Procedure for aligning samples onto the axis of rotation for Tomography

1. Open a continuous image set using the video camera icon 
2. Find sample using TXMController software at a sample angle of 0 degrees (Metrology Rotation = 0 degrees).
3. Focus the sample in SAMZ
4. Select the Center Alignment Tool from the menu
5. Center the sample on the alignment cross
6. Record the motor positions as indicated below (note the value of SAMY should not be changed during this alignment procedure, but it is good to note in case an incorrect motor button is pushed):

	Metrology Rotation Angle (degrees)	SAMX (microns)	SAMY (microns)	SAMZ (microns)	M1 (microns)	M2 (microns)
Values at 0° :	0					

7. Stop the image acquisition so that you will have an image (and recorded motor positions to return to if there are any alignment issues) 
8. Now rotate the sample to -100 degrees
9. Now rotate the sample to -90 degrees (Moving first to -100° and then to -90° removes any backlash irreproducibility in the rotation stage)
10. Locate the sample using the Attocube M2 motor. You can visually move the sample and roughly bring it back into the field of view using the overhead camera. Continue to move M2 to center the sample in the alignment cross. It may be necessary to adjust the M1 motor as well to bring the sample into focus. Once the sample is in reasonable focus and aligned to the cross, record the positions of the Attocube motors:

	Metrology Rotation Angle (degrees)	SAMX (microns)	SAMY (microns)	SAMZ (microns)	M1 (microns)	M2 (microns)
Values at -90° :	-90					

11. Stop the image acquisition so that you will have an image (and recorded motor positions to return to if there are any alignment issues)

12. Now rotate the sample to 90 degrees. Again locate the sample using the Attocube M2 motor. You can visually move the sample and roughly bring it back into the field of view using the overhead camera. Continue to move M2 to center the sample in the alignment cross. It may be necessary to adjust the M1 motor as well to bring the sample into focus. Once the sample is in reasonable focus and aligned to the cross, record the positions of the Attocube motors:

	Metrology Rotation Angle (degrees)	SAMX (microns)	SAMY (microns)	SAMZ (microns)	M1 (microns)	M2 (microns)
Values at 90° :	90					

13. Stop the image acquisition so that you will have an image (and recorded motor positions to return to if there are any alignment issues)
14. Now center the sample by calculating the midpoint of the values at -90° and 90° as follows:

The newly aligned M1:

$M1_{aligned}$ is the midpoint between the position at -90 degrees, $M1_{-90^\circ}$, and the position at 90 degrees, $M1_{90^\circ}$, which can be found using the following formula:

$$M1_{aligned} = \frac{M1_{-90^\circ} + M1_{90^\circ}}{2}$$

For example if $M1_{-90^\circ}$ = -1500, and $M1_{90^\circ}$ = -36, then

$$M1_{aligned} = \frac{-1500 + -36}{2}$$
$$M1_{aligned} = \frac{-1536}{2}$$
$$M1_{aligned} = -768$$

Use the same procedure to align M2:

$M2_{aligned}$ is the midpoint between the position at -90 degrees, $M2_{-90^\circ}$, and the position at 90 degrees, $M2_{90^\circ}$, which can be found using the following formula:

$$M2_{aligned} = \frac{M2_{-90^\circ} + M2_{90^\circ}}{2}$$

For example if $M2_{-90^\circ}$ = 632, and $M2_{90^\circ}$ = -211, then

$$M2_{aligned} = \frac{632 + -211}{2}$$
$$M2_{aligned} = \frac{421}{2}$$
$$M2_{aligned} = 210.5$$

15. Move the Attocube to these values. It will now be necessary to find this new sample location with the TXMController SAMX motor. Scan the SAMX motor until the sample is again in the center of the alignment cross.
16. Record the motor positions as indicated below:
17. Now rotate to -10 degrees
18. Now rotate to 0 degrees (Again the rotation to -10 and then 0 removes any backlash irreproducibility in the rotation stage)
19. Now adjust M1 until the sample is centered in the alignment cross.
20. Focus the sample in SAMZ
21. Record all the motor positions as indicated below:
22. Rotate the sample to -100 degrees.

Now check the alignment by running a quick tomography scan (19 mages from -90 to 90, binning of 1, 1 second exposures). The alignment procedure regularly requires 2-3 iterations to get the sample well positioned onto the rotation axis.

Once you are satisfied that the sample is well aligned onto the rotation axis, run focal scans in SAMZ to find the optimum focus for the sample. You may need to adjust the position of the sample using SAMX to re-center the sample; however, no adjustments to the Attocube are required as the rotation axis has already been defined.

Now you are ready to take a tomography data set. I recommend that you take a quick scan to verify that the sample is well located within the field of view prior to taking a detailed scan.

The number of images and the exposure time per image will vary greatly from sample to sample. It is best to saturate (60,000 counts) the detector for every angle, so that you have sample features visible within each image. For absorption contrast this could be as few as 181images (one image for every degree of rotation from -90 to 90) and 1 second per image if you have a strongly absorbing sample, and for phase contrast it could be as many as 1801 images (one image for every 0.1degrees of rotation from -90 to 90) and 60 seconds per image for a weakly interacting sample with little contrast.