Engineering Deficiencies in OEM Gaskets

Background: A Mid-Atlantic power producer was bringing a unit back online after a planned outage. Their OEM-supplied replacement gaskets, for a hydrogen-cooled generator, failed, delaying startup. New replacement gaskets recommended by the OEM were determined inappropriate for the application, so the company contacted VSP on a Friday with a request to engineer and supply an improved gasket. By Monday, the company had a newly designed gasket in hand with proper installation instructions. Additional downtime replacement power cost for this unplanned outage exceeded $631,000.

VSP Investigation: During VSP's initial investigation, it was determined that the gaskets used were made from a material containing elastomer binders. Due to the high temperature application (300+°F), the use of the binder in the material virtually guaranteed that the gasket would deteriorate and fail over time. The OEM recommended a replacement material that also contained an elastomer binder and therefore offered only minimal improvement. In addition, the large surface area of the gasket design, coupled with the high minimum compressive stress, would have resulted in insufficient compression using the OEM torque values.

Problem Resolution: In order to correct the problems, VSP completely evaluated the entire connection, including the design of the gasket as well as the material being used. In order to remain within the bolt torque limits recommended by the OEM, VSP designed a gasket that had less surface area while still providing an adequate seal and balancing flange loads. The patented design technology is known as "One-Piece Reduced Area" or "OPRA" (see Figure 1). OPRA™ designs remove unnecessary gasket material, greatly decreasing the surface area of the gasket, thus reducing the required assembly torque.

Figure 1. The figure above shows the OPRA design, which was used to decrease the surface area of the gasket.

In addition to revising the design of the gasket, VSP recommended an alternate material. The conditions and temperatures in this hydrogen cooler application eliminated elastomer materials from consideration. VSP recommended the use of expanded PTFE (ePTFE). The new ePTFE was an ideal choice for the application since it experiences no loss of physical properties in service below 450°F while also remaining chemically inert. As a material, ePTFE requires far lower compressive stress than other materials. Combining lower seating stress requirements and reduced area of the gasket allowed for reliable, effective joint design with assembly torque requirements that were within OEM specifications.

Lessons Learned: It is important to understand load requirements, capabilities and limitations when selecting a gasket design and material. Gasket materials should not be selected based solely on chemical compatibility and temperature and pressure limits. Maximum reliability and performance of gaskets is highly influenced by their suitability for the specific flange geometry and available bolt load. Evaluations should be performed by engineers fluent and experienced in bolted flange connection design and behaviors.

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