An introduction to...

Valves in helium applications

When it comes to valves, the issue of high tightness to environment is becoming more and more important. Nowhere is this more true than in the case of future gas applications in growing sectors – such as new gas transportation concepts that involve hydrogen, or the use of helium in science applications.

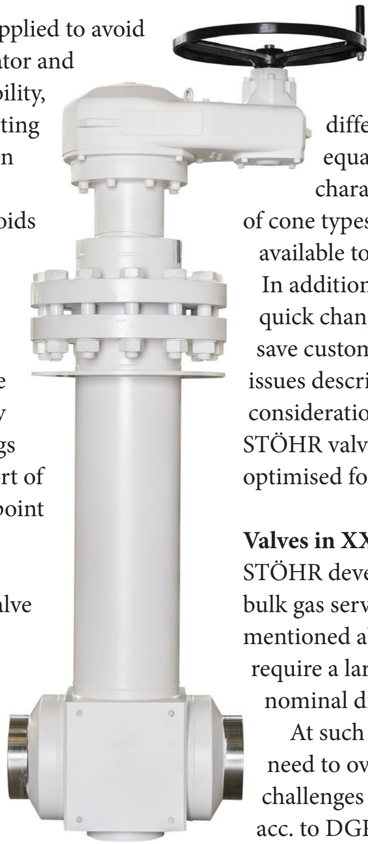
Given the flammability of hydrogen – and with rapid growth in truck trailers, ship transportation and hydrogen filling stations predicted for the coming years – it's vital that leakage is minimised for safety reasons. High levels of operator, customer and plant safety must be assured across a large number of sites with minimum of additional effort and cost compared to today's petrol-oriented infrastructure.

Public safety regulations relating to the handling of gases in indoor areas focus on reducing high concentrations that pose a health risk if inhaled. Specifications relating to liquid helium, in particular, prioritise handling efficiency and related operating costs, due to the high unit price of the gas and the sheer energy consumption required to achieve the liquid form.

Appropriate design solutions for helium applications

Very few valve types guarantee high tightness by design. Bellow sealed valves top the league, with a helium tightness higher than 1x10E-8 mbar*l/sec – which is equivalent to a gas loss of one cubic centimetre over three years. Design-wise, the bellow is welded to both stem and top plate, and combined with a metal seal ring for maximum tightness.

But the fugacity of helium isn't the only challenge to the valve manufacturer. At a temperature of 4K or below, liquid helium requires the right choice of body material to prevent cold leaks, and sealings that are required to achieve tightness at seat. Adequate stem extension must be applied to avoid freezing of the actuator and the resultant immobility, while vacuum-jacketing applied for insulation purposes requires a valve design that avoids damaging the vacuum. Ultimately, the effort and cost required to achieve these goals would be wasted – swept away by inadequate fittings used for the transport of the medium to the point of use.



Heat loads can be minimised with a valve body design that's simplistic enough to avoid mass while observing the prescribed design rules. Heat intake from outside can be minimised by transferring thermal energy from the metal stem to the outer pipe using sliding thermal contacts while moving upwards and downwards, while a copper flange handles the consecutive heat transfer from the outer pipe to a nitrogen-cooled thermal shield. Convective heat intake inside the spindle tube can be prevented by using a perlite powder filling, non-metallic spindles can reduce the heat intake further, thanks to their lower heat conductivity.

High flow coefficient (CV) values indicating an optimised medium flow indirectly contribute also to the reduction of heat intake: the higher the flow factor, the smaller the valve size required needs to be to avoid mass of the valve body and the related heat intake.

Precise flow control mainly results from designing a long travel distance of the cone between closed and fully open position. Well-defined control characteristics require valve cones in different forms – with either equal percentage or linear characteristics – so a wide range of cone types per valve size need to be available to meet customer needs.

In addition, the ability to achieve a quick changeover of cones is needed to save customers valuable time. All the issues described above were taken into consideration in developing the new STÖHR valve series 1600, for example, optimised for liquid helium applications.

Valves in XXL sizes

STÖHR developed its XXL valves for bulk gas service to provide the standards mentioned above also in applications that require a larger size of valve – even at nominal diameters of up to DN400.

At such large sizes, manufacturers need to overcome additional challenges such as Cat. IV certification acc. to DGRL 2014/68/EU (PED), as well as operational challenges such as the material handling and safety issues involved in mounting the pneumatic actuator on top of the valve – both of which weigh around one tonne – then how to dip this heavy load into a pool of liquid nitrogen for cold tests.

"We continue to push our product development to new and exciting levels, which represent new opportunities for a range of applications – and potential solutions for fresh challenges within the gas industries," the company explained to **gas**world.

WITH THANKS

gasworld would like to thank STÖHR ARMATUREN for contributing this month's equipment profile. STÖHR ARMATUREN is a high precision valves manufacturer based in Germany.

www.stoehr-valves.de