

CASE HISTORIES

# Causes of Flange Isolation Gasket, Sleeve, and Washer Failure

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*Many of the problems with flange isolation stem from using alternative materials in place of those specified.*

*These problems appear to be much more extensive than most users realize. Many failures have occurred because the materials used were inferior to or did not meet the design specifications. This article presents causes of failures and offers recommendations to ensure that flange isolation performs as desired.*

Problems with gasket and flange isolation material failures appear to be more far reaching than many users realize. A number of companies have experienced gasket failures at rates not seen since the change from flat flange isolation gaskets to pressure energized gaskets. The reasons for these failures are still being studied. This article presents the findings from evaluations of four recent failures of self-energizing gaskets. In each case, alternative “equivalents” were substituted for the specified PSI Line Backer<sup>†</sup> gaskets. Sleeve and washer failures are discussed also.

## Gasket Failures

The gasket in Figure 1 appears to have a seamless, molded sealing element with inconsistent quality control of the volume-to-void relationship. The groove depth for the sealing element also exhibits unacceptable variances.

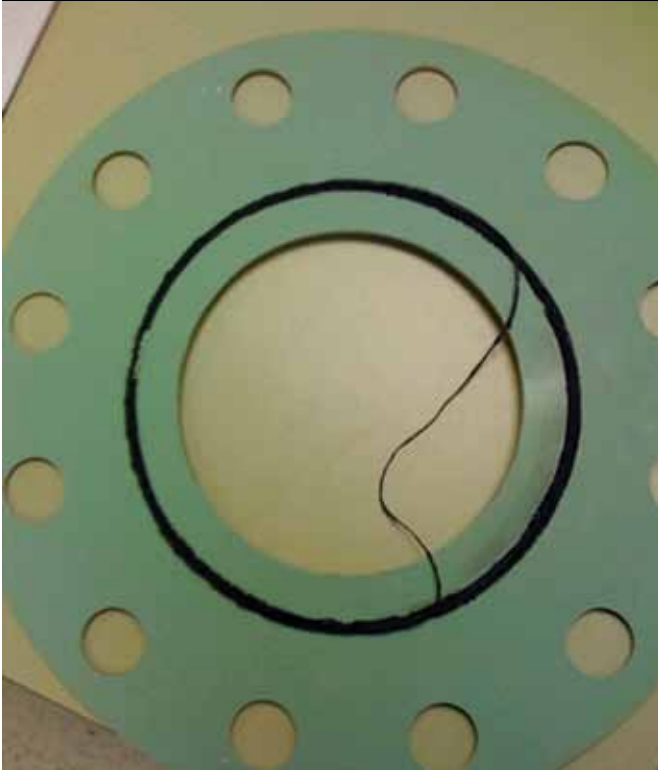
The retainer material for the gasket in Figure 2, an alternative to the specified gasket, was not made in a sheet size large enough for an 84-in (2-m) pipe, so the manufacturer spliced it together. The high visibility of the splice indicates that it was not well made; this should have been detected during field inspection prior to installation. Personnel responsible for installing flange isolation kits are not always adequately trained in component inspection criteria, however. The fabrication shop producing the alternative gaskets could not get them to pass hydrostatic pressure testing, but the originally specified gaskets installed on the same flanges worked without exception.

Figure 3 illustrates a gasket that failed upon hydrotest. The quality of the laminate, sealing element, and groove dimensions are all questionable. The user successfully replaced all such gaskets with the specified seals.

The gasket in Figure 4 appears to have split or cracked at the sealing element location from improper dimensioning or durometer testing of the elastomer. Al-

<sup>†</sup>Trade name.

FIGURE 1



Leaking oil company gasket.

FIGURE 2



The gasket for a water project failed the initial hydrotest.

FIGURE 3



A gasket for a natural gas project.

FIGURE 4



A gasket from a treated water dump.

though the original specification is absent, the gasket obviously was not made properly for the intended application.

### Factors to Consider when Specifying Flange Isolation Kits

Failures have occurred with flange isolation kits on oil and gas, product,

natural gas, and potable water lines. The following factors should be considered when specifying such kits.

#### Gaskets

Gasket quality has a significant impact on performance, as does the design of the sealing element itself. Overlapping seams on the sealing elements have been identi-

fied as the culprit. Literally hundreds of thousands of properly designed and manufactured gaskets have been in service for more than 30 years without failures. Extruded O-rings are frequently offered as a solution to concerns about overlapping seams, but they too have seams. The issue with this type of gasket is not the seams, but rather control of

FIGURE 5



Bolt sleeve failure from shear stresses.

FIGURE 6



Over-compressed white isolation washer.

tolerances and holding to exacting design, quality, and raw material standards.

With the globalization of sourcing, inexpensive raw materials that supposedly meet NEMA standards for phenolic or G-10 classification are being offered to manufacturers to reduce costs. These materials may or may not be effective as gaskets. For example, there are numerous options for phenolic that technically meet NEMA standards, but have not been properly evaluated for suitability as a gasket material. Some phenolics are more porous than others.

### *Sleeves and Washers*

Specifications for flange isolation kit sleeve material frequently call for the sleeve to be “full length,” an undefined measure for which there is no known industry standard. A better specification would require the minimum standard length of the sleeve to extend at least halfway into the back-up steel washers.

In Figure 5, the 45-degree failure angle with respect to the bolt’s axis indicates that the sleeve failed in shear. The contractor ordered G-10 isolation washers and sleeves from one supplier and the steel washers from another. Normally, the isolation and steel washers are supplied as part of a kit. In this case, the steel washers had a slightly smaller inside diameter (ID) than the G-10 washers, so there was

no clearance between the steel washers and the sleeve. As the nuts were tightened, the steel washers grabbed the sleeves and twisted them. To avoid this problem, both the steel and isolation washers must be manufactured to precise dimensions with matching ID and outside diameters (OD) for uniform loading and to allow the sleeve material to fit within the ID of both washers.

The white isolation washer in Figure 6 was squashed from the compressive load of the blue steel washer. In this case, the problem was caused by using the wrong washer material for the loads being applied and the dimensional variance between the steel and isolation washers. It also can be caused by overloading the compressive strength of the washer.

### **Gasket Life and Documentation**

Companies often have little knowledge regarding the type of gaskets in their pipelines or the materials they are made of. Many have been operating the same lines for more than 30 years, carrying fluids with different additives, chemical inhibitors, odorants, and methyl tri-butyl ethylene. The gaskets in Figures 1 through 3 have no markings that indicate their material, date of manufacture, pipe size, and pressure rating. This information should appear on all gaskets and flange

isolation kits. Existing pipelines should be surveyed for the type of gaskets presently in service, their expected longevity, and length of time in service to determine the need for replacement.

### **Conclusions**

Gasket, sleeve, and washer failures can be reduced dramatically by specifying higher grade products in new installations, and ensuring that the product being used is the same as the one specified. In addition, the specifics of gasket material should be documented for each flange, so new gaskets introduced into the system can be evaluated for their compatibility with different media or additives in the line.

The importance of initial quality cannot be overstated. Unfortunately, “garage shop or equivalents” are often being used without the operators’ or engineers’ knowledge. Isolation is performance-critical even though its cost is insignificant relative to the systems in which it is installed. As such, low-cost, high-consequence products deserve the attention they warrant.

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