



US LHC ACCELERATOR PROJECT

brookhaven - fermilab - berkeley

```
ANSYS 5.1  
POST1  
SUB = 1  
TIME = 1  
TEMP  
TEMP = 97.319  
SMB = 1.8  
SMX = 360  
1.8  
34.933  
68.867  
101.2  
134.933  
167.467  
200.6  
233.733  
265.867  
308
```

LHC IR Alignment Workshop at Fermilab

October 4-5, 1999

T. Nicol - Fermilab



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Summary

The cryostat consists of all parts of the completed magnet with the exception of the cold mass itself. As such it serves as the system which defines the warm and cold positions of the cold mass, provides the structural supports to resist shipping, handling, and operational loads (some may be permanent, some temporary), provides the features for measuring the position of the cold mass, and provides the features for aligning the cold mass in the experimental halls.

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TEPC = 97.319  
SMB = 1.8  
SYN = 260  
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167.467  
33.794
```



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Questions

- How well do we need to determine the magnetic position with respect to the outside fiducials and how well can we do it?
- How well do we need to align the Q2a and Q2b cold masses with respect to each other and how well can we do it?
- How repeatable should the warm-to-cold mechanical movement be from magnet to magnet?
- How much permanent movement of the warm position is acceptable during shipping and handling?
- What kind of structures do we need to design and build in addition to the magnets to ensure their mechanical integrity during shipping?
- How do we determine the magnetic position after shipping, i.e. at CERN?

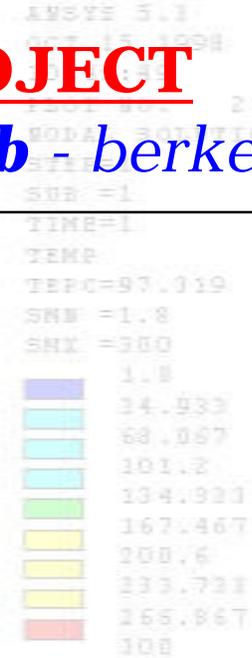


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Topics for discussion

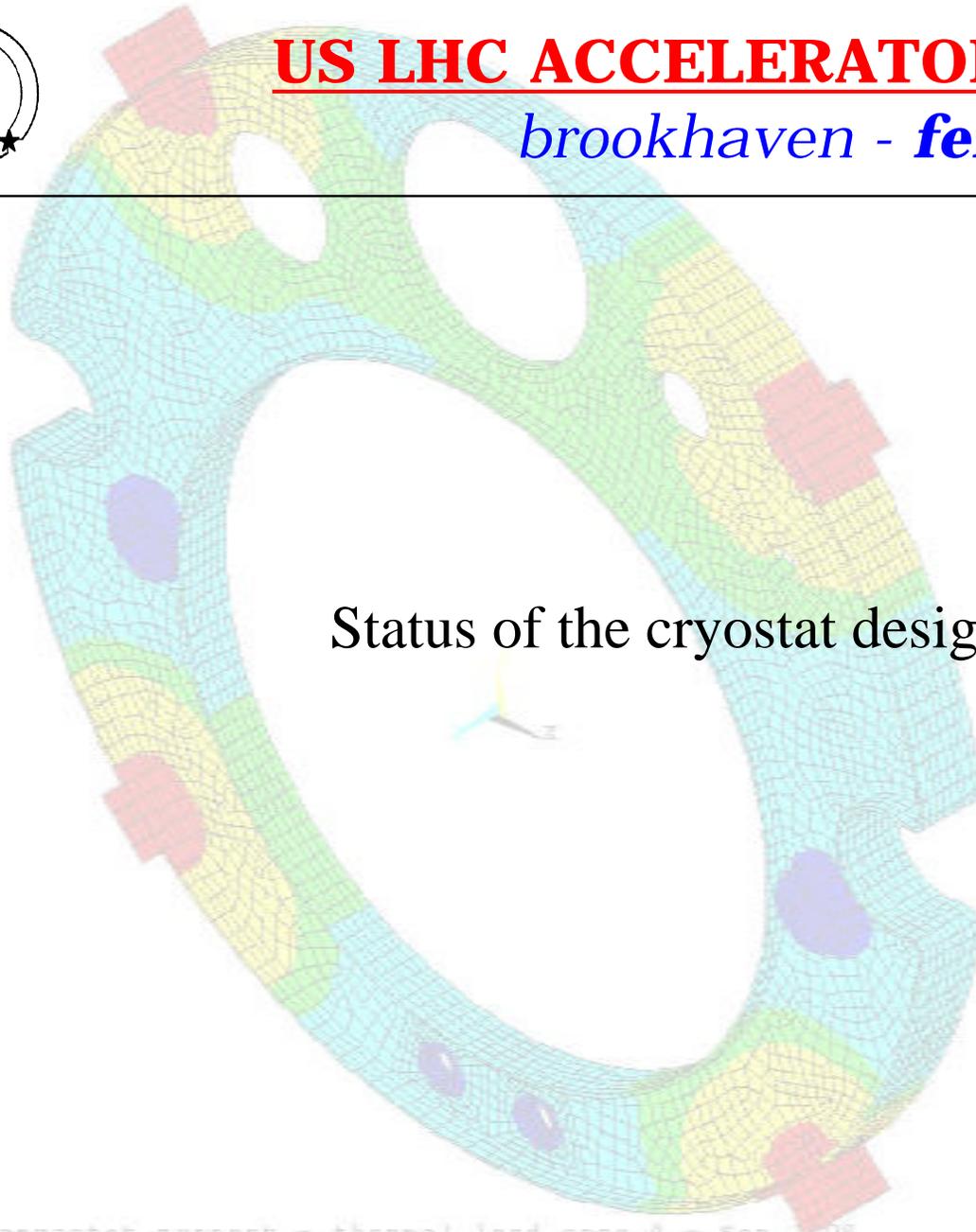
- Status of the cryostat design.
- Cold mass to suspension system interface.
- Final assembly concept.
- Deflection analysis results.
- Preliminary alignment fiducial mounting and location.
- Q2a/Q2b weld fixture and test.
- Short term plans (alignment related).





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Status of the cryostat design...

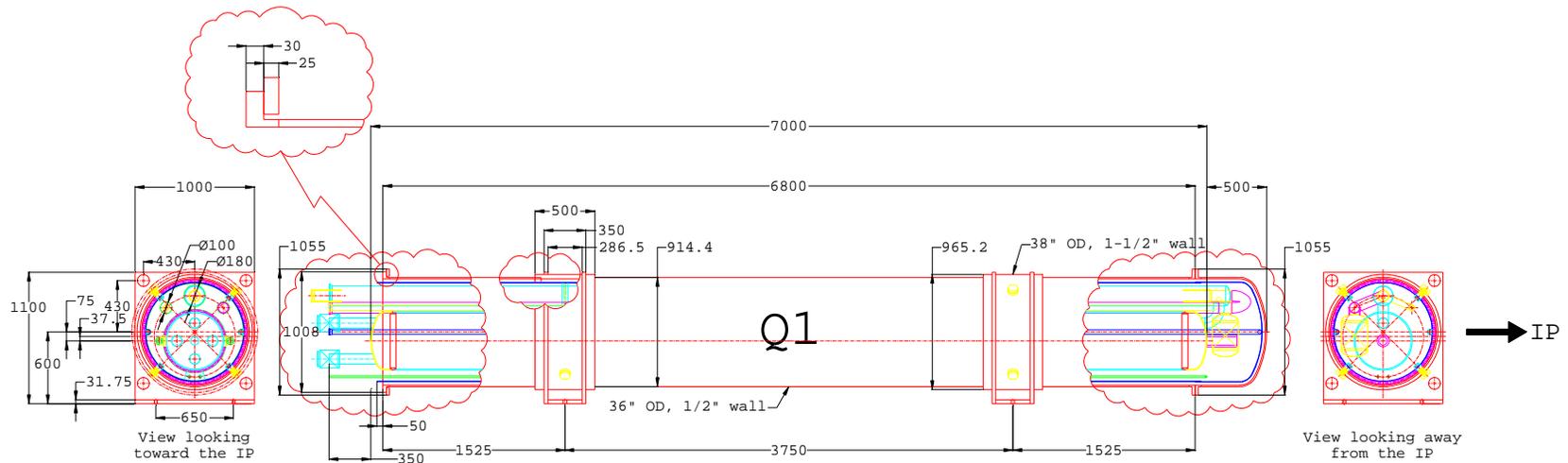
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SMX = 360
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Current Q1 cryostat conceptual design

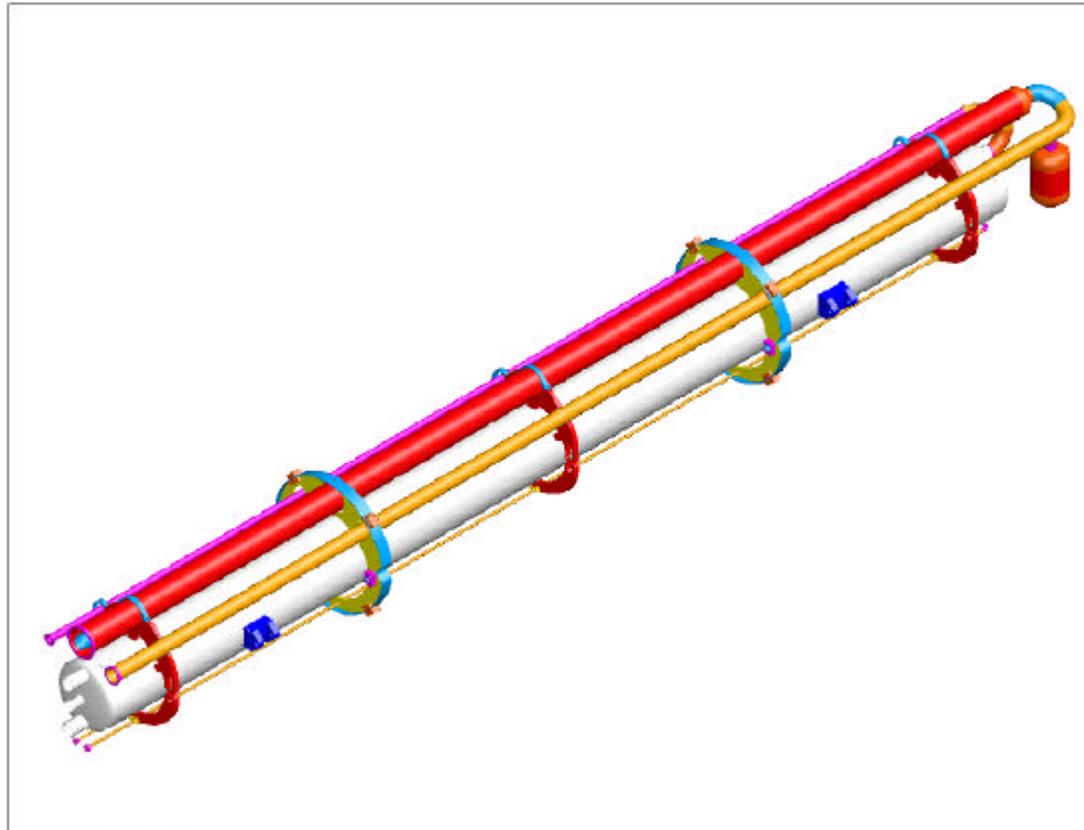




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Q1 internal piping assembly



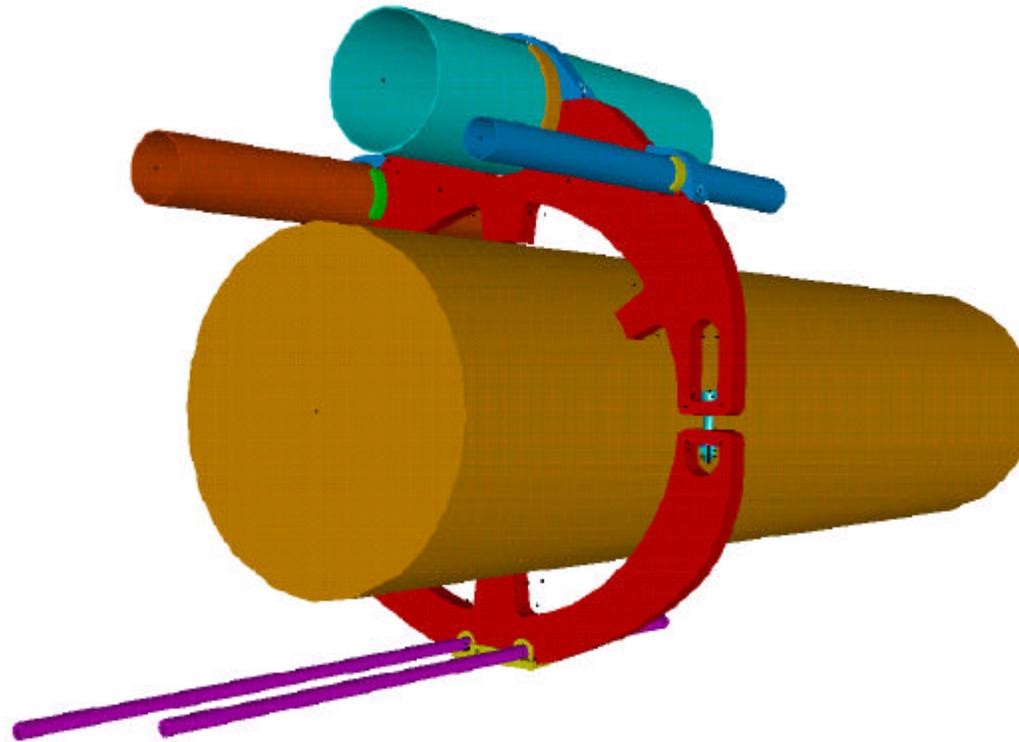
Plotted by ssmk on 20-nov-1999



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Piping support design concept

