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NO.	ASSEMBLY STEP	COMMENTS
1.00	**MC fit-up pre-check and surface insulation**	
1.01	Verify that mating MC's of a MCHP will come together without interferences by pre-fitting mating coils. This will include the Type-C coil with its interfacing Period Type-C coil.	The full assembly layout of the mating MC's can be found in Table 1 and Figure 3 below. Some of this effort may be done before the half period assembly activity begins.
2.00	**Pre-measurement of MCHP Type A, B and C coils flanges plus interfacing Type-A coil flange**	**See MCHP component designation in Table 1 of this document. MCHP Assembly Dimensional Control Plan: NCSX-PLAN-HPADC-00**
2.01	Follow the steps defined in Section 2 of the Metrology Plan for racking coils and lower the Type-A modular coil onto the jacks, "A" flange (datum "D") down and rack the "A" coil into its proper shape.	The acceptance criterion is .005" RMS deviation in alignment to the set of tooling balls. With a successful alignment a set of global fiducial monuments will have been established. Subsequent alignments of the laser tracker will be to the global monument
2.02	Scan the "B" flange (datum E) and the MC shell VV boss interface. Measure tooling balls	
2.03	Remove Type-A coil from stand and move to holding area.	
2.04	Follow the steps defined in Section 2 of the Metrology Plan for racking coils and lower the Type-B modular coil onto the jacks, "B" flange (datum "E") down and rack the "B" coil into its proper shape.	The acceptance criterion is .005" RMS deviation in alignment to the set of conical seats. With a successful alignment a set of global fiducial monuments will have been established. Subsequent alignments of the laser tracker will be to the global monument
2.05	Scan the "A" flange (datum D). Measure Tooling Balls	Flange measurement is needed for the A side (only) for the Type-B coil.
2.06	Remove Type-B coil from stand and store coil.	
2.07	Follow the steps defined in Section 2 of the Metrology Plan for racking coils and lower the Type-C modular coil onto the jacks, "B" flange (datum "E") down and rack the "C" coil into its proper shape.	The acceptance criterion is .005" RMS deviation in alignment to the set of conical seats. With a successful alignment a set of global fiducial monuments will have been established. Subsequent alignments of the laser tracker will be to the global monument
2.08	Scan the "A" flange (datum D). Measure tooling balls.	Flange measurement is needed for the A side (only) for the Type-C coil.
2.09	Remove Type-C coil from stand and store coil.	
3.00	**Shim sizing / preparations**	**Metrology procedure covering Station 2:**
3.01	Using flange measurement of the coils, define the A/B shim thickness.	This is a back office calculation where shim thickness is predetermined based on the scanned flange surface data.
3.02	Compress alumina coated shims and sort by thickness the shim set that will be installed on the MCHP.	Care must be taken when handling alumina shims to mitigate any possible surface contamination conditions.
4.00	**Pre-Installation Station 2 set-up**	**Metrology procedure covering Station 2:**
4.01	Install MCHP fixtures and metrology equipment.	
4.02	Perform metrology set-up and checks	
5.00	~~**Pre-assemble A-A**~~	**THIS STEP HAS BEEN ELIMINATED**
6.00	**A-B modular coil assembly**	**See MCHP component designation in Table 1 of this document. MCHP Assembly Dimensional Control Plan: NCSX-PLAN-HPADC-00 Reference Drawings: SE140-003 a**
6.01	Follow the steps defined in Section 2 of the Metrology Plan for racking coils, lower the Type-A modular coil onto the jacks, "A" flange (datum "D") down and rack the "A" coil into its proper shape.	The acceptance criterion is .005" RMS deviation in alignment to the set of tooling balls. With a successful alignment a set of global fiducial monuments will have been established. Subsequent alignments of the laser tracker will be to the global monument
6.02	Using the Type-A (B-flange) inboard shim template mark the nose shim locations and puck locations. Remove the template.	Use a thin equivalent washer of the puck diameter (or some other method) to provide a positional "feel" to allow measuring puck height in the A -B installed position.
6.03	Place an initial set of alumina shims (4-8) on the Type-A coil	See document XXXX for shim size and location.
6.04	Place unfilled shim bags in the wing areas	
6.05	Lower the mating "B" coil into position.	
6.06	Install the jack screws and dial indicators for horizontal positioning.	
6.07	Using three selected monuments on the "B" coil, position the coil within ±.002" normal to the mating flanges and within ±.060" horizontally.	
6.08	Install the remaining alumina coated shims; install studs, supernuts, and torque to 50% of final value.	
6.09	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.	
6.10	After tightening, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .007" (true distance) of their desired position. Adjust shims until this criterion is met.
6.11	Measure the shim puck height (at a number of points around the puck surface) at each of the nose shim puck locations. Use the data to define each puck height.	

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NO.	ASSEMBLY STEP	COMMENTS
6.12	Unfasten bolts and raise the "B" coil in height to remove the puck locating rings and install all nose shims with the properly sized pucks. Use temporary shims to support the Type-B flex shims.	
6.13	"Lightly" tack weld the nose flex shims to the perspective "A" and "B" coils.	
6.14	Unfasten all bolts and remove the "B" coil and place it on a separate fixture, with the Type-B coil side "A" flange (datum "D") facing up.	
6.15	Recheck the part alignment of the "A" coil to make sure it is still within alignment and then weld all Type-A flex shims to the plasma side, following the weld sequence plan.	
6.16	After welding the "A" coil nose shims recheck alignment to determine if the part still meets the metrology acceptance criterion.	The acceptance criterion is .005" RMS deviation in alignment to the set of tooling balls.
6.17	Time needs to be allocated for a back office assessment of the part after welding.	If Control Plan acceptance criterion is not met project input is needed to determine how to proceed.
6.18	On the separate fixture measure the "B" fiducials to establish a reference coordinate system prior to welding the "B" coil nose shims.	
6.19	With the successful "A" coil weld operation, weld all Type-B (A flange) flex shims to the plasma side, following the weld sequence plan.	
6.20	After welding the "B" coil nose shims recheck the part to determine if it still meets the metrology acceptance criterion.	Align to measurements of 6.18. Acceptance criterion is RMS .le. .004". Project input is required in the event of failure.
6.21	Time needs to be allocated for a back office assessment of the part after welding.	If Control Plan acceptance criterion is not met project input is needed to determine how to proceed.
6.22	Remove alumina shims as necessary except for the (4-8) initial locating shims on the Type-A coil in designated locations for the initial alignment of the mating coil.	
6.23	Lower the mating “B” coil into position.	
6.24	Using three selected monuments on the “B” coil, position the coil accurately in the horizontal plane.	An accuracy of ±.002” or better in each direction is expected and required for this step.
6.25	Raise the "B" coil slightly and install the remaining alumina coated shims; install Fuji paper on all outboard shims, install studs, supernuts, and torque to 50% of final value.	
6.26	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.	
6.27	After tightening, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments should be within .007" (true distance) of their desired position.
6.28	Unfasten the bolts, lift the “B” coil enough to remove the Fuji paper, and examine the load sharing. At the same time, the “back office” will analyze the measurements of the monument positions. A revised set of shim thicknesses, to provide adequate load s	
6.29	If a revised set of shims is required, install the new shims and Fuji paper. Lower and reposition the “B” coil. Repeat steps 4.26 thru 4.28.	
6.30	With a successful Fuji load pattern, unfasten the bolts, lift the “B” coil enough to remove the Fuji paper and initial shims. Install an equivalent set of alumina coated shims without Fuji paper, install studs, supernuts, and torque to 50% of final value. Recheck alignment.	Send the Fuji paper test shims out to be cleaned.
6.31	If the above step does not fall within .007" or less then loosen all studs, adjust shims locally. Re-torque all studs to 50%.	All monuments shall be within .007" (true distance) of their desired position. Adjust shims until this criterion is met.
6.32	One hole at a time, remove the supernut. Using the eccentric gage slid onto the stud define the hole eccentricity. Select bushing and machine to match required eccentricity. Install bushing. Replace nut and tighten back to 50% and recheck alignment.	This operation can be done concurrently at different locations if in so doing the part does not move.
6.33	After super bolt tightening, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .007" (true distance) of their desired position.

