



Tube Skin Temperature Monitoring
for BOILERS, FURNACES, & HEATERS

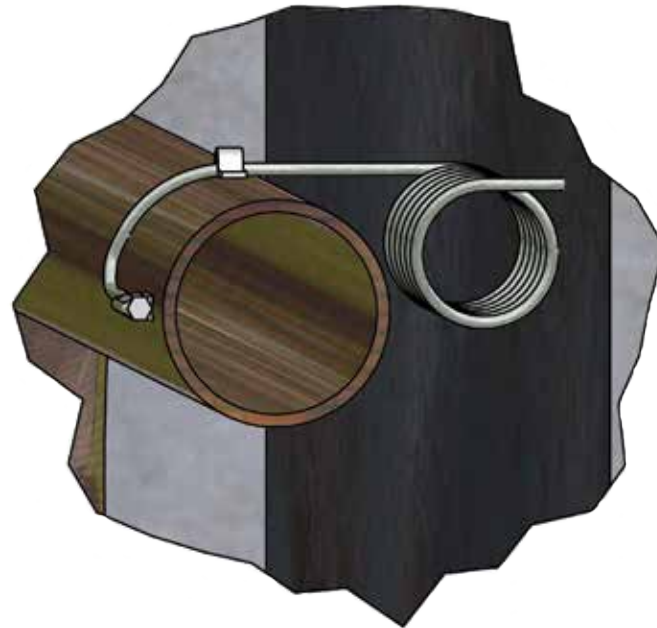


ENGINEERED SOLUTIONS

by Daily Thermetrics' *TUBE SKIN ENGINEERING*



FIRE BOX DIAGNOSTICS combined with **TUBE SKIN THERMOCOUPLE (TSTC) DESIGN AND PROFESSIONAL INSTALLATION** plays a critical role in promoting accurate, consistent temperature measurement and overall reliability. Daily Thermetrics' **TUBE SKIN ENGINEERING** division offers refiners proven solutions to common and challenging issues related to tube skin temperature measurement.



SKETCH ABOVE: Example of tube skin thermocouple in the axial position on process tube. (Heat shield not shown)

SUPERIOR TUBE SKIN THERMOCOUPLE DESIGN

One-size-fits-all is *all* wrong

PROBLEM

Premature TSTC failure due to improper design or improper application is widespread in refinery and petrochemical services. This problem commonly occurs when attempts are made to oversimplify the sensor design, often times resulting in inadequate "one-size-fits-all" furnace products.

TSTC exposure to high temperatures over extended periods of time in metallurgically toxic environments degrades the TSTC sheath and internal conductor and causes catastrophic damage to the physical integrity of the instrument.

SOLUTION

Working with Daily Thermetrics' **TUBE SKIN ENGINEERING** division, who understand the vast number of variables that affect the performance of the TSTC, can significantly enhance the general success of the application. Common variables that are often overlooked include:

FLUE GAS CHEMICAL MAKEUP
SHEATH MATERIAL
SHEATH WALL THICKNESS
SHEATH OUTSIDE DIAMETER
SENSOR WIRE TRANSITION DESIGN
PROCESS TUBE THERMAL COOLING

