

NCSX Project Closeout Notes – Dimensional Control for Assembly Stations 2 and 3

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Overview

This report contains documentation of dimensional control processes and results for Stations 2 and 3 of the NCSX Assembly. Dimensional control for coil manufacture and winding was handled by Art Brooks. Certain processing steps for stations 2 and 3, such as coil realignment and shim thickness calculations, were also handled by Art Brooks, with assistance from Mark Smith, and the supporting documentation is stored with Art's closeout notes.

Station 2 Dimensional Control

Station 2 activities consisted of the assembly of a set of type A, B, and C modular coils into a unit. After pre-measurement of the coils and flanges, assembly was accomplished by shimming and bolting coils together, and welding the nose regions together. Dimensional control oversight was applied throughout the process in order to obtain the required accuracy. Two of the six assemblies were completed, within the required accuracy, by the end of the closeout period.

The necessary dimensional control steps are described in detail in the dimensional control plan for station 2, which was approved and posted on the NCSX website. The operational steps in the dimensional control plan were incorporated into the station 2 assembly procedure, also on the NCSX website.

The critical step in the pre-measurement of coils was the racking procedure. Because of the flexibility of the modular coils, it is necessary to support them in a fashion that maintains them in the as-wound condition. This procedure is described in detail in an appendix of the station 2 dimensional control plan. A spreadsheet, which performed the calculations for this procedure, was developed for use in the field. The supporting documentation for this report includes a sample spreadsheet from one of the coil pre-measurements. All of the modular coils, except for A6, B5, B6, C4, and C6, were pre-measured before project cancellation.

During station 2 assembly, it was necessary to repeatedly measure the monuments on the outside of the modular coils, and determine their position in the half period coordinate system, and deviations from their theoretical positions. A Fortran program was written to sort measurement data, compare the measurements with theoretical positions of monuments, and report deviations in a coordinate system with its vertical axis normal to the planes of the flanges of the coils being mated. This program, "tbmvmt.f" is included in the supporting documentation. Comment statements in the program explain its use.

Another program, “test1.f”, was written to read the measurement data, and then write it in a form that “tbmvmt.f” expects. In general, the steps for processing the measurement data were: 1, obtain the measurements as a spreadsheet containing Cartesian coordinates of the points; 2, format the coordinates as numbers with 5 decimal places; 3, convert the file to a tab-delimited text file; 4, upload the text file to the cluster via ftp; 5, run “test1.f”; 6, run “tbmvmt.f”.

The processed measurement files from the first two half periods, after completion of welding, are included in the documentation for this report.

Station 3 Dimensional Control

The scope of Station 3 was reduced after project cancellation from a true assembly sequence to a trial of the movement of one half period over the vacuum vessel. The dimensional control plan for accomplishing this was completed and posted on the NCSX website. Limited measurements, including scans of the two end flanges of the field period assembly, were taken and are included in the supporting documentation for this report.