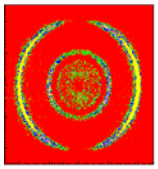
Meshes and masks for RoentDek detectors



RoentDek
Handels GmbH

Supersonic Gas Jets
Detection Techniques
Data Acquisition Systems
Multifragment Imaging Systems

RoentDek provides two types of meshes for mounting in front of MCP stacks with different sizes.

The free-standing meshes **Mesh40** and **Mesh80** for the 40 mm and 80/75 mm detector sizes (e.g. *DLD40*, *DET40, DLD80, Hex75*) are formed as bee-hive patterns etched out of UHV-compatible 0.05 mm thick Cu-alloy sheets.

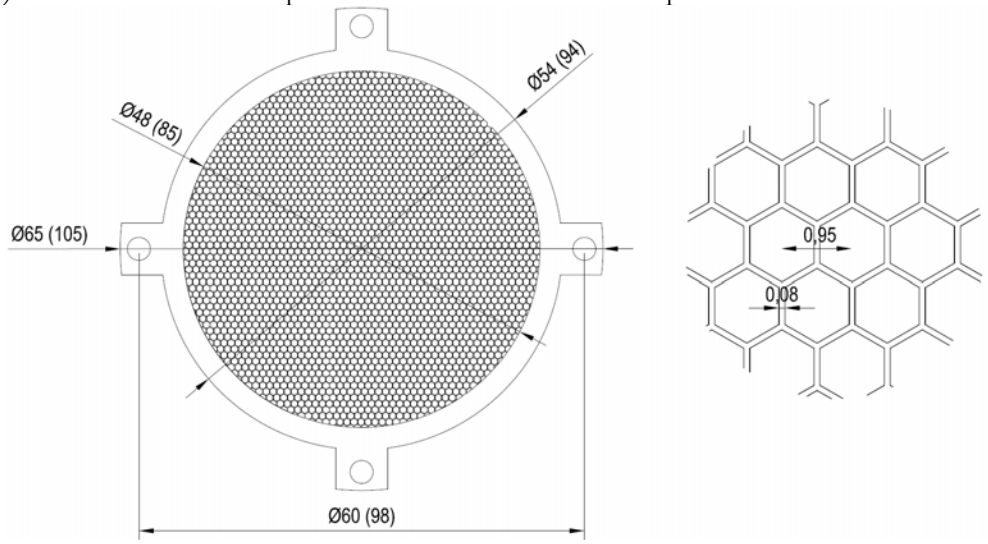


Figure 1: Mesh40/80 (displayed here: Mesh40) showing all dimensions (for Mesh80 in parentheses if different) *

The hexagonal-shaped cells have about 1mm mean diameter (center-to-center 0.95 mm) with a nominal obstacle width of 0.08 mm (0.1 mm for **Mesh80**), yielding an optical transmission of > 80%.

Some applications require smaller open cells to minimize micro-lensing effects, e.g. if the mesh is used to define/separate regions with different electrostatic field gradients. For such applications the (woven) 316L stainless steel meshes **wMesh40/80/120** with 77% optical transmission can be provided. Their micro-structure is formed by 0.14 mm square cells (0.02 mm wire, center-to-center 0.16 mm). This mesh structure is clamped in 3 mm thick round Aluminium frames (UHV compatible) with different diameters for the 40 mm, 75/80 mm and 120/100 mm detector sizes (i.e. also for *DLD120* and *Hex100*).

