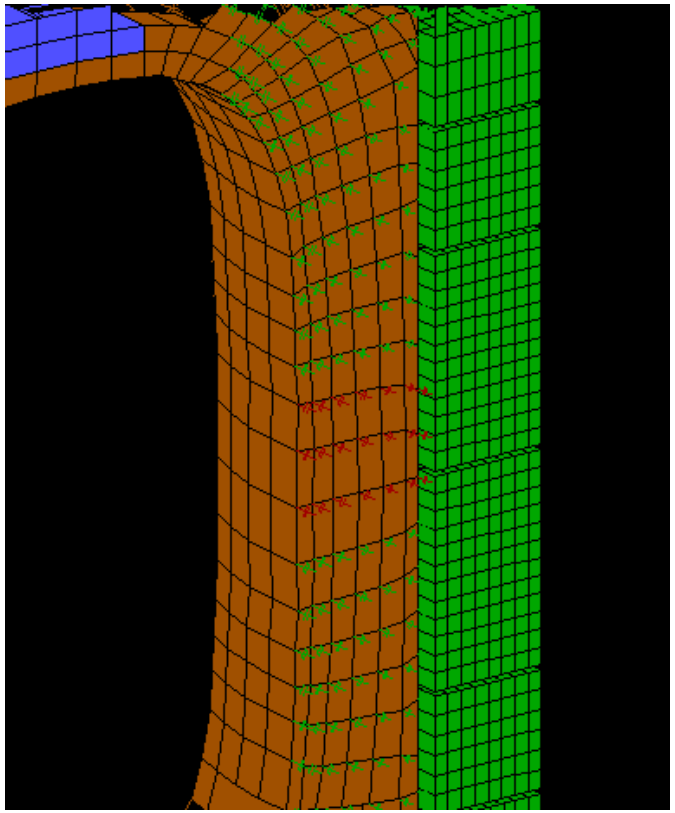
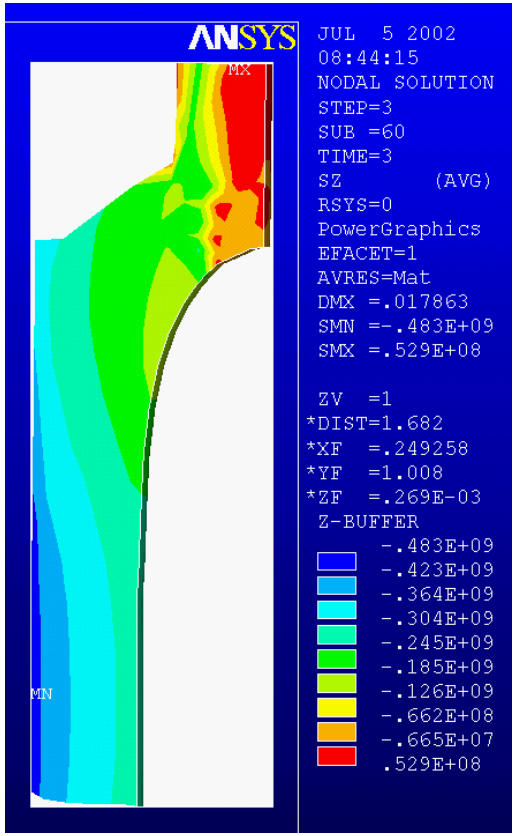
FIRE Wedge Pressure Sensitivity to Fit-up Variations

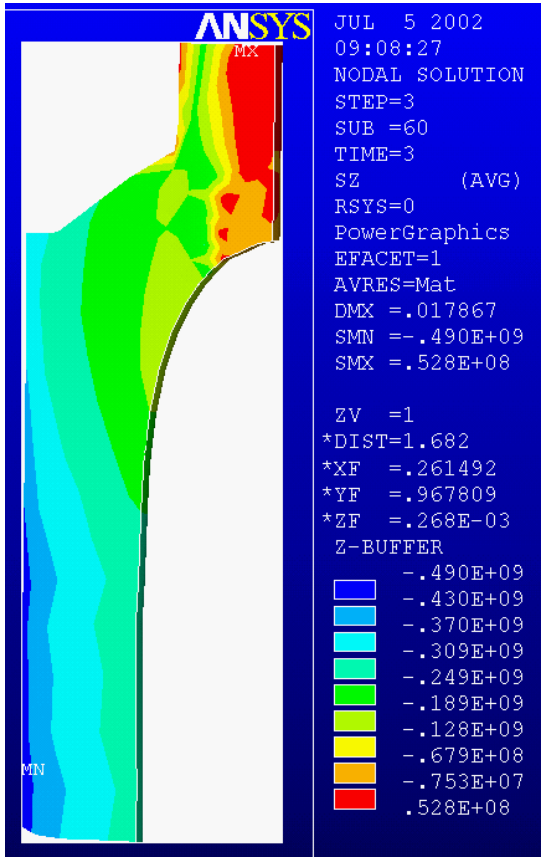
Wedge Pressure Increases by 7MPa per .1 mm fit-up Gap.
The FIRE TF is at a VM of 580 MPa with a yield of 724 MPa. –Fit-up gaps will be absorbed elastically.



