The selection of the proper screw plug immersion heater requires critical engineering judgement. After determining the heat requirement (see the technical section of this catalog), the proper selection of the plug material, heating elements sheath material and correct watt density is critical for long heater life. The following table may be used as a guide to this selection along with the Technical Information in Section Z. Ultimate choice is determined by the knowledge of the process and engineering acumen of the plant engineer.

### Heater application is influenced by the following parameters. (Refers to chart below).

1. The heated medium viscosity, specific heat density and corrosive properties.
2. Contaminants present in the medium.
3. The heater sheath material corrosion resistant properties.
4. Watt density of the heating element — the heat output per square inch.
5. Screw plug material.

### TYPICAL APPLICATIONS

- Hot water storage tanks
- Warming equipment
- Pre-heating all grades of oil
- Food processing equipment
- Cleaning and rinsing tanks
- Heat transfer systems
- Process air equipment
- Boiler equipment
- Freeze protection of any fluid

### SELECTION OF SCREW PLUG IMMERSION HEATERS

<table>
<thead>
<tr>
<th>Application</th>
<th>Solution or Heater Type</th>
<th>Alkaline Acid Content (Est. % by Volume)</th>
<th>Sheath Material</th>
<th>Typical Watt Density (Watt/sq.In)</th>
<th>Screw Plug Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water &amp; Very Mild Solution</td>
<td>Clean Water</td>
<td>pH 6 to pH 8 Neutral</td>
<td>Copper</td>
<td>45</td>
<td>Brass</td>
</tr>
<tr>
<td></td>
<td>Process Water or Very Weak Solution</td>
<td>pH 5 to pH 9 2-3%</td>
<td>Stainless Steel*</td>
<td>45</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td></td>
<td>Weak Solutions</td>
<td>5-6%</td>
<td>Incoloy</td>
<td>45</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td></td>
<td>Deionized Water</td>
<td>--</td>
<td>Incoloy or Stainless Steel*</td>
<td>45</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>Oil Heating</td>
<td>Low Viscosity Oil</td>
<td>--</td>
<td>Steel</td>
<td>23</td>
<td>Steel</td>
</tr>
<tr>
<td></td>
<td>Medium Viscosity Oil</td>
<td>--</td>
<td>Steel</td>
<td>15</td>
<td>Steel</td>
</tr>
<tr>
<td></td>
<td>High Viscosity Oil</td>
<td>--</td>
<td>Steel</td>
<td>6</td>
<td>Steel</td>
</tr>
<tr>
<td>Specialty Heaters</td>
<td>Small Tanks</td>
<td>pH 5 to pH 9</td>
<td>Stainless Steel*</td>
<td>45</td>
<td>Brass</td>
</tr>
<tr>
<td></td>
<td>Process Water</td>
<td></td>
<td>Stainless Steel*</td>
<td>45</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td></td>
<td>Demineralized Water</td>
<td></td>
<td>Hasteloy Stainless Steel</td>
<td>15</td>
<td>Hasteloy Steel</td>
</tr>
<tr>
<td></td>
<td>Severe Corrosive Solutions</td>
<td>Low Viscosity Oil 30-60%</td>
<td>Hasteloy Stainless Steel</td>
<td>23</td>
<td>Hasteloy Steel</td>
</tr>
<tr>
<td></td>
<td>Low Viscosity Oil</td>
<td></td>
<td>Incoloy</td>
<td>12</td>
<td>Steel</td>
</tr>
<tr>
<td>Spa, Hot Tubs</td>
<td>Treated</td>
<td></td>
<td>Incoloy</td>
<td>100</td>
<td>Brass</td>
</tr>
<tr>
<td>Commercial Equipment</td>
<td>Clean Water</td>
<td></td>
<td>Copper</td>
<td>60</td>
<td>Brass</td>
</tr>
</tbody>
</table>

*Passivated stainless steel recommended for water applications.*
SCREW PLUG IMMERSION HEATERS
FOR CLEAN WATER

✓ 1", 1¼", 2", 2½" Brass
Screw Plug
✓ Copper Sheath
✓ 0.75 to 18 kW
✓ With or Without
Thermostat

APPLICATIONS
For clean water pH 6 to 8 —
Clean municipal water such as used
in washing, rinsing and industrial
processes with a pH factor range of
pH 6 to pH 8.
For temperature ranges of 212°F
— Or those temperatures normally
seen in heating water.
For industrial tanks, vessels &
process piping — Or any
application where a screw plug
heater can be used or is necessary
for a physical connection to an
industrial process.

