INSTALLATION AND OPERATING INSTRUCTIONS

PV/T

VACUUM INDUCTION FURNACE

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SAFETY CONSIDERATIONS

This instruction manual is designed to aid you throughout the working life of the unit. How well it aids you depends on how thoroughly you read and make reference to it. Since the warranty does not cover damage resulting from abuse, or errors in installation, set-up, or operation, it is to your advantage to read this manual, in addition to all provided component manuals, as comprehensively as possible. Observe all Warnings and Cautions to minimize serious hazards involved. Carelessly or improperly operated equipment can cause serious injury or death to personnel and damage to the equipment and/or facilities.

This system is a complex piece of equipment composed of several different fully integrated mechanical, electrical, pneumatic, and vacuum systems. This system has its own unique requirements regarding power, gases, water, air, and vacuum services. Specific safeguards and safety features are engineered into the system. Do not defeat or override these safety devices in any way. PV/T Incorporated has no control over the use of the equipment and is not responsible for injury or damage resulting from its misuse.

The safety and emergency procedures in this manual are provided to help suitably trained users, and other qualified personnel, to install, operate, and service the unit safely. It is the responsibility of the user to maintain safe-operating conditions at all times. The consequences of unskilled, improper, or careless operation of the equipment can be serious, even deadly.

It is the sole responsibility of the user of the equipment to comply with all local, state, and federal safety requirements, laws, and regulations applicable to the system. The safe use and disposal of hazardous or potentially hazardous materials, of any kind, is the responsibility of the user.

All users of this system should be alert to several levels of hazard presented in this manual, identified as follows:

WARNING!

Warnings indicate situations where failure to observe instructions or procedures may cause injury or death to operating personnel.

CAUTION!

Cautions indicate situations where failure to observe instructions could result in significant damage to equipment and/or facilities.

SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedures. They are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

WARNING!

High voltage is used in this equipment, high enough to kill through electrical shock. Always break the primary circuit to the power supply before working on the system. Do not attempt to replace components or make adjustments on the unit with the high voltage turned on.

WARNING!

Do not service or adjust this equipment alone under any circumstance. Always have someone present who is capable of offering assistance and rendering aid.

WARNING!

Under no circumstance should personnel enter the vacuum chamber without first guarding against accidental entrapment inside the chamber (securing the door in the open position).

WARNING!

Do not use flammable or explosive liquids, solids, or gases, or any material with the potential to become flammable or explosive, in or around the equipment.

WARNING!

This vessel and its components are designed for vacuum and limited pressure service. It is not designed to be over-pressurized for testing or any other purpose. This could cause the vessel or its components to burst, possibly expelling sharp pieces at deadly speeds.

WARNING!

Water used to cool the system can reach scalding temperatures. Touching or rupturing the cooling system can cause serious burns.

CAUTION!

Alcohol, acetone, and other solvents degrade O-ring material, reducing its ability to hold a vacuum. Do not use any solvent on the O-rings. If it is necessary to clean an O-ring, wipe with a clean, lint free cloth, mild detergent and water, or a small amount of pump oil.

CAUTION!

USE ONLY DRY CHARGE MATERIAL. Trapped liquids will vaporize with explosive force in the melt and cause an eruption of molten metal.

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1. INTRODUCTION

1.1 GENERAL DESCRIPTION

The PV/T Incorporated vacuum induction furnace is intended for batch melting and casting of ferrous and non-ferrous alloys. The vacuum furnace is equipped with a tilting transite induction furnace and crucible.

The furnace vacuum chamber and accessories are designed for full vacuum operation and for inert gas operation up to an absolute pressure of one atmosphere.
The furnace arrangement is comprised of equipment and components summarized as follows:

- A furnace vacuum chamber that is a horizontal cylindrical chamber with a stainless steel type 304-L interior, carbon steel water cooling jackets, one full opening hinged door with o-ring groove seals and a clamp type door latch. The chamber interior is polished.
- The induction furnace and tilting mechanism is mounted on the door. When the door is hinged open, this arrangement provides ease of access to the crucible, and the optional mold heater or mold turntable.
- One stainless steel power port is provided in the chamber door for the induction melt coil.

