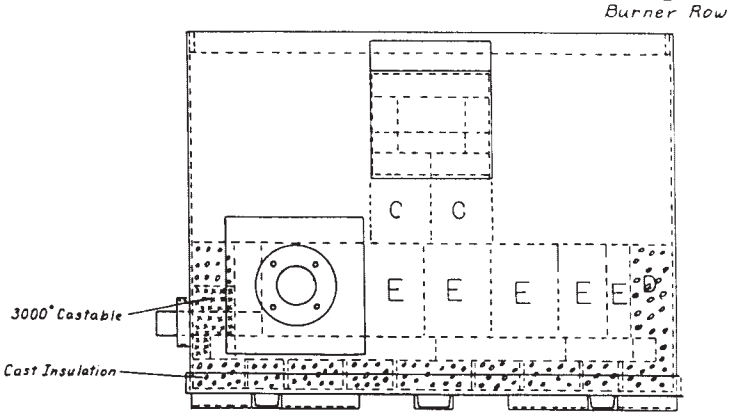
K1 K2





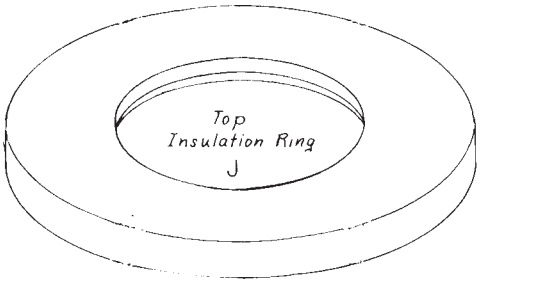


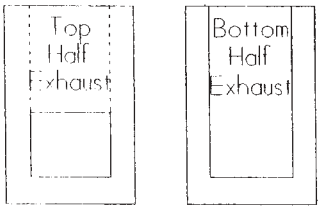




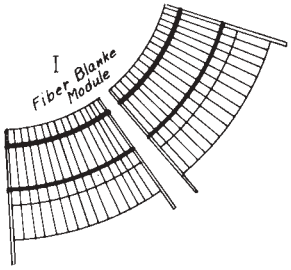
DO-1000A Brick Diagram

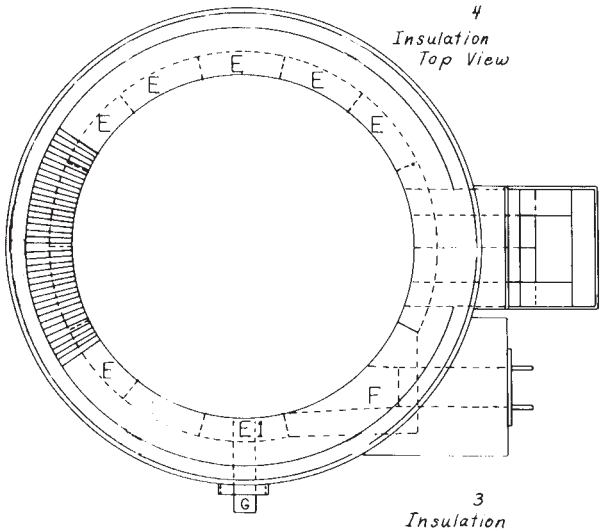
A	Bottom Brick - 2 1/2î x 6î x 13 1/2î	12
AA	Bottom Brick - 2 1/2î x 6î x 13 1/2î (cut)	4
B	Bottom Brick - 2 1/2î x 6î x 11î	4
C	Bottom Brick - 2 1/2î x 6î x 11î (cut)	4
D	Bottom Brick - 2 1/2î x 6î x 13 1/2î	4
E	DO-1000A Side Liner Bricks	18
F	DO-1000A Burner Brick	1
G	1î Ceramic Fiber Blanket (under top ring)	1
H	1î Ceramic Fiber Blanket (crucible seal)	1
I	Top Insulation Ring	1
J1	Exhaust Liner Top Brick (cast)	1
J2	Exhaust Liner Bottom Brick (cast)	2
K	Drain Brick	1

