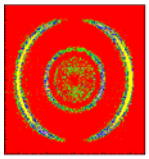
Meshes and masks for RoentDek detectors



RoentDek Handels GmbH

Supersonic Gas Jets
Detection Techniques
Data Acquisition Systems
Multifragment Imaging Systems

RoentDek provides two types of *mesh*es for mounting in front of MCP stacks with different sizes.

The free-standing *mesh*es ***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.

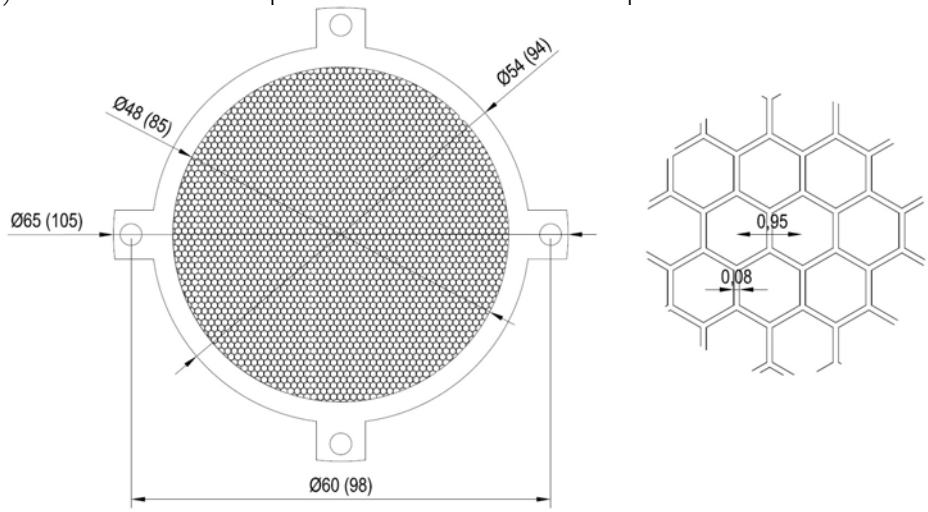


Figure 1: *Mesh40/80* (displayed here: *Mesh40*) showing all dimensions (for *Mesh80* in parentheses if different) *

The hexagonal-shaped cells have about 1mm mean diameter (center-to-center 0.95 mm) with a nominal obstacle width of 0.08 mm, 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 *mesh*es ***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 *DLD105/120* and *Hex100/120*). For ***wMesh120*** details please refer to the respective manual.