Furnace Basic Configuration

- A Mechanical vacuum pump and pneumatic roughing valve.
- A hand operated chamber vent valve.
- A hand operated furnace tilt crank.
- A furnace control system enclosure with valve control
- A dial vacuum gauge
- Vacuum pump motor start\stop control with motor overload protection

Induction equipment, including:

- An Inductotherm Power-Trak VIP power supply that can be used for automatic or manual melting, including; a water cooled induction furnace coil assembly, water cooled power leads and a vacuum sealed dielectric power lead thru port cover.

Furnace Optional Configuration

- A two stage high speed pumping system with mechanical vacuum booster
- A High Vacuum Diffusion Pump with holding pump.
- Quick access filter box and a pump port screen.
- A digital vacuum gauge controller.
- A system graphic panel with lighted push-button controls.
- A PLC for safety interlocks, and control of the valves and pumping system.
- A water-cooled optical port with two color pyrometer and remote temperature display.
- Auto Melt (Requires the two color optical pyrometer accessory)
- Control cabinet air conditioner
- An inert gas system with capacitance manometer pressure controller.
- An over-pressure relief valve for the melt chamber.
- A set of remote induction controls for melting.

1.1.1 Furnace Optional Accessories:

- Programmable Servo Controlled furnace pour tilt drive with gear reducer.
- Adjustable furnace trunions for repositioning of the furnace pouring lip.
- Two vacuum-sealed sight ports with shutter splatter guards.
- An immersion thermocouple/sampler with lock box.
- A late additions charger with four (4) canisters mounted inside the vacuum chamber.
- A Motor driven mold table for mold indexing or centrifugal casting
- Induction mold heater
- A cooling water control system with water flow alarm
- A Swivel bridge breaker

2. INSPECTION & INSTALLATION

2.1 INSPECTION

Every effort is made to insure that the system is packed properly. However, rough and/or careless handling in transit occasionally results in shipping damage. In such cases, the carrier is responsible for the damages. First, carefully inspect the outside of all shipping containers for shipping damage. If shipping damage is found, stop and immediately contact the carrier. Save the shipping container and the packing materials if making a damage claim.

WARNING!!!

This equipment and its parts are big and heavy. Always use power assisted equipment and trained moving / installing personnel to avoid dropping, slipping or overturning which could kill or seriously injure the inexperienced worker.

2.1.1 Utilities

Electrical Supply 480V/3PH/60HZ

Standard Equipment

Mechanical Pump	9.0 KVA
Control Transformer	3.0 KVA
Total	12.0 KVA

Optional Equipment

Diffusion Pump	5.0 KVA
Mechanical booster	5.0 KVA
Hold pump	0. 5 KVA
Programmable Pour	1.5 KVA
Total	12.0 KVA

Water supply	60 psig @ 90° F. (Max.)
Vacuum equipment	12 gpm
Induction equipment	27 gpm
Total	39 gpm

Plant Air:
Dry, filtered, regulated and lubricated ..... 2 cfm @ 100 psig

2.2 SERVICE CONNECTIONS

2.2.1 Power

WARNING!!!

This equipment operates at HIGH VOLTAGES that are high enough to kill through electrical shock. Always break the primary circuits of the power supply when direct access to an electrical cabinet is required.

A source of electrical power for the system should be brought into the top of the control cabinet. Connect power to the top of the disconnect switch located within this cabinet. Consult the electrical schematic drawing for power requirements and wiring details.

2.2.2 Air

A source of compressed air is required by the system to operate the various pneumatic valves and cylinders. Connect a supply of air to the coupling provided on the lower left-hand side of the system cabinet. Air should be supplied at a pressure between 80 and 120 psig with a minimum capacity of 2 cfm.

2.2.3 Water

WARNING!!!

The water used to cool the system can reach scalding temperatures. Touching or rupture of the cooling system can cause serious burns.

Water is required by the system to cool its various components and should be supplied at a maximum temperature of 80°F.

Connect a source of cooling water to the coupling provided on the lower left hand side of the system cabinet. The water supplied to the system should have a pH value of between 6.0 and 8.0 and a calcium carbonate concentration of less than 75 parts per million (typical municipal drinking water quality). For applications of lower pH or greater hardness, water conditioning may be required. Consult Water Schematic for water requirements and piping details.

2.2.4 Inert Gas

CAUTION!!!