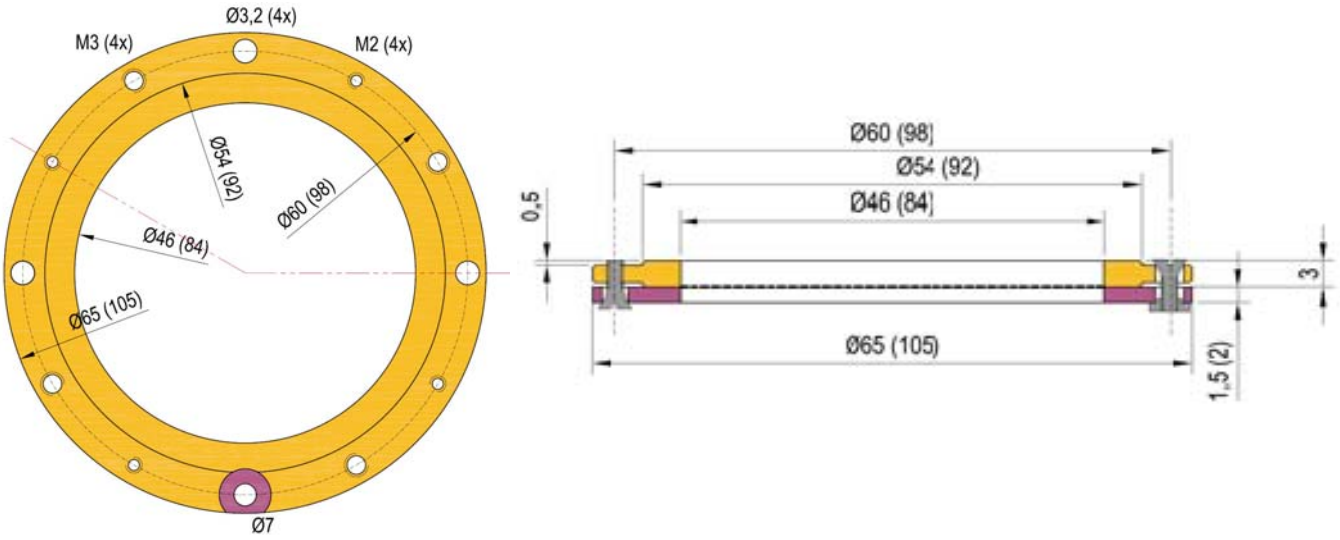


Figure 2: Sketch of wMesh40/80 (displayed here: wMesh40) showing all dimensions (for Mesh80 in parentheses if different). The RoentDek meshes can be mounted right onto the front ceramic ring (wMesh120: via spacers).

* **RoentDek** also provides etched calibration masks for determining detector linearity and resolution by a shadow projection. Some of those have a very high optical transmission and may also be used as a potential mesh, if large openings are tolerable.

Mesh mountings

Always use great care and do not touch the mesh or the MCP surface.

The **RoentDek** meshes (or masks) can be mounted right onto the front ceramic ring with the same M2 screws/recessed nuts as used for MCP contacting (for **wMesh120** see below). A mesh should be fixed on at least two opposing (for zero distance) or more positions with the bias cable connected on one end. It is recommended to connect the mesh bias either via a blocking resistor placed very close to the mesh contact (i.e. in vacuum) or to use a *HFST*-type signal terminator. In case of operation with a *FT12TP* its "X" line can be used for biasing the mesh (includes signal terminator). Depending on details how the connecting scheme of the MCP bias contacts was made there may be mechanical conflicts to consider during mesh mounting. It may especially be required that the MCP front contact lug is placed on the MCP side of the ceramic ring.

Make sure that the mesh is not touching any other biased part of the detector assembly (and none of the spring clamps) and that sufficient distance is kept between detector parts biased at different potentials (> 500 V) relative to mesh potential. Allow at least 1 mm distance per 1000 V potential difference (even more in presence of sharp edges). Use extra insulation (e.g. with Kapton sheet) if distances are too small in this respect. The maximum voltage rating between mesh and MCP front potential is 2000 V if mounted right on the ceramic ring*. For **wMesh** mountings for high (> 2 kV) MCP-face to mesh potential difference see Figure 8 to 10 below.

If the mesh is bent or damaged corona discharges can appear between MCP and mesh, producing charged particle background which may saturate and ultimately even damage the MCP stack.

