Princeton Plasma Physics Laboratory
Procedure

Procedure Title**: Dimensional Control and Metrology for NCSX Modular Coils**

Number: **D-NCSX-MCF-005**	Revision: **2**	Effective Date: **June 20, 2006** Expiration Date: *(2 yrs. unless otherwise stipulated)*

Procedure Approvals

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Responsible Division: **NCSX**

Procedure Requirements
Designated by RLM

LABWIDE:

X	Work Planning Form # **WP-1138 & WP-1188** (ENG-032)		Lockout/Tagout (ESH-016)
	Confined Space Permit (5008,SEC.8 Chap5)		Lift Procedure (ENG-021)
	Master Equip. List Mod (GEN-005)		ES&H Review (NEPA, IH, etc.) NEPA 1283
	RWP (HP-OP-20)		Independent Review
	ATI Walkdown		Pre-Job Brief
	Post-job Brief *		Hazard analysis

D-SITE SPECIFIC:

X	D-Site Work Permit (OP-AD-09)		Door Permit (OP-G-93)
	Tritium Work Permit (OP-AD-49)		USQD (OP-AD-63)
	Pre-Job Brief (OP-AD-79)		T-Mod (OP-AD-03)
	** DCA/DCN (OP-AD-104) #⎯⎯⎯⎯		

** OP-AD-104 was voided by procedure ENG-032. However, DCAs that were open at the time
of adoption of ENG-032 are still considered valid for work approval purposes.

1. **Purpose**

   1.1. The purpose of this procedure is to provide guidance for achieving the desired placement of the current centroid of the NCSX Modular Coils. The procedure describes the steps required to measure, control and adjust the location of the Modular Coil conductor so that the net resultant current is within the tolerance specified.

2. **Scope**

   2.1. This procedure details the steps to use the Romer pCMM arm for the winding and positioning of conductor onto the NCSX Modular Coil Winding Forms.

       2.1.1. Measuring the Modular Coil Winding Forms as delivered.
       2.1.2. Installing and measuring location(s) of additional fiducial monuments.
       2.1.3. Establishing a baseline surface before Cladding and Ground Wrap installation.
       2.1.4. Setting clamp positions prior to winding activities.
       2.1.5. Verifying conductor placement during the winding process.
       2.1.6. Adjustment of coil pack's centroid by re-positioning clamps.
       2.1.7. Re-measuring the coil pack before the lacing is completed.
       2.1.8. Measuring the locations of the Co-wound loops

   2.2. This procedure provides a mechanism for ensuring and documenting the following:

       2.2.1. pCMM arm is calibrated, per manufacturer's instruction, prior to measurement.
       2.2.2. Unique measurement instructions, specific to the modular coils, are identified.
       2.2.3. Information gathered during the measurement/inspection process is collected, labeled, and saved in a manner that it is readily available for further use.

   2.3. Measurements shall be made by individuals that are trained in the operation of the pCMM arm and the use of the *PowerINSPECT* software. This procedure **DOES NOT** provide instruction on the use of the pCMM arm.

   2.4. When measuring or inspecting a component against its CAD model, a measurement routine is typically used. The routine, which is run from the *PowerINSPECT* software, defines the measurement steps required to inspect the part. For the NCSX Modular Coils the basis for the measurement routine will be defined in this procedure.

3. Definitions

3.1. "Best Fit" alignment	Alignment option using a minimum of three points, but typically performed with more than three points.
3.2. "Best Fit" optimization	Optimization of the alignment using data obtained from the part.
3.3. CAD	Computer Aided Design Drafting.
3.4. pCMM	Portable Coordinate Measurement Machine.
3.5. "Free Form" alignment	Alignment method used when there are no fiducial points.
3.6. Fiducial Points	Reference features used for alignments.
3.7. "Length Check" procedure	Process for calibrating the pCMM to a NIST length standard.
3.8. "Point Check" procedure	Process for establishing or verifying the calibration of a probe.
3.9. "Surface Inspection" mode	Taking data and comparing it to the CADD model
3.10. Three Point" alignment	An alignment using only three points.
3.11. TRC	Twisted Racetrack Coil
3.12. Metrology Engineer	Individual responsible for the metrology program. Oversees the measurement process.
3.13. Metrology Technician	Individual trained to operate the metrology equipment for taking measurements.
3.14. Dimensional Control Representative	Individual Responsible for the definition of dimensional requirements.

4. References

4.1. PowerINSPECT 2.2 operating manual.

4.2. PowerINSPECT 3.0/3.050 operating manual.

4.3. PowerINSPECT Training manuals.

4.4. D-NCSX-MCF-001,	"Modular Coil Fabrication – Winding Form Preparation Activities"
4.5. D-NCSX-MCF-002,	"Modular Coil Fabrication – Winding Station Activities"
4.6. NCSX-MIT/QA-142-01	"Manufacture, Inspect and Test/Quality Assurance Plan"
4.7. NCSX-PLAN-CMFOP-00	"NCSX Coil Manufacturing Facility Operations Plan"
4.8. SE780-011	"Weld-On Metrology Target Holders" drawing

4.9. NCSX-PLAN-MCWDC-00 "Modular Coil Winding Dimensional Control Plan"

5. Tools and Special Equipment

5.1. Romer pCMM Arm

5.2. Templates for setting winding clamp side legs.

5.3. G-10 templates for establishing spacing for "Standard Pattern" measurement

6. **Precautions and Limitations**

   6.1. The ROMER pCMM arm is a delicate instrument. The precision encoders at every joint will be damaged if the pCMM is bumped or dropped.

   6.2. The Probe tips are susceptible to damage. If the operator suspects that the probe has been damaged, a different probe shall be used until the damaged probe has been recalibrated and/or repaired. Altered and/or replacement probes shall be calibrated to the particular pCMM arm prior to use.

   6.3. The accuracy and precision of measurements is greatly affected (or rendered invalid) if either the pCMM or the measured component moves during the measurement. Ensure that both the pCMM base and the measured component are secure and will not move relative to each other during the measurement process.

