Replaceable Furnace Tubeskin Thermocouples Best Practices

Coking.com

Coker Safety Seminar
Galveston 2008

GAYFSCD

Disclaimer

- What we won't tell you
  - We are not process experts.
    - We are not experts in the actual operation of the coker. Those questions should be directed to a Coking Process expert. We can comment on the operation of the coker furnace as it pertains to temperature measurement.
  - We are not materials experts.
    - We can not recommend materials for use inside the furnace. A materials expert should be consulted for the choice of metals used in the furnace. We can suggest commonly used materials.

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Introductions

- Robert Torgerson
  - Sales and Marketing Manager
  - Industrial Engineering – Vanderbilt University
  - 19 yrs Industry Exp (Baker Petrolite, ICI Katalco, Univar)
  - Patent –, Insert able Catalyst basket

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Who is GAYESCO?

- **Founded in 1958**
- **Specializing in temperature measurement solutions for the refining and petrochemical industries**
- **Innovations in Multipoint technologies, tubeskin temperature measurement, pilot light detection, and reactor skin temperature measurement.**
- **Provide field support for installation**
- **ASME Code U & R stamps**

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Who is Gayesco

- Annual Sales – $20 Million
  - –Approx 60% International
  - –Approx 60% reactor instrumentation (Flex – R)
- 90+ Employees
- Headquarters
  - –**2859 Westside Drive, Pasadena, TX**

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Furnace Experience

- Chevron
- Shell
- Lyondell
- UOP
- Valero
- BP
- Marathon
- Saudi Aramco
- Reliance

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Coker Furnace Challenges

- Frequent Cycling
  - Tube movement due to expansion and contraction
- Alternate Fuel Firing
  - Fuel Oil Composition
- Accurate Temperature Measurement

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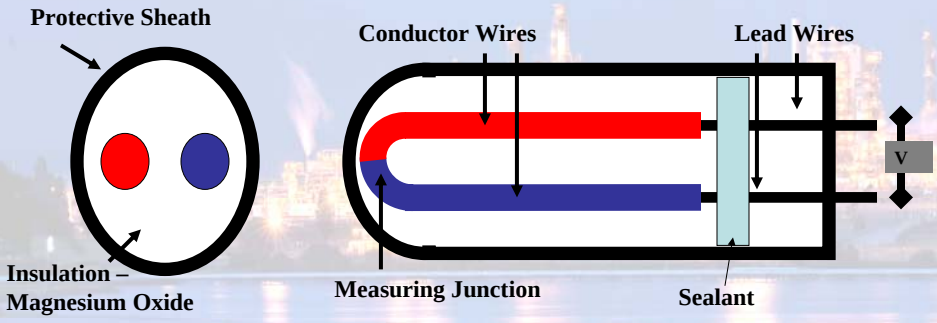
Thermocouple Basics

- Thermocouple Parts



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Thermocouple Types	Principle Wire Constituents
J	Iron vs Nickel Copper alloy
T	Copper vs Nickel Copper alloy
K	Nickel Chrome Vs Nickel Manganese – silicon aluminum alloy
E	Nickel Chrome vs Nickel copper alloy
N	Nickel Chromium Silicon alloy vs nickel silicon magnesium alloy
S	Platinum-Rhodium alloy vs Platinum
R	Platinum-Rhodium alloy vs Platinum
B	Platinum-Rhodium alloy vs Platinum-Rhodium alloy

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Thermocouple Basics
Common TC Failure Modes

- Sheath Breach
- Grain Growth
- Transition Problems
- Fast Burn out

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Sheath Breach

- Failure of the protective sheath resulting in contamination of the insulation or separation of the TC.

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Thermocouple Failure Modes

- Grain Growth in the Conductors
  - Time at temperature may cause grain growth in the conductors.
  - Different thermal expansion rates of the various metals can result in a separation. *(Sheath, positive conductor, negative conductor)*
    - Small Conductor sizes are more susceptible than larger conductors.
    - Matched expansion rates can be a solution for some applications. (Type N & Pyrocil D)

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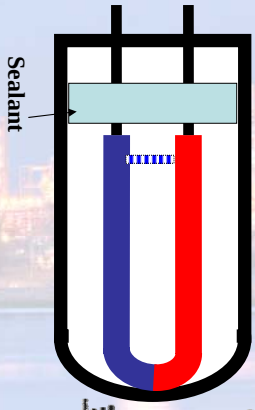
Failure Mode - Transition