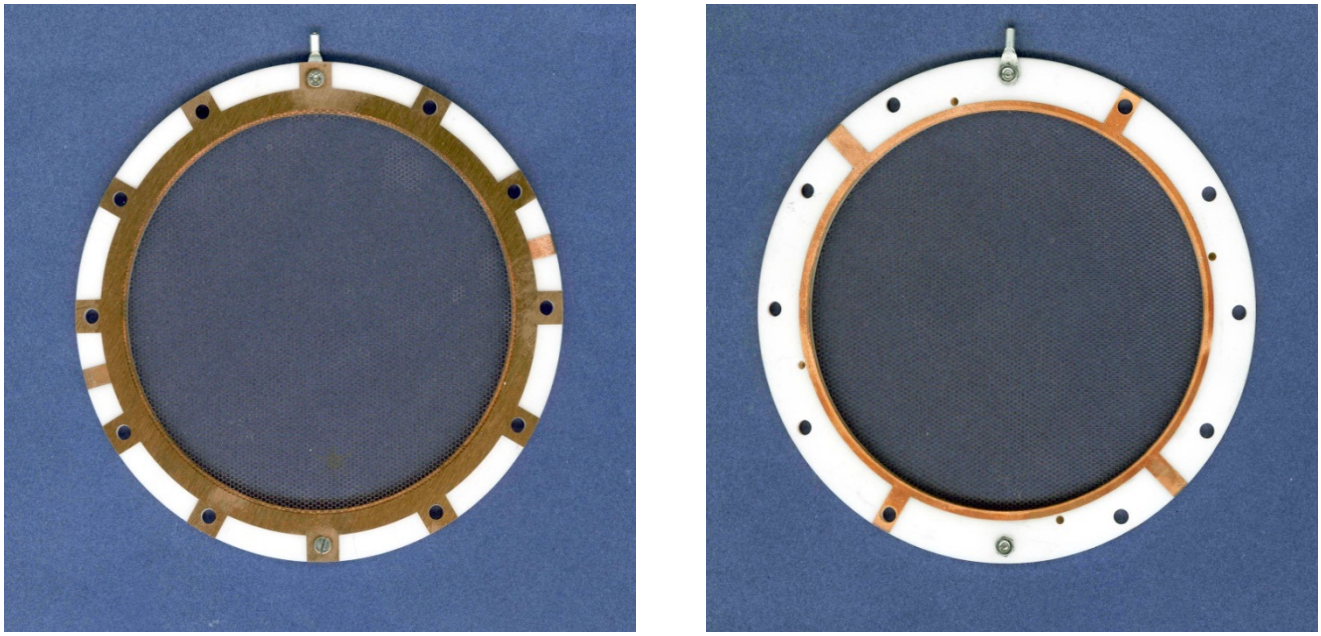


Figure 3: Free-standing Mesh80 mounted to the MCP front ring (left: front side, right rear side of the front ring). Unused lugs of the mesh can be cut away with scissors to avoid conflicts with other contact pins. A mesh can also be mounted at a greater distance from the MCP by introducing spacers.

RoentDek also provides etched calibration masks (e.g. pin-hole masks) for determining detector linearity and resolution by a shadow projection. The mounting of those to the ceramic rings of the MCP stacks is very similar to the mesh mounting as described above, i.e. the same precautions must be followed. The hexagonal meshes can also be used as calibration masks.

It is to note that parallax or lensing effects may disturb the shadow projection. A mask should therefore be mounted as close to the MCP front face as possible. Mounting the mask right onto (i.e. in physical contact with) the front MCP face is possible **but may damage the MCP surface.**

For mounting a **wMesh** on a detector, the same precautions as described above must be considered. The 3 mm thick mesh-clamping frame is shaped so that the spring clamps on a mounted MCP stack are not touched (for mounting

* for **wMesh120** the maximum voltage depends on the distance as set by the spacers.

the **wMesh120** see below). A 7 mm cut-out is provided to allow a contact screw (e.g. from MCP front contact) to protrude towards the detector front side without touching the mesh.

Figure 4: Picture of wMesh40 mounted on a ceramic ring (for mounting options see text below). The cut-out is at the position of MCP front contact. The mesh contact can be made as described for the free-standing meshes or by using the M2 holes as shown here (lower left corner).

There are two methods of mounting a **wMesh** on the corresponding MCP holding ceramic rings supported. First, the position of the mesh most be chosen, either facing towards the MCP stack (usually recommended, see Figure 2) or placed on the far side. Ideally, a **wMesh** is fixed by a countersunk screw (M2x6) via the M2 holes onto the ceramic ring (see left side of the cut in Figure 2). This, however, requires disassembling a pre-mounted MCP stack. For mounting of a **wMesh40/80** on a pre-assembled detector the 3 mm holes can be used for fixing the mesh via recessed M2 nuts and (M2x5) countersunk screws, as done for contacting the MCP stack (right side of the cut in Figure 2 and Figure 4).