FEATURES
Rugged construction — Sturdy
0.315", 0.375" and .475" diameter
elements, silver brazed to brass
screw plugs provide superior rigidity
and strength. Heavy duty jumper
straps and terminal posts to assure
permanent tightness of connections
and an extra margin of current
carrying capacity.

Long life metal sheath — High
grade virgin copper is used to make
seamless copper tubing, insuring
integrity of the heavy wall copper
outer sheath, eliminating structural
weak point crevices or surface
imperfections.

High conductivity elements —
Filled with highest purity blends of
magnesium oxide refractory (MgO)
compacted to a rock hard density to
insure maximum electrical resistance,
and assure long element life.

Heavy coil construction — Watt
density on the heating coil is
designated for low watt density
operation by increasing the coil
diameter and length to give
maximum coil surface area and limit
coil surface temperature, providing
longer coil life.

Liberal electrical clearances —
are provided in all terminal
enclosures in accordance with the
NEC insuring that proper arcing and
creepage clearances are
maintained. Termination insulators
provide electrical isolation between
terminations and grounded metal
sheath — all to insure personal
safety and equipment service life.

Superior performance at element
bends — with all bent elements
repressed in hydraulic presses after
bending to assure recompaction of
refractory material to eliminate hot
spots and electrical insulation voids.

Easy access to terminal wiring —
with a large terminal enclosure
providing ample wiring and
termination space insuring cool
terminations and making installation
easy.

Grounding connector standard —
A solid terminal connector is
standard on all OMEGALUX immersion heaters insuring positive
ground and personal safety.

Precise temperature control —
Standard heaters provided with
built-in temperature controls. For
those units not provided with
controls, see Section P. Standard
temperature ranges are:

<table>
<thead>
<tr>
<th>Type</th>
<th>Temp. Range °F</th>
<th>Type</th>
<th>Temp. Range °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot; NPT Screw Plug</td>
<td>0-127</td>
<td>T1</td>
<td>0-100</td>
</tr>
<tr>
<td>2&quot; &amp; 2½&quot; NPT Screw Plug</td>
<td>60-240</td>
<td>T2</td>
<td>60-250</td>
</tr>
<tr>
<td>Standard</td>
<td>60-180</td>
<td>T3</td>
<td>200-550</td>
</tr>
</tbody>
</table>

Note: The integral thermostat functions as a
temperature control only. This is not a fail
safe device so an approved pressure and/or
temperature limit control should be used with
these heaters to assure safe operation.

To set the control temperatures of
heaters equipped with standard
general purpose enclosure adjust
the knob on the outside of the
terminal enclosure. For those
heaters equipped with a
Type E-2 enclosure (explosion
resistant/moisture resistant*)
remove the terminal enclosure lid to
expose the temperature adjusting
knob. For safety reasons, power to
heater and pilot duty power must be
turned off before removing
enclosure lid.

This control is wired in as a line
thermostat for loads up to 4.2 kW on
120 Volts and up to 6 kW on 240 V.
For high wattage ratings and 480 V,
this control is for pilot duty only and
should be wired to operate the
holding coil of magnetic contactor
by customer.

TERMINAL ENCLOSURES
Specify type enclosure required
when ordering.
General Purpose sheet metal,
NEMA 1.
Type E-2 Combination moisture
resistant, explosion resistant*.
Caution: Explosion resistant* type
E-2 construction refers to heater
design features which provide
explosion resisting containment of
electrical wiring according to
National Electric Code. Abnormal
applications or use of heaters which
result in excessive temperatures
can create hazardous conditions
which can lead to fire.

U.L. Listing — U.L. Listing
available for most screw plug
immersion heaters — consult factory.

*(Explosion Resistant Enclosure not
Intended for use in Hazardous Area).
A chemical plant has a covered cylindrical steel tank containing clean water. The tank is insulated all around and on top with 2 inches of fiberglass insulation. The tank sits on grade, is 3 feet in diameter, 5 feet high, weighs 150 pounds empty, and initially contains 200 gallons of water. Initially, the tank and its contents are to be heated from 70°F to 180°F in 2 hours. Thereafter, 50 gallons/hour of water flowing through the tank must be heated from 70°F to 180°F. Select a heater to work in this application. Power available is 240 V, 3 phase. A temperature controller will be used for heating control.

