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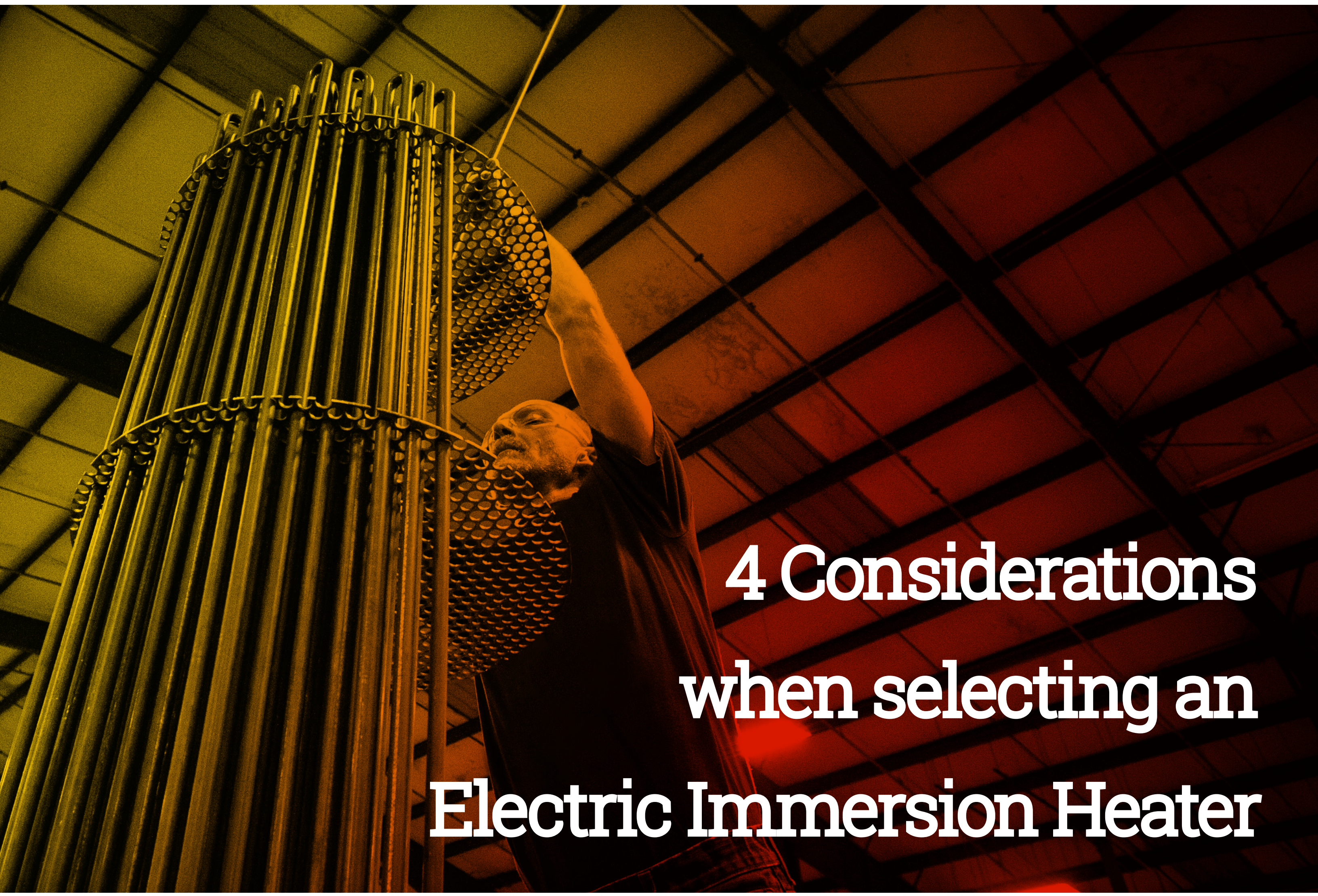

4 Considerations when selecting an Electric Immersion Heater

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4 Considerations when selecting an Electric Immersion Heater

Electric immersion heaters are often used in water tanks for freeze protection or to maintain elevated process temperature and in oil tanks to maintain proper viscosity. Because the elements are fully immersed, they are almost 100% efficient, small, and easily controlled. Electric heaters have many advantages over other heating methods such as steam, hot water boiler systems or gas fired pipe heaters. We will look at a few of the basic decisions one must make when selecting an electric immersion heater.

First decisions, watt density and sheath selection

Electric immersion heaters in water tanks can be subjected to prolonged periods of stagnant water with treatment chemicals and contaminants. Selection of the sheath material is an important first consideration because the elevated temperature of the element sheath is a catalyst for accelerated chemical corrosion. Both copper and 304 stainless steel sheathed, compacted tubular heating elements at 50-70 watt/in2 have proved successful in clean water while derating to 20-30 watts/in2 is indicated with significant additives. Incoloy alloys, incoloy 800 or incoloy 840, can be a cost effective alternative over 304 SS or 316 SS in certain corrosive environments, particularly chlorides.

For "clean" water applications or with DI water the sheath material is upgraded to 316 SS often pickled and passivated to remove surface carbon or even electroplated for an almost mirror element surface. Important to note that in some very clean DI water applications metal sheathed elements, no matter how treated, are not recommended.

