INSTRUCTION MANUAL

Iceman Heater/Chiller System
Low Temperature

2150 Elmwood Avenue - Buffalo, NY 14207
P# 716-876-9951 - F#716-874-8048 - www.mokon.com

MOK4001D 03/20

Table of Contents

Portable Chiller and Full Range Systems
Quick Start-Up Checklist

Please verify that the product received matches the product ordered and that the equipment is designed for the intended application. The following quick checklist is an abridged version - always refer to the Mokon Manual provided for additional data and requirements prior to the commissioning of the unit.

✓ Electrical Inspection

- ❑ Verify amp draws and voltage on serial tag match electrical service being supplied.
- ❑ All electrical termination points checked for tightness.
- ❑ Electrical wiring completed and disconnect sized and installed per code and compliance.
- ❑ Motor rotation verified, motor(s) and compressor(s) bumped.
- ❑ Verify any remote control wiring is complete.

✓Mechanical Inspection

- ❑ Mechanical fittings tight.
- ❑ Unions tight.
- ❑ Compression fittings tight.
- ❑ Insure Supply, Drain and Process connections are connected properly and operating pressure does not exceed ratings.

✓ Refrigeration Inspection

- ❑ Insure all refrigeration work has been completed by a certified refrigeration technician.

✓ Location and Good Standard Installation Practices

- ❑ Confirm safe access to equipment for maintenance, removal and lockout- tag out.
- ❑ Insure equipment is designed for the installed environment.
- ❑ Water-cooled condenser - Confirm water supply to condenser, if City water use 1.5 GPM/Ton, if Cooling Tower water use 3 GPM/Ton.
- ❑ Air-cooled condenser - Confirm there is no short-circuiting of exhaust air into intake of condenser.
- ❑ Allow a minimum of 4 feet (1.2 meters) on all four (4) sides to allow for proper ventilation of condenser.
- ❑ Unobstructed heights above systems vary from 5 feet (1.5 meters) to 20 feet (6 meters). See user's manual for recommendations. Please use extreme caution when dealing with hot surfaces.
- ❑ If systems are to be installed side by side where one system will be exhausting hot air on the next unit, they should be spaced apart a minimum of 15 feet (4.6 meters) for proper & efficient operation.
- ❑ Proper non-automotive glycol mixture is being used for selected temperature range under 50°F (10°C).

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Notice

Addition of glycol required!!

Due to the operating range of this equipment, it is possible that glycol will need to be added **prior** to startup.

The chiller zone controller on this system is factory set at 50°F. **If you lower this setting, glycol must be added to the system.** Failure to do so may result in a freeze-up.

If you have any questions regarding the addition of glycol to this system please contact the Mokon Customer Service Department at 716-876-9951.

Section 1 – Warnings and Cautions

Please read and understand this manual before operating the system!

1.1 Electrical Warning

The Mokon heater/chiller system, as with all high voltage electrical equipment, should be connected according to all local and national codes. All installation, maintenance, service, repair, adjustment, and operation should be done only by qualified trained electrical personnel who have read and completely understood this instruction manual. To the upper right is a symbol for **ELECTRICAL DANGER**. When it is seen on the following pages of this manual as well as on the system, care should be taken to avoid possible electric shock. All maintenance and service should be performed with the power isolated and locked out except where noted.

1.2 Evaporator Freeze-Up Caution

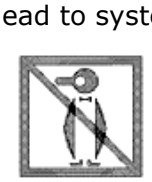
Protect the evaporator on the Mokon heater/chiller system from freeze-up. Evaporator temperatures are 10˚F - 15˚F (-2° to -9˚C) lower than the coolant temperature shown on the thermostat or the temperature controller. **Standard systems are set to operate between 50˚F – 180˚F (10˚C – 82.22˚C) for open circuit systems, and 50˚F – 250˚F (10˚C – 121.11˚C) for closed circuit systems (with a heat exchanger), but are engineered to operate as low as 20°F (-7˚C). Unless your system was set to operate <u>below</u> 50°F (10˚C) at the time of purchase, <u>do not attempt to operate your Mokon heater/chiller system below 50˚F (10˚C) without first contacting the Mokon customer service department</u>. It will be necessary to derate the capacity of the system, change the default settings, and add glycol to the Mokon heater/chiller system. For 300°F (149˚C) operation of the heating system, a pressurized tank for the process loop is required.**

Do not use automotive antifreeze in the Mokon heater/chiller system due to waxy deposits that will form on the internal components at lower temperatures, reducing efficiency. <u>Using automotive antifreeze will void your warranty!</u>

Only pure ethylene glycol/water mixture should be used. Mokon recommends that a food coloring die be added to signify that glycol is present in system. The glycol should have a corrosion inhibitor added to reduce the risks of metalic degradition.

NOTE: The automatic fill option should not be used when system operating temperatures are below 50◦F. The glycol in the reservoir tank will become diluted which will lead to system freezing.

1.3 Cold Weather Caution



If the Mokon heater/chiller system will be moved from your plant and will be subjected to freezing temperatures, the water in the system must be completely drained and/or sufficient antifreeze (not automotive antifreeze) added to prevent serious water damage from freezing.

1.4 Hot Fluid Warning

Exercise **EXTREME CAUTION** while working on or in the area of the Mokon heater/chiller system. The high temperature of the fluid will cause the process lines, the system components, and the metal cabinetry to become **VERY HOT** and therefore should **NOT** be touched. To the upper right is a symbol for **SURFACE MAY BE HOT, HIGH TEMPERATURE.** When it is seen on the following pages of this manual, care should be taken to avoid possible burns. All maintenance and service must be performed with the system completely cooled. It is advisable to plug the process ports of any unused zones so that if a wrong button is pressed, fluid will not be pumped through them.

1.5 Overhead Piping Warning

When overhead piping is connected to a Mokon heater/chiller system equipped with an open reservoir or non-pressurized expansion tank there is risk of overflow of the system's reservoir tank upon shutdown, this is due to the back flow of fluid volume from the overhead piping system. To prevent reservoir tank overflow an overhead piping kit should be installed. This kit is available from Mokon as an option.

1.6 Reservoir Tank Overflow Connection

A reservoir tank overflow connection is supplied on all Mokon heater/chiller systems with an automatic fill option. Should the automatic fill option malfunction the overflow connection will protect the system against an overflow condition. This connection is clearly labeled on the system and must be plumbed to a non-pressurized open drain connection.

1.7 Short Circuit Current Rating Caution

Equipment supplied with a safety door disconnect or power cord is design rated for a short circuit current rating (SCCR) of 10,000 amperes RMS if protected with a class "J" fuse.

1.8 No Flow Warning

It should be noted that if any external valves are installed in the process flow path, they must be opened before starting the Mokon temperature control system or risk causing serious damage to the system and the process.

Fluid must be established (flowing) through the Mokon temperature control system in order for the safety features to work properly and adequately protect the Mokon temperature control system. The use of valves downstream of the Mokon temperature control system are not recommended as they could potentially render the system safeties inoperative if closed. This could cause serious system damage and would void the warranty. To avoid disabling the standard safety features, please contact Mokon to discuss optional safety features that may be required to adequately protect the assembly.

1.9 Non-Potable Water System

This system has been designed for use in <u>non-potable</u> water applications only. For applications requiring potable water use please contact Mokon directly to discuss a product offering.

Section 2 – Installation

2.1 Unpacking

Upon arrival inspection should be done to assure there was no damage during shipping. In addition, all electrical and mechanical connections should be inspected to insure that they are secure and tight. This includes all electrical terminations, mechanical fitting union hubs, compression fittings, etc.

Note: Refer to Section 4.1 Preventative Maintenance.

Properly rated equipment should be used to move this machinery.

When removing system from pallet, lift from bottom only. Care should be taken to ensure that the system will not tip. After removing from pallet, the system should only be placed on a level surface.

2.2 Location

Mokon systems should be located in an area that provides adequate space for pedestrian and vehicle traffic. If this is not feasible, owner should provide additional safeguards including safety signs.

For optimum system performance, allow adequate space and ventilation around entire system, as well as a means to direct vapors away from work area.

There should be a minimum of four (4) feet of clearance around the entire Mokon system (all sides) for adequate ventilation and operation of the system.

If multiple systems (air-cooled) are installed side by side a minimum of fifteen (15) feet of clearance is required between systems for proper operation.

Recommended unobstructed heights above the system as follows:

- Up to 3 Ton Systems – 5’
- 5-10 Ton Systems – 10’
- 15 Ton and greater Systems – 20’

If braking casters are included, they must be in the locked position when system is in the operating position. Prior to moving, unlock the casters.

Customer supplied and installed air vents (mechanical or electrical) should be placed at the highest point in the process for application where the process height is greater than eight (8) feet above Mokon system.

2.3 Warnings

Owner should ensure by adequate supervision that correct safety, installation, maintenance and operating procedures described in this manual, as well as recognized industry practice, are followed by all personnel.

All panels must be in place during normal operation.

The top of the machinery should not be used for storage.

Power sources or energy types referred to in this manual are water, glycol and electricity.

This machinery is not for use in hazardous or explosion proof environments.

Under normal operating conditions, the decibel level of the machinery is 85 db or lower from 5' away from the system. When operating the system, hearing protection is recommended.

Any alteration, additions or modifications to any part of the system must receive prior written approval from Mokon's Engineering or Customer Service Departments.

Refer to serial tag for motor and heater electrical information and schematic drawing number.

2.4 Electrical Connections

Warning: The Mokon heater/chiller system, as with all high voltage electrical equipment, should be connected according to all applicable state and local codes. All installation, maintenance, service, repair, adjustment, and operation should be done only by qualified trained electrical personnel who have read and completely understood this instruction manual.

Before operating the Mokon heater/chiller system, the grounding wire must be connected. The grounding wire is the green or green and yellow wire connected to the frame of the system.

Connect ground wire to the ground screw (labeled PE) located in the electrical box. Connect power lines L1, L2, L3, to disconnect switch or terminal blocks marked L1, L2, and L3 respectively, inside the electrical box. Overcurrent protection of the supply conductors should be sized according to The National Electrical Code (NEC) and any other applicable state and local codes.

2.5 Fluid Connections

Following are the fluid connections for the Mokon heater/chiller system. **Connect each port with full size, unrestricted, insulated hose or pipe**. The hose or pipe should be equivalent in diameter to the port and rated for a minimum of 150 PSI (689 kPa) and 300°F (148.89°C).

Process Fluid Connections (All Systems)

There are two process fluid connections, "To Process" and "From Process" located on the back of the system.

To Process: Connect this port to the process inlet; through temperature controlled water will enter the process. Use full size unrestricted high temperature hose or pipe.

From Process: Connect this port to the process outlet, through which temperature controlled water will leave the process. Use full size unrestricted high temperature hose or pipe. **The fluid returning from the process must have a temperature of lower than 180°F (82.22°C) unless the system is a true closed circuit system with a heat exchanger.**

For units with a direct feed option, there are two direct process connections located on the back of the system.

Direct Feed To: Connect this port to the process inlet for direct feed chilled fluid.

Direct Return From: Connect this port to the process outlet for direct feed fluid return.

NOTE: Mokon recommends that you install a strainer on the "from process" line and "direct feed from" to prevent contamination from the process to enter the heater/chiller. These strainers are available from the Mokon factory.

Reservoir Tank Overflow Connection

A reservoir tank overflow connection is supplied on all systems with an automatic fill option. Should the automatic fill option malfunction the overflow connection will protect the system against an overflow condition. This connection clearly labeled on the system and must be plumbed to a non-pressurized open drain connection.

Condenser Cooling Water Connections (Water Cooled Systems Only)

Condenser cooling water may be obtained from city or tower water supplies. The water usage is dependent on the tonnage of the system. Variation in the cooling water temperature will lead to variation in water usage. Mokon recommends that you install a strainer on the condenser water supply line to eliminate any unnecessary fouling. The connections for the condenser cooling water are located in the back of the system, labeled "Supply Water" and "Drain Water".

Supply Water: Connect this port to an adequate source of cold, clean supply water. Do not restrict incoming water to the condenser.

Drain Water: Connect this port to drain. Do not restrict outgoing water from the condenser.

2.6 Filling Reservoir Tank

- Isolate and lock out all power sources.
- Remove the top panel of the Mokon heater/chiller system.
- Remove the lid to the reservoir tank.
- Fill the reservoir tank to a minimum of 3/4 full of water or water/glycol mixture. Use of glycol **IS REQUIRED FOR OPERATION BELOW 45ºF**. The table below lists the correct glycol/water mixtures for operating at temperatures below 45ºF.

  Warning: The use of "ultra" pure fluids (de-ionized, de-mineralized, etc.) in the standard Mokon systems is prohibited and will void the systems warranty.

  Please contact the Mokon factory for further recommendations.

  Warning: Use a pure ethylene glycol/water mixture with a corrosion inhibitor in the Mokon heater/chiller system. Do not use automotive antifreeze! Automotive antifreeze will cause damage to the system, <u>voiding your warranty</u> and result in reduced efficiency.

- After the Mokon heater/chiller system is operating and all lines to the process and within the chiller are full, maintain a minimum 3/4 full tank level. This will require the addition of more water or water/glycol to the tank after start up. The table below is for reference only.

Water/Glycol mixture

Fluid temperature from system	% Glycol	% Water
10°F to 0°F (-12°C to -18°C)	40	60
0°F to -20°F (-18° to -29°C)	50	50

NOTE: Evaporator temperatures are 10°F – 12°F (-12°C to -11°C) lower than process fluid temperatures.

NOTE: Standard systems are set to operate between 10˚F to -10˚F (-12˚C to - 23˚C), but are engineered to operate as low as - 20°F (-29˚C). Do not attempt to run the chiller without adding freeze protection.

Section 3 – Operation

The Mokon heater/chiller systems are designed by integrating a Mokon temperature control system with a portable chiller system in the same framework. The system provides a complete temperature range of -10˚F – 180˚F (-23.33˚C – 82.22˚C) for open circuit (direct cooling) systems and -10˚F – 250˚F (-23.33˚C – 121.11˚C) for closed circuit (indirect cooling) systems with a heat exchanger. For 300°F (149˚C) operation of the heating system, a pressurized tank for the process loop is required.

Due to the use of high-pressure refrigerant and to ensure proper operation of the system, several safety devices are standard on the Mokon portable chiller system. **Only a qualified refrigeration technician should be allowed to service the system.**

3.1 Initial Starting Procedure

After all connections are made and the reservoir tank is filled as described in Section 2.6, the Mokon heater/chiller system is ready to be started.

NOTE: Prior to starting process pump wait for chiller temperature to be achieved. Or wait for chiller to come to setpoint prior to starting process pump.

