1 Introduction

According to the ray-trace procedure (PS-C-XFD-PRC-008), any synchrotron beam stop needs to have a ±3mm clearance in addition to the extreme ray foot-print. The ISS ray trace (PD-ISS-RAYT-0001_final) shows that one component (MA2) does not fulfill this requirement. The pink beam stop PSB fulfills this requirement nominally; however, the extreme rays assuming the worst-case scenario of mirror misalignment (CM1 and CM2) result in a footprint which allows only 0.4mm vertical clearance. This technical note describes the technical details, explains that the system is appropriately protecting all shielding elements, and provides guidance to verify the alignment of all components.

Figure 1: Collimation mirror system with MA1, the high heat load mirror CM1, MA2, the collimation mirror CM2, MA3 and various secondary bremsstrahlung shields (beam direction: right to left).
2 Technical Description

Five masks and one pink beam stop (PBS) are determining the extreme rays of the synchrotron ray trace. Mask MA0 provides protection against the large PPS-synchrotron fan, is well oversized and provides a large beam aperture; in contrast to masks MA1, MA2, and MA3, which determine the beam path through the collimation mirror system, MA0’s alignment is not critical. It is mounted on a separate steel table. Long-term stability is not a concern.

The beam-determining mask set MA1, MA2, and MA3 are mounted together with the mirror system on a single granite unit, which will provide good long-term stability and will provide accurate relative alignment of the system.

Masks MA3 and MA4 are limiting the maximal synchrotron fan which hits the PBS. Mask MA4 and the PBS are mounted on a separate granite block, which is mounted about 400 mm downstream of the CM granite foundation. The close proximity of the two granite blocks will allow minimizing relative motions between the individual radiation safety components.

3 Reduced Clearance

Mask MA2 acts not only as a beam guidance element, but also as white beam stop in the case that the mirror CM1 is moved out of the beam (see Figure 4). In this case the upper vertical clearance is less than 3 mm. In case of misalignment of MA2 the beam will be absorbed by MA3; no equipment is in this beam path. The vertical clearance of MA3 is significantly larger than 3 mm. Therefore, no special action is required to ensure that the MA2 is positioned within its tight tolerances.
Figure 3: Detail of the Synchrotron ray trace showing the extreme race (with maximum misalignment of the mirrors). The vertical clearance in this case is 0.39mm.

Nominally, as shown in Figure 4, the PBS fulfills all requirements of the ray trace procedure. However, the extreme rays, expecting complete misalignment of the mirror system, will result in a maximum foot-print on the beam stop PBS which allows only a clearance of 0.39 mm (see figure 3).

To avoid any risk, a survey of the external fiducial marks of MA1, MA2, MA3, MA4 and PSB will be performed every 4 month over the first year of operations and the results will be compared with the original survey reports (Masks Survey Result At 8-ID-ISS Beamline 2016-01-21 and The Pink Beam Stop And Collimator Assembly Survey Result_12-15-15). After a year, an addendum to this note will be prepared, which will define the future intervals between resurveying and aligning the masks and pink beam stop.
Figure 4: detailed view of the vertical synchrotron ray tracing of 8-ID. The upper vertical clearance of MA2 is 0.4mm. However, in case that the beam would miss MA2, it will be absorbed on MA3. The clearance of MA3 is significant larger than 3mm.