High pressure and/or unregulated gas sources can cause damage to the flow meter and/or gas lines. Under no circumstances should a high pressure or unregulated gas source be connected to the system

Connect a supply of inert gas to the coupling provided for the optional inert gas. Inert gas should be supplied at a maximum pressure of 20 psig with a minimum capacity of 20cfm.

3. START UP

3.1 INITIAL START UP

To start up the system for the first time, first turn on all service connections, i.e. power, water, air, etc., at their source. Next turn on the power by turning on the main power disconnect switch, located on the upper rear of the control cabinet. Within a second of doing this, the alarm bell will begin to ring and the POWER light will flash. To reset the alarm condition simply depress the amber push-button marked ALARM RESET. While doing so, note that all of the lights on the control panel will come on for as long as Alarm Reset is depressed (Alarm Reset can be used at any time to test the lights on the control panel). Turn on the control system power by pressing the ON push-button located below the red POWER light. This will turn on the instrument power and allow operation of the system.

3.1.1 Pump Rotation

CAUTION!!!

The mechanical vacuum pumps are equipped with THREE PHASE MOTORS and their direction of rotation must be considered. Operating these pumps in the wrong direction for prolonged periods can cause severe damage to the pump. At this time the mechanical vacuum pumps should be checked for proper rotation per their owners manual. To do so, first put the key switch into the MANUAL position, then, one at a time, turn on each of the mechanical pumps (Rough Pump, Blower, and Hold Pump) with it's push-button and observe the pump motors direction of rotation. If it is incorrect, shut off the main power disconnect switch, open the door of the control cabinet, and exchange any two of the wires leaving the motor starter connected to the pump in question. After the change has been made repeat the above procedure to confirm that rotation is correct.

3.1.2 Vacuum Gauge Configuration

Check the Televac MM200 relay set point #4 accessed through SETUP
(refer to the Televac MM200 Manual)

Relay Set point #4 controls the Inert Gas pressure. This is factory set for on at 600 Torr and off at 730 Torr and is user adjustable.

3.2 NORMAL START UP

3.2.1 Standard System

To start the system proceed as follows:

1. Turn on the control and instrument power by pressing the ON push-button located under the red POWER light.

2. Depress the pushbutton marked ROUGH PUMP. Upon doing so the Rough Pump will come on.

3. The system is now ready for operation.

Place Chamber under vacuum by opening the Rough Valve.

3.2.2 Startup\Operation with the optional Diffusion Pump.

To start the system proceed as above then perform the additionl:

1. Turn on the control and instrument power by pressing the ON push-button located under the red POWER light.

2. Depress the pushbuttons marked ROUGH PUMP and HOLD PUMP. Upon doing so the Rough and Hold Pumps will come on,

3. Open the HOLD PUMP VALVE and the FORELINE VALVE with their pushbuttons. Observe the Diffusion Pump Foreline pressure.

4. When the foreline pressure reaches 100 microns turn on the DIFFUSION PUMP with its push-button and allow time for it to heat up (60 minutes).

5. After the Diffusion Pump has been on for 60 minutes, the system is ready to be operated.

Place Chamber under vacuum.

1. Close foreline valve.

2. Open chamber roughing valve

3. When Chamber reaches 100 microns close the roughing valve and open the foreline valve.

4. Open the high vac Valve

3.3 PURGING OF INERT GAS LINES

The following instructions cover the purging of the inert gas backfill lines. This must be done, before the initial use of the furnace, and whenever a new source of gas is connected. Failure to do so could result in severe damage to the product due to oxidation.

Manual purging of the gas lines should only be attempted by qualified personnel since improper manual operation could be harmful to the furnace's pumping system.

1. All gas supplies should be valved off at their source.

2. With the chamber door closed, and the system in the READY-MAN UAL, condition, open the ROUGH VALVE by depressing its push-button.

3. Enter the Maintenance Mode (see section 4.4.4 for discussion of Maintenance Mode)

4. Open the INERT GAS VALVE by depressing its push-button, and open its valve.

5. At this point the furnace and the inert gas lines are being evacuated by the Rough Pump.

6. When the unit reaches a pressure of about 100 microns (1.0×10^{-1} Torr), close the ROUGH VALVE allowing approximately two seconds for it to do so.

