

# Detector Distance & Beam Center Calibration for GADDS

## Purpose

These instructions cover the calibration procedures for accurately measuring the true direct-beam center and the sample-to-detector distance. The direct-beam center is defined as the X and the Y coordinates (unwarped centroids) of the direct beam at a swing angle of zero. The sample-to-detector distance is defined as the distance between the goniometer center and the flat front surface of the detector (where the fiducial plate mounts). These parameters are critical for proper integration of diffraction patterns and other GADDS processing functions.

**Note:** *This is not an alignment procedure. You are not aligning the detector's center to the direct beam. Instead, you simply need to measure where the direct beam hits the detector and to record that value in the GADDS program. If the beam center coordinates you attain are off by more than 1/2 pixel, the quality of the integrated diffraction pattern will suffer in positional and FWHM values. Thus, you should repeat this procedure whenever you modify the beam optics or realign the goniometer. Periodic checks are also recommended.*

## Procedure

To measure the sample-to-detector distance:

1. Read the value on the scale embedded in the goniometer 20 arm. If your detector dovetail mount has a title plate at the front, read the value directly below the front edge of the plate. If it has no title plate, read the value directly below the arrow on the side of the mount.
2. Enter the value in the GADDS program using the Configure> Edit command (either now, or later when entering data for the X, Y direct beam center coordinates). You may fine tune this distance and the X, Y coordinates later, as explained in 269-022000, GADDS Application Test Procedure.

To measure the X, Y direct beam center coordinates:

1. Remove any sample and sample holder or stage which may block the direct beam.
2. Remove the beam stop. You may have to release the screw holding the beam stop and take it off, or reposition it away from the direct beam.
3. Attach the attenuator (0.060" Al cover plate) to the detector face. You may also use a 0.004" thick brass attenuator (not shipped with the system, order part number 042-004300) in place of the Al cover plate.

**Caution:** *Ensure that the direct beam is suitably attenuated before you open its shutter, or you could damage the detector.*

~ **Important:** *if several attenuator plates are available, we recommend that you use more attenuation and set the generator to the power typically used during data collection, especially on a rotating anode.*

4. Set the generator power settings so the detector count rate is smaller than 100,000 cps/frame and 100 cps/pixel when using 512 frame size. The following table gives recommendations for the generator power settings with a sealed tube, or a rotating anode with a 0.3 x 3 mm filament. The generator settings depend on your collimator size and filament size. Set the generator to lower power if your beam is larger. Always start the test with a lower power if you are not sure about the generator setting.

Generator	Collimator	Al Cover Plate	Brass Attenuator
Sealed Tube	0.2mm	>40kV50mA	40kV20mA
	0.3 mm	>40kV50mA	40kV10mA
	0.5mm	40kV50mA	20kV10mA
	0.8mm	40kV30mA	20kV05mA
Rotating Anode	0.2mm	50kV100mA	40kV20mA
	0.3 mm	50 kV 80 mA	40 kV 10 mA
	0.5mm	50kV50mA	20kV20mA
	0.8mm	50kV30mA	20kV10mA

5. Use the Drive command to position the detector at  $2\theta=0^\circ$ .
6. Use the Add command to collect a direct beam image. A direct beam spot with an  $I_{max}$  of 100 counts in a pixel is sufficient.
7. Use the Cursors> Box command to get the beam center (unwarped X,Y) coordinates.
8. Use the Configure> Edit command to enter the beam center coordinates. Ensure that the frame size is correct.

To install and adjust the position of the beam stop:

1. With the attenuator(s) still installed on the detector face (for coarse positioning of the beam stop), mount the beam stop to the collimator.
2. Slide the beam stop down to the scatter shield of the collimator, and coarsely position (center) the beam stop on the scatter shield.
3. Use the Add command to collect an obstructed direct-beam image, starting with a quick exposure of a few seconds. If you observe no direct beam, gradually increase the exposure time to 30 seconds.
4. **Preferred Method (safer):** Repeatedly collect a frame, close the shutter, then make adjustments until you observe no direct beam on the image.

**Alternative Method:** Coarsely position the beam stop while using the Add command with the Realtime Display enabled and the Reset Interval set to 1 to a few seconds until you observe no direct beam on the image.

5. Remove the attentuator(s) for fine positioning of the beam stop.
6. Use the Add command to collect an obstructed direct-beam image, starting with a quick exposure of a few seconds. If you observe no direct beam, gradually increase the exposure time to 30 seconds.
7. **Preferred Method (safer):** Repeatedly collect a frame, close the shutter, then make adjustments until you observe no direct beam on the image.

**Alternative Method:** Finely position the beam stop while using the Add command with the Realtime Display enabled and the Reset Interval set to 1 to a few seconds until you observe no direct beam on the image.

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