MIFCO

McEnglevan Industrial Furnace Company, Inc.

Dear MIFCO Customer:

We would like to thank and congratulate you on the purchase of a 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 the 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 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 so that you will receive optimum results in its operation and use.

Sincerely yours,

Matt Walter

Matt Walter
CEO

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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. Use the above Electrical Service Specifications as your guide in selecting the correct schematic drawing.

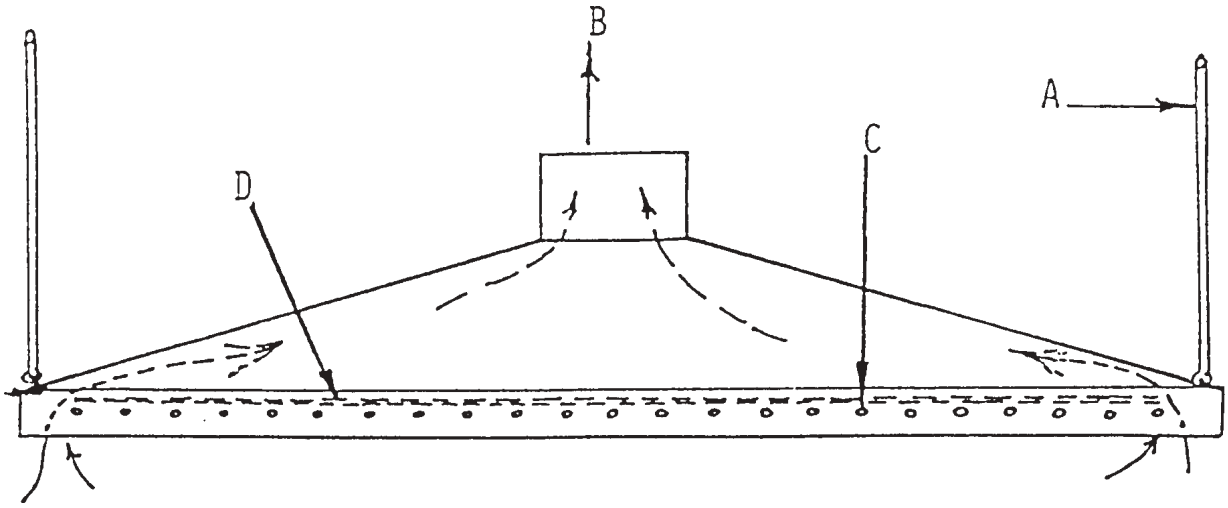
LOCATION OF FURNACE:

Locate furnace and casting area at least four feet from the wall, across the room from windows or ventilation openings. Such openings should face to the direction of the prevailing wind. As fresh air is drawn in through the ventilation openings or windows, it will sweep across the shop floor and over the casting and furnace area. It will then be drawn out with the fumes and heat through the hoods and exhaust system. NEVER LOCATE A FURNACE WHERE WORKING ROOM IS RESTRICTED OR THE AREA IS HARD TO VENTILATE PROPERLY. A ìHOT CORNERî is both dangerous and uncomfortable.

VENTILATION AND HOODS:

For ideal working conditions, it is advisable to install a hood or hoods over the entire hot work area. This includes the heat treating furnaces, melting, molding, pouring, forging and welding area. Individual hoods can be manifolded to a main exhaust system, or one main hood can cover the entire area, depending on the size of the installation.

For adequate ventilation, we suggest the exhaust system should be designed to change the total volume of air in the shop at least twenty times per hour, or the total volume of air direcfy beneath the hood at least twice every minute. For furnaces with BTU ratings in excess of 150,000 BTU per hour, we suggest the hood area should be a minimum of forty-eight square feet. The National Ventilating Code, requires 250 lineal feet of air flow per minute, across the total face of the hood opening. LOCAL OR AREA CODES MAY VARY, SO IT IS ADVISABLE TO CHECK WITH LOCAL OR STATE AUTHORITIES ON FINAL DESIGN AND CAPACITY. A small hood, located and sized to remove only the products of combustion from the fumace, is not adequate.



A. Rigid Hood Support Rods - 3/8î Round
B. Hood Exhaust Opening to Exhaust Fan
C. Inner Baffle Support Cross Rods - 3/8î Round
D. Galvanized 26 Gauge Sheet Baffle

Removal of the products of combustion from the shop area is vital, BUT OF EQUAL IMPORTANCE IS THE REMOVAL OF THE FUMES AND SMOKE FORMED WHEN THE HOT METAL IS POURED INTO THE SAND MOLDS. The size of the hood should be large enough to extend over all parts of the casting area to pick up casting fumes. An alternate system is to have a casting or pouring area hooded and ventilated separately from, and in addition to, the hoods for the fumace and melting area.

