Ask the Expert

The Ask The Expert column gives readers the opportunity to have their valve concerns addressed, find out the answers to their pressing valve challenges and ask for feedback on application issues. If you have a questions that you need answered, please feel free to contact s.bradley@kci-world.com with the email subject: Ask The Expert.

If you are an individual with extensive valve expertise that you believe the Valve World readership could benefit from, please contact our Editor-in-Chief to become a future featured Expert.

This month our Expert is Phil Mahoney - Manager of Research & Development, Stationary – A.W. Chesterton.

Q Are lubricants really that important in a bolted connection?

A Whether you're talking about a bolted flange or a valve packing gland, lubricants are a very important consideration. Bolted connections look very simple at first glance. Tightening the bolt (or stud) and a nut results in a clamping force or load on the flange or packing gland. But the sealing device, whether it is a gasket or a compression packing set, requires a specific load from the bolted joint to seal properly. Too low a load on the assembly could result in leakage or failure of the seal; too high a load could cause failure of the seal as well as damage to the whole assembly. The applied load needs to be as accurate and consistent as possible to ensure best performance of the seal.

The most common method means of achieving the required load on a bolted joint is by using a torque wrench (calibrated of course). The simple formula used to determine the torque required to achieve a specific bolt load is T = KFD, where T is torque, K is a 'nut factor', F is the load required on the bolt and D is the bolt diameter. The load required on the bolt and the bolt diameter are known values, but the K value is not as clear cut. Friction between the threads and the mating surfaces of the nut and bolt assembly can vary widely depending on the materials of construction as well as their fit and finish. The higher the friction forces are, the greater the applied torque will have to be to achieve the required load. 'K' in the formula above represents these variables, and this is where the importance of lubricants comes in to play.

There are two important factors that lubricants help with in a bolted connection. In almost all cases, a good lubricant will provide a lower 'K' value than if no lubricant is used at all. As an example, a dry bolted assembly might have a 'K' of .25; add a lubricant on the threads and under the heads of the same assembly and that 'K' value can be .17. Plug those values into the basic formula and you see that the torque required to achieve the required load 'F' drops significantly. The lower 'K' value essentially means that more of the torque applied to the bolted assembly is translated into load rather than being absorbed by friction.

The second factor is consistency. All threaded fasteners have variability in finish, tolerances etc. which can result in a wide variation in 'K' when they are assembled. Assemble 10 dry bolts and nuts of the same size and material, torque them all to the same value, and there can be a significant variation in the actual load between them. Variability in the resulting load can mean the difference between a bolted joint sealing properly and leaking. A good lubricant provides increased consistency in that 'K' value which means the required load can be achieved more reliably and accurately.

Q Which else should be considered when choosing a lubricant?

A Besides the points discussed above, there are of course other considerations when choosing a lubricant that are application specific. Metallurgy of the bolted assembly is one; some lubricants may have better consistency or a lower 'K' value with certain materials (i.e. higher 'K' value with stainless vs. carbon steel). Compatibility of the lubricant with the media the assembly is exposed to is another. As an example, in an application where a strong oxidizer is present, some lubricants may react with the media and affect the bolted joint adversely.

Service temperature is an important consideration, especially if there is potential for adjustments to the bolted assembly while in-service, and thus the 'K' factor still needs to be consistent and reliable. In high temperature applications, it can be expected that the 'K' factor can increase because of a change in state of the lubricant. As an example, an anti-seize may have a published 'K' factor of .18 at room temperature assembly, but after being at high temps for a period of time, the oil base of the lube may volatilize leaving the solid components behind (this is by design of course). These solids still function to decrease friction (and prevent thread galling), but the 'K' factor in the assembly can increase. This means that re-applying the same torque value may not result in the same applied force on the assembly that was achieved initially.

The important thing here is to review your application carefully, and consult with the lubricant manufacturer with any questions regarding proper selection and use of their product.