Of course, a **wMesh** can also be placed at a greater distance from the MCP by introducing spacers.

For mounting a **wMesh120** onto the metal front ring of a *DLD120* or *Hex100* it is required to care for insulation, i.e. via the ceramic eyelets/standoffs provided: Three of the M3 PEEK screws (at relative 120^{o} angle) must be removed from the assembled MCP stack and the standoffs are then placed at these positions. Now the **wMesh120** can be placed onto the standoffs and fixed with (longer) M3 PEEK screws guided through the eyelets or standoffs. Use great care when fixing the screws and avoid excessive force during tightening those (see detector manual for *DLD120*/*Hex100* MCP mounting). The **wMesh120** can be contacted in the same way as the MCP front ring.

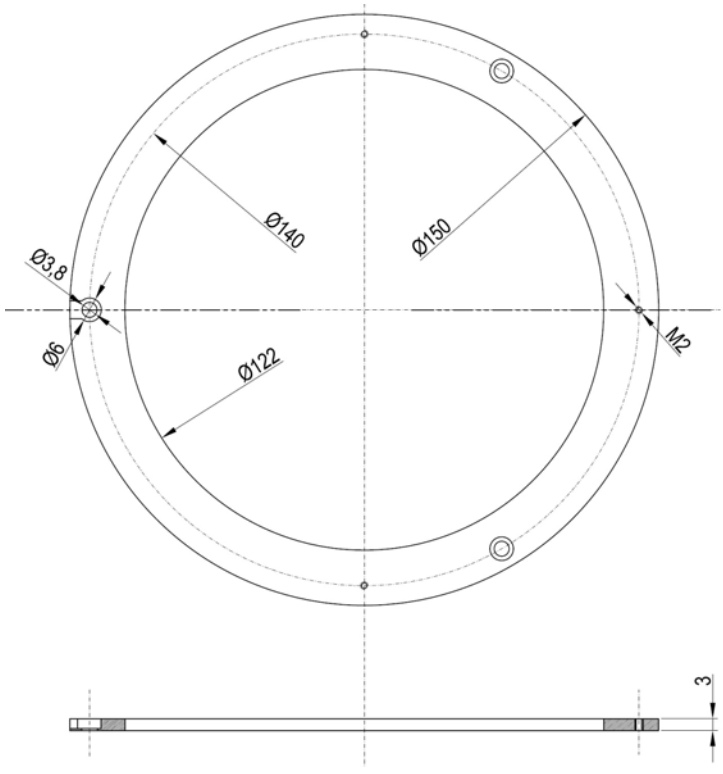


Figure 5: Sketch of wMesh120
(for mounting options see text above)

The RoentDek calibration masks

RoentDek offers detector calibration masks which can be used to verify and (via special software routines) correct non-linearity effects in the imaging. Additionally, spatial resolution can be estimated. The bee-hive patterns in the **RoentDek Mesh40/80** can already be used for these purposes. The high-transparency mesh **HT_Mesh40/80** may even be permanently mounted (possibly also in between the individual MCP of a stack) to provide an embedded calibration grid. Alternatively, hole masks are available so that linearity/resolution performance can easily be estimated from an acquired shadow image.

The free-standing masks shown below are etched out of a 50 micron thick Cu-alloy sheet. They can be mounted as the **Mesh40/80** (please observe the same advices for mounting and operational safety as described for those).

The main elements in the **CalibMask40/80** are holes of diameter 0.4 mm and 0.15 mm respectively at 1 mm spacing*. Additional patterns near the center serve to estimated spatial resolution more precisely: The **CalibMask40** has a "window" field with bars of 0.1 mm thickness, the **CalibMask80** additionally two fields with horizontal/vertical slits of 100, 70 and 50 micron width and a field with three open squares separated by 50 micron wide bars.