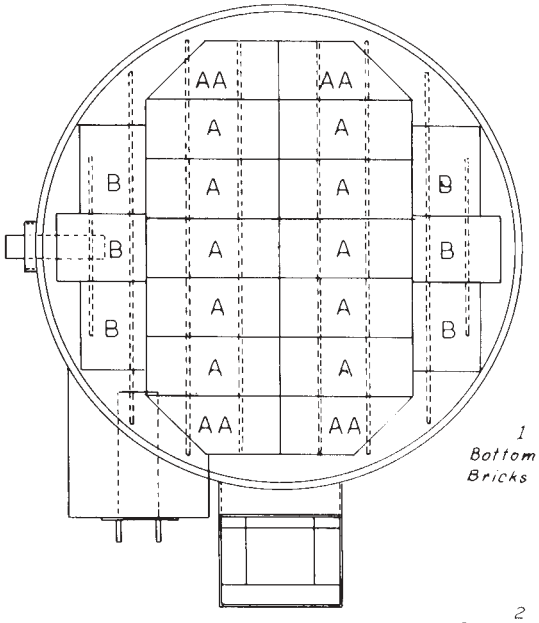


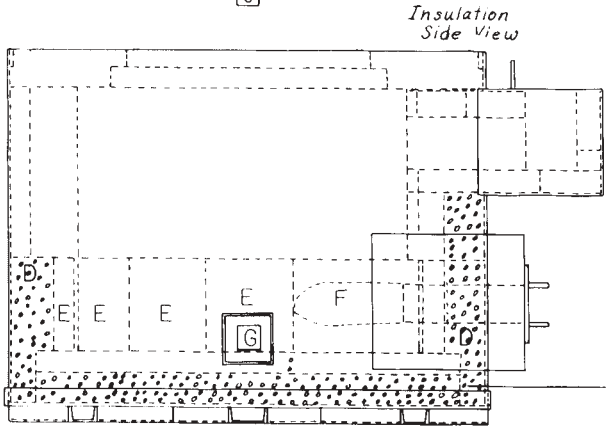


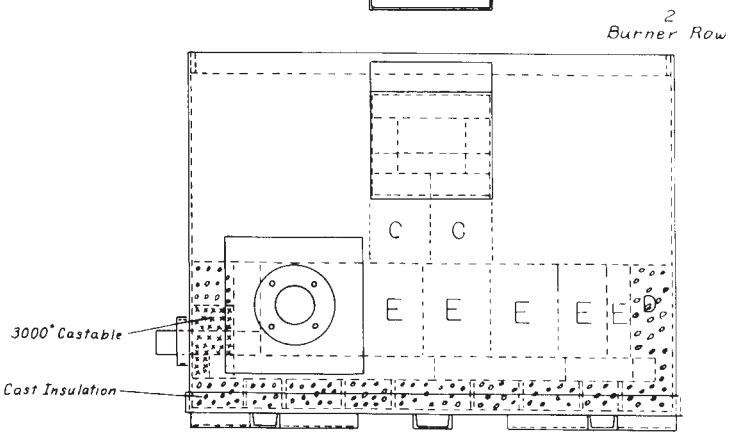
J1 J2





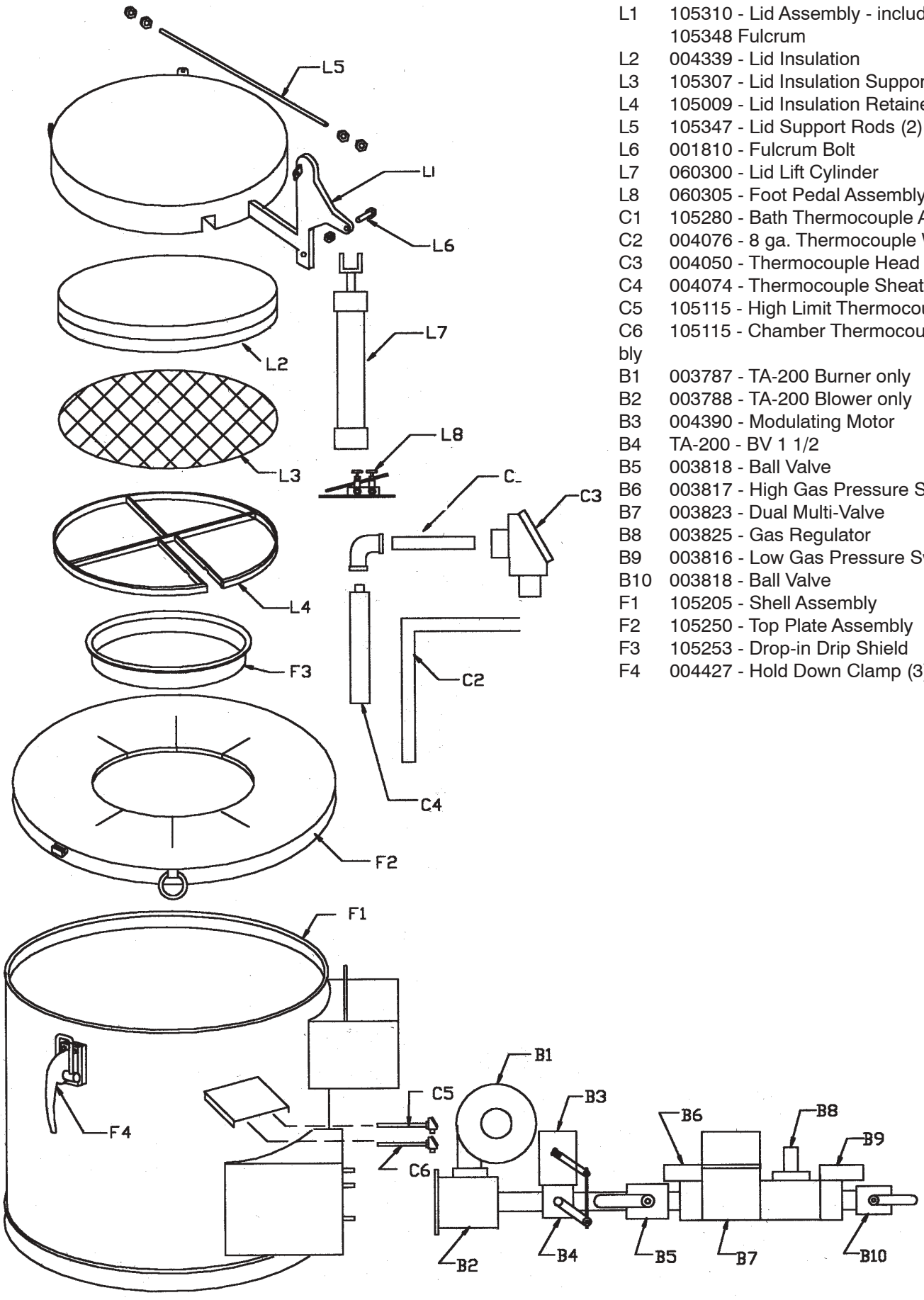






DO-1000A Melter Parts List

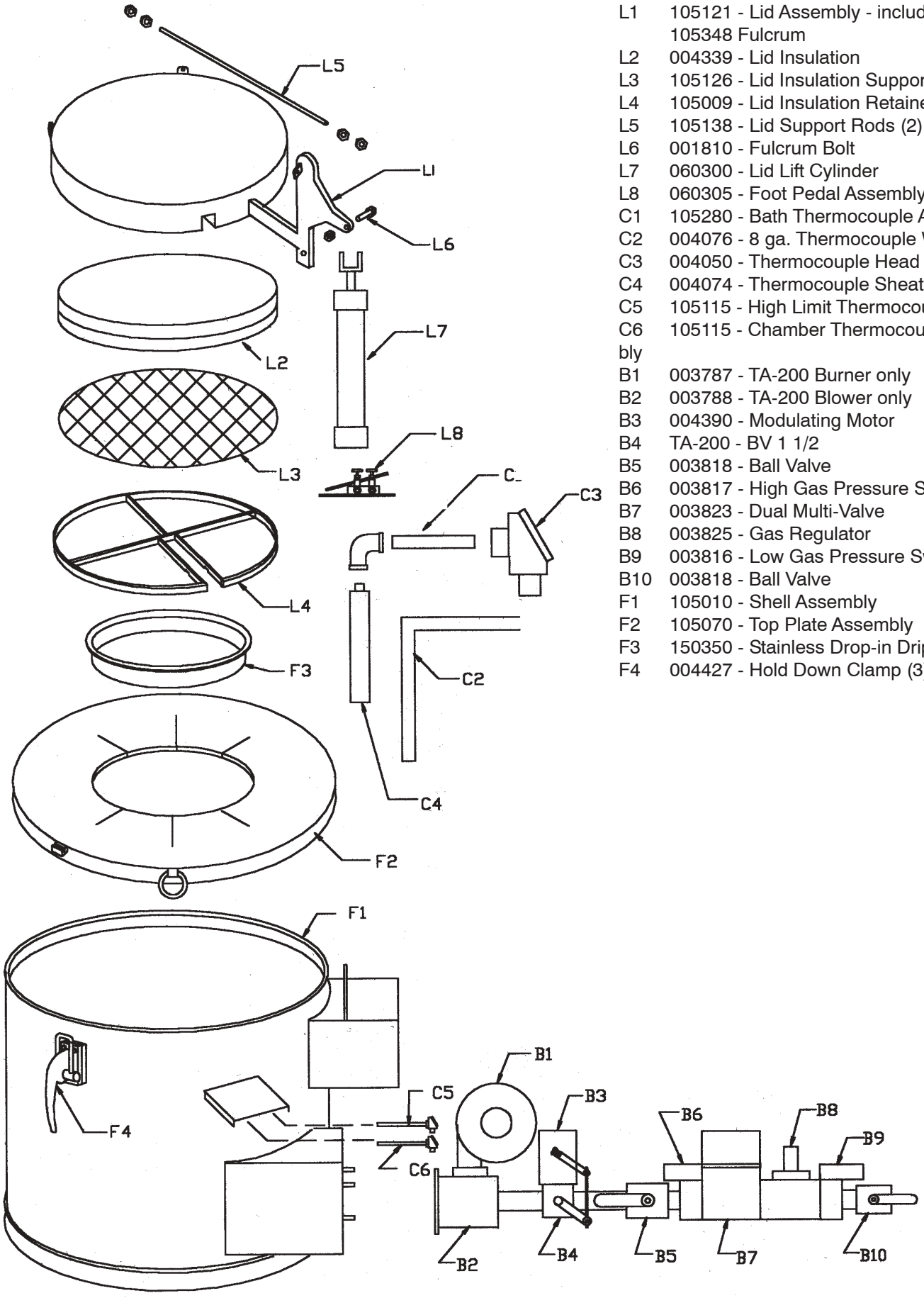
(Some units may not have all parts.)



L1	105310 - Lid Assembly - includes 105348 Fulcrum
L2	004339 - Lid Insulation
L3	105307 - Lid Insulation Support
L4	105009 - Lid Insulation Retainer
L5	105347 - Lid Support Rods (2)
L6	001810 - Fulcrum Bolt
L7	060300 - Lid Lift Cylinder
L8	060305 - Foot Pedal Assembly
C1	105280 - Bath Thermocouple Assembly
C2	004076 - 8 ga. Thermocouple Wire
C3	004050 - Thermocouple Head
C4	004074 - Thermocouple Sheath
C5	105115 - High Limit Thermocouple Assm.
C6	105115 - Chamber Thermocouple Assembly
B1	003787 - TA-200 Burner only
B2	003788 - TA-200 Blower only
B3	004390 - Modulating Motor
B4	TA-200 - BV 1 1/2
B5	003818 - Ball Valve
B6	003817 - High Gas Pressure Switch
B7	003823 - Dual Multi-Valve
B8	003825 - Gas Regulator
B9	003816 - Low Gas Pressure Switch
B10	003818 - Ball Valve
F1	105205 - Shell Assembly
F2	105250 - Top Plate Assembly
F3	105253 - Drop-in Drip Shield
F4	004427 - Hold Down Clamp (3)

