Caution:

Rotating shafts and above ground electrical potentials of Dynamatic eddy-current equipment can be hazardous. Therefore, it is strongly recommended that all electrical work, installation, and maintenance be performed only by qualified personnel... preferably factory trained.

Because high level, above ground potentials exist, electrical work, conforming to National Electrical Codes and local regulations, should only be handled by qualified electricians. Only factory recommended test procedures, included in the instruction manual, should be followed. Electric power should always be disconnected before working inside of the control enclosure.

Even when the output shaft is motionless, it should be considered “alive” as long as its motor, or prime mover, is running; keep hands away from the output shaft until the motor has completely stopped.

Note:

Since improvements are continually being made to available equipment, the enclosed data is subject to change without notice. Any drawings are for reference only, unless certified. For additional information contact your nearest Sales Office or Representative listed in the Yellow Pages under “Power Transmission Equipment”.

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WATER PIPING DATA

WARNING
pH of Cooling Water
The pH of water indicates the degree of acidity or alkalinity, seven being neutral. Values above seven—alka-
line; below—acid. Under no circum-
stances operate Dynamic water
cooled equipment with cooling water
that has a pH of less than 7 (acid).
Premature rusting of all steel parts
occurs very rapidly as will chemical
attack of coil containers, bearing
seals, etc. Eaton warranty is void if
cooling water with a pH of less than
7.0 to 7.8 pH is used.
In the event water with a pH of 8
(alkaline) is used, outlet temperatures
must be reduced to a maximum of
110°F. to avoid rapid scaling.
The dissolved solids consisting of carbon-
ates, sulfates and chlorides should be
limited to 400 parts per million (23.3g)
grains per U.S. gallon.

Outlet Water Piping
DO NOT PERMIT ANY RESTRICTION
OF OUTLET
(1) By using a pipe reducer in tapped
outlet of coupling.
(2) By piping incorrectly with respect
to rotation.
(3) By piping in any manner that
would permit accumulation of
water to occur or remain in the
base or well of unit.

The Water Piping System
General
The layout and parts list of the water
pipmg system required to properly
cool this unit are shown on the water
pipmg drawing. The water piping sys-
tem is wired into the control starting
circuit which is shown on the wiring
diagram and explained in the Oper-
ating Instructions.

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Semi-Automatic Piping System
A typical semi-automatic water pip-
ing system, which is shown in Figure
1A, includes a strainer, solenoid
valve, water pressure switch, con-
stant flow valve and water tempera-
ture switch. The solenoid valve,
pressure switch and temperature
switch are shown schematically in
the starting circuit of Figure 2. When
contact is closed and the Run button
is pressed, the water solenoid valve
is energized, allowing water to flow
into the unit. As water begins flow-
ing, the pressure builds up until it is
sufficient to close the pressure
switch. In practice, this is almost in-
stantaneous.

If the components of the water piping
system are exposed to greater pres-
sure than they were designed for,
they will fail to function properly.
Conversely, if the pressure fails or
temporarily falls below the minimum
specified, the pressure switch will
open, thereby de-energizing the start-
ing circuit.

The bulb of the temperature switch is
installed in the unit so it is covered
with discharge water. If the tempera-
ture of the water exceeds the prede-
termined setting of the temperature
switch, it opens and de-energizes the
starting circuit and removes ex-
citation from the unit. The unit can-
not be re-energized as long as the
temperature switch remains open.
The temperature switch will not operate
properly unless it is covered with
water.

Automatic Piping System
When it is desirable to conserve
water and not use more than is nec-
sary to cool the unit, or where a
large quantity of water is required, a
fully automatic water piping system,
similar to the one shown in Figure
1B, is used. The typical automatic water
piping system contains the same com-
ponents as the semi-automatic water
piping system, plus a water control
valve and a by-pass line. With this
system a constant flow valve is used
in the by-pass line. On some units a
constant flow valve is used in the
main line to limit maximum water flow.
When the solenoid valve is energized,
and the pressure and temperature
switches are closed, a fraction of the
available water flows through the bypass line into the unit. The water control valve, which is normally closed, is connected by a capillary tubing to a temperature-sensitive bulb installed in the unit. The bulb is located in the unit so the discharge water completely covers it. As the temperature of the discharge water begins to rise, the bulb reacts so as to admit additional water to flow into the unit as required for proper cooling.