7. Open the FORELINE VALVE with its push-button.

8. Open the HIGH VACUUM valve.

9. When a pressure of 5.0×10^{-4} Torr is reached, close all the gas valves by again depressing their respective pushbuttons. If this pressure cannot be reached in a reasonable amount of time (I hour), check for possible leaks in the gas lines to the system.

10. Return to the safetied manual mode.

11. Close the HIGH VACUUM VALVE.

12. Turn on the inert gas source.

3.4 INERT GAS ADJUSTMENT

The furnace is capable of being heated up while maintaining an inert gas atmosphere. This is useful in processing materials that have vapor pressures higher than the vacuum capabilities of the furnace. Pressure is maintained by bleeding in an inert gas, by means of a valve, while roughing the chamber out with the Rough Pump. If this feature is not to be used, the valve should be kept closed. If it is to be used, the valve should be adjusted at this time in the following manner:

1. While in the manual mode, evacuate the chamber, by opening the ROUGH VALVE, to a pressure below that desired.

2. Open the INERT GAS valve by depressing its push-button.

3. Adjust the valve, located on the rear of the chamber, teed on the vacuum break line, until the desired pressure is maintained.

4. Close the INERT GAS valve by again depressing its push-button.

   Once this is done, the Inert Gas may be used as required in either the manual mode or in an automatic cycle.

Note: The above procedure should be repeated if this feature has not been used in some time, the inert gas source has been replaced, or if the pressure of the gas source has been altered. Failure to do so could result in unexpected operation of the Inert Gas system.

4. NORMAL OPERATION

4.1 PRECAUTIONS

1. The unit should never be operated without all services being connected and on.

2. Be sure the rotation of the mechanical vacuum pumps is correct per the pump owner's manuals.

3. The unit should be left under vacuum when not in use.

4. All materials placed in the melt furnace should be carefully checked for vapor pressure at maximum operating temperature. Failure to do so could result in the severe contamination of the system.

5. Only dry charge material should be placed in the melt furnace. Trapped liquids will vaporize with explosive force in the melt and cause an eruption of molten metal.

6. Type W thermocouples should not be used in a temperature cycle exceeding 2640°F due to their tendency to lose calibration above this temperature in vacuum.

5. ALARMS

Incorporated into the system are several independent alarm mechanisms designed to protect the furnace system and the workload. They are as follows:

5.1 WATER

Water is required to cool various aspects of the furnace system. If water to the system fails, as determined by flow switch 506FLS, this alarm will be triggered, the system will shut off, and the WATER ALARM light will flash. When water returns the alarm will have to be reset by the ALARM RESET push-button.

5.2 VACUUM VALVES NOT OPEN

If any of the vacuum valves (Rough, Foreline, Hi Vac, or Vacuum Break) cannot open or close within a time limit the ALARM light will flash along with the light of the valve in question. If the Foreline or Hi Vac fails to close properly the Diffusion Pump will be shut off.

5.3 VACUUM

After the Foreline has been pumped to 100 microns and if the Diffusion Pump is at its operating speed, the pressure must not rise above 550 microns. If it does the Diffusion Pump will be shut off.

6. PUMP & VALVE INTERLOCKS

The system is interlocked by various means to help avoid improper operation.
the interlocks are as follows:

6.1 ROUGH PUMP

- For the Rough Pump to be on, the following must be true:
- The control system is enabled and all power is on.
- An alarm for Rough Pump off is not in progress.
- A Water Alarm is not in progress.

6.2 BLOWER

- For the vacuum Blower to be on, the following must be true:
- The Rough Pump is on.
- The pressure is below the set point on the blower pressure switch.
- The Inert Gas is off.

6.3 ROUGH PUMP VACUUM BREAK VALVE

- For this valve to be open, the following must be true:
- The Rough Pump is off.
- The Rough Valve is closed.
- The Foreline Valve is closed.

6.4 ROUGH VALVE

- For this valve to open, all the following must be true:
- The Rough Pump is on.
- The air supply for pneumatics is above 60 psig
- The chamber door is closed.
- The Foreline Valve is closed.
- The High Vacuum Valve is closed.
- The Vacuum Break Valve is closed.