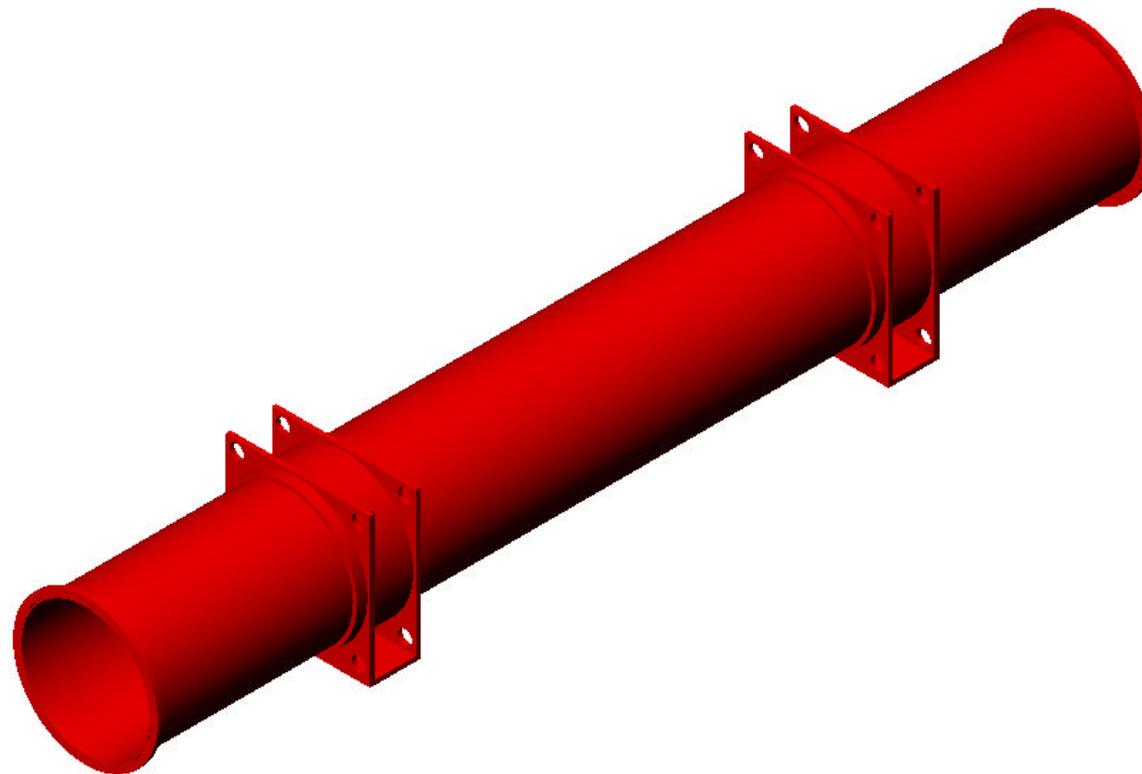




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Q1 vacuum vessel

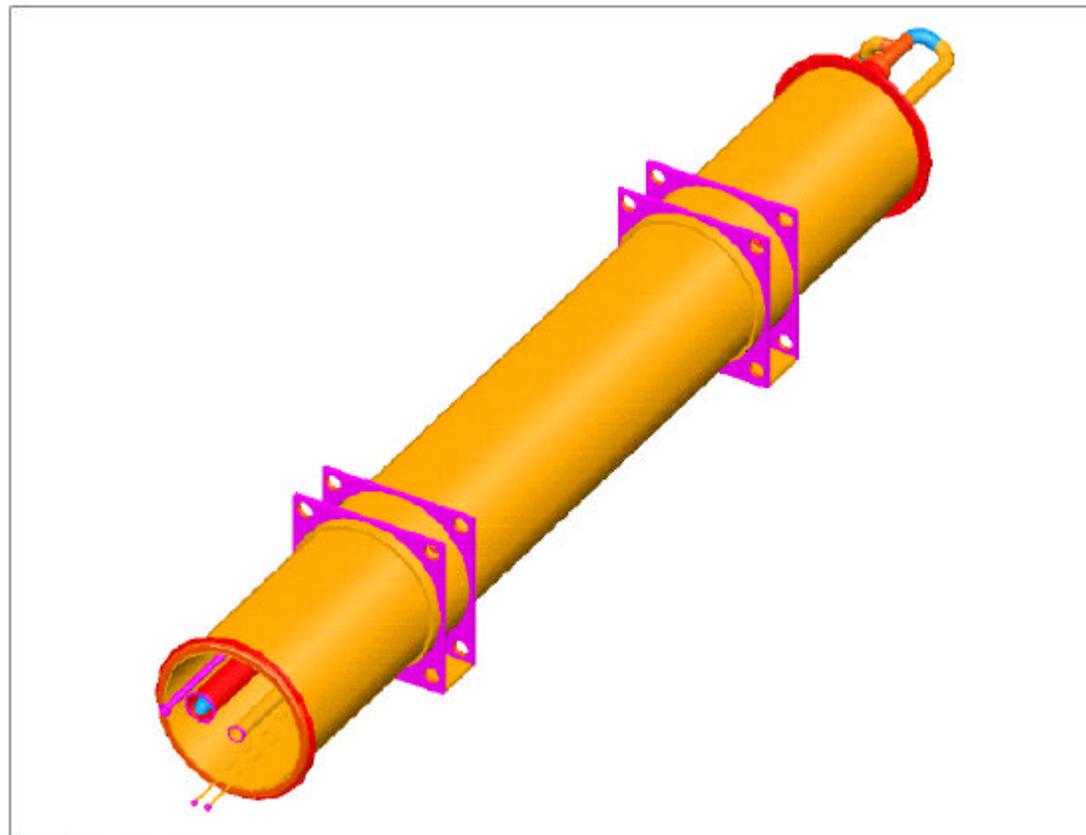




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Q1 cryostat assembly (without end dome)



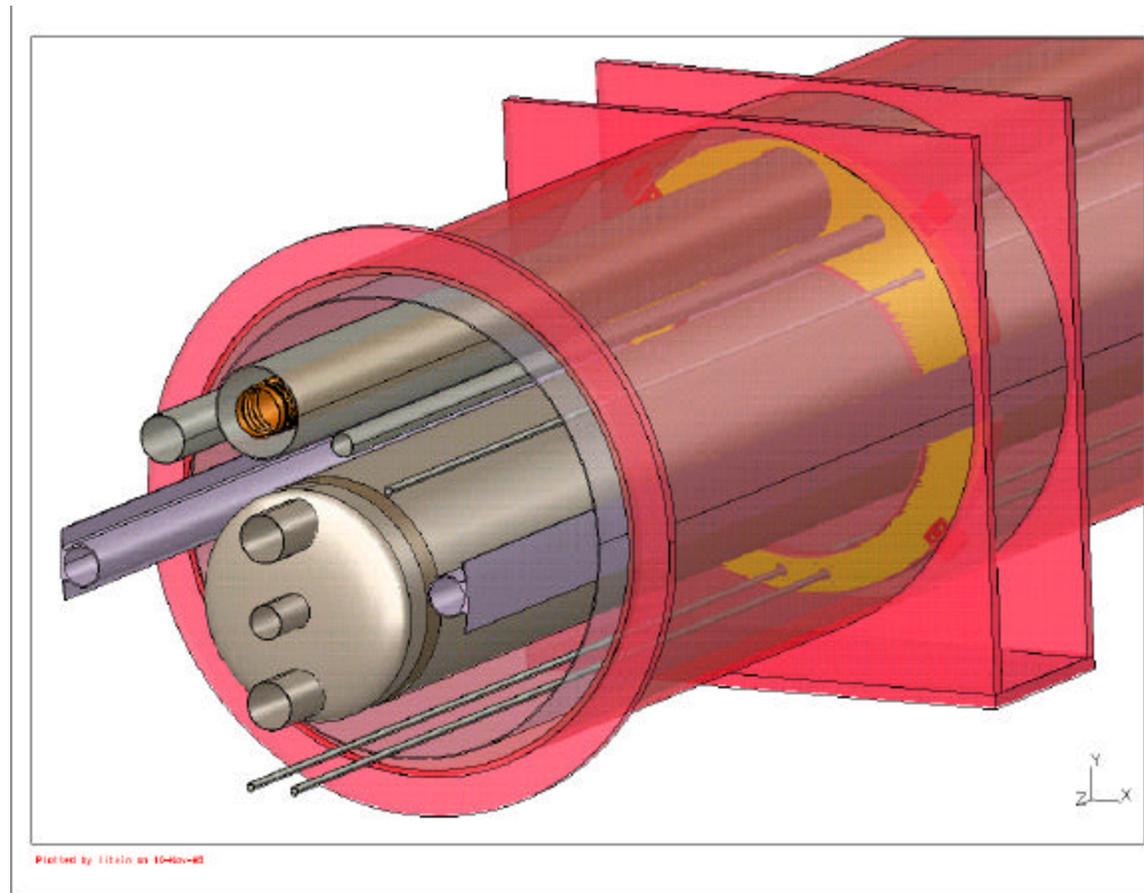
Plotted by ssmk on 01-nov-1999



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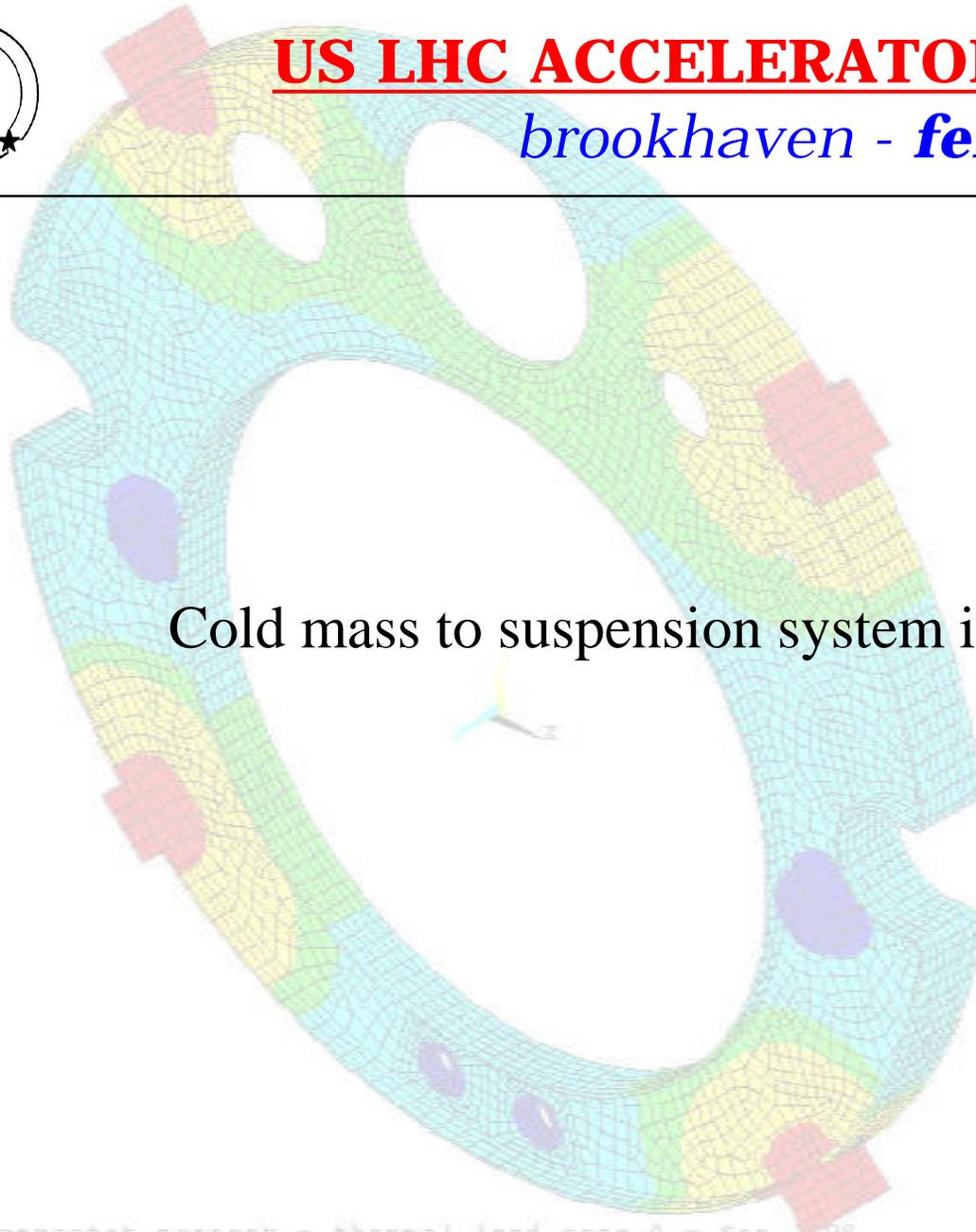
IRQ cryostat end view





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233.733  
265.867  
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```

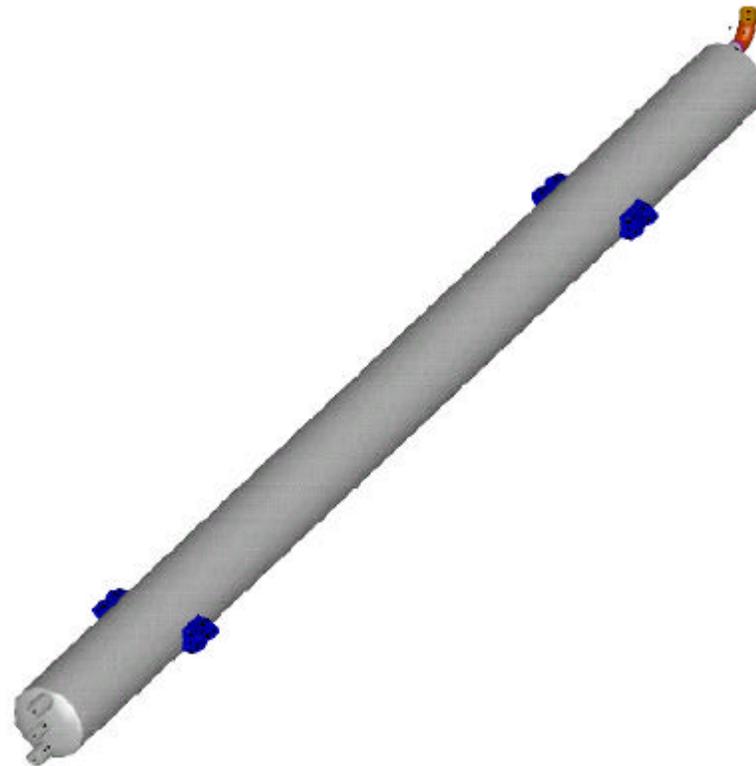
Cold mass to suspension system interface...



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Support to cold mass connection

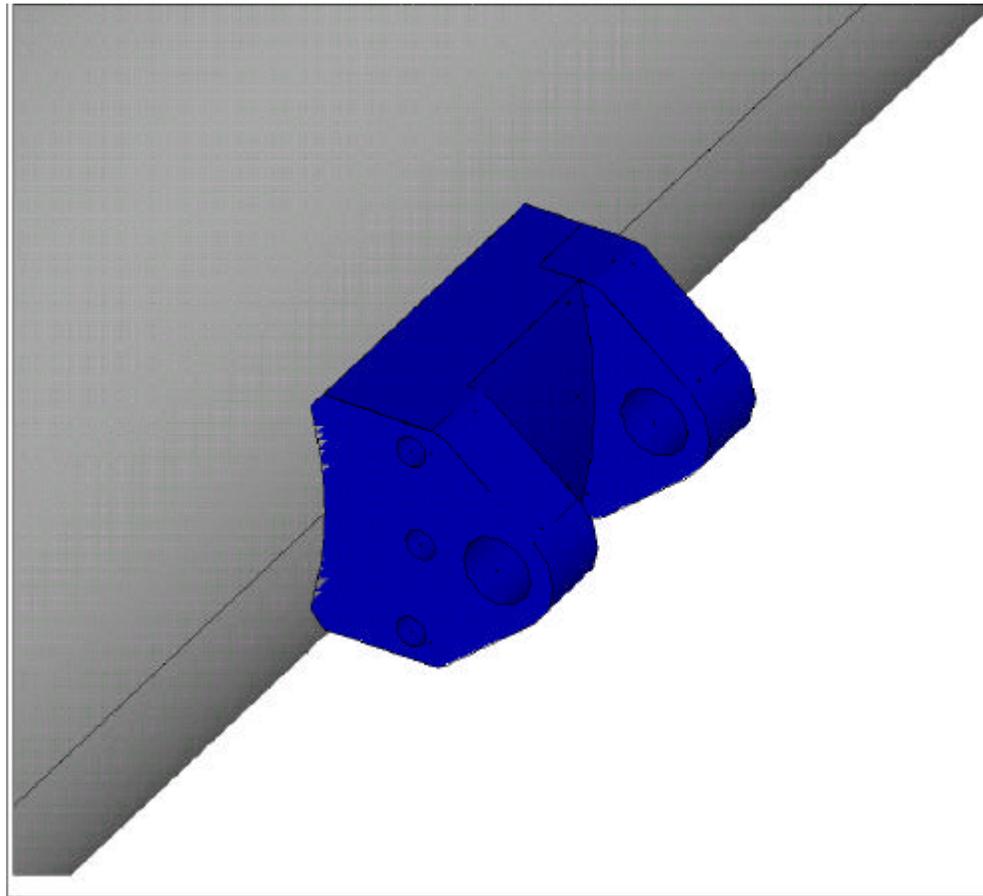




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Support to cold mass connection

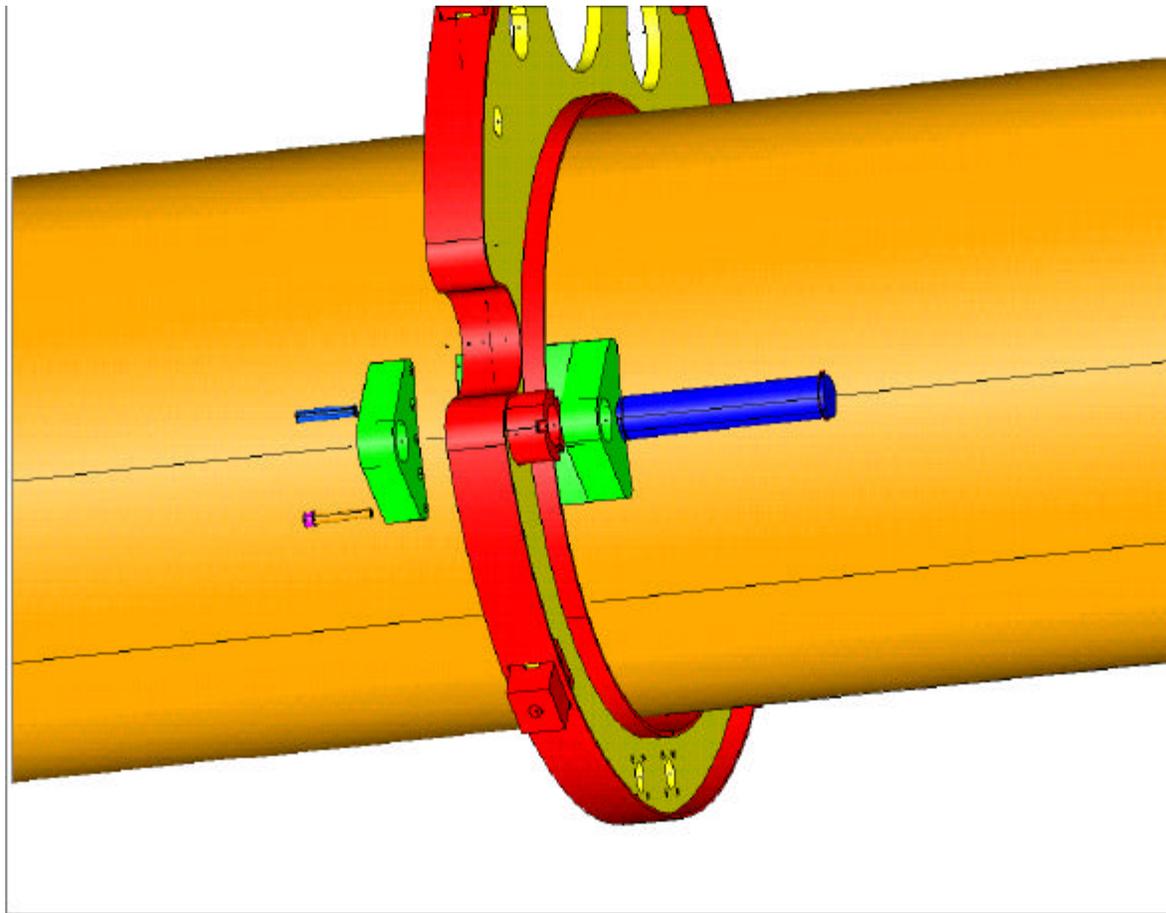




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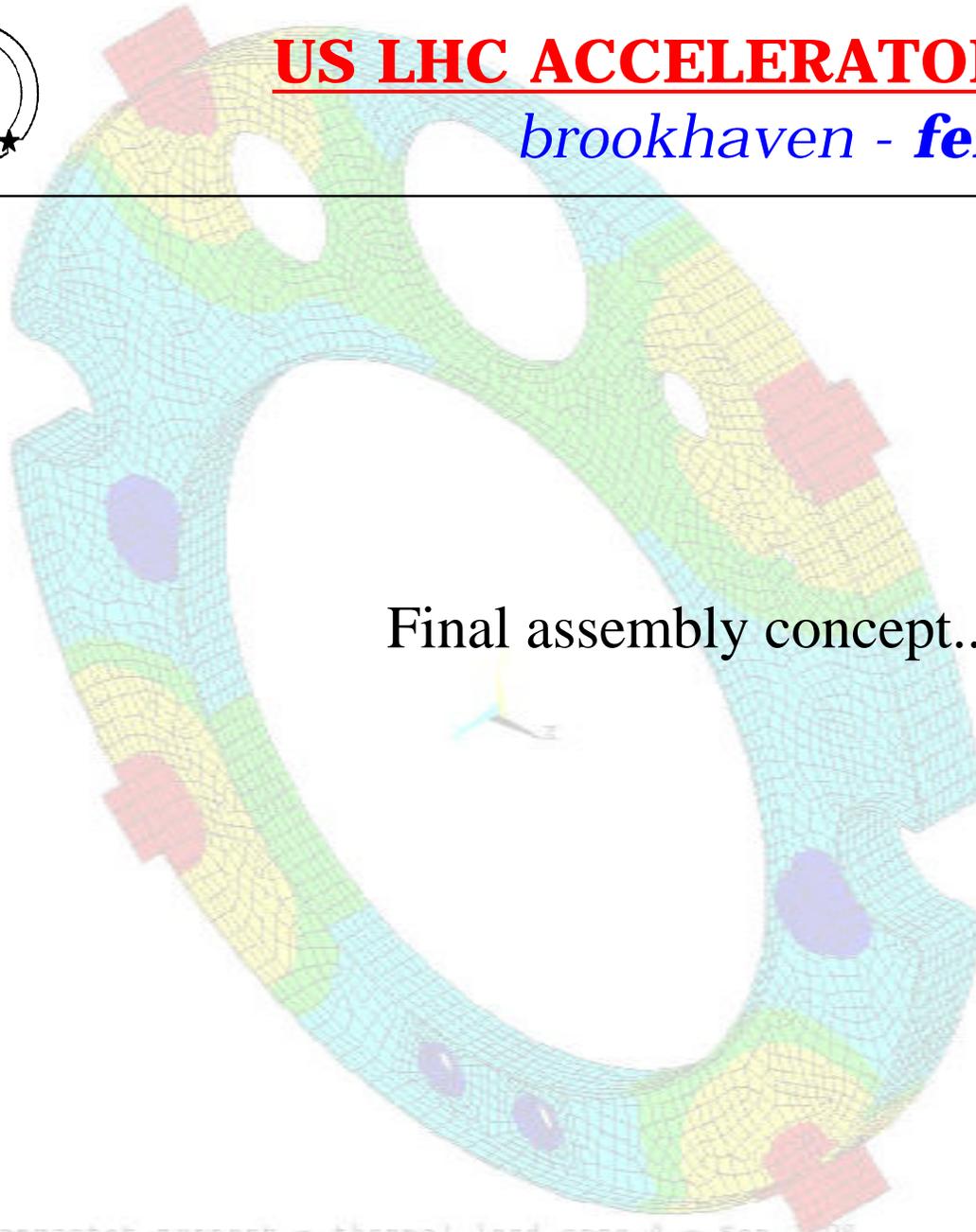
Support to cold mass connection





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Final assembly concept...

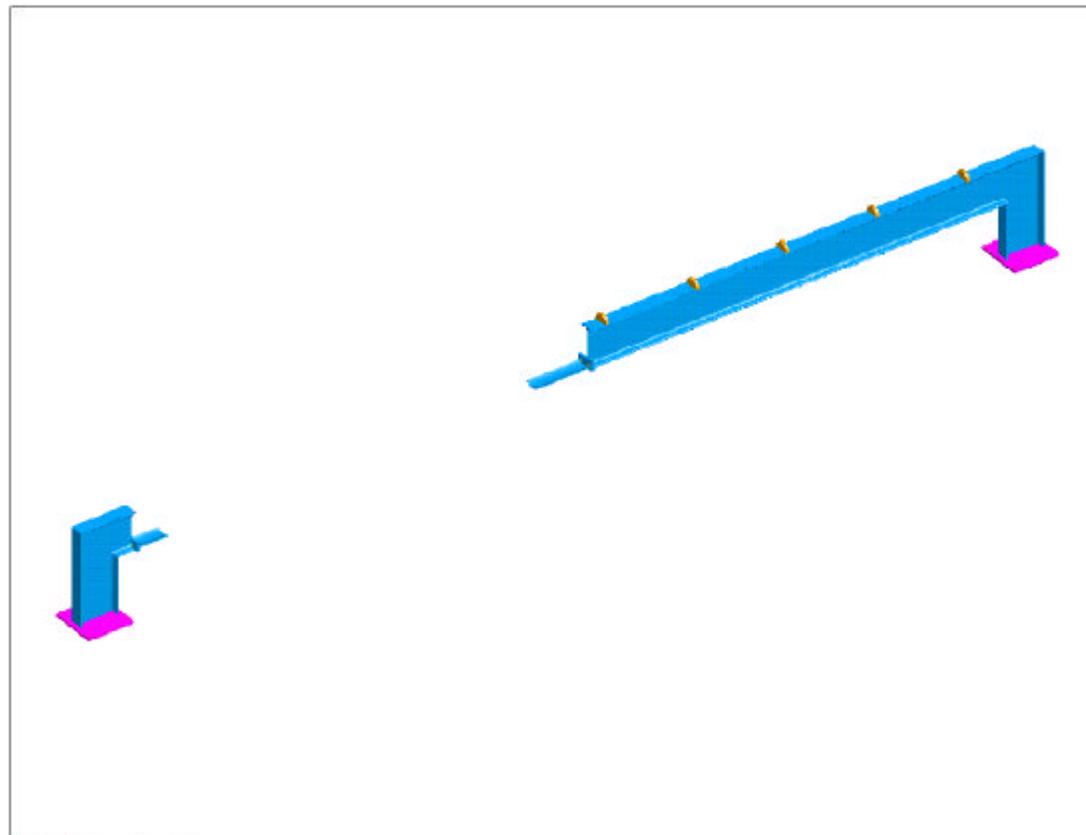
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167.467  
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308
```



