Ask the Expert

The *Ask The Expert* column will give 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 question 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 to become a future featured Expert.

This month our Experts are Luke Chou – Staff Engineer for Neway Valve International, Inc. and Rodney Roth & Scott Boyson – Business Development Managers for A.W. Chesterton Company.

Q How are low emission valves designed differently than standard valves?

A The American Petroleum Institute (API) has published the new API 600 13th Edition Standard which includes compliance to API 624 low emission testing as a mandatory requirement. Per the new Edition, "valves shall be qualified by type testing to meet the fugitive emissions requirements of API standard 624." Therefore, it is now incumbent on valve designers and manufacturers to review their valves and manufacturing processes to comply with the new standard.

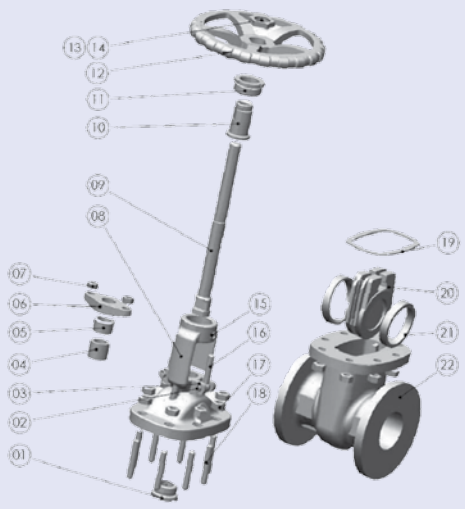

Figure 1. Typical components of an API 600 gate valve.

The valve industry has continually struggled to create practical and unified standards to qualify and test valves with regard to required fugitive emission qualifications and standards. In response, API added more stringent requirements to API 622 as part of the 2011 edition of the standard. One major change to the standard was the removal of the allowance of performing the test in a valve. API 624 was created as a pass/fail type test for to qualify new valves as manufactured. These two standards rely upon each other by mandating usage of API 622 qualified packing in API 624.

The creation of the necessary products needed to meet API 624 and other global emission standards requires packing and valve manufacturers to work together for the review of their products with regard to compliance on not only the required Low E performance, but compliance to changing industry design codes for valves.

The low emission engineering review process must be performed for all components of a valve when upgrading a commodity valve for low emission service. Every component that comes into direct contact with the packing or affects the movement of parts in contact with the packing requires evaluation.

For components in contact with the packing sealing surfaces, roughness and hardness are two important parameters to evaluate. Parts that contain the packing set also require tight tolerance and clearances.

For low emissions the stem is a very critical component. Surface roughness is critical as a smooth surface is easier to seal but too smooth a finish will cause high friction and graphite to stem adhesion issues resulting in poor performance. A rough surface finish provides more lubrication to the packing set but results in higher leakage rates. Stem tolerance is important as low emission packing has tighter fit requirements. Stem straightness is critical as the packing set needs to remain tight throughout the valve stroke.

Figure 2. Simulation of high eyebolt stress on weaker gland flange design.

The compression stress required to achieve low emission is higher than in existing valve designs. The gland flange design or material selection needs to be reviewed and necessary changes implemented. Without this step, one can cause permanent deformation of the gland flange upon low emission packing installation as seen in Figure 2.

The gland flange surface finish and hardness are also more important with low emission sealing. Surface finish variations in the gland flange will result in different Knut friction factors affecting the gland sealing load.

Figure 3. Inadequate Gland Flange Surface Finish and Hardness for Low Emission Sealing.

For instance, a small variation of + / - 15% of friction will cause a variation in packing gland stress load 30% which will impact sealing performance. A gland flange that has low hardness may too easily gall and increase friction under the gland flange nut. Gland flanges need to be centered and have adequate clearance to transfer proper gland pressure.

The gland should have the correct clearances to prevent packing extrusion at both the inside diameter and outside diameter of the gland. Clearances that are too great will allow for extrusion of the packing set (Figure 4). It should be centered and have a profile that applies uniform pressure on the low emission packing set under gland flange load. Gland length needs to be adequate to have the correct amount of gland available for in-field packing adjustments after proper low emission sealing loads have been established.

The stuffing box needs to have the correct depth for the optimum amount of packing rings. Stuffing box bore tolerance and manufacturing consistency is very important to maintain the correct packing fit and sealing loads. Proper bore surface finish can also aid in low emission sealing performance.

After the product has been designed, certified and released, it will be essential that the packing and valve manufacture continue to have quality and consistency in their production. A valve that is capable of achieving low emission (100ppm), easy to operate, and requires minimal maintenance over the course of the plant's life cycle is within reach with today's technology at a sensible cost as long as the valve companies and their packing suppliers do their due diligent at all stages of the product cycle of Low-E valve.

Figure 4. Low emission packing extrusion caused by excessive gland clearance.