- The hermetic seal at the “cold” end of the TC provides a barrier to keep out moisture
- If moisture gets in to the sheath, a second semi junction may be formed.
- The output reading will be an average of the measuring junction and the semi junction
- This failure is repairable in the field for **single** element thermocouples



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Successful TC System

- Elements for a successful TC system
  - TC Choice
    - TC System
    - Elements and Calibration
    - Sheath Metallurgy
  - TC Routing Design
    - Routing
    - Furnace Exit
  - TC Installation
    - Experienced Installers
    - System Installation Ease

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TC System Choice

- Shielded Designs

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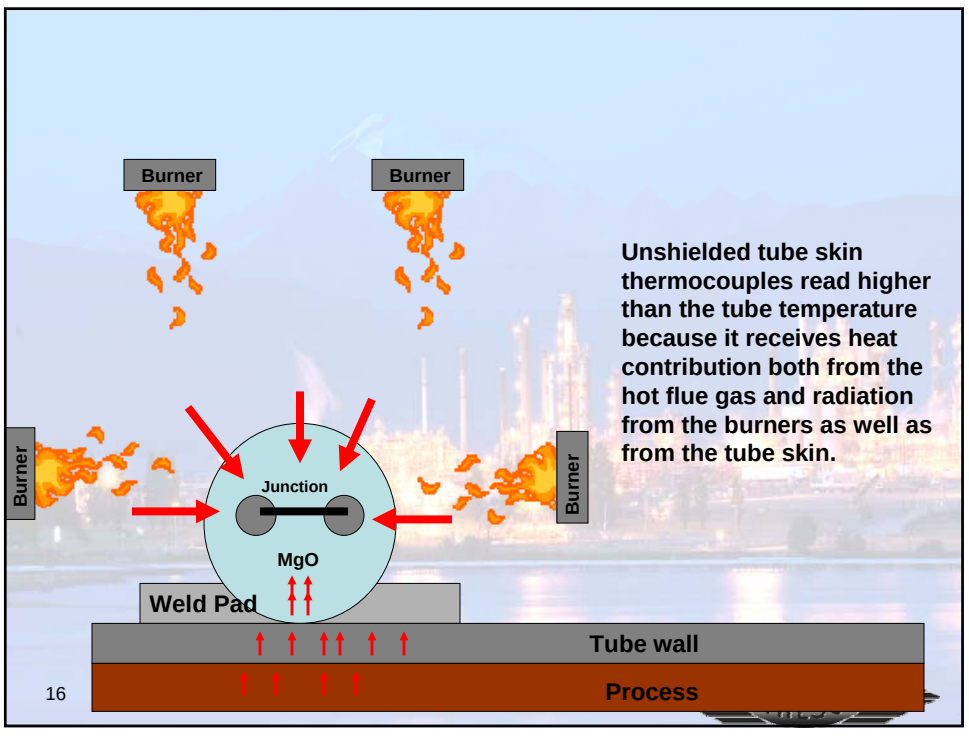

Unshielded tube skin thermocouples read higher than the tube temperature because it receives heat contribution both from the hot flue gas and radiation from the burners as well as from the tube skin.