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NO.	ASSEMBLY STEP	COMMENTS
6.34	~~Install wing support hardware~~	Assume three welded chair supports with nut-plates on each wing
6.35	~~Load the wing support hardware to pre-weld condition~~.	
6.36	Tighten all bolts to their final torque.	
6.37	After tightening hardware, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .010" (true distance) of their theoretical position.
6.38	Weld the A / B nose region solenoid side following the weld procedure.	
6.39	Measure the positions of all monuments per the process defined in the Metrology Plan, steps 2.3.3 through 2.3.7.	All monuments shall be within .015" (true distance) of their desired position.
6.40	Review the above results with Back Office. Adjust wing supports if needed to meet alignment requirements	
6.41	Identify, if possible, a set of monuments that have moved less than .005" from their original positions. The alignment that will be necessary for mating to the "C" coil will use monuments from among this set.	
6.42	Fill all lose bushings with Stycast 2850FT	
6.43	Scan the "B" flange (datum "E") of the "B" coil, for the purpose of defining the shim thickness for the mating to the "C" coil. Save the measurement file and back it up.	
6.44	Using the "B" flange (datum "E") measurement of the Type-B coil and the earlier "A" flange (datum "E") measurement of the Type-C coil, define all B/C flange shim thickness.	This is a back office calculation where shim thickness is predetermined based on the scanned flange surface data.
6.45	Compress alumina coated shims and sort by thickness the shim set that will be installed on the B/C interface.	Care must be taken when handling alumina shims to mitigate any possible surface contamination conditions.
7.00	**(A-B) to C modular coil assembly (MCHP)**	**See MCHP component designation in Table 1 of this document. MCHP Assembly Dimensional Control Plan: NCSX-PLAN-HPADC-00 Reference Drawings: SE140-003 a**
7.01	Bolt the "A" coil to its fixture and lift the (A-B) coil, along with the fixture, onto another wedge with its top surface tilted at 20 degrees from horizontal. Bolt the fixtures together.	
7.02	Select a subset of monuments identified in step 4.38 that will be used for the initial alignment in this next phase of half	
7.03	Align to the set of monuments selected in 5.02. Acceptance criterion is .005" RMS deviation.	
7.04	Establish a set of global monuments, including three positions on the fixture and five on the building.	
7.05	Using the Type-B (B-flange) inboard shim template mark the nose shim locations and puck locations. Remove the template.	Use a thin equivalent washer of the puck diameter (or some other method) to provide a positional "feel" to allow measuring puck height in the A -B installed position.
7.06	Place an initial set of alumina shims (4-8) on the Type-B coil in designated locations for the initial alignment of the mating coil.	See document XXXX for shim size and location.
7.07	Place unfilled shim bags in the wing areas	
7.08	Lower the mating "C" coil into position.	
7.09	Install the jack screws and dial indicators for horizontal positioning.	
7.10	Using three selected monuments on the "C" coil, position the coil accurately in the Z-direction and within .002" in the X - Y plane.	An accuracy of .002" is expected and required.
7.11	Install the remaining alumina coated shims; install studs, supernuts, and torque to 50% of final value.	
7.12	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.	
7.13	After tightening, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .015" (true distance) of their desired position. Adjust shims until this criterion is met.
7.14	Measure the shim puck height (at a number of points around the puck surface) at each of the nose shim puck locations. Use the data to define each puck height.	

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NO.	ASSEMBLY STEP	COMMENTS
7.15	Unfasten bolts and raise the "C" coil in height to remove the puck locating rings and install all nose shims with the properly sized pucks. Use temporary shims to support the Type-C flex shims.	
7.16	"Lightly" tack weld the nose flex shims to the perspective "B" and "C" coils.	
7.17	Unfasten all bolts and remove the "C" coil and place it on a separate fixture, with the Type-C coil side "A" flange (datum "D") facing up.	
7.18	Recheck the part alignment of the "A / B" coil to make sure it is still within alignment and then weld all Type-B flex shims to the plasma side, following the weld sequence plan.	RMS deviation .005" or less is the acceptance criterion. Consult Dimensional Control if this criterion is not met.
7.19	After welding the "B" coil nose shims recheck alignment to determine if the part still meets the metrology acceptance criterion.	RMS deviation .005" or less is the acceptance criterion. Consult Dimensional Control if this criterion is not met.
7.20	Time needs to be allocated for a back office assessment of the part after welding.	If Control Plan acceptance criterion is not met project input is needed to determine how to proceed.
7.21	On the separate fixture measure the "C" fiducials to establish a reference coordinate system prior to welding the "C" coil nose shims.	
7.22	With the successful "A / B" coil weld operation, weld all Type-C (A-flange) flex shims to the plasma side, following the weld sequence plan.	
7.23	After welding the "C" coil nose shims recheck the part to determine if it still meets the metrology acceptance criterion.	RMS deviation .004" or less is the acceptance criterion. Consult Dimensional Control if this criterion is not met.
7.24	Time needs to be allocated for a back office assessment of the part after welding.	If Control Plan acceptance criterion is not met project input is needed to determine how to proceed.
7.25	Remove alumina shims as necessary except for the (4-8) initial locating shims on the Type-B coil in designated locations for the initial alignment of the mating coil.	
7.26	Lower the mating “C” coil into position.	
7.27	Using three selected monuments on the “C” coil, position the coil accurately in the X -Y plane.	An accuracy of .002” or better is expected and required for this step.
7.28	Raise the "C" coil slightly and install the remaining alumina coated shims; install Fuji paper on all outboard shims, install studs, supernuts, and torque to 50% of final value.	
7.29	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.	
7.30	After tightening, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .015" (true distance) of their desired position.
7.31	Unfasten the bolts, lift the “C” coil enough to remove the Fuji paper, and examine the load sharing. At the same time, the “back office” will analyze the measurements of the monument positions. A revised set of shim thicknesses, to provide adequate load sharing and dimensional accuracy, will be generated if required.	
7.32	If a revised set of shims is required, install the new shims and Fuji paper. Lower and reposition the “C” coil. Repeat steps 7.29 thru 7.31.	
7.33	With a successful Fuji load pattern, unfasten the bolts, lift the “C” coil enough to remove the Fuji paper and initial shims. Install an equivalent set of alumina coated shims without Fuji paper, install studs, supernuts, and torque to 50% of final value. Recheck alignment.	Send the Fuji paper test shims out to be cleaned.
7.34	If the above step does not fall within .015" or less then loosen all studs, adjust shims locally. Re-torque all studs to 50%.	Repeat until the desired tolerance is met.
7.35	One hole at a time, remove the supernut. Using the eccentric gage slid onto the stud define the hole eccentricity. Select bushing and machine to match required eccentricity. Install bushing. Replace nut and tighten back to 50% and recheck alignment.	This operation can be done concurrently at different locations if in so doing the part does not move.