NOTE: The total number of start/stop buttons on the Mokon heater/chiller system may vary for "standard" vs. "custom" system designs.

Three (3) Button Systems: Standard systems will be equipped with three (3) start/stop buttons labeled supply pump, process pump, and compressor.

Two (2) Button Systems: Custom designs will include systems designed for low temperature operation as well as remote start/stop buttons vs. local. These systems will have two (2) start/stop buttons labeled chiller and process pump.

Four (4) Button Systems: Four (4) start/stop button systems are the same as three (3) button standard systems but with a second heating "process" zone.

- For "initial start-up" it is recommended to turn on the main electrical disconnect **for at least 12 hours before starting the Mokon heater/chiller system.** This will preheat the compressor oil and liquid refrigerant helping to protect the compressor.

  If the power has been disconnected more than 2 hours and less than 3 where the Mokon disconnect switch is in the "off" position, power to main electrical disconnect is recommended **for at least 4 hours before starting the Mokon heater/chiller system.** This applies if the ambient air temperature is above 60°F (15.5°C), and the system is located indoors. If the system is not located indoors or the ambient air temperature is lower than 60°F (15.5°C), refer to the initial start-up instructions.

  If power disconnection to the compressor is longer than 3 hours refer back to initial start-up instructions above.

  Ideally, it is recommended that power be applied to the system continuously except for service purposes.

  It is recommended that the crankcase heater should be checked for proper operation on a regular basis.

Warning: During normal operation the compressor can get very hot which can cause burns. Do not touch the compressor or any of the refrigeration system piping during operation or if the system has been in operation.

- Remove both side panels for access to, and observation of, the system.
- For water-cooled condensing systems, turn on the water flow to "supply water" connections. (See Section 2.5 for Fluid Connections)
- Check the chiller supply pump rotation using the following procedure (for 3 phase systems – not necessary for single phase systems):
    - Three Button Systems: momentarily press the "supply pump start" button (the green light will illuminate) then press the "supply pump stop" button (the green light will go off).

      Two Button Systems: momentarily press the "chiller" start button (the green light will illuminate) then press the "chiller" stop button (the green light will go off).

      Four Button Systems (Systems Equipped with Two Heating Zones): momentarily press the "supply pump start" button (the green light will illuminate) then press the "supply pump stop" button (the green light will go off).
    - Check the rotation of the supply pump by viewing the motor armature through the louvers on the back of the motor as it slows down. The armature should be turning clockwise from the lead (rear) end.
    - If the rotation is incorrect, deactivate the power supply to the Mokon portable chiller system and switch any two power cord wires (L1, L2, L3) on the inlet of the disconnect switch.
- Three and Four Button Systems: restart the supply pump. The supply pump should provide 35 - 45 PSIG (241 - 310 kPa) of pressure to the heating zone pump(s). For 300°F (148.89°C) systems, the supply pump should provide 60 PSI. Allow the fluid to circulate for a few minutes to eliminate air pockets from the lines. This will decrease the possibility of cavitations.

  Two Button Systems: the supply pump is linked to the "chiller" start/stop button, pressing this button will energize the supply pump.
- Three and Four Button Systems: turn on the compressor by pressing the "compressor start" button (the green light will illuminate).

  Two Button Systems: the compressor is linked to the "chiller" start/stop button, pressing this button will energize the compressor.

NOTE: Phasing of the compressor is verified at the Mokon factory and should not be tampered with in anyway. If compressor phase verification is required contact the Mokon customer service department for instructions. Failure to do so will void your system's warranty.

Warning: Do not run the scroll compressor in reverse direction.

- Check the refrigerant pressure for the proper reading. The normal high-pressure reading is 150 - 300 PSI (1379 - 2068 k Pa) for R-22/R-407C or 110 – 230 PSI (758 - 1586 k Pa) for R-134A dependent on load. The normal low-pressure reading is 60 – 85 PSI. If the pressures are other than these, **CONSULT THE MOKON FACTORY**.

Normal low pressure gauge readings

Chilled fluid temperature	**Nominal low pressure gauge reading**
	R-507
60°F (16°C)	35 PSIG (241kPa)
50°F (10°C)	35 PSIG (241kPa)
40°F (4°C)	35 PSIG (241kPa)
30°F (-1°C)	35 PSIG (241kPa)
20°F (-7°C)	35 PSIG (241kPa)
10°F (-12°C)	35 PSIG (241kPa)
0°F (-18°C)	25 PSIG (172kPa)
-10°F (-23°C)	18 PSIG (124kPa)
-20°F (-29°C)	11 PSIG (76kPa)

NOTE: Some Mokon heater/chiller systems can be designed to operate up to 300°F (149°C). Please refer to the serial tag for the maximum operating temperature.

- Start the heating zone(s) by pressing the "process pump start" button (green light will illuminate).

- Set the controller to the desired temperature. (See Section 5 for Controller Instructions)

3.2 Changing Temperature Setting

If a new temperature setting is required while the system is in operation, adjust the controller to the new desired set point temperature. (See Section 5 for Controller Instructions)

3.3 Shut Down Procedure

Cool the Mokon heater/chiller system down by reducing the setpoint temperature to 100°F (38°C) or lower. **DO NOT SHUT THE SYSTEM OFF AT ELEVATED TEMPERATURES, THIS CAN BE DETRIMENTAL TO SYSTEM LIFE.**

When the system is cooled:

- Turn off the heating zone(s) by pressing the "process pump stop" button (the green light will go off).

- Turn off the compressor by pressing the "compressor" stop button on a three and four button system or the "chiller" stop button on a two button system (green light will go off).

- Allow the pump to run for 2 to 3 minutes to allow for the refrigerant in the evaporator to boil off.

Note: When the power is turned off to the system, the compressor crank case heater is also turned off which will hamper the system's ability to burn off liquid in the compressor which will result in damage to the compressor.

- Turn off the supply pump by pressing the "supply pump" stop button on a three and four button system or the "chiller" stop button on a two button system (the green light will go off).

- The main electrical power and the supply water (for water-cooled systems) to the Mokon heater/chiller system may be turned off if the system is being relocated or for prolonged shut down.

3.4 Restarting Procedure

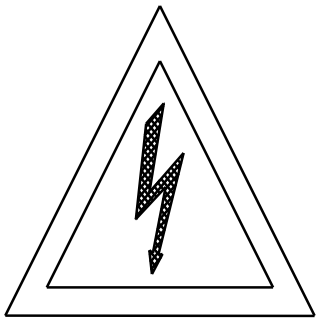
- If the water lines and main electrical power have not been disconnected, refer to Section 3.1.

- If the water lines and/or the main electrical power have been disconnected, refer to Section 2.4 for Electrical Connections, Section 2.5 for Fluid Connections, and Section 3.1 for Initial Start-Up Procedure.

Section 4 – Maintenance and Service

Warning: The maintenance and service procedures included in Sections 4.1 – 4.12 require that all power sources to the Mokon heater/chiller system be shut off, isolated and locked out (exceptions noted). Follow all local and national codes and procedures for working on electrical equipment. Failure to do so could result in injury or death. Only qualified electrical personnel should install, maintain, repair, adjust, and operate Mokon heater/chiller systems. The instruction manual furnished with the system should be completely read and understood before system maintenance.

The following hazard warning symbols will be used to denote a specific hazard associated with a procedure.



Electrical Danger

High Temperature
Surface May Be Hot

High Voltage &
Hot Surface

4.1 Preventative Maintenance

Mokon heater/chiller systems are designed for a long, trouble free service life under a variety of conditions, with a minimum of maintenance. Performing the following preventative procedures will extend the life of your system. Refer to Section 4.1 - 4.12 in the instruction manual for specific adjustment or service procedures. Refer to the condensed parts list included in Section 8 of the instruction manual for proper replacement parts if required.

The preventative maintenance section is broken into weekly, monthly, and every three months checks. Associated with each check is a series of corrective procedures that may solve a problem detected in the check. If the corrective procedures do not resolve a problem detected in the check, see the trouble shooting guide in Section 7 for a complete list of corrective measures.

Heater Section

Electrical Preventative Maintenance

Weekly Checks	Corrective Procedures
Check electrical box interior components for any discoloration, or any burn marks	Correct component wiring
	Verify voltage and frequency stamped on system matches customer supply voltage and frequency
	Correct excessive system load (current draw)
	Verify customer supply voltage is balanced and fluctuations are within 15% of nominal
	Verify wire gauge for main power hookup is properly sized
	Replace components if needed
Check for blown fuses	Replace with the correct size and style fuse
For units with solid state contactors, inspect the screen covering the fan inside the electrical enclosure	If clogged with debris, clean or replace the screen. If not cleaned or replaced excessive heat build up can occur in the electrical enclosure reducing component life and wiring. System warranty will be void.
Monthly Checks	**Corrective Procedures**
Check that the high temperature switch (TS) has a set of N.O. and N.C. contacts, and it is properly wired	Replace the switch if necessary
Check that the low pressure switch (PS) has a set of N.O. and N.C. contacts, and it is properly wired	Replace the switch if necessary
Every 3 Months Checks	**Corrective Procedures**
Check that the interior electrical and mechanical components are securely fastened to the back panel, and/or to the sides of the electrical box	Tighten with proper tooling
Check that the ratings of overload protection (such as fuses and circuit breakers) adequately protect the line's maximum current carrying capacity	Inspect/replace fuses
	Inspect/replace motor starter overloads
Check the fuses against the electrical schematic for proper size according to the systems voltage	Replace if different
Slightly tug on each wire / conductor to make sure it makes a solid contact to its attached component. Pay close attention to the green grounding wires.	Tighten with proper tooling

Pump/Motor and Mechanical Connections Preventative Maintenance

Weekly Checks	Corrective Procedures
Check for foreign materials obstructing airflow in the motor and pump area	Remove all dust, lint, grease or oil with a cloth and/or brush
Check the motor rotation is correct by observing the direction of rotation through the grillwork on the motor (Power On then Off)	Reverse any two incoming power cord leads to correct rotation
Monthly Checks	**Corrective Procedures**
Check that all bolts and screws are securely tightened	Tighten with proper tooling
 Check for plumbing leaks	Repair solder joints
	Replace necessary parts if leaks persist
Visually check all threaded fittings for signs of leakage	Tighten with proper tooling
	Replace necessary parts if leaks persist
Check that the motor current draw matches the serial tag rating	Correct motor wiring
	Verify supply voltage is balanced and fluctuations are within 15% of nominal
 Check gauge readings on the cabinet (Power On)	Verify suction or discharged line not partially clogged
	Verify no restrictions in process or supply lines
	Replace gauge(s) if needed
Semi Annual Checks	**Corrective Procedures**
Check that all threaded fittings within the fluid loop are securely tightened	Tighten with proper tooling
	Replace necessary parts if leaks persist

Miscellaneous Preventative Maintenance

Monthly Checks	Corrective Procedures
Check that the heater current draw matches the serial tag rating	Verify heater wiring stake-on is secured
	Correct heater wiring
	Verify customer supply voltage is balanced and fluctuations are within 15% of nominal
	Replace elements if necessary
Check that the "Warning," "High Voltage," "Caution," and lamicoid labeling are adhering to the correct locations	Replace torn, damaged or missing labels
 Check that all applicable lights, gauges, and optional indicators are functioning properly (Power On)	Replace necessary components
 Check the cooling solenoid operation by elevating setpoint temperature manually. While in the heating mode, push the manual air purge button. Listen for the cooling solenoid's audible energizing and de-energizing "clicking sound." Observe process temperature decreasing. (Power On)	Using a Voltmeter, determine if solenoid coil is energizing
	Replace solenoid valve, if necessary
 Check the controller calibration by setting the controller for three random setpoints within the operating range of the system. Observe that the process temperature output is within the accuracy of the controller. (Power On)	Calibrate Controller using Section 5 in the instruction manual (Power On)
	Verify the thermocouple wires at controller are secure
	If controller does not respond to any of the above steps, consult the Mokon factory **Do not attempt repairs as the warranty could become void.**
 Check the system for leaks at operating temperatures. As the system reaches the setpoint temperature, visually check for leaks. Pay close attention to the heater elements. (Power On)	Repair leaks and/or tighten fittings
	Replace necessary parts

Chiller Section

Electrical Preventative Maintenance

Weekly Checks	Corrective Procedures
Check electrical box interior components for any discoloration, or any burn marks	Correct component wiring
	Verify voltage and frequency stamped on system matches customer supply voltage and frequency
	Correct excessive system load (current draw)
Check voltage and current capacities	Verify customer supply voltage is balanced and fluctuations are within 15% of nominal
	Verify wire gauge for main power hookup is properly sized
	Replace components if needed
Slightly tug on each conductor to make sure it makes a solid contact to its attached component. Pay close attention to the green grounding wires.	Tighten with proper tooling
Every 3 Months Checks	**Corrective Procedures**
Check that the interior electrical and mechanical components are securely fastened to the back panel, and/or to the sides of the electrical box	Tighten with proper tooling
Check that the ratings of overload protection (such as fuses and circuit breakers) adequately protect the line's maximum current carrying capacity	Inspect/replace fuses
	Inspect/replace motor starter overloads

Pump/Motor and Mechanical Connections Preventative Maintenance

Weekly Checks	Corrective Procedures
Check for foreign materials obstructing airflow in the motor and pump area	Remove all dust, lint, grease or oil with a cloth and/or brush
Monthly Checks	**Corrective Procedures**
Check that all bolts and screws are securely tightened	Tighten with proper tooling
Check that the motor current draw matches the serial tag rating	Correct motor wiring
	Verify supply voltage is balanced and fluctuations are within 15% of nominal
Visually check all threaded fittings for signs of leakage. **Note:** If refrigeration oil has visibly leaked from the refrigeration loop plumbing, it must be repaired only by a qualified refrigeration technician.	Tighten with proper tooling
	Contact Mokon customer service or a qualified refrigeration technician
	Replace necessary parts if leaks persist
Semi Annual Check	**Corrective Procedures**
The system's internal and external hoses and clamps should be inspected	Tighten with proper tooling
Check that all threaded fittings within the fluid loop are securely tightened. **Note:** If refrigeration oil has visibly leaked from the refrigeration loop plumbing, it must be repaired only by a qualified refrigeration technician.	Tighten with proper tooling
	Contact Mokon customer service or a qualified refrigeration technician
	Replace necessary parts if leaks persist

