



Introduction

The use of helium as cryogen is cost intensive and it can sometimes even be difficult to get it on the market in the required volumes. A way to reduce these costs and also the risk of shortages is therefore to try to recover as much of the helium in the facilities where it is used. However, gas recovery systems may also be installed in cryogenic cooling applications using Neon or Nitrogen or in any other cryogenic system with gases like Hydrogen and Argon.



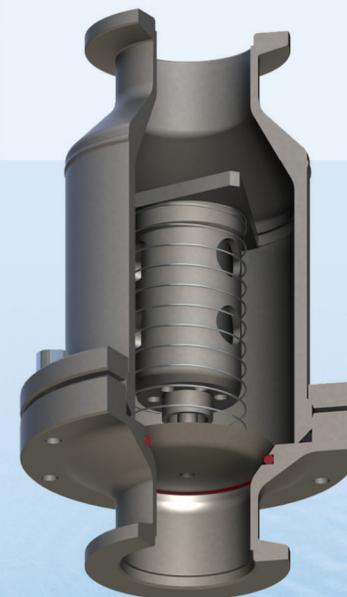
To prevent backflow of boil-off gas into a cryostat or any other cryogenic system, a check valve with a low cracking pressure may be installed. This check valve should be placed in the boil-off gas line at ambient temperature. Design considerations and applications of such low cracking pressure check valves will be described and presented.

Valve properties

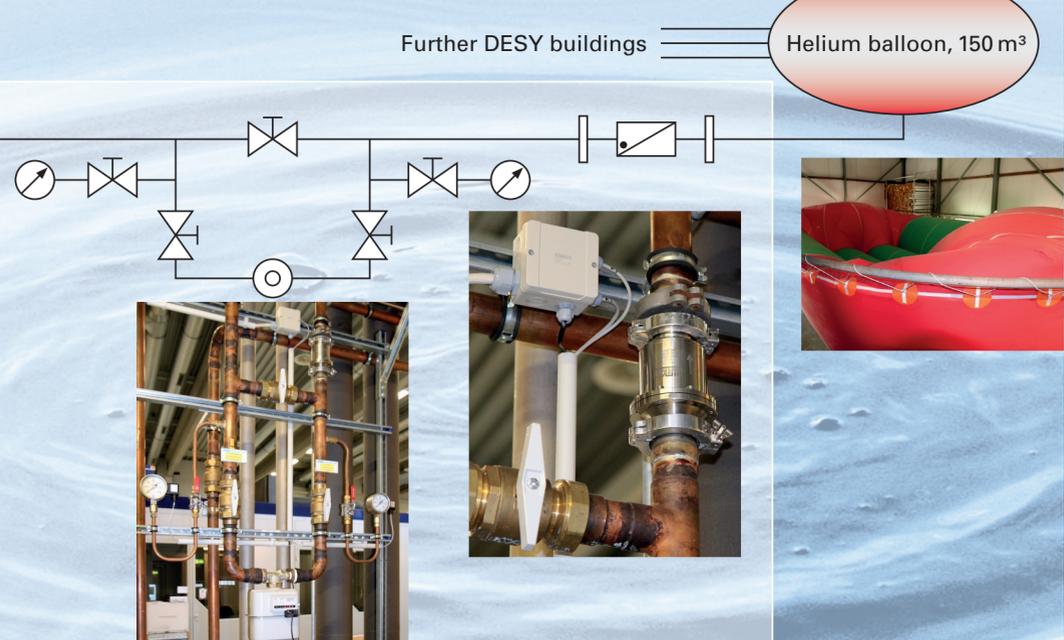
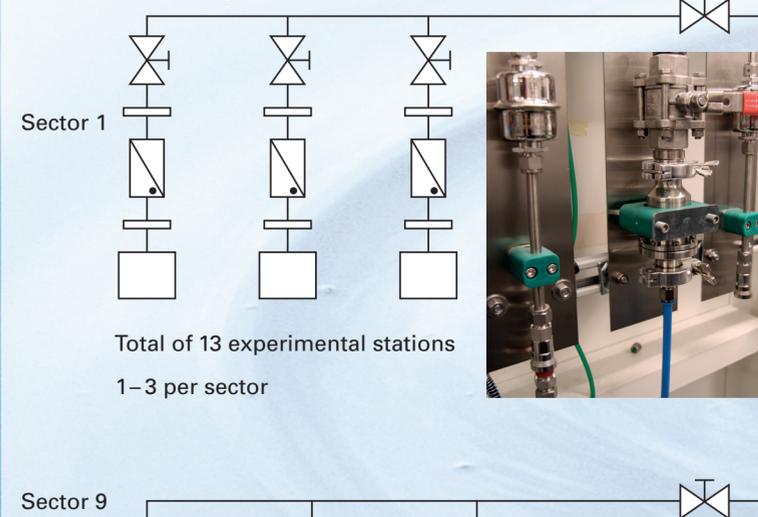
WEKA check valves of the type ClpdV can typically be used for gases like He, Ne, H₂, N₂, or Ar. They are designed for a nominal pressure PN4 (4bar) and operate at service temperatures from -20 to 60 °C. Standard sizes are DN25, DN40 and DN50 with vacuum KF-flange connections. If bigger diameters or other connection types, for example butt weld ends or female or male threads are required, the valve can be manufactured accordingly.

The main parts (body, insert, springs, screws and nuts) are manufactured in stainless steel grade A2 or class 304, whereas the seat head and the seat sealing consists of aluminium and a special soft rated silicon o-ring. The seat cracking pressure of the valve in flow direction is below 10 mbar, independent of the orientation, thus allowing the recovery of the gases at the smallest pressure differences. Increasing the cracking pressure to a higher value if needed is possible as well.

Each valve is pressure tested at 1.5*PN and integral tightness tested to the outside. A tightness test of the valve seat as well as a test for the closing pressure is performed to guarantee proper function of the valve.



PETRA III building



Typical application

A typical application of a helium recovery system can be found at Deutsches Elektronen-Synchrotron, A Research Centre of the Helmholtz Association in Hamburg, Germany. From several buildings the helium boil off gas of the experimental stations is collected and stored in a helium balloon.

In the building PETRA III for example there are nine sectors with a total of 13 experimental stations using cryogenic cooling with helium gas supplied by mobile dewars. Each of these stations is equipped with a check valve and a ball valve, connecting the station to the main helium gas recovery line of the building. The check valve prevents the backflow of helium from the main line into the experimental station, but allows on the other hand the recovery of the boil off gas into the main line by a very small pressure difference of a few mbar.

From the main lines of the several buildings the gas is stored in a balloon. After cleaning it is refilled in bottles and can be reused for experiments again. The recovery of the gas is high enough for DESY not having to buy helium in gaseous form.

Conclusion

The recovery of helium boil off gas can reduce the purchase of helium in a considerable way and reduces the dependency of the suppliers. When recovering helium it is important to avoid any interference of the several experimental stations. This can be achieved by installing check valves with a low cracking pressure as described.