**Water Supply Requirements**

A satisfactory water supply, which fulfills the requirements of pressure, temperature and purity, must be made available to properly cool this unit.

**Typical Water Piping Systems**

![Diagram of typical water piping systems]

The minimum water pressure required by the unit (usually 35 PSI) is specified on its nameplate and on the title page of this instruction manual. In order to operate the unit the pressure of the water supply must be above the minimum specified pressure, but below 100 PSI. If the pressure is too high, a pressure regulator must be installed (a reduction of unit pressure to 40 PSI is recommended).

The temperature of the cooling water entering the unit should not be higher than 90°F. Water discharged from the unit should not exceed 140°F., thus minimizing scale deposits.

Internal components of water cooled units are protected by a corrosion-resistant coating. Listed in Table 2 are the maximum water solid content values for water, which we would consider satisfactory for use in our equipment, although these figures should not be considered absolute limits.

**Typical Control Starting Circuit**

![Diagram of typical control starting circuit]

**Chemical Analysis - Maximum Values**

| Maximum Water Content | Parts Per Million | Grains Per U.S. Gal.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total carbonate</td>
<td>200</td>
<td>11.68</td>
</tr>
<tr>
<td>Total sulphate</td>
<td>150</td>
<td>8.76</td>
</tr>
<tr>
<td>Total alumina</td>
<td>75</td>
<td>4.36</td>
</tr>
<tr>
<td>Total iron</td>
<td>75</td>
<td>4.36</td>
</tr>
<tr>
<td>Total chloride</td>
<td>50</td>
<td>2.92</td>
</tr>
</tbody>
</table>

If your local water condition exceeds these values consideration should be given to either treating the water, or regularly removing the scale deposits.

Water obtained from the Great Lakes usually has a pH range of 7.0 to 7.9; with a maximum total solid content of 160 parts per million, or 9.35 grains per gallon. Total solids are made up of carbonates, 132 parts per million; sulphates, 23 parts per million; and total chloride (salt), 6 parts per million. It has been our experience that this water is perfectly satisfactory for use in our water cooled machines, resulting in practically no deposition or corrosion.

Direct cooled (water-in-gap) machines are not affected as much by scale deposits as are indirect cooled (dry gap) machines, since the building of scale is impeded by water erosion; however, if the water is acidic, serious corrosion may take place on the inductor drum, resulting in increased air gap. The acid water condition, therefore, must be watched carefully.

Indirect cooled machines require more careful attention, since their heat dissipation capacity is decreased as deposits are formed in the cooling rings. Two methods for eliminating scale may be used: (1) by treating the water, thus preventing the deposit, and (2) by allowing the deposit to form but regularly removing through the use of approved scale removing agents.
Deposits of solids are dependent upon cooling water temperature. Scale deposition (in areas of high solids contents) may thus be reduced by decreasing the outlet water temperature. Satisfactory operation may be obtained when using water with total solids of 1000 ppm, provided the outlet water temperature is held below 125°F.

Dynamatic drives are equipped with adjustable water control valves with a temperature range of 80°F to 140°F. Self regulating valves are usually set to start opening at 95°F ± 5°F. Power assist valves are usually set to regulate water temperature at 135°F ± 5°F. These settings should be reduced where solids contents are high.

How to Install Water Piping System
If the automatic water piping system is not assembled or is not installed on the unit, it will be necessary to do so before putting the unit into operation. Figure 1 clearly shows the location of each part. The location of water inlets and outlets are clearly marked on the unit and are shown on the drawings. Figure 3 shows the outlet to use in relation to the direction of the drum rotation, where arrows 'A' and 'B' indicate directions of drum rotation and direction of water flow.