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NO.	ASSEMBLY STEP	COMMENTS
7.36	After super bolt tightening (50 % value), measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .015" (true distance) of their desired position.
7.37	~~Install wing support hardware~~	Assume three welded chair supports with nut-plates on each wing
7.38	~~Load support hardware to pre-weld condition.~~	
7.39	Tighten all bolts to their final torque.	
7.40	After tightening hardware, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .017" (true distance) of their desired position.
7.41	Weld the B / C nose region solenoid side following the weld procedure.	
7.42	Measure the positions of all monuments per the process defined in the Metrology Plan, steps 2.3.3 through 2.3.7.	All monuments shall be within .020" (true distance) of their desired position.
7.43	Back office of above results and adjust wing supports if needed to meet alignment requirements	
7.44	Fill all lose bushings with Stycast 2850FT	
8.00	**Inflate all wing shim bags**	CHANGED FROM TACK WELD INBD WELDED SHIMS
8.01	~~Fill all wing bladders and cure~~	
9.00	~~**Install trim coil**~~	MOVED TO STATION 5
10.00	**Complete local service and interface details**	
10.01	~~Install all wing support bladders~~ between wing surfaces (A/B, B/C) and on the C wing (MCHP - Right Side only)	This work is now done earlier in the Station 2
10.02	~~Make local service runs/connections~~ on the shell of each MC.	Jim Chrzanowski will make service connections across the poloidal breaks. All remaining services will be done in Station 5.
10.03	Inject sealant compound to fill in all shim spaces in order to prevent VV/MC insulation from falling out.	
11.00	**Final measurements / transfer completed MCHP to holding area**	**Reference drawing: xxxxxxx**
11.01	Using tension tester measure bolt length on all tension fasteners and record the results.	
11.02	Mark part for identification	Part identification should indicate the period and subparts (ex. MCHP - Left Side C1/B1/A!)
11.03	Install base supports.	See figure 5 for base supports.
11.04	Remove from stand and measure weight of completed assembly	
11.05	Move to holding area.	

Table 1.0 Period Assembly Make-up

Period 1:	MCHP – Left Side C1 / B1 / A1	MCHP – Right Side A2 / B2 / C2
Period 2:	MCHP – Left Side C3 / B3 / A3	MCHP – Right Side A4 / B4 / C4
Period 3:	MCHP – Left Side C6 / B5 / A5	MCHP – Right Side A6 / B6 / C5

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NO.	ASSEMBLY STEP	COMMENTS

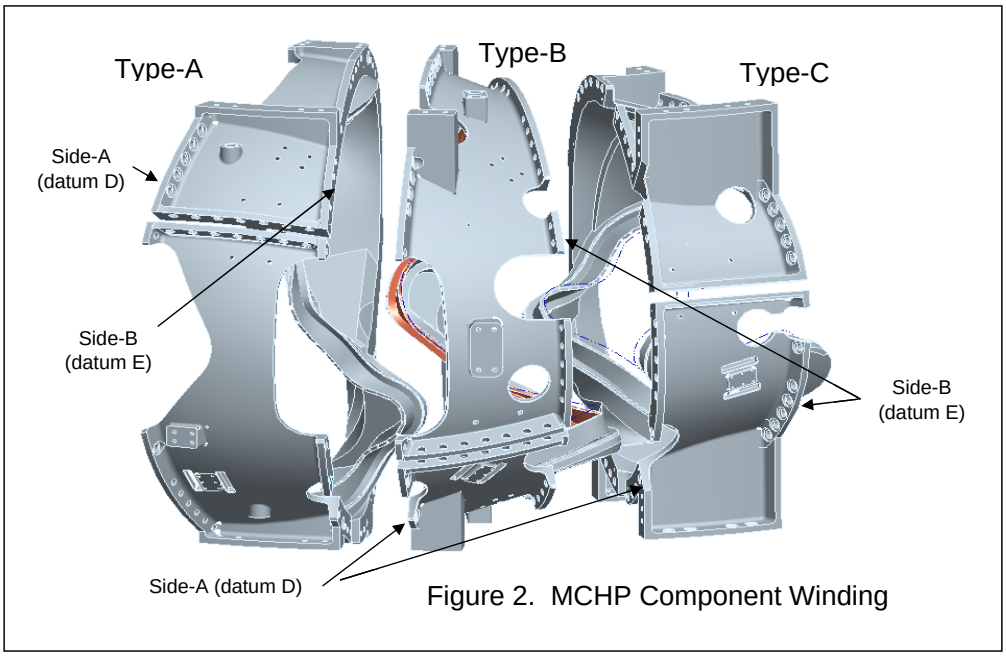
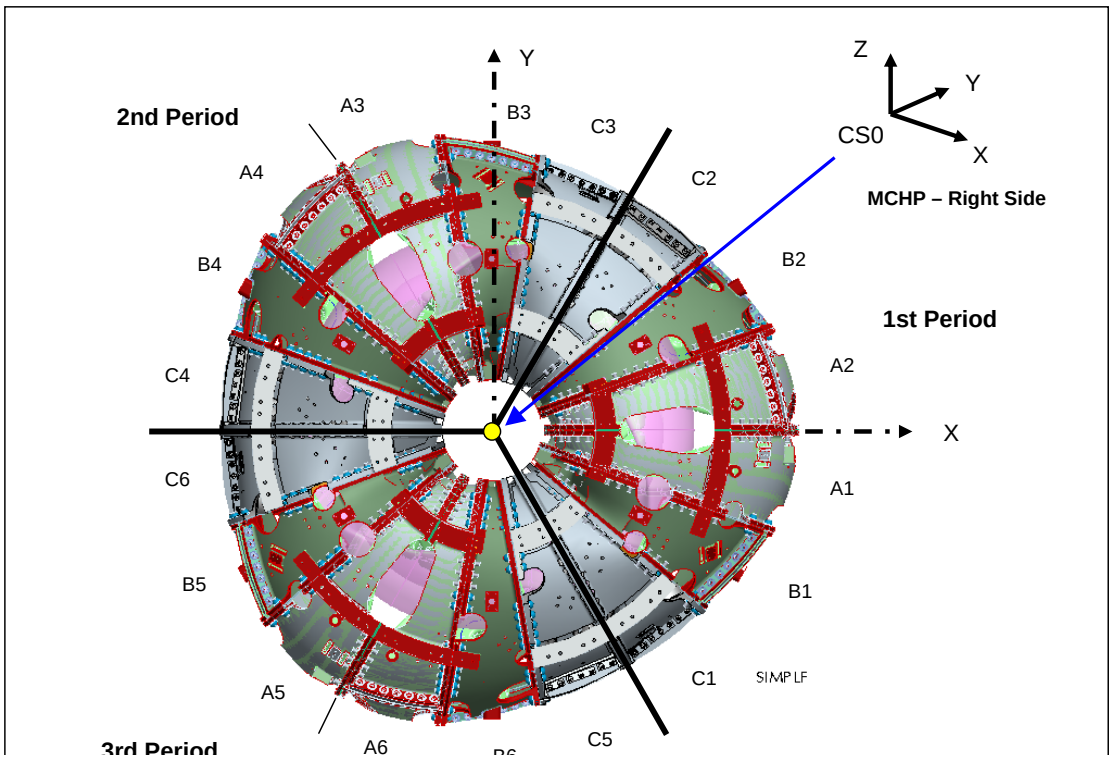