   6.4. The pCMM must remain at a constant, stable temperature (preferably the same as the part) during calibration and subsequent measurements.

   6.5. Each pCMM arm has a dedicated laptop and set of standard probes. Do not interchange these components without the consent of the Metrology Engineer.

   6.6. Within the Romer pCMM operating software, predetermined measurement routines for each coil type will be generated, reviewed and approved by the Metrology Engineer and the Dimensional Control Representative. The metrology technicians should complete *all* the steps that are defined in the measurement routine. Deviations from the routine shall require the approval of the Metrology Engineer *or* the Dimensional Control Representative. At a minimum, the typical measurement routine shall contain the following sequences:

      6.6.1. Align to Coil by measuring fiducials (Aligns the pCMM coordinate system to the CADD coordinate system)

      6.6.2. Measure desired features (Measurements of surfaces and part features)

      6.6.3. Re-measure the fiducials (verifies that pCMM and/or the Coil have not moved during measurement).

7. Prerequisites

7.1. When arm is "set up" and/or prior to the start of a critical measurement, the pCMM shall undergo the "Length Check" procedure.

7.2. The Modular Coil shall be mounted into the turning fixture in Station 1, 2 or 4 and the coil shall be clean of oils and debris prior to the measurements.

7.3. A CAD model of the fiducial points and surfaces to be measured is to be loaded into the *PowerINSPECT* measurement routine. The required surfaces are a subset of the approved, latest revision of the Pro/Engineer models and include:

7.3.1. Bare Winding Form casting (with fiducial locations)

7.3.2. Surfaces of layers that are to be measured. This includes the winding form and the outer surface of the completed, wound coil pack.

7.3.3. Establish a new *PowerINSPECT* file for the measurement. The file should be named in the following format:

(Date)_(Coil Identifier)_(Side Identifier)_(Surface identifier), where:

7.3.3.1. Date: mm_dd_yy
7.3.3.2. Coil Identifier: A1 to A6, B1 to B6, C1 to C6
7.3.3.3. Side Identifier: SideA or SideB
7.3.3.4. Surface Identifier: Casting, Layer 10 or 11, "after Adjustment", etc.

8. Procedure for Measuring Modular Coils

8.1. Station 1: Measuring the machined winding form:

8.1.1. In the table below, enter the coordinates of any known fiducial points. Typically, these fiducial points are installed by the fabricating vendor and are identified and located during the QC/inspection process. *Note that the coordinates may change if a "Best Fit" transformation is performed later.*

| Point ID	Target Type	X-coordinate	Y-Coordinate	Z-Coordinate	Comments

8.1.2. With the pCMM arm set up in the measuring stand, and with the 15mm ball probe (Probe 1) installed, rotate the coil to various positions and survey the winding form to determine the locations for "Conical Seat" type fiducial pucks. Ensure that the Romer arm can reach at least 8 fiducial points at any coil rotation angle. Mark these locations so that the Conical Seat, Weld-On Pucks can be readily

located for welding. The weld-on fiducial points are identified in drawing SE780-011 part 1.

Metrology Engineer: _____ Date: _____

8.1.3. Weld additional fiducial points onto the casting.

Note: If there are no "vendor supplied" fiducials then skip this step and perform steps 8.1.5 to 8.1.9. If there are "vendor supplied" fiducials then perform 8.1.4 and skip 8.1.5 to 8.1.9.

8.1.4. After the pucks are welded onto the coil, perform a "Best Fit" alignment (using as many fiducials as can be reached) to "vendor supplied" fiducials, and then measure the location of the Conical Seat fiducials. Record below. *The coil may have to be rotated to several positions and realigned to the Romer to complete this task.*

| Point ID	Target Type	X-coordinate	Y-Coordinate	Z-Coordinate	Comments

8.1.5. If there are none, or an inadequate number of fiducial points to perform an alignment, then perform a "Free Form" alignment to the part.

8.1.6. Using "Surface Inspection" mode, take inspection data along the winding surface with the 6mm ruby ball probe (probe 2). Break up the data into 4 separate inspection groups, one group for each sidewall and for each base of the winding surface. Start at clamp 1 and take data at consecutive clamps until all measurements are complete for both sides. The points should be taken in a pattern as shown in figure 2, which is referred to as the "standard pattern". The "standard pattern" involves taking six rows of points (three horizontal and three vertical) in the spaces between the clamps. The rows are adjacent to the clamp pad and midway between clamp pads. Use the templates to obtain the proper spacing for the points taken on the base and sidewall. The template(s) have the proper number of correctly spaced notches for each particular type of coil (A, B or C). Measuring the entire coil will require at least one rotation and re-alignment. The data in these files should be overlapped by three clamps. (for example, if the first file contains data from clamps 10-55, the second set should start at clamp 53 and end at clamp 12).
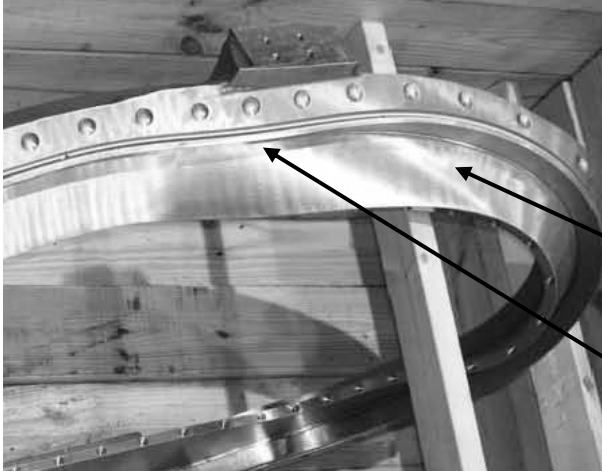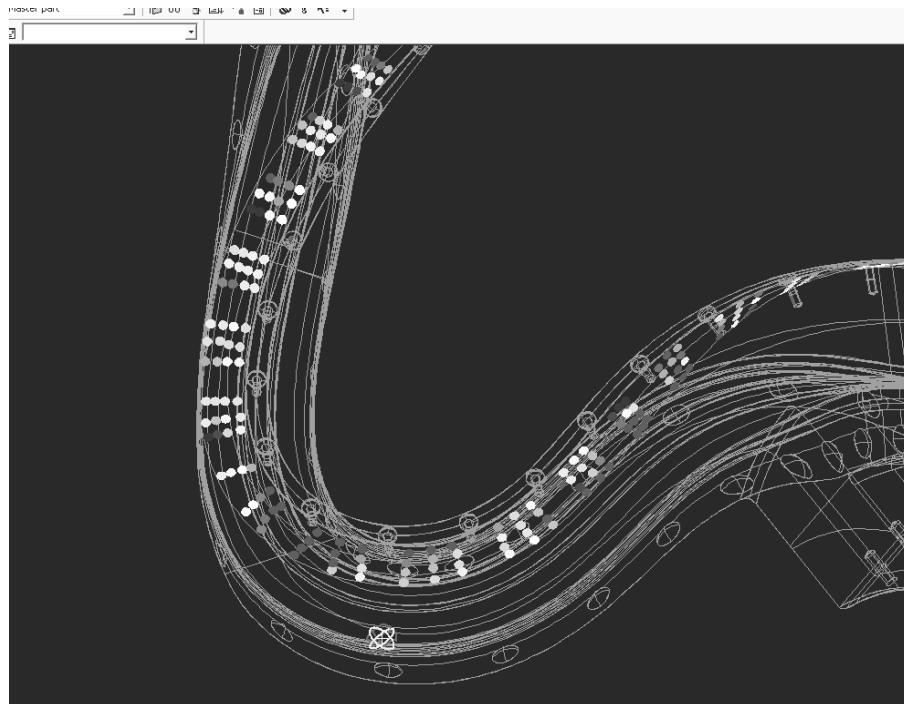