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Assembly tooling insertion beam



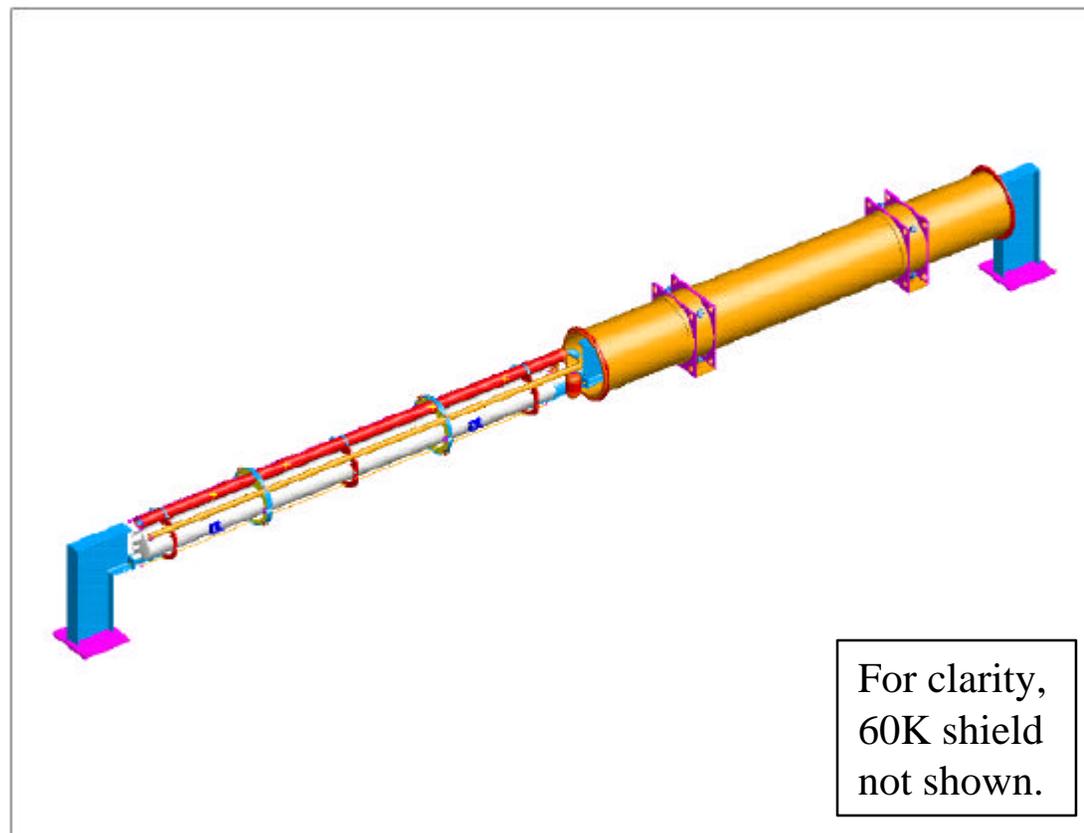
Printed by a3000 at 20-nov-1999



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Assembly tooling insertion beam - initial setup



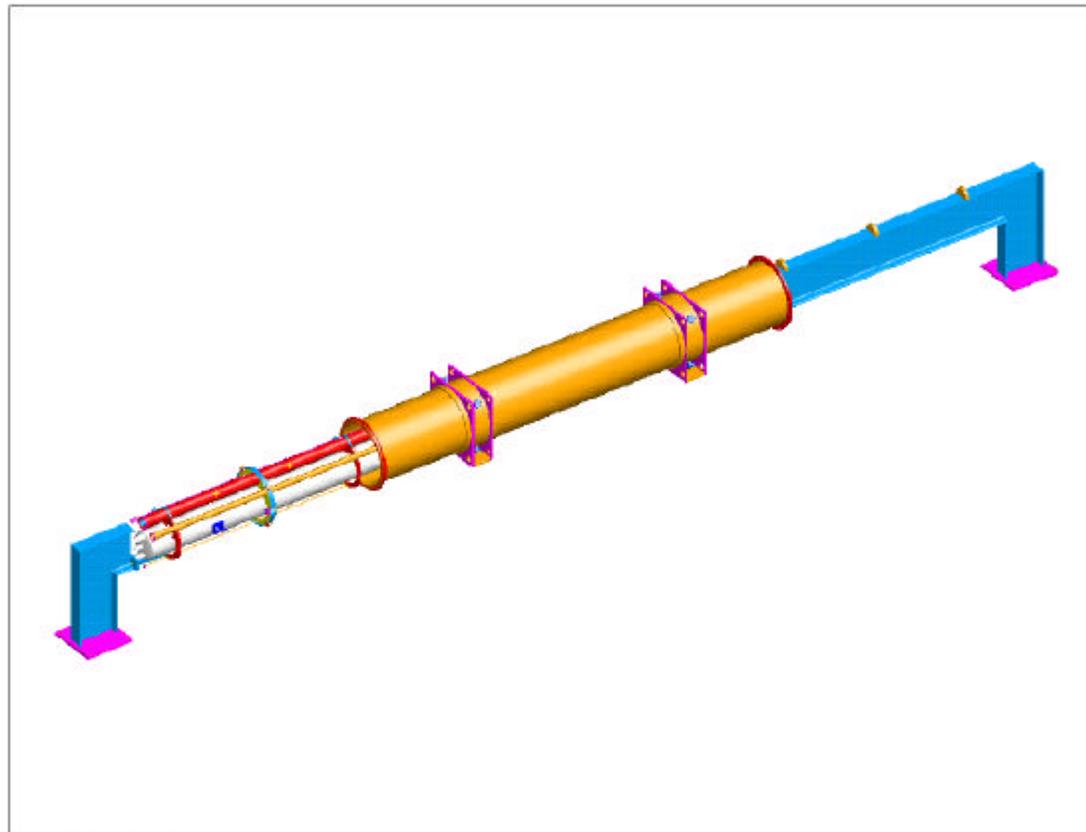
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Assembly tooling insertion beam - insertion in progress