A hood large enough to cover both the melting and casting areas may be too large for the capacity of the blower selected for the ventilating system. This may be corrected by baffling the center area of the hood with sheet metal so a slot with a minimum width of twelve inches around the outer edge of the hood forms the total hood opening. The smaller total hood opening area should carry the full capacity of the ventilation suction unit. By being a smaller total hood face area, there should be an increase in the air velocity or lineal flow to meet the minimum 250 lineal foot flow. SEE ILLUSTRATION ON PAGE THREE.

DO NOT CONNECT VENTILATING STACKS DIRECTLY TO THE EXHAUST PORT OF THE FURNACE. Furnaces capable of melting metals have an extremely high exhaust or flue gas temperature, and will cause rapid deterioration of the stack metal. By positioning the hood high enough above the melting station, the ventilating system draws additional air from the adjacent area, and will reduce the exhaust gas temperature to an acceptable, cooler level. We suggest that the hood should be suspended with rigid mounting and have at least eight feet clearance from the floor to the bottom of the hood. This will allow adequate head room for the operator to charge or draw the hot crucible from the fumace chamber, using standard crucible tongs.

INSTALLATION

GAS SERVICE LINE:

The gas connecting line should be one pipe size larger than the gas inlet size of the mixer. Main gas line shut off valves must be full flow design to insure maximum gas flow. Natural gas pressure should be at least four ounces at the gas shut off cock with the furnace operating at the maximum firing rate. Low gas pressure or inadequate volume will result in flame fluctuation, improper firing, and slow heating. The easier method of determining whether or not you have sufficient gas supply to operate the furnace correctly is to operate the furnace with the blower air adjusting valve completely open. At this setting, there should be excess gas available. If excess gas is not available, the utility company may be able to increase gas line pressure, and use a step down pressure regulator at the furnace gas solenoid valve. Maximum gas pressure allowable by the solenoid valve manufacturer is 2 Ibs. THE GAS COMPANY SHOULD BE CONSULTED FOR ADEQUATE PIPE SIZING ON INITIAL INSTALLATION, or where pressure drop is a problem.

FURNACE SET UP:

Set furnace in a permanent location and connect the motor blower gas-air mixer assembly to the furnace manifold by joining both halves of the pipe union. Connect the spark electrode and Ultra Violet scanner leads to the top left burner. Connect power leads per wiring schematic. Check air for correct rotation.

If the furnace is supplied with a hydraulic operated tilting system, bolt the hydraulic assembly to the rear lower side of the right furnace upright. Make hydraulic hose connections and electric power connections per appropriate schematic drawings, which are part of this manual.

Secure furnace base to floor using lag bolts through channel base lugs. Secure turbo blower to floor by similar method. Fill hydraulic system with **Quaker Quintolubric** fire resistant fluid, shipped with the furnace. Refer to Quaker Chemical bulletin contained within this manual for complete specification details and availability. The hydraulic system has heen filled and tested and should not have air in it in any great quantity. If there does seem to be any soft or spongy effect when it is operated, the hose fittings at four different points may be loosened.

With the pump ON and the control level pushed slightly in the UP position, loosen fittings No. 1 and 2 (refer to Page No 11) until the oil comes out freely. Again, with the pump ON and the control lever in the DOWN position, loosen fittings 3 and 4 until the oil flows freely. Should the pump not start delivering oil right away, it will be necessary to remove the hose at fitting No. 5 at the pump

outlet, to let the air out of the pump. Hold a gallon can in front of the fitting and jog the pump. **Be sure the pump is rotating in the direction of the arrow. Rotation can be determined by observing the rotation of the cooling fan on the back of the motor.** Raise and lower the furnace several times completely to get whatever air is left out of the system. Your hydraulic system is supplied with Quaker Chemicals Quintolubric #822-220 oil. Specifications on the oil are in a later chapter.

The lid lift is furnished with a bolt in the support arm which goes through the lid stop. This bolt must be in place before the furnace is tilted or the lid will fall out on the floor.

The time required to tilt or lower the furnace can be varied by adjusting the flow control needle valves - (refer to Page No. 11) located in the two hydraulic lines connected to the bottom section of the lever/cam operated directional control valve.

If the furnace is a manual nose pivot tilt model requiring a separate hoist to tilt the furnace, the hoist should have a minimum capacity equal to the shipping weight of the furnace. Use electric cable or chain hoists with the lowest rated feet of lift per minute for better control during tilting. Adjustable air hoists or manual chain hoists are satisfactory. The selection and installation of the manual tilting facilities is the responsibility of the purchaser. Attention should be directed to any safety codes or similar requirements at time of installation.

The center pivot tilting furnaces are designed with a worm and worm gear box unit. The hand wheel operated manual tilt design gives infinite control of the pouring rate of metal from the crucible. The electric operated tilt is available in 115/230 volt, single phase or 230/460 volt, three phase, electrical service.