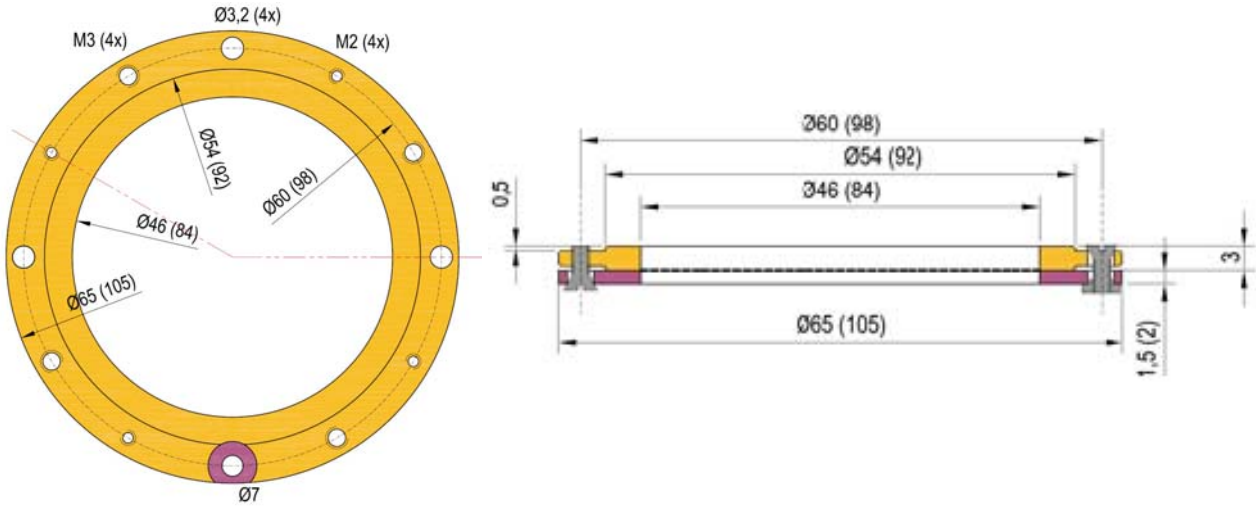


Figure 2: Sketch of *wMesh40/80* (displayed here: *wMesh40*) showing all dimensions (for *Mesh80* in parentheses if different). The RoentDek *mesh*es can be mounted right onto a front ceramic ring or via spacers to a metal ring.

* **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 (and *mask*) mountings

Always use great care and do not touch the *mesh* or the MCP surface. The distance of a *mesh* to a support ring/plate and to a the biased MCP front surface shall be chosen so that no discharge or corona emission can be driven by the a field between MCP/support ring and a *mesh* biased at a different potential. As a thumb rule, safe distance is 1 mm for each kV of potential difference. In absence of sharp edges and tips the field may reach up to 2 kV/mm at most.

If a **RoentDek** *mesh* (or *mask*) shall be mounted right onto on a ceramic ring (e.g. the same as used for MCP stacking) this can be done with the same M2 screws/recessed nuts as used for MCP contacting. For mounting of *mesh*es at some distance or for mounting on a metal front ring, e.g. ***wMesh120***, see below. A separate manual is supplied for mounting *mesh*es/*masks* on the metal front rings for 40 and 80 mm MCP.

A *mesh* should be fixed on at least two opposing (for zero distance) otherwise on at least three positions with the bias cable connected on one side. 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 a 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.

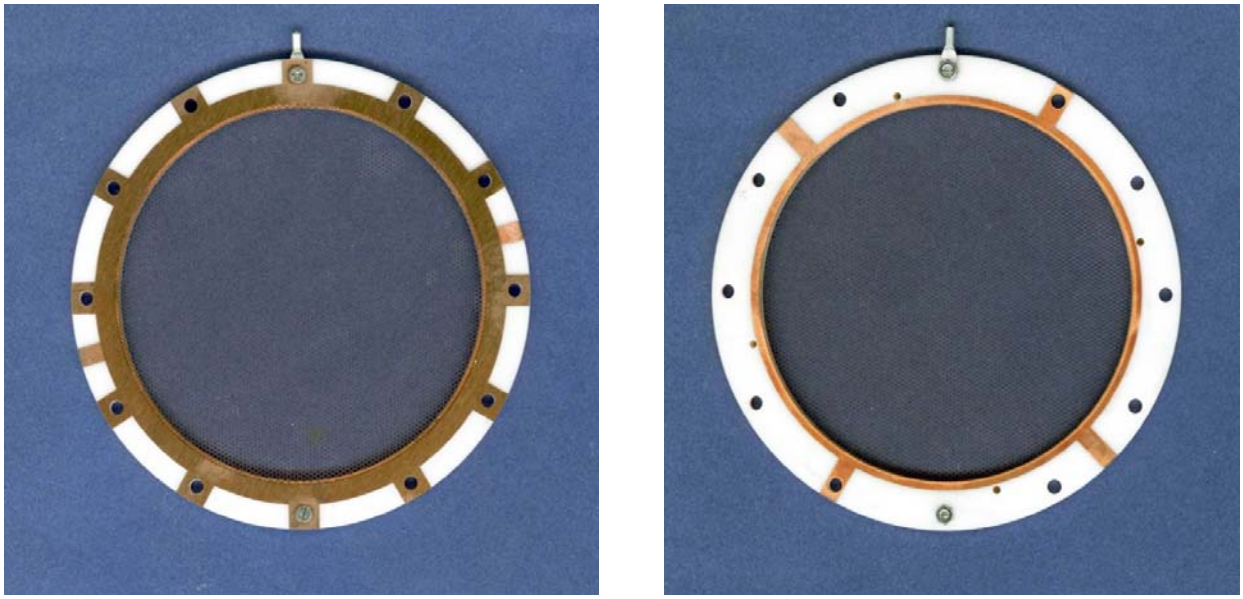


Figure 3: Free-standing Mesh80 mounted to ceramic MCP front ring (left: front side, right rear side of the front ring). Unused lugs of the *mesh* can be cut away with scissors to avoid conflicts with other contact pins. A *mesh* can also be mounted at a greater distance from the MCP by introducing spacers. This is especially necessary when the *mesh* shall be insulated from a metal ring in an MCP frame

