

The He-battery operation resembles a 1K pot operation, but with much greater heat load and higher pumping line impedance. The inclusion of He-battery into Bluefors system slightly contradicts the idea of having a "cryogen-free" dry dilution refrigerator system. This option was developed for an extreme case when vibrations from PT must be eliminated completely (usually in applications with free-space optics). He-battery is a helping upgrade for very advanced laboratories, rather than a standalone device. Thus, we focused our He-battery development mostly on the parts that are inside the cryostat. However, since we are selling this option, we have to provide a way to prove the concept. We provide the filling line and instructions for He-battery use in order to show that its operation is possible with existing GHS. Of course, frequent use of the battery through GHS will lead to excessive loss of Helium gas, which is expensive. We usually suggest our customers to acquire their own Helium pumping, compressing and purification system for more or less closed cycle operation of He-battery.

KF25-to-6mm filling line does not necessarily have to be connected to GHS. One can use externally built manifold with pump and He-bottle connection. External connection can be even beneficial, as it reduces the risk of GHS malfunction: if GHS is used to fill and pump the battery through the service manifold using Scroll2, the p6 pressure may not exceed 1 Bar (abs). P6 pressure higher than 1.8 Bar will result in catastrophic event of leaking of p6 volume gas towards mixture circulation path through v18. Such filling line overpressurization is not harmful to DR circuit if the filling line is not connected to AUX port.

The He-battery operation manual only suggests a way to use it in absence of external equipment. In this case, we can only expect the equipment that we produce to be connected to the GHS. Normally, Bluefors cryostats are vented with room air, thus we considered the VENT port as available for supplying Helium gas. We do not provide any bottle connection as they can be very different. In some cases even Helium "from the wall outlet in the lab" is used. Other available ports are TEST and AUX, both KF-25. Our filling line is also made with KF-25 flange. Naturally, the filling line can be connected to TEST or AUX. Or, in case of fast sample exchange option, when the AUX port is occupied with loading bellow pumping line, the only available port is TEST. Customers may choose between VENT, AUX and TEST to connect filling line and Helium supply, depending on their availability of tube adapters. For standardization reasons we choose to connect Helium supply to VENT and filling/pumping line to AUX.

We recommend flushing the manifold and the line with gas several times, using Scroll2. Residual (outgassing) pressure of  $\sim 5 \times 10^{-2}$  mBar was found to not affect the performance of the battery.

In the case of mandatory use of Nitrogen for venting we can suggest to use KF-16 T-tube on VENT port and two manual valves, so that one can choose which gas to supply to the service manifold - either He or N<sub>2</sub>.