Figure 1: Bare Casting. This is the TRC; the Full-sized Modular Coils are similar

Coil "Sidewall"

Coil "Base"
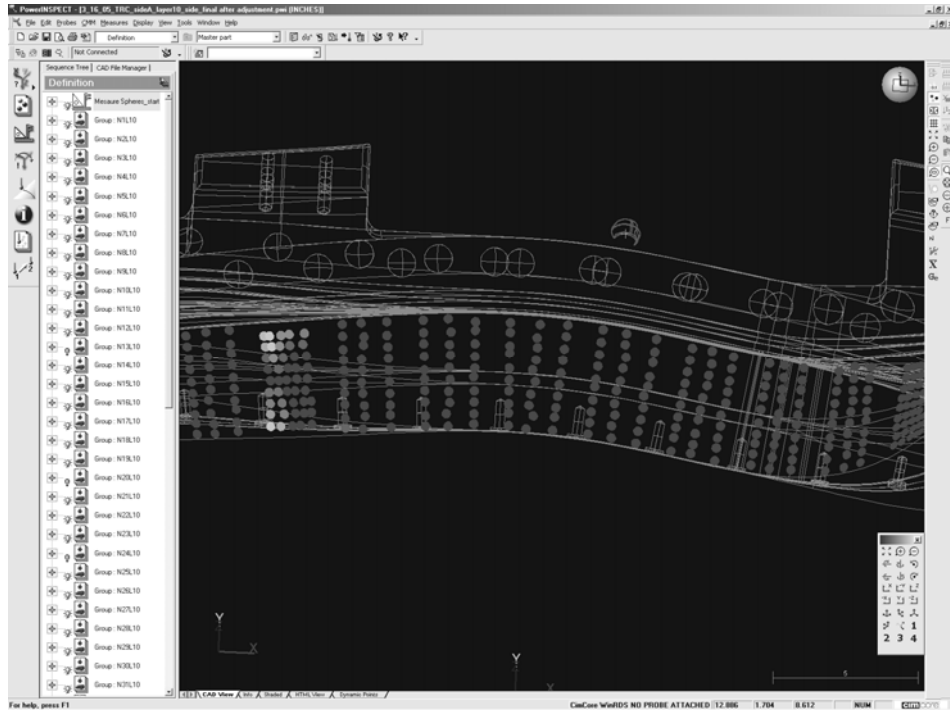
Side Pattern: 3 rows of 10 points or 3 rows of 11 points, depending on coil type

Top Pattern: 3 rows of 4 points for all coil types

Figure 2: Inspection pattern for "Surface Inspection" of coil.

8.1.7. Refine the alignment with a "Best Fit" optimization using the inspection data from the winding surface. **DO NOT** rotate the coil or move the Romer pCMM at this point.

8.1.8. After the "Best Fit", measure the location all the Conical Seat fiducials that can be reached.

8.1.9. If all conical seats cannot be reached, then rotate the coil and realign the Romer pCMM using the coordinates of the conical seats measured in the previous step. When all the conical seat fiducials are measured, record coordinates below:

Point ID	Target Type	X-coordinate	Y-Coordinate	Z-Coordinate	Comments

8.1.10. Using "Surface Inspection" mode, take inspection data along the winding surface with the 6mm ruby ball probe (probe 2). Break up the data into 4 separate inspection groups, one group for each sidewall and for each base of the winding

surface. The points should be taken in a pattern as shown in figure 2, which is referred to as the "standard pattern". The "standard pattern" involves taking six rows of points (three horizontal and three vertical) in the spaces between the clamps. The rows are adjacent to the clamp pad and midway between clamp pads. Use the sheet-metal templates to obtain the proper spacing for the points taken on the base and sidewall. The template(s) have the proper number of correctly spaced notches for each particular type of coil (A, B or C).

8.1.11. Inspect the remaining areas of the Coil (Flanges, bolt holes, new fiducial points and "As-Cast" surfaces) as specified by the Metrology Engineer.

8.1.12. This completes the initial inspection of the bare Modular Coil winding form/casting. Installation of studs and cladding can commence.

Metrology Engineer:_____ Date:_____

Dimensional Control Representative:_____ Date: _____

8.2. Stations 2 & 4: Measuring the conductor during/after winding activities:

Note: The modular coil has two sides that are wound independent of each other. Once both sides are completed the coil is measured with the reduced standard pattern (the first row/column of the std. pattern). The measured data is analyzed and the two sides are adjusted (by means of clamp repositioning) to bring the net current centroid within tolerance. A final set of measurements (full standard pattern) is taken after adjustments are completed.

