

1.0 OBJECTIVE

Perform the structural analyses of the EnergySolutions 8-120B Cask under normal conditions of transport (NCT), using a 3-dimensional finite element model.

2.0 INTRODUCTION

EnergySolutions 8-120B Cask (Reference 1) is designed as a Type B radioactive-material shipping package. To be certified by the U.S.N.R.C., the cask needs to meet the requirements of 10 CFR 71 (Reference 2) and follow the guidelines of U.S.N.R.C. Regulatory Guide 7.8 (Ref. 3).

This document presents the structural analysis of the 8-120B Cask for the normal conditions of transport (NCT). The analyses in this document are performed using the finite element modeling techniques. A three-dimensional model of the cask that includes all its major components has been employed in the analyses. Temperature dependent material properties of the major components of the cask are used in the analyses.

The results of the analyses for various load cases are presented pictorially in stress intensity contour plots as well as digital data format.

3.0 REFERENCES

1. EnergySolutions Drawing No. C-110-E-0007, Rev. 14, 8-120B Shipping Cask.
2. Code of Federal Regulations, Title 10, Part 71, Packaging and Transportation of Radioactive Material, January 2003.
3. U.S. NRC Regulatory Guide 7.8, Revision 1, March 1989, Load Combinations for the Structural Analysis of Shipping Casks for Radioactive Material.
4. ASME Boiler & Pressure Vessel Code, Section II, Part D, Materials, The American Society of Mechanical Engineers, New York, NY, 2001.
5. NUREG 0481/SAND77-1872, An Assessment of Stress-Strain Data Suitable for Finite Element Elastic-Plastic Analysis of Shipping Containers, Sandia National Laboratories, 1978.
6. U.S. NRC Regulatory Guide 7.6, Revision 1, Design Criteria for the Structural Analysis of Shipping Cask Containment Vessels, 1978.
7. ANSYS, Release 12.1, ANSYS Inc., Canonsburg, PA, 2009.
8. Energy Solutions Document No. ST-608, Rev. 0, 3-60B Cask ANSYS Finite Element Model Grid Convergence Study
9. EnergySolutions Document TH-027, Rev.0, Steady State Thermal Analyses of the 8-120B Cask Using a 3-D Finite Element Model.

4.0 MATERIAL PROPERTIES

Material	Temp. (°F)	Strength (ksi)			Young's Modulus (10 ⁶ psi)	Coefficient of Thermal Expansion (10 ⁻⁶ in/in °F)
		Yield (S _y)	Ultimate (S _u)	Membrane Allowable (S _m)		
ASTM A240 Type 304L		(1)	(1)	(1)	(1)	(1)
	-20	25.0	70.0	16.7	28.8	-
	70	25.0	70.0	16.7	28.3	8.5
	100	25.0	70.0	16.7	-	8.6
	200	21.4	66.1	16.7	27.5	8.9
	300	19.2	61.2	16.7	27.0	9.2
	400	17.5	58.7	15.8	26.4	9.5
	500	16.4	57.5	14.7	25.9	9.7
ASTM A516 Gr. 70 Steel		(1)	(1)	(1)	(1)	(1)
	-20	38.0	70.0	20.0	30.3	-
	70	38.0	70.0	20.0	29.4	6.4
	100	38.0	70.0	20.0	-	6.5
	200	34.8	70.0	20.0	28.8	6.7
	300	33.6	70.0	20.0	28.3	6.9
	400	32.5	70.0	20.0	27.9	7.1
	500	31.0	70.0	20.0	27.3	7.3
ASTM A354 Gr. BD (Lid Bolts)		(1)	(1)	(1)	(1)	(1)
	-20	130	150	30	29.7	-
	70	130	150	30	29.2	6.4
	100	130	150	30	-	6.5
	200	119.1	150	30	28.6	6.7
	300	115	150	30	28.1	6.9
	400	111	150	30	27.7	7.1
	500	105.9	150	30	27.1	7.3
ASTM B29 Lead		(2)			(2)	(2)
	-20	-	-	-	2.43	15.65
	70	5	-	-	2.27	16.06
	100	-	-	-	2.21	16.22
	200	-	-	-	2.01	16.70
	300	-	-	-	1.85	17.33
	400	-	-	-	1.70	18.16
	500	-	-	-	1.52	19.12

Notes:

- (1) From ASME B&PV Code 2001, Section II, Part D (Reference 4).
- (2) From NUREG/CR 0481 (Reference 5)

5.0 ALLOWABLE STRESSES

Material →		ASTM A240 Type 304L	ASTM A516 Gr. 70	ASTM A354 Gr. BD
Yield Stress, S_y	(psi)	25,000 ⁽¹⁾	38,000 ⁽¹⁾	130,000 ⁽¹⁾
Ultimate Stress, S_u	(psi)	70,000 ⁽¹⁾	70,000 ⁽¹⁾	150,000 ⁽¹⁾
Design Stress Intensity, S_m	(psi)	16,700 ⁽¹⁾	20,000 ⁽¹⁾	30,000 ⁽¹⁾
Normal Conditions	Membrane Stress	16,700 ⁽²⁾	20,000 ⁽²⁾	60,000 ⁽³⁾
	Mem. + Bending Stress	25,050 ⁽²⁾	30,000 ⁽²⁾	90,000 ⁽³⁾
Hypothetical Accident Conditions	Membrane Stress	40,080 ⁽⁴⁾	48,000 ⁽⁴⁾	105,000 ⁽⁵⁾
	Mem. + Bending Stress	60,120 ⁽⁴⁾	70,000 ⁽⁴⁾	150,000 ⁽⁵⁾

Notes:

- (1) From ASME B&PV Code 2001, Section II, Part D (Reference 4).
- (2) Established from Regulatory Guide 7.6 (Reference 6), Position 2.
- (3) Regulatory Guide 7.6 (Reference 6) does not provide any criteria. ASME B&PV Code, Section III, Subsection ND has been used to establish these criteria.
- (4) Established from Regulatory Guide 7.6 (Reference 6), Position 6.
- (5) Regulatory Guide 7.6 (Reference 6) does not provide any criteria. ASME B&PV Code, Section III, Appendix F has been used to establish these criteria.

5.0 MODEL DESCRIPTION

The structural analyses of the 8-120B Cask under NCT have been performed using finite element modeling techniques. ANSYS finite element analysis code (Reference 7) has been employed to perform the analyses. The cask has two horizontal axes of symmetry. Therefore, a one-half model of the cask is made using 3-dimensional 8-node structural solid elements (ANSYS SOLID185) to represent the major components of the cask, the cask body, the lid, and the bolts. The shell components of the cask - the inner and outer shells, and the baseplates have been represented in the finite element model by SOLSH190 elements.

The fire shield does not provide any structural strength to the cask. Therefore, it is not included in the model.

The poured lead in the body of the cask is not bonded to the steel. It is free to slide over the steel surface. Therefore, the interface between the lead and the steel is modeled by a pair of contact (CONTA174) and target (TARGE170) elements. These elements allow the lead to slide over the steel at the same time prevent it from penetrating the steel surface.

Figure 1 shows the outline of the model depicting the material numbering. Figure 2 shows the partial finite element grid of the lid, seal plate, bolts and the cask. Figure 3 shows the finite element grid of the cask body without the lead and Figure 4 shows that of the lead. The interface between various components of the cask is modeled by target-contact surface definition. Figure 5 shows target surfaces of various contact-target pairs. The printout of the pertinent model quantities is included in Appendix 1.

Boundary Conditions

For the analyses of the 8-120B Cask under various NCT loading cases, it is assumed that the cask is resting on the upper impact limiter in the vertical orientation, because in this orientation the payload applies deadweight loading, in addition to the internal pressure loading, on the lid closure, which is the most vulnerable part of the cask. The model is conservatively restrained in the vertical direction at the skirt instead of the entire bearing surface of the upper impact limiter. Also, since the model represents a 180° circumferential symmetry, the nodes on the cut-planes are restrained from displacement normal to these planes.

Modeling Technique Validation and Grid Convergence Study

The finite element modeling techniques used in the 8-120B Cask have been previously used in the 3-60B cask analyses. A comprehensive modeling technique validation and the grid convergence study had been performed in Reference 8. The solid element types, grid size and the use of contact elements for modeling the interfaces used in the 8-120B Cask analyses are similar to those in the 3-60B Cask analyses. Therefore, the modeling technique validation and the grid convergence/sensitivity results provided in Reference 8 are also applicable to the 8-120B Cask finite element models used in the current analyses.

Loading

For various NCT loading cases, the loading on the model include the following, as applicable.

Deadweight

The deadweight of the cask is included in the analyses as the body load in the finite element model subjected to the acceleration due to gravity. The deadweight of the lower impact limiter is included as the uniform pressure on the surface where the impact limiter contacts the cask. The deadweight of the payload is included as the uniform pressure on the lid inside surface.

Mass of each Impact Limiter = 4,860 lb

Inside Radius of the Impact Limiter = 25 in

Outside Radius of the Cask = $72.20/2 = 36.60$ in

Pressure on the cask due to impact limiter weight,

$$p_{ILL} = 4,860 / [\pi \times (36.6^2 - 25^2)] = 2.17 \text{ psi}$$

Payload Mass = 14,680 lb

Lid Radius = $61.8/2 = 30.9$ in

Pressure on the lid surface due to payload weight,

$$p_{lid} = 14,680/(\pi \times 30.9^2) = 4.90 \text{ psi}$$

Because of the segmentation of arc length in the finite element models, the mass of the model is always lower than the actual mass. To account for this, as well as to include the mass of miscellaneous items not included in the model, an adjustment is made in the value of acceleration due to gravity.

$$\text{Cask Body Mass} = 74,000 - 14,680 - 2 \times 4,860 = 49,600 \text{ lb}$$

$$\text{Mass of the FEM} = 2 \times 23,938 = 47,876 \text{ lb}$$

$$\text{Use acceleration due to gravity} = 49,600/47,876 = 1.03g$$

Internal Pressure

The cask internal pressure under various NCT loading conditions is applied as the uniform pressure over the nodes representing the cavity of the cask. The external pressure, if applicable, is applied over the nodes representing the entire exterior surface of the cask.