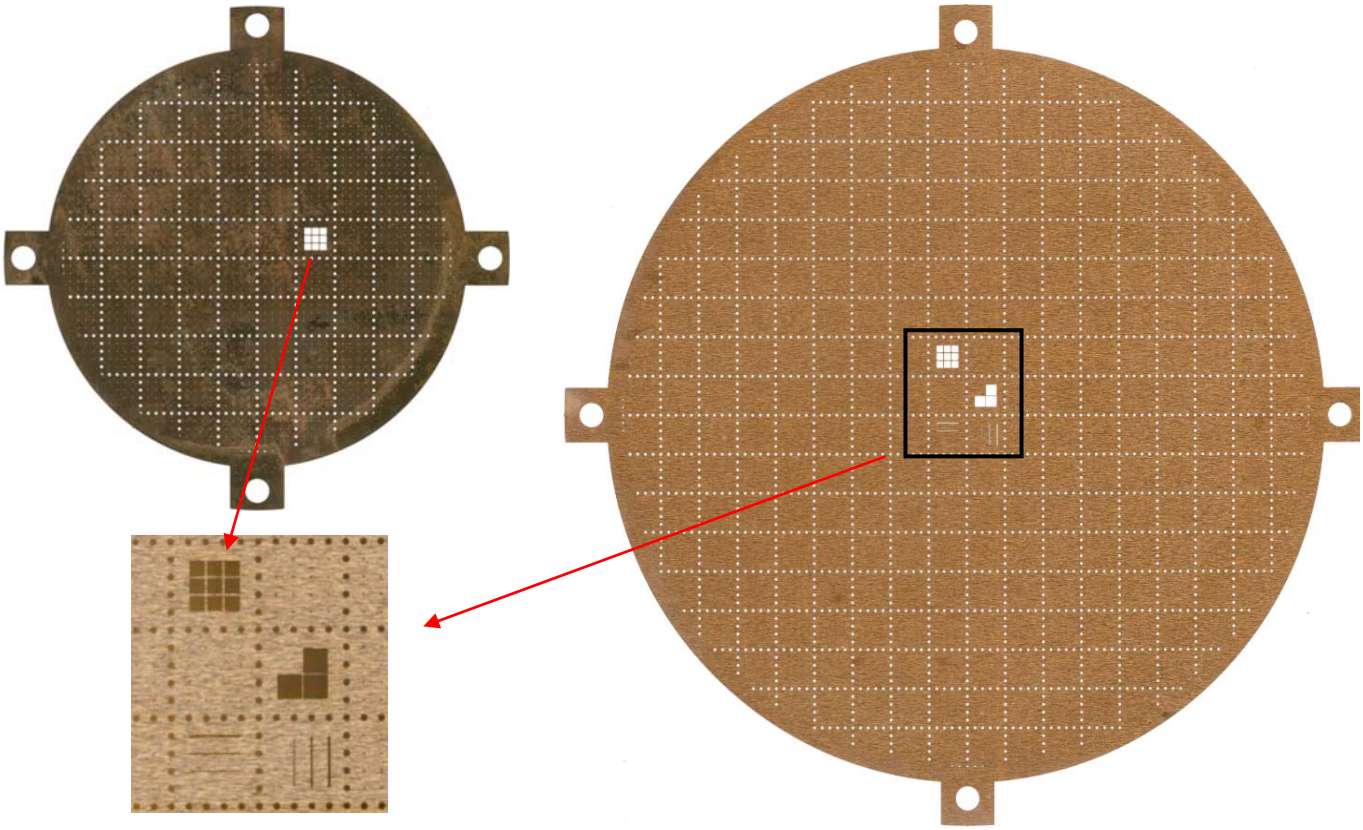


Figure 6: CalibMask40/80

When using any of the **CalibMask** on an MCP detector it is important to consider that their poor optical transmission of only a few % may increase pumping time considerably if the mask is mounted right on same MCP front rings without a venting gap. The local pressure at the MCP stack may be very different from the vacuum reading elsewhere in the chamber.

Furthermore, the very localized exposure to incoming photons/particle flux may lead to local saturation at comparably low overall count rate and may lead to premature local wear-out of the MCP stack. It is important to carefully calculate/control the maximum local rate and dose.

