Ask Larry...

Improper O-Rings Cause Self-Sealing Fastener Failure

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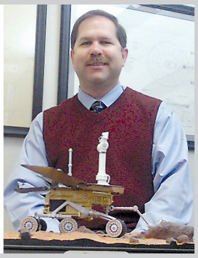


Are you ready for a shocker? The two most frequently asked questions I receive are, "What is your most common O-ring", and "What is the cheapest O-ring you have?"

It's scary to see the magnitude of companies who fail to realize that O-ring selection is a crucial element to the sealing capability of every self-sealing fastener. Statements like, "I'll take the one with the orange O-ring," indicates that buyers often are not equipped with the necessary tools to order the proper self-sealing fastener and therefore end up buying a fastener destined to fail. For buyers to purchase the correct self-sealing fastener for their application, they need to know the application variables such as temperature, pressure, environment, vacuum, fluid, vibration and chemical exposure. It is the combination of known variables that determines which O-ring compound is best suited to achieve a sustained seal in a specific application. Unfortunately, in many cases the Design Engineer who was aware of these variables is inaccessible to the buyer. This makes it almost impossible for the buyer to make an informed decision.

Companies that buy self-sealing fasteners with a random O-ring selection process are playing Russian Roulette with people's lives. If you are an original equipment manufacturer, make sure that your fastener supplier is not purchasing cheap knockoffs from fastener manufacturers who don't provide the engineering support or technological expertise that this modern age demands.

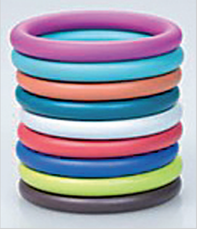
In the June/July, *Ask Larry* column, the focus was on recognizing the difference in self-sealing fastener products so that buyers could differentiate between a proper groove design and a poor groove design. The column also specified the design parameters required to achieve self-sealing fastener success. O-ring selection is nearly as important as the groove design. Ordering a self-sealing fastener without the proper O-ring could be catastrophic. Therefore, O-ring selection is the focus of this column.

There is broad range of O-ring materials available. However, the following eight compounds account for over 95% of the current O-ring market. These are Nitrile (Buna-N), Silicone, Fluorosilicone, Fluorocarbon (Viton), Ethylene Propylene (EPDM), Chloroprene (Neoprene), Butyl and Polyacrylate. Originally, all O-rings were either clear or black in color, and companies who ordered multiple O-ring compounds would sometimes mix up the O-rings resulting in huge production disasters. This became such a concern that a system was devised by **Parker Seal Company** to differentiate the O-rings by color. This idea was quickly adopted throughout the USA O-ring industry. Now customers can choose whether they want a colored O-ring or the original clear or black. The most common colors are black for Nitrile, orange for Silicone, blue for Flurosilicone, brown for Fluorocarbon, violet for Ethylene Propylene and red for Neoprene. However, the color of an O-ring does not dictate the durometer (hardness), quality of an O-ring, or even the O-ring compound. In fact, considering the current global market, buyers must be careful not to assume the color standard is universal. Some foreign O-ring makers do not use the same color code, and it is particularly confusing to see red Nitrile O-rings and black Silicone O-rings that some of these foreign companies produce.

O-ring failures due to compression set (top), abrasion (middle), chemical degradation (bottom).

Although Nitrile is by far the most widely used compound, it is not wise to assume that it will work in every application. For example, if your application has a working temperature of 350°F and the fastener must provide a sustained seal against motor oil, ethylene glycol (anti-freeze) and water. You may have selected Nitrile because it's the best product for sealing against all the fluids in your application. Unfortunately, seal failure is imminent in this application because Nitrile cannot withstand working temperatures beyond 275°.

Additionally, consider the following scenario; you have a fastener application that must provide a sustained seal at a working temperature of 350° with occasional temperature spikes up to 450°. The fastener will be used to seal a petroleum based micro lubrication system in a product attached to an orbiting satellite. The head of the fastener can be seen from inside of a two man compartment. Most of the time the compartment is exposed to the outside environment, but it can also provide a nitrogen/oxygen environment in case the satellite must be serviced in person. At first glance one might think that silicone is the best choice in this application. Silicone can easily handle a working temperature of 450°, and some silicone compounds can handle temperature spikes over 700° without a problem. Silicone has excellent nitrogen, oxygen, ozone, and all-around excellent weather resistance. However, none of that matters because the O-ring will be destroyed by the petroleum-based oil used in the lubrication system. In this application, it would be best to stick with a flurosilicone or a fluorocarbon O-ring compound. Although the temperature range of the silicone easily exceeds either of these two compounds, both can handle the temperature requirements, and they also have excellent resistance to all the other variables of this application.



Color-coded O-rings first developed by Parker Seal.

Most applications have multiple variables to consider in selecting the proper O-ring for a specific application, and just one of these variables could determine the overall success or failure of the application.

The previous examples show an educated effort to select an O-ring for a specific application. But many companies don't put this level of thought into their self-sealing fastener assembly, and are obviously not aware of the critical importance of O-ring selection. They opt for random O-ring selection instead of having a qualified sealing engineer specify the proper O-ring. Random O-ring selection increases the probability of self-sealing fastener failure and greatly increases a company's product liability. The best way to assure sealing success in any application is to communicate the application variables to a sealing Design Engineer at the company where you buy the product, and let them select the best O-ring for the application. The best way to limit liability is to buy guaranteed self-sealing fastener products from firms like **Sealtight® Technology**, Santa Barbara, CA, USA, which has an engineering staff to assure customers receive the proper O-ring for every application. If your company does not purchase self-sealing fasteners from a company that offers engineering support, then it would be wise to find a company that does. If you are at a loss as to what self-sealing fastener assembly would be best for your application, just remember that consulting a Design Engineer can help you avoid self-sealing fastener failure. FF