SELECTION OF SCREW PLUG IMMERSION HEATERS

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.

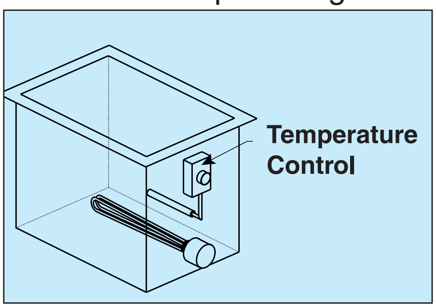
Heater application is influenced by the following parameters. (Refers to chart below).

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.

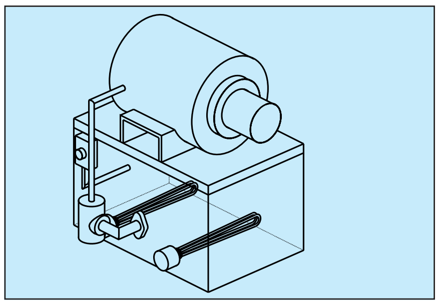
TYPICAL APPLICATIONS

See screw plug immersion heater selection guide below for your application.

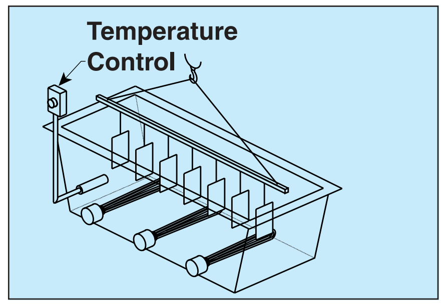
- **Hot water storage tanks**
- **Warming equipment**
- **Pre-heating all grades of oil**
- **Food processing equipment**
- **Cleaning and rinsing tanks**
- **Heat transfer systems**
- **Process air equipment**
- **Boiler equipment**
- **Freeze protection of any fluid**



MT heater screwed into tank wall parallel to bottom for use as a hot water rinse.



MTO heater used to preheat oil to insure efficient lubrication for heavy motor.



MTO heaters applied to conveyorized degreasing operation of many parts at once.

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

**Passivated stainless steel recommended for water applications.*

SCREW PLUG IMMERSION HEATERS FOR CLEAN WATER

MADE IN USA

- **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:

Type	Temp. Range °F	Type	Temp. Range °F
1" NPT Screw Plug		**2 & 2½" NPT Screw Plug**	
TL	0-127	T1	0-100
TH	60-240	T2	60-250
Standard	60-180	T3	200-550

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).*

IMMERSION HEATER SIZING EXAMPLE

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 (ΔT) 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:

$$kWh = \frac{Q_W + Q_C}{3412} + \frac{L_S H}{1000 \times 2}$$

where:

Q_W = energy to heat initial charge of water = 1670 x 1.0 x 110 =183,700BTU

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

$$kWh = \frac{183{,}700 + 1980}{3412} + \frac{542 \times 2}{1000 \times 2} =$$

54.4 + 0.5 = 54.9 kwWh

kW Capacity for Initial Heating =

$$\frac{kWh}{H} = \frac{54.9}{2} = \mathbf{27.5}$$

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 =

$$50 \frac{gal}{hr} \times \frac{ft^3}{7.48\ gal} \times 62.4 \frac{lb}{ft^3} = 418 lb/hr$$

$$kW = \frac{Q_{WO}}{3412} + \frac{L_S}{1000}$$

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 x54.2 = 542 watts

$$kW = \frac{45980}{3412} + \frac{542}{1000} = 13.5 + 0.5 = \mathbf{14.0}$$

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.

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