Direction of Water Flow

WARNING: Discharge water must be permitted to flow freely, by gravity, from the water outlet in the sump of the unit. Discharge water piping must not impose restrictions of outlet water in any way which would allow excessive accumulation and back-up in the base of the unit; this must be avoided to prevent flooding inside.

PIPING SYSTEM COMPONENTS

Strainer
Description
A strainer is included in the water piping system to filter the water and prevent foreign matter from damaging the water piping components or the unit. Figure 4 shows a section view of a typical strainer. In a modular piping system, the strainer is constructed as a part of the solenoid valve.

Installation
If a strainer is not installed in the water piping system, it is important to do so before running water through the water piping or the unit. Install the strainer as shown on the water piping drawing. The arrow on the strainer body indicates the direction of water flow.

Solenoid Valve
Description
To ensure that the operator doesn't forget to turn the water on, a solenoid valve is included in the water piping system. The solenoid valve is energized by the starting control circuit, shown in the wiring diagram. The solenoid valve's construction is explosion proof and watertight.

A sectional view of a typical normally closed diaphragm type solenoid valve is shown in Figure 5. While the coil is de-energized, the pilot orifice is closed, and full line pressure is applied to the top of the diaphragm, providing seating force for tight closure. The spring holds the pilot orifice closed. When the coil is energized, the pilot orifice is opened, releasing pressure on top of the diaphragm to the outlet side of the valve. Line pressure raises the diaphragm to open the main orifice and allow water to flow.

Typical Solenoid Valve N.C.
Diaphragm Type

WARNING: Coat the threads with sealing compound before installation to ensure effective sealing without excessive tightness. Tighten only enough to prevent leakage.

Maintenance
The strainer element must be checked periodically for accumulation of foreign particles since water flow will be reduced by a plugged strainer element. To clean the strainer, remove the drain plug and strainer element. Clean the strainer element and place it back into the strainer body. Install the drain plug. Strainer element material - monel particle retention .020.
Figure 6 is a section view of a typical normally closed piston type solenoid valve. Until the coil is energized, the disc is in the position that is represented by the dotted lines in the figure, and held there by the spring, thus allowing no water to flow. However, when the coil is energized, the plunger and disc assembly is pulled upward and the water is permitted to flow.

**Typical Solenoid Valve N.C. Piston Type**

**Installation**

Before energizing the unit the water valve solenoid must be installed according to the accompanying water piping drawing. Connect the wires of the solenoid to the control starting circuit, as shown on the accompanying wiring diagram, so the solenoid is energized when the Run button is pressed. The solenoid voltage is stamped on the nameplate.

**WARNING:** Coat the threads with sealing compound before installation to ensure effective sealing without excessive tightness. Tighten only enough to prevent leakage.

**Water Pressure Switch**

**Description**

The water pressure switch is in its normally open position whenever the pressure applied to its bellows is less than 11 PSI. Pressure in excess of its setting closes the switch, thus permitting excitation (see Figure 2). 11 PSI is the pressure required to entirely cover the temperature switch at minimum slip. If the temperature switch is not covered with discharge water from the drum, it will not accurately detect an excessively hot drum, and thus remove excitation by opening the electrical circuit at the temperature it is set for. At maximum slip, or load, an input of 35 PSI of pressure is usually required. Since line pressure variations may be great enough to momentarily reduce the pressure below 11 PSI and remove excitation, a recommended supply pressure into the water piping system is 35 to 100 PSI.

**Installation**

The water pressure switch must be installed in the water piping system as shown on the water piping drawing. One type of pressure switch used is shown in Figure 7. Terminal 'A' is the common lead terminal of the switch and should be connected directly to the terminal of the relay contacts (D4 in the typical starting circuit of Figure 2). Terminal 'B', the normally open contact of the switch, which is open when water pressure is not sufficient to close the switch, should be connected to the common terminal of the temperature switch. Terminal 'C' is the normally closed terminal and is not used in the control circuit of this unit.