Figure 2. MCHP Component Winding



NO.	ASSEMBLY STEP	COMMENTS
	3rd Period A6 B6 C5	

Figure 3. MC arrangement for the full machine assembly

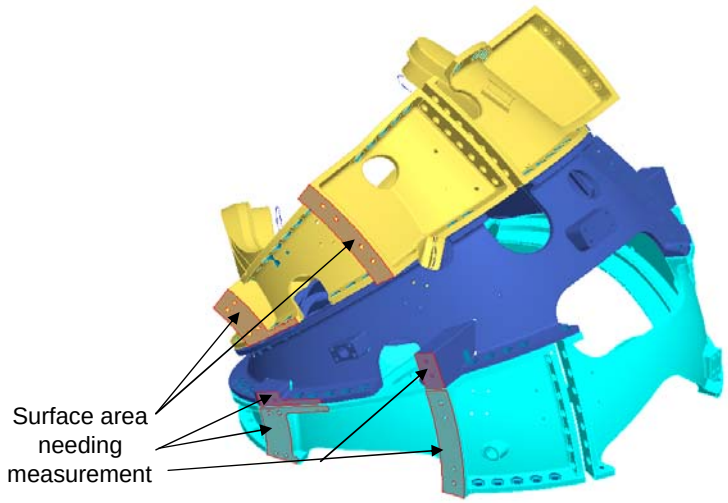


Figure 4. Measurement of MCHP feet

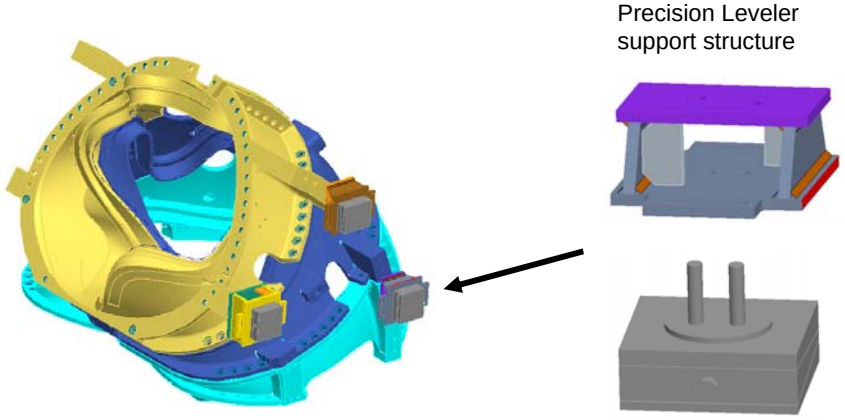


Figure 5. MCHP base supports

Change in 9.3

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NO.	ASSEMBLY STEP	COMMENTS
1	Includes Bob Ellis's final dimensional control inputs (highlighted in red).	

Change in Rev 9.2:

1 Revised Step 6.07 to relax X-Y positioning; eliminated Steps 6.34, 6.35, 7.37 and 7.38 all dealing with the wing supports.

Change in Rev 9.1:

1 Added Steps 6.40, 6.45 and 7.43

Change in Rev 9:

1 Updated sequence plan for Station 2 to meet final welded nose approach

Change in Rev 8:

1 Updated sequence plan for Station 2 to meet welded nose approach and following Dimensional Control Plan: NCSX-PLAN-HPADC-00-dC

Change in Rev 7:

1 Updated sequence plan per Ron's schedule: NCSX Prelimary CP Sched 20070531

Change from Rev 4:

1 Developed a Station 2 - 1st article sequence plan that includes the addition of metal shims and Fuji paper to use for shim qualification test.
2 Reintroduced the A - A pre-fit up to establish a success oriented full period installation operation.
3 Added a shim sizing / preparation step
4 Developed a Station 2 - Production article sequence plan that excludes Fuji paper and installs all alumina coated shims on the first pass.

Change from Rev 3:

1 The Pre-assemble A-A (old step 4.0) has been eliminated in favor of alignment of separate MCHP.
2 Fuji paper will no longer be included in the installation process although it may be used on the first MCHP article (separate plan).
3 Alumina coated shims with close tolerance bolt hole installed on first pass.
4 Assembly tolerance increase to .010" from .007" in (A-B) to C fit-up.