Specific Heat of Steel
= 0.12 BTU/lb-°F
Specific Heat of Water
= 0.12 BTU/lb-°F

Initial Weight of Water in Tank
(equivalent to 200 gal)
= 200 gal x ft³/7.48 gal x 62.4 lb/ft³
= 1670 lb

Exposed Surface Area of Tank
(cylindrical portion and the top surface) = 3.14 x D x H + (3.14 x r²)
= 3.14 x 3 x 5 + (3.14 x 1.5 x 1.5)
= 47.1 + 7.1 = 54.2 ft²

Temperature Difference for Heating (∆T) is 180 - 70 = 110°F

From Figure A-3 on page Z-18 (heat loss curves), the heat loss from the exposed surface area of the tank is 10 watts/ft².

First calculate the Heating Requirements to heat up the initial charge of 200 gal of water.

**TO FIND INITIAL HEATING CAPACITY IN kW:**

\[
q_W = \frac{Q_W + Q_C + L_S H}{3412 \times 1000 \times 2}
\]

where:

- \(Q_W\) = energy to heat initial charge of water = 1670 x 1.0 x 110 = 183,700 BTU
- \(Q_C\) = energy to heat steel tank = 150 x 0.12 x 110 = 1980 BTU
- \(L_S\) = Surface heat losses = 10 x 54.2 = 542 watts
- \(H\) = heating time, hours
- 3412 = BTU to kWh conversion
- 1000 = watts to kW conversion
- 2 = averaging factor for surface heat losses over initial 2 hour heating time

\[
kW = \frac{183,700 + 1980 + 542 \times 2}{3412 \times 1000 \times 2} = 54.4 + 0.5 = 54.9 \text{ kW/hr}
\]

Next, calculate the steady-state operating kW requirements to heat 50 gal/hr of water passing through the tank and to make up for heat losses from the exposed tank and to make up for heat losses from the exposed tank surface area (operating kW requirements are calculated on an hourly basis).

**TO FIND OPERATING kW REQUIREMENTS:**

Weight of water passing through tank =

\[
50 \text{ gal/hr} \times \frac{62.4 \text{ lb}}{7.48 \text{ gal}} = 418 \text{ lb/hr}
\]

\[
kW = \frac{Q_{WO} + L_S}{3412 \times 1000}
\]

where:

- \(Q_{WO}\) = energy to heat additional water passing through tank
  = 418 x 1.0 x 110 = 45980 BTU
- \(L_S\) = Surface heat losses = 10 x 54.2
  = 542 watts

\[
kW = \frac{45980 + 542}{3412 \times 1000} = 13.5 + 0.5 = 14.0 \text{ kW}
\]

Therefore, both the initial kW requirements and the operating kW requirements have been calculated. The greater of the two is installed.

A 20% safety factor is commonly added to the greater kW value calculated to arrive at the final kW value to be installed.

Most commonly, the initial kW requirements works out to be the greater value. This is true in the example above where the initial kW requirements are 27.5 kW.

Therefore, final kW to install
= 27.5 x 1.2 = 33 kW

**SELECT THE HEATER**

If a temperature controller is to be used for heating control, then three model no. MT-3120A, 240 V, 3 phase, clean water screw plug immersion heaters (see page F-16) rated at 12 kW each could be used. This would make a total of 36 kW installed. The heating initial time would make a total of 36 kw installed. The heating initial time would therefore be reduced to a little less than 2 hours.
More than 100,000 Products Available!

- **Temperature**

- **Flow and Level**
  Air Velocity Indicators, Doppler Flowmeters, Level Measurement, Magnetic Flowmeters, Mass Flowmeters, Pitot Tubes, Pumps, Rotameters, Turbine and Paddle Wheel Flowmeters, Ultrasonic Flowmeters, Valves, Variable Area Flowmeters, Vortex Shedding Flowmeters

- **pH and Conductivity**
  Conductivity Instrumentation, Dissolved Oxygen Instrumentation, Environmental Instrumentation, pH Electrodes and Instruments, Water and Soil Analysis Instrumentation

- **Data Acquisition**

- **Pressure, Strain and Force**
  Displacement Transducers, Dynamic Measurement Force Sensors, Instrumentation for Pressure and Strain Measurements, Load Cells, Pressure Gauges, Pressure Reference Section, Pressure Switches, Pressure Transducers, Proximity Transducers, Regulators, Strain Gages, Torque Transducers, Valves

- **Heaters**