8.2.1. Prior to the start of conductor installation, at a point after the whisker detector but before the conductor reaches the coil, use a set of calipers to measure the height and width of the conductor. Record below:

	Spool 1	Spool 2	Spool 3	Spool 4	nominal
Tall dimension					0.415"
Short dimension					0.384

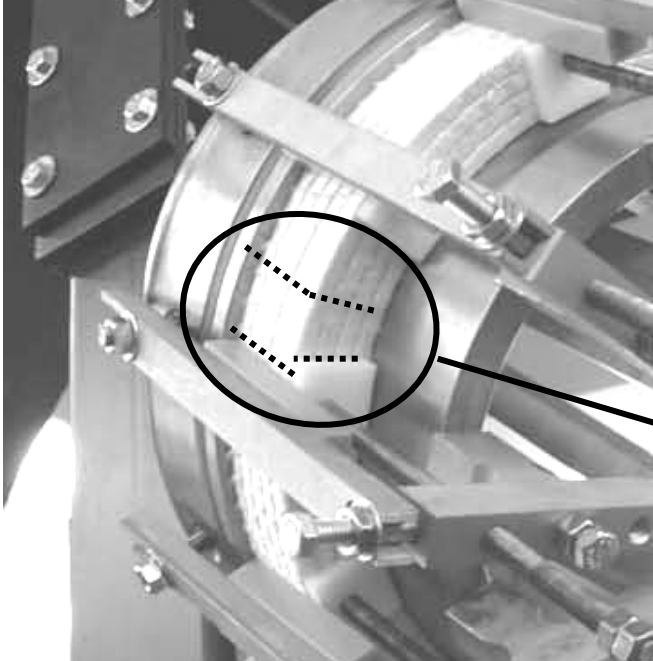**Measurements during the winding process:**

Per direction of the Dimensional Control Representative and/or the Metrology Engineer, measurements of a layer of conductor after it is installed can be taken. The measurements are made against the CADD model of the particular layer.

8.2.2. After the installation of a layer, measure the coil pack surface by:
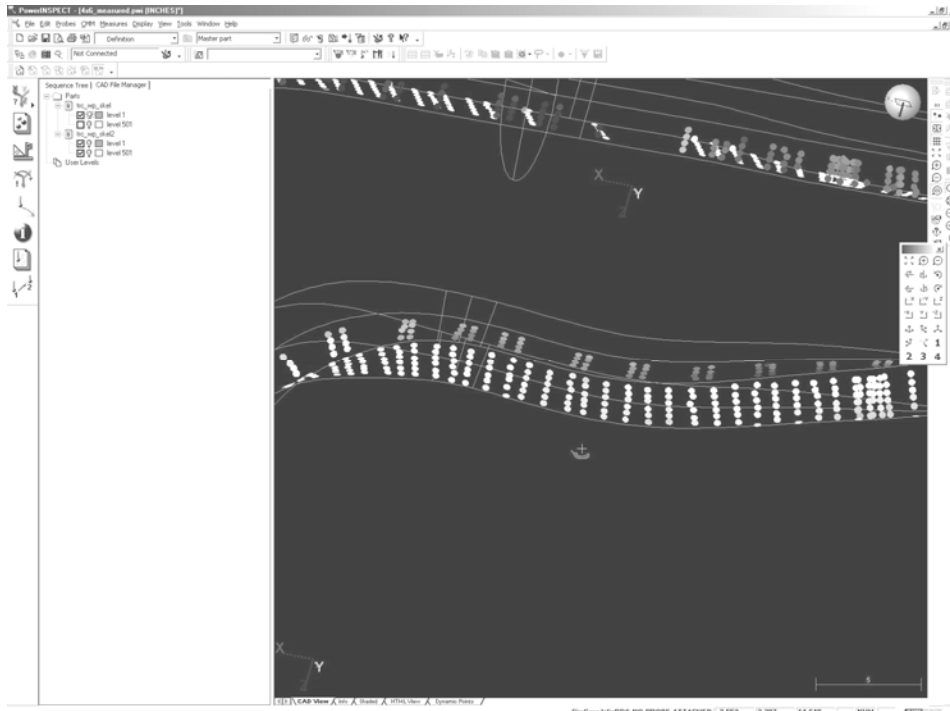 **8.2.2.1.** Load CAD model(s) for surface(s) being measured into PowerINSPECT.
  8.2.2.2. Align to coil.
  8.2.2.3. Measure the surface of the conductor pack (approximate center of each individual conductor) using the 6mm probe in the "Standard Pattern".

Figure 3: Locations for measuring the winding pack.

Measure winding pack next to clamp and midway between clamps.

Figure 4: Winding Pack measurement data in PowerINSPECT

8.2.3. When all layers are installed and prior to completion of the outer ground wrap insulation, take a reduced set of measurements of the winding pack. The reduced set is comprised of only the first rows (one along the septum and one along the base) of the standard pattern:

8.2.3.1. Load CAD model(s) for surface(s) being measured into PowerINSPECT.

8.2.3.2. Align to coil.

8.2.3.3. Measure the winding pack taking only the first row of the "Standard Pattern".

8.3. Adjusting the Winding Pack to position the current center.

Using the cross-sectional view of the "as-built" pack for guidance and the Romer arm for feedback, adjust the dimensions of the winding pack. This adjustment attempts to keep the current center of the coil within tolerance (0.020") of the design position in places where setting of the top clamps to the calculated values can not be achieved. At each clamp location, work on both sides A and B, systematically in regions of 3-5 clamps. Start in regions of high torsion/curvature. Measurements should be taken with a 6mm probe.

8.3.1. At each clamp location, readjust both sides of winding pack to put height and width within ±0.020" of calculated values where possible. If the desired location cannot be achieved on one side of the pack, the other side can be used to compensate.