Temperature

The temperature distribution under various NCT loading conditions is obtained from the thermal analyses performed in Reference 9 and is applied as the nodal temperature in the finite element model.

6.0 ANALYSES

The finite element model described in Section 5.0 is analyzed for the following loading conditions:

1. Hot Environment – This load case is based on the requirements of 10 CFR 71.71 (c) (1). The finite element model is subjected to the following loading:

Cask Deadweight	✓
Upper Impact Limiter Deadweight	✓
Payload Deadweight	✓
Temperature from Reference 9	Load Case 1
Internal Pressure	35 psi
External Pressure	No

See Figure 6 for the plot of the temperature profile and pressure distribution used for this load step.

2. Cold Environment – This load case is based on the requirements of 10 CFR 71.71 (c) (2). The finite element model is subjected to the following loading:

Cask Deadweight	✓
Upper Impact Limiter Deadweight	✓
Payload Deadweight	✓
Temperature from Reference 9	Load Case 2
Internal Pressure	35 psi
External Pressure	No

See Figure 7 for the plot of the temperature profile and pressure distribution used for this load step.

3. Normal Hot - This load case is based on the requirements of 10 CFR 71.71 (b). The finite element model is subjected to the following loading:

Cask Deadweight	✓
Upper Impact Limiter Deadweight	✓
Payload Deadweight	✓
Temperature from Reference 9	Load Case 3
Internal Pressure	35 psi
External Pressure	No

See Figure 8 for the plot of the temperature profile and pressure distribution used for this load step.

4. Normal Cold - This load case is based on the requirements of 10 CFR 71.71 (b). The finite element model is subjected to the following loading:

Cask Deadweight	✓
Upper Impact Limiter Deadweight	✓
Payload Deadweight	✓
Temperature from Reference 9	Load Case 4
Internal Pressure	35 psi
External Pressure	No

See Figure 9 for the plot of the temperature profile and pressure distribution used for this load step.

5. Maximum Normal Operating Pressure - This load case is analyzed to obtain the load-controlled stresses in the cask under MNOP. The finite element model is subjected to the following loading:

Cask Deadweight	✓
Upper Impact Limiter Deadweight	✓
Payload Deadweight	✓
Temperature from Reference 9	70°F
Internal Pressure	35 psi
External Pressure	No

See Figure 10 for the plot of the temperature profile and pressure distribution used for this load step.

6. Reduced External Pressure - This load case is based on the requirements of 10 CFR 71.71 (c)(3). The finite element model is subjected to the following loading:

Cask Deadweight	✓
Upper Impact Limiter Deadweight	✓
Payload Deadweight	✓
Temperature from Reference 9	Load Case 3
Internal Pressure	50 psi
External Pressure	No

See Figure 11 for the plot of the temperature profile and pressure distribution used for this load step.

7. Increased External Pressure & Immersion - This load case is based on the requirements of 10 CFR 71.71 (c)(4). This load case also envelopes the requirement of 10 CFR 71.73(c)(6). The finite element model is subjected to the following loading:

Cask Deadweight	✓
Upper Impact Limiter Deadweight	✓
Payload Deadweight	✓
Temperature from Reference 9	-20°F
Internal Pressure	No
External Pressure	25 psi

See Figure 12 for the plot of the temperature profile and pressure distribution used for this load step.

7.0 RESULTS

The results obtained from various load case analyses include displacements and stress intensities at the nodal points of the finite element model. The summary results of the stress quantities, obtained from the post-processing of each load case, are provided in Appendix 2. The total printout from all the load cases is included in Appendix 3. Stress intensity contour plots are presented in Figures 13 through 19. The stress intensities in various components of the 8-120B Cask under these loading conditions are tabulated in Tables 1 through 7. It should be noted that the maximum stress intensities obtained from the finite element models are peak stresses, as classified by the ASME code. The stress intensity values are compared with the corresponding allowable values in Tables 1 through 7. A factor of safety is calculated for

every component for each load case. A factor of safety value of 1.0 or larger indicates that the stress intensity is acceptable for the loading considered.

The results of the analyses show that the stresses for all the normal operating load cases are well within the allowable values.

8.0 APPENDICES

Appendix 1 Print-out of the ANSYS model data input

Appendix 2 Stress Summary Print-out

Appendix 3 Electronic data on CDROM

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Tables

(7 Pages)

Table 1

Stress Intensities in 8-120B Cask under Hot Environment Loading

Component	Stress Category	Allowable S.I. (psi)	Calculated S.I. ⁽¹⁾ (psi)	F.S. ⁽²⁾
Primary Lid	P _m	20,000	3,989	5.01
	P _m + P _b	30,000	3,989	7.52
Secondary Lid	P _m	20,000	2,255	8.87
	P _m + P _b	30,000	2,255	13.30
Bolting Ring	P _m	20,000	16,385	1.22
	P _m + P _b	30,000	16,385	1.83
Inner Shell	P _m	20,000	13,872	1.44
	P _m + P _b	30,000	13,872	2.16
Outer Shell	P _m	20,000	14,314	1.40
	P _m + P _b	30,000	14,314	2.10
Baseplate	P _m	20,000	9,919	2.02
	P _m + P _b	30,000	9,919	3.02
Primary Lid Bolts	P _m	60,000	12,516	4.79
	P _m + P _b	90,000	12,516	7.19
Secondary Lid Bolts	P _m	60,000	4,189	14.32
	P _m + P _b	90,000	4,189	21.48

Notes:

- (1) Unless otherwise indicated in this column, the maximum stress intensity values have been conservatively reported as P_m and P_m + P_b stress intensities.
- (2) Factor of Safety, F.S. = (Allowable S.I.) / (Calculated S.I.)

Table 2

Stress Intensities in 8-120B Cask under Cold Environment Loading

Component	Stress Category	Allowable S.I. (psi)	Calculated S.I. ⁽¹⁾ (psi)	F.S. ⁽²⁾
Primary Lid	P _m	20,000	3,695	5.41
	P _m + P _b	30,000	3,695	8.12
Secondary Lid	P _m	20,000	2,102	9.51
	P _m + P _b	30,000	2,102	14.27
Bolting Ring	P _m	20,000	4,177	4.79
	P _m + P _b	30,000	4,177	7.18
Inner Shell	P _m	20,000	5,075	3.94
	P _m + P _b	30,000	5,075	5.91
Outer Shell	P _m	20,000	4,778	4.19
	P _m + P _b	30,000	4,778	6.28
Baseplate	P _m	20,000	2,312	8.65
	P _m + P _b	30,000	2,312	12.98
Primary Lid Bolts	P _m	60,000	6,197	9.68
	P _m + P _b	90,000	6,197	14.52
Secondary Lid Bolts	P _m	60,000	3,904	15.37
	P _m + P _b	90,000	3,904	23.05

Notes:

(1) Unless otherwise indicated in this column, the maximum stress intensity values have been conservatively reported as P_m and P_m + P_b stress intensities.

(2) Factor of Safety, F.S. = (Allowable S.I.) / (Calculated S.I.)

Table 3
Stress Intensities in 8-120B Cask under Normal Hot Loading

Component	Stress Category	Allowable S.I. (psi)	Calculated S.I. ⁽¹⁾ (psi)	F.S. ⁽²⁾
Primary Lid	P _m	20,000	3,083	6.49
	P _m + P _b	30,000	3,083	9.73
Secondary Lid	P _m	20,000	1,803	11.09
	P _m + P _b	30,000	1,803	16.64
Bolting Ring	P _m	20,000	7,827	2.56
	P _m + P _b	30,000	7,827	3.83
Inner Shell	P _m	20,000	6,161	3.25
	P _m + P _b	30,000	6,161	4.87
Outer Shell	P _m	20,000	6,966	2.87
	P _m + P _b	30,000	6,966	4.31
Baseplate	P _m	20,000	4,505	4.44
	P _m + P _b	30,000	4,505	6.66
Primary Lid Bolts	P _m	60,000	5,914	10.15
	P _m + P _b	90,000	5,914	15.22
Secondary Lid Bolts	P _m	60,000	3,332	18.01
	P _m + P _b	90,000	3,332	27.01

Notes:

- (1) Unless otherwise indicated in this column, the maximum stress intensity values have been conservatively reported as P_m and P_m + P_b stress intensities.
- (2) Factor of Safety, F.S. = (Allowable S.I.) / (Calculated S.I.)

Table 4
Stress Intensities in 8-120B Cask under Normal Cold Loading

Component	Stress Category	Allowable S.I. (psi)	Calculated S.I. ⁽¹⁾ (psi)	F.S. ⁽²⁾
Primary Lid	P _m	20,000	3,516	5.69
	P _m + P _b	30,000	3,516	8.53
Secondary Lid	P _m	20,000	2,014	9.93
	P _m + P _b	30,000	2,014	14.90
Bolting Ring	P _m	20,000	3,632	5.51
	P _m + P _b	30,000	3,632	8.26
Inner Shell	P _m	20,000	3,686	5.43
	P _m + P _b	30,000	3,686	8.14
Outer Shell	P _m	20,000	4,153	4.82
	P _m + P _b	30,000	4,153	7.22
Baseplate	P _m	20,000	2,234	8.95
	P _m + P _b	30,000	2,234	13.43
Primary Lid Bolts	P _m	60,000	5,306	11.31
	P _m + P _b	90,000	5,306	16.96
Secondary Lid Bolts	P _m	60,000	3,736	16.06
	P _m + P _b	90,000	3,736	24.09

Notes:

- (1) Unless otherwise indicated in this column, the maximum stress intensity values have been conservatively reported as P_m and P_m + P_b stress intensities.
- (2) Factor of Safety, F.S. = (Allowable S.I.) / (Calculated S.I.)