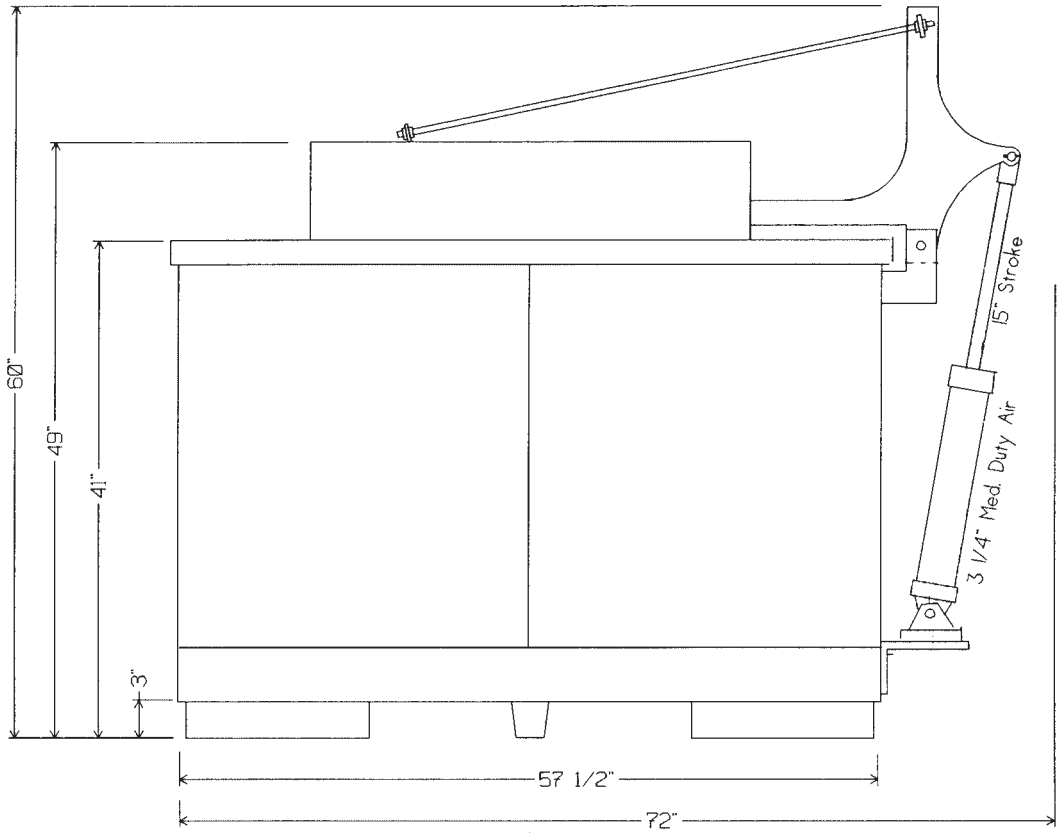
DO-600A Melter Parts List

(Some units may not have all parts.)