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NO.	ASSEMBLY STEP	COMMENTS
1.00	**MC fit-up pre-check and surface insulation**	
1.01	Verify that mating MC's of a MCHP will come together without interferences by pre-fitting mating coils. This will include the Type-C coil with its interfacing Period Type-C coil.	The full assembly layout of the mating MC's can be found in Table 1 and Figure 3 below. Some of this effort may be done before the half period assembly activity begins.
2.00	**Pre-measurement of MCHP Type A, B and C coils flanges plus interfacing Type-A coil flange**	**See MCHP component designation in Table 1 of this document. MCHP Assembly Dimensional Control Plan: NCSX-PLAN-HPADC-00**
2.01	Follow the steps defined in Section 2 of the Metrology Plan for racking coils and lower the Type-A modular coil onto the jacks, "A" flange (datum "D") down and rack the "A" coil into its proper shape.	The acceptance criterion is .005" RMS deviation in alignment to the set of tooling balls. With a successful alignment a set of global fiducial monuments will have been established. Subsequent alignments of the laser tracker will be to the global monument
2.02	Scan the "B" flange (datum E) and the MC shell VV boss interface. Measure tooling balls	
2.03	Remove Type-A coil from stand and move to holding area.	
2.04	Follow the steps defined in Section 2 of the Metrology Plan for racking coils and lower the Type-B modular coil onto the jacks, "B" flange (datum "E") down and rack the "B" coil into its proper shape.	The acceptance criterion is .005" RMS deviation in alignment to the set of conical seats. With a successful alignment a set of global fiducial monuments will have been established. Subsequent alignments of the laser tracker will be to the global monument
2.05	Scan the "A" flange (datum D). Measure Tooling Balls	Flange measurement is needed for the A side (only) for the Type-B coil.
2.06	Remove Type-B coil from stand and store coil.	
2.07	Follow the steps defined in Section 2 of the Metrology Plan for racking coils and lower the Type-C modular coil onto the jacks, "B" flange (datum "E") down and rack the "C" coil into its proper shape.	The acceptance criterion is .005" RMS deviation in alignment to the set of conical seats. With a successful alignment a set of global fiducial monuments will have been established. Subsequent alignments of the laser tracker will be to the global monument
2.08	Scan the "A" flange (datum D). Measure tooling balls.	Flange measurement is needed for the A side (only) for the Type-C coil.
2.09	Remove Type-C coil from stand and store coil.	
3.00	**Shim sizing / preparations**	**Metrology procedure covering Station 2:**
3.01	Using flange measurement of the coils, define the A/B shim thickness.	This is a back office calculation where shim thickness is predetermined based on the scanned flange surface data.
3.02	Compress alumina coated shims and sort by thickness the shim set that will be installed on the MCHP.	Care must be taken when handling alumina shims to mitigate any possible surface contamination conditions.
4.00	**Pre-Installation Station 2 set-up**	**Metrology procedure covering Station 2:**
4.01	Install MCHP fixtures and metrology equipment.	
4.02	Perform metrology set-up and checks	
5.00	~~**Pre-assemble A-A**~~	**THIS STEP HAS BEEN ELIMINATED**
6.00	**A-B modular coil assembly**	**See MCHP component designation in Table 1 of this document. MCHP Assembly Dimensional Control Plan: NCSX-PLAN-HPADC-00 Reference Drawings: SE140-003 a**
6.01	Follow the steps defined in Section 2 of the Metrology Plan for racking coils, lower the Type-A modular coil onto the jacks, "A" flange (datum "D") down and rack the "A" coil into its proper shape.	The acceptance criterion is .005" RMS deviation in alignment to the set oftooling balls. With a successful alignment a set of global fiducial monuments will have been established. Subsequent alignments of the laser tracker will be to the global monument
6.02	Using the Type-A (B-flange) inboard shim template mark the nose shim locations and puck locations. Remove the template.	Use a thin equivalent washer of the puck diameter (or some other method) to provide a positional "feel" to allow measuring puck height in the A -B installed position.
6.03	Place an initial set of alumina shims (4-8) on the Type-A coil in designated locations for the initial alignment of the mating	See document XXXX for shim size and location.
6.04	Place unfilled shim bags in the wing areas	
6.05	Lower the mating "B" coil into position.	
6.06	Install the jack screws and dial indicators for horizontal positioning.	
6.07	Using three selected monuments on the "B" coil, position the coil within ±.002" normal to the plane of the mating flanges and within ±.060" in the plane of the mating flanges.	An accuracy of .002" RMS is expected and required.
6.08	Install the remaining alumina coated shims; install studs, supernuts, and torque to 50% of final value.	
6.09	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.	
6.10	After tightening, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .007" (true distance) of their desired position.

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NO.	ASSEMBLY STEP	COMMENTS
6.11	Measure the shim puck height (at a number of points around the puck surface) at each of the nose shim puck locations. Use the data to define each puck height.	
6.12	Unfasten bolts and raise the "B" coil in height to remove the puck locating rings and install all nose shims with the properly sized pucks. Use temporary shims to support the Type-B flex shims.	
6.13	"Lightly" tack weld the nose flex shims to the perspective "A" and "B" coils.	
6.14	Unfasten all bolts and remove the "B" coil and place it on a separate fixture, with the Type-B coil side "A" flange (datum "D") facing up.	
6.15	Recheck the part alignment of the "A" coil to make sure it is still within alignment and then weld all Type-A flex shims to the plasma side, following the weld sequence plan.	
6.16	After welding the "A" coil nose shims recheck alignment to determine if the part still meets the metrology acceptance criterion.	The acceptance criterion is .005" RMS deviation in alignment to the set of tooling balls.
6.17	Time needs to be allocated for a back office assessment of the part after welding.	If Control Plan acceptance criterion is not met project input is needed to determine how to proceed.
6.18	On the separate fixture measure the "B" fiducials to establish a reference coordinate system prior to welding the "B" coil nose shims.	
6.19	With the successful "A" coil weld operation, weld all Type-B (A flange) flex shims to the plasma side, following the weld sequence plan.	
6.20	After welding the "B" coil nose shims recheck the part to determine if it still meets the metrology acceptance criterion.	Align to measurements of 4.18. The acceptance criterion is .004" RMS deviation in alignment to the set of tooling balls.
6.21	Time needs to be allocated for a back office assessment of the part after welding.	If Control Plan acceptance criterion is not met project input is needed to determine how to proceed.
6.22	Remove alumina shims as necessary except for the (4-8) initial locating shims on the Type-A coil in designated locations for the initial alignment of the mating coil.	
6.23	Lower the mating “B” coil into position.	
6.24	Using three selected monuments on the “B” coil, position the coil within ±.002" in the x, y, and z directions.	An accuracy of .002” or better is expected and required for this step.
6.25	Raise the "B" coil slightly and install the remaining alumina coated shims; install studs, supernuts, and torque to 50% of final value.	
6.26	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.	
6.27	After tightening, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .007" (true distance) of their desired position.
6.28	If the above step does not fall within .007" or less then loosen all studs, adjust shims locally. Re-torque all studs to 50%.	Repeat until the desired tolerance is met.
6.29	One hole at a time, remove the supernut. Using the eccentric gage slid onto the stud define the hole eccentricity. Select bushing and machine to match required eccentricity. Install bushing. Replace nut and tighten back to 50% and recheck alignment.	This operation can be done concurrently at different locations if in so doing the part does not move.
6.30	After super bolt tightening, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .007" (true distance) of their desired position.
6.31	Install wing support hardware	Assume three welded chair supports with nut-plates on each wing
6.32	Load the wing support hardware to pre-weld condition.	
6.33	Tighten all bolts to their final torque.	
6.34	After tightening hardware, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .010" (true distance) of their desired position.
6.35	Weld the A / B nose region solenoid side following the weld procedure.	
6.36	Measure the positions of all monuments per the process defined in the Metrology Plan, steps 2.3.3 through 2.3.7.	All monuments shall be within .015" (true distance) of their desired position.