POURING FLOOR:

It is a good practice to install the furnace on a ìpadî of tamped molding sand, clay, or loam, since molten metal or constant heat will damage a concrete floor. By extending the size of the pad into a pouring floor - a safe pouring area can be added to the casting area. A satisfactory pad can be made in the shop by welding a rectangular framework of angle iron. Size will depend on the room available and the instructor's preference, but the pad should be large enough for the fumace plus eight molds. The inner area is then piled and tamped with old molding sand or foundry clay. The pad should be at least two inches thick. Expanded metal, laid on the surface of the earthen pad will help prevent tracking earth or clay through the shop area.

PIT INSTALLATION:

The larger B-700 and B-1500 series furnaces are usually installed in a furnace pit to simplify handling the crucible of metal. Illustrations of the Speedy-Melt Model B-1500 illustrate such installation. Overall furnace dimensions are found in the Relining Section of this manual. Diagrams show both pit and surface installation. THE BLOWER, GAS/AIR MIXER, AND CONTROL SYSTEMS SHOULD ALWAYS BE LOCATED AT FLOOR LEVEL AND NEVER IN THE FURNACE PIT. The controls should be located in a safe, accessible location.

FURNACE OPERATION AND STARTUP:

Locate the crucible block in the center of the furnace chamber. ALWAYS use the correct size block and NEVER place the crucible on the floor of the furnace over the drain hole. Doing so causes a cold spot at the bottom of the crucible and retards melting. The block locates the crucible at the proper height for the hottest combustion and reflected heat. If the crucible sticks to the base block, apply fine graphite or silica flour to the top of the block, or wet a piece of corrugated cardboard and drop on the base block just before the crucible is set in place. If the furnace is cold, use the cardboard dry. The paper will char and form a parting layer between the block and the crucible. DO NOT CHARGE METAL THROUGH, OR OBSTRUCT THE LID EXHAUST HOLE IN ANY MANNER WHILE IN OPERATION. If the crucible breaks while in the furnace, the molten metal will flow out the drain at the bottom of the furnace.

A layer of high temperature refractory insulation is cast between the pre-burned brick lining and the steel furnace shell. This increases melting efficiency and holds heat loss through the fumace walls to a minimum. Since 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 excess moisture.

Instructions in the flyer USE AND CARE OF GRAPHITE 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.

NOTE OF CAUTION WHEN MELTING ALUMINUM:

Due to the high velocity of the flame and the light weight of molten aluminum, THE FURNACE SHOULD BE THROTTLED TO HALF FIRING RATE DURING THE LAST HALF OF THE MELTING CYCLE, or after the aluminum has reached the PLASTIC or MUSHY state. If the furnace is fired at maximum rate when the aluminum is molten and ready to pour, THE HIGH VELOCITY FLAME WILL PICK UP ALUMINUM PARTICLES FROM THE CRUCIBLE AND EXPEL THEM THROUGH THE TOP EXHAUST HOLE. This condition will not be experienced with heavier metals such as brass or gray iron.

At maximum firing rate, the Speedy Melt Series of furnaces are noisy. This is due to the high velocity flame and the amount of BTU's generated within the combustion chamber to obtain the rapid melting cycles. If the noise is objectionable, the furnace can be operated at a lower input rate with slightly slower melting cycles. However, for melting gray iron, the furnace must be fired at maximum input.

The exposed refractory should periodically be cleaned thoroughly and coated with a refractory sealer. A separate section called ìTHE CARE AND MAINTENANCE OF FURNACE LININGSî gives detailed instructions.

REFRACTORY MAINTENANCE:

All MIFCO 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 that fail during the final burning and are discarded. This assures controlled quality refractory for all MIFCO 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 LININGS:

The basic refractory used for our sealer is ground to a very fine powder. It is then mixed with a water soluble bonding agent which develops a mechanical bond to the refractory. When the furnace is fired to a high temperature, the bonding agent burns out and the refractory sealer forms a ceramic bond with the furnace lining. It is available in twenty pound bags and should be stored in a dry warm area. Prepare only the quantity to be used at one time for one application.

PLASTIC 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 consists of the same refractory as the sealer, except a coarser grain size is used. It is a medium grained, heat setting mix that should be thoroughly tempered with water before use. The material not used must be discarded. Mix with water only the amount needed each time.

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. Prepare the surface by priming with a saturated solution of sodium silicate. 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. This forms a strong bond between the refractory and patching plastic. Place a layer of patching plastic with a maximum thickness of 1/8" into the area being filled. The thin patch should be allowed to dry for one hour, then heat the area to a red temperature by using the furnace. When the furnace has cooled, add another thin layer, not exceeding 1/8" thickness over the original layer, using the above instructions for the second patch. Successive thin layers should be applied and burned, 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:

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. Allow the mixture to set overnight to completely dissolve the bonding agent.

Step 4. 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 pre-saturated 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 5. Allow the furnace to dry for a period of at least two hours.
Step 6. Light furnace and fire slowly for about five minutes, then shut furnace down. (THIS PROVIDES HEAT TO EXPEL MOISTURE FROM THE PATCHING PLASTIC.)
Step 7. Allow the furnace to dry an additional 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 while the furnace is cold, 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 of crucible can be used for melting aluminum, brass, or gray 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 gray iron is to be melted in appreciable quantity, a special clay lined silicon carbide crucible is recommended. DO NOT USE JUST ANY SIZE CRUCIBLE IN YOUR FURNACE, USE THE SIZE FOR WHICH THE FURNACE WAS DESIGNED.