A region of Gaps near the equatorial plane have separate real constants and can be input with an assembly gap or interference.



Nominal Wedge Pressure FIRE, 2.14m



Wedge Pressure Change for a .1mm

FIRE Fit-Up Approaches

TF inner leg wedge face fit-up is essential. If the wedge face of the TF inner legs are allowed to bear against high spots, the compressive stress in the insulator could be unacceptable. There is margin in the compressive stress for the 10T 2.14m FIRE, but a 30% margin is desired and an attempt will be made to retain the margin at this stage of the design process.

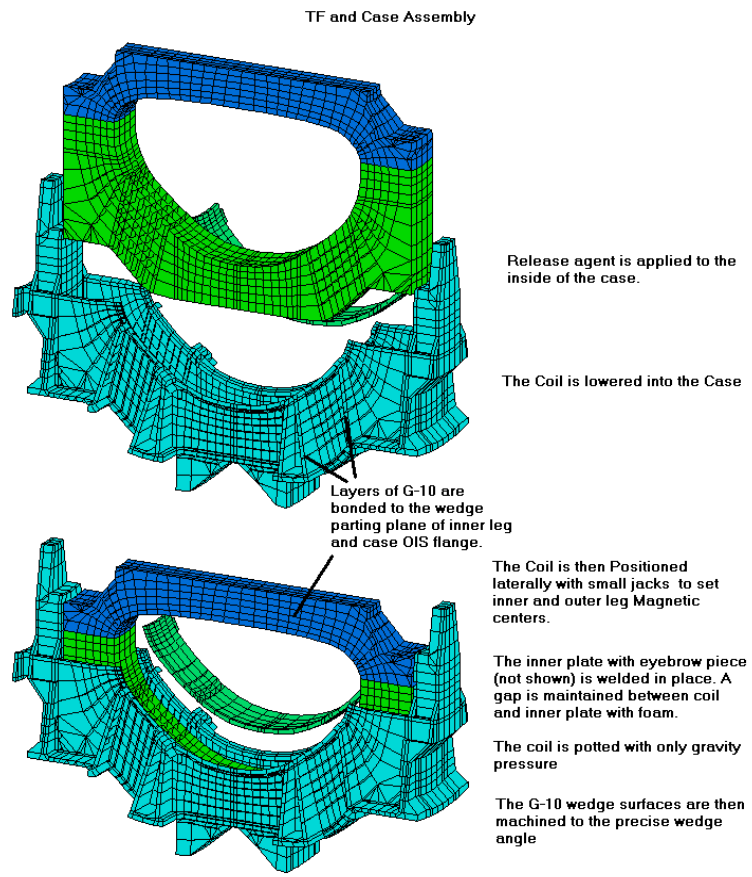
Start with the planned assembly scheme for a single coil/case. : Release agent is applied to the inside of the case.

The coil is lowered into the case. The bladders and/or shims have been located at the ledge surface, and the perimeter of these shims is dammed to preclude potting compound from entering the space that will later be filled via the inflatable shims.

Insulation layers have been bonded to the wedged parting plane of the inner leg and OIS flange.

The coil is then positioned laterally with small jacks to set the inner and outer leg magnetic centers.

The inner plate with the eyebrow piece is welded in place. A gap is maintained with foam between the coil and inner plate. The coil is potted with only gravity pressure. The insulated surfaces are then machined to the precise wedge angle.

