BURNS ENGINEERING

Application Note

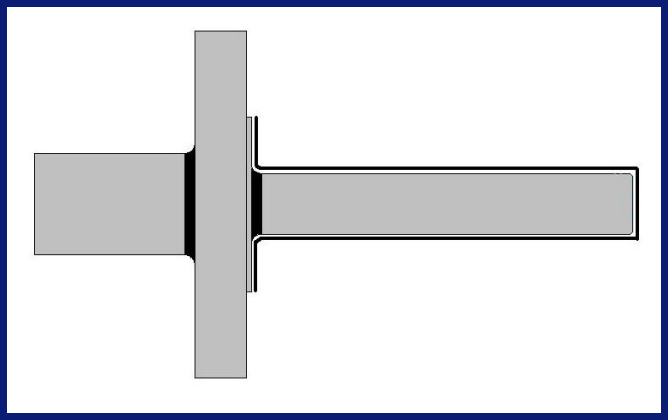
A081031

Tantalum Sleeve Minimizes Corrosion on a Thermowell in Steel Pickling Process

APPLICATION

A steel mill is treating their mill run metal surfaces with a process called pickling. Strong mineral acids remove impurities, stains, rust and scale with sulfuric acid. The acid etches away surface contaminants at rate proportional to pH and temperature. Measuring the temperature is critical to process control optimizing the etch process and minimizing waste.

15673



Flanged Thermowell with Tantalum Sleeve

CHALLENGE

A temperature sensor was installed in the pickle liquor feed line to monitor the liquid temperature. Due to the high flow rate in the line, time response was crucial to the effectiveness of the measurement. They were using direct immersion thermocouples and were having challenges with both the accuracy of the measurement and the lifespan of the thermocouple due to etching of the sheath. They wanted to switch to an RTD temperature sensor but were reluctant to do so due to the higher cost and the frequency at which they change out.

SOLUTION

To increase the accuracy of the measurement an RTD was proposed. To increase the life expectancy of the RTD a thermowell was needed. A Teflon thermowell is corrosion resistant but slowed down the time response too much. A metal thermowell was required but to manufacture a metal thermowell completely out of corrosive resistant metal became cost prohibitive. The solution was to use a standard 304 SS thermowell but make a tantalum sleeve to protect the thermowell sheath. The end result was a temperature measurement of greater accuracy and lower maintenance cost overall.

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Application Note

A110630

Wake Frequency and Strength Calculations

APPLICATION

***ASME PTC 19.3 TW - 2010**

PTC 19.3 TW-2010 is a completely new standard that establishes the practical design considerations for thermowell installations in power and process piping. This code is an expanded version of the thermowell section contained in the PTC 19.3-1974, and incorporates the latest theory in the areas of natural frequency, Strouhal frequency, in-line resonance and stress evaluation. ASME responded to changing industry demands for a more comprehensive set of thermowell evaluations. Key enhancements over the 1974 edition include:

- Expanded coverage for thermowell geometry
- Natural frequency correction factors for mounting compliance, added fluid mass, and sensor mass
- Consideration for partial shielding from flow
- Intrinsic thermowell damping;
- Steady state and dynamic stress evaluations
- Improved allowable fatigue limit definition.

CHALLENGE

Any thermowell can fail due to the effects of high or viscous flow rates. Performing strength and wake frequency calculations will indicate a safe immersion length and stem configuration. This needs to be balanced with the minimum immersion length required to obtain an accurate temperature measurement. For typical thermowells this means an immersion of 4.5" or greater to avoid stem conduction error. If the two requirements do not agree then the thermowell design needs to be modified or an alternate location or method of obtaining the temperature needs to be considered. The ASME spec recommends shortening the immersion length and/or increasing the stem diameter to alleviate the affects of flow. Previously velocity collars or other similar devices to support the stem were allowed. The new revision does not recommend their use.

*Excerpted from ASME website: http://staging.files.asme.org/Catalog/Codes/PrintBook/25750.pdf

Flanged Thermowell

Crack in flange due to stress

SOLUTION

Every thermowell installation should have the calculations performed to insure that the well will not vibrate due to wake frequency and is strong enough to resist the drag caused by viscous fluids or high flow rate. Specifying option code WE05 to any Burns thermowell or sensor and thermowell assembly will get you the information you need to insure that your installation is successful. You will be asked to provide the process conditions which are used in performing the calculations.

The example pictured is a flanged thermowell that failed because the effects of flow were not considered or the calculations were not done properly. The crack is outlined in purple and would have resulted in a complete failure if not noticed earlier. The stem can break off, travel downstream, and cause all sorts of damage.