RECEIVING AND STORAGE:

A great deal of stress 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. ìSOUNDî each crucible by tapping lightly with a hammer handle. If cracked, the crucible will have a dull sound. Undamaged crucibles will have a clear ring. 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 stock the crucibles in an exposed, unheated location, they should be moved to a warm area for two or three days prior to using. EXCESS 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, provided the crucibles are not subjected to a 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.

ANNEALING NEW CRUCIBLES:

All clay graphite crucibles should be properly annealed before being put into production. Annealing relieves all strains set up in the crucible during manufacture. This also DEVELOPS A FULL ELASTIC PROPERTY TO WITHSTAND THERMAL SHOCK during service. The crucible should be dried as outlined previously, and placed in a warm furnace.

Adjust the furnace burners at idle, or lowest heat input, for the first ten minutes. Increase burner setting gradually to raise furnace temperature to a red heat. Total heating cycle should cover a period of forty to forty-five minutes. After the crucible has reached a red heat, it can be removed from the furnace, charged with metal, and put into immediate service.

CHARGING THE CRUCIBLE WITH METAL:

Crucibles are usually charged with metal before they are placed in the furnace chamber. 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 the melting temperature is reached. These oxides and impurities are carried into the casting metal, resulting in porous and unsound castings. Heat is transmitted to the 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. This is 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 THE CRUCIBLE:

Heavy sections of the 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 THE 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 against the sides of the crucibles, 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 excess 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. INGOT CAN BE PLACED AROUND THE LID, WELL AWAY FROM THE EXHAUST PORT.

MELTING CAST GRAY IRON:

If cast iron ingot material is used, we suggest that you purchase a Class 25 or a Class 30 iron. This type of cast iron melts at a slightly lower temperature and has better fluididity than the higher class irons. If new ingot is not available, good cast iron scrap can be used. One type which has good casting features is the scrap cast iron in steam radiators. The original ingot used to produce this quality of casting had to have good casting characteristics and high fluidity. Otherwise, it would not produce the thin walled, steam tight castings required in steam systems.

Cast iron motor blocks and other machinery products should not be used as scrap for remelting in a gas fired crucible type furnace. The pouring temperature of alloyed scrap iron is usually 100 - 150∞ higher than the Class 25 or the Class 30 Iron. The higher temperature needed to melt this alloy is very detrimental to both crucibles and the furnace linings. Pieces of steel or malleable iron scrap should not be added to the crucible charge because they also raise the melting temperature of the iron. In addition to having less desirable casting properties and being harder to pour, the finished castings may be hard and very difficult to machine.

Standard clay graphite or silicon carbide crucibles can be used for melting gray iron, however, the clay or alumina lined silicon carbide crucible is more suitable. Molten iron has an extremely high affinity for carbon, and it will leach or absorb carbon from the inner wall of the crucible during the melt. This will erode the inner surface of the crucible and shorten crucible life. The alumina or clay lined crucible has an inner lining of alumina refractory, which acts as an inert barrier between the molten iron and the carbon in the crucible. The cost of the clay lined silicon carbide crucible is slightly higher than the standard silicon carbide crucible. Availability is the problem, so ample lead time must be considered when purchasing this type of crucible.

Graphitic Carbon should be added to the cast iron scrap when the crucible is filled, prior to setting in the furnace. Certain types of Graphitic Carbon are absorbed rapidly by the molten iron, so care must be taken in selection of the correct Graphitic Carbon Raiser. Approximately three percent, by weight, of Graphitic Carbon Raiser should be added with the charge metal. A suitable material is charcoal briquets, but they do not furnish the same form of carbon. It is not as readily absorbed by the iron as is the Graphitic type of carbon raiser. Approximately six charcoal briquettes should be added to a #30 size crucible and it should be mixed with the scrap iron. This crucible will hold about 75 lbs. of iron. When charging the crucible with iron, thin sections should be added along with heavier pieces and the ingot. The thin sections will melt rapidly and form a molten puddle, which will transfer heat to the heavier sections more rapidly and reduce the over-all melting time. Additional scrap can be added to the crucible as the charge melts down. The Graphitic Carbon will generate additional heat as it burns, but more important, it will protect the molten metal from oxidation during the melt and maintain the carbon content of the cast iron.

It is imperative that both students and operators use cobalt blue goggles when melting iron, to protect their vision from the high temperature radiation. They must check the melt periodically to determine the fluidity of the melt preparatory to pouring the mold. There is usually a heavy slag formation over the surface of the melt so a rod should be used to penetrate the heavy slag to check the fluidity of the molten bath. DO NOT USE A LANCE PYROMETER WITH THERMOCOUPLE TO CHECK THE TEMPERATURE. THE MOLTEN IRON WILL MELT THE TIP OF THE LANCE.