**NOTE:** The water pressure switch is sensitive to pressure drops in the water supply system. Demands on the system by other machinery or equipment may cause temporary or prolonged pressure drops, opening the pressure switch and cutting off power to the unit. Do not attempt to correct this situation by by-passing the pressure switch or decreasing the setting of the switch below the required minimum pressure without approval from the Engineering Department at the factory. Make certain that the water supply system is adequate to maintain proper cooling water pressure under all conditions.

**Adjustments**

The pressure switch is factory adjusted to open when the water pressure drops below a nominal 11 PSI. If the setting must be changed, rotate the adjustment screw, shown in Figure 7, until the switch opens between 10 and 12 PSI with decreasing pressure. With the pressure switch adjusted properly, it will not close again when the pressure is increased to the same setting because there is a differential between the opening and closing pressures. But, it will open at a slightly higher pressure.

**Typical Water Pressure Switch**

**Constant Flow Valve**

**Description and Installation**

In many applications a constant flow valve is installed in the main line just ahead of the water inlet to the unit. Its purpose is to maintain a con-
constant water flow for line pressures from 36 to 100 PSI.

If a constant flow valve is installed in a by-pass line around a water modulating valve, it will maintain a fixed by-pass flow to the unit at all times with line pressure variation from 36 to 100 PSI.

Be sure to install each constant flow valve as shown on the water piping drawing. Install with the arrow pointing in the direction of water flow.

**WARNING:** Coat the threads with sealing compound before installation to ensure effective sealing without excessive tightness. Tighten only enough to prevent leakage.

**Water Modulating Valve**

**NOTE:** Since the water piping system on Dynamatic liquid cooled machines may include a modulating valve from one of several manufacturers, specific instructions vary inasmuch as the operation is the same. Therefore, if the instructions do not completely correspond with your valve, compare the intent of the instructions with your valve to determine how to obtain the required effect. If you still have problems, refer the manufacturer's name, along with Dynamatic PRO number of your Dynamatic drive, to the factory for more specific instructions.

**Description**

**General**

An automatic water piping system requires a water modulating valve (Figure 8) to regulate water flow to the unit. A by-pass line provides a steady supply of water to cover the temperature switch and modulating valve's thermostatic bulb which are installed in the unit. As a rise in temperature is sensed by the bulb, the modulating valve begins opening and supplies additional water (as required) to the unit. There are essentially two types of modulating valves used by Eaton: self-regulated and air-regulated.

**Self-Regulated**

A self-regulated modulating valve is composed of a bellows operated valve and a thermostatic bulb joined together with a length of capillary tubing. The thermostatic bulb, installed in the liquid cooled unit, encloses a volatile fluid. When the water discharge temperature increases, the volatile fluid in the bulb expands. When the temperature rises to approximately 90°F, the expanded gas transmits pressure to the modulating valve's bellows through the capillary tubing, causing the valve to open (See Figure 8). If the temperature continues to rise, the valve opens wider. If the discharge water temperature rises to approximately 130°F, the valve is fully open. Consequently, further temperature increases result in no additional flow of water. If the temperature continues to rise, the temperature switch will open, and remove excitation from the unit.

**Air-Regulated**

An air-regulated modulating valve system consists of a diaphragm operated valve and an air regulator. The position of the diaphragm determines the amount of water that flows. Initially, the regulator, which contains a temperature-sensitive tube and is installed in the unit to detect temperature changes, adjusts the air pressure on the diaphragm to 15 to 20 PSI, thus keeping the modulating valve closed. When the temperature of the discharge water rises above the setting of the temperature adjust knob on the regulator, the regulator bleeds off some of the air, which results in a reduction of air pressure on the valve diaphragm. With less than 15 to 20 PSI of air pressure exerted on the diaphragm, the modulating valve opens sufficiently to admit the required amount of additional water to the unit.