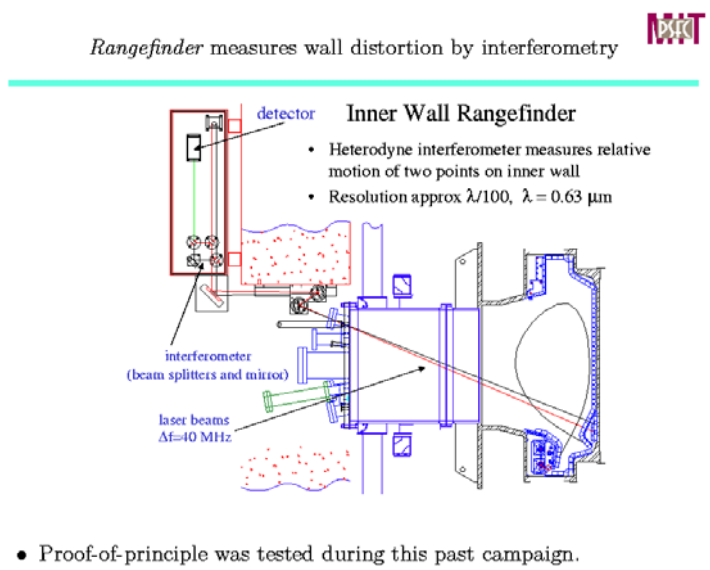


Checking the fit-up of the Wedge Faces and Nose of the TF in the Shop

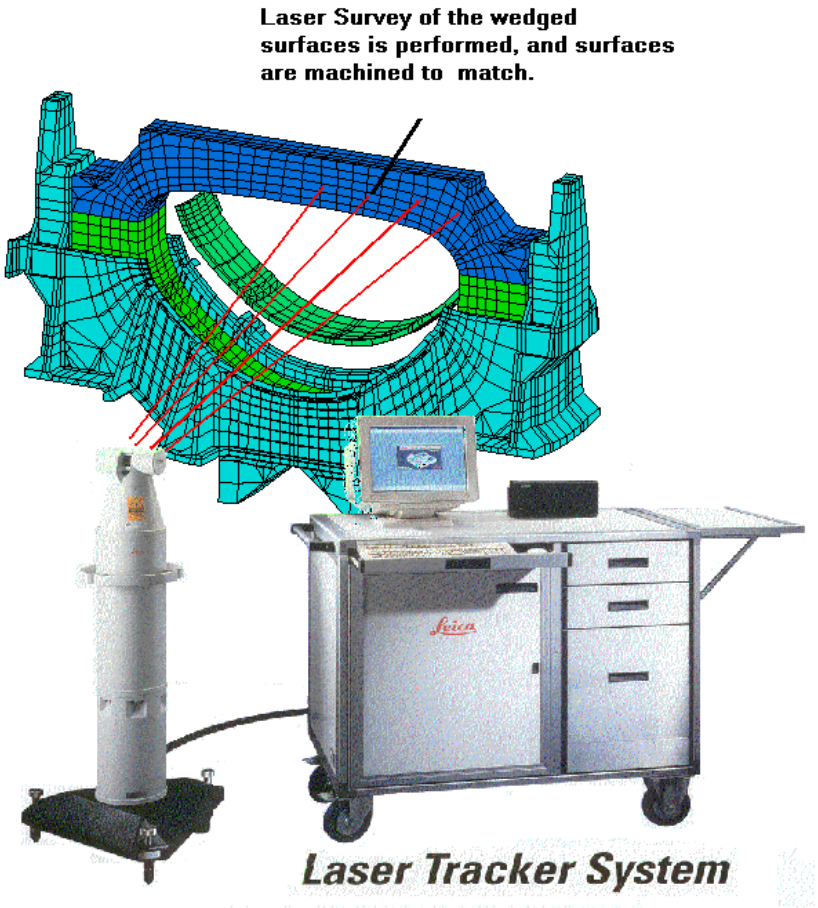
The wedge faces of the inner leg of the TF need to bear uniformly on each other.

Once the wedge faces are machined they can be laser surveyed and checked against tolerances.

Laser interferometry is currently being used to monitor disruption deflections of the C-Mod vessel inner wall. A retro-reflector (a mirror in the form of three sides of a cube that reflects a laser beam directly back at it's source) is mounted on the vessel wall.



From Bob Granetz's Feb.2000 C-Mod PAC Presentation



Laser Survey of Wedged Surfaces

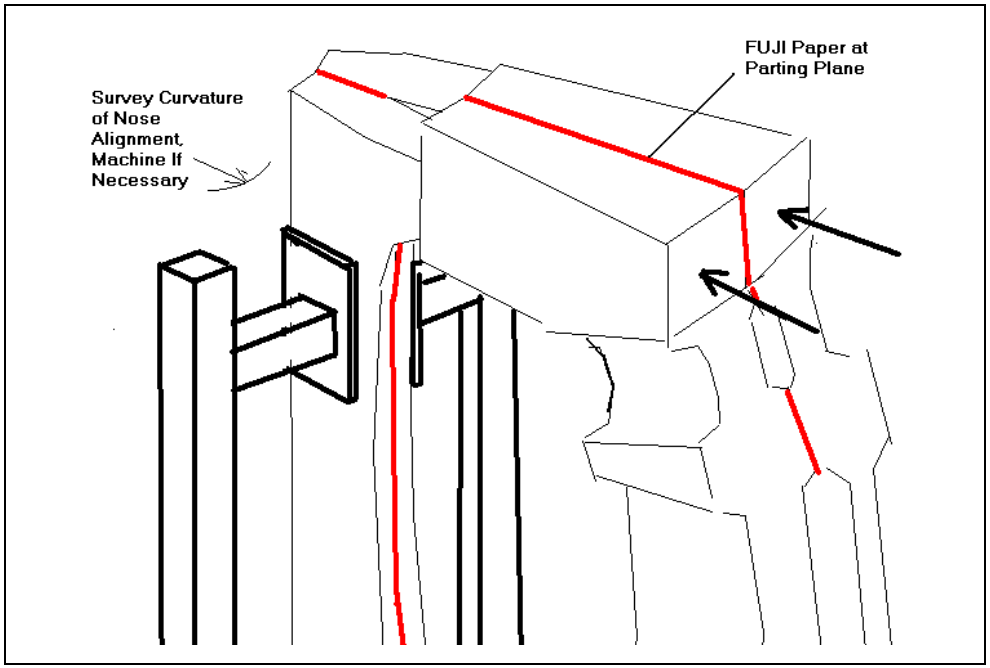
PPPL Owns a Leica System like that shown above. Leica Systems are being used at Brookhaven National Lab for LHC and SNS magnets