8.3.2. When adjustments are complete, measure the winding surface by:

8.3.2.1. Aligning to coil.

8.3.2.2. Measure the top and side surfaces of the winding pack using the "Standard Pattern".

8.3.3. Re-measure the fiducial points.

8.3.1. Perform final analysis to make sure design position of current center of coil is achieved, using final measurements of both sides as input.

8.3.2. If current center position is not satisfactory, repeat adjustment of both sides at the non-conforming locations.

8.3.3. Perform final measurement of height and width of winding packs after adjustment is complete.

Dimensional Control Representative: _____ Date: _____

8.4. Measuring the Co-Wound Loop

8.4.1. After the co-wound diagnostic loops are installed, establish their locations by:

8.4.1.1. Align to coil.

8.4.1.2. Set up the PowerINSPECT software to take "Points on the Fly".

8.4.1.3. Using the point probe, take two points between each set of clamps. Try and space out the points so that they are not more than two inches apart.

8.4.1.4. In areas that are tight due to tight inner radii, only one point may be taken as long as the distance between consecutive points is not greater than 2 inches.

9. Post Measurements

9.1. Once measurements have been completed perform the following steps:

9.2. Save data

9.3. Create *PowerINSPECT* report.

9.4. Shut down the system; carefully remove the pCMM Arm from its stand and store in its storage compartment.

9.5. Provide copy of *PowerINSPECT* file and Inspection report to the Metrology Engineer or the Dimensional Control Representative.

Appendix A

Procedures and Acceptance Criteria for Various Measurement Techniques:

1. **Length check Procedure:**

    This procedure verifies the calibration of the arm by making 5 measurements of a known standard length. The Accuracy is determined by the average of the measurements and the precision is determined by the standard deviation (Range/2) of the measurements.

    a. Measure the N.I.S.T. length standard per instructions in the Romer training manual.
    b. The calculated "Average Length" should be within the range of the length standard value (printed on the label on the bar) +/-0.1mm. If it does not fall within this range then repeat measurement.
    c. The measured "Range/2" should be less than 0.1mm [the length tolerance (LthTol)].
    d. **If the arm cannot measure the length standard within the specified tolerance, then remove this arm from service.**

2. **Point Check Procedure:**

    This process checks the calibration of the probes. The 15mm steel ball probe is considered a "standard" and cannot be re-calibrated. If the probe fails its calibration check then it should be taken out of service and return to Romer. Other probes can be re-calibrated (the lookup file that contains the probe parameters can be re-written) if there is any suspicion that they have been bent or damaged. Note that the acceptance criterion is for the 15mm probe. Other probes (especially longer probes) typically have greater "Range/2" values.

    15mm Probe (Probe 1)
    a. Perform the Point Checkout per the instructions in the Romer training manual.
    b. The measured "Range/2" value for X, Y, and Z, should each be less than the Point Tolerance (PtTol).
    c. If the "Range/2" is greater than the PtTol then take probe out of service.
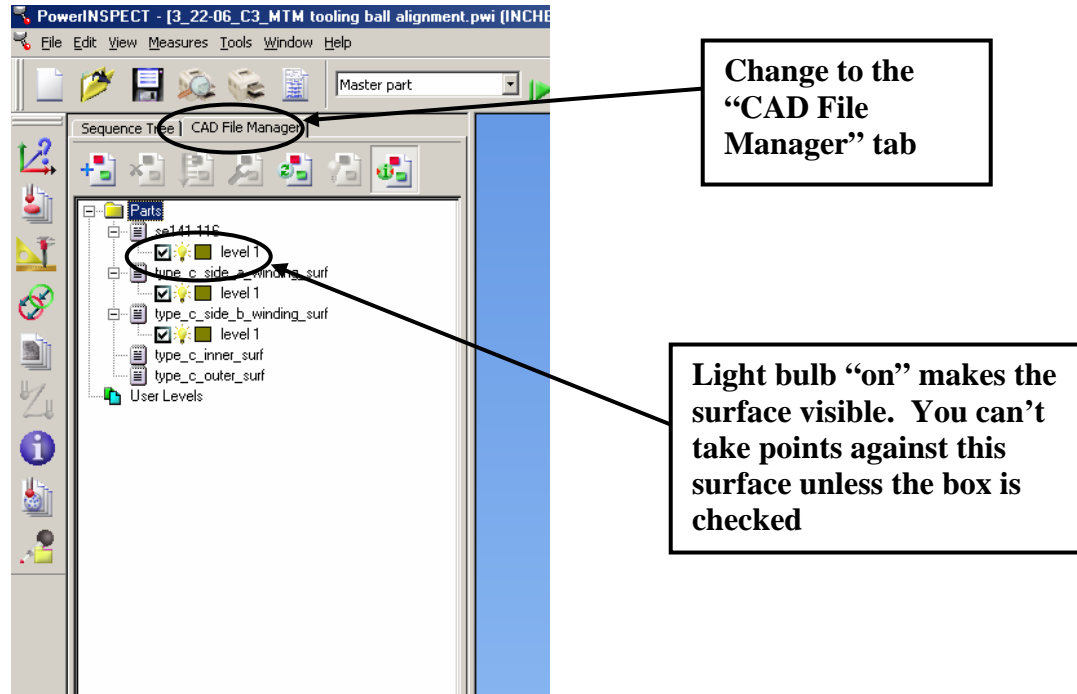
    Other Probes
    d. Perform the Point Checkout per the instructions in the Romer training manual. Make note of the "Range/2".
    e. Accept the calibration of the point and repeat the Point Checkout procedure. The "Range/2" should be equal to or less than the value in step "d". If not, repeat the process.