**Installation**

When the water piping is installed at the Dynamatic Plant, no further installation will be required. If not, consult the water piping print furnished for the locations of the modulating valve and bulb.

The valve either has an arrow cast on its body or the inlet and outlet sides are clearly marked. It is necessary that the valve be installed in the same direction as the flow of water. Also, if the bulb has a flat surface, as shown in Figure 9, it must be installed with the word "Top" facing upwards.

**Standard Bulb**

The bulb must be installed with the word "Top" facing upward. The bulb should either lie horizontally, or, with the end lower than the head. The end should never be higher than the head.

**WARNING:** Coat threads with sealing compound before installation to ensure effective sealing without excessive tightness. Tighten only enough to prevent leakage.
Coil the extra capillary tubing (1\(\frac{1}{2}\) inch minimum radius), and place it in a position such that it is protected and does not interfere with any operation (the recommended position is found on the water piping print).

Do not twist, bend, vibrate, heat, or kink the tubing unnecessarily.

Do not cut or disconnect the tubing from the bulb or valve unit top.

Adjustments

Testing Self-Regulated Modulating Valves – Stop water flow through the valve.

Raise the Temperature of the Bulb –
Direct Acting Regulators: raise the temperature to the control point so the valve plug is seated.
Reverse Acting Regulators: raise the temperature until the valve is fully open.

Record the Valve Position: place a ruler on top of the packing gland and mark the position where the ruler touches the stem.

Lower the Temperature of the Bulb –
Direct Acting Regulators: cool the bulb 30° below the control point so the valve is fully open.
Reverse Acting Regulators: cool the bulb to the control point so the valve is seated.

Record the Valve Position: place a ruler on top of the packing gland and mark the position where the ruler touches the stem.

Temperature Adjustment – The valve should be in operation at the time of adjustment at the desired operating temperature at the operating pressure of the system, since a difference in pressure will affect the control point of the adjusting nut.

To Raise Temperature - Insert an adjusting rod into a hole in the adjusting nut (Figure 8) and turn right to left (on some models this can be done by hand).

To Lower Temperature – Turn from left to right.

Maintenance
If a drop of water develops, tighten the packing gland or lubricator assembly (if included) finger tight to lubricate (Figure 8). If the gland dries up, a drop or two of oil in the gland is recommended.

Water Temperature Switch

Description
The water temperature switch, shown in Figure 10, is a normally closed, temperature-sensitive switch. The switch opens when the discharge water temperature exceeds its set temperature, which is adjustable by means of the slotted temperature adjusting screw. The differential between the opening and closing temperatures is approximately 0.2°F. The bulb must be covered with water in order to detect excessive temperatures in the unit. The temperature switch is equipped with a temperature locking device for vibration and tampering.

WARNING: The switch must open by the time the water temperature at the bulb reaches 188°F. Do not increase the setting beyond this point.

Installation
If it is necessary to install the water temperature switch, do so in the position shown in the water piping drawing and wire the leads into the control starting circuit as shown in the wiring diagram. The temperature switch bulb is located in the unit so it will always be covered with water even at minimum water flow. The wire leads are connected into the starting circuit so the switch is in series with the Stop button. Therefore, the starting circuit will be open when the water temperature switch is open.

WARNING: Coat the threads with sealing compound before installation to ensure effective sealing without excessive tightness. Tighten the switch only enough to prevent leakage. The temperature setting may be affected by excessive tension on the pipe threads. The water temperature switch is installed in this unit to protect the equipment against overheating. Do not by-pass this switch when making electrical installations.

CORRECTIVE MAINTENANCE

If Open Starting Circuit Is Inoperative – Check:
1. Fuse. Replace.
2. For short circuits and grounds.
3. Thermal overload.
4. Pressure switch. Low water pressure may not be opening switch.
5. Strainer. May be plugged.
7. Incoming water pressure.
8. Incoming line voltage.