



Upright Hot Oil Temperature Control Units

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Write Down Your Serial Numbers Here For Future Reference:

_____	_____
_____	_____
_____	_____

We are committed to a continuing program of product improvement.
Specifications, appearance, and dimensions described in this manual are subject to change without notice.

DCN No. _____
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Shipping Info

Unpacking and Inspection

You should inspect your portable hot oil tcu for possible shipping damage.

Thoroughly check the equipment for any damage that might have occurred in transit, such as broken or loose wiring and components, loose hardware and mounting screws, etc.

In the Event of Shipping Damage

According to the contract terms and conditions of the Carrier, the responsibility of the Shipper ends at the time and place of shipment.

Notify the transportation company's local agent if you discover damage.

Hold the damaged goods and packing material for the examining agent's inspection. **Do not return any goods before the transportation company's inspection and authorization.**

File a claim with the transportation company. Substantiate the claim by referring to the agent's report. A certified copy of our invoice is available upon request. The original Bill of Lading is attached to our original invoice. If the shipment was prepaid, write us for a receipted transportation bill.

Advise customer service regarding your wish for assistance and to obtain an RMA (return material authorization) number.

If the Shipment is Not Complete

Check the packing list as back-ordered items are noted on the packing list. You should have:

- Portable Hot Oil TCU
- Bill of lading
- Packing list
- Operating and Installation packet
- Electrical schematic and panel layout drawings
- Component instruction manuals

Re-inspect the container and packing material to see if you missed any smaller items during unpacking.

If the Shipment is Not Correct

If the shipment is not what you ordered please contact the parts and service department immediately at (262) 641-8610. Have the order number and item number available. *Hold the items until you receive shipping instructions.*

Returns

Do not return any damaged or incorrect items until you receive shipping instructions from the shipping department.

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Chapter 1: Safety

1-1 How to Use This Manual

Use this manual as a guide and reference for installing, operating, and maintaining your portable hot oil temperature control unit (TCU). The purpose is to assist you in applying efficient, proven techniques that enhance equipment productivity.

This manual covers only light corrective maintenance. No other maintenance should be undertaken without first contacting a service engineer.

The Functional Description section outlines models covered, standard features, and safety features. Additional sections within the manual provide instructions for installation, pre-operational procedures, operation, preventive maintenance, and corrective maintenance.

The Installation chapter includes required data for receiving, unpacking, inspecting, and setup of the portable hot oil TCU. We can also provide the assistance of a factory-trained technician to help train your operator(s) for a nominal charge. This section includes instructions, checks, and adjustments that should be followed before commencing with operation of the portable hot oil TCU. These instructions are intended to supplement standard shop procedures performed at shift, daily, and weekly intervals.

The Operation chapter includes a description of electrical and mechanical controls, in addition to information for operating the portable hot oil TCU safely and efficiently.

The Maintenance chapter is intended to serve as a source of detailed assembly and disassembly instructions for those areas of the equipment requiring service. Preventive maintenance sections are included to ensure that your portable hot oil TCU provides excellent, long service.

The Troubleshooting chapter serves as a guide for identification of most common problems. Potential problems are listed, along with possible causes and related solutions.

The Appendix contains technical specifications, drawings, schematics, parts lists, and available options. A spare parts list with part numbers specific to your machine is provided with your shipping paperwork package. Refer to this section for a listing of spare parts for purchase. Have your serial number and model number ready when ordering.

Safety Symbols Used in this Manual

The following safety alert symbols are used to alert you to potential personal injury hazards. Obey all safety messages that follow these symbols to avoid possible injury or death.

DANGER! *DANGER indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.*

WARNING! *WARNING indicates a potentially hazardous situation or practice that, if not avoided, could result in death or serious injury.*

Caution! *CAUTION indicates a potentially hazardous situation or practice that, if not avoided, may result in minor or moderate injury or in property damage.*

1-2 Warnings and Precautions

Our equipment is designed to provide safe and reliable operation when installed and operated within design specifications, following national and local safety codes. This may include, but is not limited to OSHA, NEC, CSA, SPI, and any other local, national and international regulations.

To avoid possible personal injury or equipment damage when installing, operating, or maintaining this equipment, use good judgment and follow these safe practices:

- ☑ Read and follow these operation and installation instructions when installing, operating, and maintaining this equipment. If these instructions become damaged or unreadable, additional copies are available from the manufacturer.
- ☑ Follow all **SAFETY CODES**.
- ☑ Wear **SAFETY GLASSES** and **WORK GLOVES**.
- ☑ Work only with approved tools and devices.
- ☑ Disconnect and/or lock out power before servicing or maintaining the equipment.
- ☑ Use care when **LOADING, UNLOADING, RIGGING, or MOVING** this equipment.
- ☑ Operate this equipment within design specifications.
- ☑ **OPEN, TAG, and LOCK ALL DISCONNECTS** before working on equipment. You should remove the fuses and carry them with you.
- ☑ Make sure the equipment and components are properly **GROUNDING** before you switch on power.
- ☑ When welding or brazing in or around this equipment, make sure **VENTILATION** is **ADEQUATE. PROTECT** adjacent materials from flame or sparks by shielding with sheet metal. An approved **FIRE EXTINGUISHER** should be close at hand and ready for use if needed.
- ☑ Do not restore power until you remove all tools, test equipment, etc., and the equipment and related components are fully reassembled.
- ☑ Only **PROPERLY TRAINED** personnel familiar with the information in this manual should work on this equipment.

We have long recognized the importance of safety and have designed and manufactured our equipment with operator safety as a prime consideration. We expect you, as a user, to abide by the foregoing recommendations in order to make operator safety a reality.

1-3 Responsibility

These machines are constructed for maximum operator safety when used under standard operating conditions and when recommended instructions are followed in the maintenance and operation of the machine.

All personnel engaged in the use of the machine should become familiar with its operation as described in this manual.

Proper operation of the machine promotes safety for the operator and all workers in its vicinity.

Each individual must take responsibility for observing the prescribed safety rules as outlined. All warning and danger signs must be observed and obeyed. All actual or potential danger areas must be reported to your immediate supervisor.

General Responsibility

No matter who you are, safety is important. Owners, operators and maintenance personnel must realize that every day, safety is a vital part of their jobs.

If your main concern is loss of productivity, remember that production is always affected in a negative way following an accident. The following are some of the ways that accidents can affect your production:

- Loss of a skilled operator (temporarily or permanently)
- Breakdown of shop morale
- Costly damage to equipment
- Downtime

An effective safety program is responsible and economically sound.

Organize a safety committee or group, and hold regular meetings. Promote this group from the management level. Through this group, the safety program can be continually reviewed, maintained, and improved. Keep minutes or a record of the meetings.

Hold daily equipment inspections in addition to regular maintenance checks. You will keep your equipment safe for production and exhibit your commitment to safety.

Please read and use this manual as a guide to equipment safety. This manual contains safety warnings throughout, specific to each function and point of operation.

Operator Responsibility

The operator's responsibility does not end with efficient production. The operator usually has the most daily contact with the equipment and intimately knows its capabilities and limitations.

Plant and personnel safety is sometimes forgotten in the desire to meet incentive rates, or through a casual attitude toward machinery formed over a period of months or years. Your employer probably has established a set of safety rules in your workplace. Those rules, this manual, or any other safety information will not keep you from being injured while operating your equipment.

Learn and always use safe operation procedures. Cooperate with co-workers to promote safe practices. Immediately report any potentially dangerous situation to your supervisor or appropriate person.

REMEMBER:

- **NEVER** place your hands or any part of your body in any dangerous location.
- **NEVER** operate, service, or adjust the temperature control unit without appropriate training and first reading and understanding this manual.
- Before you start the temperature control unit check the following:
 - Remove all tools from the tcu;
 - Be sure no objects (tools, nuts, bolts, clamps, bars) are laying in the TCUs operating area;
- If your TCU has been inoperative or unattended, check all settings before starting the unit.
- At the beginning of your shift and after breaks, verify that the controls and other auxiliary equipment are functioning properly.
- Keep all safety guards in place and in good repair. **NEVER** attempt to bypass, modify, or remove safety guards. Such alteration is not only unsafe, but will void the warranty on your equipment.
- When changing control settings to perform a different mode of operation, be sure selector switches are correctly positioned. Locking selector switches should only be adjusted by authorized personnel and the keys removed after setting.
- Report the following occurrences **IMMEDIATELY**:
 - unsafe operation or condition
 - unusual temperature control unit action
 - leakage
 - improper maintenance
 - **NEVER** stand or sit where you could slip or stumble into the temperature control unit while working on it.
- **DO NOT** wear loose clothing or jewelry, which can be caught while working on a tcu. In addition, cover or tie back long hair.

- Clean the tcu and surrounding area **DAILY**, and inspect the machine for loose, missing or broken parts.
- Shut off power to the tcu when it is not in use. Turn the switch to the **OFF** position, or unplug it from the power source.

Maintenance Responsibility

Proper maintenance is essential to safety. If you are a maintenance worker, you must make safety a priority to effectively repair and maintain equipment.

Before removing, adjusting, or replacing parts on a machine, remember to turn off all electric supplies and all accessory equipment at the machine, and disconnect and lockout electrical power. Attach warning tags to the disconnect switch.

When you need to perform maintenance or repair work on equipment above floor level, use a solid platform or a hydraulic elevator. If there is a permanently installed catwalk on your equipment, use it. The work platform should have secure footing and a place for tools and parts. **DO NOT** climb on equipment, machines, or work from ladders.

If you need to repair a large component, use appropriate handling equipment. Before you use handling equipment (portable “A” frames, electric boom trucks, fork trucks, overhead cranes) be sure the load does not exceed the capacity of the handling equipment or cause it to become unstable.

Carefully test the condition of lifting cables, chains, ropes, slings, and hooks before using them to lift a load.

Be sure that all non-current carrying parts are correctly connected to earth ground with an electrical conductor that complies with current codes. Install in accordance with national and local codes.

When you have completed the repair or maintenance procedure, check your work and remove your tools, rigging, and handling equipment.

Do not restore power to the equipment until all persons are clear of the area. **DO NOT** start and run the machine until you are sure all parts are functioning correctly.

BEFORE you turn the machine over to the operator for production, verify all equipment enclosure panels, guards and safety devices are in place and functioning properly.

Reporting a Safety Defect

If you believe that your equipment has a defect that could cause injury, you should immediately discontinue its use and inform the manufacturer.

The principle factors that can result in injury are failure to follow proper operating procedures (i.e. lockout/tagout), or failure to maintain a clean and safe working environment.

Chapter 2: Functional Description

2-1 Models Covered in This Manual

This manual provides operation, installation, and maintenance instructions for portable hot oil temperature control units. Model numbers are listed on the serial tag. Make sure you know the model and serial number of your equipment before contacting the manufacturer for parts or service.

Your portable hot oil temperature control unit circulates thermal transfer-type oil through your process and precisely, automatically, and reliably maintains it at a temperature you can select. Portable hot oil temperature control units are sized to meet the specific requirements stated by the Customer at the time of purchase.