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NO.	ASSEMBLY STEP	COMMENTS
6.37	Back office of above results and adjust wing supports if needed to meet alignment requirements	
6.38	Identify, if possible, a set of monuments that have moved less than .005" from their original positions. The alignment that will be necessary for mating to the "C" coil will use monuments from among this set.	
6.39	Fill all lose bushings with Stycast 2850FT	
6.40	Scan the "B" flange (datum "E") of the "B" coil, for the purpose of defining the shim thickness for the mating to the "C" coil. Save the measurement file and back it up.	
6.41	Using the "B" flange (datum "E") measurement of the Type-B coil and the earlier "A" flange (datum "E") measurement of the Type-C coil, define all B/C flange shim thickness.	This is a back office calculation where shim thickness is predetermined based on the scanned flange surface data.
6.42	Compress alumina coated shims and sort by thickness the shim set that will be installed on the B/C interface.	
7.00	**(A-B) to C modular coil assembly (MCHP)**	**See MCHP component designation in Table 1 of this document. MCHP Assembly Dimensional Control Plan: NCSX-PLAN-HPADC-00 Reference Drawings: SE140-003 a**
7.01	Bolt the "A" coil to its fixture and lift the (A-B) coil, along with the fixture, onto another wedge with its top surface tilted at 20 degrees from horizontal. Bolt the fixtures together.	
7.02	Select a subset of monuments identified in step 4.38 that will be used for the initial alignment in this next phase of half period assembly.	
7.03	Align to the set of monuments selected in 5.02. Acceptance criterion is .005" RMS deviation.	The acceptance criterion is .005" RMS deviation in alignment to the set of tooling balls.
7.04	Establish a set of global monuments, including three positions on the fixture and five on the building.	
7.05	Using the Type-B (B-flange) inboard shim template mark the nose shim locations and puck locations. Remove the template.	Use a thin equivalent washer of the puck diameter (or some other method) to provide a positional "feel" to allow measuring puck height in the A -B installed position.
7.06	Place an initial set of alumina shims (4-8) on the Type-B coil in designated locations for the initial alignment of the mating coil.	See document XXXX for shim size and location.
7.07	Place unfilled shim bags in the wing areas	
7.08	Lower the mating "C" coil into position.	
7.09	Install the jack screws and dial indicators for horizontal positioning.	
7.10	Using three selected monuments on the "C" coil, position the coil within ±.002" normal to the plane of the mating flanges and within ±.060" in the plane of the mating flanges.	An accuracy of .002" is expected and required.
7.11	Install the remaining alumina coated shims; install studs, supernuts, and torque to 50% of final value.	
7.12	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.	
7.13	After tightening, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .015" (true distance) of their desired position.
7.14	Measure the shim puck height (at a number of points around the puck surface) at each of the nose shim puck locations. Use the data to define each puck height.	
7.15	Unfasten bolts and raise the "C" coil in height to remove the puck locating rings and install all nose shims with the properly sized pucks. Use temporary shims to support the Type-C flex shims.	
7.16	"Lightly" tack weld the nose flex shims to the perspective "B" and "C" coils.	
7.17	Unfasten all bolts and remove the "C" coil and place it on a separate fixture, with the Type-C coil side "A" flange (datum "D") facing up.	
7.18	Recheck the part alignment of the "A / B" coil to make sure it is still within alignment and then weld all Type-B flex shims to the plasma side, following the weld sequence plan.	The acceptance criterion is .005" RMS deviation in alignment to the set of tooling balls. Consult Dimensionl Control if this criterion is not met.

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NO.	ASSEMBLY STEP	COMMENTS
7.19	After welding the "B" coil nose shims recheck alignment to determine if the part still meets the metrology acceptance criterion.	The acceptance criterion is .005" RMS deviation in alignment to the set of tooling balls. Consult Dimensionl Control if this criterion is not met.
7.20	Time needs to be allocated for a back office assessment of the part after welding.	If Control Plan acceptance criterion is not met project input is needed to determine how to proceed.
7.21	On the separate fixture measure the "C" fiducials to establish a reference coordinate system prior to welding the "C" coil nose shims.	
7.22	With the successful "A / B" coil weld operation, weld all Type-C (A-flange) flex shims to the plasma side, following the weld sequence plan.	
7.23	After welding the "C" coil nose shims recheck the part to determine if it still meets the metrology acceptance criterion.	The acceptance criterion is .004" RMS deviation in alignment to the set of tooling balls. Consult Dimensionl Control if this criterion is not met.
7.24	Time needs to be allocated for a back office assessment of the part after welding.	If Control Plan acceptance criterion is not met project input is needed to determine how to proceed.
7.25	Remove alumina shims as necessary except for the (4-8) initial locating shims on the Type-B coil in designated locations for the initial alignment of the mating coil.	
7.26	Lower the mating “C” coil into position.	
7.27	Using three selected monuments on the “B” coil, position the coil within ±.002" in the x, y, and z directions.	An accuracy of .002” or better is expected and required for this step.
7.28	Raise the "C" coil slightly and install the remaining alumina coated shims; install studs, supernuts, and torque to 50% of final value.	
7.29	Make a hand "wiggle" test (rotate on bolt) on all shims to make sure that they are tight. If a loose shim is found back off on sufficient adjacent bolts to allow a replacement shim to be inserted. Tighten bolt and recheck.	
7.30	After tightening, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .015" (true distance) of their desired position.
7.31	If the above step does not fall within .015" or less then loosen all studs, adjust shims locally. Re-torque all studs to 50%.	Repeat until the desired tolerance is met.
7.32	One hole at a time, remove the supernut. Using the eccentric gage slid onto the stud define the hole eccentricity. Select bushing and machine to match required eccentricity. Install bushing. Replace nut and tighten back to 50% and recheck alignment.	This operation can be done concurrently at different locations if in so doing the part does not move.
7.33	After super bolt tightening, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .015" (true distance) of their desired position.
7.34	~~Install wing support hardware~~	Assume three welded chair supports with nut-plates on each wing
7.35	~~Load support hardware to pre-weld c~~ondition.	
7.36	Tighten all bolts to their final torque.	
7.37	After tightening hardware, measure the position of all monuments per the Dimensional Control Plan, following steps 2.3.3 through 2.3.7.	All monuments shall be within .017" (true distance) of their desired position.
7.38	Weld the B / C nose region solenoid side following the weld procedure.	
7.39	Measure the positions of all monuments per the process defined in the Metrology Plan, steps 2.3.3 through 2.3.7.	All monuments shall be within .020" (true distance) of their desired position.
7.40	Back office of above results and adjust wing supports if needed to meet alignment requirements	
7.41	Fill all lose bushings with Stycast 2850FT	
8.00	**Inflate all wing shim bags**	CHANGED FROM TACK WELD INBD WELDED SHIMS
8.01	Fill all wing bladders and cure	
9.00	**Install trim coil**	MOVED TO STATION 5
10.00	**Complete local service and interface details**	
10.01	~~Install all wing support bladders~~ between wing surfaces (A/B, B/C) and on the C wing (MCHP - Right Side only).	This work is now done earlier in the Station 2
10.02	~~Make local service runs/connections~~ on the shell of each MC.	Jim Chrzanowski will make service connections across the poloidal breaks. All remaining services will be done in Station 5.
10.03	Inject sealant compound to fill in all shim spaces in order to prevent VV/MC insulation from falling out.	