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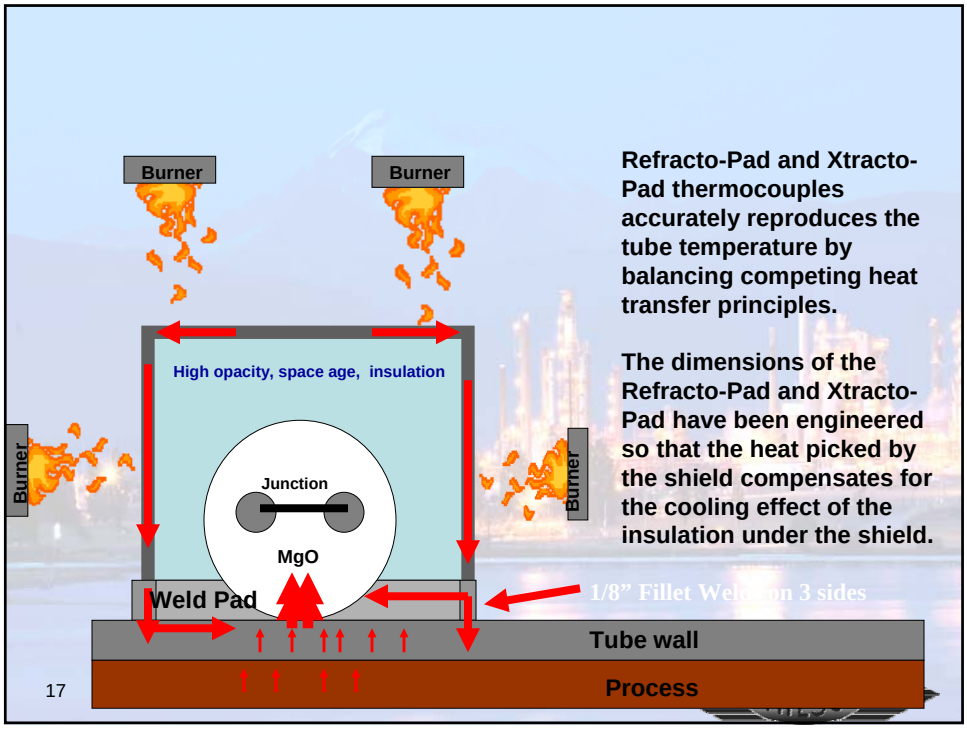

Refracto-Pad and Xtracto-Pad thermocouples accurately reproduces the tube temperature by balancing competing heat transfer principles.

The dimensions of the Refracto-Pad and Xtracto-Pad have been engineered so that the heat picked by the shield compensates for the cooling effect of the insulation under the shield.

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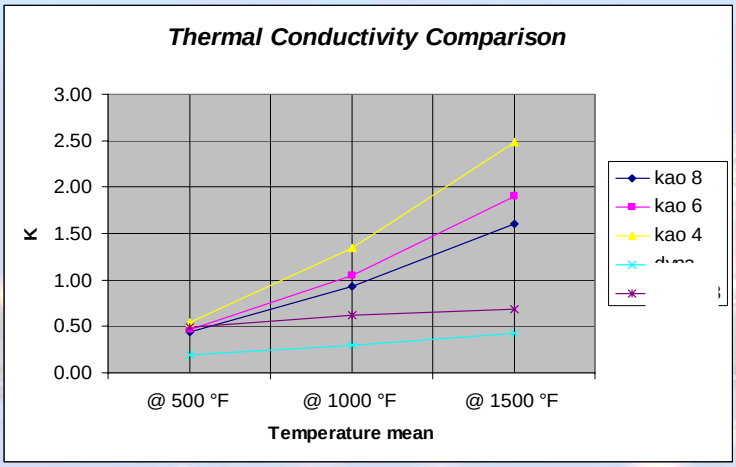
Thermal Conductivity Comparison of Insulation



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TC Elements

- Element Size
  - Larger is more resistant to grain growth
  - Smaller is more flexible and easier to install
- Calibration

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Sheath Metallurgy

- Temperature Considerations
- Fueling Condsiderations
- Stainless Steel
- Nickel Alloys
- Passivated Alloys
- New Innovations

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Proper TC Routing Plans

- Routing Best Practices
  - Furnace “cool” zones
  - Tube runs and attachment
  - Furnace Movements
    - Expansion loops vs Piston Exits

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Furnace Exits

- Expansion Coils VS Piston Style
  - Why to use Expansion Coils
  - Why to use Piston Style Exit
  - Piston is preferred on “high” cycle furnaces

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Furnace Exits

- Fixed Example

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Furnace Exits

- Piston Examples
  - Good
  - Not so good

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Installation

- Proper Installation is essential
- Installation Best Practices
  - Welding
  - Placement
  - Excess Material

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Xtracto-Pad™ “Design Differences”

- The weld pad is fabricated as part of the guide assembly.
- ***New!*** U-shaped guide tube assembly allows the end of the T/C to have direct tube contact at the weld pad.
- The heat shield is modified to keep the weld pad/guide assembly in position.
- The tube clips that hold the thermocouple in place are reusable

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Xtracto-Pad™ “Design Differences”

- Weld able Parts
  - Only done once
    - No re welding
    - No re inspection
  - Can be done by tube manufacturer for new construction

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Thank you

For specific information on your projects please contact

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