Blog Post

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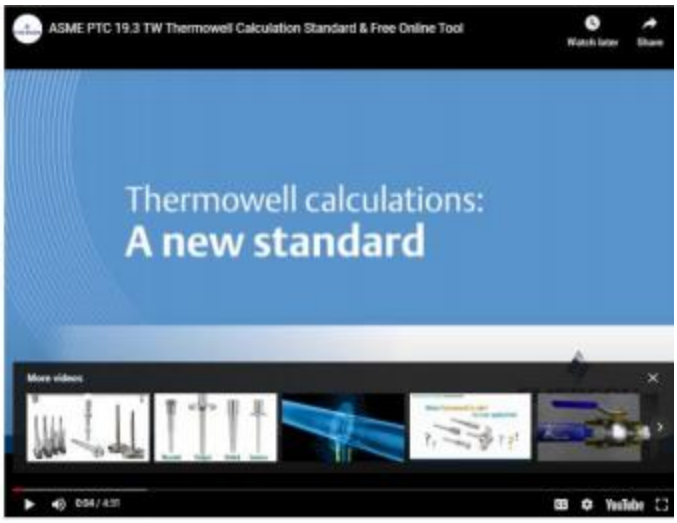
Online Calculation Tool for Thermowell Installations

Back in 1974, the ASME (founded as the American Society of Mechanical Engineers) published a performance technology standard for thermowell calculations and overall temperature measurement best practices, PTC 19.3. Based on decades of industry and research data, the updated PTC 19.3 TW-2010:

> *…incorporates the latest theory in the areas of natural frequency, Strouhal frequency, in-line resonance, and stress evaluation.*

The updated standard was a collaborative effort among instrumentation suppliers, including Emerson, end-users, engineering contractors, and academia. The intent was to update the aging standard, which was limited in scope and simplistic. The thermowell calculation portion of ASME PTC 19.3-1974 was 4 pages. By comparison, the new standard, released in July 2010, is over 40 pages due to the explanations of theory and the sheer complexity of the process.

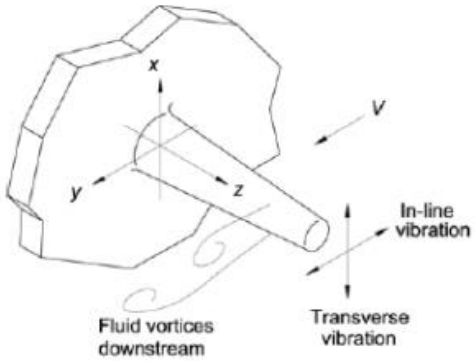
To help understand the updated standard, Emerson's Rosemount Temperature measurement team has put together a new video and thermowell calculation website. These highlight some of the changes and make a calculation tool available for preliminary thermowell design calculations.



https://videos.emerson.com/detail/videos/temperature-measurement/video/3867761366001/asme-ptc-19.3-tw-thermowell-calculation-standard-free-online-tool

In the video, Emerson's Dirk Bauschke highlights three key differences in the new standard. It includes stem profiles not previously covered in the original standard. The natural frequency calculations have been updated to reflect real-world effects from thermowell installations. The ideal natural frequency is corrected for the effects of adding a temperature sensor and mounting style.

These corrections lower the effective natural frequency. Correction factors for beam correction, fluid mass, sensor mass, and mounting compliance are also elements in the corrected natural frequency calculation.



The second key change is that the Strouhal number has gone from a constant 0.22 in the original standard to a variable number. A calculation across a range of flow conditions—such as laminar or turbulent flow. As the vortex shedding frequency, or Strouhal frequency, approaches the thermowell natural frequency, the tip displacement and stresses are greatly magnified. The

thermowell can fail due to a large amount of energy it must absorb. The third change is that the updated standard considers in-line oscillations in addition to transverse or perpendicular oscillations.

As the process ramps up, it will go through the in-line oscillation frequency first. If the thermowell is impacted more by this in-line vibration than the transverse vibration, it becomes the new limiting factor in the thermowell design.

The resonant frequency of the thermowell must be sufficiently high so that destructive oscillations are not excited by the fluid flow. If the design requires that the thermowell pass through the in-line resonance to get to the operating conditions, there is an additional fatigue check at resonance. This updated standard applies to all new projects and retrofit projects where there is a change in the process conditions.

The online thermowell calculation can help with preliminary calculations and official documentation with the R21 report. Also, this thermowell calculations whitepaper describes the updated standard and calculations in more detail.

The Rosemount Temperature team, who performs more than 35,000 calculations for process manufacturers each year, can provide you with a formal R21 report to document the design to be in accordance with the PTC 19.3 TW standard.