An optical pyrometer or a replaceable thermocouple tip, lance type pyrometer should be used to check the temperature of the molten iron. The replaceable tip pyrometer is equipped with a socket type receptacle to which the thermocouple tip is attached. The thermocouple tip, when immersed in molten iron, will resist melting and destruction long enough to get a high temperature reading. A NEW TIP MUST BE USED FOR EACH TEMPERATURE READING. This equipment is quite expensive to purchase, and to maintain, except in industrial use.

After the melt has attained the proper temperature and fluidity, remove it from the furnace, then add a cast iron flux material to the crucible. This will change the plastic condition of the slag and make it easier to skim. After the molten iron has been skimmed, it is advisable to add ferro-silicon shot to replace the silicon lost during the melt. Ferro-silicon is usually wrapped in a paper envelope, and plunged beneath

Another important factor in pouring gray cast iron is to design the feeding system with larger runners, gates, and risers. The feeding system which would be used for aluminum or brass casings, will not permit a fast enough flow of molten iron into the mold cavity. The molten iron must be free to fill the mold cavity rapidly and completely. Risers will be used more frequently in iron castings than in either brass or aluminum, due to shrinkage normally found in iron solidification. We do not recommend pouring cast iron into petroleum bonded sand, due to the smoke and gas evolution. If petroleum bonded sand is used, the mold should be designed with additional venting. The smoke and gases formed when the hot metal contacts the petroleum bonded sand can then leave the mold cavity freely. It is also important to delay casting shake-out to be sure the hot casting has cooled sufficiently so the oil bonded sand does not ignite and burn.

The melting furnace should be adjusted so that the air valve is completely open, utilizing the total output of the blower. The gas valve is adjusted so there is a reducing or slightly gas-rich atmosphere in the melting chamber of the furnace. The different pouring temperatures for different classes of cast gray iron and temperatures for malleable irons and steels are as follows:

Metal	Melting Point	Pouring Temp.
Gray Iron Class 20	2150° F	2550° F
Gray Iron Class 25	2270° F	2625° F
Gray Iron Class 60	2370° F	2650° F
Malleable Iron*	2585° F	2800° F Avg.
Steel*	2700° F	2800° F Avg.

*Alloyed Gray Cast Iron, Malleable Iron, and Steel, should be melted in a Cupola or an Electric Induction or Arc Furnace.

The lower two classes of gray iron, #20 and #25, can be poured at lower temperatures, and are the most suitable for crucible melting. Cast Gray Iron alloyed with chromium or nickel, such as the grade used for gasoline engine blocks, transmission housings, etc., will have a casting temperature range which is slightly higher than the Class 60 Grey Iron. Such elevated temperatures are extremely detrimental to the furnace and crucible. These metals SHOULD NOT BE USED for crucible melting.

ACCESSORIES:

Correctly designed tongs and shanks should be used, both for safety and to minimize crucible failure. MIFCO Tongs and Shanks are designed especially for use with our furnaces.

The MIFCO Crucible Tong is designed and manufactured according to the recommendations of crucible manufacturers. Each gripper pad is die coined to uniform shape, and nests the crucible below the bilge diameter. Adjustable stops prevent excessive pressure being exerted on the crucible walls, thus avoiding crushing. All Tongs are equipped with a lifting eye and a safety bar lock.

The MIFCO Safety Shank was developed by our engineers at the request of School Shop Instructors and Educational Administrators. It is simple in design, easy to operate, and holds the crucible securely. This prevents accidental dropping and dumping a crucible of molten metal. The holding ring is die coined and formed to insure proper size and shape for secure seating of the crucible.

Automatic temperature control of our B, C, and small T series furnaces is not practical from a cost standpoint. These crucible furnaces are designed for fast melting and are fired with high input burners. Consequently, the furnace chamber develops a high thermal head that makes automatic control extremely difficult and cost prohibitive. Normal foundry practice is to use a portable lance pyrometer to check the furnace temperature periodically. When the metal approaches pouring temperature, the burners are throttled down, and the thermal head in the furnace finishes the heat. The crucible should be pulled, fluxed, and poured immediately.

the surface of the molten cast iron with a bell plunger. A stainless steel bell plunger is more satisfactory because of the high temperature. It is extremely important that the ferro-silicon is added just prior to the pour. Adding this alloy at an earlier time in the melt will retard or prevent carbon absorption. About one and one half percent, by weight, should be used for crucible melting.

As an added precaution against chill or hard spots in the gray iron casting, it is advisable to place an inoculating agent in the mold. One such agent is in the form of a small tablet called Inotab, and is made up of a compound which combines with the iron. It innoculates the iron to prevent the formation of chills and hard spots. The Inotab is placed in the sprue well of the mold prior to pouring. IT IS VITALLY IMPORTANT THAT THE MOLD BE POURED CONTINUOUSLY ONCE POURING HAS STARTED.