Table 5

Stress Intensities in 8-120B Cask under Maximum Normal Operating Pressure Loading

Component	Stress Category	Allowable S.I. (psi)	Calculated S.I. ⁽¹⁾ (psi)	F.S. ⁽²⁾
Primary Lid	P _m	20,000	3,049	6.56
	P _m + P _b	30,000	3,049	9.84
Secondary Lid	P _m	20,000	1,754	11.40
	P _m + P _b	30,000	1,754	17.10
Bolting Ring	P _m	20,000	1,272	15.72
	P _m + P _b	30,000	1,272	23.58
Inner Shell	P _m	20,000	1,591	12.57
	P _m + P _b	30,000	1,591	18.86
Outer Shell	P _m	20,000	556	35.97
	P _m + P _b	30,000	556	53.96
Baseplate	P _m	20,000	1,626	12.30
	P _m + P _b	30,000	1,626	18.45
Primary Lid Bolts	P _m	60,000	6,783	8.85
	P _m + P _b	90,000	6,783	13.27
Secondary Lid Bolts	P _m	60,000	3,247	18.48
	P _m + P _b	90,000	3,247	27.72

Notes:

(1) Unless otherwise indicated in this column, the maximum stress intensity values have been conservatively reported as P_m and P_m + P_b stress intensities.

(2) Factor of Safety, F.S. = (Allowable S.I.) / (Calculated S.I.)

Table 6

Stress Intensities in 8-120B Cask under Reduced External Pressure Loading

Component	Stress Category	Allowable S.I. (psi)	Calculated S.I. ⁽¹⁾ (psi)	F.S. ⁽²⁾
Primary Lid	P _m	20,000	4,488	4.46
	P _m + P _b	30,000	4,488	6.68
Secondary Lid	P _m	20,000	2,612	7.66
	P _m + P _b	30,000	2,612	11.49
Bolting Ring	P _m	20,000	8,215	2.43
	P _m + P _b	30,000	8,215	3.65
Inner Shell	P _m	20,000	6,199	3.23
	P _m + P _b	30,000	6,199	4.84
Outer Shell	P _m	20,000	7,133	2.80
	P _m + P _b	30,000	7,133	4.21
Baseplate	P _m	20,000	4,476	4.47
	P _m + P _b	30,000	4,476	6.70
Primary Lid Bolts	P _m	60,000	5,997	10.01
	P _m + P _b	90,000	5,997	15.01
Secondary Lid Bolts	P _m	60,000	4,832	12.42
	P _m + P _b	90,000	4,832	18.63

Notes:

- (1) Unless otherwise indicated in this column, the maximum stress intensity values have been conservatively reported as P_m and P_m + P_b stress intensities.
- (2) Factor of Safety, F.S. = (Allowable S.I.) / (Calculated S.I.)

Table 7

Stress Intensities in 8-120B Cask under Increased External Pressure and Immersion Loading

Component	Stress Category	Allowable S.I. (psi)	Calculated S.I. ⁽¹⁾ (psi)	F.S. ⁽²⁾
Primary Lid	P _m	20,000	2,743	7.29
	P _m + P _b	30,000	2,743	10.94
Secondary Lid	P _m	20,000	1,077	18.57
	P _m + P _b	30,000	1,077	27.86
Bolting Ring	P _m	20,000	3,027	6.61
	P _m + P _b	30,000	3,027	9.91
Inner Shell	P _m	20,000	4,877	4.10
	P _m + P _b	30,000	4,877	6.15
Outer Shell	P _m	20,000	2,554	7.83
	P _m + P _b	30,000	2,554	11.75
Baseplate	P _m	20,000	2,812	7.11
	P _m + P _b	30,000	2,812	10.67
Primary Lid Bolts	P _m	60,000	6,466	9.28
	P _m + P _b	90,000	6,466	13.92
Secondary Lid Bolts	P _m	60,000	1,018	58.94
	P _m + P _b	90,000	1,018	88.41

Notes:

(1) Unless otherwise indicated in this column, the maximum stress intensity values have been conservatively reported as P_m and P_m + P_b stress intensities.

(2) Factor of Safety, F.S. = (Allowable S.I.) / (Calculated S.I.)

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Figures

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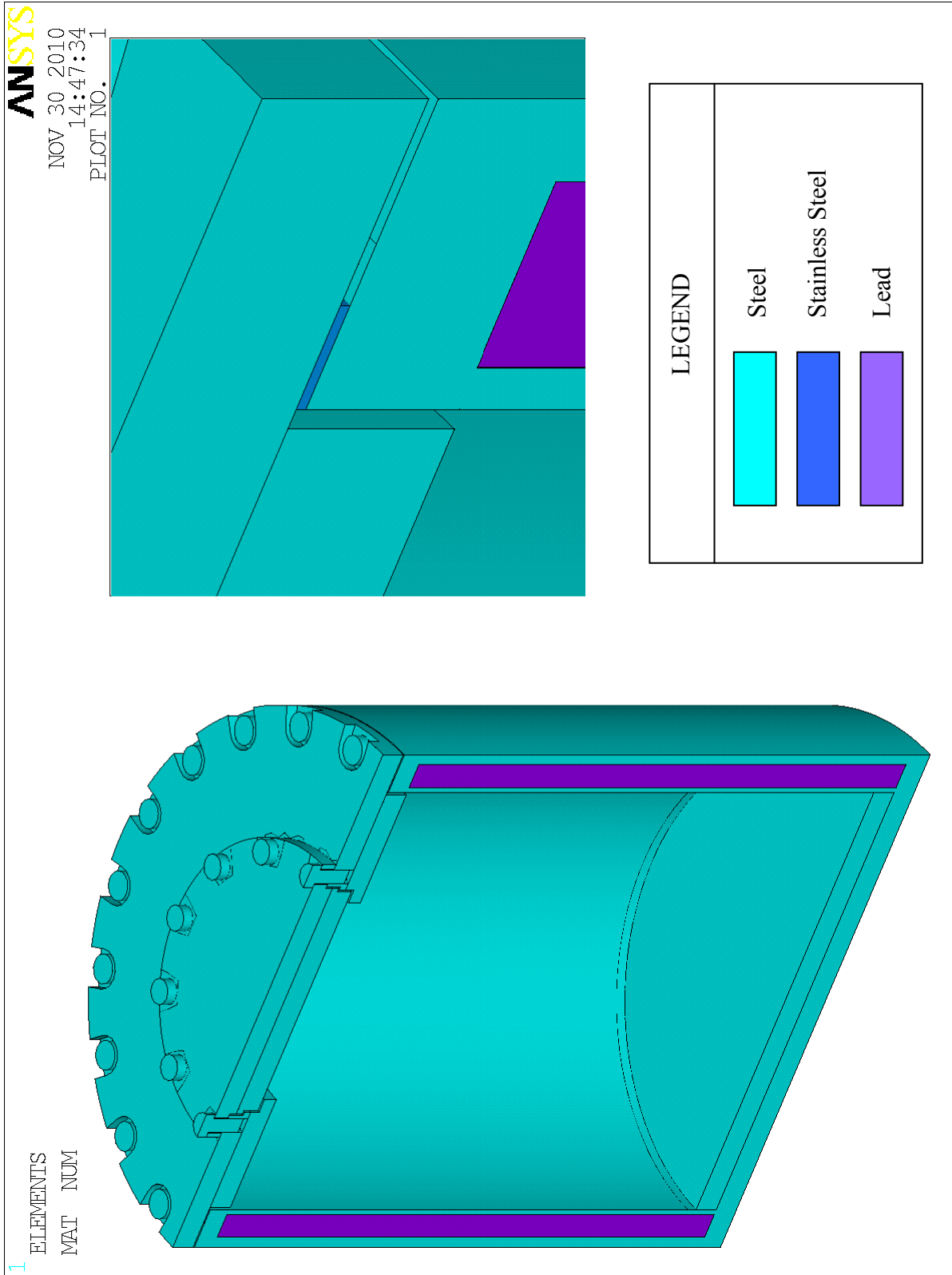


Figure 1
Finite Element Model of the 8-120B Cask Identifying the Cask Components with Material Numbers