2-2 General Description

The operating range of your temperature control unit is from 100°F to 550°F (38°C to 288°C). The unit is best suited for use with a specially formulated Heat Transfer Fluid. A recommended list of commercially available heat transfer fluids can be obtained through Customer Service.

Rapid recirculation of the relatively small amount of fluid provides a close and uniform temperature relationship between the TO PROCESS and FROM PROCESS lines. This does, of course, depend on the configuration of your process, and any restrictions within the mold.

This recirculation, combined with the immersion heater and optional cooling capability, gives fast and accurate response to bring the fluid up to temperature, or to changes in the settings when needed.

Performance is assured through matching the unique controllers to the high temperature system. The two systems are fully integrated to achieve accurate control, along with efficient use of water and electricity.

2-3 Standard Features

Mechanical Features

- Dual stage immersion heater with IEC contactors
- 550°F (288°C) maximum operating temperature {400°F (244°C) maximum operating temperature for 6 kW heaters}
- Manual bypass
- Pressure switch for low pump pressure shut-down
- To Process pressure gauge
- Independent safety thermostat
- Y strainer on From Process line
- Automatic venting sequence
- Positive displacement pumps capable of reversing to evacuate the process
- Easily removable panels for quick access to internal components
- 1 year warranty on parts and labor (Labor at factory)

Electrical Features

- Non-fused lockable rotary disconnect
- Branch circuit fusing
- NEMA 12 electrical enclosure
- UL listed subpanel

Controller Features

- M2B+ microprocessor controller with fuzzy logic; includes diagnostic features with indicator and warning status lights
- System status graphic display
- Low level alarm for reservoir
- Audible alarm
- 5 year warranty on controller

2-4 Options

Options marked with “*” indicate options that can be factory installed or retrofitted in the field.

- Drain valve
- Hour meter; measures total pump run time hours
- General fault visual alarm
- Autovent sequence; deducts available
- Low level alarm; deducts available
- High level indicator light
- Manual bypass; deducts available
- M2B+ microprocessor controller options include:
 - 4-20 mA remote set point and retransmission
 - SPI protocol, RS-485
 - General protocols, types RS-232, -485
 - Remote sensor; 10 Ft. (3m)
- Heat exchanger options of 3.9 sq. ft. (0.3627 sq. m) and 6.7 sq. ft. (0.6231 sq. m)
- Remote controller
- Lexan cover
- Optional operating voltages of 208/3/60, 230/3/60, 575/3/60, 380/3/50, and 415/3/50

2-5 Feature Descriptions

Immersion Heaters

The fluid is heated by the specially designed three-phase low watt density electrical immersion heater, and regulated by the controller. The standard heater has a steel sheath for low watt density and good heat transfer.

These models can be supplied with 6, 12, 18, or 24 kW low watt density immersion heaters, depending upon the heating needs of the process. The 18 and 24 kW models are built to provide full or partial heat as required by the process and determined by the controller, to provide more precise control.

Heater Tank

The Upright features a single pass heater tank. The tank is designed to maintain an optimum balance of fluid velocity versus watt density, and turbulence for excellent heat transfer, and minimal pressure drop. The high fluid velocity will greatly prolong the life of the heater and fluid.

Pump

The pump is a mechanical seal, positive displacement pump. It features a nearly maintenance free design, and was selected after extensive testing to provide superior performance, flexibility, and low maintenance. It is well suited for use with a variety of commercially available heat transfer fluids. The pump has only two internal moving parts, and a specially designed seal to give years of trouble free service, even at high temperatures. The only routine maintenance required is the monthly greasing and occasional head space adjustment; see Section 5-3 on Page 40 for more information.

The pump is capable of running in either direction. Thus, the pump reverse feature can be used to draw fluids back from the process. It is not necessary to install a service air line to purge lines before changing molds. Since the pump is capable of achieving extremely high pressures, it is necessary to regulate the pressure through use of a regulating bypass line (Ful-Flo valve). Because the pump is a positive displacement pump, it will supply the process with rated flow at or below the rated pressure.

The flow is constant until the pressure reaches the rated pressure. The pressure however is a function of frictional losses through the process that it is attached to. Systems with large process connections, ports, and piping will operate at low pressures. While systems with small process connections, ports, and piping will operate at higher pressures. Once pressure requirements exceed the rated pressure, the Ful-Flow valve will open and bypass the necessary fluid to prevent high pressures.

Ful-Flo Valve

A regulating bypass line featuring a Ful-Flo valve is standard in all units. This is a safety device to prevent excessive pressure in the event that the delivery line is obstructed. Each Ful-Flo valve is factory preset to limit system pressure as specified by the customer. It must not be tampered with in any way.

In the event of an obstruction in the line, the Ful-Flo valve will open and divert fluid from the delivery TO PROCESS line to the return FROM PROCESS line. A constant flow of fluid is maintained through the heater tank to prevent damage to the heating elements and fluid.

Connection Lines

Connections for TO PROCESS and FROM PROCESS lines are 1" NPT (25.4 mm). Water connections for COOLING WATER SUPPLY and COOLING WATER DRAIN are ¾" NPT (19.1 mm); see Section 3-4 on Page 20 for more information. *The customer is responsible for conversions to metric standards.*

The manufacturer stocks many lengths of flexible metal hose; the part number is 572-16969. State the length of hose you want when ordering.

WARNING!



Component failure may result in high-temperature oil spray, causing serious injury or death. Make sure hoses, valves, and other components installed in your process can withstand maximum temperature and pressure of the Upright unit; check unit nameplate for specific capacities. All components must be carefully inspected for condition before installing. Make sure you have factory components if you have any doubt.

Electrical System Controls

The electrical controls of your Upright unit are specially engineered for reliability, safety, and simplicity of operation. Switch functions are clearly labeled. Your Upright unit has a system status board so you can evaluate the status and performance of the unit at a glance. Pilot lights are provided to indicate key unit functions.

An audible alarm is standard with your unit. The alarm will sound in the event of the following conditions:

- motor overload
- safety thermostat trip (over temperature)
- low fluid pressure
- low fluid level
- high fluid level (optional)

Push the ALARM SILENCE button to silence the alarm. See Section 4-2 on Page 25 for more information on control functions.

Electrical Panel and System Components

The pump motor and immersion heater operate on three-phase, 50/60 cycle, nominal voltage with the control circuit at 115 V single phase. The control circuit voltage is provided by a single phase machine tool transformer with primary fuse protection and a grounded secondary. A main power disconnect is included for ease of service. The electrical panel is UL listed and complies with N.F.P.A. 79 provisions.

All components are IEC rated for long life and reduced maintenance. The heater elements are branch fused, and protected from contactor welding by a separate primary voltage contactor. The pump motor is controlled by a full voltage magnetic reversing starter, with fused branch circuit overcurrent and thermal overload protection. Many additional features are available as options.

A NEMA 12 enclosure is standard, with NEMA 4 available as an option.

Air Purge

Upon initial start-up and mold/process change-out, you'll need to purge all air and water from the system. The Upright unit has appropriate valving to ensure complete purging. Procedures are covered in Section 3-5 on Page 23.

WARNING! *Failure to purge the system of air before heating may result in serious injury or critical system and equipment damage. Make sure you properly purge the system of air before starting the heater cycle.*



Pressure Switch

A pressure switch is built into each unit to guard against heater damage. This feature prevents the heater elements from being energized unless the pump is running and fluid is in the system. After a preset time, the pump shuts down if the fluid pressure is not re-established. The pressure switch is preset at the factory; do not tamper with it.

Safety Thermostat

The safety thermostat is a J-thermocouple sensing, adjustable fail-safe device located in the heater tank. This is to guard against the unlikely event of “runaway” heating. If over-heating does occur, the safety thermostat shuts down the heater outputs and sounds an audible alarm. A red pilot light on the status board also illuminates. The unit continues to pump fluid through the system to prevent heater damage. Auxiliary factory installed alarms such as beacons and klaxons are available as options.

All controller functions are locked out until the main supply power is disconnected. Resetting the alarm condition is initiated by depressing the red pump stop button. The reset button is located inside the electrical enclosure, mounted on the left wall of the enclosure. It is imperative that a qualified maintenance technician determine and correct the cause of the fault before resuming operation.

Reservoir Tank

A reservoir tank with sight gauge is standard; usable capacity is seven (7) gallons (26.5 liters). The tank permits thermal expansion of the heat transfer fluid, and provides makeup fluid.

WARNING! *The reservoir tank may cause serious injury if it ruptures from not being properly vented. Make sure that the reservoir tank is always properly vented to prevent tank rupture.*



The reservoir tank drain is extended beyond the base of the unit for ease of draining. Optional ball valves are available to further simplify draining.

Cooling (Optional)

The manufacturer-designed shell and tube heat exchanger is provided as optional equipment in this unit. The design features U-tube construction and copper-nickel tubes for durability and optimal heat transfer.

The modular construction (unique to our units) allows the tube bundle to be easily removed for periodic cleaning. Additionally, check valves are installed on the water supply and drain lines to prevent water from back flowing into the heat exchanger from a closed drain or into the water supply piping.

The controller automatically regulates cooling by opening and closing the cooling solenoid. This allows the proper amount of cooling water to pass through the tubes of the heat exchanger and out the drain. A water supply of 75 psi (517.1 kPa/5.2 bars) maximum is required for connection to the heat exchanger.

2-6 Safety Devices and Interlocks

This section includes information on safety devices and procedures that are inherent to the portable hot oil tcu. This manual is not intended to supersede or alter safety standards established by the user of this equipment. Instead, the material contained in this section is recommended to supplement these procedures in order to provide a safer working environment.

At the completion of this section, the operator and maintenance personnel will be able to do the following:

- Identify and locate specific safety devices.
- Understand the proper use of the safety devices provided.
- Describe the function of the safety device.

Safety Circuit Standards

Safety circuits used in industrial systems protect the operator and maintenance personnel from dangerous energy. They also provide a means of locking out or isolating the energy for servicing equipment.

Various agencies have contributed to the establishment of safety standards that apply to the design and manufacture of automated equipment. The Occupational Safety and Health Administration (OSHA) and the Joint Industrial Council (JIC) are just a few of the organizations that have joined with the plastics industry to develop safety standards.

Every effort has been made to incorporate these standards into the design of the portable hot oil tcu; however, it is the responsibility of the personnel operating and maintaining the equipment to familiarize themselves with the safety procedures and the proper use of any safety devices.

Fail Safe Operation

If a safety device or circuit should fail, the design must be such that the failure causes a “Safe” condition. As an example, a safety switch must be a normally open switch. The switch must be held closed with the device it is to protect. If the switch fails, it will go to the open condition, tripping out the safety circuit.

At no time should the safety device fail and allow the operation to continue. For example, if a safety switch is guarding a motor, and the safety switch fails, the motor should not be able to run.