3. **Best Fit Alignment:**

This process is used to align the arm to the part being measured. A CAD model of the part is loaded into the PowerINSPECT software. A set of geometric elements with known coordinates is part of the model. The geometric elements are measured and the software performs a coordinate transformation (translation/rotation) of the measured pattern to the pattern defined by the CAD coordinates to align the Arm's coordinate system to the CAD coordinate system.

a. Define a set of "Geometric Elements" that corresponds to the fiducials. For tooling balls define the elements as "Spheres"; for conical seats define the elements as "Points". Enter the coordinates of known fiducial points into the "nominal value" box.
b. Measure the locations of the fiducials in the same order that they are defined in the "Best Fit Alignment"
c. Select "Best Fit (points) Alignment" option. Define the alignment points as the elements measured in step "a".
d. "Play" the "Best Fit". If you have not already done so, you will be directed to measure the points that were defined. The coordinate system will undergo a translation/rotation to align the measured pattern to the defined (nominal values) pattern.
e. Check the error of the alignment.

  i. If the "error" for more than one point is greater that 0.008" out, then reset and repeat the alignment process.
  ii. If only one point is out by more than 0.008", discard that point from the alignment process. If the resultant alignment still contains points that are more than 0.008", then "reset" the "Geometric Element" measurement and the "Best Fit" and repeat from the start.
  iii. If measuring spheres, the diameter of the measured sphere must be within 0.003" (of the nominal diameter) for that measurement to be accepted.

4. Importing and Activating CAD Surfaces.

Change to the "CAD File Manager" tab

Light bulb "on" makes the surface visible. You can't take points against this surface unless the box is checked

    a. Go to the "Cad File Manager" tab.
    b. If you want to add a CAD file then:
        i. Click on "Add CAD File" icon and use the browser window to locate the proper file.
    c. If you wand to make a particular surface visible and/or active then:
        i. Expand the + sign associated with the surface and click on the light bulb to make it visible.
        ii. Check the box to make it an active surface that can be measured against.
    d. If you want to change the color of the surface then:
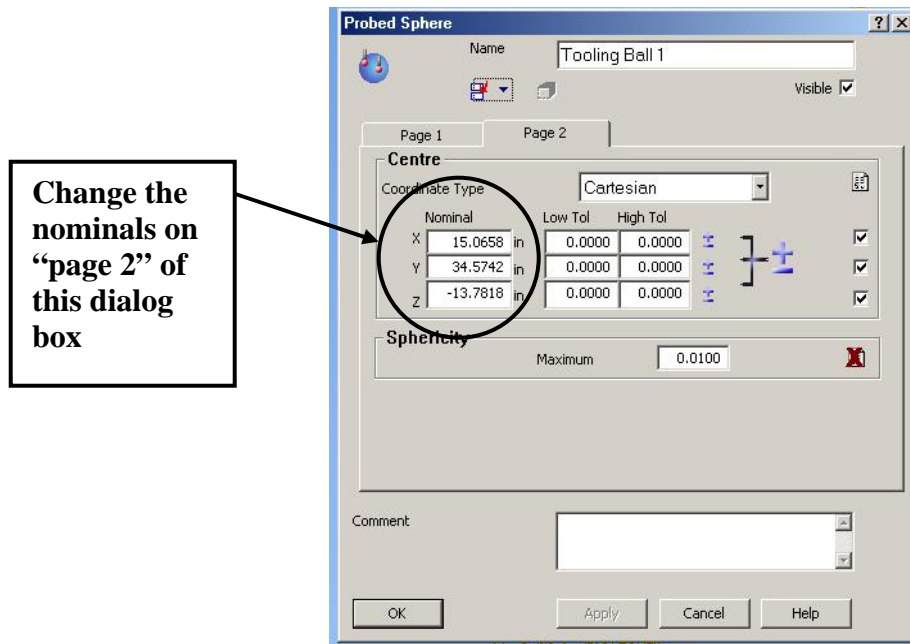   i. Expand the + sign associated with the surface and click on the color box. Change to the desired color.

5. **Alignment to Tooling Balls and establishing Conical Seat Locations**

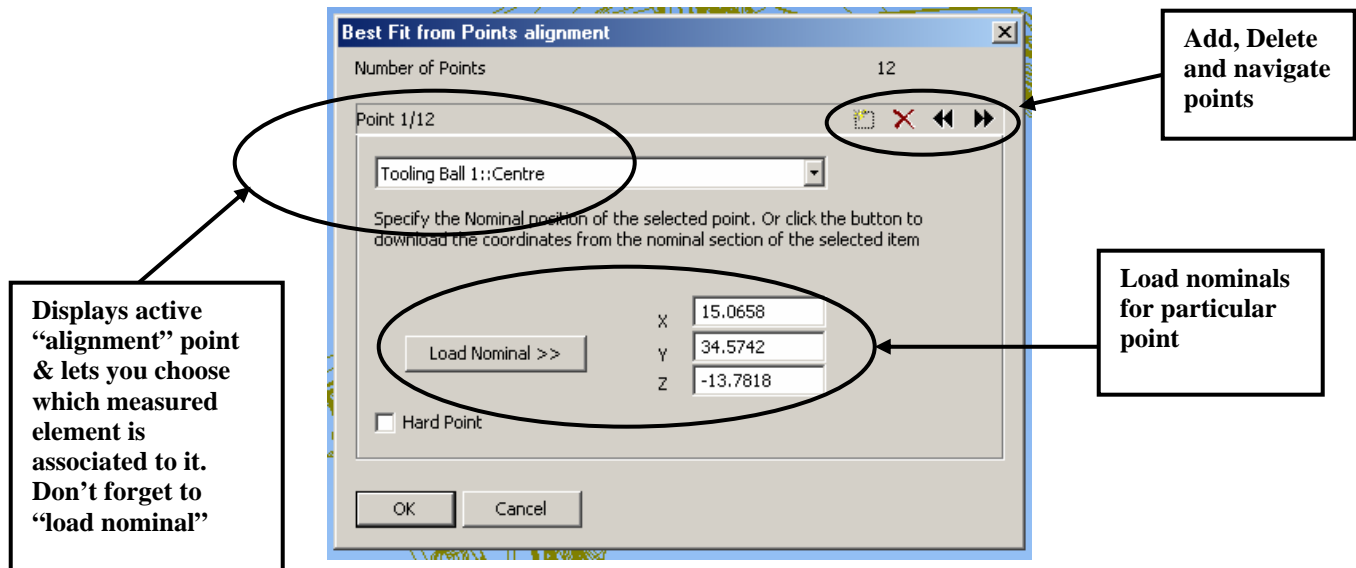   a. **Creating a file with Spherical Geometric Elements:**
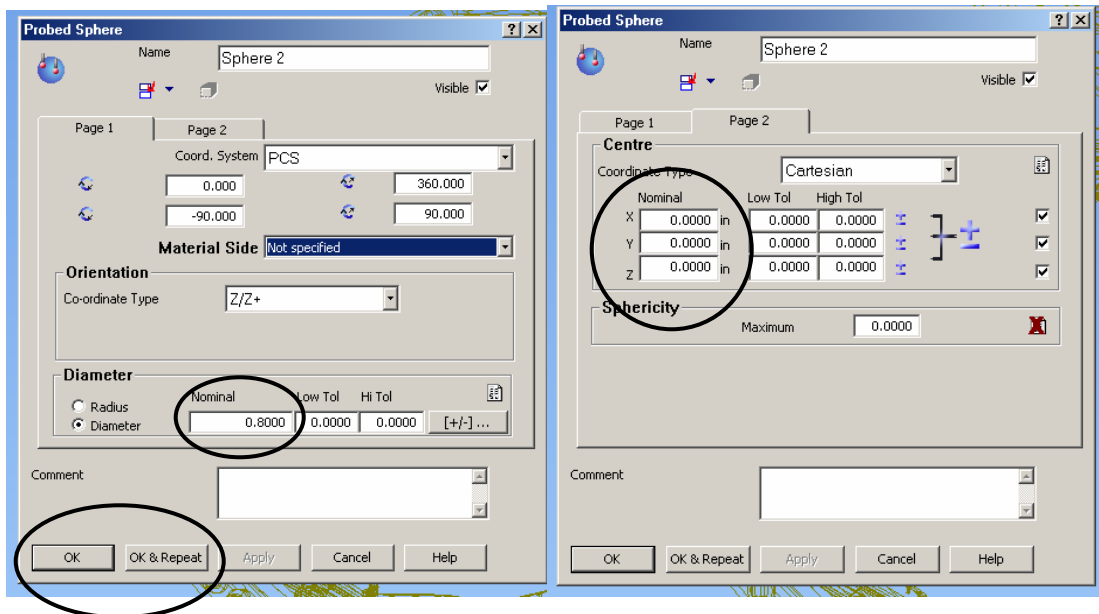
     i. **On the far left, click on the Geometric Elements icon. It will open up a window where you can set tolerances and name the group. Once you click OK, it will put you into the detailed geometric elements sub-folder.**