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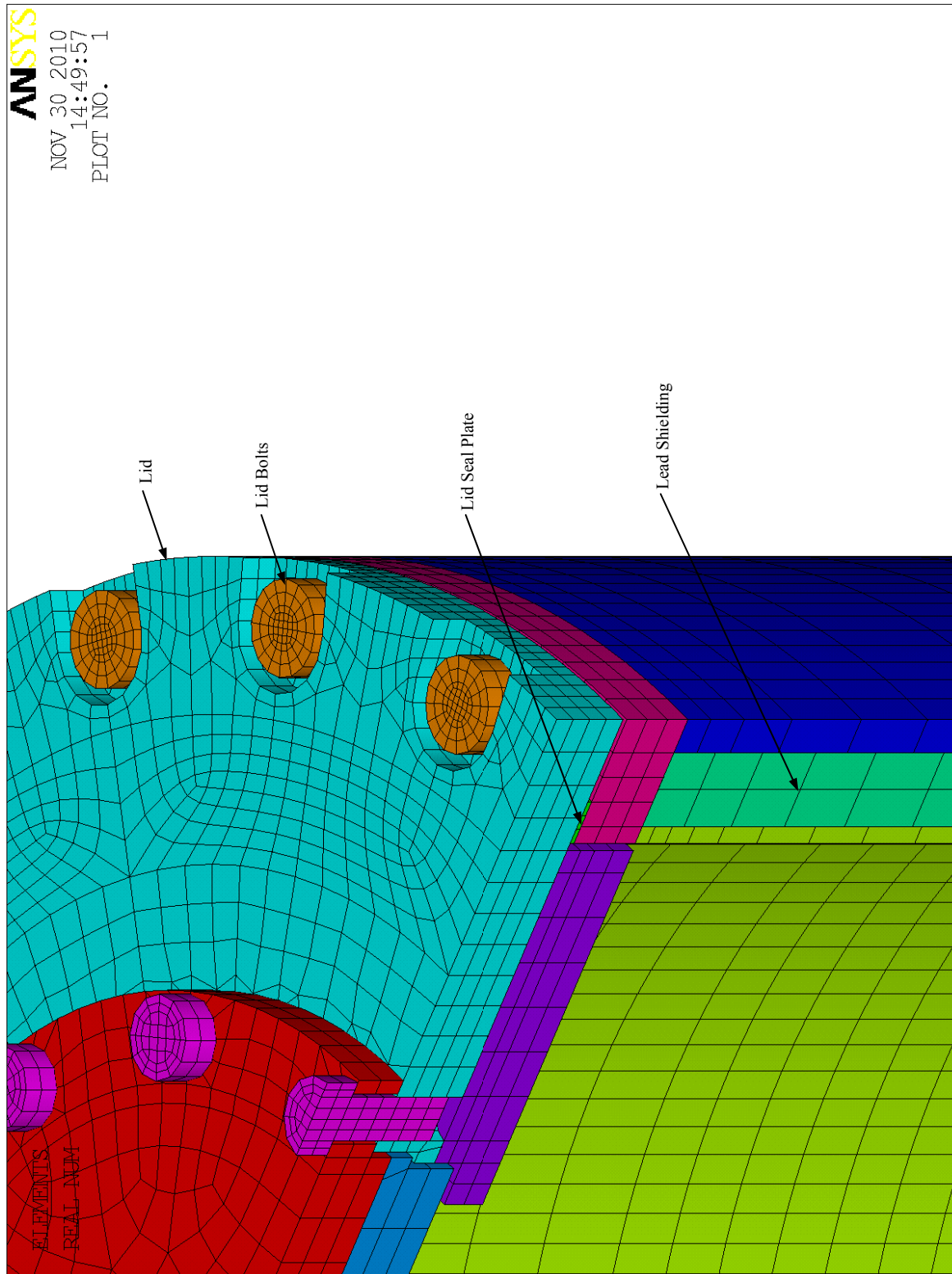


Figure 2
Finite Element Model of the Lid, Seal Plate, Bolts and the Cask

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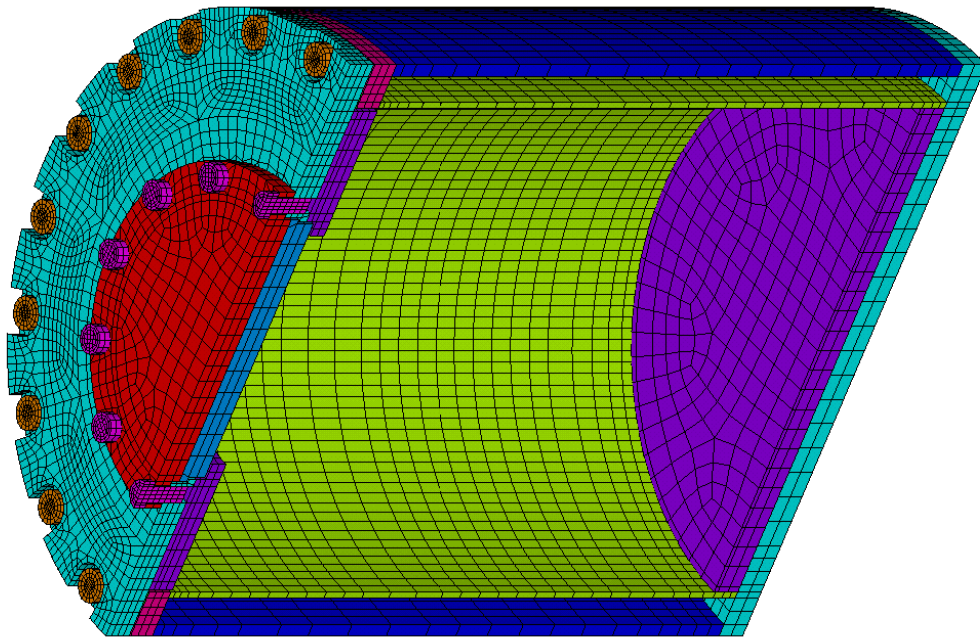


Figure 3
Finite Element Model of the cask Body without the Lead

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PLOT NO. 1

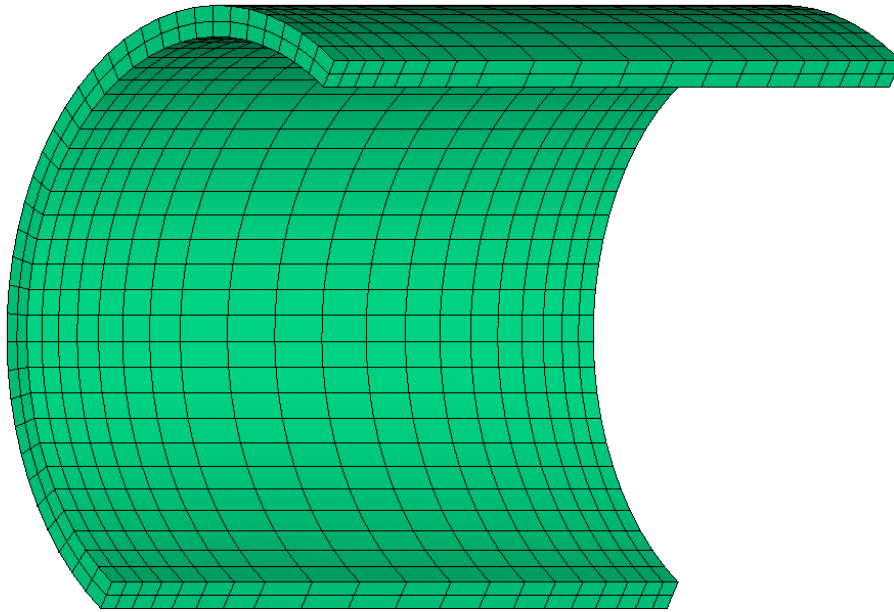


Figure 4
Finite Element Model of the Lead

ELEMENTS
REAL NUM

Title Structural Analyses of the 8-120B Cask Under Normal Conditions of Transport

Calc. No. ST-626 (Figures)

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DEC 1 2010

15:40:43

PLOT NO. 1

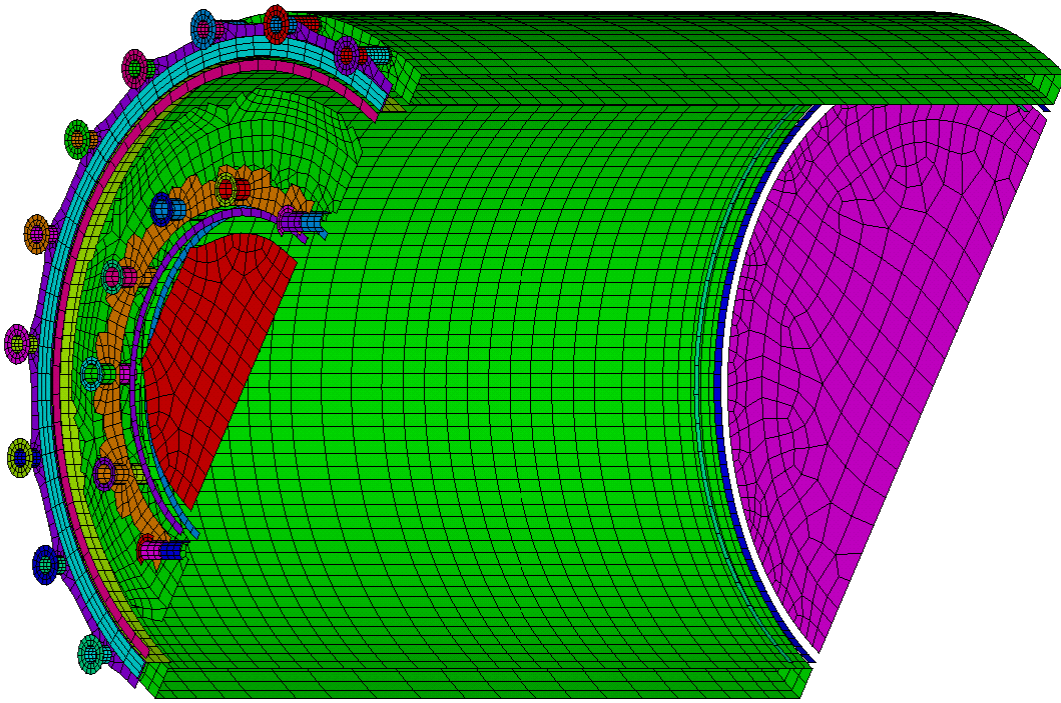


Figure 5
Finite Element Model of the Contact-Target Elements (Only Contact Elements Shown)