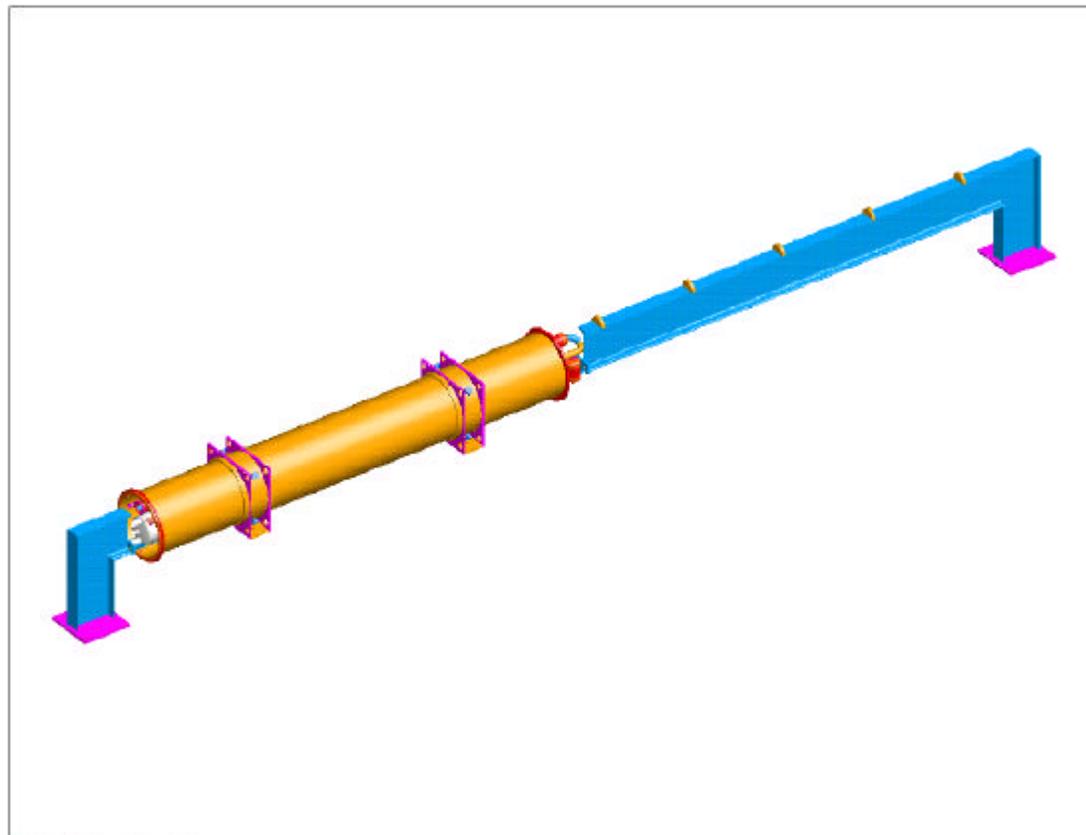
Plotted by a30016 on 20-nov-1999



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Assembly tooling insertion beam - insertion complete

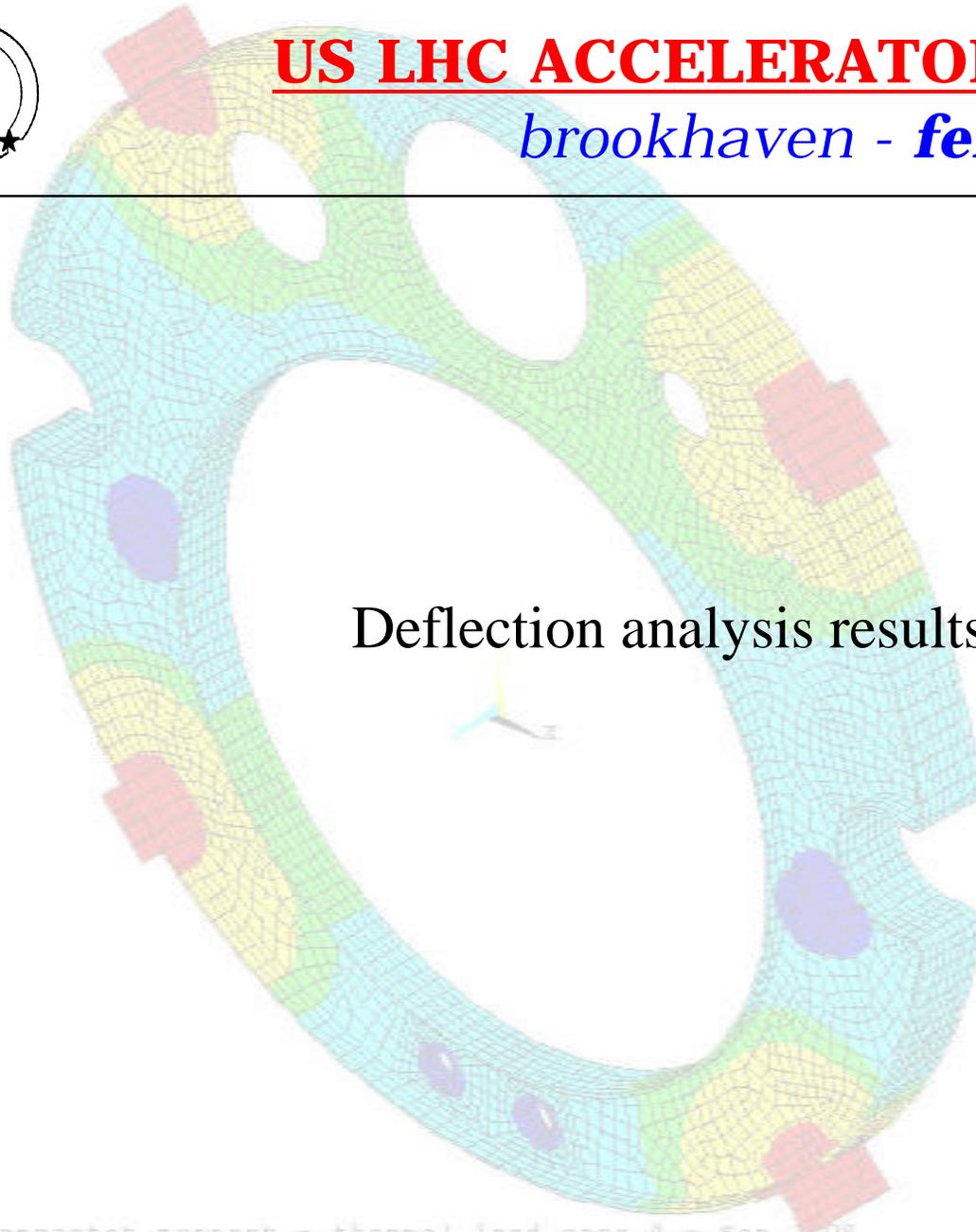


Printed by a3000 at 20-nov-1999



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Deflection analysis results...

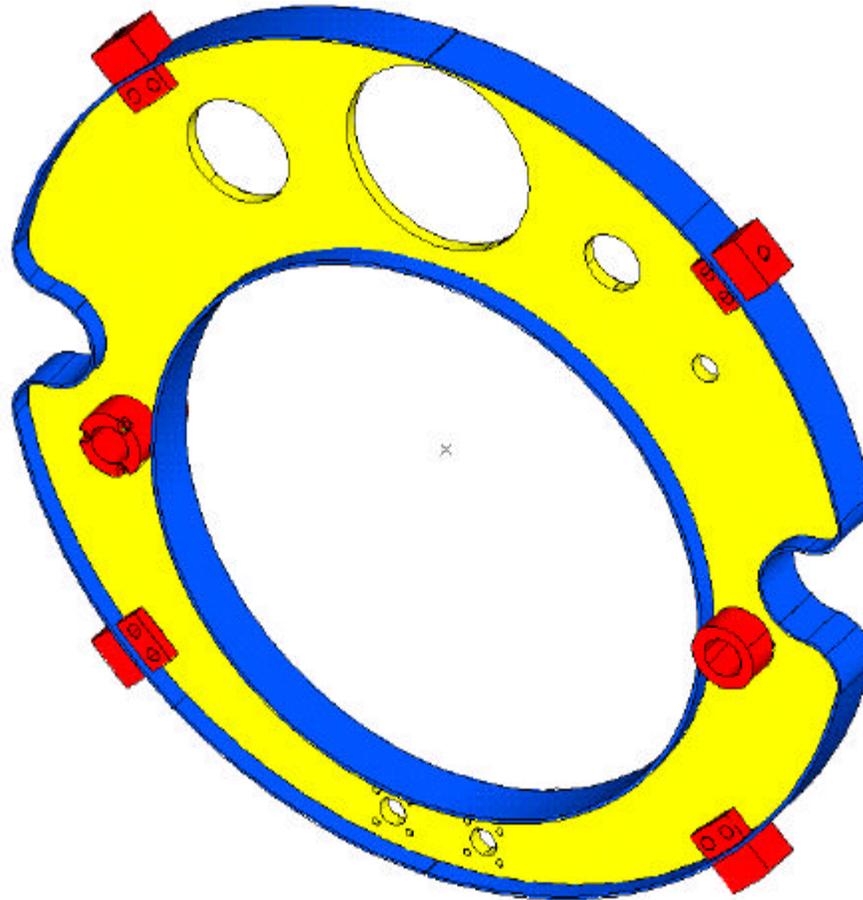
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```



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IRQ cryostat “spider” support