For mounting a *mesh* at more than few mm distance from a supporting structure **RoentDek** can provide a solid ring with dimensions similar to those used with a ***wMesh*** (see below). Such-supported *mesh*es can also be used as semi-transparent electrode of a custom ***time-of-flight spectrometer*** setup.

* for **wMesh120** the maximum voltage depends on the distance as set by the 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 or metal rings forming the MCP stack frame is very similar to the *mesh* mountings described here, i.e. the same precautions must be followed. The hexagonal *mesh*es 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 MCP stack mount via ceramic rings are not touched (for mounting 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 *mesh*es 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 rings. 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). For mounting a ***wMesh40/80*** on a metal MCP front ring please refer to the separate manual.

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

For mounting a ***wMesh120*** onto the metal front ring of a *DLD120* or *Hex100* it is usually required to care for insulation via spacers unless it is operated on the same potential as MCP front. For this, three of the M3 PEEK screws (at relative 120° angle) must be removed from the assembled MCP stack and the supplied 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.

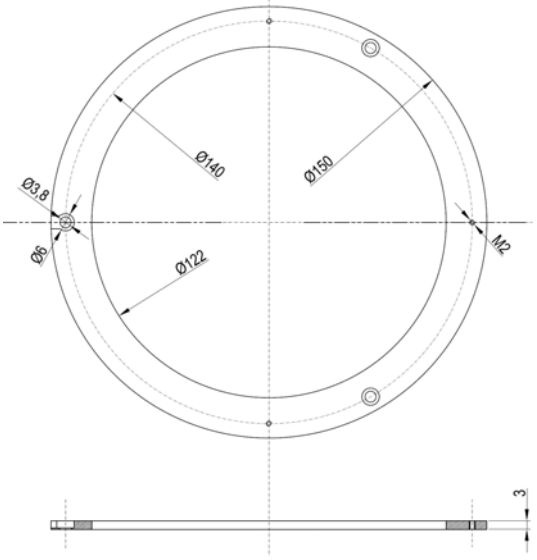


Figure 5: Sketch of *wMesh120*
(for mounting options see text above)

If a *mesh* shall be mounted onto a ceramic ring but at some distance, or onto a metal Cu front ring (e.g. for *DLD40* and *DLD80*) extra PEEK screws and standoff provisions are required. Unless a *mesh* is not of rigid type (e.g. ***wMesh***) an intermediate ring should be used for support (see Figure 3). No standoff provisions are required if a *mesh* (even of non-rigid types is mounted right on the Cu front ring, sharing its potential. A separate manual is available.

