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Thermocouples don't last forever. In most industrial applications, they fail at a somewhat predictable interval. Prior to total failure, they will give false readings: thermocouple millivolt output will be low, and the furnaces may be hotter than instruments indicate. The thermocouple's failure interval is affected by variables like temperature, exposure to various corrosive gases or liquids, or physical abuse. In most industrial heat treat applications, temperature is the key factor that influences life expectancy.

Changing thermocouples on top of a furnace is a hot, miserable, and sometimes dangerous job. It is often done on an emergency basis when a sensor fails during production. Climbing on and around very hot furnaces (1000° to 1800°F) presents many opportunities for injury.

It's no wonder that when a maintenance man is on top of a very hot, dirty furnace to change a thermocouple, all he wants to do is get it changed as quickly as possible and get off the furnace. But, that opens the door to a world of installation and quality problems:

- If he doesn't check the protection tube for holes, the new thermocouple can fail more quickly than its average life expectancy. (On atmospheric furnaces, this can cause other problems, too.)
- If he doesn't dump out the buildup of scale and broken insulators at the bottom of the tube, they'll insulate the junction and cause measuring delays.
- If he doesn't carefully strip back some new wire when the insulation on the old wire is frayed bare at the end, it can cause a short, leading to furnace overheating and much more expensive damage.
- If he doesn't put the head cover back on the thermocouple head or replace an old, broken, or corroded connector block, it can cause a high resistance connection and false readings.

## **Working Smarter**

The obvious solution is to change your thermocouples on a routine basis before they fail. Scheduled replacements can be done during a shutdown, when the furnace is cool and safe to work on. Under these circumstances, the protection tube can be removed, dumped, examined, and replaced if necessary. Wiring can be done properly, and new connector blocks and head covers can be installed.

While we're on the subject of thermocouple wiring, I'd like to make an observation. Many thermocouples have poor wiring arrangements at the furnace. The extension leadwire is usually made of some high-temperature material like fiberglass braid. Over the years, this insulation becomes very brittle and frayed at the thermocouple head. Often, there's not enough slack in the wire to cut off the bare part and reterminate it. Additionally, the heat causes the wires to lose their color, making it hard to tell their polarity.

We've found a clean solution to this problem, and have been using it successfully with many customers. We install thermocouple jacks on the furnace near the thermocouple, and mount the female jacks in a standard conduit box with a 3/4" knockout. Next, we install a new piece of leadwire on the thermocouple and terminate it in a male plug. All that's left is to plug the connector into the female jack – and we're all set!

As an added bonus, if you do have a failure during production, and it becomes necessary to change a thermocouple on a hot furnace, you can assemble a spare thermocouple with a length of leadwire and a male plug. Then, you take the new assembly to the furnace, replace the old one with the new, and you're done.



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## Quality Assurance

With today's emphasis on quality assurance, calibration, and ISO compliance, there is a high emphasis in making sure your process is running at the right temperature. If you're only changing thermocouples when they fail, I can virtually guarantee that your furnace is hotter than is indicated just prior to total T/C failure. Many auditors and new heat treat specifications are calling for thermocouple replacement programs and/or calibration programs.

## Illiana Instrumentation Service Can Help

We've been working on this type of equipment since 1969. We can help you inventory your thermocouple applications and make recommendations for implementing a routine replacement program. We can document your system, sell you all the thermocouple products you need. We can even assume full responsibility for your routine thermocouple replacement program and implement it for you.

## The Steps Involved

1. Make a list of your equipment and the types of thermocouples you use on each item.
2. Decide on the necessary replacement frequency. (See our Recommendations table.)
3. Order thermocouples and materials from Illiana to have on hand to begin program implementation.
4. Decide on a documentation system to keep track of thermocouple replacement dates and due dates.
5. Cost justify the program and sell it to your management team.
  - a. Consider reduced downtime due to untimely thermocouple failure. (Management LOVES this one.)
  - b. Increased quality. (Good management likes this one.)
  - c. Decreased risk of accidents from reduced employee exposure to hot furnaces. (Management hates to think about this stuff, but it's a fact of business, and it scares them.)

Please call our office if you have any questions about thermocouple replacement programs. We welcome the opportunity to meet with you to discuss your requirements.

A handwritten signature in black ink, appearing to read "Paul", written in a cursive style.

Paul D. Grolla



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## **Thermocouple and Protection Tube Replacement Recommendations**

### **Type J or K: Temperature Ranges of 400° F or Below**

Illiana has some customers that use Type J or K thermocouples on ovens operating in temperature ranges of 400° F or below. When installed in the proper protection tubes, these thermocouples seem to last five or more years with no signs of deterioration.

### **Type K: Temperature Ranges of 900° to 1200° F**

Many heat treat applications run in the 900° to 1200° F area, and use Type K thermocouples. Again, when installed in proper protection tubes and not physically damaged, these thermocouple elements last several years. Keep in mind, however, that these operations are often critical annealing and stress relieving operations, and are often the final heat treat operation. We recommend replacing these thermocouples every one or two years.

### **Type K: Temperature Ranges of 1200° to 1800° F**

When we move up the temperature scale above 1200° F, and particularly into the 1500° to 1800° F range, life expectancy of the Type K thermocouple drops off. Elements at this temperature tend to show signs of deterioration in the 6-to-12-month time frame. At this temperature, the protection tubes, although made of various grades of stainless steel or Inconel, also show signs of deterioration over a similar time frame. For applications running at 1800° F, replacement of thermocouples and protection tubes every six months to a year is recommended.

### **Type K: Temperature Ranges of 1800° to 2200° F**

Illiana Instrumentation Service has some customers that use Type K thermocouples at temperatures above 1800° F, and as high as 2200° F. Life expectancy at these temperatures is a matter of a few months. While this sounds like a bad idea, customers usually use these Type Ks because the applications expose the thermocouples to high vibration and a high likelihood of physical abuse. It is much cheaper to accept the damage to the less expensive Type Ks than it would be to use more expensive platinum elements. With these high-temperature applications, we recommend replacement every three months. And, depending on the vibration levels, some elements may fail more quickly than this.

### **Platinum Types R, S, or B: Temperature Ranges Above 1800° F**

When operating at temperatures above 1800° or 1900° F, you should consider using platinum thermocouples of Types R, S or B. While their initial cost is substantially higher than other types, they have a very long life expectancy. In fact, unless physically damaged or contaminated by chemicals, platinum thermocouples will last indefinitely.