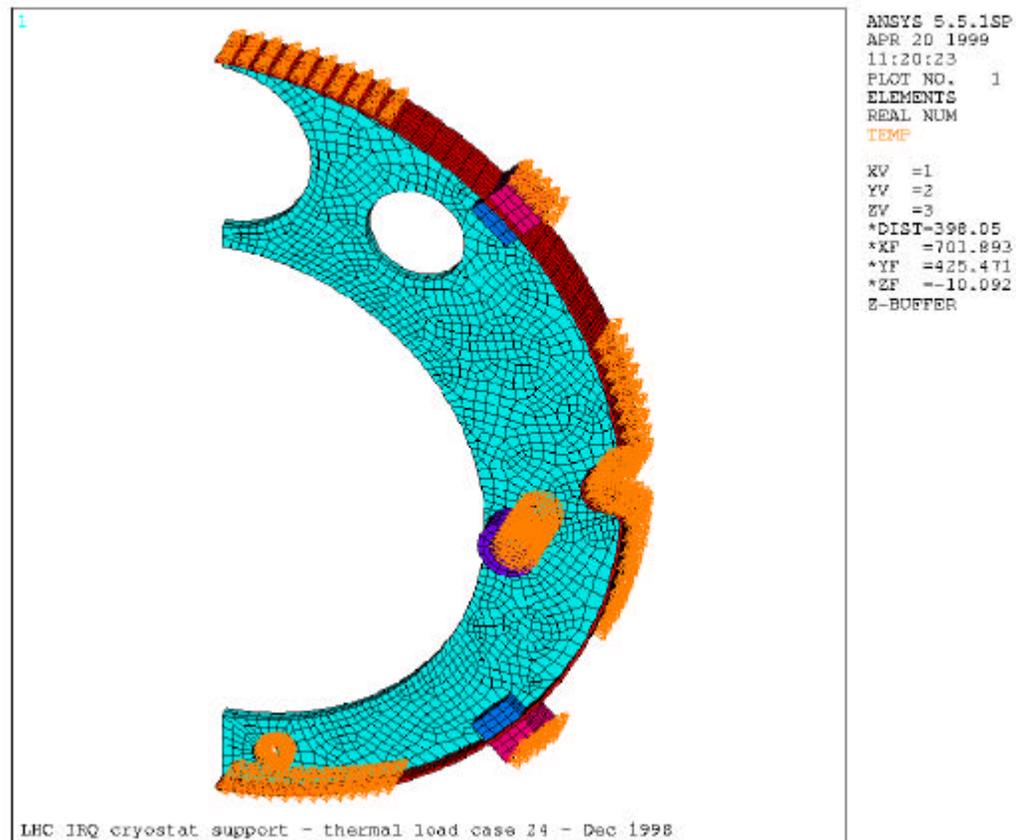




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IRQ cryostat support analysis thermal boundary conditions

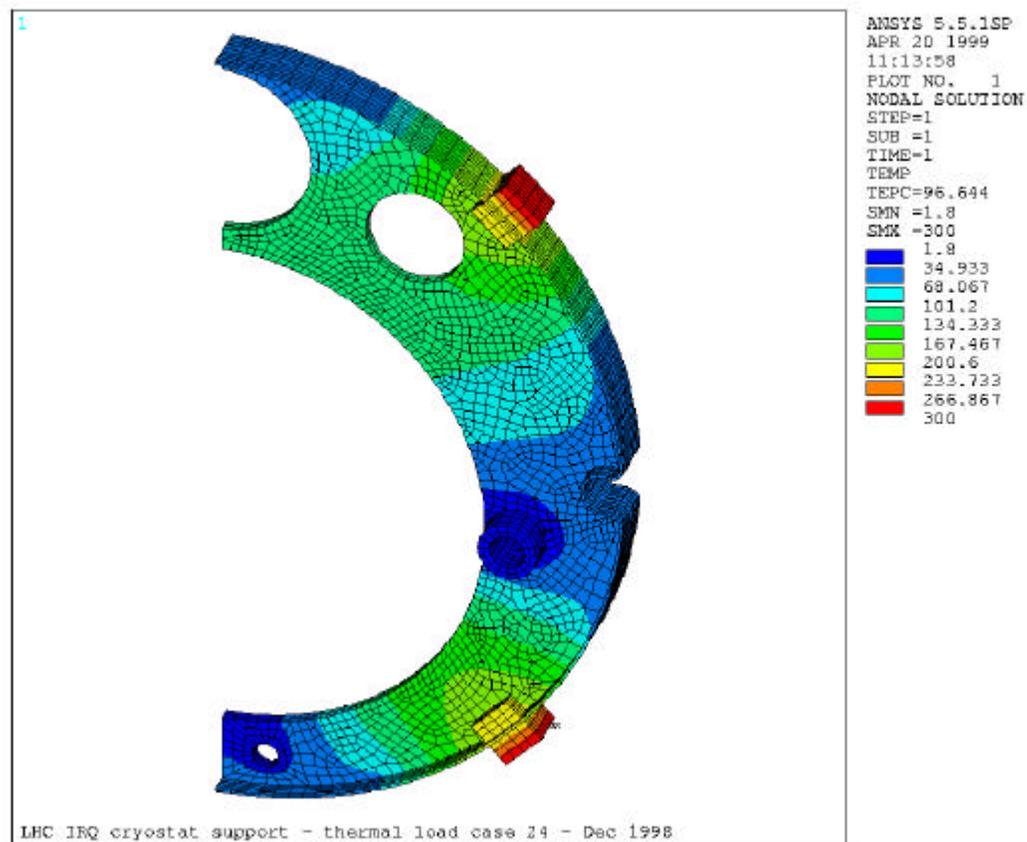




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IRQ cryostat support analysis temperature distribution

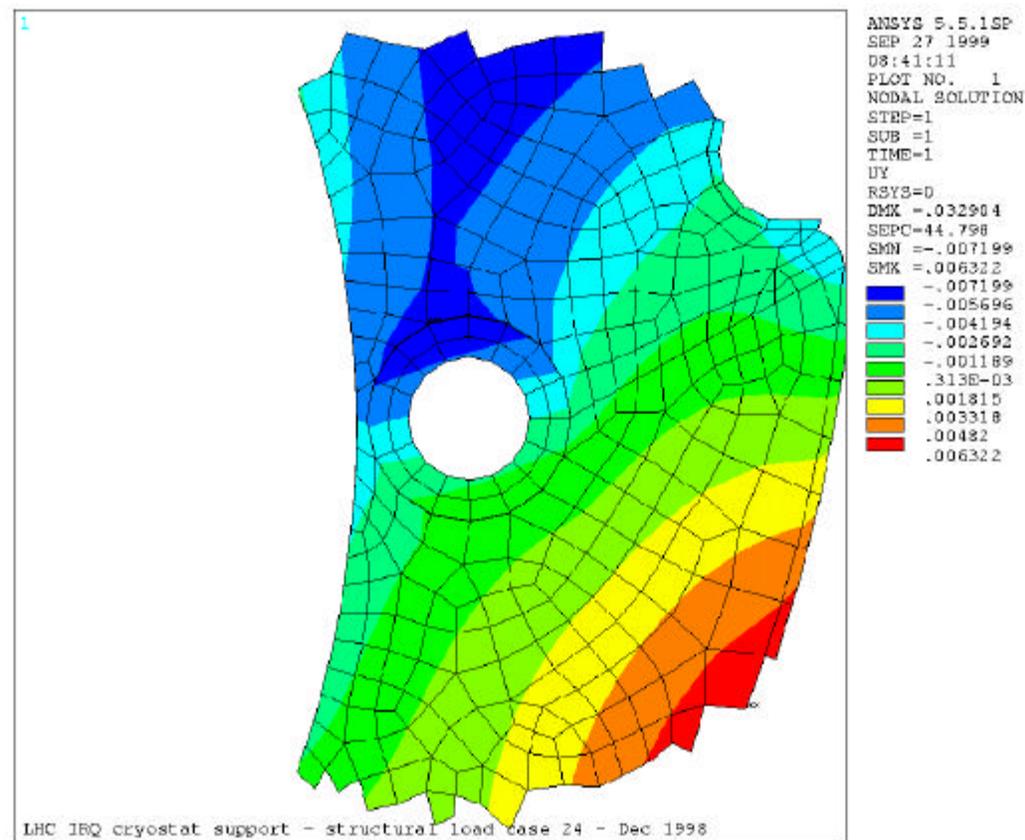




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Vertical deflections - cooldown + 1g vertical load (inches)

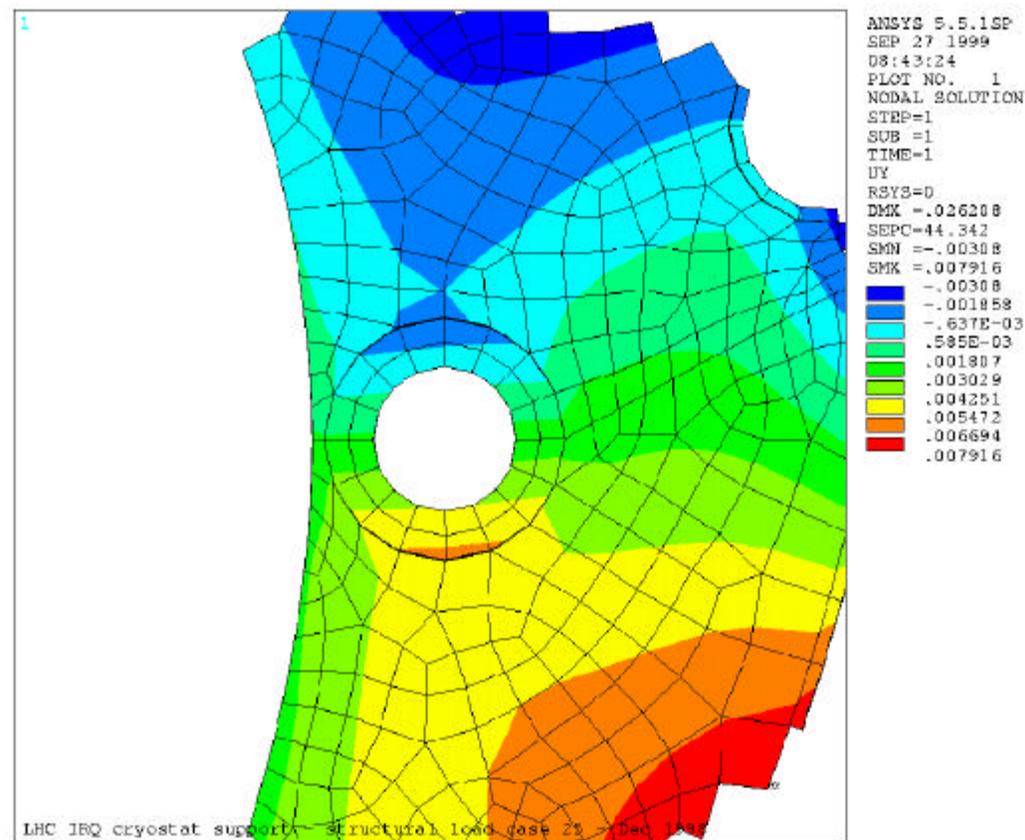




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Vertical deflections - cooldown only (inches)

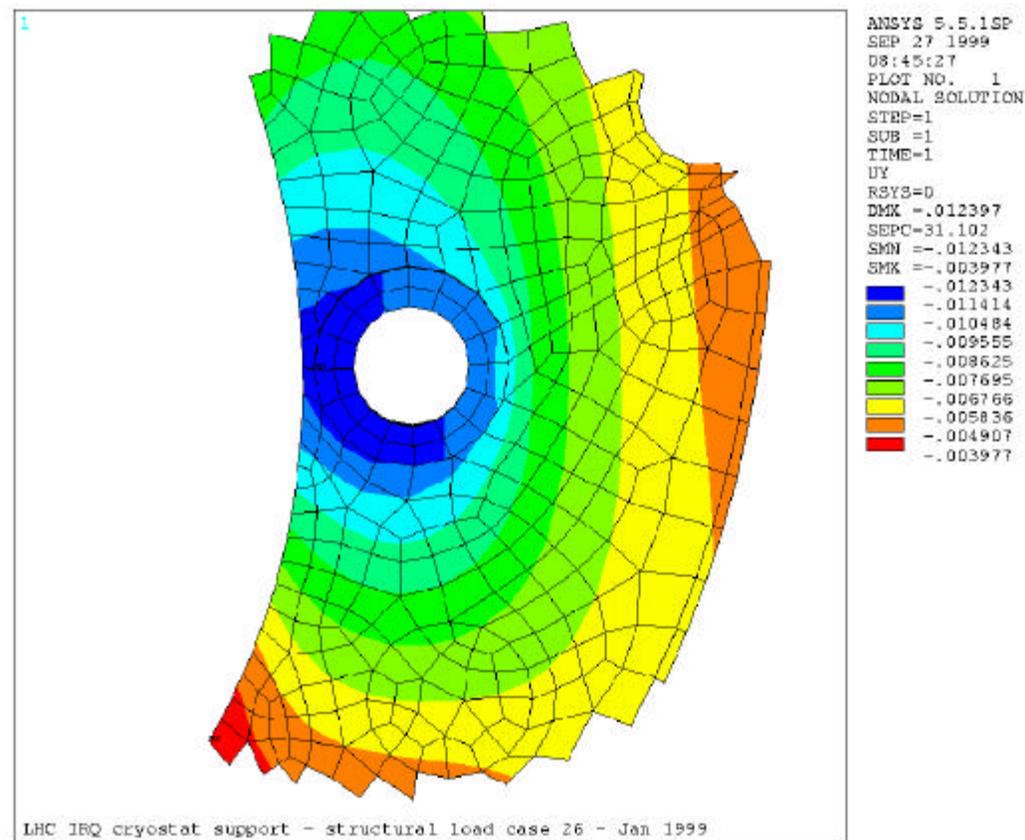




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Vertical deflections - 2g vertical load only (inches)



