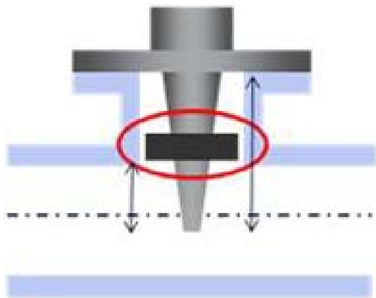
Velocity collars: no longer best engineering practice

1.1 Introduction

A velocity collar is a metal ring machined into the shank of a thermowell and installed tightly in to the standoff of a pipe.



1.2 Why use velocity collars?

The goal of a velocity collar is to reduce the effective unsupported length of a thermowell. In theory, this helps accomplish two things:

1. Eliminates vortex-induced failures. Shorter unsupported lengths raise the natural frequency of a thermowell, which allows higher flow rates to avoid causing the thermowell to vibrate at its resonant frequency.
2. Reduces bending stress. Process fluids create a drag force on thermowells, causing them to bend. A shorter moment length will reduce the stress at the root of the thermowell, reducing failures.

1.3 Thermowell operation in the real world

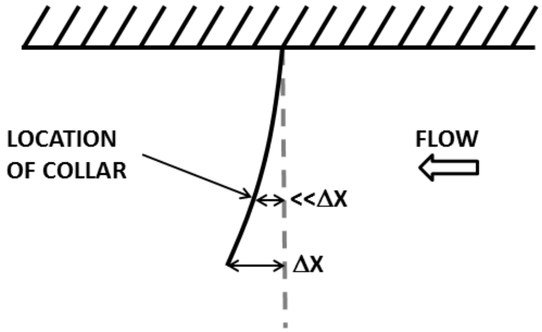
Velocity collars sound great in theory, right? They limit bending stresses AND reduce the likelihood of failure due to vortex-induced vibration at resonance frequencies.

The problem is that for a velocity collar to effectively reduce the unsupported length there must be an interference fit between the collar and standoff to allow for no vibration.

Thermowells in resonance have been shown to have small tip displacements -even as small as 0.011mm.(1) The reality is that tip vibrations caused by vortex shedding are very small, typically far less than 1 mm.

(1) *Haslinger, "Flow-induced vibration testing of replacement thermowell designs" (2003).*

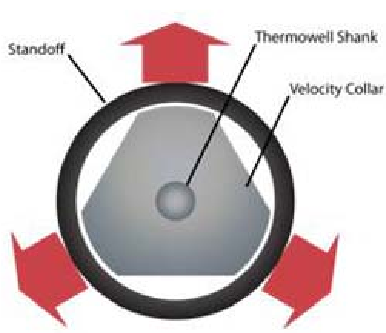
While displacements at the tip are small, the velocity collar sees an even smaller displacement, as seen below.



Even the tightest tolerance for a machined velocity collar and standoff will result in a small gap, which allows failure-inducing vibration.

Gaps that are smaller than the displacement at the collar will widen over time due to deformation of the collar and standoff, leading to similar failure modes.

Finally, if the thermowell and standoff are made from dissimilar materials, thermal expansion may cause the collar to expand at a lower rate than the standoff pipe, increasing the gap and rendering the collar useless.



1.4 Is your collar tight?

Beyond the inherent design flaws of velocity collars, the other piece to consider is the installation. Despite tight machining and installation tolerances, the installation on site may be different.

If a thermowell with a collar does not fit in the pipe, an installer may modify the thermowell or standoff to make it fit and unknowingly negate the benefits of the velocity collar.

Additionally, once installed, measuring the gap between the collar and nozzle to verify the fit becomes impossible.

1.5 ASME's stance on velocity collars

The standard ASME PTC 19.3TW-2010 specifically addresses the use of velocity collars:

"Support collars or other means of support are outside the scope of the standard. The use of support collars is not generally recommended, as rigid support can only be obtained with an interference fit between the support collar and the installed piping... Such designs require methods beyond the scope of this standard." [(1)]

1.6 Emerson's take

Due to the nature of thermowell vibration behavior, installation practices, and ASME's position, Emerson does not recommend velocity collars as a best practice for means of reducing vibration-related failure.

Emerson also feels that other installation methods that attempt to reduce unsupported length in a similar fashion to velocity collars, such as DIN Weld-in style thermowells, are not a best practice.

As such, Emerson will no longer provide calculation reports where a velocity collar is used. We feel there are better means of reducing risk of failure. These include:

- Reduce immersion length into pipe or standoff height to reduce unsupported length
- Change root diameter to affect the affected frequency due to flow conditions
- Change thermowell style
- Install thermowell at an angle or in an elbow of a pipe
- If all other options fail, consider surface mounted sensors

For more information, please contact your local Emerson representative.

(1) ASME PTC 19.3TW-2010

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