ULTRA VIOLET COMBUSTION SAFEGUARD WITH SPARK IGNITION

MIFCO COMBUSTION SAFEGUARD SYSTEM No. 4

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.)

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. 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 with a dual electric gas valve.

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.

SAFE STARTING:

1. Open the lid and swing away from the burner. (WARNING - DO NOT SWING THE HOT LID OVER BURNER EQUIPMENT.)
2. Open main gas line shut off cock leading to the furnace.

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. (If present.)

3. Once everything is checked out and is in proper position, the Control Module powers the blower and the system then goes through a 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 Manual Control or the Temperature Control Instrument.

SHUT DOWN FOR POURING OR TEMPERATURE CHECK:

Idle furnace down to low fire by holding burner control switch to low fire position, then press the stop button. This closes the gas solenoid shut off valve and stops the blower. To restart the furnace, press the start button and the furnace will re-ignite at the idle position.

SHUT DOWN TO SECURE FURNACE AT END OF MELTING PERIOD:

Press the stop button. Close the gas line shut off cock. Close the furnace cover.

RE-IGNITION AFTER FLAME FAILURE:

a. Press the stop button on the start-stop station.
b. Wait 50 to 60 seconds for safety timers to cool off.
c. Depress the RESET button on the flame supervision chassis.
d. Open the furnace cover. Repeat ignition steps 1 through 3.

SERVICING - TROUBLE SHOOTING:

Problems with MIFCO furnaces with Fireye Controls can be easily isolated by following the approved procedure in the sequence given below. Before starting any trouble shooting, however, make sure of the following:

1. Installation and wiring has been made in accordance with the manufacturerís instructions.
2. The Fireye Chassis is securely plugged in and the top and bottom retaining screws are tightened. The Lockout Switch (red pushbutton) is reset.

In the following list, problems are listed first, and the possible causes are listed below in numerical order. Refer to the manufacturerís instruction manual included in this operating manual for proper component and contact identification. It is necessary to have a 20,000 ohm, DC volt meter to perform signal testing. This meter, set on 150 volt AC scale, may be used to check line and load voltages at the identified terminal studs on the components.

A. FURNACE WILL NOT START:

1. No voltage at start button or at UV terminals S1 and S2:
    a. Power cord not plugged into outlet.
    b. No power at outlet, (check with meter).
    c. Disconnect switch is off that feeds outlet.

A. FURNACE WILL NOT START: - (cont.)

d. Broken wire between outlet and control box.
e. Blown fuse that feeds circuit breaker.
f. Check the 2 amp control fuse.

2. Insufficient voltage at UV terminals S1 and S2:
   a. Minimum voltage is 102 volt - 50/60 cycle.
   b. Maximum voltage is 132 volt - 50/60 cycle.

3. No voltage to coil of motor starting relay R-1:
   a. With volt-meter, check wires to relay coil from start / stop buttons.

4. Unit not properly grounded.

B. MOTOR STARTING AND HOLDING RELAY WILL NOT OPERATE:

1. No action when start button is activated:
   a. Check for voltage on either side of start button. If there is no voltage, replace the bad switch.
   b. Check relay coil, gray wire, for voltage.

C. HOLDING RELAY WORKS BUT MOTOR DOES NOT RUN:

1. Check motor overload:
   a. Check with voltmeter to see if power is passing through to motor. Check from ground to overload.
   b. Push the reset button on the motor overload.
   c. Check the heater element on the top of the motor overload to see if it is burnt in half.
   d. Examine relay contacts.

D. THE MOTOR RUNS, BUT THE SPARK DOES NOT COME ON:

1. Check the spark plug for power:
   a. Remove the spark plug cap. Hold this cap by the outside corner and hold the cap up to a metal part of the furnace and push the start button to see if there is a spark at the cap.

2. Check the air pressure switch:
   a. Remove the junction box cover on the top of the air pressure switch (004226). Place both wires inside on the same terminal, this will by-pass the switch. If you get a spark when you press the start button, you know the switch is bad.
   b. With the air switch by-passed and the motor running, check UV terminals 2 & 4 for line voltage, 120V. If no voltage is present, replace UV chassis.

3. Check the spark plug:
   a. Pull off the spark wire and hold by the outside corner of the connector cap. Hold the metal part of the cap close to the burner and press the start button. If it sparks, the transformer is OK. If not, check the spark wire connections on both ends and try again. If there is still no spark and there is 120 volts-on terminals 2 & 4, then you should replace the spark transformer.

4. The spark plug does not fire:
   a. Remove the plug and look for cracks in the porcelain insulator. If it is cracked, replace with the same electrode.

4. (cont.)
   b. If the plug is not cracked, install it back in the furnace. The gap between the wire tip of the plug and the end of the burner nozzle should be 1/16" to 1/8". This can be adjusted by bending the electrode wire, swiveling the electrode, and then tightening the clamping nut to hold it in place. Observation can be made with a mirror inside the furnace or through the UV Scanner observation port. In either case, **BE SURE THE GAS IS OFF**.