Miscellaneous Preventative Maintenance

Monthly Checks	Corrective Procedures
 Check that all applicable lights, gauges, and indicators are functioning properly (Power On)	Replace necessary parts
 Check the system for leaks at operating temperatures	Repair leaks and/or tighten fittings
	Replace necessary parts
Check that the "Warning," "High Voltage," "Caution," and lamicoid labeling are adhering to the correct locations	Replace torn, damaged or missing labels
Check the condenser coil (air-cooled systems) is free of dirt and debris	Vacuum, blow clean, or chemically clean

4.2 Pump Maintenance

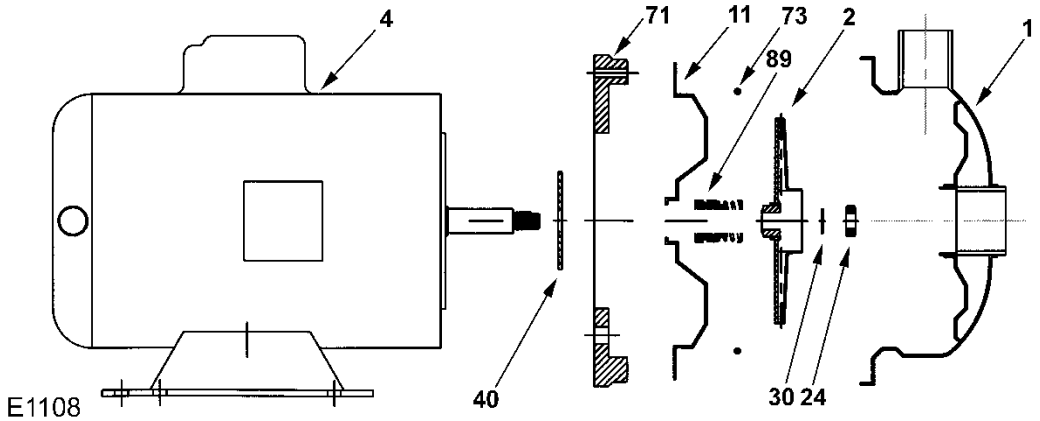
Heater Section

Models: DN, DO, DR, DT, DU, DW, DY, DZ, HN, HR, HW, HX, HY, HZ

Exploded View Drawing Models:
DN, DO, DR, DT, DU, DW, DY, DZ

REF. NO.	QTY.	DN 3 HP	DO 5 HP	DR 1.5 HP	DT ¾ HP	DU 5 HP	DW 3 HP	DY 1.5 HP	DZ ¾ HP	DESCRIPTION	PART #
1	1									CASE 1.25 x 1 NPT	018266
	1	✓		✓	✓		✓	✓	✓	CASE 1.25 X 1 NPT	018268
	1		✓			✓				CASE 1.5 x 1.25 NPT	018267
2	1				✓				✓	IMPELLER 4.88", STAINLESS	018275
	1			✓				✓		IMPELLER 5.25", STAINLESS	018276
	1	✓					✓			IMPELLER 6.3", STAINLESS	018277
	1		✓			✓				IMPELLER 6.3", STAINLESS	018342
4	1	✓	✓	✓	✓	✓	✓	✓	✓	MOTOR 56J	CONSULT FACTORY
11	1	✓	✓	✓	✓	✓	✓	✓	✓	COVER, STAINLESS	018269
24*	1	✓	✓	✓	✓	✓	✓	✓	✓	NUT	018270
30*	1	✓	✓	✓	✓	✓	✓	✓	✓	D-WASHER	018371
40*	1	✓	✓	✓	✓	✓	✓	✓	✓	FLINGER	018272
71	1	✓	✓	✓	✓	✓	✓	✓	✓	DISC IRON	018273
73*	1	✓	✓	✓	✓	✓	✓	✓	✓	GASKET, CASE	018274
89*	1	✓	✓	✓	✓	✓	✓	✓	✓	SEAL, 5/8"	IN REPAIR KIT

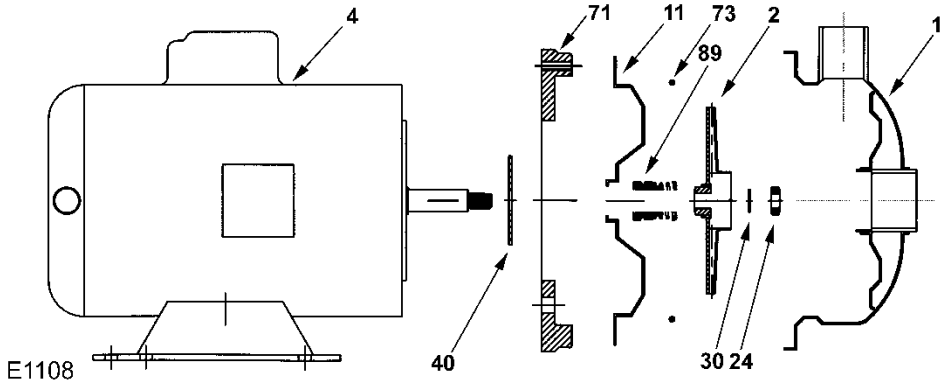
*** - DENOTES COMPONENTS INCLUDED IN REPAIR KIT 018246.**



Models: HN, HR, HW, HX, HY, HZ

REF. NO.	QTY.	HN 3.0 HP	HR 1.5 HP	HW 2.0 HP	HX 1.0 HP	HY ¾ HP	HZ ½ HP	DESCRIPTION	PART #
1	1	✓	✓	✓	✓	✓	✓	CASE 1.25 x 1 NPT	018266
2	1				✓	✓		IMPELLER 4.88", STAINLESS	018275
	1						✓	IMPELLER 4.0", STAINLESS	018498
	1		✓	✓				IMPELLER 5.25", STAINLESS	018276
	1	✓						IMPELLER 6.3", STAINLESS	018277
	1							IMPELLER 6.3" STAINLESS	018342
4	1	✓	✓	✓	✓	✓	✓	MOTOR 56J	CONSULT FACTORY
11	1	✓	✓	✓	✓	✓	✓	COVER, STAINLESS	018269
24*	1	✓	✓	✓	✓	✓	✓	NUT	018270
30*	1	✓	✓	✓	✓	✓	✓	D-WASHER	018371
40*	1	✓	✓	✓	✓	✓	✓	FLINGER	018272
71	1	✓	✓	✓	✓	✓	✓	DISC IRON	018273
73*	1	✓	✓	✓	✓	✓	✓	GASKET, CASE	018274
89*	1	✓	✓	✓	✓	✓	✓	SEAL, 5/8	IN REPAIR KIT

*** - DENOTES COMPONENTS INCLUDED IN REPAIR KIT 018246.**



Seal Replacement/Maintenance

Warning: Make certain that the system is disconnected from the power source in compliance with all local and national codes before attempting to service or remove any components. Never run the pump when dry.

Maintenance:

Inspection: Pump should be periodically checked for proper operation. If the system has changed or if the pump is operating noisily or erratically, then the pump should be removed and examined. It should be repaired and parts replaced as necessary.

Cleaning: Remove oil, dust, dirt, water, chemicals from exterior of pump and motor. Blow out interior of open motors with clean compressed air at low pressure. Regularly drain moisture from TEFC motors.

Draining: If the pump is located in an area subject to freezing temperatures, the pump must be drained when not in operation or add sufficient antifreeze.

Seal Replacement:

Disassembly:

- Turn off power.
- Close suction and discharge valves (if equipped).
- Drain pump.
- Remove bolts holding base to foundation.
- Remove casing bolts.
- Remove motor and rotating element from casing, leaving casing and piping undisturbed, if possible. If not, then remove the whole assembly.
- Insert a screwdriver in one of the impeller waterway passages and back off the impeller nut (Ref 24).
- Remove motor shaft end cap. Insert a screwdriver in slot of motor shaft. While holding shaft against rotation, unscrew impeller (Ref 2) from shaft by turning counterclockwise when facing impeller.
- Pry off rotating member of mechanical seal from motor shaft by using two (2) screwdrivers. Be careful not to damage the pump cover (Ref 11).
- Remove pump cover (Ref 11 & 71) from cast iron disc. (There is no hardware used to attach cover to disc.) Place cover on a flat surface with convex side down. Push out stationary member of mechanical seal. It is not necessary to remove the cast iron disc from the motor to replace the seal.

Reassembly:

Caution: The mechanical seal is a precision product and should be handled accordingly. Use care when handling lapped running surfaces of the mechanical seal to ensure they remain clean and are free of chips or scratches.

- Clean gasket and flange faces, seal seat cavity and shaft, in particular, shaft shoulder fitting against impeller.
- Lubricate the seal seat cavity of the cover and the rubber cup or O-ring of stationary seal seat with the lubricating fluid that comes with the mechanical seal or repair kit. Press the stationary seat in seal seat cavity in the cover squarely and evenly using an arbor press (if possible) and the cardboard disc supplied with the seal. Be certain that the lapped face (shiny side) is facing you.
- Position the cover (Ref 11) so that the convex side with the lapped seal seat is facing you. Place the cover on the motor disc and align the holes in the disc with the holes in the cover. (Note: There isn't any hardware required to attach the cover to the motor disc.)
- Apply the lubricating fluid that comes with the mechanical seal or repair kit to the motor shaft and the rubber bellows of the rotary seal. Slide the seal head on the shaft; press the rubber drive band on the rotary head until the lapped face on the head seats firmly against the lapped face of the stationary seat. Install seal spring on head and seal spring retainer on spring. Do not chip or scratch faces during installation. Take extra care to make sure the lapped faces are clean.
- Hold shaft against rotation as described in step 8 of disassembly procedure, then thread impeller on shaft until it is tight against the shaft shoulder. The impeller will compress the seal spring to the proper length assuring correct pressure on lapped faces.
- Replace D-washer (Ref 30) and impeller nut (Ref 24) holding impeller against rotation as indicated in step 7 of disassembly procedure.
- Remove any burrs caused by screwdriver on the vane of impeller in waterway passages.
- Replace motor and rotating element in casing. Be sure that any damaged O-rings are replaced.

  - or -

  If whole assembly was removed install O-ring on cover. Be sure that any damaged O-ring is replaced.
- Position case (Ref 1), cover (Ref 11), and motor disc (Ref 71) so the holes line up. Install socket head cap screws through the case and cover and thread into motor disc. Tighten all cap screws alternately and evenly until finger tight.

  - Or -

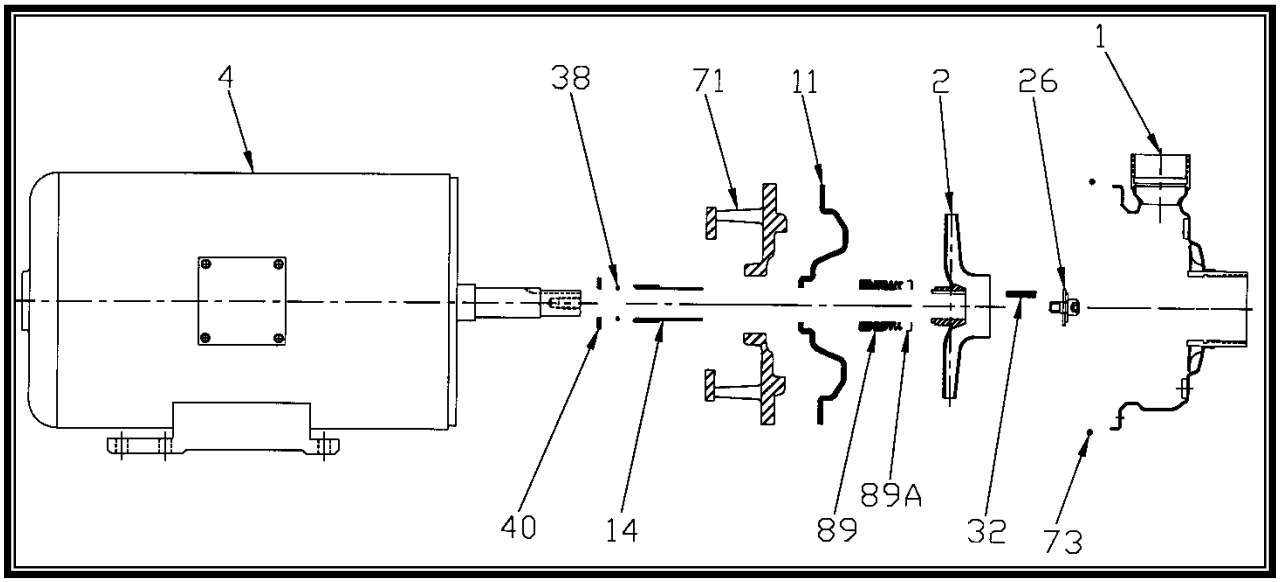
  When whole assembly is removed place pump casing against pump cover. Ensure that impeller eye is centered in pump case and position case, cover and motor disc so that the holes line up. Install socket head cap screws through the case and cover, thread into motor disc. Tighten all cap screws alternately and evenly until finger tight.
- Finish tightening the cap screws alternately and evenly to approximately 6 ft. lbs. torque. Note: It is imperative that screws be tightened alternately and evenly, as this action centers the cover in the casing, assuring proper alignment. Binding of the impeller in the case and adaptor may occur if the cap screws are not tightened as listed above.
- Replace hold-down bolts.
- Check for free rotation after assembly is completed.
- Replace motor shaft end cap.
- Seal all drain openings using pipe sealant on threads.
- Re-prime before starting. Do not start until pump is completely filled with water.

Models: DP, DQ, DV, DX

Exploded View Drawing

REF.	QTY REQ.	DESCRIPTION	PART NUMBER
1	1	CASE, 236, 2.0" X 1.5" NPT	018310
2	1	IMPELLER, 236, 304SS, 6.3" DIAMETER	018311
4	1	MOTOR, 7.5 HP, 3/60/208-230/460, 3500 ODP	Contact Factory
	1	MOTOR, 10.0 HP, 3/60/208-230/460, 3500 ODP	Contact Factory
11	1	COVER	018312
14*	1	SHAFT SLEEVE	018313
26*	1	IMPELLER RETAINER	018314
32*	1	KEY	018315
38*	1	SHAFT O-RING	018316
40*	1	FLINGER	018317
71	1	ADAPTER	018318
73*	1	CASE GASKET	018319
89*	1	SEAL, VN-CARB/SIL	018308
89A	1	SEAL SPRING RETAINER	018320
*	*	REPAIR KIT, VN-CARB/SIL	018309

***-DENOTES COMPONENTS INCLUDED IN REAPIR KIT**



Seal Replacement/Maintenance

Warning: Make certain that the system is disconnected from the power source in compliance with all local and national codes before attempting to service or remove any components. Never run the pump when dry.