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NO.	ASSEMBLY STEP	COMMENTS
11.00	**Final measurements / transfer completed MCHP to holding area**	**Reference drawing: xxxxxxx**
11.01	Measure the tooling balls on all coils. Save the data file and back it up. Print reports of all alignments used, and nonconformance reports, and keep with run copies of the assembly procedure.	The maximum deviation from the "realigned" points should be .020" or less. If the deviation is greater that .020", Project input is needed to determine how to proceed.
11.02	Install or identify three primary fiducials that will be used in positioning the Period in Station 3.	
11.03	Scan the "B" flange of Type-C coil as well as the interfacing base support feet (see Figure 4). Record the results.	
11.04	Using tension tester measure bolt length on all tension fasteners and record the results.	
11.05	Mark part for identification	Part identification should indicate the period and subparts (ex. MCHP - Left Side C1/B1/A!)
11.06	Install base supports.	See figure 5 for base supports.
11.07	Remove from stand and measure weight of completed assembly	
11.08	Move to holding area.	

Table 1.0 Period Assembly Make-up

Period 1:	MCHP – Left Side C1 / B1 / A1	MCHP – Right Side A2 / B2 / C2
Period 2:	MCHP – Left Side C3 / B3 / A3	MCHP – Right Side A4 / B4 / C4
Period 3:	MCHP – Left Side C6 / B5 / A5	MCHP – Right Side A6 / B6 / C5