Safety Device Lock-Outs

Some safety devices disconnect electrical energy from a circuit. The safety devices that are used on these temperature control units are primarily concerned with electrical power disconnection and the disabling of moving parts that may need to be accessed during the normal operation of the machine.

Some of the safety devices utilize a manual activator. This is the method of initiating the safety lock out. This may be in the form of a plug, lever or a handle. Within this lockable handle, there may be a location for a padlock. Personnel servicing the equipment should place a padlock in the lockout handle.

In addition to the safety devices listed above, these temperature control units are equipped with a line cord plug. This allows the operator or maintenance personnel to unplug the tcu from its power source and tag it out. The plug can then be tagged with any number of approved electrical lockout tags available at most electrical supply stores.

WARNING! *Always disconnect and lockout all electrical power and pneumatic (i.e. compressed air) sources prior to servicing or cleaning the temperature control unit. Failure to do so may result in serious injury. No one but the person who installed the lockout may remove it.*



Chapter 3: Installation

3-1 Uncrating the Equipment

Portable hot oil temperature control units are shipped mounted on a skid, enclosed in a plastic wrapper, and contained in a cardboard box.

1. Pry the crating away from the skid.

Note: *Remove the nails holding the box to the skid and lift the box off carefully; avoiding staples in the 1' x 4' wood supports. Cut the steel banding.*

2. Use a pry bar to remove the blocks securing the unit to the skid.
3. Lift unit from sides. Use a pry bar if necessary to carefully remove the skid from the unit.
4. Lower slowly.

3-2 Rigging and Placing the TCU

Make sure that you meet the following requirements when installing and operating your Upright hot oil temperature control unit.

Installation Location Considerations

Locate the Upright unit as close as possible to the process for proper circulation and temperature control. Take care when selecting a location. The area surrounding the unit must be free of obstructions to ensure proper ventilation of internal components. Allow a minimum clearance of at least 30 inches (76 cm).

Make sure that the unit location is not in a confined space to ensure proper air circulation. Special air circulation/ventilation is required for units operating at temperatures exceeding 500°F (260°C). Vapors can escape from areas such as the reservoir tank during high temperature operation.

Caution!



Harmful vapors may be generated from thermal fluid during high temperature operation. Prolonged or repeated exposure of these heat-generated vapors may result in eye and respiratory tract irritation. Avoid contact or inhaling harmful amounts or material. Consult the Material Safety Data Sheet (MSDS) for precautions and instructions for the thermal fluid you are using.

Note: *Before storing your Upright temperature control unit, make sure you remove all residual water with compressed air to avoid a potential freezing hazard. See Section 5-2 on Page 39 for more information.*

Note the following table of ambient temperature ranges permitted for storage and operation:

Ambient storage range		Ambient operation range	
°F	°C	°F	°C
-40°F to 185°F	-40°C to 85°C	-4°F to 120°F	-20°C to 49°C

You should preheat the process heat transfer fluid first if you want to start the unit below an ambient temperature of 30°F (-1°C).

3-3 Electrical Connections

These units are designed for three-phase voltage operation. Refer to the unit nameplate for proper voltage and amperage requirements, and make sure your electrical service conforms.

Check the unit nameplate for correct voltage and amperage *before* making electrical connections!

Caution!

1. *Provide a correctly sized and protected power supply to the unit.*
2. *If an electrical supply disconnect is not installed as a factory option, the customer is responsible to properly size and install a suitable disconnect.*
3. *Refer to National Electric Code (NEC) 430-24-26 for proper feed conductor and supply disconnect sizing.*
4. *Voltages must be within plus or minus ten percent ($\pm 10\%$) of the nameplate rating.*
5. *Maintain a safe ground and disconnect the power supply before servicing the unit.*

A qualified electrician should make electrical connections and disconnect the electricity when service calls are needed.

- Locate disconnects in an easily accessible location. Operators should not have to squeeze around the Upright unit to reach disconnects, especially in case of emergency.
- When running conduit whips to the Upright unit, make sure that whips are routed away from hot piping.



DANGER! *Improper electrical connections can cause damage to the unit and cause serious operator injury or death! Make sure that ALL electrical connections are made by a qualified electrician, and that ALL connections are tight.*

Make all electrical supply connections at the front of the unit. An access panel covers all electrical connections. Run electrical connections to the supply terminals from either side of the unit. Make sure that all three phases are wired correctly. *The pump runs backwards if not wired properly.*

3-4 Setup Procedures

This section provides the procedures necessary for configuring your portable hot oil temperature control unit.

Configuration of your TCU includes connecting cooling, process and vent piping. We recommend that you carry out these procedures in the order given here.

Note: *Before carrying out these procedures, install all equipment as described in this section.*

Connecting Piping

Make sure that all external piping is properly sized to reduce external pressure drop as much as possible. Do not install process or water supply/drain piping smaller than the fittings on the unit. If the water supply piping is larger than unit fittings, reduce the pipe size at the unit.

The following table lists recommended Upright TCU pipe sizes.

Connection	Size diameter	
	inches NPT	mm (approx.) ①
To Process	1"	25.4
From Process	1"	25.4
Cooling Water Supply	¾"	19.1
Cooling Water Drain	¾"	19.1
Oil Drain	½"	12.7
Fill Port	1"	25.4

① Customer is responsible for converting to metric.

Note: *Always use a backup wrench to support Upright unit piping when making connections. Make sure all external piping is supported independently of the Upright unit.*

The manufacturer recommends that you have strainers installed on the cooling water inlets and customer-supplied shut-off valves on all piping connections. Use common black welded pipe for permanent installations.

The Upright is designed to operate with an open, unrestricted drain line. Steam rapidly expands within the heat exchanger, so any overpressure condition from backpressure or standing columns of water against the drain must be avoided.

If you must use a pipe joint compound, use a compound that can withstand the high temperatures and pressures of your Upright unit. Always insulate all piping to prevent burn hazards and to retain heat. Make sure insulation is properly rated for maximum operating temperatures of your Upright unit.

Piping Considerations for Mobile Installations

Because your Upright unit is fitted with casters, its portability is well suited for multiple applications. You can purchase high-quality flexible metal hose from the manufacturer to enhance the mobility of your Upright unit; state the length you want when ordering.

Although they cause a drop in pressure, you can also install quick disconnects to your Upright unit. However, do not install check valves with quick disconnects unless *absolutely necessary!*

Connecting Process Piping

When connecting process piping, ensure that the Cautions listed below are observed and followed:

Caution!

- *Hoses, valves and other components in your process must be able to withstand Upright unit maximum temperatures and pressures.*
- *Maximum temperatures and pressures are listed on the unit nameplate.*
- *Carefully inspect all components before installation.*
- *If in doubt about component suitability, obtain factory components.*
- *Fix all leaks! Fluid can be a potential fire and slip hazard.*

Connecting Cooling Water Piping

You must provide cooling water at 25 psi to 75 psi (172.4 kPa to 517.1 kPa/1.7 bars to 5.2 bars) for proper operation. Untreated water can foul or corrode the heat transfer surfaces, slowing water flow and causing fluid temperature control problems. The manufacturer sells a complete line of water treatment equipment that can reduce downtime and maintenance costs.

Run properly-sized cooling water lines—never smaller than the outlets on the Upright unit. If external piping is larger than Upright unit connections, reduce the size of the piping at the unit.

Connecting Vent Piping

You must leave the vent connection open to the atmosphere at all times. The vent connection is located on top of the reservoir. On systems with piping above the reservoir level, you must run vent piping to a minimum height of one foot (1' / 31 cm) above the highest point in the system. Run the piping down into an auxiliary vented overflow chamber, such as a vented, covered 55-gallon (208-liter) drum. This practice ensures that overflow will not create a hazard to personnel.

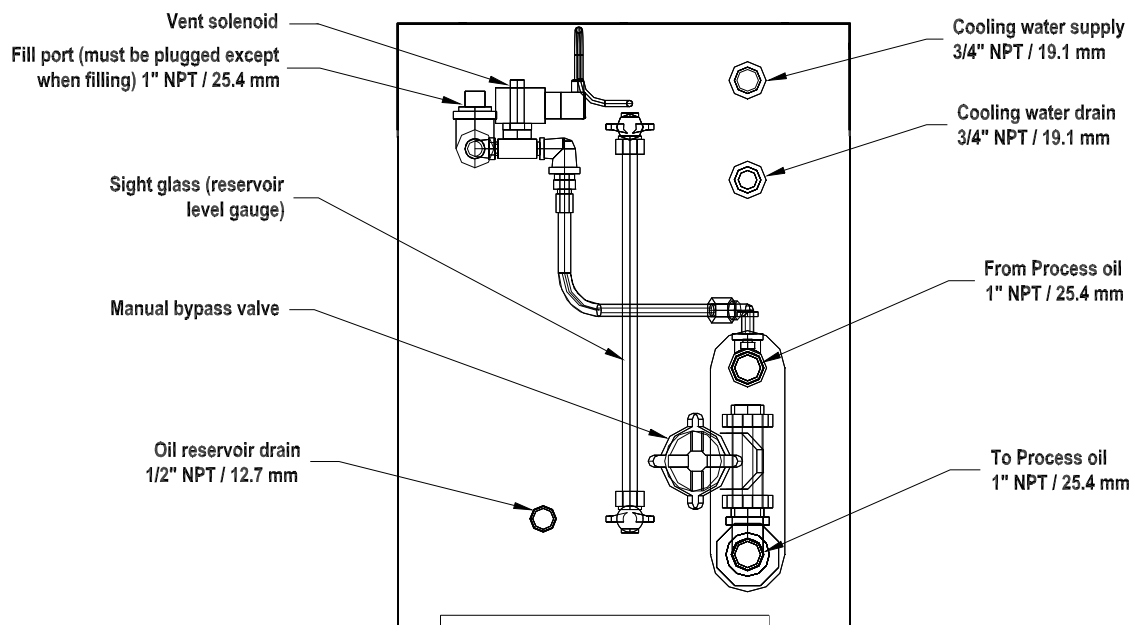
Note: All external piping must be supported independently of the Upright unit.

Caution! *The reservoir tank must be vented to prevent pressurization. A pressurized reservoir could rupture, allowing hot fluid to escape and become a potential fire and slip hazard.*

Note: Heat transfer fluids expand when heated. Expansion rates vary, depending on fluid types and temperatures. For more information on expansion rates, refer to specification information for the heat transfer fluid you select.

Generally, most heat transfer fluids expand at the rate of 2.5% for every increase of 50°F/°C from temperatures above 60°F (16°C).

Figure 1: Upright Unit Piping Setup



Connect the TO PROCESS hookup to the entrance of the process and the FROM PROCESS hookup to the exit of the process. Connect the COOLING WATER SUPPLY to your plant water supply. Connect the COOLING WATER DRAIN line to an open drain, or to the return line of your central water system. If returning to a central water system, use a condensate/return tank to avoid a standing water column on the heat exchanger drain line.

Caution! *If you are routing the drain line to an open drain, make sure that the line is directed away from personnel to avoid scalding.*

Carefully select connecting lines and connectors between the Upright unit and the process to best meet the needs and requirements of your application.

