Summary of Stress Analysis of CC Cryostat w/o Stiffening Rings

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Introduction

A finite element model of the CC cryostat was used to investigate the stresses resulting in this structure under internal pressure (30 psi at the top of the vessel increasing linearly to 40 psi at the bottom) and weight loadings. Figures 1 and 2 show the model and relevant physical dimensions. The results are given in Table I.

Stress Results

The stresses were extracted from the nodal stress output for individual elements. The variation of stress over the element is some indication of mesh adequacy in the absence of additional results from a finer mesh. Based on this variation, the stresses output for the central cylinder and head appear to be quite good. The nodal stresses vary about 15% within the most highly stressed elements. The maximum stresses in the outer cylinder occur in the element defined by the four nodes used for support. Stresses within this element vary by a factor of ~2. It is fair to say that no detailed information on stresses in the shell at the support is available with this mesh. However, outer shell stresses away from the supports are well within the limits for SS 304 as given by Section VIII, Division 2, Appendix 4.

A basic node map of the axisymmetric node pattern is shown in Fig. 3 as an aid in interpreting output. This pattern is repeated 25 times about the Y-axis, with an increment of 70 in node number, and an angular increment of 7.5° .

Conclusion

It can be concluded from the stress results that stiffening rings are not necessary in the assembled central calorimeter cryostat due to the relatively short length of the vessel and the stiffening effects of the heads. Detailed stress results in the region of the supports will be investigated in the future with a refined local mesh.

Table I. Stress Results

Component	Stress Category	Stress Intensity	Location (see Fig. 2)
Central Cylinder	$P_L + P_b + Q$	12700	A
	P_L	11200	A
Head	$P_L + P_b + Q$	29200	B
	P_L	17200	B
Outer Cylinder	$P_L + P_b + Q$	17800	C
	P_L	9000	C

ANSYS
86/ 2/ 4
14.7050
PLOT NO. 1
POST1
ELEMENTS

DAIG SCALING
XV=1
YV=1
ZV=1
DIST=90.8
XF=-.218
YF=21.6
ZF=-20.3
HIDDEN

Fig 1

CENTRAL CALORIMETER CRYOSTAT - NO STIFFENING RING

CENTRAL CALORIMETER CRYOSTAT - NO STIFFENING RING

Fig 3 Support Locations and Location of maximum stress intensities

ANSYS

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10.6061

PLOT NO. 3

POST1

NODES

ORIG SCALING

ZV=1

DIST=53.2

XF=48.4

YF=28.5

Fig 3 Node Map