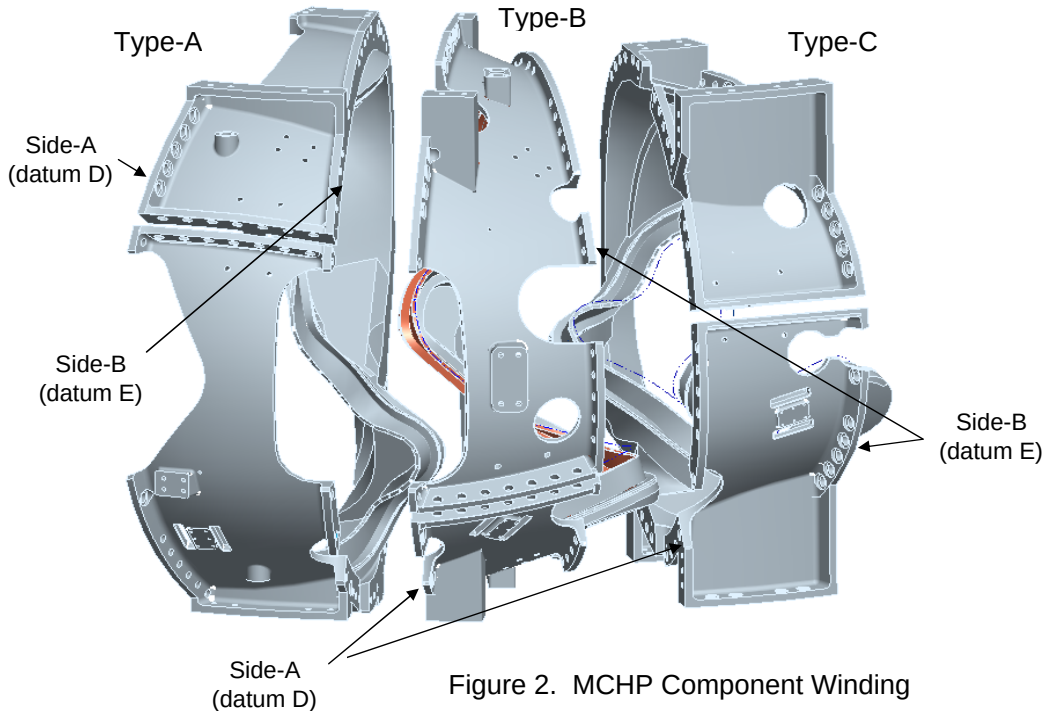


Figure 2. MCHP Component Winding

NO.	ASSEMBLY STEP	COMMENTS

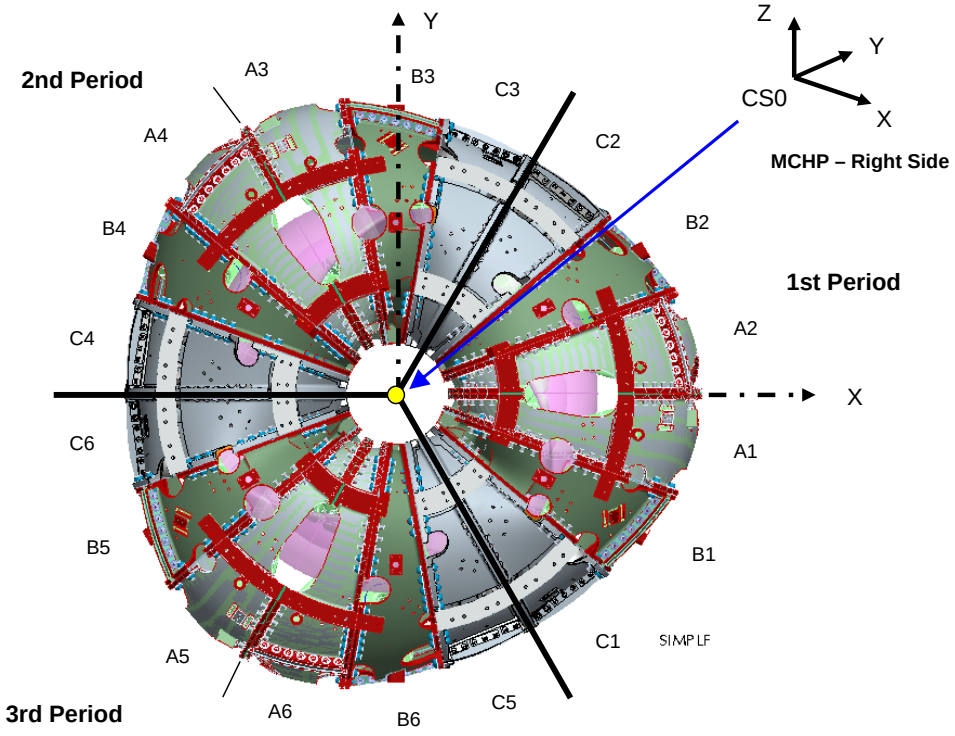
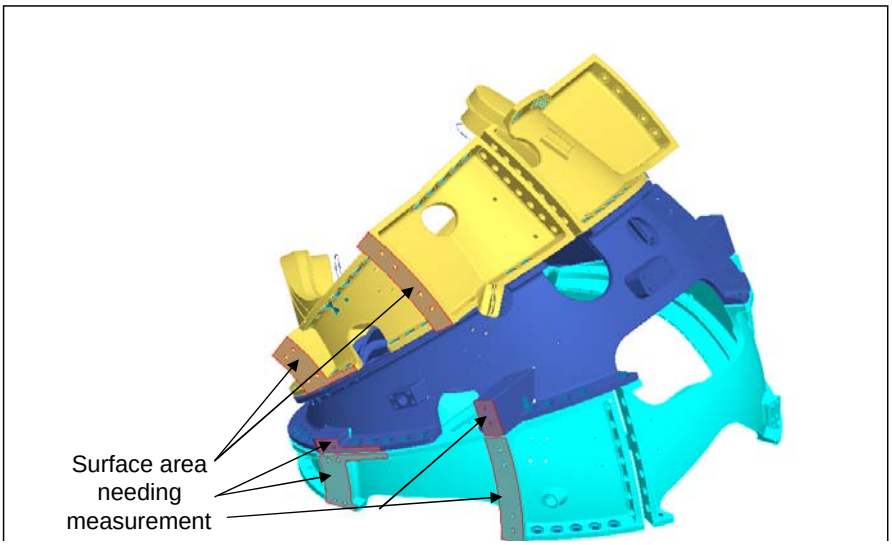


Figure 3. MC arrangement for the full machine assembly



NO.	ASSEMBLY STEP	COMMENTS

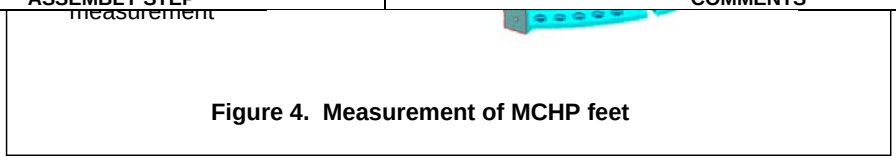


Figure 4. Measurement of MCHP feet

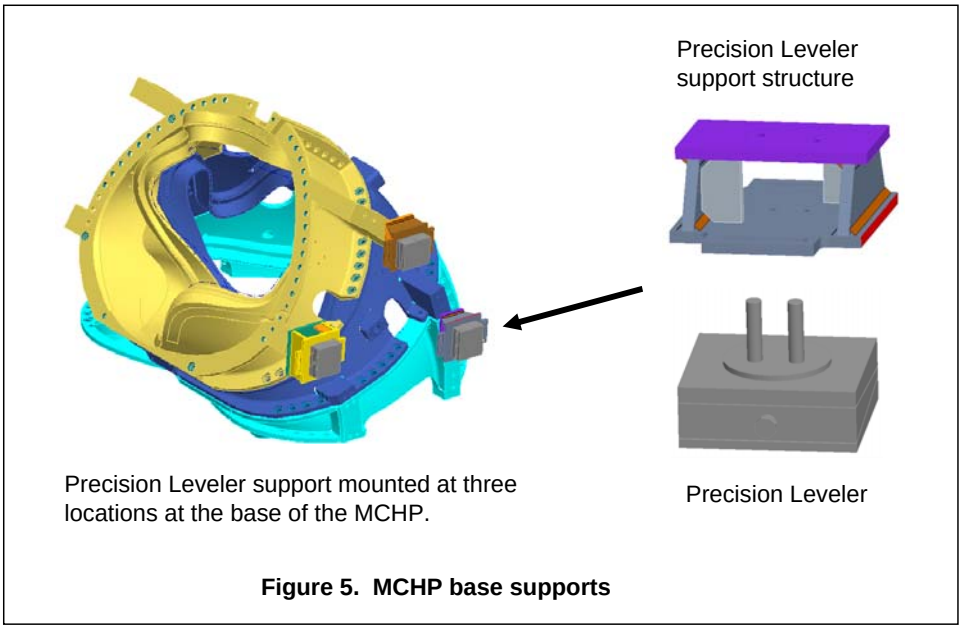


Figure 5. MCHP base supports

Change in 9.3
1 Includes Bob Ellis's final dimensional control inputs (highlighted in red).

Change in Rev 9.2:
1 Revised Step 6.07 to relax X-Y positioning; eliminated Steps 6.31, 6.32, 7.34 and 7.35 all dealing with the wing supports.

Change in Rev 9.1:
1 Added Steps 6.37, 6.43 and 7.40

Change in Rev 9:
1 Updated sequence plan for Station 2 to meet final welded nose approach

Change in Rev 8:
1 Updated sequence plan for Station 2 to meet welded nose approach and following Dimensional Control Plan: NCSX-PLAN-HPADC-00-dC

Change in Rev 7:
1 Updated sequence plan per Ron's schedule: NCSX Prelimary CP Sched 20070531

Change from Rev 4:
1 Developed a Station 2 - 1st article sequence plan that includes the addition of metal shims and Fuji paper to use for shim qualification test.
2 Reintroduced the A - A pre-fit up to establish a success oriented full period installation operation.
3 Added a shim sizing / preparation step
4 Developed a Station 2 - Production article sequence plan that excludes Fuji paper and installs all alumina coated shims on the first pass.

Change from Rev 3:
1 The Pre-assemble A-A (old step 4.0) has been eliminated in favor of alignment of separate MCHP.
2 Fuji paper will no longer be included in the installation process although it may be used on the first MCHP article (separate plan).
3 Alumina coated shims with close tolerance bolt hole installed on first pass.
4 Assembly tolerance increase to .010" from .007" in (A-B) to C fit-up.