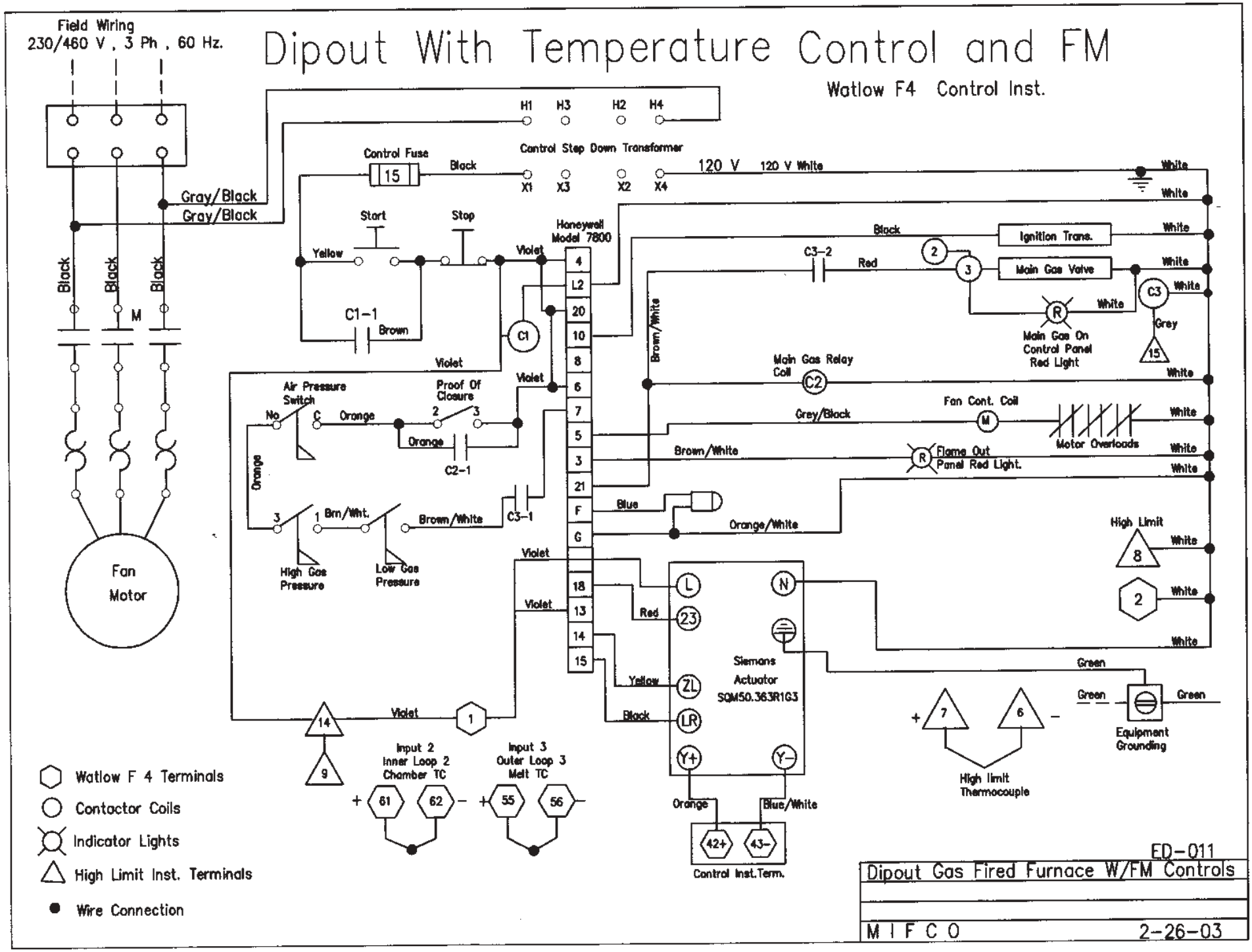
L1 105121 - Lid Assembly - includes 105348 Fulcrum
L2 004339 - Lid Insulation
L3 105126 - Lid Insulation Support
L4 105009 - Lid Insulation Retainer
L5 105138 - Lid Support Rods (2)
L6 001810 - Fulcrum Bolt
L7 060300 - Lid Lift Cylinder
L8 060305 - Foot Pedal Assembly
C1 105280 - Bath Thermocouple Assembly
C2 004076 - 8 ga. Thermocouple Wire
C3 004050 - Thermocouple Head
C4 004074 - Thermocouple Sheath
C5 105115 - High Limit Thermocouple Assm.
C6 105115 - Chamber Thermocouple Assembly
B1 003787 - TA-200 Burner only
B2 003788 - TA-200 Blower only
B3 004390 - Modulating Motor
B4 TA-200 - BV 1 1/2
B5 003818 - Ball Valve
B6 003817 - High Gas Pressure Switch
B7 003823 - Dual Multi-Valve
B8 003825 - Gas Regulator
B9 003816 - Low Gas Pressure Switch
B10 003818 - Ball Valve
F1 105010 - Shell Assembly
F2 105070 - Top Plate Assembly
F3 150350 - Stainless Drop-in Drip Shield
F4 004427 - Hold Down Clamp (3)

Pnuematic Lid Lift for Dip-Out Furnaces



Parts List

Hydraulic Cylinder - Parker #3.25CBB2MAU14AC x 15.00
Rod Clevis - Parker #50942
Mounting Plate - Parker #69196
Pivot Pin - Parker #68639
Cushions on both ends.
Nongren Foot Pedal - K18EA00-KC0-KT2


