

INSTRUCTIONS FOR THE USE OF REFRACTIVE X-RAY LENSES

1. We fabricate refractive x-ray lenses with beryllium, aluminium, and nickel (on request) as lens material. They have or rotationally parabolic (2D-lenses in a circular frame, 12 mm in diameter) or cylinder parabolic profile (1D-lenses in a frame $20 \times 20 \text{ mm}^2$).
2. The lenses should only be touched by clean gloved hands and they should only be handled in a flow box in order to avoid contamination by dust particles.
3. Beryllium is poisonous, in particular, when inhaled as dust particles. Therefore the beryllium should not be touched by fingers and any production of dust particles must be avoided. Hence, the lenses should be kept in a dry atmosphere, free of ozone in order to avoid corrosion and the production of beryllium oxide or other compounds of beryllium.
4. In general, a refractive lens system will contain many individual lenses in a stack. In order to achieve optimum performance for focusing and imaging it is necessary to align the optical axes of the individual lenses in a stack with submicrometer precision. We provide lens casings which guarantee this precision.
5. During operation the lens stack must be installed in vacuum. The lens frames have an upper side and a lower side. All upper sides should show in the same direction in order to avoid air pockets when evacuating. For that purpose each lens frame has a 1 mm ventilation hole.
6. The frames of 1D-lenses are quadratic in shape with one corner having a triangular cut and an adjacent one having a circular cut. This defines a bottom and a top edge. The triangular edge is at the top edge and the circular one is at the bottom edge. The bottom edge must be in contact with the reference plane which is needed for aligning the individual lenses in the stack. When looking at the top surfaces of all frames the triangular corner must be on the right hand side and on the top edge.
7. At both ends of the lens stack should be installed a pinhole or a slit which limits the incoming beam in its lateral extension. The pinholes and the slits should be a little smaller than the geometric aperture of the lenses. This reduces scattered radiation from those parts of the lens which are non-parabolic.
8. During operation in the synchrotron radiation beam the temperature of the stack must not exceed 100°C for aluminium lenses and 300°C for beryllium and nickel lenses. It may be necessary to cool the lens stack.

- When the lenses in a stack are arranged with identical optical axes the whole stack has to be aligned in the beam. For that purpose the support of the stack needs 5 degrees of freedom: 3 translations and 2 rotations. Our lens casings have alignment holes parallel to the optical axis and outside of the lens frames. It is easy to thread the beam through one pair of these holes. A parallel displacement brings the beam then very close to the optical axis. A fine adjustment (tilt about 2 axis) finishes the optical alignment.
- The tilt axes must go through the pinhole / slit on the entrance side of the stack as indicated in the figure. If, for instance, the tilt axes would go through the middle of the stack or, even worse, through the exit pinhole / slit then the entrance pinhole would (partially) cut off the beam when the lens casing is tilted, resulting in a (partial) loss of intensity and in artefacts in the beam shape.

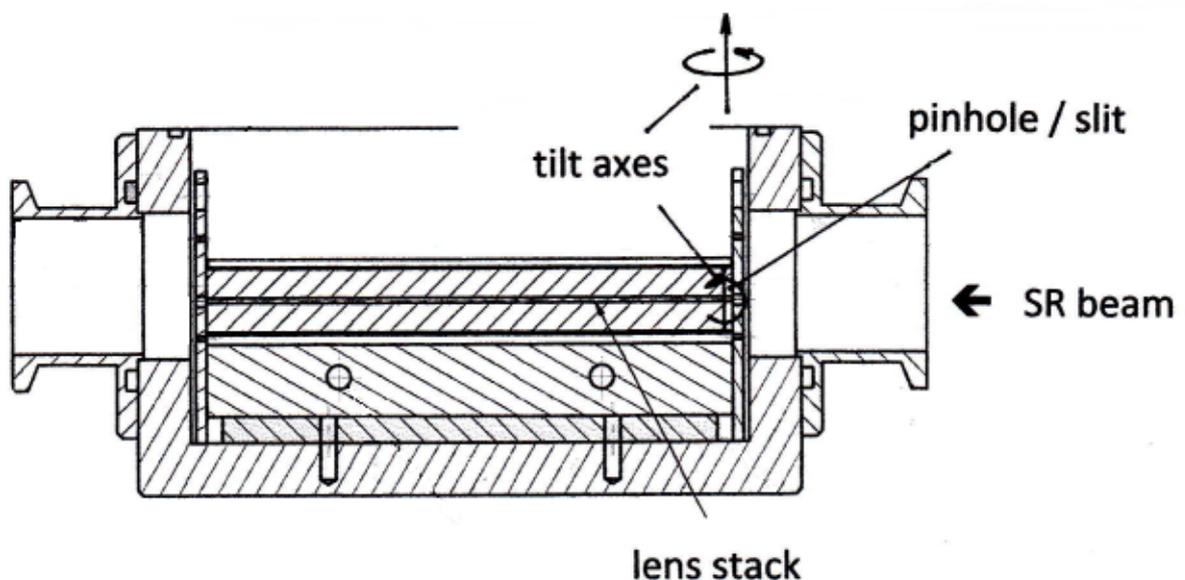


Figure 1: Lens casing