    ii. **Click on the fourth icon from the top which will expand the row to a larger number of choices.**

   iii. **Click on the Probed Sphere icon. A dialog box will appear where you can set the parameters of the sphere. If you know them, enter the diameter (on page 1) and the nominal coordinates of the sphere (on page 2).**

   iv. **If you are entering more than one sphere then click OK & Repeat, and define as many spheres as required.**

b. Editing a file with Spherical Geometric Elements:

Probed Sphere

Name: Tooling Ball 1

Visible ☑

Page 1 | Page 2

Centre

Coordinate Type: Cartesian

	Nominal		Low Tol	High Tol
X	15.0658	in	0.0000	0.0000
Y	34.5742	in	0.0000	0.0000
Z	-13.7818	in	0.0000	0.0000

Sphericity

Maximum: 0.0100

Comment:

OK | Apply | Cancel | Help

Change the nominals on "page 2" of this dialog box

i. **Go to the Sequence Tree tab**
ii. **Either double click (or right click and choose "modify item") on the sphere that you wish to edit. A dialog box will appear where you can set the parameters of the sphere.**
iii. **Enter the new diameter (on page 1) and the new nominal coordinates of the sphere (on page 2).**
iv. **Repeat, and re-define as many spheres as required.**

c. **Creating a "Best fit from Points" alignment**

Displays active "alignment" point & lets you choose which measured element is associated to it. Don't forget to "load nominal"

Add, Delete and navigate points

Load nominals for particular point

Best Fit from Points alignment

Number of Points   12

Point 1/12

Tooling Ball 1::Centre

Specify the Nominal position of the selected point. Or click the button to download the coordinates from the nominal section of the selected item

Load Nominal >>   X   15.0658
                       Y   34.5742
                       Z   -13.7818

☐ Hard Point

OK   Cancel

i.   On the far left, click on the "alignments" icon (top icon)
ii. Click on the sixth icon and a dialog box will appear. The default alignment will have 3 points. You will add additional points as required.
iii. Click on the "new points" icon until the desired number of alignment points are added.
iv. Click on the "drop down" window and select the geometric element that defines that alignment point.
v.   Click on the "Load Nominal" box. Note that this works only if you have previously defined the nominals for the geometric elements.
vi. Scroll to the next point (using the forward arrow) and repeat steps iv an v.
vii. You can delete points by clicking on the red "X". Be sure that the correct point id chosen (denoted by the "Point X/XX" above the drop down window.

d. Editing a "Best fit from Points" alignment

This is usually performed when creating a new "conical seat" alignment template from an old one.

   i. Go to the Sequence Tree tab.
   ii. Either double click (or right click and choose "modify item") on the already defined "PLP alignment" icon. A dialog box will appear where you can set the parameters of the alignment.
   iii. Add or delete points until the desired number of alignment points is set.
   iv. Click on the "drop down" window and select the geometric element that defines that alignment point.
   v. Click on the "Load Nominal" box. Note that this works only if you have previously edited the nominals for the geometric elements.
   vi. Scroll to the next point (using the forward arrow) and repeat steps iv an v.

6.   Working with the Conical Seat Alignment & Measurement Template

a. Open the Conical Seat Alignment & Measurement Template file.
b. Immediately do a "Save As" and give it a new name following the convention described in step 7.3.3 of this procedure.
c. Perform you alignment to the conical seats.
d. On the bottom of the Window, click on the "Info" tab. Highlight each one of the conical seat measurements and compare the "Actual" to the Nominal numbers. If the results are unacceptable, do a "Reset" and re-measure the conical seats. If you get points that do not come close enough to the nominals after repeated measurements, you may have to delete the point(s) from the alignment.
e. If you're going to be taking data in multiple files from this alignment, now is the time to create those files using the "Save As and Rename or the Export Alignment methods.
f. Take the measurements.
g. Save data.