* Special hole masks are available containing only holes (0.25 mm diameter throughout except for a central hole with 0.4 mm)

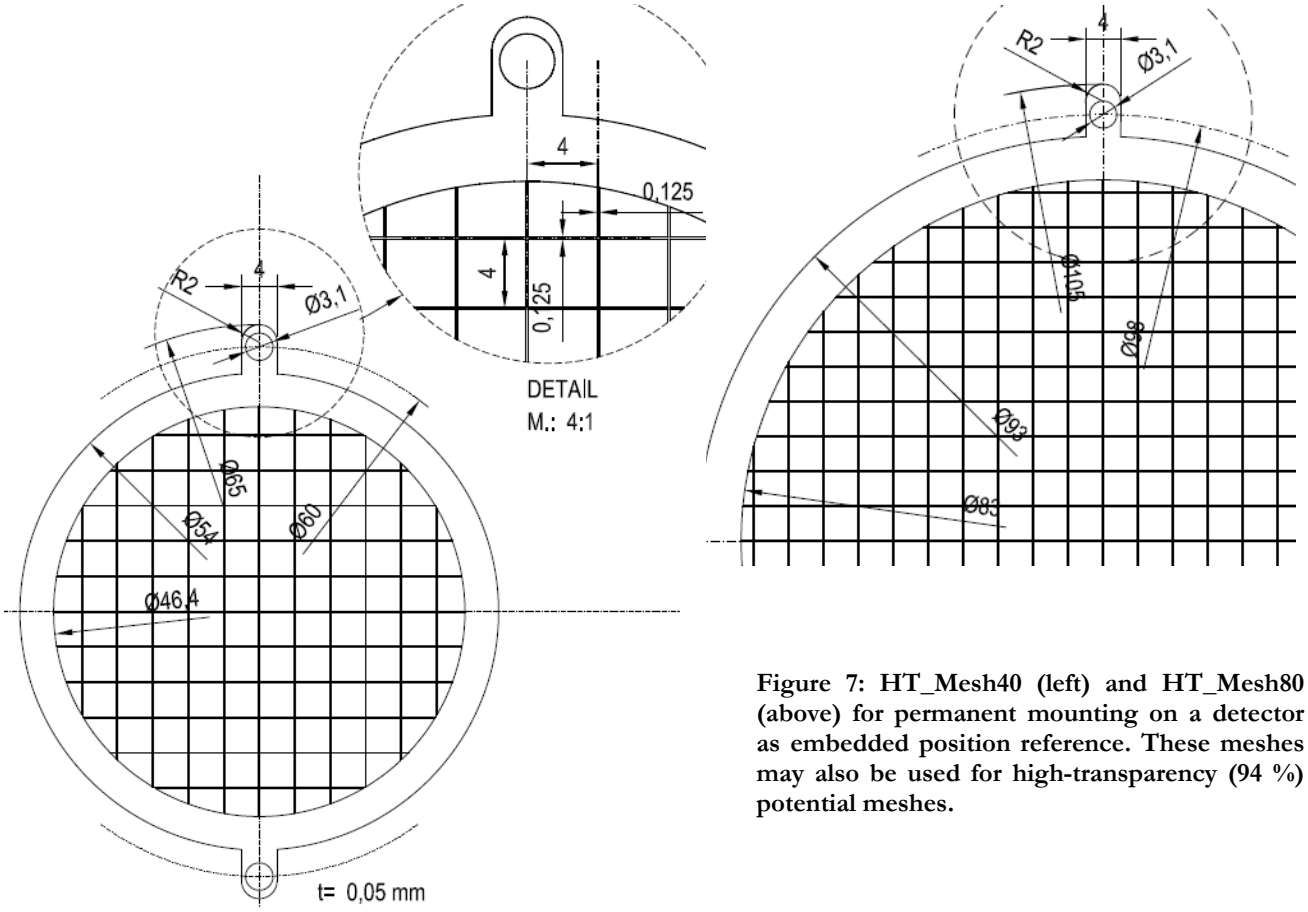


Figure 7: HT_Mesh40 (left) and HT_Mesh80 (above) for permanent mounting on a detector as embedded position reference. These meshes may also be used for high-transparency (94 %) potential meshes.