Maintenance:

Inspection: Pump should be periodically checked for proper operation. If the system has changed or if the pump is operating noisily or erratically, then the pump should be removed and examined. It should be repaired and parts replaced as necessary.

Cleaning: Remove oil, dust, dirt, water, chemicals from exterior of pump and motor. Blow out interior of open motors with clean compressed air at low pressure. Regularly drain moisture from TEFC motors.

Draining: If the pump is located in an area subject to freezing temperatures, the pump must be drained when not in operation or add sufficient antifreeze.

Seal replacement:

Disassembly:

- Turn off power.
- Close suction and discharge valves (if equipped).
- Drain pump.
- Remove bolts holding down pump to mounting plate.
- Remove pump from system.
- Remove case.
- Insert a screwdriver in one of the impeller waterway passages and back off the impeller retaining assembly with a socket wrench.
- Remove impeller from shaft, being careful not to lose the impeller key, spring and gasket. If impeller is difficult to remove, it may be necessary to use a bearing puller to remove.
- Pry off rotating member of mechanical seal from motor shaft by using two (2) screwdrivers. Be careful not to damage the pump cover.
- Remove pump cover from cast iron disc. (There is no hardware used to attach cover to disc.) Place cover on a flat surface with convex side down. Push out stationary member of mechanical seal. It is not necessary to remove the cast iron disc from the motor to replace the seal.
- Inspect shaft sleeve. If damage or worn, remove from shaft and replace.

Reassembly:

Caution: The mechanical seal is a precision product and should be handled accordingly. Use care when handling lapped running surfaces of the mechanical seal to ensure they remain clean and are free of chips or scratches.

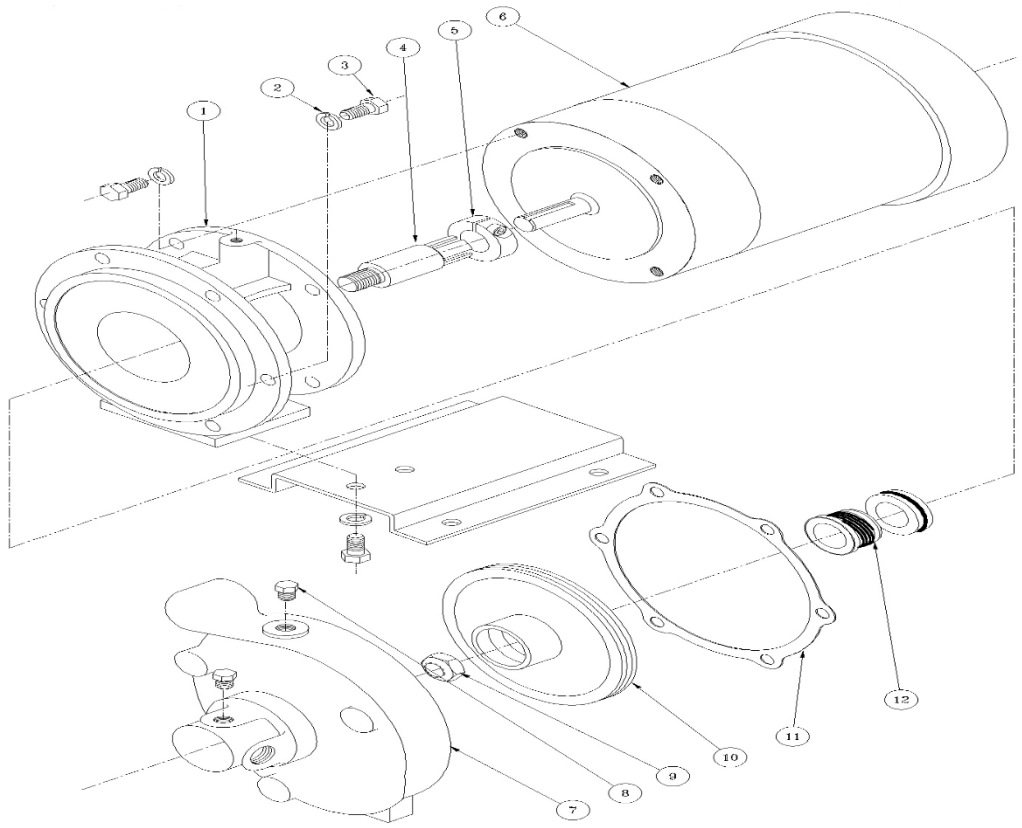
- Clean gasket and flange faces, seal seat cavity, shaft sleeve, and motor shaft.
- Position cover so that the convex side is facing you. Lubricate the seal seat cavity of the cover and the rubber cup or O-ring of seal seat with the lubricating fluid that comes with the mechanical seal or repair kit. Press the stationary seat in seal seat cavity of the cover squarely and evenly using an arbor press (if possible) and the cardboard disc supplied with the seal. Be certain that the lapped face (shiny side) is facing you.
- Install the flinger on the motor shaft until it bottoms on the motor shaft.
- Slide the shaft O-ring on the motor shaft until it is tight against the flinger. Make sure that the shaft O-ring does not get damaged during this procedure.
- Position the cover so that the convex side with the lapped seal seat is facing you. Place the cover on the motor disc and align the holes in the disc with hoes in the over. (There isn't any hardware required attach cover to motor disc.)
- Apply the lubricating fluid that comes with the mechanical seal or repair kit to the motor sleeve and the rubber bellows of the rotary seal. Slide the seal head on the shaft sleeve; press the rubber drive band on the rotary head until the lapped face on the head seats firmly against the lapped face of the stationary seat. Do not chip or scratch faces during installation. Take extra care to make sure the lapped faces are clean.
- Install the seal spring on the seal head and retainer on spring.
- Place key in key seat. Line up keyway in impeller with key on motor shaft. Be certain that the key is positioned in the keyway of the motor and impeller. Slightly compress seal spring with impeller and hold impeller while installing impeller retaining assembly in motor shaft.
- Insert a screwdriver in a waterway passage of the impeller holding it against rotation as discussed in Paragraph g of the disassembly instructions.
- Remove any burrs caused by screwdriver on the vane of impeller in waterway passage.
- Install O-ring on cover. Be sure that any damaged O-ring is replaced.
- Place pump casing against pup cover. Ensure that impeller eye is centered in pump case and position case, cover and motor disc so that the holes line up. Install socket head cap screws through the case and cover, and thread into the motor disc. Tighten all cap screws alternately and evenly until finger tight.
- Finish tightening the cap screws alternately and evenly to approximately 6 ft. lbs. torque. Note: It is imperative that the screws be tightened alternately and evenly, as this action centers the cover in the casing, assuring proper alignment. Binding of the impeller in the case may occur if the case is not positioned properly and/or the cap screws are not tightened as listed above.
- Replace hold-down bolts.
- Check for free rotation after assembly is completed.
- Close all drain openings, using pipe sealant on threads.
- Re-prime before starting. Do not start until pump is completely filled with water.

Models: DB, DC, DF, DG, DJ, DL

Exploded View Drawing

REF.	QTY.	DB	DC	DF	DG	DJ	DL	DESCRIPTION	PART #
1	1	✓	✓	✓	✓	✓	✓	ADAPTOR FRAME	034007
2	12	✓	✓	✓	✓	✓	✓	LOCK WASHER 3/8 x 1/8 S.S.	034004
3	12	✓	✓	✓	✓	✓	✓	HEX HEAD CAP SCREW 3/8-16 x 1″ S.S.	034009
4	1	✓	✓	✓	✓	✓	✓	SHAFT DRIVE SLEEVE S.S.	034006
5	1	✓	✓	✓	✓	✓	✓	DRIVE CLAMP ASSEMBLY	034020
6	1	✓	✓	✓	✓	✓	✓	MOTOR 56 C FRAME	Contact Factory
7	1	✓	✓		✓	✓		HOUSING 1 X 3/4	034021
				✓			✓	HOUSING	034027
8	2	✓	✓		✓	✓		PIPE PLUG / GUAGE PORT	017043
9	1	✓	✓	✓	✓	✓	✓	HEX JAM NUT 5/8 – 18 x 5/16 x 3/8 S.S.	034016
10	1	✓	✓	✓	✓	✓	✓	IMPELLER BRASS 5.9″	034025
11	1	✓	✓	✓	✓	✓	✓	GASKET RM A-56 FLOROBESTOS	034014
12	1	✓	✓	✓	✓	✓	✓	SEAL ASSEMBLY	034008
	1							SHIM SET .032 (NOT SHOWN)	034018

NOTE: YOUR PUMP MAY LOOK SLIGHTLY DIFFERENT



Seal Replacement/Maintenance

Warning: Make certain that the system is disconnected from the power source in compliance with all local and national codes before attempting to service or remove any components. Never run the pump when dry.

Maintenance:

Inspection: Pump should be periodically checked for proper operation. If the system has changed or if the pump is operating noisily or erratically, then the pump should be removed and examined. It should be repaired and parts replaced as necessary.

Cleaning: Remove oil, dust, dirt, water, chemicals from exterior of pump and motor. Blow out interior of open motors with clean compressed air at low pressure. Regularly drain moisture from TEFC motors.

Draining: If the pump is located in an area subject to freezing temperatures, the pump must be drained when not in operation or add sufficient antifreeze.

Seal replacement:

Disassembly:

- Turn off the electric power and the water supply to the system.
- Drain the system. Flush if necessary.
- Remove the S.S. bolts (Ref 3) holding the housing (Ref 7) to the adaptor frame.
- Remove the two S.S. bolts mounting the assembly to the Mokon system base plate.
- Remove the cap screws, which hold the adaptor frame (Ref 1) to the motor.
- Loosen drive clamp assembly (Ref 5) and remove the pump.

The seal seat and seat cup will remain in the pump adaptor frame. If not damaged or worn, do not remove. If necessary, remove the adaptor frame counter bore with a piece of wood or a screwdriver handle inserted through the adaptor frame from the drive end. A sharp tap or two is usually sufficient to knock out the seal seat. Use caution when removing the seal seat so as not to damage the face or distort the metal seat.

Reassembly:

- Clean all castings with mild cleaning solvent such as kerosene. All dirt and foreign matter should be removed.
- The pump seal assembly must be installed over the clamp end of the drive sleeve. The large diameter end of spring goes against the impeller hub. The small diameter end of the spring rests against the seal cage. The small diameter of the seal cage faces the impeller. The large diameter of the seal cage holding carbon washer faces the adaptor frame holding seal.
- Make sure the drive sleeve is CLEAN and free of nicks or burrs. Use fine steel wool to polish sleeve. Lubricate the sleeve with soapy water.

NOTE: DO NOT USE OILS OR S.T.P. They allow the seal bellows to set up too quickly on the sleeve, thus preventing free movement of the seal cage after assembly.

- Lightly lubricate all internal surfaces of bellows, with soapy water.
- Place the spring over the drive sleeve (large diameter end) against the impeller hub.
- Place the seal cage over the sleeve with carbon washer facing away from the impeller.
- Press cage assembly down far enough to compress spring and release. The seal cage will return to free height.
- Lubricate the seal seat cavity with soapy water.
- Lubricate the seal seat gasket with soapy water.
- Use a wood dowel of sufficient diameter to press the seal seat squarely into cavity on pump frame. HAND PRESSURE ONLY

NOTE: Polished metal surface must face opposite the seal seat cavity on pump frame. Optional ceramic seal assemblies require less pressure to seat squarely, too much pressure will crack ceramic seal.

- Place impeller and seal cage assembly in housing as shown in the above figure. Affix the gasket on the frame over the drive sleeve onto housing.
- Attach the pump frame to pump head with bolts and secure evenly. Install the shaft clamp onto the shaft and attach entire assembly to motor. Tighten the shaft clamp with an Allen wrench.

See Maintenance Section on the following page to adjust the pump impeller clearance.

Mounting the Motor to the Pump

- Check the rotation of the motor to be sure it coincides with the required rotation of the pump assembly.
- Loosen the drive clamp assembly (Ref 5) but do not remove.
- Slide the pump assembly onto the motor drive shaft, aligning the holes in the adaptor frame (Ref 5) with tapped holes in the motor mounting face, until adaptor frame (Ref 1) contacts the motor mounting face.
- Install two cap screws (diagonally opposite) and tighten to secure the pump assembly to the motor.
- Center the drive clamp assembly (Ref 5) and tighten.
- Proceed to following page to check the impeller clearance.

Impeller Removal

- Remove seal bellows and spring assembly (Ref 12).
  NOTE: The seal bellows will be bonded to the shaft sleeve and will require some patience and caution to remove in order not to damage the seal bellows and cage.

- Place the impeller drive sleeve (Ref 4) between two pieces of wood in a vise. Take care so as not to damage sleeve.

- Remove the impeller jam nut (Ref 9) from the end of the shaft sleeve. Unthread the impeller (Ref 10) by turning counterclockwise (left hand).

Inspection

Check all parts for wear. For ease of reassembly, the shaft sleeve should have all nicks and burrs removed. Replace damaged parts with new parts. Inspect the seal seat and seal cup for grooves; scuff marks, or other deterioration. If a perfect lapped surface remains on the seal seat, it may be reused. If the seal cup is in good condition, it may be reused. If the seal seat, cup, washer, or bellows are damaged or worn, a new seal assembly should be installed (See pages above for seal replacement).

Impeller Clearance Adjustment

Impeller face and back clearances are not critical. The impeller must be adjusted axially so that it does not rub, that is it should be centered in the space between the adaptor frame and housing.

After the pump has been installed on the motor with two cap screws, the impeller can be adjusted as follows:

- Center the drive clamp assembly (Ref 5) and tighten.

- Loosen the two cap screws holding the pump to the motor (not shown).

- Pull the motor away from the pump and insert the .032” (.813 mm) shims (Ref 12) between the pump adaptor frame (Ref 5) and the motor. Align the holes in the shims so that remaining two cap screws can be installed.

- Install the remaining two cap screws and tighten all four.

- Rotate motor slowly by hand to make certain the impeller does not rub the housing or adaptor frame.

If the impeller still rubs, loosen the drive clamp assembly (Ref 5), remove two of the cap screws and shims (not shown), loosen the other two cap screws and repeat above procedure.