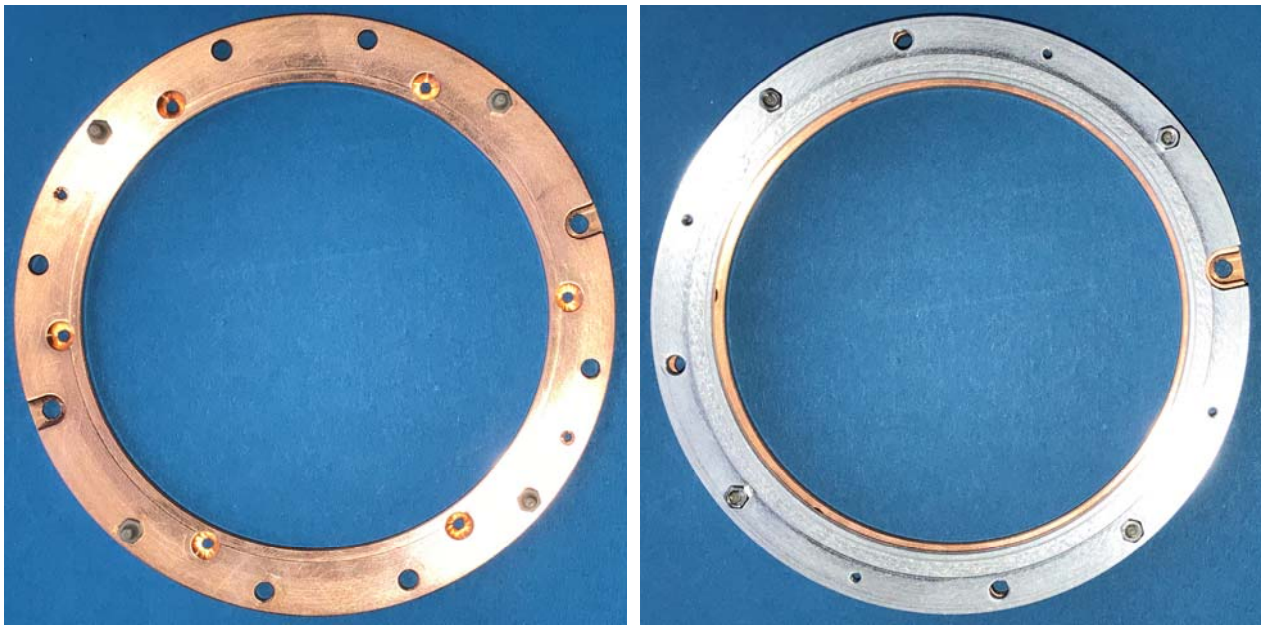


Figure 6 (above) shows typical mounting provisions in the front ring (screws in the front ring must be placed before MCP stack assembly)*. If a ***wMesh40/80*** is mounted in this way the distance between biased parts is 1 mm to 3 mm, depending on the employed PEEK M2 screws and nuts/washers. Larger distances can be achieved via M3 screws.

The mounting scheme in Figure 6 can also be applied with ceramic front rings.

*certain Cu rings have extra M2 screws at favorite positions for optionally mounting a ***wMesh*** without need for preparing mounting provisions beforehand.

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, pin-hole *masks* are available so that linearity/resolution performance can easily be estimated from an acquired shadow image.

The *masks* shown below are etched out of 50 -100 micron thick Cu-alloy sheets. They can be mounted as the ***Mesh40/80*** (please observe the same advices for mounting and operational safety as described for those), preferably in direct contact with the MCP front ring.

The main elements in the ***CalibMask40/80/120*** 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*** and ***CalibMask120*** 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.