Make sure lines and connectors have a service rating of at least 100 psig (689.5 kPa/6.9 bars), and a temperature rating at least equal to the maximum operating temperature of your Upright unit.

Note: *To prevent debris from fouling reservoir fluid, the Upright unit is equipped with an internal vent on the reservoir tank. Use the plug provided to close off the external fill port after filling the unit with heat transfer fluid.*

3-5 Initial Start-up

Starting the Hot Oil TCU

Before you begin your heating process, perform the following startup procedures. Doing so ensures that all air is vented from the system to prevent fluid degradation and damage to the heater.

1. Add recommended heat transfer fluid to the reservoir tank until the level is near the top of the sight glass.
2. If so equipped, open the manual vent valve on the back of the unit.
3. Push the PUMP START button to start the pump, then check motor rotation by observing the pressure gauge.

If the gauge indicates positive pressure, rotation is correct. If not, disconnect power and reverse the incoming power leads.

4. As fluid is drawn out of the reservoir tank to fill the process, the fluid level falls in the tank. Continue to add fluid to maintain the level about four inches (4"/10 cm) from the bottom of the sight glass.

Air and thermal fluid vent through the vent solenoid or the manual vent valve and into the reservoir tank.

Caution! *You must purge the system of air before the heating cycle. Personal injury and system damage can occur from a pressurized system.*

Make sure that the reservoir tank vent port is not plugged. The reservoir tank must never be pressurized!

5. When the unit has built at least five (5) psi (34.5 kPa) of pressure, wait two (2) minutes, then select a set point of 100°F (38°C) and switch the unit into AUTO mode.

As the oil warms up, viscosity decreases and pressure falls.

6. Increase the set point to 150°F, then 200°F (65°C, then 93°C) at two-minute intervals.
7. Any water present in the system must boil off before continuing operation. Select a set point of 215°F (102°C) and observe the reservoir tank vent for any signs of escaping steam.

Continue to run at this set point temperature until no more steam appears and pressure stabilizes.

8. When fluid level stabilizes and the air and water are purged from the system, allow the vent timer to run out.

- or -

If so equipped, close the vent valve. Do not open the vent valve at temperatures exceeding 250°F (121°C).

With the system properly purged, only four to six inches (4" to 6" / 10 cm to 15 cm) of fluid should be visible in the sight glass. This lets the fluid expand as it heats, also permitting process fluid additional capacity when the pump reverses and fluid is withdrawn from the mold.

The Upright unit is now ready for use. All that is now required, is to select a process set point on the controller.

Note: If all traces of water are not removed from the system, severe cavitation may occur at elevated temperatures. Indications are a rough-sounding pump, fluctuating or dropping pressure, or a rapidly rising fluid level in the expansion tank. Repeat Step 3 if this occurs.

Chapter 4: Operation

4-1 Start-up

1. Push the PUMP START button to start the pump.
2. When the unit has built at least five (5) psi (34.5 kPa) of pressure, wait two (2) minutes, then select a set point of 100°F (38°C) and switch the unit into AUTO mode.
As the oil warms up, viscosity decreases and pressure falls.
3. Four to six inches (4" to 6" / 10 cm to 15 cm) of fluid should be visible in the sight glass.
4. Select a process set point on the controller.

4-2 Controller Description & Operation

The M2B+ controller is an easy-to-operate microprocessor-based PID control device. When the process reaches the set point, the PID control cycles the cooling valve and/or immersion heater to maintain the proper leaving temperature.

The controller has been fully factory tested. Set the desired process temperature set point and the controller does the rest.

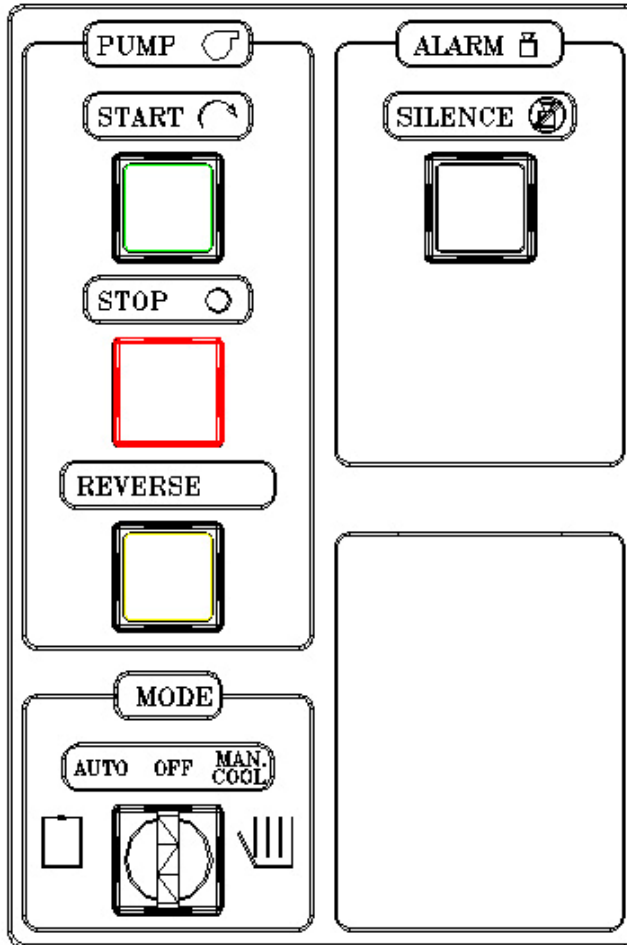
Built-in range of operation on the controller is **-4°F to 120°F (-20°C to 49°C)**.

Refer to the M2B+ Owner's Manual supplied with your unit for specific operation instructions.

Identifying Control Panel Switches

This section lists the descriptions and functions of the control panel switches. These switches control the operation of the unit.

Figure 4: Control Panel Switches



Pump Start. Press the START button to start the pump in the normal forward direction.

Pump Stop. Press the STOP button to stop the pump and de-energize the controller.

Caution!



Always press the Pump Stop button and allow the pump to come to a complete stop before pressing the Pump Reverse button.

Failure to let the pump stop before reversing may damage the pump and drive.

Pump Reverse. Press the REVERSE button to start the pump in the reverse direction. Use this feature to purge oil from the mold.

Vent Cycle Start. Press the VENT button to start the vent cycle timer. Use this feature to purge air and water from the unit and process.

Mode Select. With the pump running, you can select the AUTO position or the Maintained (manual cooling) position with the Mode Select switch. Select AUTO mode to energize the controller, permitting it to monitor and control the process. The switch automatically returns to the Center Default position when in AUTO mode. The switch stays in the Maintained position in Manual Cooling mode.



Caution! Always let the pump run for at least one (1) minute before switching to AUTO mode.

Never switch to AUTO mode when filling or venting the unit, except as described in the Unit Startup. Improper switching can seriously damage the heater, as it could become energized with air in the system.

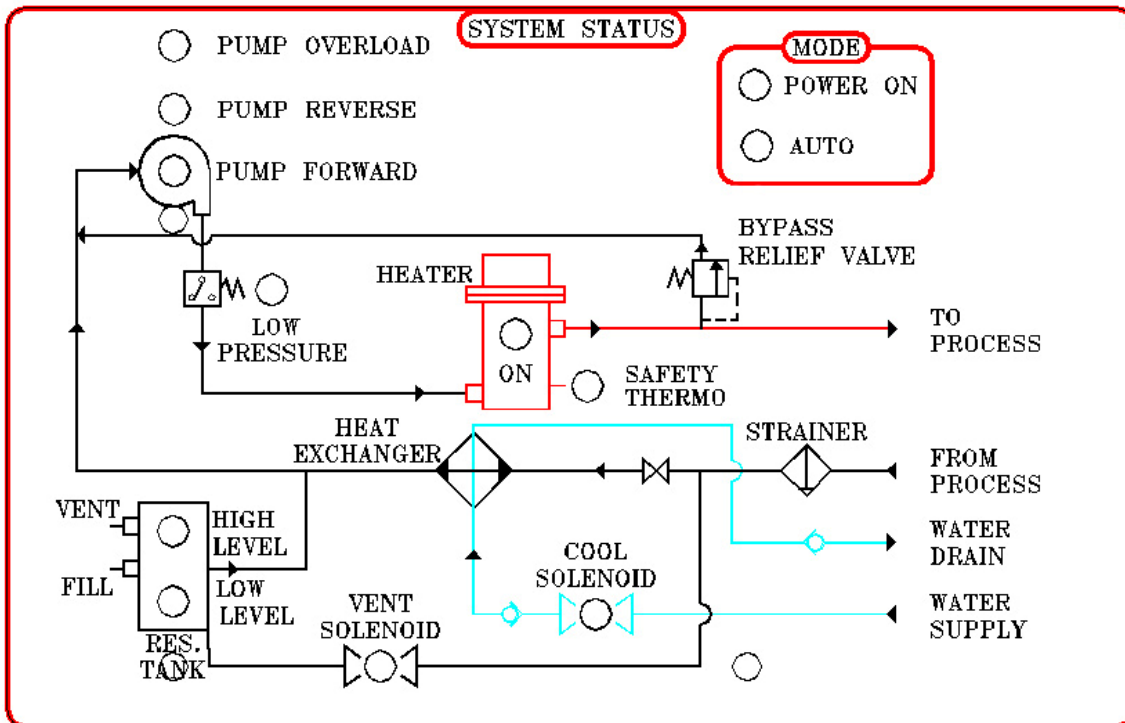
Alarm Silence. Press the ALARM SILENCE button to silence the audible alarm on the console.

Caution! After you silence the alarm, make sure you locate and correct the alarm condition before continuing with unit operation.

Identifying System Status Board Indicators

The system status board is located next to the controller panel. It displays indicator lights to show current operation status, letting you analyze system performance.

Figure 5: System Status Board Indicators



Use the status board to optimize unit performance. For example, if you observe a rapid cycling of the Heater and Cool Solenoid indicators, the unit is operating with a process inefficiency; see the Troubleshooting section for more information.

What follows is a description of system status board indicators.

Status Indicator Lights

Pump Reverse Indicator Light. The Pump Reverse indicator light illuminates when the unit pump runs in reverse.

Pump Forward Indicator Light. The Pump Forward indicator light illuminates when the unit pump runs in the normal forward direction. This indicator typically illuminates continuously during normal operation.

Heater On Indicator Light. The Heater On indicator illuminates when the heater energizes.

Cool Solenoid Indicator Light. The Cool Solenoid indicator illuminates when the cooling solenoid energizes. It is used only on the optional heat exchanger.

Vent Solenoid Indicator Light. The Vent Solenoid indicator illuminates when the venting solenoid energizes during venting sequences.

Mode Indicator Lights

Select the unit operating mode by using the selection switch.

Power On Mode Indicator Light. The Power On mode indicator light illuminates to indicate that the control circuit is energized in the unit.

Auto Mode Indicator Light. The Auto mode indicator light indicates that the Auto mode is active and the controller is monitoring the system and controlling the process.