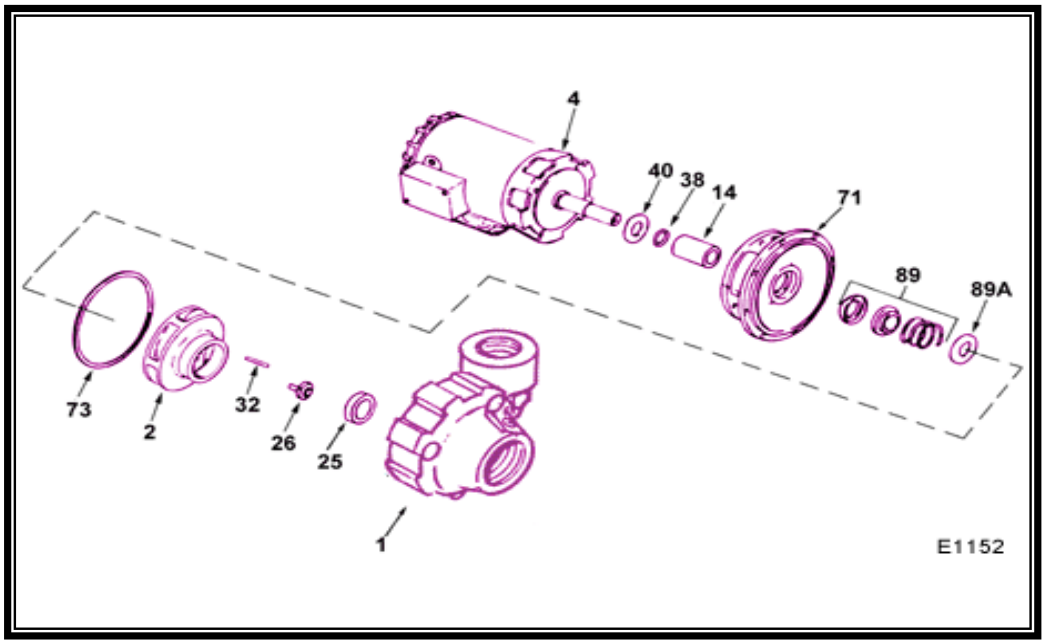
If the above procedure does not stop the impeller from rubbing, CONSULT THE FACTORY.

Models: DA, DD, DE, DH, DK, DM

Exploded View Drawing

REF.	QTY.	DESCRIPTION	PART NUMBER
1	1	CASE, 50, 2.0" X 1.5" NPT, IRON - 5, 7.5 HP	018321
		CASE, 52, 2.5" X 2.0" NPT - 10 HP	018333
2	1	IMPELLER, 50, IRON 6.25" – 5 HP	018322
		6.5" – 7.5 HP	018323
		IMPELLER, 52, IRON 6.5" – 10 HP	018334
4	1	MOTOR, 5.0 HP, 3/60/208-230/460, 3500, ODP	Consult Factory
		MOTOR, 7.5 HP, 3/60/208-230/460, 3500, ODP	Consult Factory
		MOTOR, 10 HP, 3/60/208-230/460, 3500, ODP	Consult Factory
14*	1	SHAFT SLEEVE	018324
25	1	WEAR RING, 50	018325
		WEAR RING, 52	018335
26*	1	IMPELLER RETAINER	018326
32*	1	KEY	018315
38*	1	SHAFT O-RING, VITON	018328
40*	1	FLINGER	018317
71	1	ADAPTER	018328
73*	1	CASE GASKET	018329
89*	1	SEAL, VN-CARB/SIL	018330
89A*	1	SEAL SPRING RETAINER	018331
	*	REPAIR KIT, VN-CARB/SIL	018332

NOTE: YOUR PUMP MAY LOOK SLIGHTLY DIFFERENT



Seal Replacement/Maintenance

Warning: Make certain that the system is disconnected from the power source in compliance with all local and national codes before attempting to service or remove any components. Never run the pump when dry.

Maintenance:

Inspection: Pump should be periodically checked for proper operation. If the system has changed or if the pump is operating noisily or erratically, then the pump should be removed and examined. It should be repaired and parts replaced as necessary.

Cleaning: Remove oil, dust, dirt, water, chemicals from exterior of pump and motor. Blow out interior of open motors with clean compressed air at low pressure. Regularly drain moisture from TEFC motors.

Draining: If the pump is located in an area subject to freezing temperatures, the pump must be drained when not in operation or add sufficient antifreeze.

Seal replacement:

Disassembly:

- Turn off power.
- Close suction and discharge valves (if equipped).
- Drain pump.
- Remove bolts holding base to foundation.
- Remove casing bolts.
- Remove motor and rotating element from casing, leaving casing and piping undisturbed, if possible. If not, then remove the whole assembly.
- Insert a screwdriver in one of the impeller waterway passages and back off the impeller nut.
- Remove impeller from shaft, being careful not to lose the impeller key, spring and seal retainer. If impeller is difficult to remove, it may be necessary to use a bearing puller to remove.
- Pry off rotating member of mechanical seal from motor shaft by using two (2) screwdrivers.
- Remove bolts holding adapter to motor and take off adapter.
- Place adapter on a flat surface with case rabbet facing down, and push out stationary part of mechanical seal.
- Inspect the shaft sleeve, shaft O-ring, and flinger. If damaged or worn remove and replace with a new one.

Reassembly:

Caution: The mechanical seal is a precision product and should be handled accordingly. Use care when handling lapped running surfaces of the mechanical seal to ensure they remain clean and are free of chips or scratches.

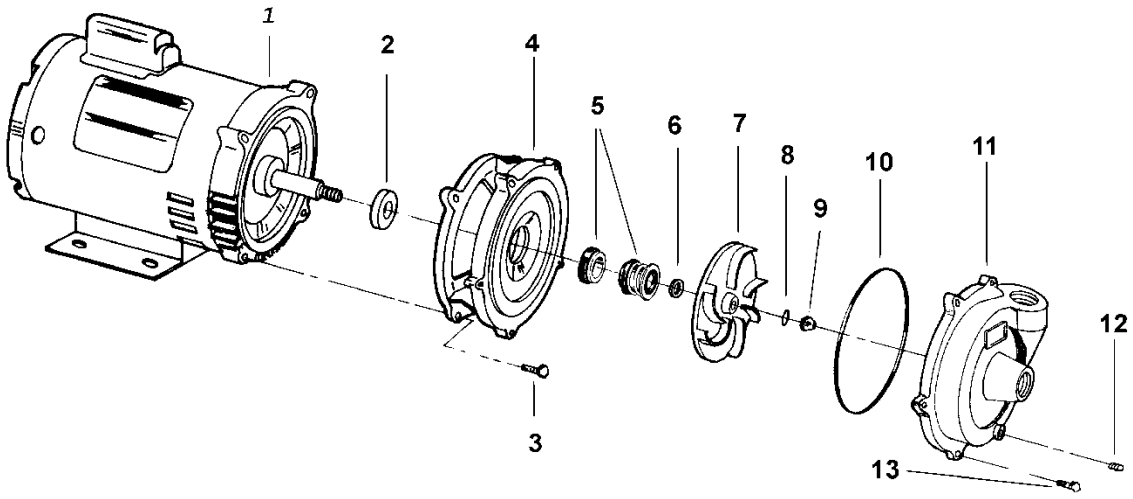
- Clean gasket and flange faces, seal seat cavity, shaft sleeve, and motor shaft.
- Lubricate the seal seat cavity of the adapter and the rubber cup or O-ring of seal seat with the lubricating fluid that comes with the mechanical seal or repair kit.
- Press the stationary seat in seal seat cavity of the adapter squarely and evenly using an arbor press (if possible) and the cardboard disc supplied with the seal. Be certain that the lapped face (shiny side) is facing you.
- Install the flinger on the motor shaft until it bottoms on the motor shaft.
- Slide the shaft O-ring on the motor shaft until it is tight against the flinger. Make sure that the shaft O-ring does not get damaged during this procedure.
- Position shaft sleeve chamfer toward motor and slide on motor shaft.
- With motor preferably in vertical position, remount the adapter on motor, making sure the motor shaft does not dislocate or chip the stationery seat of the seal.
- Apply the lubricating fluid that comes with the mechanical seal or repair kit to the stub shaft and the rubber bellows of the rotary seal. Slide the seal head on the stub; press the rubber drive band on the rotary head until the lapped face the head seats firmly against the lapped face of the stationary seat. Do not chip or scratch faces during installation. Take extra care to make sure the lapped faces are clean. Install seal spring on seal head and retainer on spring.
- Place key in key seat. Line up keyway in impeller with key on stub shaft, and slide impeller on stub shaft. Be certain that the key is positioned in the keyway of the stub and impeller. Slightly compress seal spring with impeller and hold impeller while installing impeller retainer assembly in stub shaft.
- Insert a screwdriver in a waterway passage of the impeller holding it against rotation and tighten the retaining assembly as discussed in step 7 of disassembly instructions. The impeller will compress the seal spring to the proper length assuring the correct pressure on the lapped surfaces.
- Remove any burrs caused by screwdriver on the vane of impeller in waterway passage.
- Slide motor and rotating element in casing. Be sure that any damaged O-ring or gasket is replaced.
- Tighten casing bolts alternately and evenly.
- Replace hold-down bolts
- Check for free rotation after assembly is completed.
- Seal all drain openings using pipe sealant on threads.
- Re-prime before starting. Do not start until pump is completely filled with water.

Model: MT

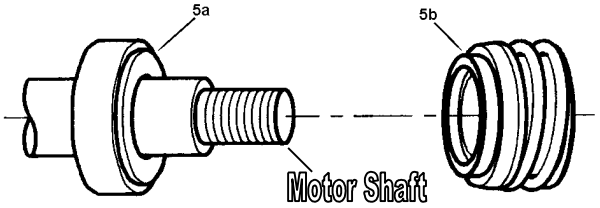
Exploded View Drawing

REF.	QTY.	DESCRIPTION	PART #
1	1	MOTOR	Consult Factory
2	1	5/8 SLINGER WASHER	034115
3	4	3/8-16 x ¾" HEX HEAD CAP SCREW S.S.	Standard Hardware
4	1	ADAPTER	034114
5	1	SEAL ASSEMBLY- SILCONE CARBIDE (SEE NOTE BELOW)	034113
6	1	IMPELLER SHIM SET	034112
7	1	IMPELLER	034111
8	1	# 013 O-RING VITON	034110
9	1	7/16-20 ACORN NUT	034109
10	1	# 243 O-RING	034108
11	1	CASING	034107
12	1	1/8" PIPE PLUG S.S.	017044
13	5	¼ - 20 x 7/8" CAP SCREW S.S.	Standard Hardware

NOTE: WHEN REPLACING SEAL ASSEMBLY (REF 5) A NEW IMPELLER O-RING (REF 8) SHOULD BE USED



SEAL ASSEMBLY DETAIL



Seal Replacement/Maintenance

Warning: Make certain that the system is disconnected from the power source in compliance with all local and national codes before attempting to service or remove any components. Never run the pump when dry.

Maintenance:

Inspection: Pump should be periodically checked for proper operation. If the system has changed or if the pump is operating noisily or erratically, then the pump should be removed and examined. It should be repaired and parts replaced as necessary.

Cleaning: Remove oil, dust, dirt, water, chemicals from exterior of pump and motor. Blow out interior of open motors with clean compressed air at low pressure. Regularly drain moisture from TEFC motors.

Draining: If the pump is located in an area subject to freezing temperatures, the pump must be drained when not in operation or add sufficient antifreeze.

Seal replacement:

Disassembly:

Should the mechanical seal, which consists of seal seat (Ref 5a) and seal head (Ref 5b), require replacement, proceed as follows and refer to Figure 1.

Important: Always replace both the seal seat and seal head to insure proper mating of component! Also, the impeller seal should be replaced anytime the impeller lock nut (Ref 9) has been removed.

- Remove five bolts (Ref 13) connecting the casing (Ref 11) to the adaptor (Ref 4)
- Remove the casing.

Caution: Care should be taken not to "pinch" or "shave" the O-ring gasket (Ref 10) between the adaptor and the casing.

- Use a box and/or socket wrench to remove the impeller nut (Ref 9). Remove the impeller seal (Ref 8) and the impeller (Ref 7).

Important: Care should be taken to insure that the same number of shim washers (Ref 6) are placed behind the impeller as was removed. The shim washers are located directly behind the impeller and become loose as the impeller is removed.

- The seal head (Ref 5a) can now be pulled from the shaft.
- Pry the seal seat (Ref 5b) from the adaptor (Ref 4).

Reassembly:

Caution: The precision lapped faces on the mechanical seal are easily damaged. Handle your replacement seal carefully.

- Thoroughly clean all surfaces of the seal seat cavity.
- Using a clean cloth, wipe the shaft and shaft sleeve and make certain that they are perfectly clean.
- Wet the rubber portion of the new seal seat with a light coating of soapy water. While wearing clean gloves or using a clean light rag, press seal seat squarely into adaptor recess. Avoid scratching the white ceramic surface. If seat will not position properly, place a cardboard washer over the polished surface and use a piece of pipe to press in firmly but gently.
- Dispose of cardboard washer. Check again to see that ceramic surface is free of dirt and all other foreign particles and that it has not been scratched or damaged.
- Wet the inside rubber portion of the new seal head with alight coating of soapy water. Slide head onto the motor shaft with the sealing surface facing the seal seat. Reinstall any shims, which have been removed. (See below for Shim Adjustment)
- Thread the impeller onto the motor shaft and replace the impeller seal before screwing the impeller nut into place.
- Reassemble the pump.
- A short "run-in" period may be necessary to provide completely leak proof seal operation.

Shim Adjustment:

When installing a replacement impeller (Ref 7) or motor (Ref 1), it may become necessary to adjust the number of shims (Ref 8) to insure proper running clearance between the impeller and the casing. Proceed as follows:

NOTE: A proper running clearance is between 0.015" and 0.020" (.38mm and .5mm).

- For impeller replacement, add one (1) shim in addition to those removed originally.
- For motor replacement, add two (2) shims in addition to the shims removed during disassembly.
- Reassemble the pump as described in Steps 2 and 3. (See above for Reassembly)

Important: Insure that the casing is snugly in place and check the shaft to make sure it is turning freely. (Use the screwdriver slot in the motor to turn the shaft). If it turns freely, check to insure that the casing cover and casing fitted "metal to metal" where they meet on the outside. If they are not "metal to metal", tighten the fasteners (Ref 13) and recheck the shaft for free turning. Tighten carefully turning the shaft while tightening so that the motor bearings are not damaged in the event that too many shims were installed. If shaft seizes before fasteners are completely tight, disassemble the pump and remove one (1) and repeat reassembly.

