Causes & Costs Of Gasket Failure

By Jim Drago
Downtime in a chemical processing plant has been estimated to cost $500,000 per day, so it behooves the industry to prevent gasket failures by discovering their root causes. Increasingly, the potential for failure may be diminished by getting these high-consequence devices some attention. In a recent customer survey, respondents indicated that every joint in their plants is critical, and there is zero tolerance for any type of leakage whatsoever.

Gaskets represent a miniscule fraction of the cost of the systems in which they are installed. Yet if they fail, the consequences can range from nuisance leaks to major catastrophes, resulting in millions of dollars in damage, downtime, lost production and non-compliance penalties, not to mention injury and even death. Add to these potential litigation and damage to the company’s reputation, and the cost is virtually incalculable.

Today’s chemical processing industry is facing unprecedented competitive pressure, even as it finds itself under severe cost constraints. Increasingly characterized by low-volume, high-mix on-demand production, much of the industry is already operating beyond plant designs, raising process parameters to improve yields. This high-pressure, high-temperature operation mode places considerable demands on systems and components, including gaskets.

Efforts to increase competitiveness—reducing costs while increasing process parameters—can lead to greater potential for failure of these devices. In an environment of heightened cost-consciousness, it is relatively easy to target gaskets as a source of savings. But whatever savings are realized by installing the wrong gaskets can be more than wiped out by a single incident.

The causes of gasket failure vary, but recent analysis of 100 randomly selected failed gaskets indicated 68 were due to insufficient load and 14 were the result of using the wrong gasket for the application. Crushing, cavitation, erosion and other factors contributed to the failure of the rest. Accounting for nearly 70 percent of these failures, insufficient load was attributed to improper installation (37), misapplication (14), poor flange design and/or bolt selection (9), and rotated flanges (6).

With regard to gasket installation, use of torque wrenches or other controlled tightening methods can help assure that proper load is achieved and evenly distributed on the flange. Most installers use torque wrenches only on what they consider to be critical applications, but even the most benign processes can cause serious problems. A simple drip from a water pipe, for example, may not have a significant impact on line pressure, but the resulting puddle could lead to injuries, Workers’ Compensation claims and OSHA citations. It can also damage electronic equipment.

Let’s take a closer look at several of the failed gaskets examined by our analysts.

The under-compressed PTFE gasket (two lower left-side images) extruded at the lowest point of compression as internal pressure forced it out of the flange assembly, resulting in an oblong shape. It is also possible to over-compress gaskets, crushing them, resulting in concentric splitting throughout the compressed portion. This can occur not only from excessive bolting loads, but also from repetitive tightening.

Some times installers also use caulk to affix gaskets in place during assembly, or to compensate for damaged or irregular flange surfaces. However, some caulks contain acetic acid-based cure systems that can attack elastomeric gaskets and gaskets containing rubber binders. Because of their lubricity, caulks can also cause gaskets to shift within the flange assembly, thereby losing their effectiveness. Gaskets should be installed using products specifically designed to compensate for flange inconsistencies and to hold them in place, such as spray adhesives.

The second most frequent contributor to gasket failure is selecting the wrong type for the intended application. This compressed sheet gasket (left top-most image) failed due to under-compression from being installed in a flat-face flange. In most cases, flat-face flanges require full-face rubber gaskets, whereas compressed sheet ring gaskets are better suited for raised-face flanges. The numbers on the gaskets correspond to thickness measurements for comparison with gasket thickness in the uncompressed state.

Insufficient gasket load also can result from poor flange design or bolt selection, which account for eight of the 100 failures. This typically occurs if the flange or bolts are not strong enough to compress the gasket without deforming. Similarly, six of the 100 gasket failures are due to a phenomenon known as rotated flanges, which occurs when flanges bend and cup when bolts are tightened.

The best way to prevent costly joint failures is to match the gasket with the application and install it properly, carefully following the manufacturer’s recommended procedures. A simple acronym—STAMP—can serve as a general guide to ensure correct gasket selection. The initial S stands for the size of the flanges to be sealed; T stands for temperature; A is for the actual application (flanges, bolts, equipment, etc.); M is for media (liquids, gases, chemicals, water, steam, etc.); and P is for pressure. Based on this data, application engineers can recommend the best gasket for a particular application, as well as alternatives.
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