E. THE MOTOR RUNS, THERE IS A SPARK, BUT NO GAS:

1. Scanner does not see spark:
   a. Remove the scanner to see if the sight tube is blocked.
   b. Wipe off scanner bulb with soft cloth or tissue and replace.

2. Broken Scanner wire:
   a. Check for cuts or mashed conduit.

3. Ignition signal testing using a 20,000 ohm per volt DC volt meter:
   a. Connect the meter to terminals S1 & S2.
   b. Set the volt meter on the 10 volt DC scale and initiate a normal start up, but with the gas valve CLOSED. The meter should read between 41/2 and 5 volts. If the-meter goes backwards, reverse the leads. If the reading is less than 41/2 volts, the scanner needs to be replaced.

F. GAS SOLENOID WILL NOT OPEN:

1. After checking all of the above, check terminals 2 & 3 on UV Chassis for line voltage:
   a. Put the volt meter back on the AC-250 volt scale and put the leads on terminals 2 & 3. Start the furnace, and when the unit goes to Main Flame, terminal 3 should be energized, reading 120 volts. If it is not, and every thing else proves out, the chances are that the UV Chassis is bad and needs replacing.

2. Terminal 3 is powered but the solenoid still will not open:
   a. Check for broken wires or loose connections.
   b. The solenoid wires can be taken loose by a qualified electrician and powered with 120 volts to see if it will open. If it does not open, it will have to be replaced.
   c. Check to see that the gas pressure is not higher than the rating on the valve nameplate.

G. MAIN FLAME SIGNAL TESTING:

1. Same procedure as STEP îEî - ì3î.

H. MAIN FLAME DOES NOT LIGHT:

1. Gas valve shutoff someplace in building.

I. MAIN FLAME LIGHTS AND GOES OUT AFTER 10 SECONDS:

1. Flame not adjusted properly:
   a. It is best to get the furnace flame at least half way open before the spark goes off, especially on a cold start up.

J. FURNACE SHUTS DOWN WHEN IT IS ADJUSTED TO MAXIMUM FIRE:

1. Insufficient gas supply:
   a. Excess of air extinguishes the flame. Have the gas utility company check the gas pressure with the furnace running. If the pressure drops to ì0î, the gas supply is inadequate.
   b. Not enough gas in adjustment, the flame should come out of the exhaust port about 3 inches.

2. Too much gas:
   a. The flame is burning away from the burner port. The UV Scanner cannot see flame and turns off gas.

K. SLOW MELTING:

1. Insufficient gas supply:
   a. The operator should be able to open the air valve all the way and still have an excess of gas after the flame has been balanced.

2. Low service line voltage:
   a. The voltage on the service line should be 115 volts. Low voltage causes the rpm of the motor to drop, which results in a reduced volume of air.
   b. Bad bearings will also slow down a motor.

L. FURNACE WILL NOT RESTART AFTER STOPPING:

1. Gas valve was shut off before stop button was pressed:
   a. The reset has kicked out. Push the Reset Button on the UV Chassis and then restart.

2. UV Chassis may be going out.

3. Gas supply marginal and / or fluctuates:
   a. When starting with the valves in a set position and the gas supply or pressure changes, like when a boiler comes on, the valve setting would not be right and the unit would not start.

M. FURNACE WILL NOT START AFTER FLAME FAILURE:

1. Not enough time has elapsed for blower to stop spinning and allow the air switch to reset:
   a. Allow blower to stop spinning then press reset button on UV Chassis.

2. Bad UV Chassis.

3. Bad UV Scanner.
   a. Check and replace if necessary.

N. ELECTRICAL SEQUENCE:

1. Press the start button and the system performs- self check.
2. Holding coil pulls in and motor starts.
3. Air switch closes powering terminal 6 in UV Chassis.
4. Terminals 4 and 3 powered. Ignition transformer powered and ignition timing starts. Main gas solenoid powered.

N. ELECTRICAL SEQUENCE - (cont.):

5. Gas in scanner ionized, allowing power to flow between electrodes.
6. Main flame is proven and stays on.
7. Flame failure for any reason cuts off power to terminal 4 and 3 in 3 seconds.
8. Alarm light comes on.
9. Push reset button.
10. Blower failure, air switch opens - cutting power to gas solenoid. Blower runs another 10 seconds and turns off.

Preventive Maintenance
For Model T-200 Tilting Furnace

Electrical System

Always check start stop buttons, to make sure they remain tight in the control box. Loose buttons can cause the wire connectors inside to pull away from the buttons, thus causing a short or other failures.

Make sure that the UV cover is always in position. If the cover were missing this could allow for bumping of the spark wire and possible disconnection of the wire, and also damage to the scanner cable.

Make monthly checks of the spark wire to make sure that the angle connector is tight on the wire, and also pushed up tight on the electrode. At the same time, remove the scanner from the swaged nipple and clean the glass globe with a clean cloth.