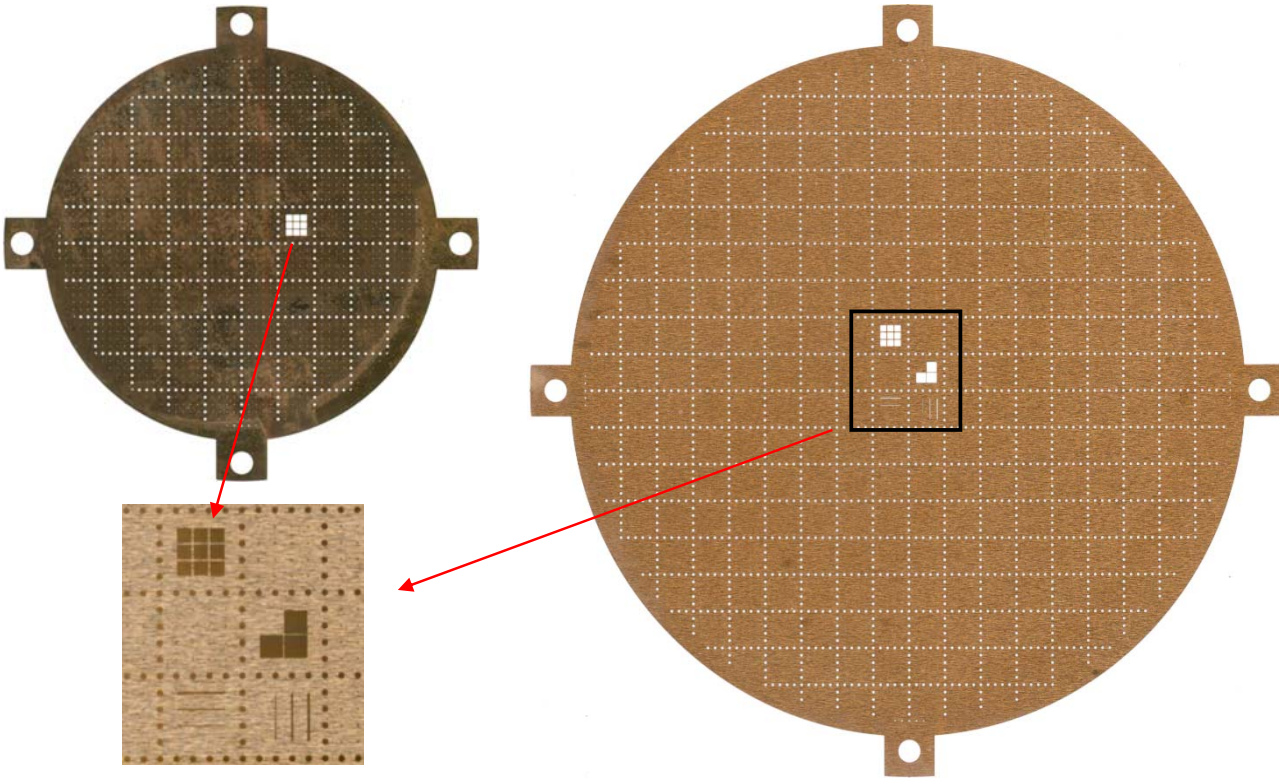


Figure 7: ***CalibMask40/80.*** **The** ***CalibMask120*** **(not shown) is similar to the** ***CalibMask80*****, only bigger and for use with DLD105/120 or Hex100/120 detectors**

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 pin-hole *masks* are available containing only holes (0.25 mm diameter throughout except for a central hole with 0.4 mm). Please inquire for additional test pattern *masks* available from **RoentDek**.