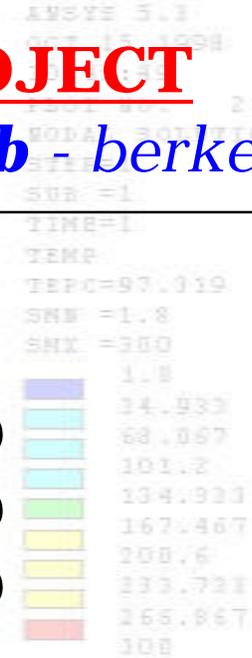


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Summary of deflection estimates

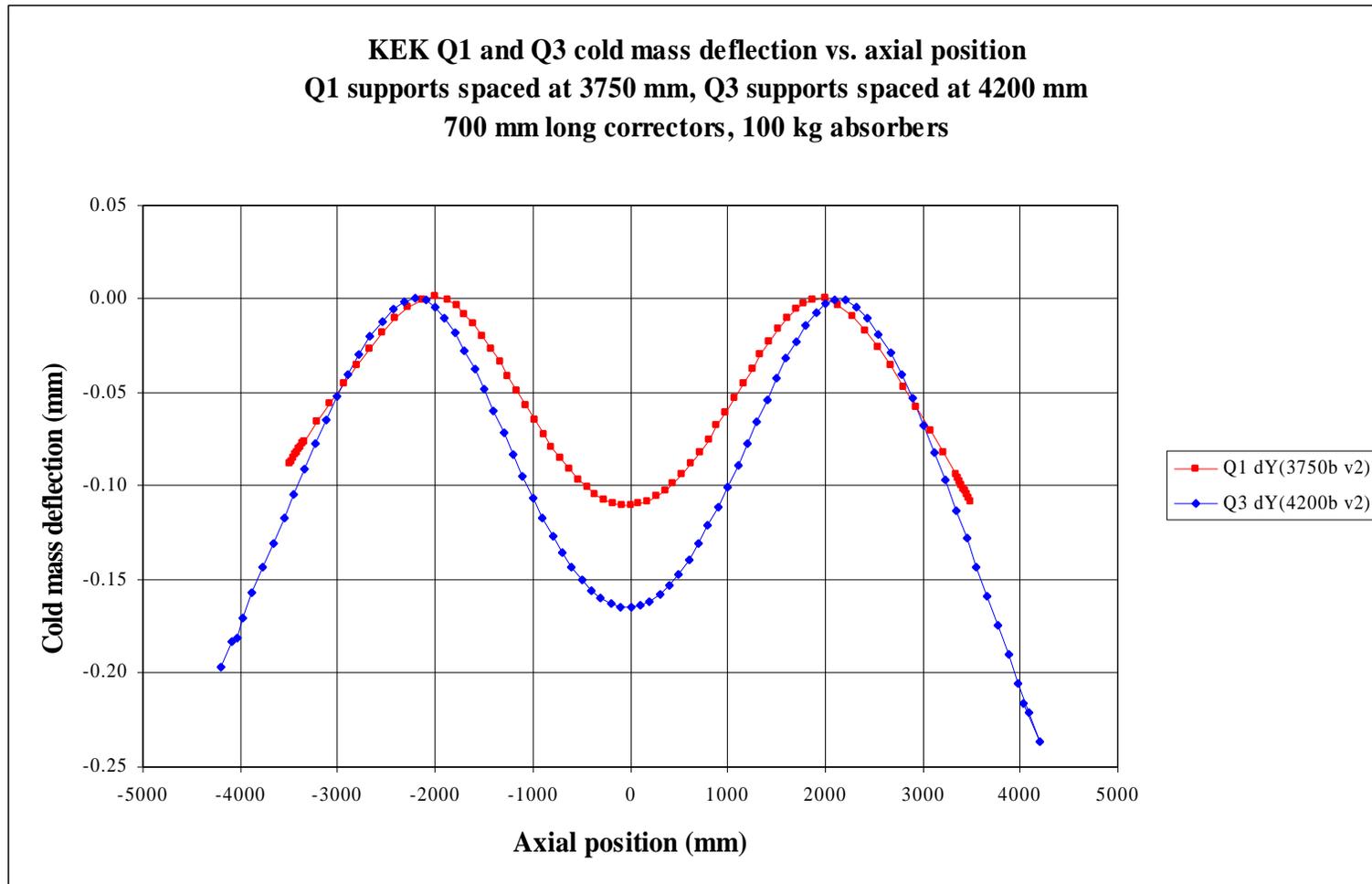
- Deflection due to weight only: $-0.006''$ (-0.00024 mm)
- Change during cooldown: $+0.002''$ ($+0.00008$ mm)
- Net change: $-0.004''$ (-0.00016 mm)





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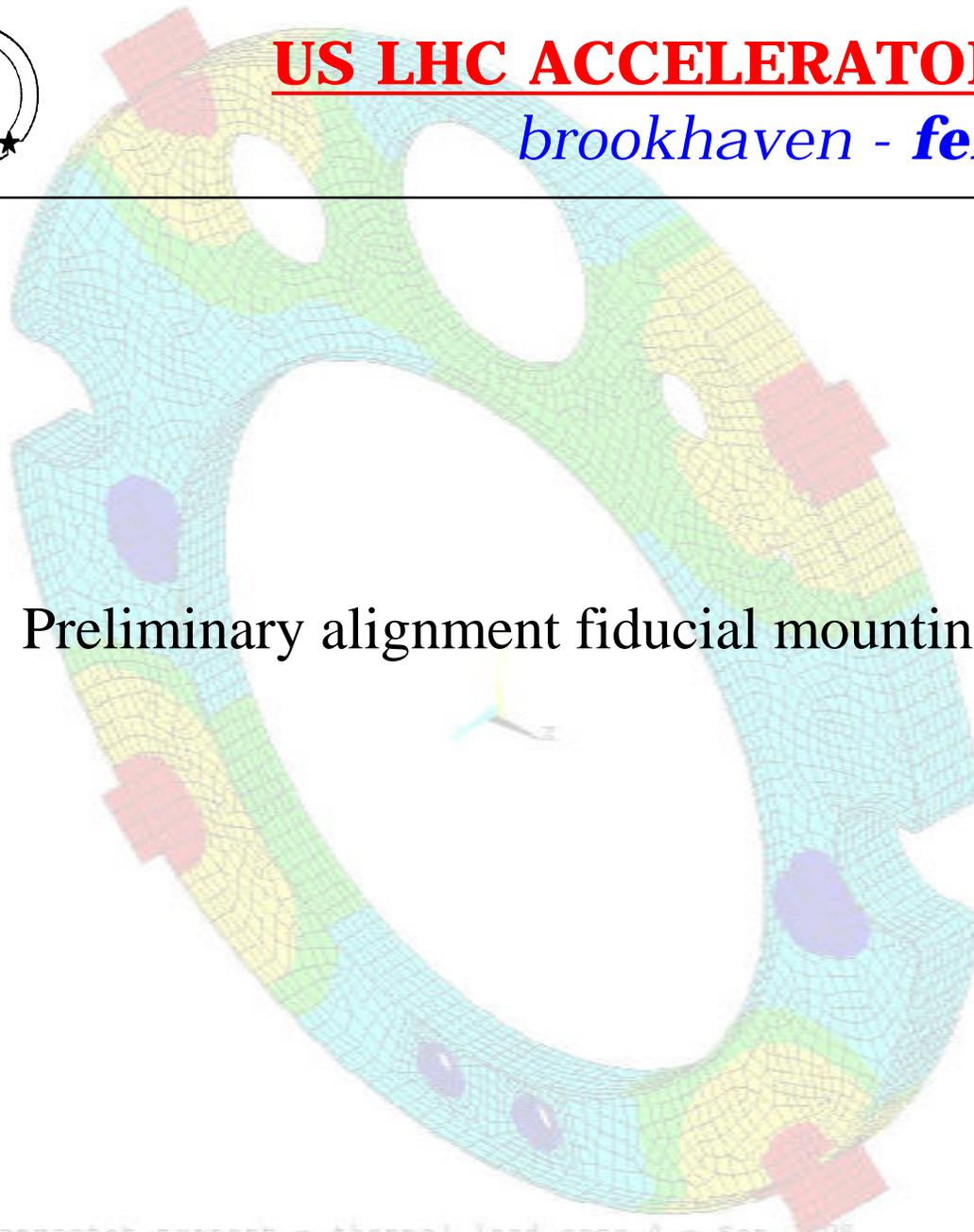
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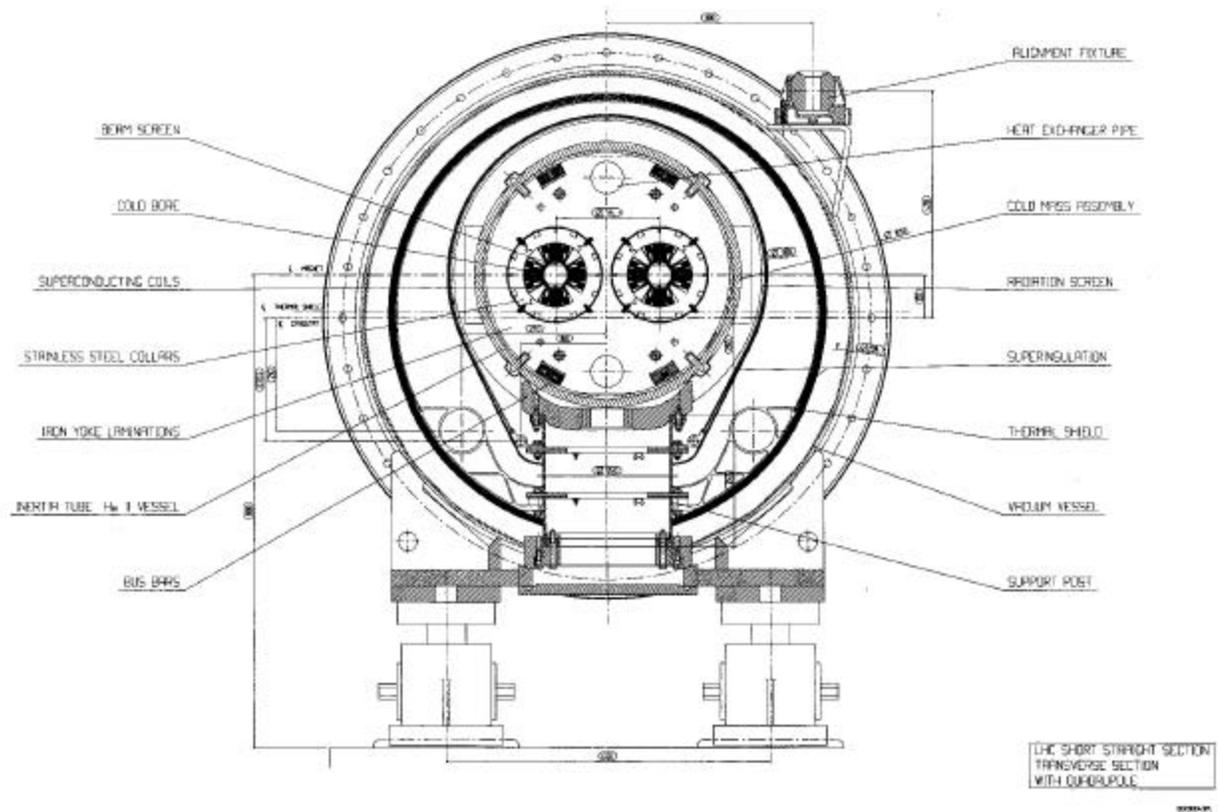
Preliminary alignment fiducial mounting and location...