6.5 MELT INDUCTION POWER

- For the Melt Induction Power to be on, all the following must be true:
- The control system is enabled and all power is on.
- A Water Alarm is not in progress.
- If the Melt Selector switch is in the Auto position the Pyrometer Isolation valve must be open.
- The chamber door is closed.

6.6 INERT GAS VALVE

- For this valve to open all, the following must be true:
- The control system is enabled and all power is on.
- The air supply for pneumatics is above 60 psig
- The chamber door is closed and locked.
- The Rough Valve is closed.
- The High Vacuum Valve is closed.

7. HONEYWELL HC900

The Honeywell HC900 was custom programmed for the operation of inductive melting. This section is considered to be an addendum to the Honeywell HC900 Manual covering only the PV/T custom programming. For all other functions refer to the Honeywell HC900 manual.

7.1 DISPLAY SCREENS

The Honeywell HC900 has 8 main screens and each main screen has sub pages that are displayed by the page up or page down keys.

The screens are.

1. Page 1, Process Programmer

2. Page 1, Horizontal trend
   Page 2, Horizontal trend with digitals
   Page 3, Horizontal trend with vertical bars
   Page 4, Vertical trend
   Page 5, Vertical trend with horizontal bars

3. Page 1, Process info

4. Page 1, Data storage status

5. Page 1, Alarm status

6. Page 1, Auto Tune

7. Page 1, Process setup

8. Page 1, Rotating information panel

7.1.1 Operator Keys

For other keys refer to the HC900 manual.

Main Menu

Page Up

Page Down

Digit Select

7.2 INITIAL SETUP

Before proceeding with an auto melt the program and recipe need to be loaded and the storage disk needs to be initialized.

7.2.1 Initialize the Storage Disk

Insert a standard blank 1.44-megabyte floppy disk into the UMC-800 Drive.
Select the HC900 main menu key, then select disk utilities and Initialize storage disk.
This operation will take about 3 min. after the disk is initialized a green S storage indicator is displayed on the bottom of the HC900 Display.

7.2.2 Load Recipe

The recipe contains two parameters, the optical crossover temperature, and the Vacuum alert set point.
To edit or create a new recipe press the main menu key, then select the recipe menu.
Select recipe by scrolling the highlight on the recipe then enter to modify.

7.2.3 Load the Set point Program

The HC900 has three PV/T starter programs.
Melt01, new crucible melts.
Melt02, cold used crucibles
Melt03, hot furnace
To load a Program, from the Process Programmer screen select load, then change the number to the program to be loaded using the digit select keys.

7.3 EXAMPLE SET POINT PROFILE PROGRAM

Segment	Guar Soak	Type	Time min.	Temp °F	Power Percentage	Notes
1		Soak	10	1900°	10%	Pre-Heat 1
2		Soak	10	1900°	20%	Pre-Heat 2
3		Soak	10	1900°	50%	Pre-Heat 3
4	☑	Soak	2	1900°	100%	Crossover to PID
5		Soak	5	2000°	0%	PID Control Start Point
6		Ramp	5	2400°	0%	Ramp to Melt Temperature
7		Soak	5	2400°	0%	Soak at Melt Temperature
8		Ramp	5	2600°	0%	Ramp to Additions Temperature
9		Soak	5	2600°	30%	Additions Segment
10		Ramp	5	1900°	0%	Ramp to pour Temperature
11		Soak	5	1900°	0%	Soak at pour Temperature
12		Soak	5	2800°	30%	Pour Segment no PID Output

7.3.1 Explanation of segments

Glossary of Terms

Optical Crossover- set within the recipe; value reflects the lowest usable temperature of the optical thermometer.

Crossover to PID - any value above the Optical Crossover temperature.

Gsoak- guaranteed soak, holds process time until temperature is within Guar. soak High and Gaur. Soak low values in set point profiles program.