SENSOR WIRE DIAMETER
WIRE GROUNDING
THERMAL EXPANSION
SENSOR TIP SELECTION
HEAT SHIELD
PROCESS TUBE SCALING

WELDING OF TIP
ROUTING OF SHEATH
SHEATH ROUTING CLIPS
SENSOR WIRE MATERIAL
FIRE BOX TEMPERATURE
SENSOR ENTRY LOCATION

PROFESSIONAL INSTALLATION

Poor installation: the fast track to TSTC failure

PROBLEM

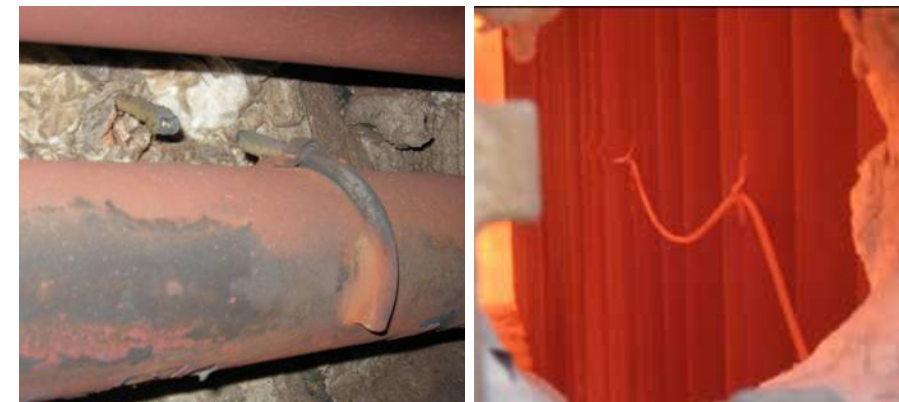
Incorrect TSTC installation by untrained installers in an effort to save money. These DIY (Do It Yourself) installations are typically performed by personnel that do not understand the critical mechanical considerations of the installation and routings. Important steps to promote maximum reliability are skipped entirely.

SOLUTION

Enlist the expertise of the Global Experts, Daily Thermetrics' **TUBE SKIN ENGINEERING** division. The dollars saved by attempting a DIY installation is minimal compared to the increased future risks in the furnace box and possible damage to the furnace/heater equipment and process tubes resulting from the loss of important temperature data.

Daily Thermetrics' **TUBE SKIN ENGINEERING** division employs experienced mechanical engineers to provide industry leading guidance and service from the 'drawing board' to the field.

Utilizing persons without specific training and experience to route and install TSTC is the fastest course to early tube skin thermocouple failure.



ABOVE LEFT: Severed TSTC due to unrealized heat expansion. ABOVE RIGHT: Improper routing of TSTC may appear correct at time of installation but unreliable during operation.

FIRE BOX DIAGNOSTICS

PROBLEM

TSTC entry/exit locations and fire box environments are overlooked when designing and routing TSTC.

Traditional methods for designing/specifying thermocouples destined for pipelines or vessel skins are not appropriate for the specialized nature of TSTC.

Entry/exit locations can hasten TSTC failure if such a location requires the TSTC to span an unsuitable location in the fire box.

SOLUTION

Take advantage of Daily Thermetrics' **TUBE SKIN ENGINEERING** division field experience in simple relocation of TSTC entry/exit points, burner location analysis, and furnace fuel composition analysis to dramatically improve the life and reliability of the TSTC instrument.



IMAGE ABOVE: Example of TSTC entry into furnace firebox.

Daily Thermetrics' **TUBE SKIN ENGINEERING** division performs heater/furnace analysis to approach each variable properly and recommend cost effective solutions for the end-user.

TUBE SKIN THERMOCOUPLE (TSTC) COMPONENTS

CRUCIAL AREAS OF CONSIDERATION TO ACHIEVE OPTIMUM RESULTS

Daily Thermetrics' TUBE SKIN ENGINEERING account for all components to insure they work as an integrated system.



IMAGE BELOW: Furnace and internals for illustration purposes only. Not drawn to scale.



SHEATH GUIDE CLIPS

PURPOSE #1: TO ALLOW FOR THERMAL EXPANSION WITHOUT SUBJECTING TSTC WELDS TO STRESS.

PURPOSE #2: TO MAINTAIN SHEATH CONTACT WITH PROCESS TUBE/PIPE FOR THERMAL COOLING PROPERTIES.

PROCESS TUBE/PIPE

FEEDSTOCK FLOWS THROUGH PROCESS TUBE/PIPE

RECOMMENDED:

PRECISION SHEATH BENDS

PURPOSE: TO PROMOTE EXTENDED TSTC LIFE AND TO MINIMIZE SHEATH STRESS

- Precision bends are performed by trained TUBE SKIN ENGINEERING Field Engineers to properly route and align thermocouple sheath without unnecessary stress to the thermocouple sheath.

EXPANSION COILS

PURPOSE: TO ALLOW FOR THERMAL EXPANSION WITHOUT SUBJECTING TSTC WELDS TO STRESS

- Specially designed by Daily Thermetrics' TUBE SKIN ENGINEERING division for each furnace depending on growth rate and direction.