If the Auto light is off and the Cool Solenoid indicator light is illuminated, the controller is disabled and the cooling solenoid is open, permitting maximum cooling.

If the Auto and Cool Solenoid indicator lights are off, the unit is in standby.

Fault Indicator Lights

Pump Overload Indicator Light. The Pump Overload indicator light illuminates when the pump is overloaded. *This is an alarm condition*, so the audible alarm activates to notify you of the pump overload fault, and the unit shuts down.

Note: *Always correct the alarm condition before returning to normal operation!*

Low Pressure Indicator Light. The Low Pressure indicator light illuminates when the unit has low heat transfer fluid pressure. *This is an alarm condition*, so the audible alarm activates to notify you of the low pressure fault, and disables controller outputs, permitting the pump to continue to circulate fluid to avoid damage. If low pressure continues past five minutes elapsed time, the pump shuts off.

Note: *Always correct the alarm condition before returning to normal operation!*

Safety Thermo Indicator Light. The Safety Thermo indicator light illuminates when the unit is overheating. *This is an alarm condition*, so the audible alarm activates to notify you of the safety thermo fault, and disables controller outputs, permitting the pump to continue to circulate fluid to avoid damage.

Note: *Always correct this alarm condition before returning to normal operation!*

High Level Indicator Light (Optional). The High Level indicator light illuminates when the heat transfer fluid level in the reservoir tank is too high. Carefully remove just enough fluid so this indicator light shuts off.

Low Level Indicator Light. The Low Level indicator light illuminates when the heat transfer fluid level in the system is too low. *This is an alarm condition*, so the audible alarm activates to notify you of the low fluid level fault, and the controller outputs are disabled.

Note: Always correct the alarm condition before returning to normal operation!

4-3 Returning Fluid to the Tank

If you want to move the unit from one process to another (like mold changes), perform the following steps to drain the mold and process lines.

Note: This procedure is just the opposite of the unit startup/air purge procedure.

1. Cool the heat transfer fluid to no more than 100°F (38°C).
2. If so equipped, open the manual vent valve to add air into the pipes.
3. Press the PUMP STOP button.
4. Press and hold the PUMP REVERSE button.

The pump runs in reverse, drawing fluid from the mold and lines, then drains the fluid into the reservoir tank.

5. Watch the sight glass to prevent overflow of the reservoir tank.

Caution! *The reservoir tank may not have adequate volume to contain the total system capacity of fluid.*

An overflowing reservoir allows hot fluid to escape and become a potential fire and slip hazard.

The total capacity of the tank is 7 gallons (26.5 liters).

If it appears that the tank may overflow, connect a line from the FILL port of the reservoir tank to a clean auxiliary container.

4-4 Shutting Down the Hot Oil TCU

1. Cool down the unit by switching the CONTROL MODE switch to the MAN. COOL (manual cooling) position.

This step disables the heaters (prevents the controller from turning them on) and, if so equipped, opens the Cool solenoid.

2. You can monitor fluid temperature on the controller display during cool-down.

When fluid temperature dips below 120°F (49°C), press the PUMP STOP button to turn off the unit.

Chapter 5: Maintenance

5-1 Maintenance Schedule

The checklist below contains a list of items which should be inspected and/or replaced to keep your Portable Hot Oil TCU operating at peak efficiency. Perform each inspection at the regular intervals listed below.

System model #						Serial #							
Every week	Date/By	Date/By	Date/By	Date/By	Date/By	Date/By	Date/By	Date/By	Date/By	Date/By	Date/By	Date/By	Date/By
Check fluid level. <i>add fluid as needed</i>													
Check connecting lines, hoses, & connectors for wear or damage.													

Every month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Check for leaks at pump seal, gaskets, etc.												
Check pump drive V belt for wear.												
Check reservoir tank vent for obstructions.												

Every Quarter	Next scheduled inspection	Actual inspection Date/By	Next scheduled inspection	Actual inspection Date/By
Check the heat transfer fluid for deterioration.				
Do a routine check of the fluid every 1,000 hours of operation or every three (3) months, whichever comes first. Contact the Service Department for information on fluid testing				

Every Six Months	Next scheduled inspection	Actual inspection Date/By	Next scheduled inspection	Actual inspection Date/By
Inspect electrical connections for secure, tight terminations and ground connections. Inspect the power cable at the entrance point to the electrical enclosure.				
Check the mounting bolts on the pump, the motor, and the heater flange for tightness				
Remove the heat exchanger tube bundle and check it for lime and mineral deposits. Carefully clean the bundle as needed.				

- Photocopy this page for your maintenance records -

5-2 Preventative Maintenance



WARNING! *Make sure that your maintenance technicians comply with lock-out/tag-out procedures during any servicing or maintenance of this unit and related equipment, per OSHA article ART 1910.147.*

Before you begin servicing this unit, disconnect all power to it, let the unit cool down completely, and turn off the water.

Failure to follow these directives can result in serious injury or death!

Routine Servicing

Your hot oil temperature control unit requires little in preventive maintenance and servicing. To keep it in good, reliable working order, make sure you follow the following scheduled preventive maintenance procedures.

Keep surfaces clean and free of any excessive accumulations of dirt, oil, or debris. This is especially true for the pump. It relies on free air circulation for proper cooling.

Check the motor air intake screen for any accumulation of dirt; clean it as needed.

Servicing the Unit Monthly or Every 500 Hours

- Lubricate the pump at the grease fittings with a high-quality lithium grease rated at 400°F (204°C) or higher. Use only Dow-Corning #44 or a high temperature grease rated at 400°F or higher that is compatible with Dow-Corning #44. *Do not over-lubricate.*
- Adjust the pump drive belt tension. Make sure that the motor pulley is properly aligned with the pump pulley; use a straightedge to check. Tighten motor mounting bolts after realignment.
- Inspect the screen in the Y strainer for accumulations of debris. Clean as needed.

Servicing the Unit Every Three Months

Remove and clean the screen in the Y-strainer. Replace the screen if it is damaged.

Draining the Unit for Storage

You should thoroughly flush and drain the Upright unit if you need to take it out of service for a long time, or if you expect it to become exposed to freezing temperatures. The manufacturer recommends using a flushing fluid or equivalent for flushing your Upright unit; follow unit flushing instructions that comes with the flushing fluid.

Drain plugs are provided at the base of the heater tank, reservoir tank, and on the pump. You should also remove, drain, and reinstall the heat exchanger tube bundle before storage.

Preventative Pump Maintenance

You can extend the life of your pump and reduce the cost per gallon pumped if you perform a few preventive maintenance procedures.

Lubricating the Pump

Using #2 ball bearing grease and a hand-operated grease gun, gently lubricate all grease fittings after every 500 hours of operation or after 60 days, whichever comes first. If pump service occurs in severe conditions, lubricate more frequently. Use an appropriate type of grease for hot or cold applications.

Adjusting End Clearance

After long periods of service, the running clearance between the end of the rotor teeth and head may be increased from wear. The pump may lose some capacity of pressure as a result. If you reset the end clearance, pump performance should improve.

Examining Internal Parts

Remove the head occasionally and examine the idler, bushing, head and pin for wear. Replace the idler bushing and idler pin after moderate wear to avoid replacing more expensive parts later.

Note: Make sure the idler doesn't slide off the idler pin during head removal to avoid damage and personal injury.

Cleaning the Pump

A clean pump is easier to inspect, lubricate, and adjust; it runs better and *looks better!*

5-3 Corrective Maintenance

Pumps and Seals

Each Upright unit is completely tested and calibrated before leaving the factory. The unit is then cooled, drained, and packed for shipment.

If the unit stands idle for a long time before being installed in your factory, gaskets can dry out and possibly leak when you start the unit. In most cases, these gaskets soon swell and form a tight seal. If not, you may need to tighten the bolts to stop the leak.

Similarly, rough handling in shipping may sometimes cause minor leaks upon startup; you may need to re-tighten bolts or fittings to stop the leak.

You should expect to periodically replace the pump seal. If the pump is properly lubricated and used at moderate temperatures, the seal should last several years. The following section describes the proper procedures for replacing the seal (Mechanical seal, part no. 162-00030-160). Periodic replacement of the pump drive V-belt is also to be expected.

Note: If the pump motor wiring is disconnected for removal from the unit, you must check the actual direction of rotation when the motor is rewired to the unit. Consult Elementary Diagrams provided in unit for additional information.

Maintaining the Pump

Disassembling the Pump

WARNING! *Before opening the pump chamber:*

- ***Make sure that any pressure in the chamber has been completely vented!***
- ***Make sure that the motor cannot be inadvertently started while you work on the pump!***

Failure to follow these precautions may result in serious injury or death!

1. Mark the head and casing before disassembly to insure proper reassembly. The idler pin, which is offset in the pump head, must be positioned toward and equal distance between port connections to allow for proper flow of liquid through the pump.
2. Remove the head from the pump. Do not allow the idler to fall from the idler pin. To prevent this from happening, tilt the top of the head back when removing. Avoid damaging the head gasket.
3. Remove the idler and the bushing assembly.
4. Insert a length of hardwood or brass through the port opening between the rotor teeth to keep the shaft from turning. Bend up the lockwasher tang with a spanner wrench. Remove the locknut and lockwasher from the shaft.
5. Loosen Allen head setscrews in the face of the thrust bearing assembly. Remove the thrust bearing assembly by threading out of the bracket.
6. Loosen the radial setscrews in the thrust bearing assembly and remove the end cap using the spanner wrench.
7. Remove the bearing spacer collars and the ball bearing.
8. Using snap ring pliers, remove snap ring from shaft.
9. Remove two nuts holding seal gland plate and seal gland in place. Slide seal gland off of the shaft being careful not to damage the lip seal.
10. Using a soft headed hammer, gently tap on the end of the rotor shaft until the rotor and shaft assembly can be completely removed from the pump. Note the mechanical seal may stick to the shaft causing initial resistance when the shaft is removed.
11. Remove the mechanical seal parts from the bracket.
12. Clean all parts thoroughly and examine for wear and damage. Check lip seals, ball bearing, bushings and idler pin and replace if necessary. Check all other parts for nicks, burrs, excessive wear and replace if necessary.
13. Wash bearings in clean solvent. Blow out bearings with compressed air. Do not allow bearings to spin; turn them slowly by hand. Spinning bearings will damage race and balls. Make sure bearings are clean, then lubricate with non-detergent SAE 30 weight oil and check for roughness. Roughness can be determined by turning outer race by hand.
14. Casing can be checked for wear or damage while mounted on bracket.

Pump Assembly

The seal used in this pump is simple to install. If you take care during installation, good performance will result.

The principle of the mechanical seal is to make contact between the rotary and stationary members. These parts are lapped to a high finish, and their sealing effectiveness depends on complete contact. When requesting special seal information, make sure that you give the pump model number and serial number.