1. **Pre-heat 1** necessary on new crucibles only.
2. **Pre-heat 2** could be twice the power as Pre-heat 1. Necessary on new crucibles only. Pre-heat Segments 1 and 2 can be omitted on used crucibles.
3. **Pre-heat 3** necessary on cold crucibles can skipped if crucible is hot. The preheat segments should not exceed 1700°F

Settings:

- Type: Soak
- Value: This segment should contain the set point of the desired PID crossover temperature. (Any temperature below 1900° is not recommended.)
- Time/Rate: Pre-Heat segments typically 5 to 10 min.
- Aux out Value: Pre-Heat segments typically 5% to 50%

4. **Crossover to PID** in this segment the controller changes from a set percentage of power to actually controlling using the PID loop controller. (This segment must be a soak and not a ramp)

Settings:

- Type: Guaranteed Soak (Use the check box)
- Value: Set Desired Crossover to PID Set point. (Temperatures below 1900° are not recommended)
- Time/Rate: Set the time for a small value (about 2 min)
- Aux out Value: Set percentage for maximum output (100%)

At the beginning of this segment the percentage of power will be used (100%) and a guaranteed soak will hold the segment time until the melt achieves optical crossover temperature set in the recipe (1800° is recommended) then it will start PID controlling at the temperature set for this segment. (1900°) Upon achieving the segment temperature the process timer starts and the GSOAK is released. The segment will control for the time specified then go onto the next segment.

5. **PID Control Start Point** this segment is a necessary step to prevent the controller from shifting back to percentage of power.

(This segment must be a soak and not a ramp)

Settings:

- Type: Soak
- Value: Any setting above crossover to PID temperature.
- Time/Rate: Set the time for any value.
- Aux out Value: 0

6. **Ramp to Melt Temperature** this segment can be a ramp or a soak.

Settings:

- Type: Ramp
- Value: Temperatures to the Metals Melt point
- Time/Rate: Set the time for any value capable of achieving melt temperature
- Aux out value: 0

7. **Soak at Melt Temperature** Soak after each ramp to assure uniform temperature.

Settings:

- Type: Soak
- Value: same as the Ramp temperature.
- Time/Rate: allow enough time to equalize temperature.
- Aux out value: 0

8. **Ramp to Additions Temperature** this segment can be a ramp or a soak.

Settings:

- Type: Ramp
- Value: Temperatures to the Metals Melt point
- Time/Rate: Set the time for any value capable of achieving additions temperature.
- Aux out value: 0

9. **Additions Segment** this segment is special because it will allow the optical pyrometer to be overshadowed without the power level ramping out of control. When the additions charger is between the furnace and the optical pyrometer the perceived temperature drops below the optical crossover set point specified within the recipe program. Once this occurs the program will look for a percentage of power. This segment needs to be a soak.

Settings:

- Type: Soak
- Value: any desired additions Temperature.
- Time/Rate: any value long enough to do the additions.
- Aux out value: any value that will hold the temperature specified for this segment when the additions are being added.

10. **Ramp to pour Temperature**

Settings:

- Type: Ramp
- Value: desired pouring Temperature.
- Time/Rate: Set the time for any value capable of achieving pouring temperature.
- Aux out value: 0

11. **Soak at Pour Temperature**

Settings:

- Type: Soak
- Value: desired pouring Temperature.
- Time/Rate: allow enough time to equalize temperature.
- Aux out value: 0

12. **Pour Segment** during this segment the PID control switches off and the percentage of power is used to keep the metal at pouring temperature.

Settings:

- Type: Soak
- Value: 0
- Time/Rate: allow enough time to pour mold.
- Aux out value: any value capable of keeping the metal from freezing during the pour.

7.4 RUNNING THE HC900 PROGRAM

When the proper vacuum has been achieved, and the furnace has be charged previously,
Turn on the Inductotherm power supply, (refer to the supplied Inductotherm manual for the proper operation of the power supply)
Switch the Remote Inductotherm Manual\Auto Control to Auto (Located on the main control cabinet below the Kilowatt meter)
Open the optical pyrometer valve completely making sure the valve handle activates the limit switch.
Press the Induction on (Located on the main control cabinet below the Kilowatt meter)
Turn the power stat full clockwise (100%) (Located on the main control cabinet)
The System is now in an idle condition and the Inductotherm Power Supply is now ready to be controlled by the Honeywell HC900.
To run the active HC900 Program, press the F1 (Run Command) on the HC900.

8. SERVO CONTROLLED TILT POUR

The Servo driven programmable tilt pour is a single axis motion controller that controls the Furnace Tilt
This section covers information not included in the Vendor manuals.
Refer to the Vendor Manuals for additional information.