It is also a good idea to make frequent checks of the flexible conduit cables going to the hydraulic pump motor, to make sure that the cables are not loose from their connectors and falling down and exposing the inner wires.

Lid & Lid Lift Assembly

The jack tube assembly should be greased at least once a month. This will allow for the easy rotation of the assembly. Make sure that when the lid is raised, that it raises level. After a period of time, the lid will have a tendency to raise in the back before it raises in the front. If the lid isnít raising level, simply loosen the lock nuts on the lifting rods and back them off just a couple turns, then tighten the bottom nuts which will raise the lid up. Continue to tighten the nuts until the lid raises properly. Always remember to remove the lid handle from the fulcrum rod after the furnace has ignited and the lid is closed. On this specific unit, always make sure that the lid is bolted to the lid stop, to prevent lid from shifting when tilted. Place the lid handle in the brackets on the stand. This way you will always be able to find the handle.

Furnace Shell & Stand Assembly

Make it a practice to always check the furnace for what we call hot spots. Be mainly concerned with the area around the burner guide tube. You will notice discoloration of the paint in this area, but only be alarmed if you should see a red glow to the shell. This may indicate that the end has burned off the burner nozzle, allowing the flame to direct itself back into the insulation and thus causing damage to the shell. If you should notice this, shut the furnace down at once. Your first step would be to loosen the union on the manifold pipe and pull it away from the furnace body. Since this is a four burner furnace, you will be pulling away two burner ports at one time. If you should find the ends of the burner nozzles are burnt away, this is the time to replace all of the nozzles. It would be advisable to keep a set of four on the shelf for future use.

Another item to check frequently is the spring pin, located on the 1î round pin that goes through the clevis on our cylinders. If this pin is missing , there is a very good possibility that the pin could back its self out of the clevis with continuous lifting, and be the cause of the furnace body falling down, when lifting upward.

It is good practice to make sure that the bearings on the stand are greased at the swivel point. These bearings sustain a lot of pressure when the furnace is up in the air. Never let the bearings become dry, as it would be a major operation to have to change those bearings.

Firing Chamber

Make regular checks for cracks in the liner bricks, and also for loose mortar between the rows of brick. If there are open gaps between the brick, the flame can penetrate and erode the insulation, thus causing hot spots on the side of your furnace shell. At least once a month, take a putty knife and scrape the loose refractory, allowing it to fall to the bottom of the chamber. Then remove with a vacuum. After the removal of the loose materials, find an old paint brush and a can of water, and brush a liberal coat of water on your bricks to allow your new application of sealer to adhere to the bricks. **Keep in mind that thin applications of sealer is better than one heavy coat,** a thick coat of sealer will flake off and fall to the bottom of the chamber, as soon as the furnace is fired. It is best to fill all large openings with thick material, then thin your sealer down and apply at least three very thin coats with a low firing between each application.

When firing your furnace, always make sure that the drain plug brick is in position in the front of the furnace. If this brick is not in its proper place, the flame will exit through the hole, thus causing the insulation behind the inner liner to deteriorate. Check frequently to see that the brick is loose, and can be removed without a problem. This is your escape route for liquid metal in case a crucible should break.

Another area to watch is the bottom of the chamber, where we have the indentation for the base block. Do not allow liquid metal to build up in this area, as it will not allow the base block to remain within the indentation. The purpose of this indentation is to help hold the base block in place when the furnace is tilted. If this area is full of hardened metal the base block will seat above the metal and possibly slide forward when the furnace is tilted, and block the drain hole.

We suggest that you keep close watch on the length of your crucible support bricks, as with continuous use, the bricks will wear. We want the crucible to remain as close to the center of the chamber as possible. This will allow for even flame flow all around the crucible. We advise you to have a spare set of crucible support bricks, as well as a drain plug in stock at all times. If the crucible is allowed to fall close to the front wall of the furnace when tilted upward, this will block the continuous flame flow around the crucible.

We feel that by following these simple suggestions that this will add years of life to your unit. Continued maintenance is the key to a longer operational life of the furnace.

Hydraulic Cylinders, Hoses & Filters

Make it a practice to frequently check the floor area around your hydraulic hoses. It you notice oil on the floor, this usually means that there is a pin hole leak in a hose, or there could be oil leaking from the fittings. Also watch for ballooned areas in your hoses, that means there is a weak spot in the hose that will blow out sooner or later. If you see such an area, we advise you to change the hose as soon as possible prior to it blowing out. The hoses will develop weak areas over a period of time. Be aware of oil on the floor in the area of your oil filters. This usually means that your canister seal has gone bad. We suggest that you keep at least one of each of your oil filters on your shelf at all times. Delivery on those spare parts at times can be very lengthy. Watch for oil leaking from your hydraulic cylinders, this usually means that there is a problem with O rings within the cylinder. Those items can be replaced by following simple instructions that come with the replacement rings.

We feel that by following these few simple suggestions that you add years of life to your T-200 melter. Continued maintenance is the key to a longer operational life of the furnace.