7.   Taking "points on the Fly Measurements for the Co-wound Loops

**Single Point
on the Fly**
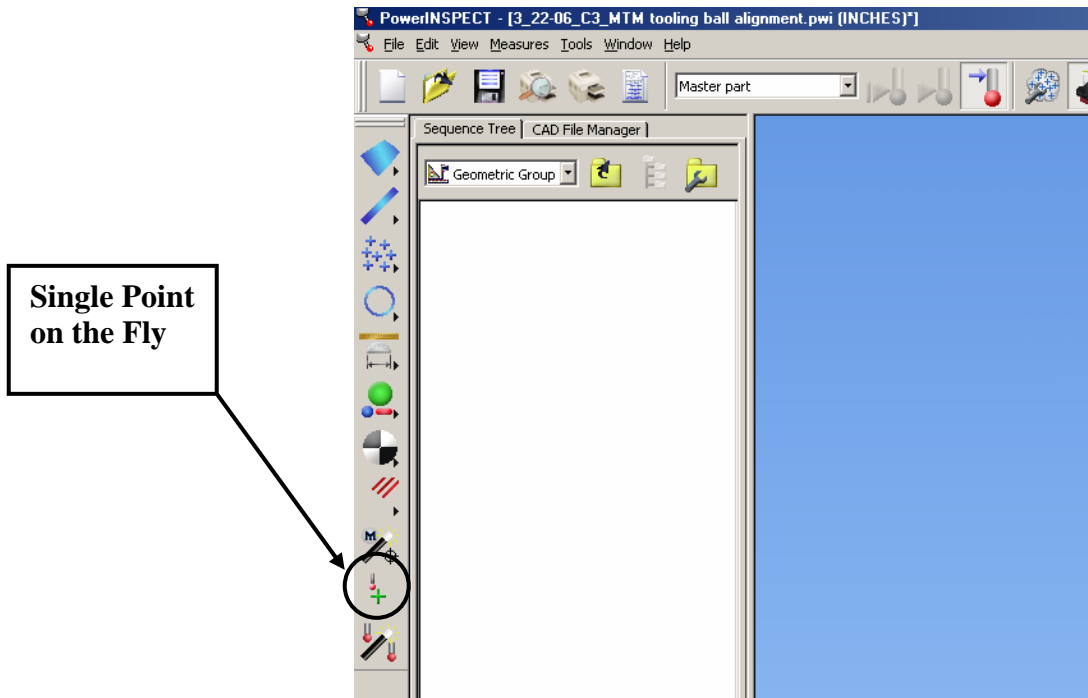
a. Open the Conical Seat Alignment Template file and align to the coil.
b. Install the "carbide tip" probe onto the arm.
c. From the far left column, choose Geometric elements and click OK on
    the dialog box.
d. Choose the tenth icon down "Single Point on the Fly". The program
    will put you into the point taking mode.
e. Measure the position of the wire by taking two points between each
    clamp.

8. **Multiple files from one alignment position**

   If you're aligned to the coil and want to measure additional features but wish to save the data in separate files, you have several options:

   a. **Multiple files via saving and using "Exported" alignments.**
      i. **Once you're aligned to the coil, go the "File" drop down menu and choose "Export Alignment".**
      ii. **Give the alignment a name – usually the date will suffice.**
      iii. **To use the exported alignment in a new file, open the conical seat template and save it with a new name.**
      iv. **Delete the PLP alignment. You have to do this for two reasons: 1) the software will not allow you to have two alignments at the same time and therefore will not let you import the saved alignment, and 2) since you are importing an alignment you can delete the conical seat measurements, but you won't be allowed to as long as the conical seats are linked to the old alignment.**
      v. **From the extreme left of the window, click on the top icon to expand the choices. Choose the fifth icon "Alignment from a File". A dialog box will appear. Browse to the location of the saved alignment and choose it.**
      vi. **You are now aligned.**

   b. **Multiple files via by reusing the first aligned file and creating new files via the "Save As" feature.**

      i. **Once you're aligned to the coil, go the "File" drop down menu and choose "Save As".**
      ii. **Choose a new name for the file. Be careful not to overwrite the current file or other previous files.**
      iii.
      iv. **If you had taken data in the original file, then perform a "Reset All" in the new file.**

      Note that you can perform both of these techniques together – you can export the alignment and create a new file and then use the "save as" method to create multiple copies of this particular alignment.

REVIEWERS (designated by RLM)	Rec'd/ Incorp.
Comments	
Accountable Technical Individual/Metrology Engineer **…………Steve Raftopoulos**	
Test Director	
Independent Reviewer	
D-Site Shift Supervisor	
Independent	
NCSX Dimensional Control Representative ……………………….**Brent Stratton**	
Vacuum	
NCSX Field Supervisors… **Jim Chrzanowski,**	
Project Engineer for Stellerator Systems (WBS 1) Manager.. **Brad Nelson (ORNL)**	
WBS Manager for Modular Coils (WBS14).. …………………	
Quality Assurance/Quality Control. ……………………… **Judy Malsbury**	
Maintenance and Operations Division	
Energy Conversion System/Motor Control Division	
Engineering ……………………………………..	
Environmental Restoration & Waste Management Division	
Environmental, Safety & Health**…………………………………**	
Industrial Hygiene**…………………………………………...**	
Health Physics**…………………**	
RLM …………………………………………………………..**Larry Dudek**	

TRAINING (designated by RLM)			
No training required _____ Instructor **Steve Raftopoulos**			
Personnel (group, job title or individual name)	Read Only	Instruction-job Briefing	Hands On
Lead Tech.		X	
Technicians performing task		X	
Field Supervisors		X	
Quality Control Representative		X	
Training Rep.			
RLM **Larry Dudek**			

RECORD OF CHANGE

Revision	Date	Description of Change
00		Initial release
01	8/18/05	Make specific to Modular Coils
02	2/20/06	Revise to incorporate field changes