Title Structural Analyses of the 8-120B Cask Under Normal Conditions of Transport

Calc. No. ST-626 (Figures)

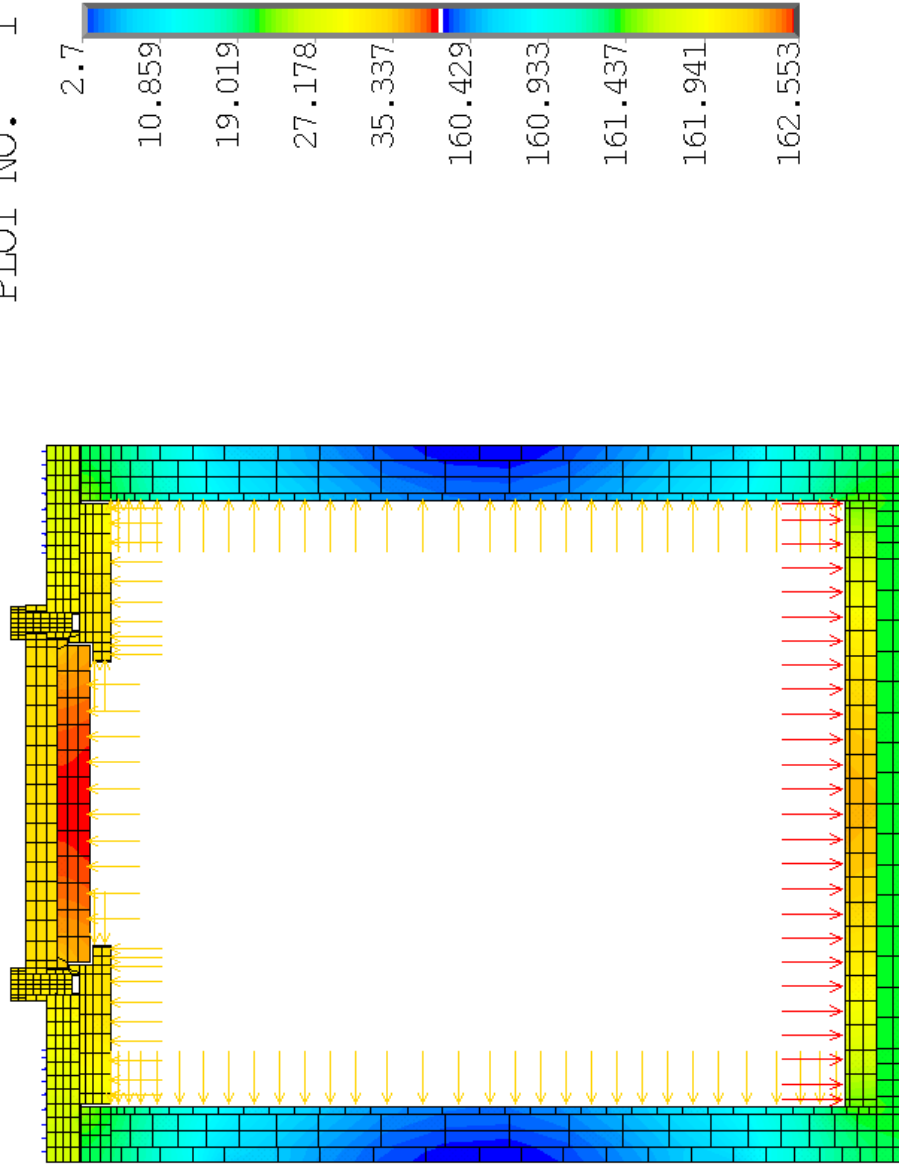
Rev. 0

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ANSYS

DEC 1 2010
14:57:59
PLOT NO. 1

ELEMENTS
PRES-NORM
TEMPERATURES
TMIN=160.249
TMAX=162.553



8-120B Cask - Hot Environment

Figure 6
Temperature Profile and Pressure Distribution for Hot Environment Loading

Title Structural Analyses of the 8-120B Cask Under Normal Conditions of Transport

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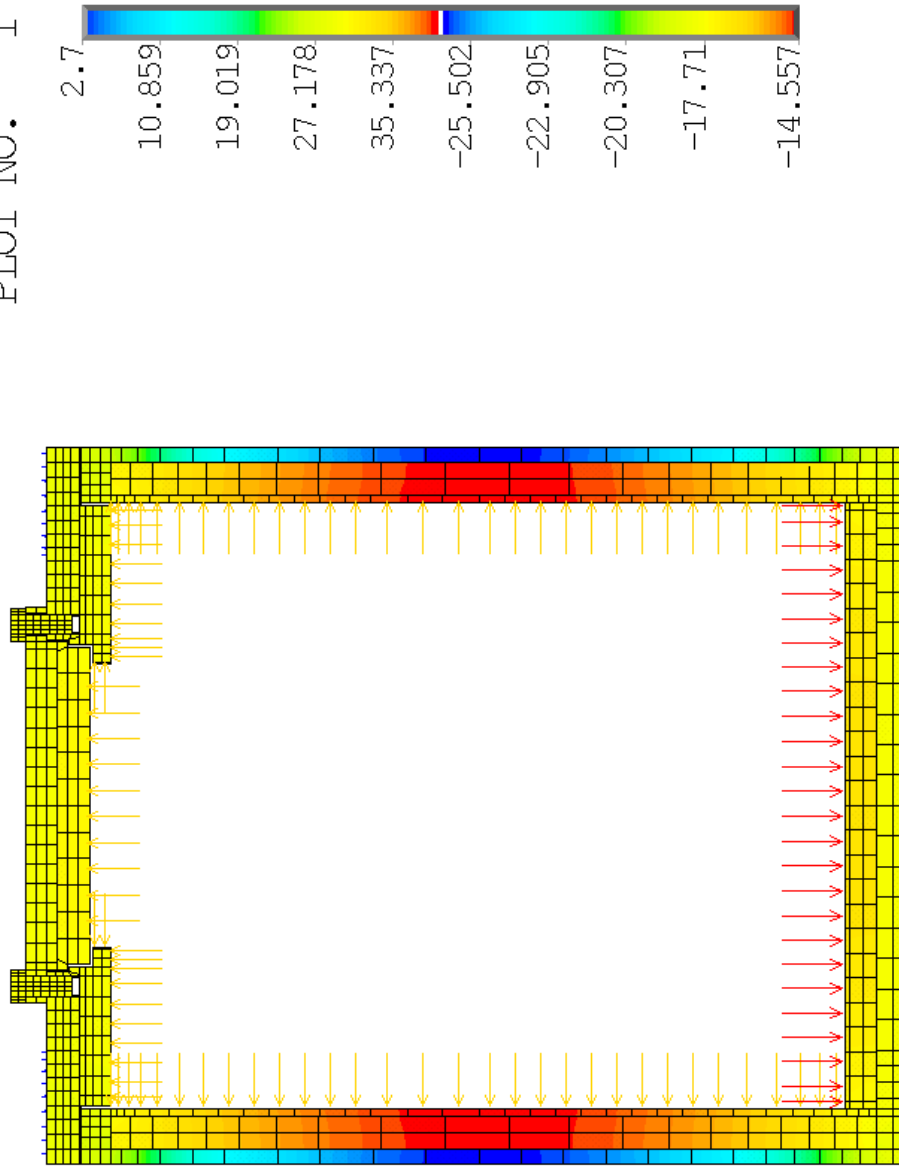
ANSYS

DEC 1 2010
14:58:00
PLOT NO. 1

ELEMENTS

PRES-NORM

TEMPERATURES
TMIN=-26.429
TMAX=-14.557



8-120B Cask - Cold Environment

Figure 7
Temperature Profile and Pressure Distribution for Cold Environment Loading