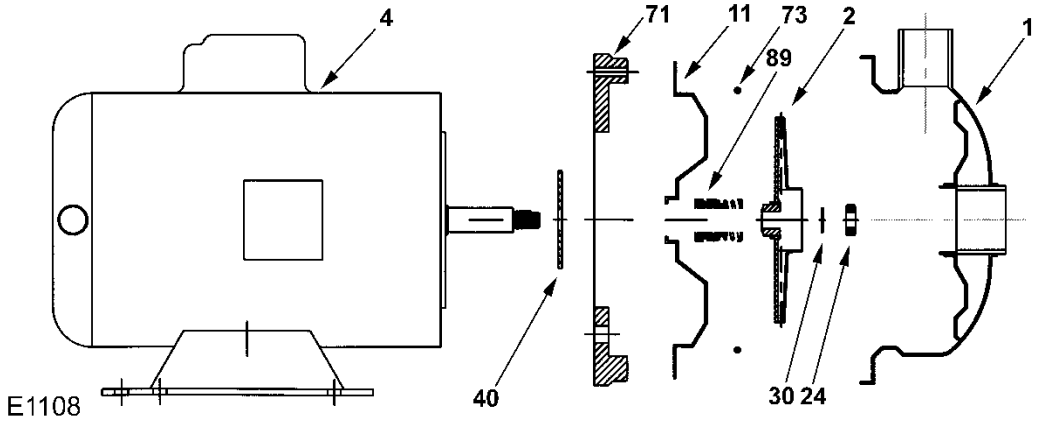
Chiller Section

Models: AC, AS, WC, WS

Exploded View Drawing

REF NO.	QTY	3 HP	1 HP	1.5 HP	5 HP	¾ HP	DESCRIPTION	PART #
1	1	✓	✓	✓		✓	CASE 1.25 x 1 NPT	018266
	1						CASE 1.25 X 1 NPT	018268
	1				✓		CASE 1.5 x 1.25 NPT	018267
2	1					✓	IMPELLER 4.88", STAINLESS	018275
	1		✓	✓			IMPELLER 5.25", STAINLESS	018276
	1	✓					IMPELLER 6.3", STAINLESS	018277
	1				✓		IMPELLER 6.3", STAINLESS	018342
4	1	✓	✓	✓	✓	✓	MOTOR 56J	CONSULT FACTORY
11	1	✓	✓	✓	✓	✓	COVER, STAINLESS	018269
24*	1	✓	✓	✓	✓	✓	NUT	018270
30*	1	✓	✓	✓	✓	✓	D-WASHER	018271
40*	1	✓	✓	✓	✓	✓	FLINGER	018272
71	1	✓	✓	✓	✓	✓	DISC IRON	018273
73*	1	✓	✓	✓	✓	✓	GASKET, CASE	018274
89*	1	✓	✓	✓	✓	✓	SEAL, 5/8"	IN REPAIR KIT

*** - DENOTES COMPONENTS INCLUDED IN REPAIR KIT 018246.**



Seal Replacement/Maintenance

Warning: Make certain that the system is disconnected from the power source in compliance with all local and national codes before attempting to service or remove any components. Never run the pump when dry.

Maintenance:

Inspection: Pump should be periodically checked for proper operation. If the system has changed or if the pump is operating noisily or erratically, then the pump should be removed and examined. It should be repaired and parts replaced as necessary.

Cleaning: Remove oil, dust, dirt, water, chemicals from exterior of pump and motor. Blow out interior of open motors with clean compressed air at low pressure. Regularly drain moisture from TEFC motors.

Draining: If the pump is located in an area subject to freezing temperatures, the pump must be drained when not in operation or add sufficient antifreeze.

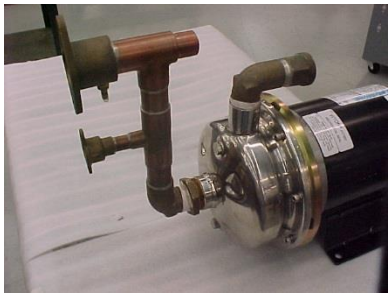
Seal replacement:

Disassembly:

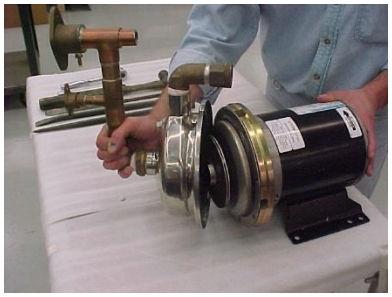
- Turn off power.
- Drain the Mokon portable chiller system. Flush if necessary.

Necessary tools:

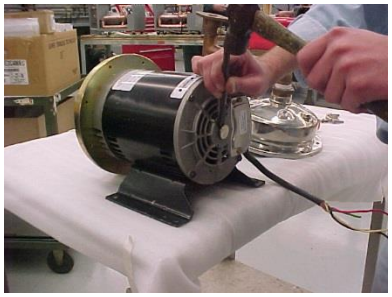
- 3/8” drive ratchet
- Pry bars (2)
- Flat blade screwdriver
- 6” socket extension 3/8”
- Gloves
- ¼” Hex Allen wrench/socket
- ½” Socket



- Remove pump/motor from cabinet.

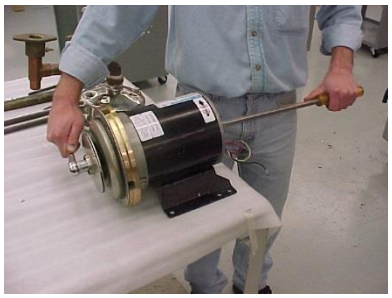


- Remove casing screws and remove case.
  Inspect o-ring for wear or damage.



- Remove the cap at the lead end of the motor. A screwdriver slot will be exposed. Use a screwdriver to stop the shaft from turning.

Caution: Do not insert screwdriver between impeller vanes to prevent rotation. This can damage the impeller.



- Remove the impeller lock nut and washers by turning counter clockwise when looking at the front of the pump.

- Remove the impeller by turning counter clockwise. Protect the hand by wearing a glove.

Caution: Failure to remove the impeller in a counterclockwise direction may damage the threading on the impeller, the shaft or both.

- Remove the spring to the mechanical seal assembly.

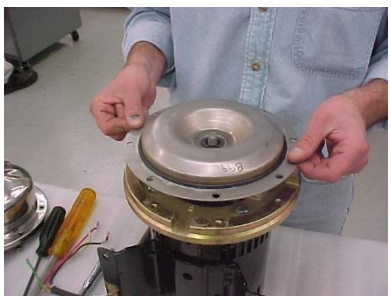
- With two pry bars 180° apart and inserted between the seal housing and the motor plate adapter and carefully separate the two parts. The mechanical seal assembly will come off of the shaft inside the seal housing. It is not necessary to remove the cast iron disc from the motor.

- Using a dowel, push the mechanical seal assembly out of the seal housing from the motor side.

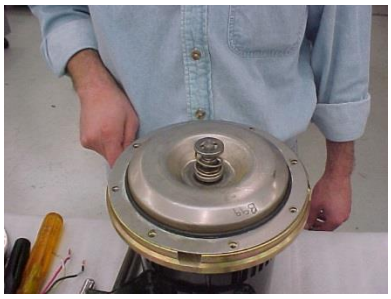
Reassembly:

Caution: The mechanical seal is a precision product and should be handled accordingly. Use care when handling lapped running surfaces of the mechanical seal to ensure they remain clean and are free of chips or scratches. Clean gasket and flange faces, seal seat cavity and shaft, in particular, shaft shoulder fitting against impeller.

- Lubricate the seal seat cavity of the cover and the rubber cup or O-ring of stationary seal seat with the lubricating fluid that comes with the mechanical seal or repair kit. Press the stationary seat in seal seat cavity in the cover squarely and evenly using an arbor press (if possible) and the cardboard disc supplied with the seal. Be certain that the lapped face (shiny side) is facing you.



- Place the seal assembly housing (with the seal assembly inserted) onto the shaft and replace the spring. Lubricating fluid can be applied to the motor shaft and the rubber bellows of the seal used to facilitate assembly. **Do not contaminate the Mechanical face seals with lubricant**. **Do not use petroleum based lubricants.**



- Thread the impeller onto the shaft by turning clockwise. Protect the hand with a glove. Prevent shaft rotation by using a screwdriver on the shaft end screwdriver slot.

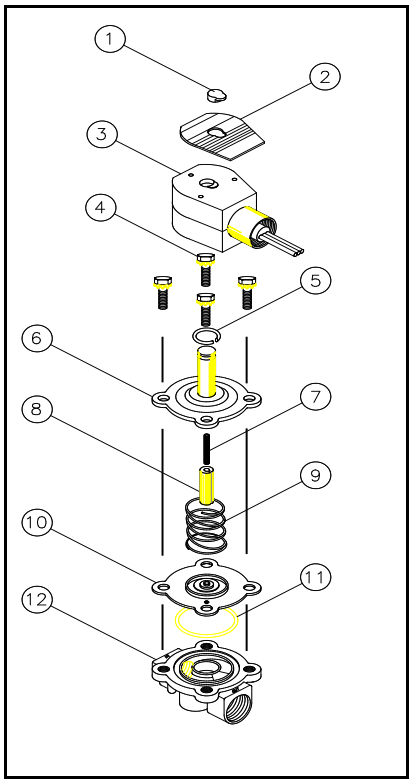
- Replace the impeller lock nut and washer by turning clockwise. Prevent shaft rotation by using a screwdriver on the shaft end screwdriver slot.

- Replace the casing and casing screws and tighten finger tight. Finish tightening the cap screws alternately and evenly to approximately 6 ft. lbs. torque.

  Note: It is imperative that screws be tightened alternately and evenly, as this action centers the cover in the casing, assuring proper alignment. Binding of the impeller in the case and adaptor may occur if the cap screws are not tightened as listed above.

- Check for free rotation then replace the cap at the rear of motor. Reinstall pump/motor into system.

4.3 Fluid Solenoid Valve Maintenance



Number	Description
1	Coil Retaining Cap
2	Cover
3	Coil Assembly
4	Bonnet Screws
5	Flux Plate
6	Solenoid Base
7	Core Spring
8	Core Assembly
9	Plunger Spring
10	Diaphragm Assembly
11	Diaphragm Body Gasket
12	Diaphragm Body

To inspect/replace the water makeup valve:

- Turn off main disconnect switch. (Follow your company's lockout/tagout procedure)
- Remove the top and both side panels of the Mokon heater/chiller system.
- Remove the coil retaining cap (1) from the valve.
- Lift the coil assembly (3) with the cover (2) up and off the post of the solenoid base (6). **Do not disconnect the wires!**
- Loosen the bonnet screws (4) and remove the solenoid base (6).

  Caution: Lift the solenoid base slowly, as to retain the core assembly (8) inside it (note the arrangement to assist in reassembly).
- Examine the core assembly (8) for broken spring, worn edges, and/or pitted seat (replace if needed).
- Remove the diaphragm spring (9) and the diaphragm (10).
- Carefully pry the diaphragm body gasket (11) out around the circumference of the diaphragm body (12). Inspect the gasket and replace if necessary.
- Inspect the diaphragm body (12) for hole obstruction and clean wit an air hose.
- Reassemble by reversing the above sequence (the core assembly goes "spring up").

4.4 Low Pressure Safety Switch

Mokon heater/chiller systems are equipped with low pressure safety shut down switch as standard. This switch incorporates an interlock to prevent the operation of the system should the supply water be insufficient. The switch is set to shut down at 4-6 PSI. **CONSULT MOKON FACTORY IF A PROBLEM IS SUSPECTED.**

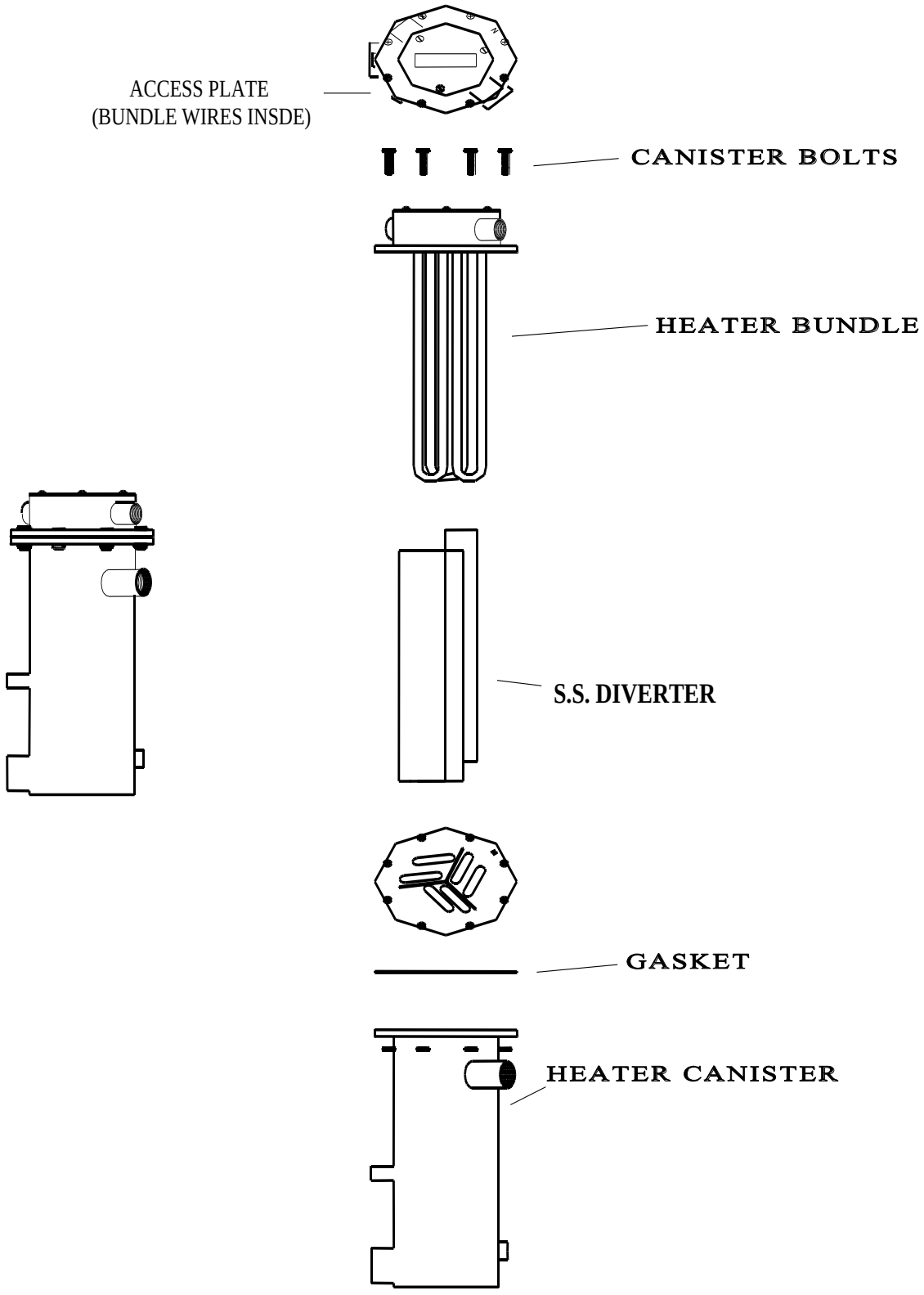
4.5 High Temperature Safety Switch

The High temperature safety shut off switch is located in or just after the heater manifold. This switch is factory set to shut the Mokon temperature control system off. For Mokon temperature control systems operating at a maximum temperature of 180°F (82°C), the switch will shut off the system when the temperature reaches 190°F (88°C). For Mokon temperature control systems operating at a maximum temperature of 250°F (121°C), the switch will shut off the system when the temperature reaches 260°F (127°C). For Mokon temperature control systems operating at a maximum temperature of 300°F (149°C), the switch will shut off the system when the temperature reaches 310°F (154°C). This switch should not be adjusted in the field. **CONSULT MOKON FACTORY IF A PROBLEM IS SUSPECTED.**

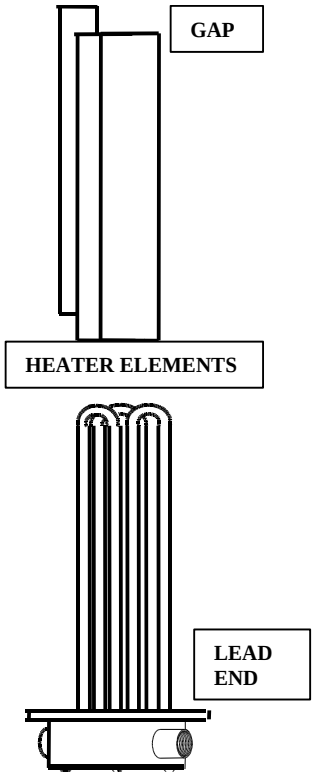
NOTE: Refer to Section 1.8 for the No Flow Warning.

