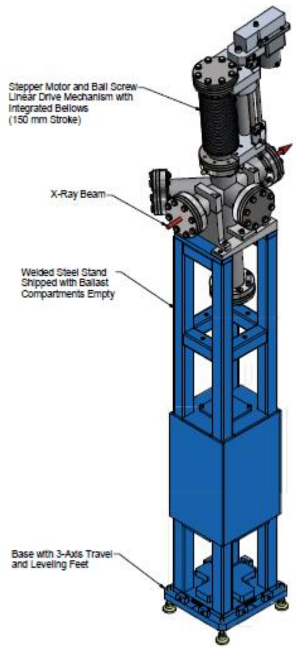
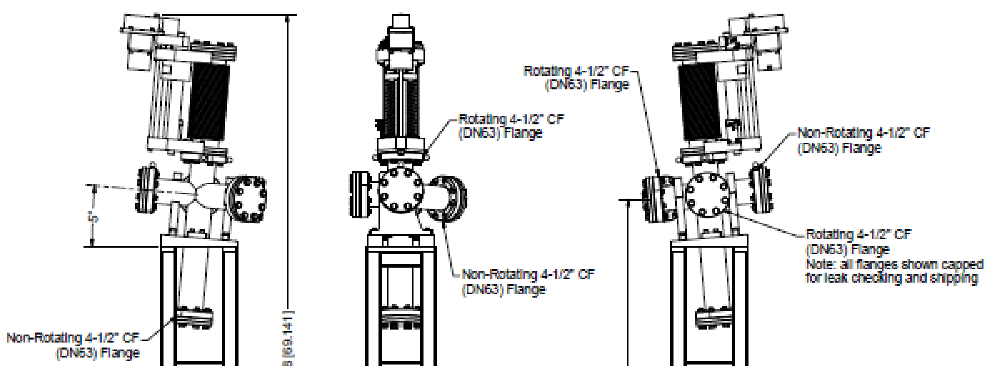
RSXS Filter Array





RSXS Filter Array This Filter Array moves 14 x-ray filters into and out of the beam using a stepper motor and ball screw drive unit. The filters are mounted to an arm which moves perpendicular to the beam, allowing an individual filter to be selected for placement in the beam. The array is enclosed in a vacuum chamber which will connect to the customer's beam line. The filters are mounted in easily interchangeable frames so that any desired filter can be installed A stand is provided for the system with horizontal, vertical, and leveling adjustments. This stand is constructed with chambers for ballast to stabilize the system, and the main chamber is made easy to fill with any locally available ballast material by the 2-inch square opening in the top plate.

Motion	Product Description	Range of Motion
Vertical	UHV Design Linear Shift Mechanism LSM64-150-SS-ES	150 mm
Vertical	Swivel Leveling Mounts	+/- 15 mm
Horizontal	2-Axes Set Screw Adjustment	+/- 10 mm

Examination of Filter Perpendicularity

RSXS Beamline at SSLS

To: Dr. Diao Caozheng
From: Tim Shea
CC: Eric Van Every
Date: 2014-03-24

Perpendicularity of the x-ray beam to the filter foils was examined by measuring parallelism between faces of the filter array arm and the face of the downstream fixed CF flange. It was assumed that this flange would be perpendicular to the beam once installed, allowing a comparison to be drawn between the measured parallelism and the perpendicularity in question. Measurements were taken of the length from the face of the flange to faces of the filter arm using a set of digital calipers with a resolution of 0.01 mm. Eight measurements of each length were obtained. See Fig. 1 for an illustration of the measured lengths and Table 1 for a summary of the measurements.

