

## Liquid Level Controls vs. Thermal CUTOFF / RESET , Devices with Electric Immersion Heaters, Which is SAFER?

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In the late 1960's we were selling two probe-conductivity type liquid level controls with over the side electric immersion heaters. As the solution in the tank evaporated below the cold zone bracket on the heater exposing the element, the level control would shut off the heater before it got to that point. We sold the level controls as a way to extend the heater life and reduce customer irritation from them leaving the heater on and prematurely burning the heater out. The tanks at the time were steel outside with PVC, plastic liners or they used large, old rubber battery casings from submarines that had the top and lead cells removed. If a tank didn't have a level control and the customer left the heater energized on a 3-day weekend, a fire would happen. Back then, the steel outer tank would contain the flame. The flame would enter the steel, stainless steel, or galvanized vent system and a) limit the spread of the flames, b) give direction to the flame until it burned itself out. In the rubber casings, the smoke was so horrific it would smolder for hours and never really strike a flame.

Enter – Polypropylene—1970's. Polypro was used extensively for process tanks because of the corrosion resistance. And after a hard day on the plating /finishing line, the fronts could be hosed off and the shop would glisten. All of a sudden the tanks were plastic, the vent systems were plastic and the fume scrubbers were also. Makes sense. Now if a fire struck up in a tank, the shop would burn to the ground. The fire would burn the tank and spread along the lip, catching the next tank on fire, enter the vent system and scrubbing system catching the roof on fire and the rest is history.

In 1979 some insurance industries rules were circulating explaining that plastic vent systems were to have extinguishing nozzles in the vent ducts. The industry didn't take to this quickly; simply because of a nozzle got corroded and opened. Water would flood out of the vent system and fill the tanks, eventually overflowing the tank on to the floor. How do you have a flood? Level controls became a necessity and not a luxury any more.

The level controls: All the level controls must be functional at or above the cold zone bracket on the immersion heater. Makes sense; you want the heater to shut off before the heating element is exposed. There are three basic types of level safety controls.

First, is the 2 prong, **conductivity type (Fig.1)** that mounts on the lip of the tank and a set of metallic probes hang in the tank. 3-24 volts is passed across the probes in solution. Remove the solution and the conductivity stops and the circuit is opened. Heater shuts off.

The second type is the **float type (Fig.2)** level control - usually a 3/8 or 1/2" poly tube with a float that contains a magnetic switch. When the float is up the system is energized. Float is down the float is off.

The third type is the **capacitance type (Fig.3)**. This type was mounted externally on poly tanks and would sense the liquid through the wall of the tank. The toughest challenge for all of the above controls is the crystalline build that happens in an electro-nickel plating tank.

The capacitance type has to be set at the right level on the outside of the tank. This sensor has to be “tuned” to the solution distance just inside the tank wall. If the anode basket is to close it will “read the anode basket as the solution” and stay on not shutting the heaters off at the appropriate time.

The float type has a small clearance between the center post and the float that the crystal cakes up on the device and make it not functional.

The conductivity types (as long as you are using titanium probes for this solution) take the least amount of space, easy to maintain, check and clean.

The cutoff/reset devices that accompany immersion heaters fall into 3 basic categories:

- 1) A miniature snap action switches with a preset temperature that opens and after cooling will close.
- 2) A wax pellet type that melts at a specific temperature. The latter are usually “one time” fuses.
- 3) A miniature RTd sensor on the inside of a sleeve on a PTFE heater (Teflon).

The reset, snap action switch with the present temperature is used in conjunction with a contactor or magnetic relay, as is the “one time”. These units are not designed to be wired in series with the heater at any time.

The cutoff/reset device is in a parallel tube alongside the main tube with the heating element. The tube extends up into the junction box of the head. Some manufacturers make this accessible through the head of the heater and others don't. If the application of the heater is set up right initially then access isn't necessary to this safety feature.

The purpose of these cutoff/ reset systems is to de-energize the heater. In the absence of water based liquids the heat from the main tube is not carried away by the solution. The heat, through radiation, is transferred to the tube, which is in turn transferred to the cutoff/reset device. The device is heated passed its operating temperature and opens. The solution has to be below the cold zone bracket of the heater.

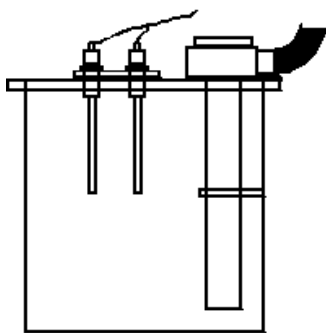
On a replaceable or “one time” device the maintenance person must disconnect and lock out the power, open the head of the heater, disconnect the wire nuts, pull the spent unit out of the tube and replace it with a new unit (that is hopefully in stock), insert it down the tube correctly (if they do not the system is moot) to the bottom, reconnect the wires, get the top back on in a fashion so moisture doesn't enter the cavity and you are finished.

With the liquid level controls mounted on the lip of the tank, the employee has less exposure to the tank chemistry. The unit can be easily tested for operation and pulled away from the tank if repairs are necessary.

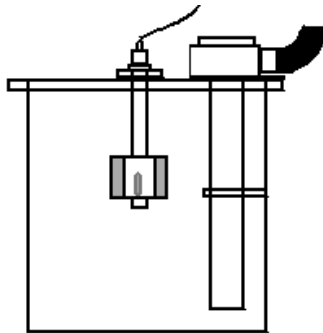
With “resettable” devices, after it has opened the device will cool down and close again. The control system will dictate what happens next. In all instances it is best to have a control system with a manual reset feature. This will prevent the system from re-energizing.

We could never understand why one would put a cutoff/resettable device on a PTFE coated heater instead of using and installing a liquid level device above the hot zone of the heater. Once the radiation from the exposed heater has transferred energy to the device, the PTFE has melted, rendering the heater less safe because of chemical corrosion attack that is about to take place on the base metal of the heater sheath. It would make more sense to install a liquid level control on the tank shutting the heater off before it reaches hot zone . Thus, saving the heater, which cost considerably more than the level control.

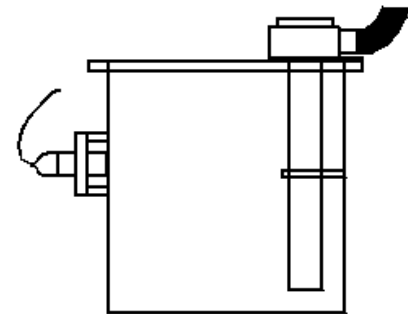
Hmmm.... Everyone's has got to have a gimmick. We think we'll stick to our level controls.



**Fig.1**  
Conductivity  
type probes



**Fig.2**  
Float  
type switch



**Fig.3**  
Capacitance  
type switch