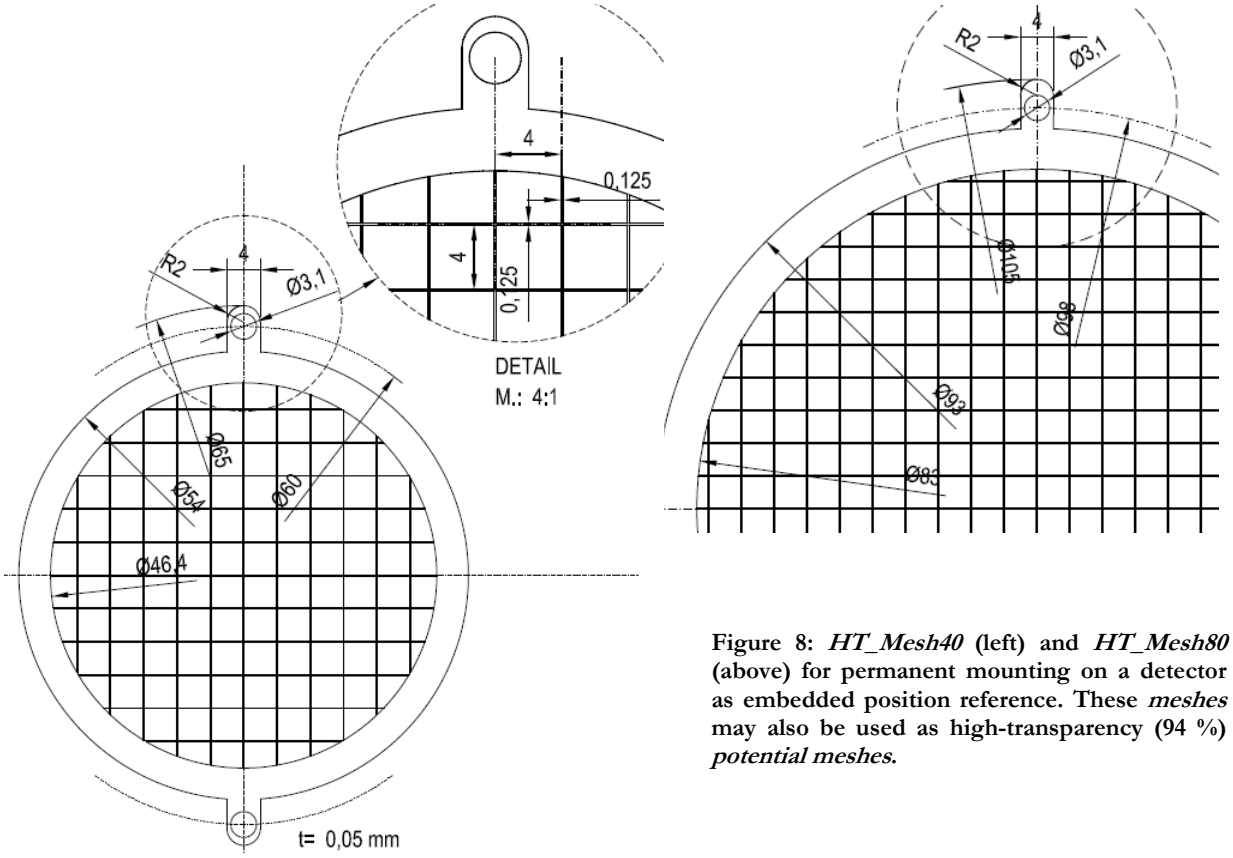


Figure 8: *HT_Mesh40* (left) and *HT_Mesh80* (above) for permanent mounting on a detector as embedded position reference. These *meshes* may also be used as high-transparency (94 %) *potential meshes*.