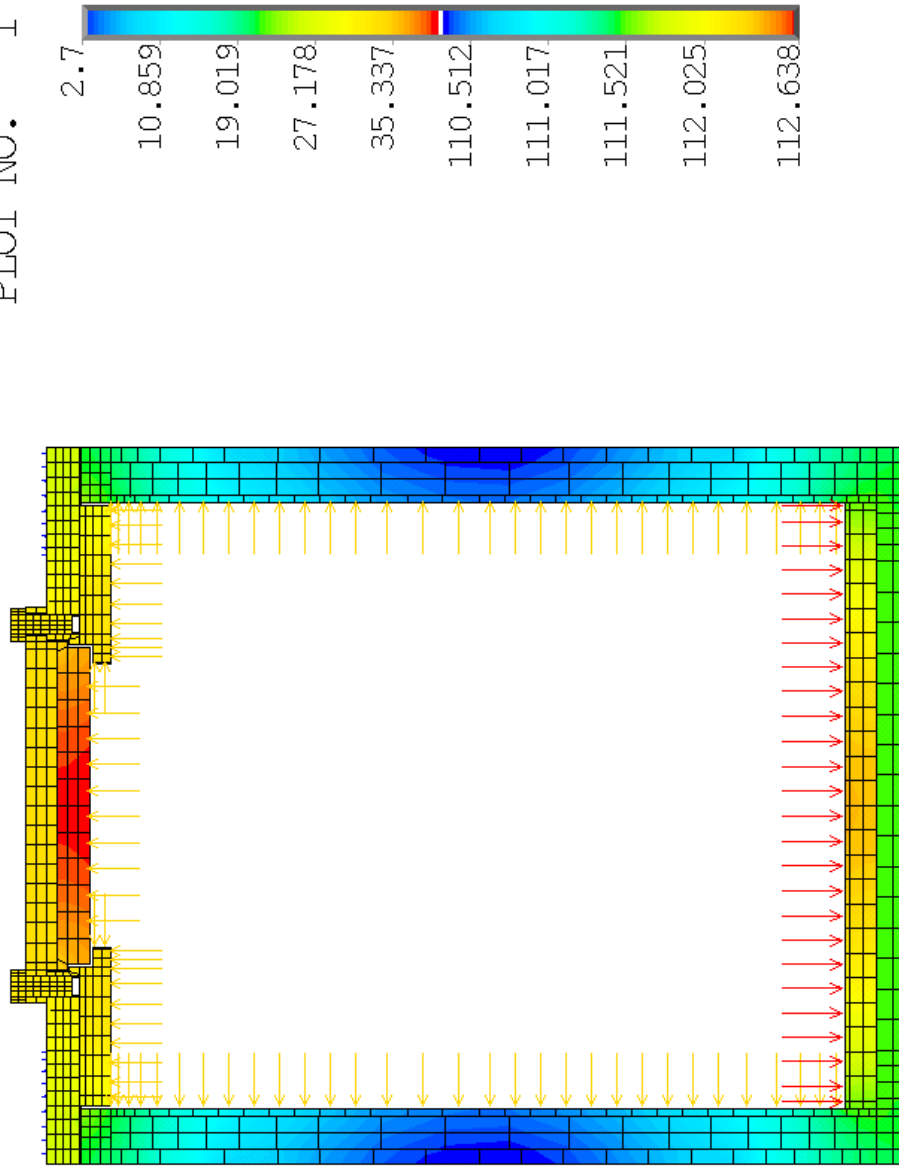
ANSYS

DEC 1 2010
14:58:01
PLOT NO. 1

ELEMENTS

PRES-NORM

TEMPERATURES
TMIN=110.332
TMAX=112.638



8-120B Cask - Normal Hot

Figure 8
Temperature Profile and Pressure Distribution for Normal Hot Loading

Title Structural Analyses of the 8-120B Cask Under Normal Conditions of Transport

Calc. No. ST-626 (Figures)

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ANSYS

DEC 1 2010
14:58:01
PLOT NO. 1

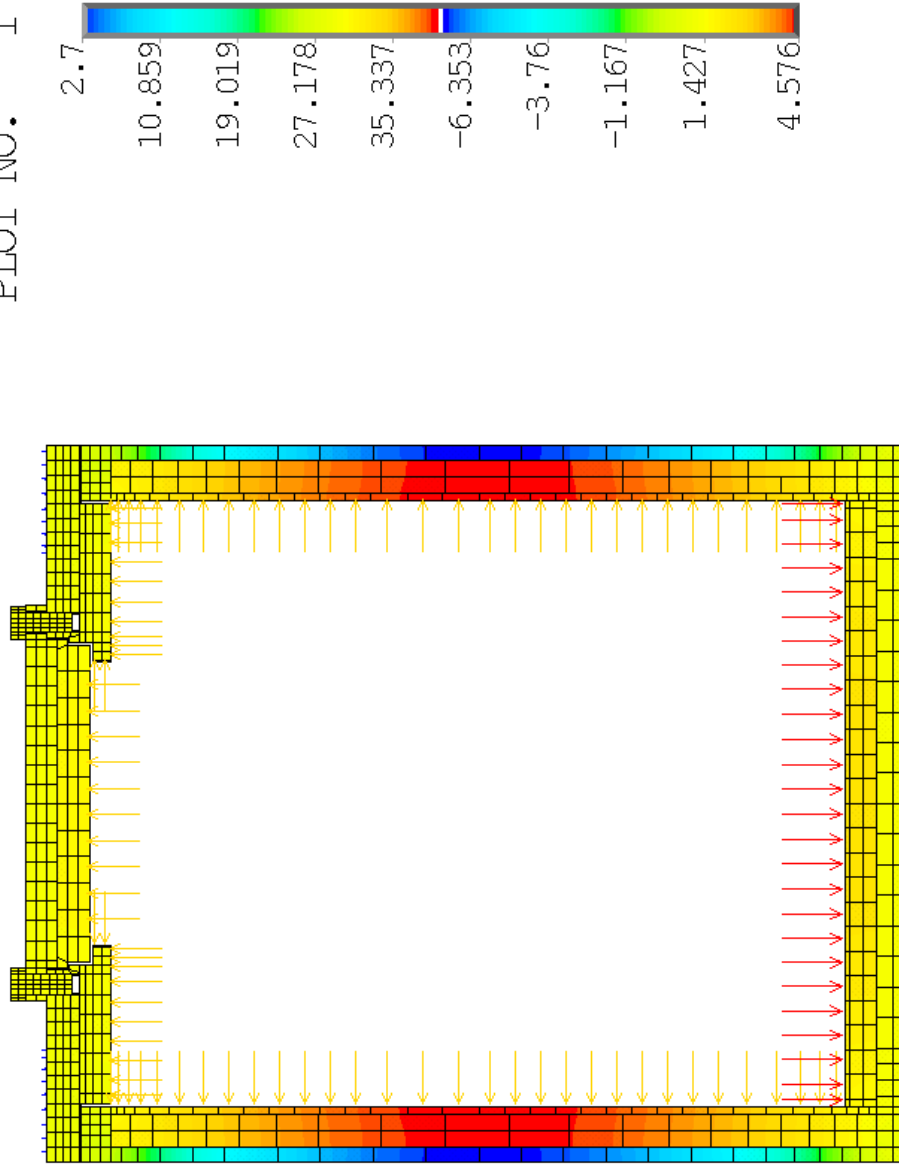
ELEMENTS

PRES-NORM

TEMPERATURES

TMIN=-7.28

TMAX=4.576



8-120B Cask - Normal Cold

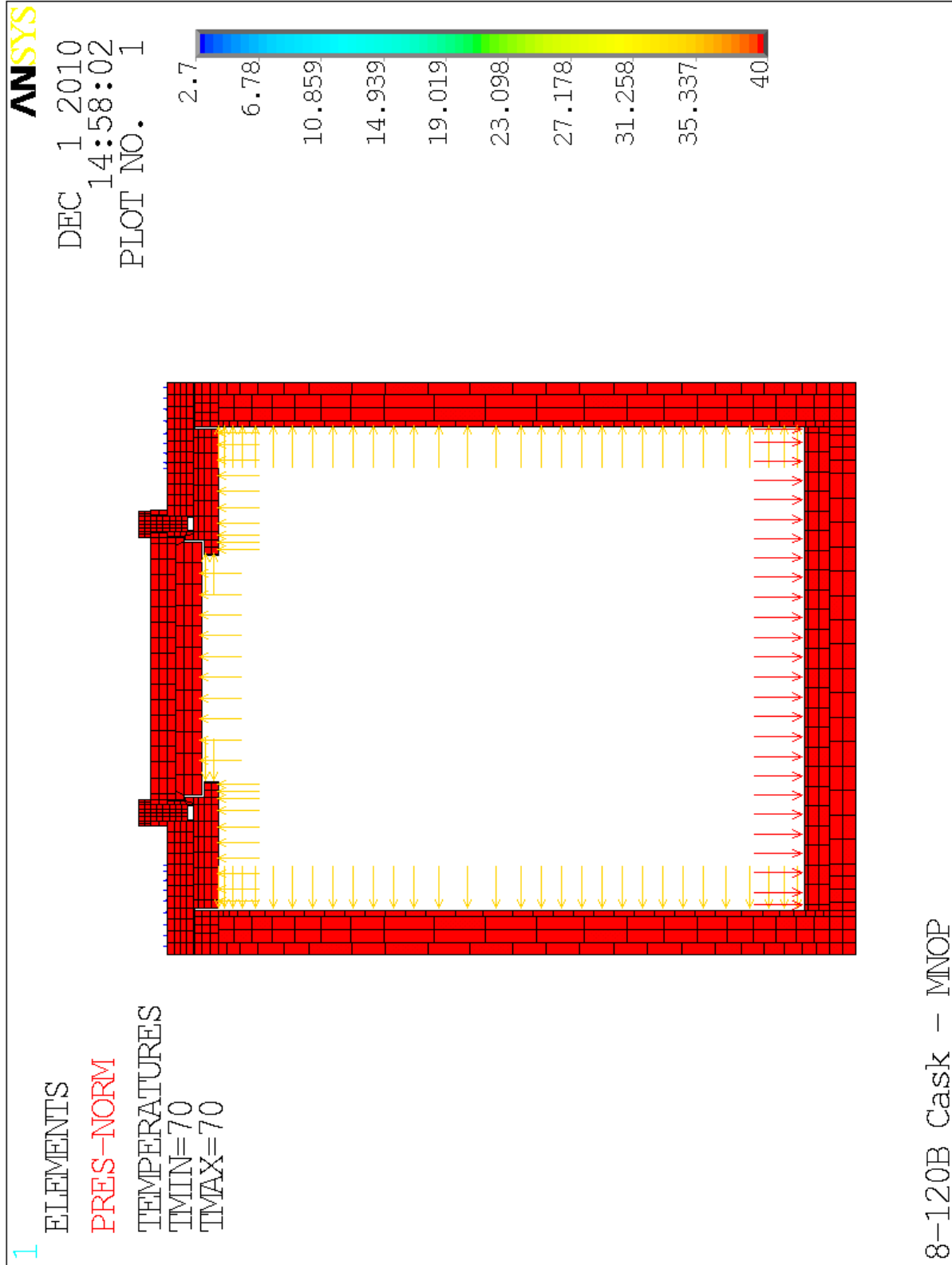
Figure 9
Temperature Profile and Pressure Distribution for Normal Cold Loading

Title Structural Analyses of the 8-120B Cask Under Normal Conditions of Transport

Calc. No. ST-626 (Figures)