Photo courtesy of Alloy Engineering
http://www.thermowells.com/library.html

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Application Note

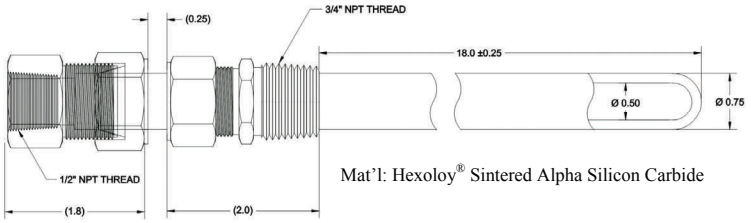
A110331

Ceramic Thermowells

APPLICATION

A proprietary process that contained corrosive chemicals at high temperature required an accurate monitoring of the temperature. Metallic thermowells had failed quickly and were expensive to replace. Installation into the vessel was a threaded connection which was not fully exposed to the process conditions and did not show significant degradation.

22192



Mat'l: Hexoloy® Sintered Alpha Silicon Carbide

Thermowell Made of Hexoloy®

CHALLENGE

The challenge was to find a material that could withstand the chemicals and also provide for high temperature resistance. Exotic alloys offered some protection from the chemical environment but at the higher temperatures the corrosion rate was not acceptable. A suitable process connection also had to be identified. Fortunately, it was not fully exposed to the process fluid or the highest temperature so that allowed for more possibilities.

SOLUTION

Burns engineers chose Hexoloy® sintered alpha silicon carbide for the thermowell. It is well suited for high performance thermowells where high temperature, corrosion, or erosion are present. Hexoloy SiC is the hardest commercially available material being 50% harder than Tungsten carbide. A list of properties include:

*Excellent thermal shock resistance
*Non-wetted by non-ferrous molten metals - Aluminum, Cu, Zn, Brass, etc.
*Universal corrosion resistance
*High thermal conductivity equal to stainless steel
*High temperature strength - won't slump at 3000°F

The process and instrument connections consist of compression type stainless steel fittings. A standard RTD or thermocouple can be installed into the tube and is protected from the process environment. Hexoloy was an ideal solution for this process and offered the lowest total life cycle cost of all the options available.

For more information or to discuss your application, contact Bill Bergquist at 952-567-6413, 952-463-8384 mobile, Skype, bill.bergquist, or email to bbergquist@burnsengineering.com.

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Application Note

A101028

Fast Response Thermowell and RTD

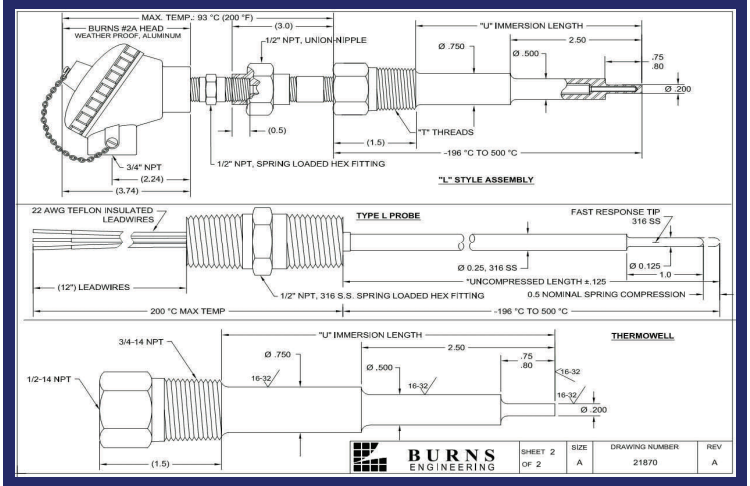
APPLICATION

Fuel custody transfer has unique requirements for calculating the volume of fuel being transferred from storage tanks to tanker cars or vice-versa. Because the fuel is sold by volume an accurate temperature measurement needs to be recorded during the transfer process to insure an accurate calculation of volume transferred. Too low a reading and too much will be transferred and too high a reading too little will be transferred. Fuels such as gasoline expand or contract with temperature changes. When transferring from a cold storage tank to a tanker truck sitting in 100°F sunshine there can be a significant difference in the fuel volume in the storage tank vs. what ends up in the tanker. Not only is overfilling a concern but the dollar value can be substantial.

CHALLENGE

A direct immersion style sensor would certainly give the fast time response necessary to keep track of a fast moving fluid. However, strength of the sensor and maintenance are concerns that call for a different solution. Opening a fuel pipeline can be dangerous, messy, and time consuming so a thermowell and separable RTD probe would be a much better solution. Standard assemblies have a time response of 20 to 30 seconds which is way too slow to accurately keep track of the volume and dollar flow of fuels.

21870



Fast Response Thermowell and RTD

SOLUTION

A unique thermowell and RTD probe combination was designed that maintains the time constant of a direct immersion probe of less than 4 seconds. This allows accurate control of the volume and dollars delivered. Maintenance is simplified because the sensor can be easily removed and calibrated or replaced without opening the piping system. The thermowell is currently available in flanged or threaded process connections in a variety of materials. Sensor is a standard 100 ohm, .00385 platinum conforming to the latest standards in IEC 60751 and ASTM E1137.

For further details contact us at 800-328-3871 extension 22 or 13.

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