Protection tubes and flexible sensors make it possible to replace thermocouples without shutting down the entire process for days or weeks.

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Large boilers and furnaces use thermocouples to monitor temperatures at strategic locations to locate "hot spots," identify tube dry-out and tube blockage conditions, monitor efficiency and uniformity, and optimize operations. In some cases, hundreds of thermocouples are installed. In almost all cases, the thermocouples are welded into place, which creates a horrendous problem when maintenance is needed.

Thermocouples fail, and must be replaced periodically. Unfortunately, replacing thermocouples inside a boiler or furnace requires shutting down the unit so it can cool enough for technicians to enter, remove the old thermocouple, and weld a new one in place. This takes a minimum of 16-24 hours if materials are on hand.

If a replacement T/C has to be ordered, this takes a minimum of four to five days—if not weeks. Consequently, many users wait until multiple thermocouples fail before shutting down the process. In some cases, they wait until half of the sensors have failed, thus crippling boiler efficiency and preventive maintenance programs.

Nobody will shut down a boiler for a failed T/C unless it's for a critical safety related item or so many have failed they are operating "blind." Loss of key temperature measurements can keep a unit from operating at its optimum heat rate—a measure of efficiency—so the unit becomes more expensive to run.

Most users resist process shutdowns, and will run blind as long as possible hoping to get to the next scheduled outage. Running partially blind can effectively cripple boiler efficiency and predictive maintenance programs.

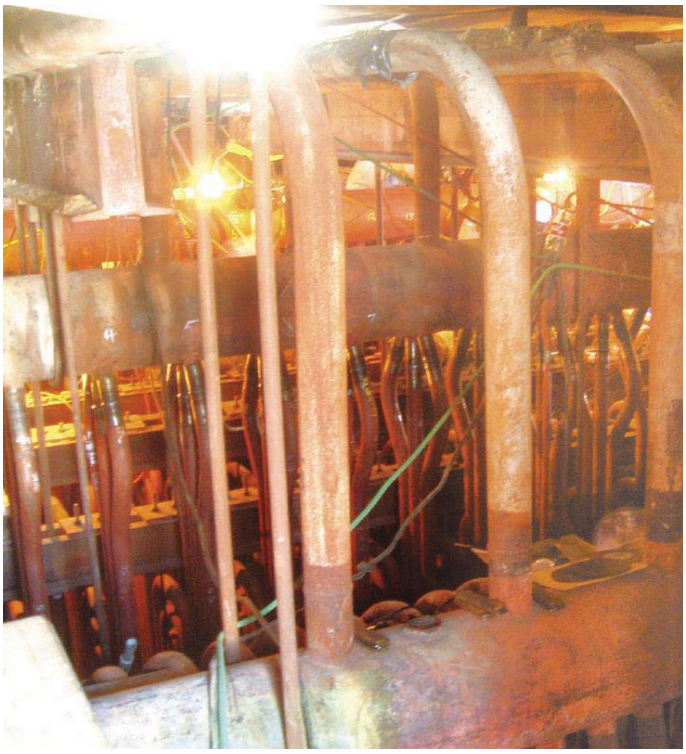

Figure 1. The superheater section of a large boiler, awaiting thermocouple installation by the end user. Thermocouples have to be welded among these pipes, and then run in conduit to the outside.

For a major power utility boiler, outage time can be incredibly expensive–lost revenue, startup costs, equipment stress, etc. If a forced outage occurs during a peak load period, the cost of purchasing replacement power to supply the customer base could be hundreds of times the utility's normal cost of generating it.

For a manufacturing plant, the steam generation boiler is often required to operate in support of production. Decreases in operational efficiency typically add to the fuel cost or can limit production due to lack of capacity. Shutting down the

boiler can partially or completely limit manufacturing output.

Instead, by using thermocouples mounted in a protection tube, it is possible to simply extract the old sensor and install a new one from outside the boiler or furnace, without shutting the unit down.

Traditional Methods

The traditional method is to have contractors attach a very long stainless steel thermocouple sensor to pipes located inside the boiler or furnace, using a welding pad attached to the tip of the sensor. The pad at the end of the sensor is welded to specific points of measurement inside the boiler or furnace.

Thermocouple wires are then routed through bundles and conduit to the outside. In new boilers, the unit may have thermocouples already attached. If not, the end user must install them, Figure 1.

When these thermocouples require replacement, it may be necessary to replace everything from the welded pad to the wiring in the conduit, Figure 2. Another problem facing technicians is that replacement thermocouples can be extremely expensive, and may have a long lead time to obtain.

In the worst possible case, it could take days or weeks to break the welds, order and receive new custom replacement sensors, and then reinstall them. This causes a loss of revenue during the long shut down period.

Flexible Sensor Saves Time and Money

Moore Industries has a better solution that saves time and money, Figure 3. Moore Industries manufactures a hollow protection tube that looks and installs the same way as a solid thermocouple sensor in this same application. Protection tubes are built with a welding pad at the tip of a long stainless steel tube. The welding pad, made of

Figure 2. Hundreds of thermocouple wires are routed to these junction boxes, mounted outside the boiler.

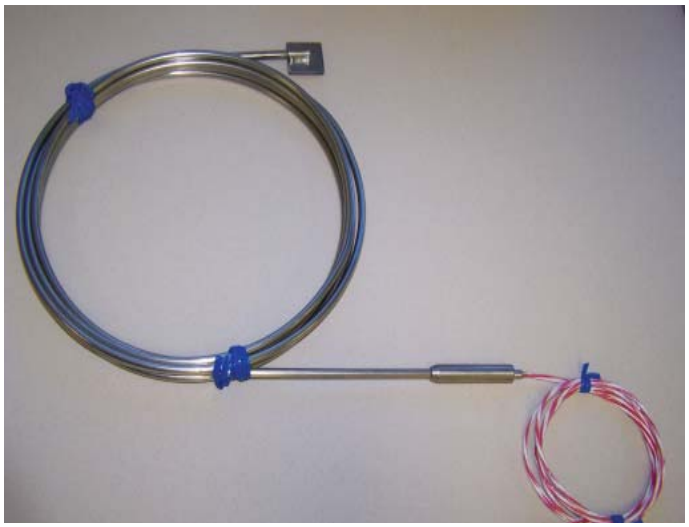

Figure 3. By using protection tubes and WORM® sensors from Moore Industries, thermocouples can be replaced from outside the boiler or furnace, eliminating the need to shut down the process. The protection tube has a welding pad at the end, which is welded into place inside the boiler or furnace. The WORM sensor slides into the protection tube, all the way to the welding pad.

compatible material, is welded to specific points of measurement inside the boiler or furnace.

A WORM® flexible thermocouple sensor slides into the tube, and is held in place by a spring. The WORM can be removed or replaced from outside the boiler area, thus preventing the need to shut down the process.

A technician slides the WORM sensor inside the tubing from outside the boiler in a safe area until it bottoms out at the end of the protection tube, where the tubing is welded to the measurement point.

Replacements are simple. If a WORM sensor fails for any reason, replacement WORMS can be kept on hand in one length of wire that fits any of these measurement points. Replacements take just minutes to install, and the wires can be cut to fit any length of tubing. Replacement costs are only a small fraction of the total cost for a solid thermocouple sensor that has failed and shuts down a process.

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