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Title Structural Analyses of the 8-120B Cask Under Normal Conditions of Transport

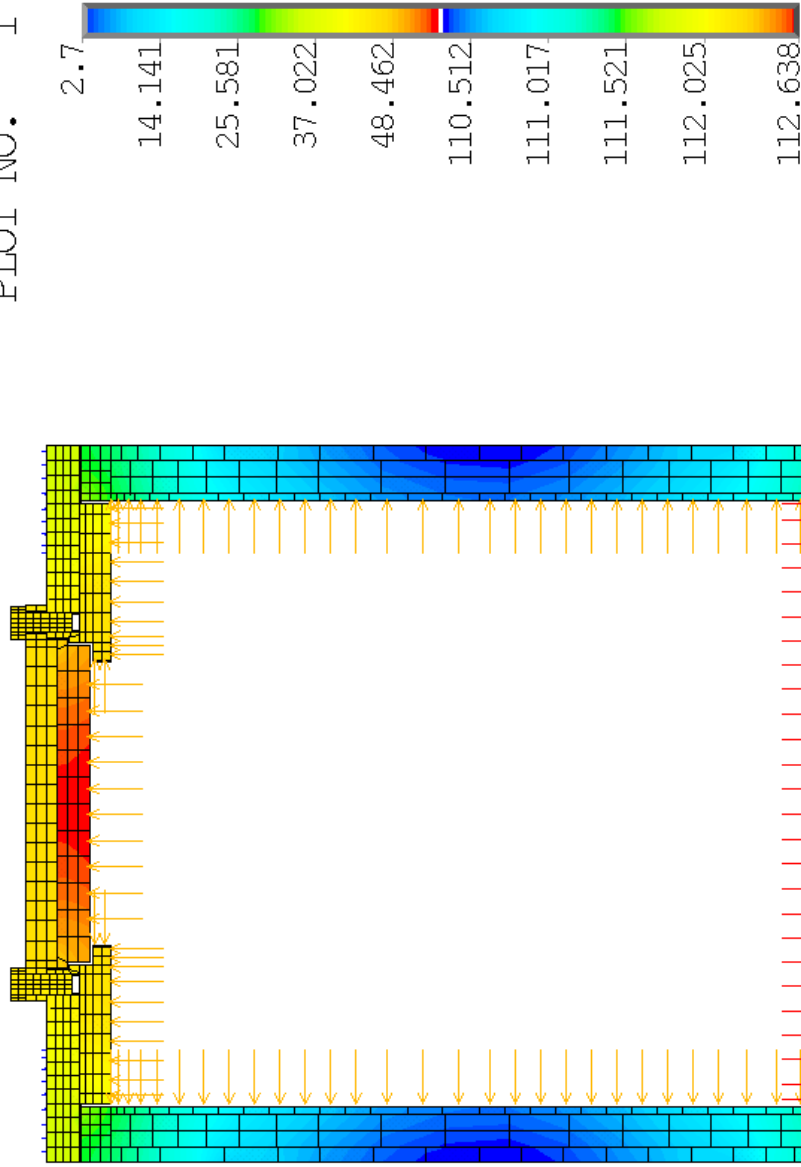
Calc. No. ST-626 (Figures)

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DEC 1 2010
14:58:03
PLOT NO. 1



ELEMENTS

PRES-NORM

TEMPERATURES
TMIN=110.332
TMAX=112.638

8-120B Cask - Reduced External Pressure

Figure 11
Temperature Profile and Pressure Distribution for Reduced External Pressure Loading

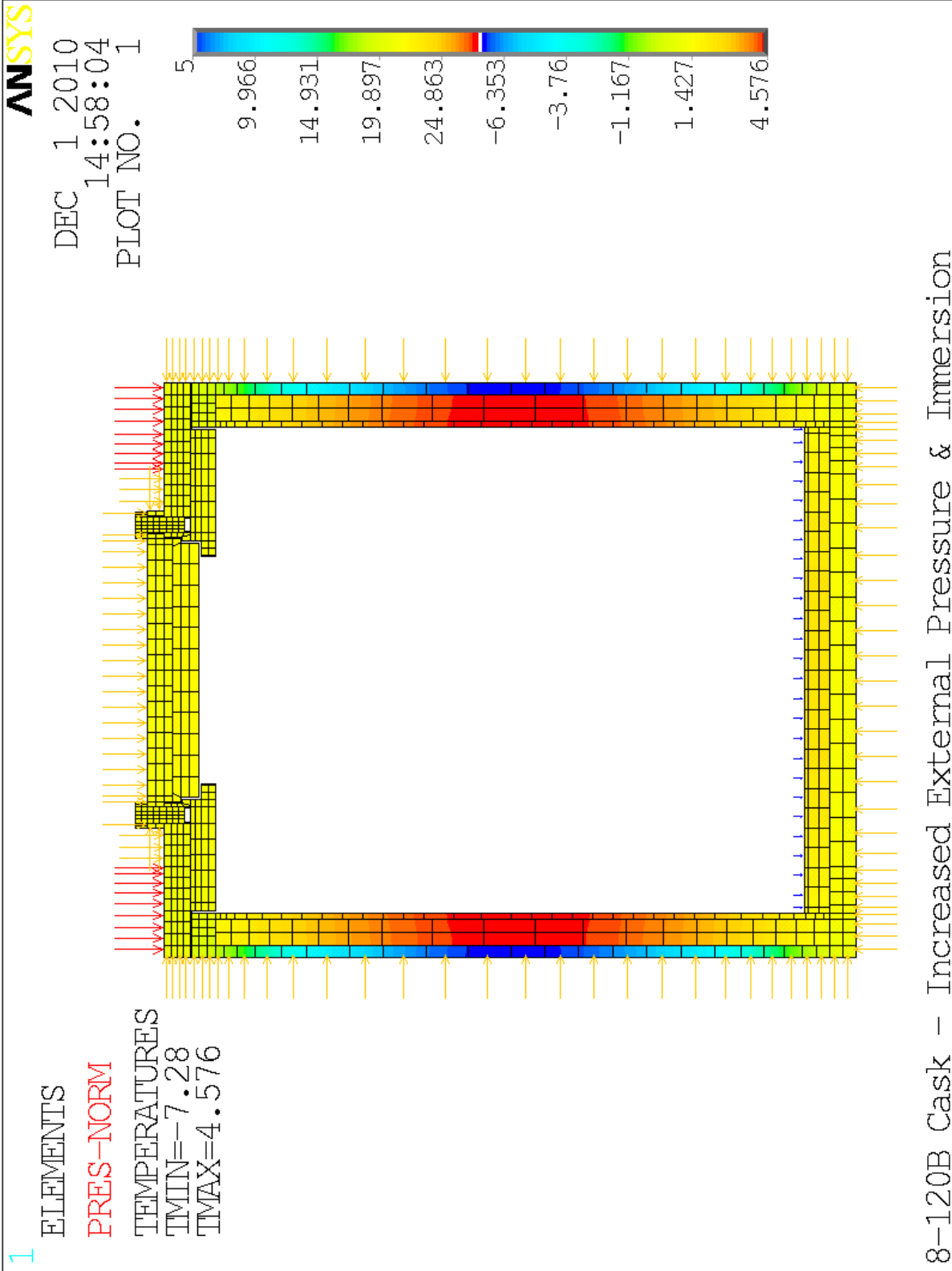


Figure 12
Temperature Profile and Pressure Distribution for Increased External Pressure and Immersion Loading

Title Structural Analyses of the 8-120B Cask Under Normal Conditions of Transport

Calc. No. ST-626 (Figures)