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*.*

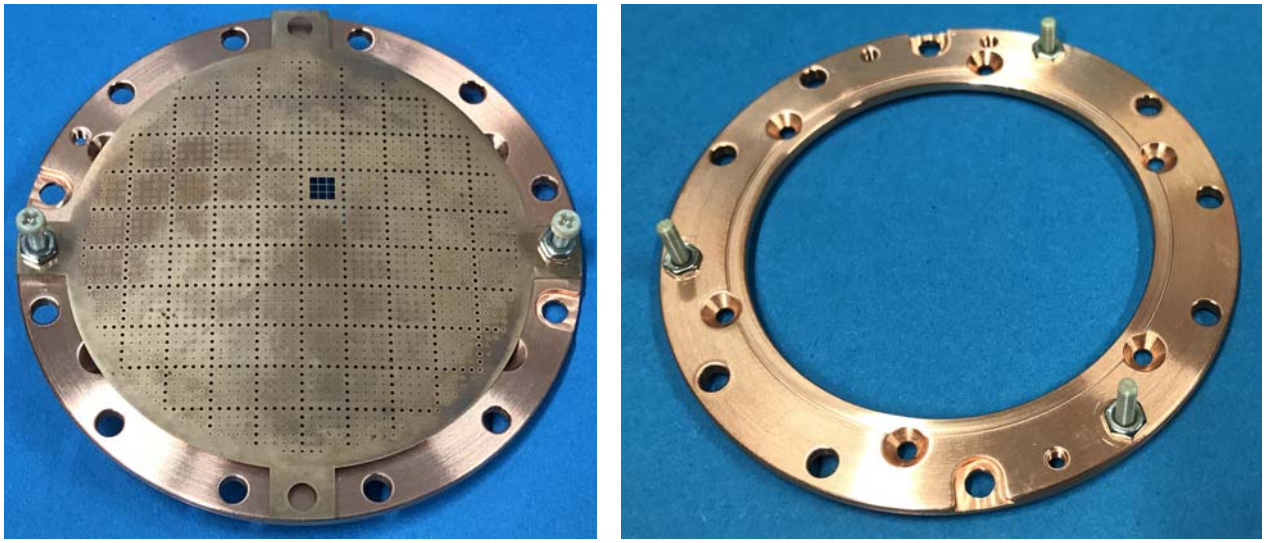
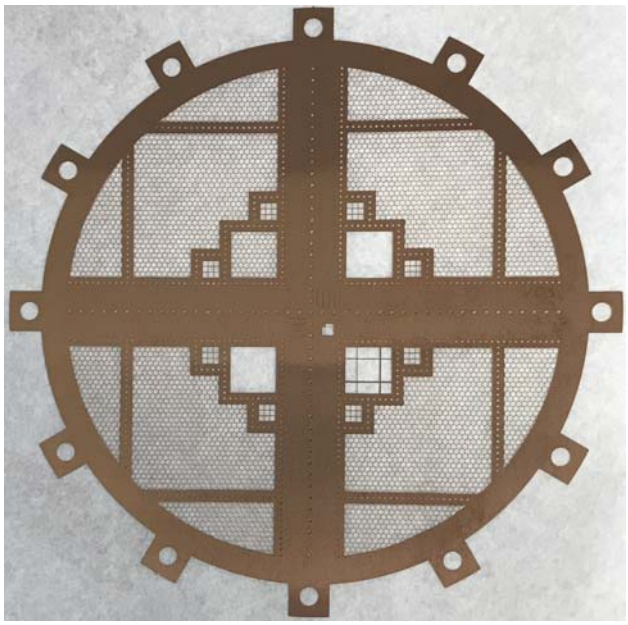
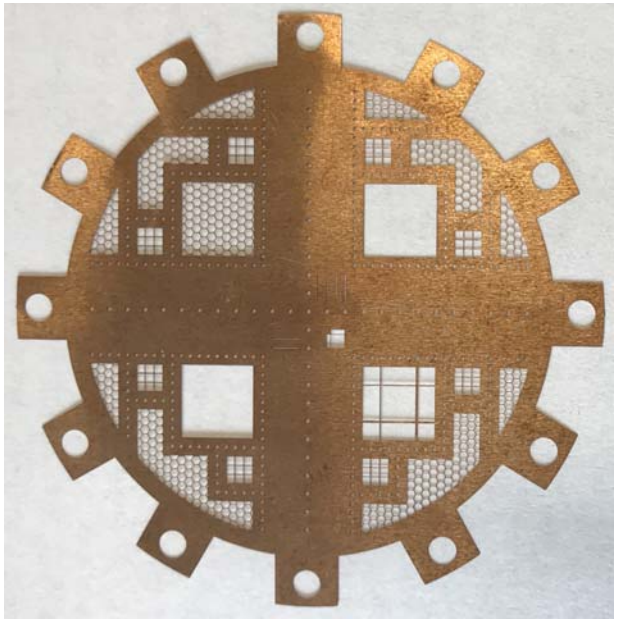


Figure 9: connecting options for *meshes* or *masks* on Cu rings.

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.





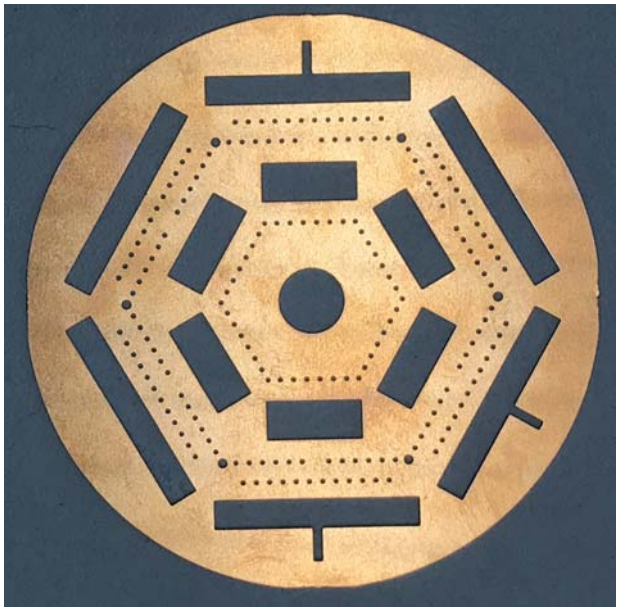


Figure 10: Examples for other *calibration masks* (here for 80 mm size) available from RoentDek, some not available for all detector sizes.