8.1 MOTION CONTROL STATION

The Motion Control Station consists of,

- A LCD Programming Keypad
- A single axis motion controller
- A single axis servo amplifier
- Servo Drive enable power switch
- Program Selector Switch
- Home command pushbutton
- Pour command pushbutton
- Abort command pushbutton
- Chamber Lamp control

8.2 SETTING UP THE SERVO DRIVES

With the system powered up under normal operating conditions,
Enable the servo drives by switching on the servo drives switch on the Motion control Station.
(This switch should be remain off when not using the servo drive)
With the furnace empty and personal clear of the furnace and table, press the home pushbutton.
The furnace will tilt back then stop at a level position

9. ADDITIONS CHARGER

The optional late additions charger this charger has four canisters that can be filled with late addition material that can be added to the melt during the late additions segment of the HC900 program, if the additions charger is used in other segments of the HC900 program the HC900 optical pyrometer feedback of the melt temperature is interrupted by the additions charger and the auto melt program assumes that the melt has gone cold and the power level of the induction supply will superheat the melt.

Turning the additions charger crank clockwise one full turn empties the first cylinder from this point you could continue emptying the other cylinders or return additions charger by turning crank counterclockwise.

9.1 ADDITIONS MATERIAL

It is suggested that the martial to be used in the additions charger be tested that it goes trough the shoot and does not jam the operation. If small chips are to be used it is recommended that it is wrapped into small balls that can easily fall trough the additions shoot.

9.2 ADDITIONS TILT INTERLOCK

When the additions charger is not in the retracted position it will inhibit the tilt motion of the furnace. The additions charger needs to be returned to the retracted position before the furnace tilt can be performed.

10. TROUBLE SHOOTING AND MAINTENANCE

All maintenance and service procedures should be followed per the supplementary instructions supplied with this manual.

A program of regular inspection and maintenance of the vacuum furnace is essential to the safe and continuous operation of the equipment and should be instituted and followed rigorously,

10.1 VACUUM SYSTEM

10.1.1 General

Numerous stationary and moving vacuum seals, O-rings and other rubber gaskets are associated with the main vacuum vessel. These seals should be inspected regularly to insure cleanliness, freedom from cracks or gouges, and elasticity retention. The main door where work regularly passes should receive particular attention.

The vacuum chamber and all associated plumbing should be kept clean and free of contamination. If cleaning is required it should be done with a lint free cloth dampened with a solvent consistent with the contaminant. Acetone or alcohol should be used for final cleaning, If the contamination is severe, the vacuum piping and valves should be dismantled and cleaned separately.

The condition and level of oil in the mechanical vacuum pumps and the Diffusion Pump is critical for their proper operation. Since the effect of the user's process on the oil is unknown at this writing, the condition and level of the pump oil should be checked after every cycle until the required frequency of oil change is determined.

10.1.2 Mechanical Vacuum Pumps

Mechanical vacuum pumps should be checked and repaired as required. A partial check list follows:

1. Correct water flow for cooling
2. Drive belts are not worn
3. Drive belts' tension is proper
4. No oil leaks at the shaft seals
5. Correct oil level
6. Oil is free of dirt and water accumulation
7. Drip legs are drained
8. Mounting bolts are tight
9. Vacuum lines and vibration couplings are tight

10.1.3 Diffusion Pumps

Diffusion Pumps should be checked and repaired as required. A partial checklist follows:

1. Correct water flow for cooling

10.1.4 Vacuum Valves

Vacuum valves should be checked and repaired as required. A partial checklist follows:

1. Air supply filter is drained and operating
2. Air supply oiler is filled to the correct level and is operating
3. Pilot valves are not leaking excess air
4. Moving O-ring seals cleaned or changed where indicating excess wear

10.2 POWER SUPPLY

The furnace power supply should be inspected and corrected as required. A partial checklist follows:

1. Primary and secondary wiring and cables tight and free from overheating
2. Proper ventilation and air-cooling or proper water flow
3. Relays and contactors should be free of contact pitting or arching, which could result in contact welding
4. Power supply voltage and current should be monitored to ensure that design limits are not exceeded

10.3 SENSORS

The condition of the various pressure, vacuum, and temperature sensors is critical for the safe and consistent operation of the system.

10.3.1 Thermocouples

A regular replacement program should be established for all thermocouples.

Note: The effective life of thermocouples varies depending on their type, the process, and temperature and vacuum levels. These factors must be considered in setting up a replacement schedule.

