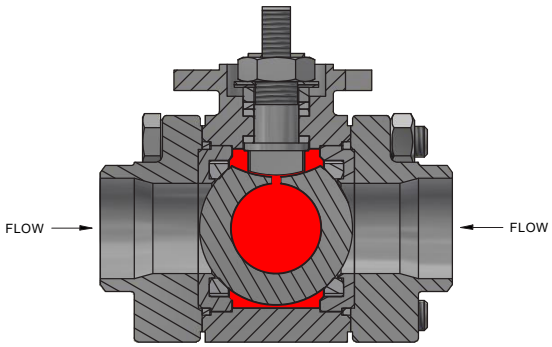
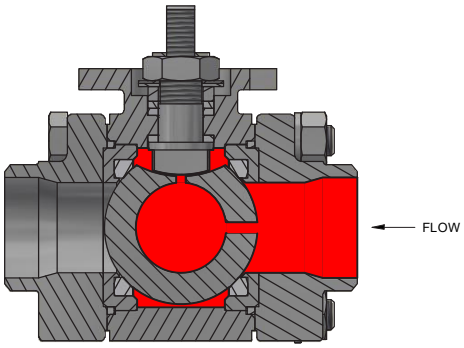
# VENTED BALL vs BI-DIRECTIONAL FLOATING BALL VALVES IN CRYOGENIC SERVICE

Extreme caution needs to be exercised in cryogenic applications to ensure it is not possible for cryogenic fluids to become trapped in any cavities throughout the piping system. Any cryogenic fluids that do become trapped in a sealed cavity have the potential to instantaneously flash from a liquid to a gas due to ambient warming. The volume change can be around 600:1 causing a sudden pressure change due to the Ideal Gas Law. If this phenomenon occurs, the sudden pressure increase will likely exceed the design pressure and lead to catastrophic failure.

The general design of a ball valve means there is a sealed cavity around the ball when in the closed position. This cavity is very likely to contain trapped fluids and be subject to sudden pressure increases which can exceed the burst pressure of the valve. The image below shows the trapped cavity (shown red) in a standard bi-directional ball valve.

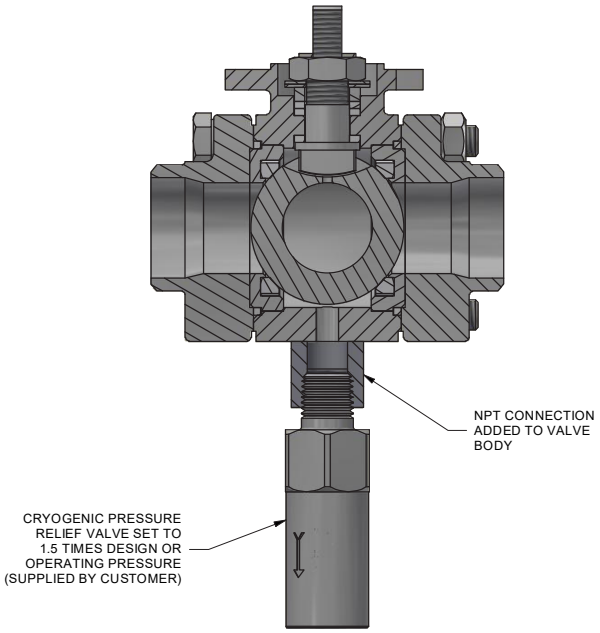



Therefore the ball valve design must cater for these sudden pressure increases. The simplest and most cost effective solution is to add a vent hole to the ball on the upstream side. The vent hole allows the excess pressure to vent to the upstream piping which can accommodate the volume change and/or has a system pressure relief valve set to relieve any excess pressure. There is a slight drawback with this solution as the vent hole renders the valve uni-directional which in most cases will be perfectly acceptable, but is not a catch-all scenario. The reason for this is the floating design of regular ball valves because the pressure pushes the ball into the downstream seat and away from the upstream seat. This means that pressure can escape when the vent hole is on the downstream side of the valve. The image on the next page shows how the vented ball design works.




The red area shows how the cavity is now open to the upstream side allowing any excess pressure to escape the valve cavity.

If bi-directional flow is required on a floating ball valve, a different method for body cavity relief is required as the vented ball is not suitable. For this we add an NPT port to the valve body to which a cryogenic pressure relief valve can be added. These are typically quite compact and can either vent to atmosphere locally, or vent to a remote location as needed. This enables a regular un-vented ball to be used and thereby gives bi-directional capabilities. The image below shows how the cryogenic pressure relief valve is connected to the valve body.




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