PROCESS TUBE/PIPE

FEEDSTOCK FLOWS THROUGH PROCESS TUBE/PIPE

INSULATED HEAT SHIELD

PURPOSE: TO PROTECT THE THERMOCOUPLE TIP AND JUNCTION FROM BURNER FLAMES.

BURNER FLAMES CAN CAUSE INACCURATE (HIGHER) TEMPERATURE READINGS AND PREMATURE THERMOCOUPLE FAILURE.

- All heat shields are insulated to provide maximum protection from flame impingement.

CONNECTION TIP

PURPOSE: TO PROVIDE SECURE, DIRECT CONTACT OF TEMPERATURE SENSOR TO PROCESS TUBE/PIPE

- Multiple Options available. Please see next page for more detailed.
- Available both for Axial Mount (Shown) and Radial Mount (Optional).

IMMEDIATE-RESPONSE™ ADVANCED GROUNDED JUNCTIONS

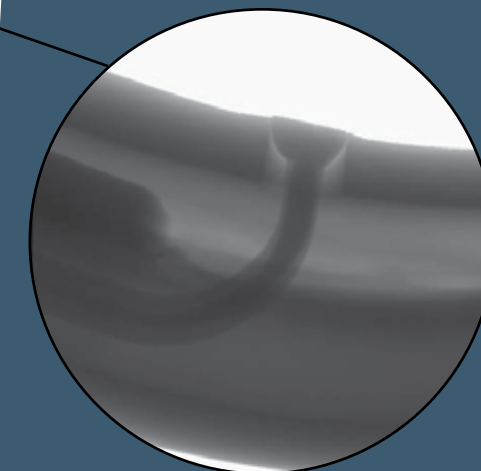
PURPOSE: TO MINIMIZE RESPONSE TIME AND MAXIMIZE ACCURACY BY PROMOTING SUPERIOR HEAT TRANSFER.

Daily Thermetrics and TUBE SKIN ENGINEERING offers IMMEDIATE-RESPONSE™ advanced grounded junctions for most tube skin thermocouple tips available.

Grounded thermocouple junctions are used to minimize response time and maximize accuracy of the sensor's measurement in surface temperature applications. Standard grounded junctions are located at the end (tip) of a thermocouple probe. For tube skin thermocouples, while this may be the easiest location to manufacture the junction, it is **not the best location** for promoting superior heat transfer and accuracy of the measurement.

IMMEDIATE-RESPONSE™ junctions are specially grounded at the location of the thermocouple tip that makes the greatest contact with the process tube surface.

TUBE SKIN ENGINEERING manufactures and x-ray inspects every IMMEDIATE-RESPONSE™ junction.



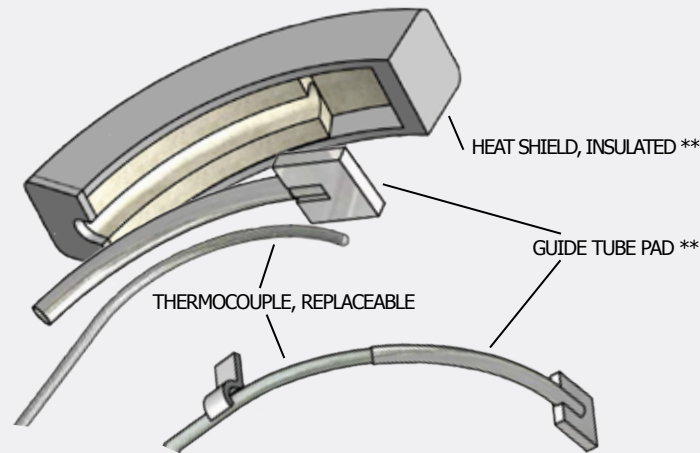
TUBE SKIN THERMOCOUPLE ASSEMBLY TYPES

Standard offerings from Daily Thermetrics' TUBE SKIN ENGINEERING division.

Please contact TUBE SKIN ENGINEERING to assist you with your individual needs.