Appendix: ***Mesh mountings for high (> 2 kV) MCP-face to mesh potential difference and for mesh/mask mountings onto Cu front rings***

When using a separate ceramic (or metal) ring a free standing mesh (e.g. **Mesh40/80**) fixed thereon can be mounted to the MCP stack assembly at a greater distance with the help of spacers (see figures below).

Figure 8: MCP front clamping ring with bias contact, here for Hex80/DLD80 (left: side facing towards MCP, right: other side). Thermoplastic screws are used to enhance high voltage withstanding.

Figure 9: wMesh80 mounted on ceramic ring with contact cable for mesh bias.

If a Cu ring is used in front of an MCP stack, a mask can easily be fixed at two M2 threads in the ring for example as shown in the figure below (left picture). In case a metal screw is used make sure that it does not protrude beyond the front ring's thickness and thus gets too close to the MCP back ring (risk of discharge). In this simplest mounting scheme the mask is always on the same potential as the front ring. It may be necessary adding a washer to allow for a venting gap between ring and mask.*

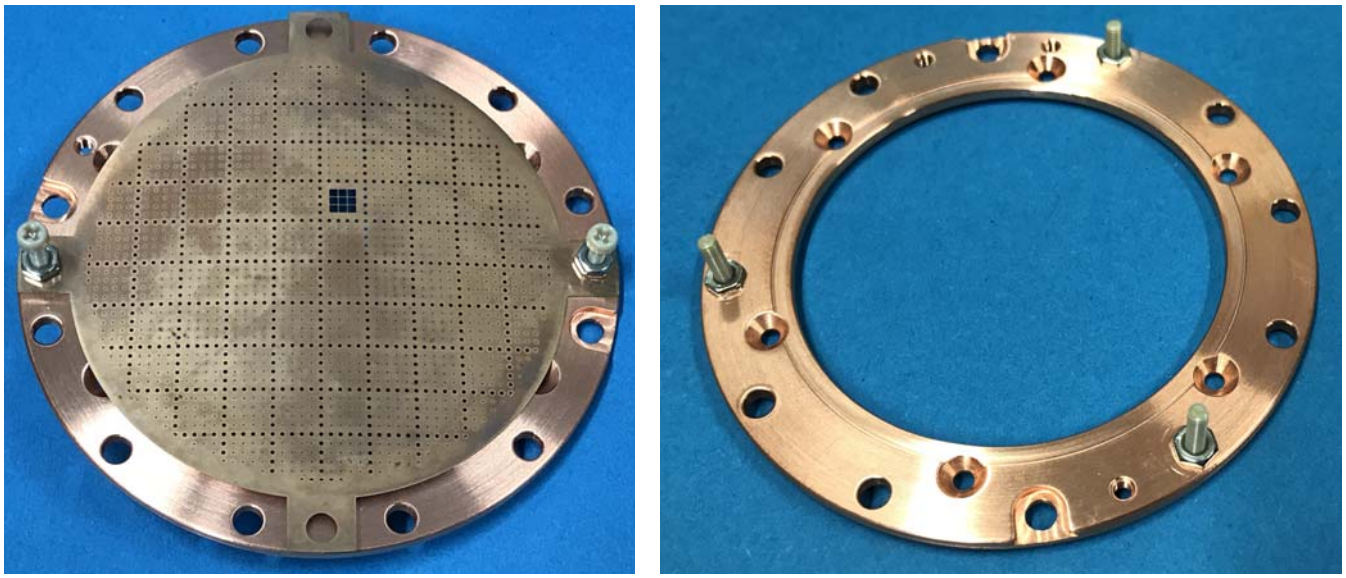


Figure 10: connecting options for meshes or masks Cu rings.

If a mesh/mask shall be mounted insulated from the front ring, extra spacers must be placed. PEEK screws can be mounted in some of the 3 mm holes and fixed by M2 nuts, either also made from PEEK or from stainless steel (then extra insulating washers must be placed before fixing the mesh).

*It turns out that an insulating washer may not always guarantee that a mesh/mask is insulated from the ring unless it is rigid enough not to touch the ring at an unsupported position.