4.6 Heater Assembly

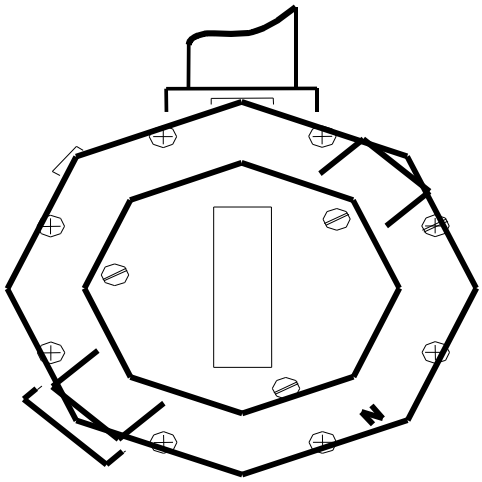
Models: DA, DB, DC, DD, DE, DF, DG, DH, DJ, DK, DL, DM, DN, DO, DP, DQ, DR, DT, DU, DV, DW, DX, DY, DZ



- Disconnect the electric power and the water supply to the system.
- Remove the back access panel to the system.
- Remove the heater bundle access plate.
- Disconnect the heater bundle wires.
- Remove the canister bolts.
- Pull the heater bundle away from the canister. The S.S. diverter is inserted between the heater elements. **Note the position of the diverter relative to the elements; it must be inserted in the same position for the new heater bundle.**
- Clean the canister. Pay particular attention to the flanged area where the gasket sits.
- Insert the diverter between the heater elements of the new heater bundle as follows (see figure to the right):
    - Locate the "N" stamped on the lead end of the heater bundle.
    - Set the heater bundle upright on the lead end with the "N" facing right (3 o'clock position).
    - Hold the diverter upright over the heater bundle with the gap on the top and facing right (3 o'clock position).
    - Slip the diverter straight down between the heater elements so that each section has an equal number of heater elements.



- Insert the new heater bundle into the canister with a new gasket so that the "N" stamped on the lead end is in the 5 o'clock position.
  (See figure below)

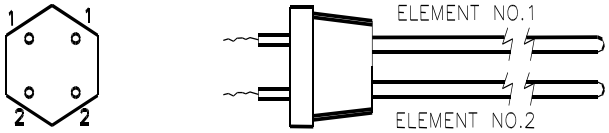


- Replace the canister bolts.
- Reconnect the heater bundle wires as diagramed on the back of the access plate.
- Replace the access plate.

Models: HN, HR, HW, HX, HY, HZ, MT

Use the following chart to select between wiring method A and B to wire MOKON replacement heaters (dual element – hair pin type). Refer to the MOKON system electrical schematic for complete heater wiring illustrations.

	190-240 Volts	380-460 Volts	550-575 Volts
Water Systems	A	B	B



A **B**

4.7 Glossary of Indicators, Gauges, and Buttons

Supply Pumps Start/Stop Buttons:	Pilot light illuminates green to supply pump (chilled water circuit) to process is activated.
Heating Zone/Process Pump Start/Stop Buttons:	Pilot light illuminates green to indicate zone pump to the process is activated.
Compressor Start/Stop Buttons:	Pilot light illuminates green to indicate refrigeration loop and compressor pump is activated.
Freeze Protection Indicating Alarm:	When scrolling across the controller, it indicates compressor has shut down due to coolant temperatures below safe operation.
Low Refrigerant Pressure Indicating Light:	When illuminated, indicates compressor has shut down due to low refrigerant pressure.
High Refrigerant Pressure Indicating Light:	When illuminated, indicates compressor has shut down due to high refrigerant pressure.
Supply Pump Pressure Gauge:	Indicates fluid pressure for the "chilled water loop" going to the process.
Reservoir Temperature Gauge:	Indicates the temperature of "chilled water loop" returning from the process.
High Refrigerant Pressure Gauge:	Indicates the pressure of the refrigerant, as it is being condensed in the condenser. This pressure is critical to the performance of the chiller and is generated by the compressor. The normal pressure is between 200-300 PSIG/ 1379-2068 kPa (R-22/R-407C) or 110-230 PSIG/ 758-1586 kPa (R-134A) (depending on load).
Low Refrigerant Pressure Gauge:	Indicates compressor suction pressure and is related to temperature setting and the adequacy of refrigerant charge.

Section 5 – Eurotherm Controller (3000 Series)
(For Both Heater and Chiller Section)

5.1 Operation

This section of the manual contains all essential information needed to operate the controller. Contact Mokon Customer Service with controller problems as well as warranty and repair issues.

The controller is configured by model number. Inputs, outputs and alarm types are preset. Final setup and configuration are done from the keypad. The controller has four basic modes: Operator 1, Operator 2, Operator 3 and the configuration mode.

The controller's is default level is Operator 1, and is used for day to day operation.

Note: Operator 2, 3 and configuration are password protected.

Home List Navigation

To step through list levels press and hold the Page button until level 1 is obtained. Press the up button or the down button to change levels.

To step through parameters within a particular list, press the Scroll button until the required parameter is obtained.

To change the value (or state) of a parameter, press the Up button or the Down button.

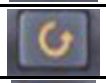
***Refer to Section 5.1 Keys for button locations and descriptions.**

Levels	Operator 1		
	Parameter Mnemonic	**Scroll**	**Function**
	WRK.OP	WORKING OUPUT The active output value	Output %
	SP1	SETPOINT 1	-------
	SP2	SETPOINT 2	-------
	DWELL	SET TIME DURATION	Auto air purge time setting
	T-REMIN	TIME REMAINING	Time remaining for Auto Air Purge
*	A1.xxx	ALARM 1 SETPOINT	Only shown if the alarm is configured. Where: xxx = alarm type. HI = High alarm; LO = Low alarm d.HI – Deviation high: d.LO = Deviation Low: D.HI = Deviation high
*	A2.xxx	ALARM 2 SETPOINT	
*	A3.xxx	ALARM 3 SETPOINT	
*	A4.xxx	ALARM 4 SETPOINT	
	A.TUNE	Auto Tune Enable	
	ID	Customer ID	Controller Revision #

*Optional

Keys

NOTE: Pictured is the 3216 Eurotherm controller - this also applies to 3204 and 3208 series controllers.

Button or Indicator	Name	Explanation
OP1	Output 1	When lit, it indicates that heating output is on. "HEATING" will scroll.
OP2	Output 2	When lit, it indicates that cooling output is on. "COOLING" will scroll.
	Page button	Press to select a new list of parameters.
	Scroll button	Press to select a new parameter in a list.
	Down button	Press to decrease a value in the setpoint.
	Up button	Press to increase a value in the setpoint.
*ALM	Alarm	Flashes when in alarm condition. "ALARM MESSAGE" will scroll.
OP4	Output 4	When lit indicates that the air purge output is on. "AUTO AIR PURGE" will scroll.
RUN	Timer Running	When lit indicates that the air purge output is on. "AUTO AIR PURGE" will scroll.

*Optional

5.2 Automatic Tuning

In tuning, you match the characteristics (PID parameters) of the controller to those of the process being controlled in order to obtain good control. Good control means:

- Stable, 'straight-line' control of the PV as setpoint without fluctuation.
- No overshoot or undershoot, of the PV setpoint.
- Quick response to deviations from the setpoint caused by external disturbances, thereby rapidly restoring the PV to the setpoint value.
- Tuning involves calculating and setting the value of the parameters listed in the table below.

The PID controller consists of the following parameters:

Parameter	Meaning or Function
Proportional Band	The proportional term, in display unit or %, delivers and output which is proportional to the size of the error signal.
Integral Time	Removes steady state control offsets by ramping the output up or down in proportion to the amplitude and duration of the error.
Derivative Time	Determines how strongly the controller will react to the rate of change in the measured value. It is used to prevent overshoot and undershoot and to restore the PV rapidly if there is a sudden change in demand.
High Cutback	The numbers of display units, above setpoint, at which the controller will increase the output power, in order to prevent undershoot on cool down.
Low Cutback	The number display units, below setpoint, at which the controller will cut back the output power, in order to prevent overshoot on heat up.
Relative Cool Gain	Only present if cooling has been configured. Sets the cooling proportional band, which equals the heat proportional band value divided by the cool gain value.

The controller uses a one shot tuner which automatically sets up the initial values of the parameters listed in the table.

The 'one-shot' tuner works by switching the output on and off to induce an oscillation in the measure value. From the amplitude and period of the oscillation, it calculates the tuning parameter values.

If the process cannot tolerate full heating or cooling being applied, then the levels can be restricted by setting the high power limit ('O P .HI') and low power limit ('O P .LO'). However, the measured value *must* oscillate to some degree for the tuner to be able to calculate values.

A One-Shot tune can be performed at any time, but normally it is performed only once during the initial commissioning of the process. However, if the process under control subsequently becomes unstable (because its characteristics have changed), you can re-turn again for the new conditions.

It is best to start tuning with the process at ambient conditions and with the SP close to the normal operating level. This allows the tuner to calculate more accurately the low cutback and high cutback values that restrict the amount of overshoot or undershoot.

How to Tune:

- Set the setpoint to the value at which you will normally operate the process.
- Operator level 1 list, press,  until A.Tune appears. Set to ON.
- Press the Page and Scroll buttons together to return to the Home display. The display will flash [tunE] to indicate that tuning is in progress.
- After one (1) minute to determine steady state conditions the controller will induce an oscillation in the temperature by turning the output on and then off. The first cycle will not complete until the measured value has reached the required setpoint.

5.3 Troubleshooting

Diagnostic Alarms:

Display Shows	What it means	What to do about it
E.ConF	A change made to a parameter takes a finite time to be entered. If the power to the controller is turned off before the change has been entered then this alarm will occur. Do **not** turn the power off to the controller while ConF is flashing.	Enter configuration mode then return to the required operating mode. It may be necessary to re-enter the parameter change since it will not have been entered in the previous configuration.
E.CAL	Calibration error	Re-instate Factory calibration
E2.Er	EEPROM error	Return to factory for repair
EEEr	Non-vol memory error	Note the error and contact your supplier
E.Lin	Invalid input type. This refers to custom linearization which may not have been applied corrector or may have been corrupted.	Go to the INPUT list in configuration level and set a valid thermocouple or input type.

Note: Some error messages may not appear, depending on the controller options.

5.4 Alarm Indicators

- ALM beacon flashing red = a new alarm (unacknowledged).
- This is accompanied by a scrolling alarm message. A typical default message will show the source of the alarm followed by the type of alarm. For example, "ALARM 1 FULL SCALE HIGH'.
- If more than one alarm is present further messages are flashed in turn in the main display. The alarm indication will continue while the alarm condition is present and is not acknowledged.
- ALM beacon on continuously = alarm has been acknowledged.

To Acknowledge An Alarm

Press  and  together.

Non-Latched Alarms

Alarm condition present when the alarm is acknowledged.

- ALM beacon on continuously.
- The alarm message(s) will continue to scroll.

This state will continue for as long s the alarm condition remains. When the alarm condition disappears all indication also disappears.

If the alarm condition disappears before it is acknowledged the alarm reset immediately.

5.5 Remote Setpoint and Retransmission "Scaling"

Scaling of the 4-20mA and 0-10V signals for this option are as follows:

- 4mA or 0V = minimum system operating temperature.
- 20mA or 5V, 10V = maximum system operating temperature.

NOTE: Maximum system operating temperature value is reflective of the series system purchased, (refer to serial tag for maximum operating temperature located on Mokon system).

Consult customer service at Mokon factory (716) 876-9951, regarding system's minimum and maximum temperatures if there are any questions.

Section 6 – Options

6.1 Process Purge Option (Air)

To facilitate mold changes with a minimum amount of fluid loss from the hoses and the process, a process purge system via air provided as an option.

NOTE: If additional fluid has been added to the Mokon heater/chiller system after initial start-up, it will be necessary to drain the excess fluid prior to using the process purge as to avoid overflowing the reservoir tank.

The following is the procedure to utilize this process purge option:

- Turn the controller to the minimum setting and wait until the process temperature is below 85°F. (See Section 5 for Controller Instructions)
- Shut off the heating system zone by pressing the "process pump" stop button.
- Connect the Air Supply to the Air Inlet on the system.
- Turn "mold purge" selector switch to the on position, mold purge light will illuminate.

Warning: Customer regulated air supply pressure should not exceed 15 psig (103 kpa).

- The fluid in the process loop will be returned to the reservoir.
- After the process is purged, return mold purge selector switch to the "off" position (mold purge light will go off).
- Refer to 3.1 to restart the process pump.

NOTE: The time required to purge the system is based on the hold up volume of the process and air supply to the system. Process fluid capacity may exceed system tank capacity be sure to observe this function at all times and be sure tank overflow connection is piped to an open drain at all times.