EXTRACTABLE PROBE PAD with optional Heat Shield



** HEAT SHIELD and GUIDE TUBE PAD are both permanently welded to the process tube.

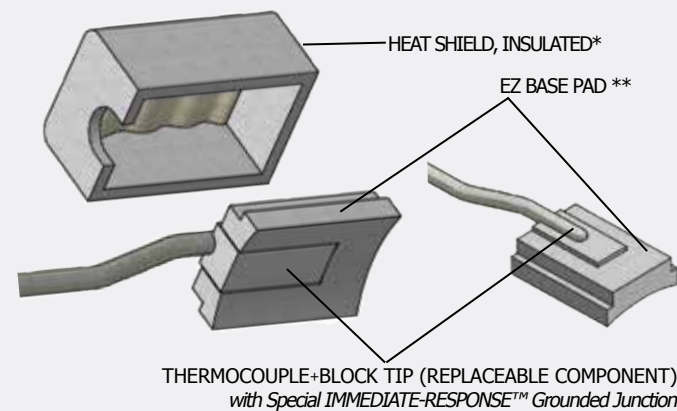
The EXTRACTABLE PROBE PAD tip design allows refiners the ability to replace tube skin thermocouples without the need to perform any re-welding on the process tube/pipe. Once the GUIDE TUBE PAD is welded to the process tube/pipe, replacing the thermocouple is as simple as extracting the failed thermocouple from the guide tube and inserting a new thermocouple.

BEST USE: In low duty furnaces or cleaner burning gas fired furnaces.

LIMITATIONS: Larger OD thermocouple requirements (greater than 5/16" or 7.9375 mm) will not perform efficiently with this design. For heavy duty thermocouple specifications, TUBE SKIN ENGINEERING division recommends the EZ-PAD™ REPLACEABLE design.

AVAILABLE SHEATH O.D.: 1/4 inch (6.35 mm)
5/16 inch (7.9375 mm)

EZ-PAD™ REPLACEABLE with optional Heat Shield



* HEAT SHIELD can be removed during thermocouple replacement and is attached to EZ BASE PAD.
** EZ BASE PAD is permanently welded to the process tube.

The EZ-PAD™ REPLACEABLE tip design allows refiners to replace tube skin thermocouples without the need to perform any re-welding on the process tube/pipe. Once the BASE PAD is welded to the process tube/pipe, replacing the *thermocouple+block* is as easy as extracting the old *thermocouple+block* from the base pad and installing a new *thermocouple+block*. **No post-weld heat-treatment is required after the initial installation.**

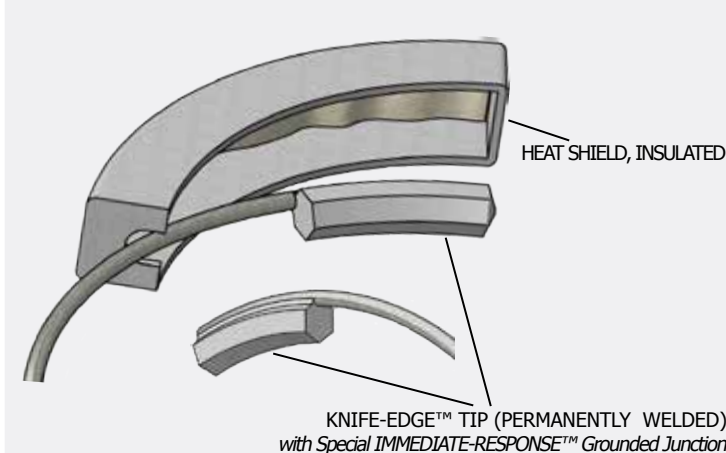
The EZ-PAD™ REPLACEABLE design is offered as an upgrade to the EXTRACTABLE PROBE PAD. This allows refiners to specify larger OD thermocouples with larger OD element wires which allow for longer life and better instrument reliability without sacrificing superior contact of the grounded junction to the process tube skin (external surface).

The EZ-PAD™ REPLACEABLE uses Daily Thermetrics' IMMEDIATE-RESPONSE™ grounded junctions for fast, accurate measurement. For more information on IMMEDIATE-RESPONSE™, please see the highlighted section on the previous page.