Trial Fit-Up

Laser Survey and machining may be sufficient, but it is advisable to pre assemble the matched pairs of leg surfaces in the shop prior to shipping them to the test cell or assembly hall.

A fixture that can accept two pairs of coil/case assemblies and can apply modest radial loads to wedge the faces would allow a fit-up check with a pressure sensitive paper, such as FUJI paper. (http://www.fujiprescale.net/).

The nose surface can be checked against specs and the alignment of the nose edges can be confirmed to ensure appropriate CS-TF clearance.



The case fit-up planes are as important to fit-up as the nose of the TF inner leg. Uniform surface contact is obtained by repeated assembly and sanding down the high spots as indicated by the pressure sensitive paper. It would be tedious, but the accuracy of the machining operation hopefully would make this exercise a confirmatory one only. The coil/case assemblies are now in sequential matched pairs.

It is also possible to use epoxy bladder/pillow type shims on the wedge faces, but the machining operations outlined above should be sufficient.

Ring Case and Coil Fit-up

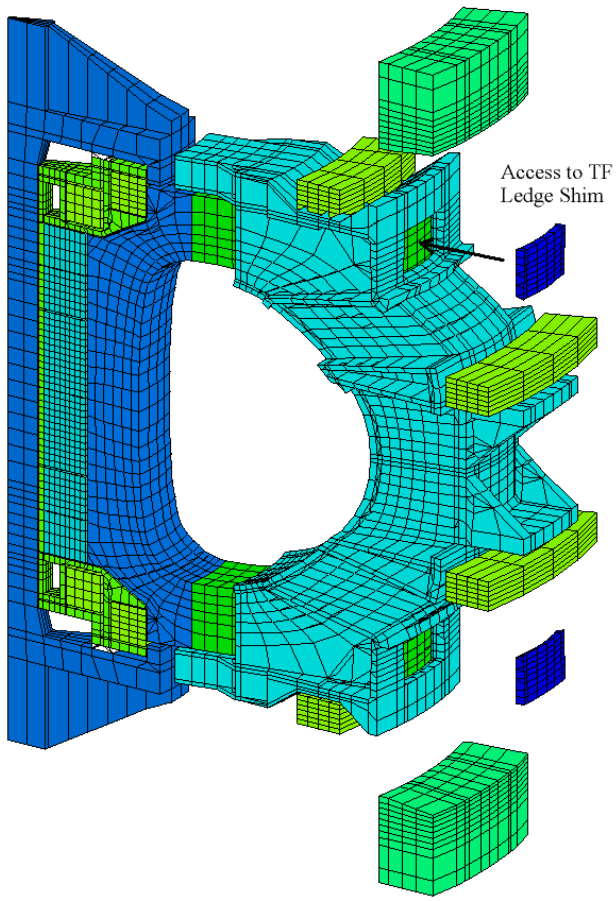
The present design uses some of the ring load to put compressive hoop stress in the case to develop frictional shear capacity at the case-to-case interfaces. This reduces the number and loading of the shear pins aligning the cases.

The rest of the ring load appears in the TF inner leg to support the OOP torsional shear in the upper and lower corners of the TF inner leg.

The loads shared between these two compressive hoop load paths, is statically in-determinant, and requires a finite element model to determine the load distribution.

A good fit-up is needed at the TF "ledge" where the case comes between ring and TF. Shims or inflatable bladders are used at the ledge.

The ledge cover is a simple bolt-on that would allow easy access to the shims. They can be bladders, or shims machined to mate the exposed TF ledge.



"Window to Access Shim. Elastic Interactions Provide Appropriate Load Share