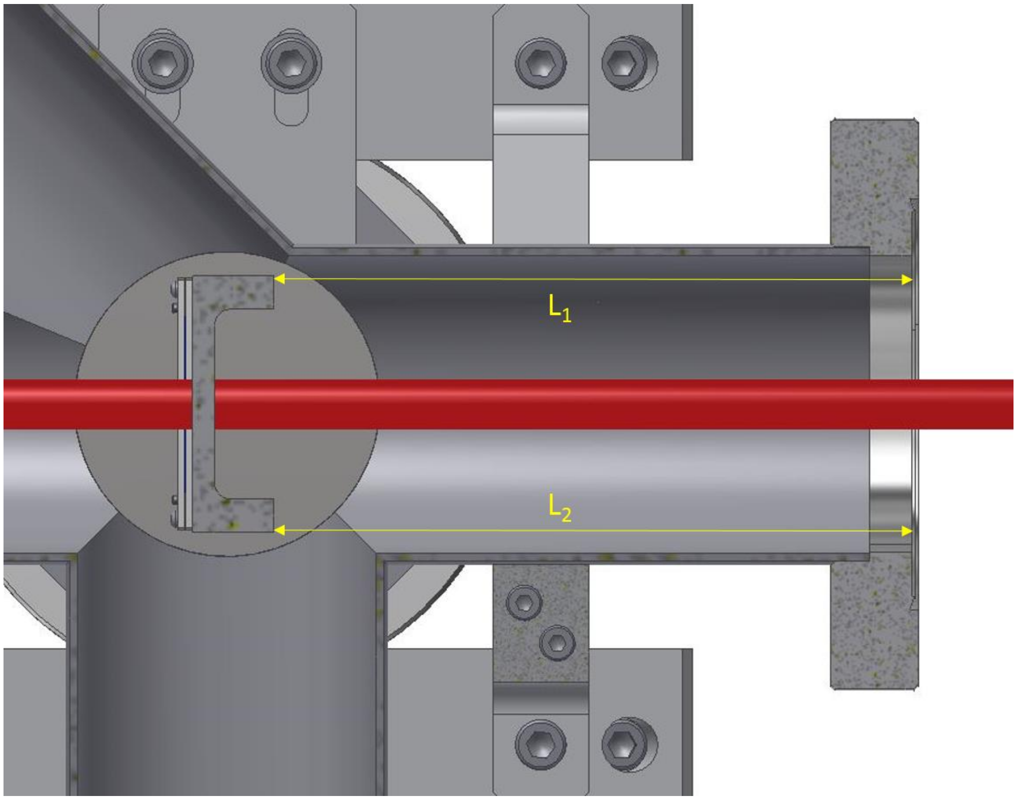


Figure 1 - Illustration of measured distances, device viewed from top

Table 1 - Summary of measurements

Perpendicularity Measurements			
Quantity	Average	Standard Deviation	Units
L1	125.56	0.1081	[mm]
L2	126.11	0.0730	[mm]
Difference	0.55		[mm]

For an arm width of 2” (50.8 mm), the angle of rotation about the longitudinal (oriented vertically in this device) axis of the arm can be determined from Eqn. 1:

$$\theta = \tan^{-1}\left(\frac{|L_1 - L_2|}{Width}\right) \qquad \text{(Eqn. 1)}$$

In this case,

$$\theta = \tan^{-1}\left(\frac{0.55\ mm}{25.4\ mm}\right) = 0.62° \ .$$

The quantity of importance however, is the amount by which the functional thickness of the foil changes as its face normal vector is rotated relative to the beam axis. Given a foil thickness, t_0, the new functional thickness, t_1, can be found from Eqn. 2:

$$t_1 = \frac{t_0}{\cos\theta} \qquad \text{(Eqn. 2)}$$

The percentage change in foil thickness will be independent of the particular thickness of any one foil, making it a useful reference quantity. This percentage change in thickness as a function of the rotation angle is expressed in Eqn. 3 below.

$$\%\, Thickness\ Change = \frac{\frac{t_0}{\cos\theta} - t_0}{t_0} * 100 \qquad \text{(Eqn. 3)}$$

For an angle of 0.62°, and an arbitrary unit thickness, the percentage change is quite small:

$$\frac{\left(\frac{1}{\cos(0.62°)}\right) - 1}{1} * 100 = 0.005\ \%$$

It should also be kept in mind that the measured rotation is adjustable through the rotatable flange mounting the actuator and filter arm assembly to the vacuum chamber.