1. Install bracket bushing if required. If bracket bushing has a lubrication groove, install bushing with groove at 6:00 o'clock position in bracket. If carbon graphite, Refer to Installation of Carbon Graphite Bushings, page 43.
2. Coat shaft of rotor shaft assembly with non-detergent SAE 30 weight oil. Start end of shaft in bracket bushing turning from right to left, slowly pushing rotor in casing.
3. Coat idler pin with non-detergent SAE 30 weight oil and place idler and bushing on idler pin in head. If replacing with carbon graphite bushing, Refer to Installation of Carbon Graphite Bushings, page 43.
4. Using a .010 to .015 inch head gasket, install head and idler assembly on pump. Pump head and casing were marked before disassembly to insure proper reassembly. If not, be sure idler pin, which is offset in pump head, is positioned toward and equal distance between port connections to allow for proper flow of liquid through pump. Tighten head capscrews evenly.
5. Place the mechanical seal installation tapered half rings over the shaft and apply P-80 oil supplied with the replacement seal, grease is not recommended on the sleeve and rotor shaft. Slide the rotating portion of the mechanical seal on the shaft until it bottoms on the shaft step. See FIGURE 7 in Appendix. Remove the seal installation tapered half rings. It is important when using the rings to make sure the thin edge is facing the direction of the shaft end, and that the thick end is facing the rotor.
6. Apply lubricant to the seal seat o-ring and push it in the bracket. Note the shiny side of the seat goes towards the carbon graphite seal face.
7. Apply Dow Corning #44 high temperature silicon grease to the lip seal area in the seal gland and install on the shaft. Install the seal gland plate and secure with two nuts.
8. Pack ball bearing with Dow Corning #44 high temperature silicon grease and install in the thrust bearing housing. Place bearing spacer collars inside the lip seals. Thread the end cap into the bearing housing and tighten with a spanner wrench. Tighten the radial set screws that lock the end cap in place.
9. Using the snap ring pliers, install the snap ring onto the shaft.
10. Thread the thrust bearing assembly into the bracket. Turn in until hand tight. This forces the rotor against the head.
11. Put lockwasher and locknut on shaft. Insert length of hardwood or brass through port opening between rotor teeth to keep shaft from turning. Tighten locknut to 50 – 70 ft.-lbs. torque and bend one tang of lockwasher into slot.
12. Adjust pump end clearance. Refer to section on Thrust Bearing Adjustment.
13. Lubricate all grease fittings with Dow Corning #44 high temperature silicon grease.

Thrust Bearing Adjustment

1. Loosen axial setscrews in face of end cap on the thrust bearing assembly. If rotor shaft cannot be turned by hand, back off the thrust bearing assembly until there is a noticeable drag of the shaft. Note mechanical seal will provide some drag and this is a normal condition. The thrust bearing assembly must be turned in until it can just be turned over by hand. This ensures the rotor is against the head and a zero end clearance condition exists.
2. Make a mark on the OD of the bearing housing and a corresponding mark on the bracket. Back off thrust bearing housing the required number of marks or distance on the OD as shown below.
3. Tighten the axial setscrews in the face of the thrust bearing assembly. Make sure the rotor shaft turns freely. If it does not, repeat steps 1 and 2.

PUMP SIZE	Turn Outer End Cap C.C.W.	
	No. of Notches*	or Length on O.D., Inches
G	-	0.75"
HL, HV	6	1"
KK	10	1.38"

*Each small notch on outer end cap represents .001 inch end clearance.

WARNING! *Before starting the pump, make sure that all drive equipment guards are in place!*



Failure to properly install the guards may result in serious injury or death!

Installation of Carbon Graphite Bushings

When installing carbon graphite bushings, extreme care must be taken to prevent breaking. Carbon graphite is a brittle material and easily cracked. If cracked, the bushing will quickly disintegrate. Using a lubricant and adding a chamfer on the bushing and the mating part will help in installation. The additional precautions listed below must be followed for proper installation:

1. A press must be used for installation.
2. Be certain bushing is started straight.
3. Do not stop pressing operation until bushing is in proper position. Starting and stopping will result in a cracked bushing.
4. Check bushing for cracks after installation.

Carbon graphite bushings with extra interference fits are frequently furnished for high temperature operation. These bushings must be installed by a shrink fit.

1. Heat bracket or idler to 750°F.
2. Install cool bushings with a press.
3. If facilities are not available to reach 750°F. temperature, it is possible to install with 450°F. temperature; however, the lower the temperature, the greater the possibility of cracking the bushing.

Chapter 6: Troubleshooting

6-1 Introduction

The utmost in safety precautions should be observed at all times when working on or around the machine and the electrical components. All normal trouble-shooting must be accomplished with the power off, line fuses removed, and with the machine tagged as out of service.

The use of good quality test equipment cannot be over-emphasized when troubleshooting is indicated. Use a good ammeter that can measure at least twice the AC and DC current that can be encountered for the machine. Be sure that the voltmeter has at least minimum impedance of 5,000 OHMS-per-volt on AC and 20,000 OHMS-per-volt on DC scales. Popular combination meters, VOM and VTVM can be selected to provide the necessary functions.

Before making haphazard substitutions and repairs when defective electrical components are malfunctioning, we recommend that you check the associated circuitry and assemblies for other defective devices. It is common to replace the obviously damaged component without actually locating the real cause of the trouble. Such hasty substitutions will only destroy the new component. Refer to wiring diagrams and schematics.

Locating mechanical problems, should they occur, is relatively straightforward. When necessary, refer to the parts catalog section.

Problem	Possible cause	Corrective action
Temperature fluctuations/rapid cycling from hot to cold.	Undersized connectors/lines.	Increase size of connectors/water lines.
	Long connecting lines between unit and mold.	Move the unit closer to the mold and shorten connecting lines.
	Serpentine flow through mold.	Connect lines for parallel flow instead of series flow.
	Blocked line in mold.	Check mold for metal chips or deposits. Clean mold.
	Quick disconnect fitting with check valve.	Remove and replace fitting or valve.
	Carbon build-up in unit piping or fittings.	Clean or replace affected piping. Replace fluid.
	Faulty TCU.	Check unit by opening the manual bypass to determine if the TCU controls the set point temperature.
	Reversed probes.	Switch Return and Delivery probes.

Problem	Possible cause	Corrective action
Unit does not heat properly/can not achieve set point.	Loss of fluid in process.	Check all lines/connections/fittings.
	Vent valve open.	Allow vent timer to run out; or, check valve operation when unit is cold by opening the fill port.
	Faulty/dirty solenoid valve; usually detected when there is a steady stream or trickle of water out of the drain line.	Switch to Manual Cool mode several times to flush valve. If the leak continues, disconnect the power to the unit, turn off the water supply, and clean or replace the solenoid.
	Degraded fluid.	Drain and replace fluid.
Unit does not heat.	Defective heater contactor.	Visual inspection of coil and contacts. Repair/replace defective contactors.
	Defective immersion heater.	Check resistance on all three (3) legs of heater with an ohmmeter. If not all equal, contact factory for replacement heater.
	Heater burnout.	Check heater tank for scorched/discolored paint. Check resistance on all three (3) legs of heater with an ohmmeter. Replace heater as needed.
	Controller heater output open.	Check the heater output with an ohmmeter to ground. It should read in the mega-ohm range. Infinite or zero readings indicate a defective output.
	Clogged Y strainer.	Clean Y strainer.
Unit overheats/unable to cool.	Water supply to unit is turned OFF.	Open water supply.
	Water drain is plugged or excessive back pressure in drain line.	Clear drain line or eliminate back pressure condition.
	Heat exchanger tubes plugged by lime deposits.	Remove tube bundles; clean/replace as required.
	Faulty solenoid valve.	Test solenoid valve by switching to Manual Cool mode and listen for valve operation. Replace if faulty.

Problem	Possible cause	Corrective action
Rapid drop in pressure/no pressure.	Leaks in connecting lines.	Inspect/replace faulty line or connection.
	Air in circulating lines.	Perform venting sequence in Chapter 3.
	Low fluid.	Check fluid level in sight glass. Add fluid if required.
	Defective Ful-Flo valve.	See Chapter 3.
	Water in fluid.	Drain water from low point in piping (see Chapter 3), or boil water off.
	Vent solenoid open.	Allow vent timer to run out; or, check valve operation when unit is cold by opening the fill port.
	Pump running in reverse.	Check motor; rewire if necessary. See electrical diagrams.
	Pump repair/adjustment needed.	Adjust head spacing or replace worn pump components.
	V belt broken/worn.	Replace as required.
Noisy pump.	Water in fluid.	Drain water from low point in piping (see Chapter 3), or boil water off.
	Severely degraded fluid.	Drain and flush system. Replace fluid.

Chapter 7: Appendix

7-1 Optional Components

The following is a list of options which your portable hot oil tcu may have been equipped with:

- Drain valve
- Hour meter; measures total pump run time hours
- General fault visual alarm
- Autovent sequence; deducts available
- Low level alarm; deducts available
- High level indicator light
- Manual bypass; deducts available
- M2B+ microprocessor controller options include:
 - 4-20 mA remote set point and retransmission
 - SPI protocol, RS-485
 - General protocols, types RS-232, -485
 - Remote sensor; 10 Ft. (3m)
- Heat exchanger options of 3.9 sq. ft. (0.3627 sq. m) and 6.7 sq. ft. (0.6231 sq. m)
- Remote controller
- Lexan cover
- Optional operating voltages of 208/3/60, 230/3/60, 575/3/60, 380/3/50, and 415/3/50

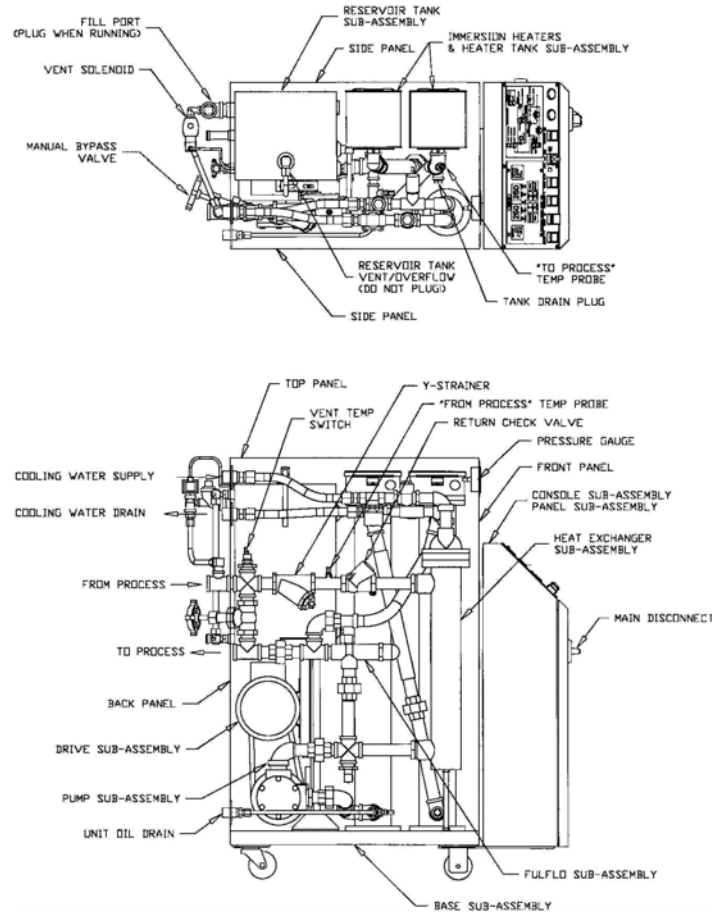
7-2 Technical Specifications

Annex B Information

The following design information is provided for your reference:

1. No modifications are allowed to this equipment that could alter the CE compliance
2. Ambient temperature: 40 degrees Celsius – Maximum (104 degrees Fahrenheit)
3. Humidity range: 50% relative humidity
4. Altitude: Sea level
5. Environment: Clean, dust-free and non-explosive
6. Radiation: None
7. Vibration: Minimal, i.e. machine mounting
8. Allowable voltage fluctuation: +/- 10%
9. Allowable frequency fluctuation: Continuous +/- 1%
10. Intermittent +/- 2%
11. Nominal supply voltage: 460/3/60 (Verify on serial number tag)
12. Earth ground type: TN (system has one point directly earthed through a protective conductor)
13. Power supply should include a ground connection.
14. Over-current protection is supplied in the tcu, but additional protection should be supplied by the user.
15. The door-mounted disconnect serves as the electrical disconnect device.
16. Tcu is not equipped with local lighting.
17. Functional identification
18. Tcu is equipped with a CE mark
19. Tcu is supplied with an operating manual in the language of the destination country.
20. Cable support may be required for power cord, depending on final installation.
21. No one is required to be in the interior of the electrical enclosure during the normal operation of the unit. Only skilled electricians should be inside the enclosure for maintenance.
22. Doors can be opened with a screwdriver, but no keys are required.
23. Two-hand control is not required or provided.
24. All tcus should be moved around and set in a place with a lift truck or equivalent.
25. There are no frequent repetitive cycles that require manual control—repetitive functions are automatic while the tcu is operating.
26. An inspection report detailing the functional test is included with the tcu.
27. The machine is not equipped with cableless controls.
28. Color-coded (harmonized) power cord is sufficient for proper installation.

Figure 6: Upright Series Hot Oil Portable Temperature Control Unit



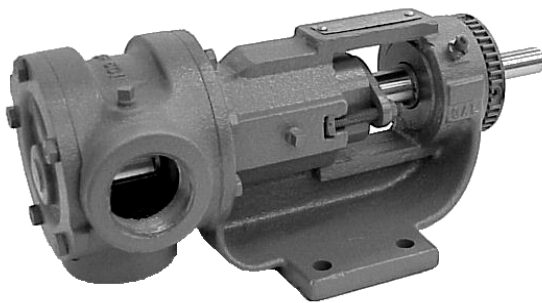
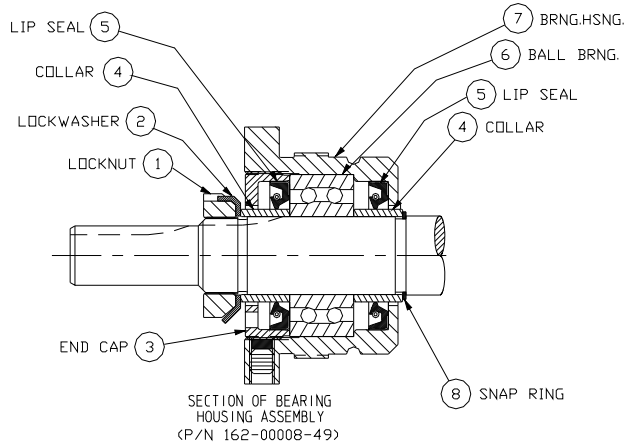
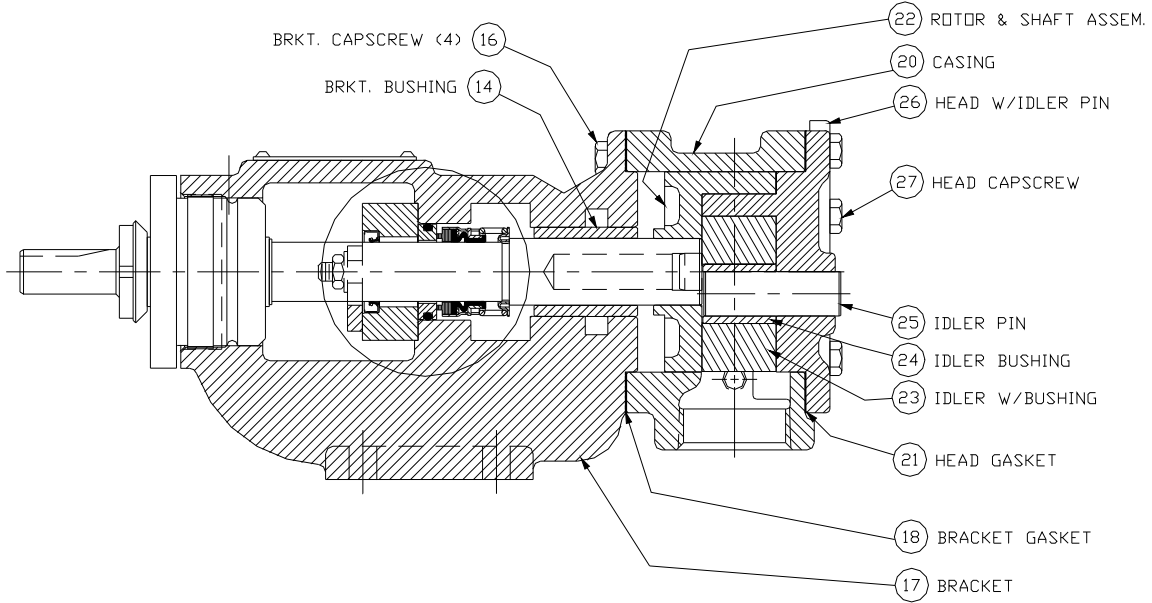
Upright Series Temperature Control Unit Specifications

Model number		Upright-			
		1	1.5	2	3
Full load amps; 460/3/60 VAC	12 kW heater	17	18	19	20
	18 kW heater	25	26	27	28
	24 kW heater	32	33	34	35
	36 kW heater	47	48	49	50
	48 kW heater	62	63	64	65
Reservoir capacity in gallons / liters		17 gallons each zone ①			
TEFC pump	hp (kW)	1 (0.75)	1.5 (1.1)	2 (1.5)	3 (2.2)
	Flow	gpm	18	24	50
		lpm	68	91	227
	Pressure	psig	30	50	30/50
bar		2	3.4	2/5.4	5.4
Connection size in inches		1"			1.5"
Dimensions in inches / (mm)	Height	62 (1,575)			
	Width	24 (610)			
	Depth	34 (864) ≤ 24 kW 44 (1,118) > 24 KW			
Shipping weight in lbs. / Kg	≤ 24 kW	700		850	
	> 24 KW	950		1,050	

① Each zone requires 15 gallons minimum to run properly.

7-3 Drawings and Diagrams

Figure 7: 18-24 GPM Pump Construction 075-00370-02



ITEM	QTY	DESCRIPTION	PART NUMBER
	1	BEARING HOUSING ASSEMBLY	162-00008-49
1	1	LOCKNUT	162-00008-35
2	1	LOCKWASHER	162-00008-40
3	1	CAP.END,BRG	162-00008-17
4	1	COL,SPCR,SET OF 2	162-00008-19
5	2	CLSR,BRG,HSG	162-00008-20
6	1	BRG,BALL	162-00008-14
7	1	HSG,BRG	162-00008-24
8	1	RING,SNAP	162-00030-108
9	1	BOLT,SEAL,HLDR	162-00030-160
10	1	SEAL,HLDR,FOR,VIKING,PMP	162-00030-159
11	1	SEAL,LIP	162-00030-153
12	1	PL,SEAL	162-00030-154
13	1	SL,MECH,HI,TEMP	162-00030-144
14	1	BUSH,BRKT	162-00008-98
15	-	-	-
16	1	CPSC,PRESS,RLF,VLV,SET OF 4	162-00008-18
17	1	BRKT&BUSH	162-00030-155
18	1	GSKT,FLNG,BACK	162-00008-09
19	3	PLUG,PIPE,STL,SQ,HD,SOLD,1/8	012-00001-00
20	1	CASING,HL,PMP	162-00008-47
21	1	GSKT,HEAD	162-00008-08
22	1	RTR&SFT,ASSY	162-00030-156
23	1	IDL&BUSH	162-00030-56
24	1	BUSH,IDL,GRAPHITE	162-00030-02
25	1	PIN,IDL	162-00008-36
26	1	PIN,HEAD&IDL	162-00030-92
27	1	CPSC,PRESS,RLF,VLV,SET OF 4	162-00008-18
28	1	NUT,PACK,GL,SET OF 2	162-00008-43

Figure 8: Thrust Bearing Assembly

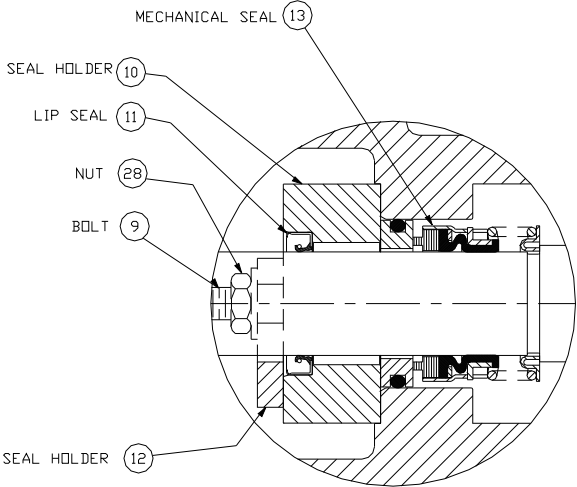


Figure 9: Belt Tensioning Instructions

How to increase Belt Life

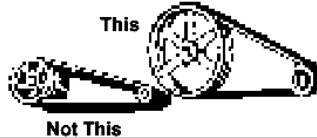
Keep sheaves and belts clean.
Abrasive dust, rust, oil and acids reduce service life.



Give drives elbow room.
Never let belts run against belt guards or other obstructions.



Use large diameter sheaves and fewer belts.
You save money and increase drive life.



Never force belts.
Move motor on adjustable base so belts can go on easily.



Eliminate slack.
Adjust motor and tighten belts in position. Slack belts wear excessively, cause slippage and deliver less power.



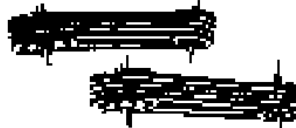
Use matched belts.
Matched belts run smoother and last longer because the load is evenly distributed. Never replace just part of a set of belts.



Avoid belt idlers.
Belt idlers decrease belt life! Always maintain proper tension through motor adjustment.