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LHC dipole cross section with fiducial holder

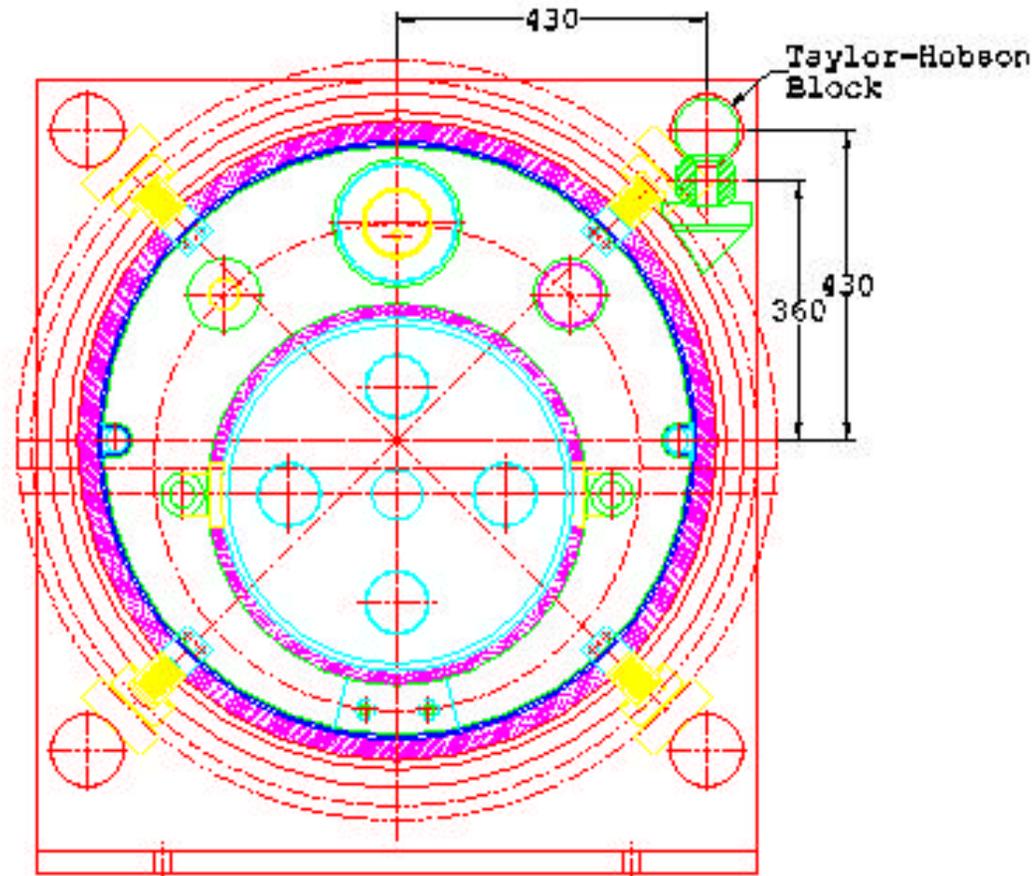




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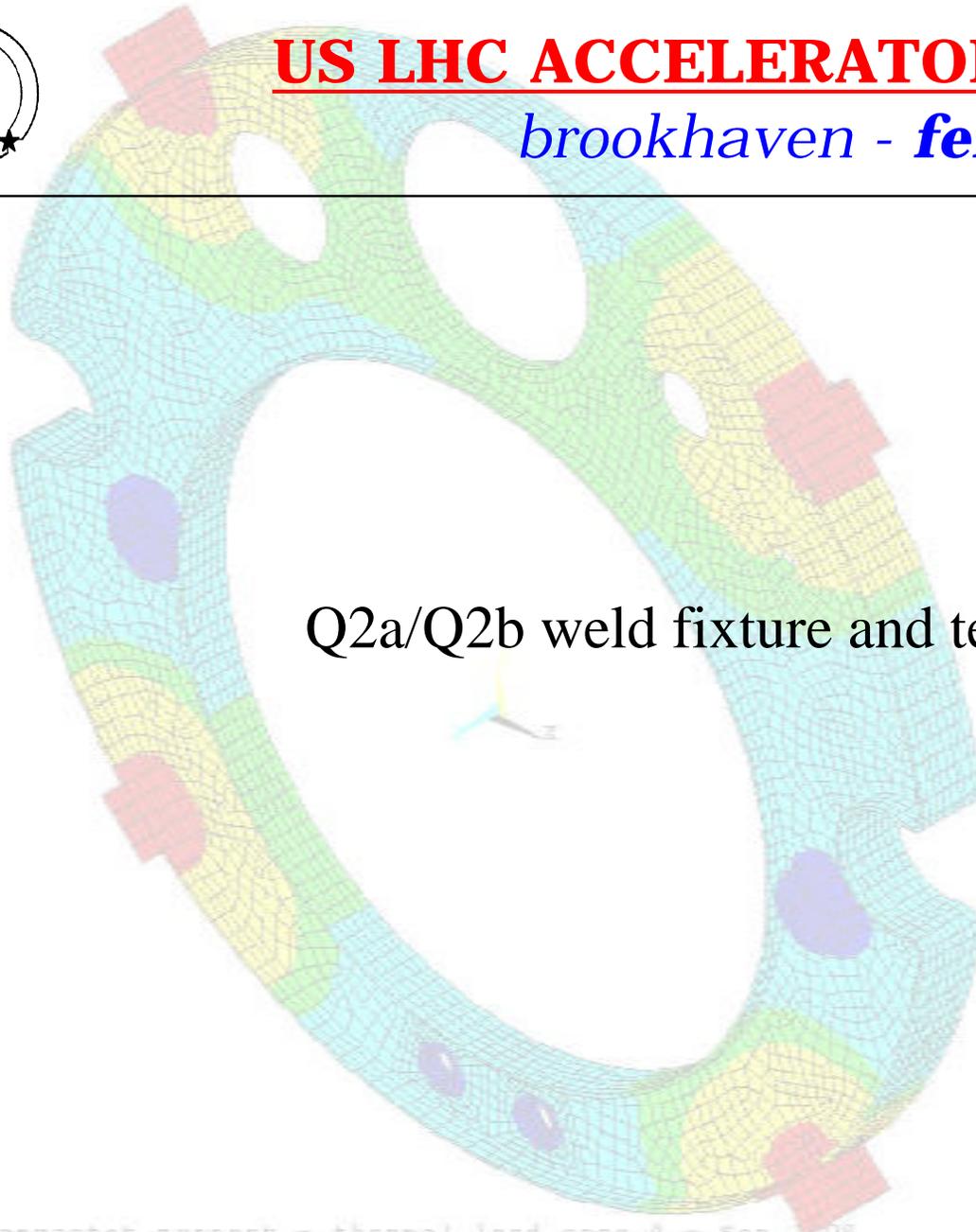
Q1 vacuum vessel





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Q2a/Q2b weld fixture and test...

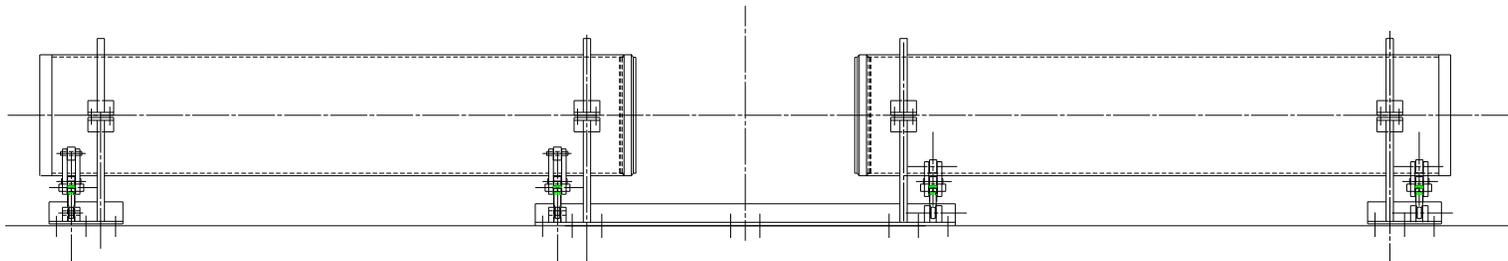
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ANSYS 5.1  
POST1  
SUB = 1  
TIME = 1  
TEMP  
TEMP = 97.319  
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SMX = 360  
1.8  
34.933  
68.867  
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134.933  
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265.867  
308
```



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Q2a/Q2b weld fixture (longitudinal view)

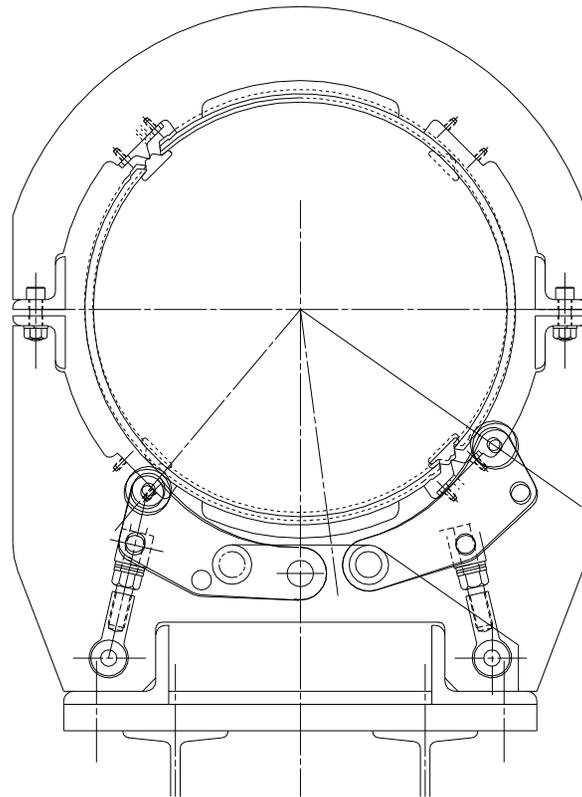




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Q2a/Q2b weld fixture (cross section)





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Short term plans (alignment related)

- Continue analysis and testing of the spider support.
- Initiate testing of the cold mass slides and slide materials.
- Finalize the design of the suspension system, including the cold mass to suspension interface.
- Test a mock-up of the weld between Q2a and Q2b.
- ...