Field Wiring
230/460 V . 3 Ph . 60 Hz.
Dipout With Temperature Control and FM
Watlow F4 Control Inst.
H1 H3 H2 H4
Control Fuse
15
Black
Control Step Down Transformer
X1 X3 X2 X4
120 V
120 V White
Gray/Black
Gray/Black
Start
Stop
Yellow
Violet
Honeywell Model 7800
4
L2
20
10
8
6
7
5
3
21
F
G
18
13
14
15
C1-1
Brown
C1
Violet
Air Pressure Switch
No
C
Orange
Proof Of Closure
2
3
Orange
C2-1
Orange
3
1
Brn/Wht.
Brown/White
C3-1
High Gas Pressure
Low Gas Pressure
Violet
Violet
Violet
14
9
1
Input 2
Inner Loop 2
Chamber TC
61
62
Input 3
Outer Loop 3
Melt TC
55
56
Black
Black
Black
M
Fan Motor
Black
Ignition Trans.
White
C3-2
Red
2
3
Main Gas Valve
White
C3
White
R
Main Gas On Control Panel Red Light
White
Grey
15
Brown/White
Main Gas Relay Coil
C2
White
Grey/Black
Fan Cont. Coil
M
White
Motor Overloads
Brown/White
R
Flame Out Panel Red Light.
White
White
Blue
Orange/White
High Limit
White
8
2
White
White
Red
L
23
Yellow
ZL
Black
LR
Y+
Y-
N
Siemans Actuator SQM50.363R1G3
Green
Green
Green
Equipment Grounding
+
7
6
-
High limit Thermocouple
Orange
Blue/White
42+
43-
Control Inst.Term.
Watlow F 4 Terminals
Contactor Coils
Indicator Lights
High Limit Inst. Terminals
Wire Connection
ED-011
Dipout Gas Fired Furnace W/FM Controls
MIFCO
2-26-03

Maintenance & Troubleshooting 5

INTRODUCTION

This chapter is divided into two sections:

- Maintenance procedures
- Troubleshooting guide

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

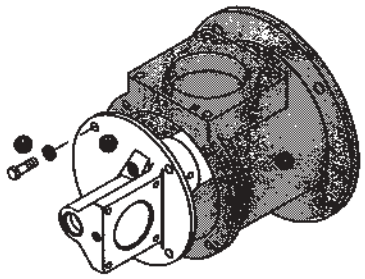
MAINTENANCE

Note:
These are guidelines only. The customer should make the final determination on maintenance intervals and tasks to be performed while considering the working environment.

Monthly Checklist

1. Inspect the flame sensing devices for good condition and cleanliness.
2. Check for proper air/gas pressures (Refer to the ThermAir Data Sheets, Series 114).
3. Test all the system alarms for proper response signals.
4. Check and clean igniter electrodes.
5. Check valve motors and control valves for free, smooth action and adjustment.
6. Check for the proper operation of ventilating equipment.
7. Test the interlock sequence on all safety equipment. Manually force each interlock to intentionally fail while at the same time noting if related equipment closes or stops as specified by the manufacturer. Test the flame safeguard by manually shutting off the gas to the burner.
8. Test the manual gas shut off cocks for proper operation.
9. Clean and/or replace the combustion air blower filter.
10. Inspect and clean the combustion air blower rotor.

Yearly Checklist



1. Leak test the safety shut-off valves for tightness of closure.
2. Test the pressure switch settings by checking the switch movements against pressure settings and comparing these with the actual impulse pressure.
3. Visually check igniter cable and connectors.
4. Remove, clean, and inspect all burners.
5. Be sure the following components are not damaged or distorted:
   - the burner nozzle.
   - the igniter.
   - the flame sensors.
   - the combustion tube.

The nozzle and combustion tube can be inspected without removing the burner from the chamber wall or entering the chamber. Perform the following:

a. Shut the burner off and manually close the main gas shut off cocks.

b. Allow the chamber temperature to cool down to 250°F (121°C).

c. Disconnect the gas piping at a union or the gas inlet flange provided on the burner.

d. Remove the four bolts ●.

e. Remove the rear cover ● from the burner housing ●.

f. To re-assemble, follow this sequence in the reverse order.