6.2 Z Purge Instructions

A 3 inch diameter threaded pipe connection is provided to receive an air or nitrogen supply, a 90 cfm blower is recommended. This blower shall not be installed or placed in the hazardous environment where hazardous fumes will be drawn from for supply air to the electrical enclosure or internal cabinetry of the Mokon system. The optimum nitrogen or air supply range to the Mokon system should be .15 to .5 inches of water column.

As an alternative to nitrogen, non-hazardous "clean" dry air can be supplied which can also include clean dry compressed shop air.
The discharge pressure of the fan or blower needs to be, at least, 3.0 inches of water column for every 100 equivalent feet of 3" duct. For 4" duct, 1.0 inch of water column per 100 feet is adequate. A 3" exhaust connection is also provided.

Note: Due to temperature considerations, the purge gas must flow (sweep) through the unit to insure adequate ventilation.

- Once the purge gas is introduced, the Dwyer model 1950-0-2F pressure switch will close, energizing a time delay relay. The relay prevents startup of the Mokon system until an adequate sweep inside the unit has taken place. The switch is set at its minimum setting of 0.15 inches of water. A green pilot light will illuminate once the relay has "timed out", indicating it is safe to operate the unit.

- The magnehelic gauge has a scale of 0 to .5 inches of water, and is clearly visible to allow the operator to monitor the unit.

- If the purge is lost, for any reason, the pressure switch will open, thus activating a customer supplied alarm through a set of auxiliary contacts. The Mokon system will also shut off.

- For systems that are classified and applied properly the applicable Class, Group and Division is listed on the bottom of the systems serial tag.

- Methods: There are typically two methods for the supply of purge gas to systems for "Z" purge applications, they are as follows:

  Method # 1 (recommended): Due to temperature considerations, the purge gas must flow (sweep) through the unit to insure adequate ventilation. This method would apply to water, oil, chiller, and full range heater/chiller systems.

  Method # 2: (not recommended): Pressurization of the cabinetry when temperature build up is not as much of a concern can be applied. Here the exhaust coupling on the cabinet would be plugged. This method would apply to water-cooled chiller systems or very low heating capacity systems.

  Note: If the "Z" purge mechanism or any other system safety devices are modified or disable in any way Mokon considers them to be non-operational and the systems warranty could be void.

6.3 Cool own and Automatic Shut Off

This option consists of an activation button labeled Auto Cool/Shutdown, a relay, and a timed relay.

To enable this feature:
While the unit is currently in operation, push the black button labeled Auto Cool/Shutdown.
The machine will disable heating and start cooling for the preset amount of time. When the time runs out the machine will shut down.

If needed the machine can still be shut down by pressing the stop button.

A Timed Relay (TDR) mounted inside the machine's electrical enclosure controls the amount of time the machine cools before shutting down. Rotating the dial on the front of the TDR can change the amount of time. The factory-preset time limit is 3 minutes; the adjustable range of the TDR is from zero to ten minutes.

Section 7 – Troubleshooting Guide

7.1 Heater Section

Problem	Possible Cause	Corrective Measure
System will not start	System unplugged / power off	Plug system in / turn power on
	Low pressure on supply side (water off)	Turn water on
	Improper power source wiring	Check wiring (electrical schematics) and correct
	Blown fuse at power supply	Isolate open fuse and replace
	Blown control circuit fuse	Replace and check for ground condition
	Blown motor branch circuit fusing	Check fuse and replace. Check for ground condition
	Low voltage	Measure incoming voltage, if too low correct
	Overload on pump/motor starter	Consult factory
Circulating pump shut down during operation	Overload on pump/motor starter	Consult factory
	Safety shut down	Consult factory
	Open winding in pump motor	Check motor windings with an OHM meter, if open reading, replace motor
	Refer to possible causes and corrective measures for Problem #1	
Discharge pressure will not build up	Incorrect pump rotation	See Section 3.1 to check and correct pump rotation
	Entrapped air	Press purge button
	Pressure gauges	Inspect/replace instruments
Pressure gauges erratic and system will not hold temperature	Entrapped air	Press purge button
	Cooling solenoid valve or pressure regulator	See Maintenance Section 4.8 to clean valve(s)
High pressure and erratic temperature	Plugged flow paths, inadequate circulation through process and connecting lines	Inspect; if plugged, dislodge
Loss of pressure and volume output	Cooling solenoid valve or pressure regulator	See Maintenance Section 4.8 to clean valve(s)
	Leak in "To Process" line	Repair leak

Problem	Possible Cause	Corrective Measure
Temperature climbs beyond setpoint	Heater contactor	Inspect/replace component
	Temperature controller	See Controller Section 5
	Thermocouple or RTD	Inspect/replace component
	Controller calibration	See Controller Section 5
System does not reach and/or hold temperature	System at end of long feeder line	Install another supply source line
	Cooling solenoid valve or pressure regulator	See Maintenance Section 4.8 to clean or replace valve(s)
	Heater burn out	Inspect/replace component
	Heater contactor	Inspect/replace component
	Lime deposits	Clean system (consult factory for recommendations)
	Temperature controller	See Controller Section 5
	Kilowatt capacity inadequate	Consult Mokon engineering
	Loose electrical connections	Tighten connection or replace broken wires
	Thermocouple or RTD	Inspect/replace component
	Controller calibration	See Controller Section 5
Variance in temperature readings	Plugged flow paths, inadequate circulation through process and connecting lines	Inspect; if plugged, dislodge
	Lime deposits	Clean system (consults factory for recommendations)
	Kilowatt capacity inadequate	Consult Mokon engineering
	Thermometers	Inspect/replace component
Leaking water around the motor shaft	Pump seal	See Maintenance Section(s) 4.2 – 4.7 to replace pump seal
Slow response after changing temperature setting	Heater burn out	Inspect/replace component
	Heater contactor	Inspect/replace component
	Lime deposits	Clean system (consult factory for recommendations)
	Kilowatt capacity inadequate	Consult Mokon engineering
	Cooling solenoid valve or pressure regulator	See Maintenance Section 4.8 to clean valve(s)
	Thermocouple or RTD	Inspect/replace component

Problem	Possible Cause	Corrective Measure
Fluctuating temperature readings from controller	Lime deposits	Clean system (consult factory for recommendations)
	Thermocouple or RTD	Inspect/replace component
	Controller calibration	See Controller Section 5
Noisy pump	System at end of long feeder line	Install another source line
	Entrapped air	Press purge button
	Cooling solenoid valve or pressure regulator	See Maintenance Section 4.8 to clean valve(s)
	Incorrect pump rotation	See Section 3.1 to check and correct pump rotation

7.2 Chiller Section

Only a qualified refrigeration technician should attempt repairs in the refrigeration loop.

Problem	Possible Cause	Corrective Measure
Compressor will not start or shuts down with supply pump running	Process fluid temperature below set point	Change set point
	Scroll compressor rotating in the wrong direction	Consult Mokon factory
	Low or high refrigerant pressure	Consult a Qualified Refrigeration Technician
	Compressor shut down due to thermal protection	Let cool, restart, and verify amp draw
	Inadequate flow of process fluid	Inspect process and lines for blockage, clear blockage if necessary
	Controller or thermostat (controller optional on 1/2 and 1 ton systems)	Consult factory (**DO NOT attempt repairs, this will VOID your warranty!**)
	Freezestat	Inspect/replace
	Blown control circuit fuse	Replace and check for ground condition
System shuts down on high refrigerant pressure Water-cooled systems	Low water flow through the condenser	Verify condenser supply water flow rate is as stated in Section 2.5
	Water regulating valve	Inspect/clean or replace
	Condenser supply water lines too small	Replace lines with insulated hose or pipe of equal diameter as the port
	Insufficient water pressure drop across condenser due to plugged or fouled condenser tubes	Inspect/clean or replace
	Condenser supply water temperature too high (above 85°F / 29°C)	Find colder source of water
System shuts down on high refrigerant pressure Air-cooled systems	Dirty condenser coils	Inspect/clean
	Fan rotation	Verify fan is rotating (counterclockwise)
	Fan not rotating	Blown control fuse
		Fan limit switch – Consult Qualified Refrigeration Technician
	High ambient air temperature	Find a cooler source or force more air
	Refrigeration loop overcharged	Consult a Qualified Refrigeration Technician

Problem	Possible Cause	Corrective Measure
System shuts down on low refrigerant pressure	Low refrigerant charge	Consult a Qualified Refrigeration Technician
	Low head pressure	
	Restriction to refrigerant flow in refrigerant loop	
	Ambient air temperature too cold (air-cooled)	Find warmer source of air
	Condenser cooling water temperature too low (water-cooled)	Find warmer source of water
	Air in process loop	Purge – See Start Up Procedure in Section 3.1
	Water/glycol solution foaming	Replace water/glycol mixture
System shuts down on freezestat	Attempting to operate below setting (45°F/7°C)	Consult Mokon factory
	Freezestat	Inspect/replace
Chiller does not keep up with load	Low water flow causing icing in condenser (water cooled)	Consult a Qualified Refrigeration Technician
	Hot gas bypass valve stuck open	
	Condenser tubes limed over/blocked (water cooled)	
	Poor condensing	
	Over condensing	
	Bad valves in compressor	
	Chiller not started correctly (before heat generating process)	See Section 3.1 for Correct Starting Procedure
	Scroll compressor rotating in the wrong direction	Consult Mokon factory
	Chiller undersized for load	Consult Mokon engineering
System does not come down to set point temperature	Lack of refrigerant	Consult a Qualified Refrigeration Technician
	Dryer clogged	
	Too large process load	
	Evaporator freezing	
	Restrictive process or process connections	Remove restrictions
	Thermocouple or RTD	Inspect/replace component
	Controller calibration	See Controller Section 5

Section 8 – Condensed Parts List

8.1 Heater Section

All Models:

Part No.	Description
006257	40 amp heater contactor 110V coil
006298	50 amp heater contactor 110V coil
006256	24 amp motor contactor 110V coil
006373	0.2 – 1.0 amp overload
006366	1.0 – 5.0 amp overload
006367	3.2 – 16 amp overload
006368	5.4 – 27 amp overload
008005	0 – 160 PSI pressure gauge, suction, and discharge
022038	Start/stop button
022185	Purge button
022187	Low pressure safety switch
025183	Adjustable relief valve
040002	Thermocouple

Note: Motor starter contactor is dependent on model/date purchase

For Duratherm Models: DA, DB, DC, DD, DE, DF, DG, DH, DK, DL, DM, DN, DO, DP, DQ, DR, DT, DU, DV, DW, DX, DY, DZ: (Refer to Serial Tag for kW capacity and voltage)

011026	9 kW heater element 460V
011020	18 kW heater element 460V
011021	24 kW heater element 460V
011023	9 kW heater element 230V
011024	18 kW heater element 230V
011025	24 kW heater element 230V
011036	9 kW heater element 208V
011042	18 kW heater element 208V
011055	24 kW heater element 208V
011029	9 kW heater element 575V
011030	18 kW heater element 575V
011031	24 kW heater element 575V
011053	9 kW heater element 380V
011034	18 kW heater element 380V
011056	24 kW heater element 380V
019036	Heater canister gasket
023070	High temperature switch (Adjustable)

For Model MT: (Refer to Serial Tag for kW capacity and voltage)

011001	2 kW copper immersion heater 230V and 460V
011004	2 kW copper immersion heater 575V
011005	2 kW copper immersion heater 208V and 380V
023070	High temperature switch (Adjustable)
034113	Pump seal assembly

For Hydrotherm II Models HN, HR, HW, HX, HY, HZ: (Refer to Serial tag for kW capacity and voltage)

011043	2.25 kW copper immersion heater 230V and 460V
011088	3 kW copper immersion heater 230V and 460V
011089	3 kW copper immersion heater 575V
011090	3 kW copper immersion heater 208V and 380V
018246	Seal replacement kit
023070	High temperature switch (Adjustable)

For additional part numbers refer to the specific section in the instruction manual or consult the Mokon factory (716) 876-9951.

8.2 Chiller Section

½ - 10 Ton Systems:

Part No.	Description
006256	Motor starter/24 amp heater contactor 110V coil (pump/motor)
006257	40 amp heater contactor 110V coil (compressor)
006366	1.0 – 5.0 amp overload
006367	3.2 – 16 amp overload
008021	0 – 160 PSI pressure gauge, suction, and discharge
018246	Seal kit for pump/motor assembly
022038	Start/stop button
023086	Thermometer
040002	Thermocouple

15 and 20 Ton Systems:

Part No.	Description
006256	Motor starter/24 amp heater contactor 110V coil (pump/motor)
006257	40 amp contactor 110V coil (compressor)
006298	50 amp contactor 110V coil (compressor)
006366	1.0 – 5.0 amp overload
008021	0 – 160 PSI pressure gauge, suction, and discharge
018246	Seal kit for pump/motor assembly
022038	Start/stop button
023086	Thermometer
040002	Thermocouple

For additional part numbers refer to the specific section in the instruction manual or consult the Mokon factory (716) 876-9951.

Section 9 – Warranty

FULL RANGE SYSTEM WARRANTY

This Full Range temperature control system manufactured by MOKON is guaranteed to be free from defective materials or workmanship for a period of one (1) year from the date of purchase. Upon discovery of any alleged defect, it is the customer's responsibility to contact the MOKON Service Department with the complete model number, serial number and the date of purchase. MOKON'S obligation under this warranty is limited to make good, from or at its factory, any parts that are returned to the company (prepaid) and deemed to be defective, within the time frame of the warranty. The customer also has the option of forwarding the system to MOKON (Buffalo, NY), prepaid by the customer and with a return authorization from MOKON for inspection and component replacement or repair. Repair and replacement in the manner provided above shall constitute a fulfillment of all liabilities of MOKON concerning the quality of the temperature control system.

No allowances, credits or reimbursements will be made for any replacement or repair made or provided for by the customer unless authorized in advance, in writing, by MOKON.

The warranty set forth above is in lieu of any and all other warranties expressed or implied including warranties of merchantability and fitness for a particular purpose. Mokon shall in no event be liable for any consequential damages or for any breach of warranty in an amount exceeding the original price of the unit.

Note: The use of automotive anti-freeze in a chiller system will void the above warranty!

End of Life Industrial Waste - Saving our Environment

In the interest of preserving our environment, please reclaim, reuse or dispose of any refrigerant, refrigerant oils, heat transfer fluid, glycol and/or water glycol mixtures contained in these systems in accordance with federal, state and local codes, prior to any equipment disposal. All metal and other materials should be repurposed and recycled where possible

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