Mount belts straight.
Shafts must be parallel and sheave grooves in alignment to prevent unnecessary belt wear.



Don't overload.
An overloaded belt drive is like a one-ton truck with a two-ton load — both are sure to break down. Always use ample capacity.





⚠ WARNING

Operating drives without guards in place can result in severe injury or death.

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BELT TENSIONING INSTRUCTIONS

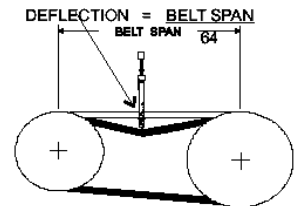


⚠ WARNING

Disconnect power before installation and maintenance. Failure to do so can result in severe injury or death.

1. Measure the belt span.
2. Calculate deflection
3. See tables below for correct deflection force.
4. Apply force at right angles to the center of the span (see diagram below). The BROWNING® belt tension checker, shown at left, is ideal for this procedure.
5. Check the tension at least twice during the first day of operation, and periodically thereafter.

Be sure — use the inexpensive BROWNING® Belt Tension Checker See Form 5453 for more detail.



The capacity of the BROWNING® belt tension checker is 35 lbs. Other means of applying force must be used if force requirement is greater than this.

**SHEAVE DIAM - INCHES
DEFLECTION FORCE - LBS.**

Belt Cross Section	Smallest Sheave Diameter Range	RPM Range	Belt Deflection Force			
			Super Gripbelts and Unnotched Gripbands		Gripnotch Belts and Notched Gripbands	
			Used Belt	New Belt	Used Belt	New Belt
A,AX	3.0 - 3.6	1000-2500 2501-4000	3.7 2.8	5.5 4.2	4.1 3.4	6.1 5.0
	3.8 - 4.8	1000-2500 2501-4000	4.5 3.8	6.8 5.7	5.0 4.3	7.4 6.4
	5.0 - 7.0	1000-2500 2501-4000	5.4 4.7	8.0 7.0	5.7 5.1	8.4 7.6
B,BX	3.4 - 4.2	860-2500 2501-4000	-	-	4.9 4.2	7.2 6.2
	4.4 - 5.6	860-2500 2501-4000	5.3 4.5	7.9 6.7	7.1 6.1	10.5 9.1
	5.8 - 8.6	860-2500 2501-4000	6.3 6.0	9.4 8.9	8.5 7.3	12.6 10.9
C,CX	7.0 - 9.0	500-1740 1741-3000	11.5 9.4	17.0 13.8	14.7 11.9	21.8 17.5
	9.5 - 16.0	500-1740 1741-3000	14.1 12.5	21.0 18.5	15.9 14.6	23.5 21.6
D	12.0 - 16.0	200-850 851-1500	24.9 21.2	37.0 31.3	-	-
	18.0 - 20.0	200-850 851-1500	30.4 25.6	45.2 38.0	-	-
3V,3VX	2.2 - 2.4	1000-2500 2501-4000	-	-	3.3 2.9	4.9 4.3
	2.65 - 3.65	1000-2500 2501-4000	3.6 3.0	5.1 4.4	4.2 3.8	6.2 5.6
	4.12 - 6.90	1000-2500 2501-4000	4.9 4.4	7.3 6.6	5.3 4.9	7.9 7.3
5V,5VX	4.4 - 6.7	500-1740 1750-3000 3001-4000	-	-	10.2 8.8 5.6	15.2 13.2 8.5
	7.1 - 10.9	500-1740 1741-3000	12.7 11.2	18.9 16.7	14.8 13.7	22.1 20.1
	11.8 - 16.0	500-1740 1741-3000	15.5 14.6	23.4 21.8	17.1 16.8	25.5 25.0
8V	12.5 - 17.0	200-850 851-1500	33.0 26.8	49.3 39.9	-	-
	18.0 - 22.4	200-850 851-1500	39.6 35.3	59.2 52.7	-	-

7-4 Spare Parts List

Immersion Heaters

Part number	Description
722-00138-07	HTR, IMM, 12 KW, 208 V, 3", 6 ELE
722-00138-08	HTR, IMM, 12 KW, 240 V, 3", 6 ELE
722-00138-09	HTR, IMM, 12 KW, 380 V, 3", 6 ELE
722-00138-10	HTR, IMM, 12 KW, 415 V, 3", 6 ELE
722-00138-11	HTR, IMM, 12 KW, 480 V, 3", 6 ELE
722-00138-12	HTR, IMM, 12 KW, 600 V, 3", 6 ELE

Note: 6KW heaters are modified 12 kW heaters; jumpers are remove from one leg.

Heater Gasket

Part number	Description
542-00007-08	GASKET, FLANGE, 3

Heater Tank

Part number	Description
572-87548-00	TANK, HEATER, Upright, 3½

Manual Reset Safety Thermostat

Part number	Description
724-00041-00	THERMOSTAT, 200°F — 550°F

Note: Please give model and serial numbers when ordering parts. Prices are subject to change without notice.

Pressure Gauge

Part number	Description
037-00119-00	GAUGE, PRESSURE, 0 — 100 PSI

Optional Heat Exchangers; Tube Bundle Only

Ass'y. part no.	Tube bundle only part no.	Description
106-00267-00	162-00047-10	3.9 SQ. FT. Upright 550°F
106-00268-00	162-00047-11	6.7 SQ. FT. Upright 550°F

Pilot Lights

Part number	Description
715-10074-00	PILOT, LED, 120 V, RED, N-12, 36", LEAD
715-10075-00	PILOT, LED, 120 V, AMBER, N-12, 36", LEAD
715-10076-00	PILOT, LED, 120 V, GREEN, N-12, 36", LEAD

Casters

Part number	Description
042-00016-00	CASTER, SWIVEL, 3"
042-00017-00	CASTER, STATIONARY, 3"

Manual Reset Safety Thermostat

Part number	Description
724-00041-00	THERMOSTAT, 200°F — 550°F

Sight Glass Assembly

Part number	Description
037-00046-00	GLASS, SIGHT, 15¾

Note: Please give model and serial numbers when ordering parts. Prices are subject to change without notice.

Controllers

Part number	Description
601-00521-06	CONTROLLER, M2B, 550°F
724-00589-01	CONTROLLER, STERLCO 4000

Selector Switches and Push Buttons

Part number	Description
721-01028-00	PUMP STOP
721-01027-00	PUMP START
721-01026-00	ALARM SILENCE
717-01016-00	MODE SELECT
721-01026-00	VENT
721-01029-00	PUMP REVERSE
717-10055-00	HALF-FULL HEAT, LOCAL-REMOTE (OPTIONAL)

Pressure Switches

Part number	Description
733-00029-00	SWITCH, PRESSURE

Pump

Part number	Description
075-00370-01	MECH. SEAL, VIKING HL4125 (0-30 GPM)

Motors

Part number	Description
720-09240-00	MOTOR, 1 HP 3/60/208, 230, 460 V
720-09242-00	MOTOR, 1½ HP 3/60/208, 230, 460 V
720-09218-00	MOTOR, 2 HP 3/60/208, 230, 460 V

Note: Please give model and serial numbers when ordering parts. Prices are subject to change without notice.

Solenoid Valves

Part number	Description
732-00007-03	¼" VALVE, 115 V COIL (0-125 PSI, 300°F)
732-00013-01	¾" VALVE, 115 V COIL (0-125 PSI, 300°F)

Sensing Probe Equipment

Part number	Description
692-07369-05	HEAT & COOL, M2B
701-00003-00	TYPE 'I' THERMOCOUPLE

Disconnect Switches

Part number	Description
728-00153-00	SWITCH, DISCONNECT, 45 AMP
728-00168-00	SWITCH, DISCONNECT, 100 AMP

Heater Tank Insulation

Part number	Description
542-88062-00	INSULATION, TANK, HEATER

Ful-Flo Relief Valves

Part number	Description
044-00239-00	VALVE, RELIEF, FUL-FLO, 1"

Breather Cap

Part number	Description
161-00072-00	CAP, BREATHER, 1"

Note: Please give model and serial numbers when ordering parts. Prices are subject to change without notice.

7-5 Returned Material Policy

Credit Returns

Prior to the return of any material **authorization** must be given by **the manufacturer**. A RMA number will be assigned for the equipment to be returned.

Reason for requesting the return must be given.

ALL returned material purchased from **the manufacturer** returned is subject to 15% (\$75.00 minimum) restocking charge.

ALL returns are to be shipped prepaid.

The invoice number and date or purchase order number and date must be supplied.

No credit will be issued for material that is not within the manufacturer's warranty period and/or in new and unused condition, suitable for resale.

Warranty Returns

Prior to the return of any material, authorization must be given by **the manufacturer**. A RMA number will be assigned for the equipment to be returned.

Reason for requesting the return must be given.

All returns are to be shipped prepaid.

The invoice number and date or purchase order number and date must be supplied.

After inspecting the material, a replacement or credit will be given, at **the manufacturer's** discretion. If the item is found to be defective in materials or workmanship, and it was manufactured by our company, purchased components are covered under their specific warranty terms.

7-6 Safety Tag Information

TCU Safety Tags



Hot!



**Read Operation
and Installation
Manual**



**High Voltage
Inside Enclosure**



Earth Ground



Lifting Point



**Protected Earth
Ground**

7-7 TCU Identification (Serial Number) Tag

(Located on back of TCU)

Company Logo	
	XXX Series TCU Model Number XXX-030 Max Heating/Cooling Capacity HR
460V	Serial Number 060701R
1Ø	Date of Manufacture 06/2003
4.5A	
Over-current Protection Device (s) 4.5A Total	
Frequency 50/60Hz	
Compressed air supply None	
TCU Mass 400 lbs/(180 KG)	
Electrical Diagrams & Pneumatic Diagram	<input type="text"/>
Street Address	City, State Zip Code
Telephone Number	

7-8 Technical Assistance

Parts Department

Call toll-free 7am–5pm CST [800] 423-3183 or call [262] 641-8610, Fax [262] 641-8653
The ACS Customer Service Group will provide your company with genuine OEM quality parts manufactured to engineering design specifications, which will maximize your equipment's performance and efficiency. To assist in expediting your phone or fax order, please have the model and serial number of your unit when you contact us. A customer replacement parts list is included in this manual for your convenience. ACS welcomes inquiries on all your parts needs and is dedicated to providing excellent customer service.

Service Department

Call toll-free 8am–5pm CST [800] 423-3183 or call [262] 641-8610
Emergencies after 5pm CST, call [847] 439-5655
We have a qualified service department ready to help. Service contracts are available for most of our products.

Sales Department

Call [262] 641-8610 Monday–Friday, 8am–5pm CST
Our products are sold by a world-wide network of independent sales representatives. Contact our Sales Department for the name of the sales representative nearest you.

Contract Department

Call [262] 641-8610 Monday–Friday, 8am–5pm CST
Let us install your system. The Contract Department offers any or all of these services: project planning; system packages including drawings; equipment, labor, and construction materials; and union or non-union installations.