PROBLEM	POSSIBLE CAUSE	SOLUTION
Start-up sequence runs but burner does not light.	No ignition: • Attempting to ignite at inputs greater than 40%.	Reduce start point gas flow. Verify control circuit.
	No ignition: • Weak or non-existent spark.	Verify ignition transformer is a 6,000 - 8,000 volt transformer. (Not half-wave)
	No ignition: • There is no power to the ignition transformer.	Restore the power to the ignition transformer.
	No ignition: • Open circuit between the ignition transformer and the igniter.	Repair or replace the wiring to the igniter.
	No ignition: • The igniter needs cleaning.	Clean the igniter.
	No ignition: • The igniter is not correctly grounded to the burner.	Clean the threads on the igniter and the burner. NOTE: Do not apply grease to the threads on the igniter.
	No ignition: • Igniter insulator is broken. Igniter is grounding out.	Inspect the igniter. Replace if broken.
	Not enough gas: • The gas flow into the burner is too low.	Check the start-up settings. Adjust low fire gas setting if necessary.
	Not enough gas: • If equipped with ratio regulator, loading line may not be attached	Reconnect loading line and verify loading pressure.
	Not enough gas: • The bypass valve is not open far enough.	Adjust bypass gas flow.
	Not enough gas: • Start gas solenoid valve does not open.	Check the solenoid valve coil for proper operation. Replace it if necessary.
	Not enough gas: • Gas valve does not open.	Check the wiring to the automatic gas shut-off valve. Check the output from the flame safeguard. Open manual gas cock.

PROBLEM	POSSIBLE CAUSE	SOLUTION
Start-up sequence runs but burner does not light. *(continued)*	No flame signal: • Broken flamerod • Dirty UV scanner lens	Inspect and clean sensor Replace if necessary
	No flame signal: • Flamerod grounding out	Verify that the flamerod is installed correctly and is the correct length.
	Too much gas: • Wrong or missing burner fuel orifice.	Check ThermAir Data Sheets, Series 114 for fuel orifice and the given fuel.
The low fire flame is weak or unstable.	• Not enough gas flowing to the burner.	Adjust the gas control valve to increase the gas flow.
	• Not enough air.	Check for proper blower rotation. Check air filter for blockage.
The burner goes out when it cycles to high fire.	• Too much gas to the burner.	Verify gas orifice size for your fuel (ref. Data Sheets 114). Verify chamber pressure for proper air flow effect. Check the start-up settings. Measure the gas pressures and adjust them where necessary. Check for valve train pressure loss.
	• Loading line to the ratio regulator (if installed) is leaking.	Repair the leak in the loading line.
The burner is erratic and does not respond to adjustment.	Internal damage to the burner: • Some parts inside the burner are loose, dirty, or burned out.	Contact your Eclipse representative or Eclipse Combustion for further information.
The burner is unstable or produces soot or smoke.	• The air/gas ratio is out of adjustment.	Measure all the gas pressures and air pressures. Compare these pressures to the documented initial start-up settings and adjust them where necessary.
The burner cannot achieve full capacity.	• Air filter is blocked. (When equipped with Ratio Regulator)	Clean or replace the air filter.
	• Gas pressure going into the burner is too low.	Adjust the gas pressure.
	• Combustion chamber pressure is too high.	Derate burner for positive pressure installations.

PROBLEM	POSSIBLE CAUSE	SOLUTION
Cannot initiate a start sequence.	• Air pressure switch has not made contact.	Check air pressure switch adjustment. Check air filter. Check blower rotation. Check outlet pressure from blower.
	• High gas pressure switch has activated. • Low gas pressure switch has activated.	Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operation.
	• Malfunction of the flame safeguard system (e.g., shorted-out flame sensor or electrical noise in the sensor line). • No power to the control unit.	Have a qualified electrician troubleshoot and correct the problem.
	• Main power is off.	Be sure the main power to the system is switched to the "on" position.