BEST USE: In HEAVY/CRITICAL DUTY furnaces; gas or oil fired recommended.

AVAILABLE SHEATH O.D.: 1/4 inch (6.35 mm)
3/8 inch (9.525 mm)
1/2 inch (12.7 mm)

KNIFE-EDGE™ TIP with optional Heat Shield*



The KNIFE-EDGE™ design provides refiners with a robust, reliable tube skin thermocouple design for the most critical, heavy duty furnaces.

Welded directly to the process tube skin (surface), the KNIFE-EDGE™ tip, combined with an insulated heat shield, offers a highly accurate measurement of the process tube surface temperature.

The KNIFE-EDGE™ tip uses Daily Thermetrics' specialized IMMEDIATE-RESPONSE™ grounded junctions for fast, accurate measurement. For more information on IMMEDIATE-RESPONSE™, please see the highlighted section on the previous page.

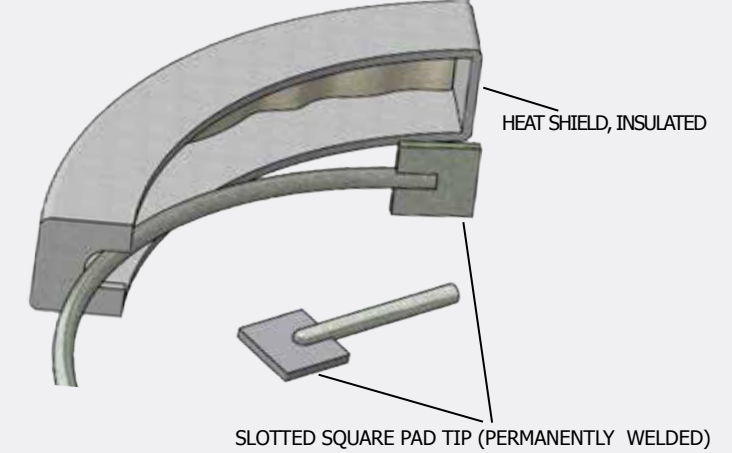
BEST USE: In HEAVY/CRITICAL DUTY furnaces; gas or oil fired recommended.

***NOTE ABOUT ALTERNATE "FAN TYPE" TMT**

This design is also offered as a FAN TYPE TMT in strict accordance with ExxonMobil specifications.

AVAILABLE SHEATH O.D.: 1/4 inch (6.35 mm)
3/8 inch (9.525 mm)
1/2 inch (12.7 mm)

SLOTTED SQUARE PAD with optional Heat Shield



The SLOTTED SQUARE PAD design provides refiners with a simple, reliable tube skin thermocouple for average duty furnaces.

Unlike other square pad style surface measurement sensors where the junction is in contact with the weld pad, the SLOTTED SQUARE PAD allows direct contact of the hot junction onto the process tube surface.

BEST USE: In average duty furnaces utilizing smaller OD thermocouple sheaths and in heavier duty furnaces employing larger OD thermocouple sheaths.

AVAILABLE SHEATH O.D.: 1/4 inch (6.35 mm)
3/8 inch (9.525 mm)
1/2 inch (12.7 mm)

TYPICAL SHEATH MOC (MATERIALS OF CONSTRUCTION)

316 SS • 310 SS • INCONEL 600 • 446 SS • HASTELLOY® X • Pyrosil® D
If a different MOC is desired, please contact Daily Thermetrics for availability.

TYPICAL SHEATH WALL THICKNESS

Unless otherwise specified, all thermocouple sheaths are **standard wall thickness**. Depending on sheath MOC and size, heavy wall construction may be available as an option in order to ensure maximum/extended service life.
Please contact Daily Thermetrics for availability.

Daily Thermetrics, a division of Daily Instruments Corporation, is internationally recognized for its excellence in designing, engineering, manufacturing, and delivering superior products to the demanding needs of our customers. The engineering staff and personnel at Daily Thermetrics are highly trained and dedicated to solve the problems and meet the challenges presented by the Refining & Petrochemical Industry. Clients around the world have relied on Daily Thermetrics' experience and expertise for over 35 years. Daily Thermetrics' world headquarters is in Houston, Texas, USA.



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