In oil tanks, carbon steel sheaths are appropriate for all but the highest temperature synthetic oils however appropriate watt density becomes critical. With water, selecting too high a watt density can accelerate the precipitation of solids on the element but does not harm the water. With hydrocarbons, and their much lower specific heat, too much watt density can cause the oil to "coke" on the heater, reference figure 1.

FIGURE 1

Coked Flange heater due to high watt density

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Watt density is determined by the thermal properties of the oil and the process temperature. In these applications it is the ability of the fluid to accept heat which is the limiting factor in selecting the watt density. In general the heavier the oil the lower this watt density. Electric heater manufacturers can help with the selection process. Indeeco can estimate the sheath watt density provided the fluids properties as indicated in figure 2 below.

Figure **2**

Properties	**Units**	**Values**
Thermal conductivity	Btu/Hr.ft.degree F	0.120
Tube diameter	Feet	0.040
Density	Pounds/Cubic feet	67.800
Volume coef. of expansion	one over degree F	7.74E-04
Fluid outlet temperature	Degree F	160.000
Operating sheath temp.	Degree F	225.000
Specific Heat	Btu/Lb.mass.degree F	0.300
Dynamic Viscocity	Lb.mass/ft.hr	0.480
Results		
Heat transfer Coeff.	Btu/Hr.Sq.Ft.degree F	118.903
Max. Watt Density	Watts/Sq.inch	15.709

Controls

A temperature regulating device and low liquid level protection are recommended for use with immersion heater(s) to control the heating process and safeguard the heater and tank from excessive temperatures. The system consists of electric immersion heater(s), a heater control panel with a temperature and liquid level sensor, or sheath mounted thermocouple, and a power switching device (usually a magnetic contactor or SSR). .

For outdoor tanks both the heater(s) and control panel should have a liquid-proof and corrosion resistant enclosure suitable for outdoor/moist locations. The control panel may control more than one heater, up to its nameplate voltage, phase, and KW rating. Various options are available for control panels such as fusing, circuit breakers, door disconnect switch, GFI protection, 65 K short circuit rating. UL and/or CSA listing may be required by local codes.

Mounting

Typically electric immersion heaters have either pipe thread mounting, (nominally NPT) or ANSI flange connection into the tank. Mounting position is often determined by the tank manufacturer with half couplings for NPT heater or weld neck ANSI flanges for flanged heaters. Best practice is placing the heating elements horizontally and low in the basin but above any anticipated sludge level. Generally the minimum fluid level should be 1˝ above the heater element(s) and a minimum 2˝ from the tank floor. Place the elements equally around tank to minimize thermal gradient, see Figure 3.

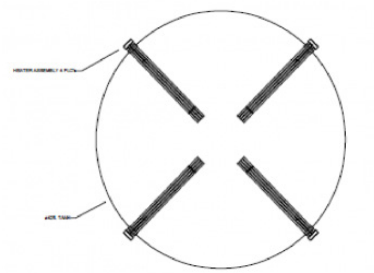

Figure **3**

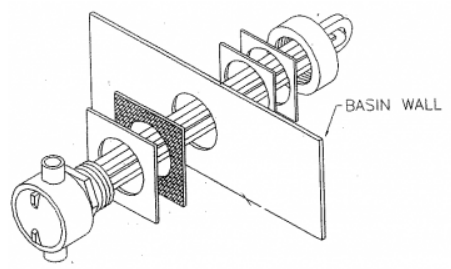

Figure **4**

Most tanks with pipe thread heater will use a half coupling to hold and position the heater. If the tank is carbon steel, with a thin wall, a zinc scru-tite hub can be used to mount. If the tank is stainless steel, a stainless steel hub or flange assembly should be used to avoid a galvanic reaction between the stainless steel wall and the zinc scru-tite hub, (figure 4 for low pressure applications). Pipe thread heaters are installed by applying Teflon tape or pipe dope to the threads and tightening into the appropriate threaded nozzle or hub. Avoid over-tightening and retighten as required if a leak develops. Element bundles must be adequately supported; typically supports should be provided every 24˝ starting at 36˝ from the heater fittings.

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Electrical connections

The size and type of incoming field wiring will depend upon the heater terminal box temperature, heater current draw per conductor, number of conductors per conduit, and wire insulation rating. Refer to the National Electrical Code Table 310-16 or C.E.C., tables 2 and 5C. Confirm all unused conduit holes in the heater terminal box are sealed with plugs suitable for the heater environment. Replace any plastic shipping plugs if an opening is not used. Attach a ground conductor to the stud located in the heater terminal box or by other appropriate means per NEC Article 250. A minimum of an annual inspection to re-tighten electrical connections to check the terminal enclosure and conduit connections for evidence of water leaks or moisture collection is advisable. Moisture in the terminal enclosure is one of the main causes of heater failure followed by operating in air and excessive build-up on the elements. Usually a performance check of outdoor control systems is done in early fall to allow repairs in a comfortable, non-critical environment.

We have the experience and expertise to provide you with the personalized support to arrive at customized solutions.

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