10.3.2 Vacuum Gauge Tubes

A regular replacement program should be established for all vacuum gauge tubes.

Note: The effective life of gauge tubes varies depending on their type and the process. These factors must be considered in setting up a replacement schedule.

10.4 INSTRUMENTATION

All the various instrumentation for temperature, vacuum, etc., should be set up on a regular test and calibration schedule.

Batteries for retaining RAM memory in such devices as programmable logic controllers, message centers, operator interface terminals, etc., should be tested and replaced on a regular schedule.

10.5 INTERLOCKS AND ALARMS

Periodic checks of all safety interlocks and alarms should be performed. Particular attention should be given to over temperature safety devices, low air pressure, insufficient cooling water, vacuum, oil temperature, and low oil alarms (as applicable to the system).

10.6 COOLING

Many components of the vacuum furnace require water-cooling. Drain lines should be inspected for proper flow and temperature of the cooling water. Pressure regulators, strainers, and safety vents should be inspected for proper setting and be maintained free from dirt and contamination.

If an evaporative cooling tower is integral to the furnace system, the tower should be cleaned, the motor and bearings greased, and the water strainers cleaned on a regular basis.

10.7 CONTINUOUS MAINTENANCE CHECK LIST

1. Review auxiliary vacuum instrumentation for proper indication of system performance, i.e., foreline, Hold Pump, Rough Pump, and Diffusion Pump operating pressure and temperature.
2. Review power instrumentation
3. Check instrumentation for "on condition".
4. Check oil level in Rough Pump and Hold Pump.
5. Check mechanical vacuum pumps, blowers, for unusual noise or vibration.
6. Check all V-belt drives for belt tension and fatigue.
7. Check gas pressure and available capacity.
8. Check for proper operation of ventilation equipment if required in the particular installation.

10.8 SHIFT MAINTENANCE CHECK LIST

1. Review auxiliary vacuum instrumentation for proper indication of system performance, i.e., foreline, Rough Pump, Hold Pump, and Diffusion Pump operating pressure and temperature.
2. Review power instrumentation settings.
3. Check instrumentation for "on condition".
4. Check oil level in mechanical and Diffusion Pumps.
5. Check mechanical vacuum pumps, blowers, gas fans, oil pumps, etc., for unusual noise or vibration.
6. Check all V-belt drives for belt tension and fatigue.
7. Check gas pressure and available capacity.
8. Determine and record the furnace chamber vacuum leak rate, and the blank off pressures of the roughing, holding, and Diffusion Pumps.

10.9 WEEKLY MAINTENANCE CHECK LIST

1. Inspect the melt furnace crucible for cracks and burn trough. Inspect the condition of the mold heating Susceptor and coil.
2. Test thermocouples and their lead wires for broken insulators, shorts, and loose connections.
3. Test visible and audible alarms for proper operation.

10.10 MONTHLY MAINTENANCE CHECK LIST

1. Test interlock sequence of all safety equipment. Manually make each interlock fail, noting that the related equipment shuts down or stops as required.
2. Inspect all electrical switches and contacts and repair as required.
3. Test all temperature instrument fail-safe devices.
4. Clean all water, gas compressor and pump strainers.
5. Change Rough and Hold Pump oils if required.
6. Test pressure relief valves and clean if necessary.
7. Inspect air, inert gas, and water lines for leaks.

10.11 PERIODIC MAINTENANCE CHECK LIST

Note: Frequency of maintenance of the following will depend on furnace use and the recommendation of the individual equipment manufacturers.

1. Inspect vacuum chamber O-rings and other gaskets for proper sealing.
2. Check the vacuum chamber vessel for evidence of hot spots indicating improper water-cooling.
3. Examine the melt furnace and mold heater in detail for deterioration or failure.
4. Lubricate motors, drives, valves, blowers, compressors, pumps, etc., as required.
5. With brush or other device remove major build up of oxides and contamination from the hot zone and accessible areas of the cold wall chamber. Blow out contamination with dry air.
6. Install new valve springs and discs and clean and flush oil from the mechanical vacuum pumps. Replace spring and O-ring in the gas ballast valves (see pump instructions).
7. Run blank-off test for the mechanical vacuum pumps to insure meeting process parameters.