Rev. 0

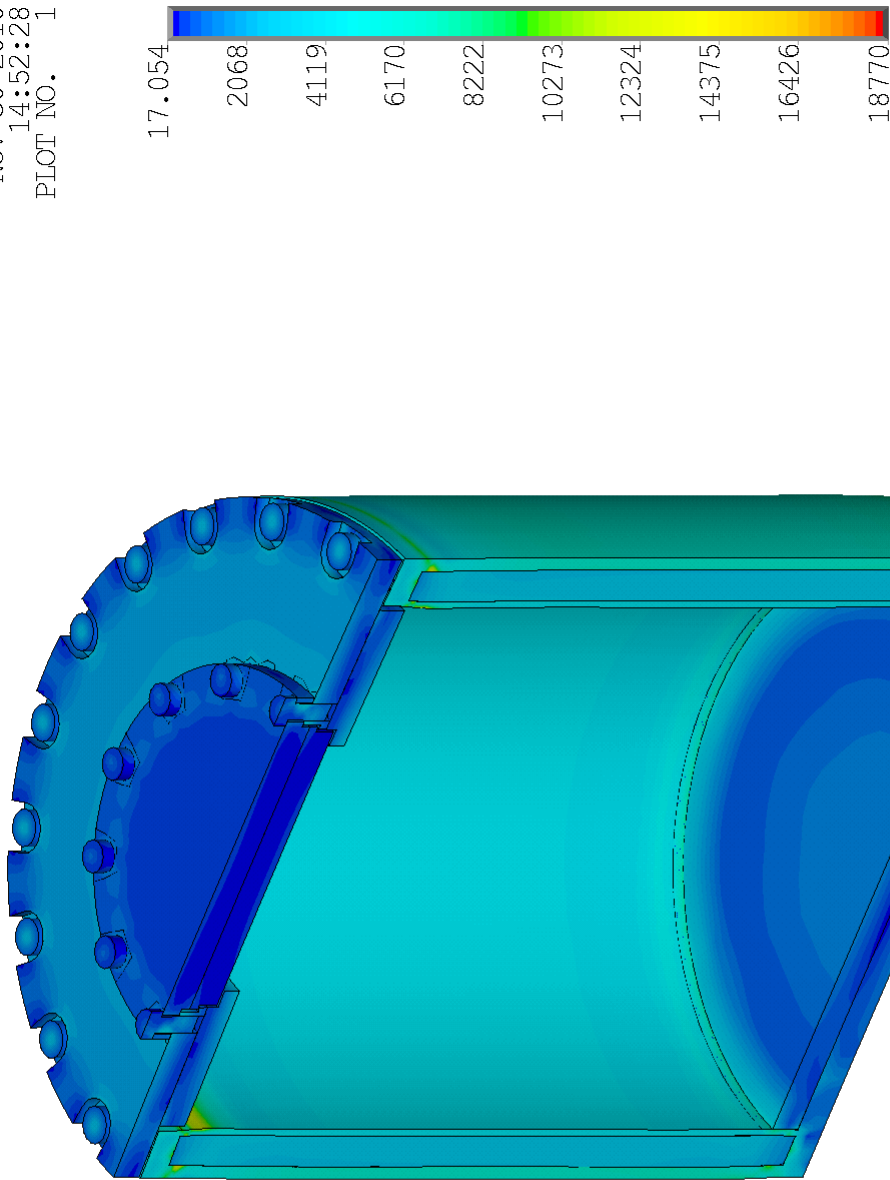
Sheet 13 of 19

ANSYS

NOV 30 2010

14:52:28

PLOT NO. 1



1 NODAL SOLUTION

STEP=1

SUB =1

TIME=1

SINT (AVG)

DMX =.073564

SMN =17.054

SMX =18770

8-120B Cask - Hot Environment

Figure 13
Stress Intensity Contour Plot - Hot Environment Loading

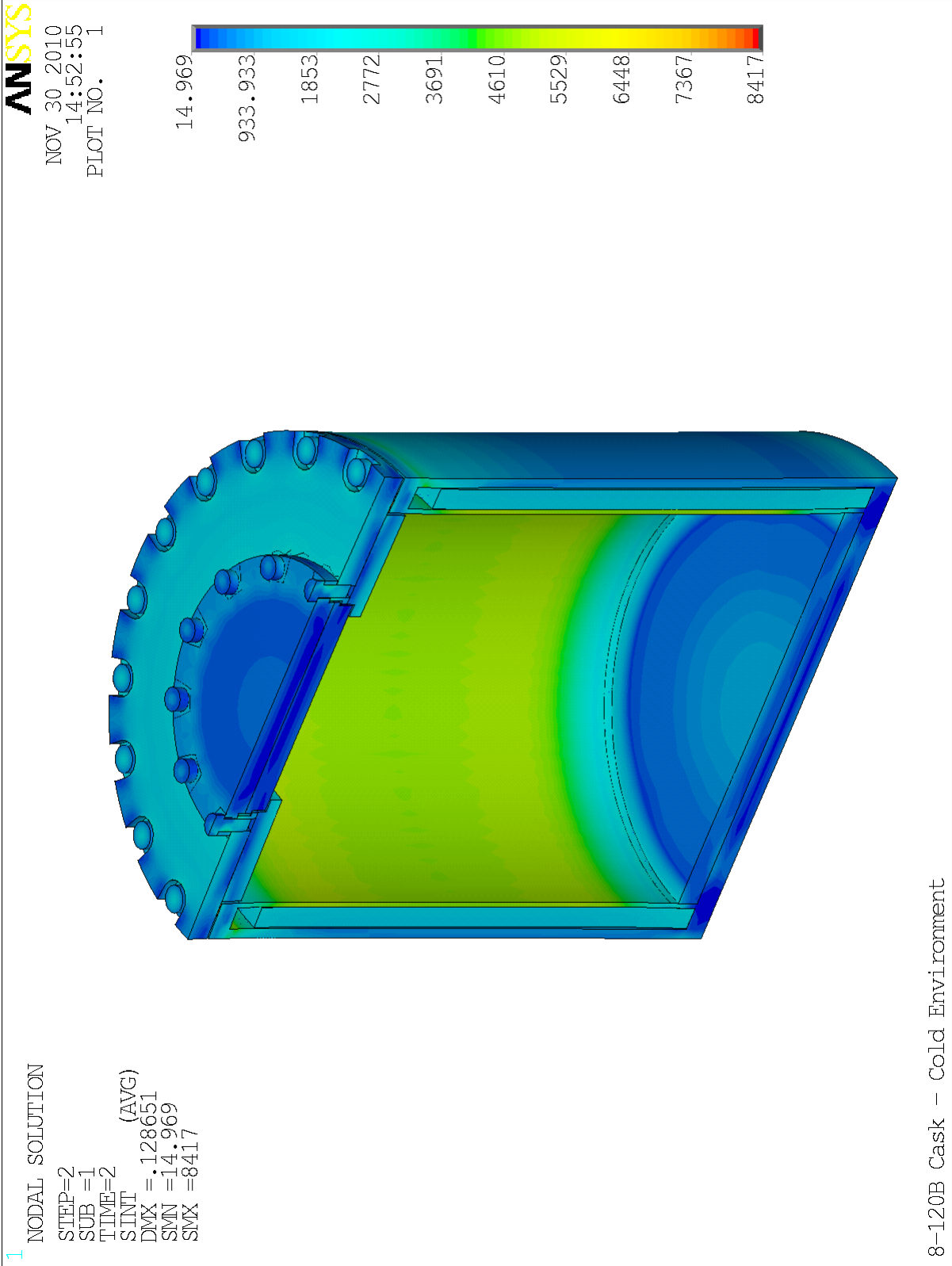


Figure 14
Stress Intensity Contour Plot - Cold Environment Loading

Title Structural Analyses of the 8-120B Cask Under Normal Conditions of Transport

Calc. No. ST-626 (Figures)

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ANSYS

NOV 30 2010

14:53:12

PLOT NO. 1

1 NODAL SOLUTION

STEP=3

SUB =1

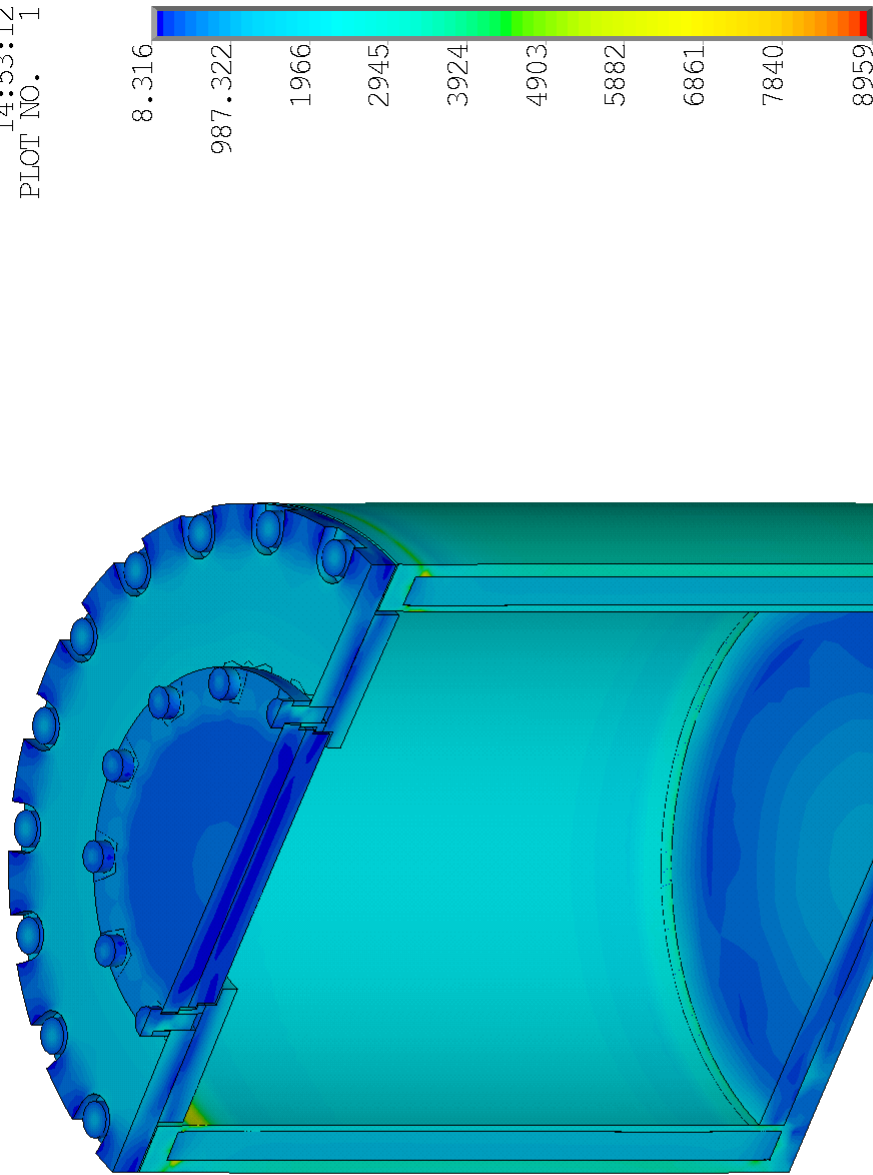
TIME=3

SINT (AVG)

DMX =.035326

SMN =8.316

SMX =8959



8-120B Cask - Normal Hot

Figure 15
Stress Intensity Contour Plot - Normal Hot Loading

Title Structural Analyses of the 8-120B Cask Under Normal Conditions of Transport

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ANSYS

NOV 30 2010

14:53:24

PLOT NO. 1

1 NODAL SOLUTION

STEP=4

SUB =1

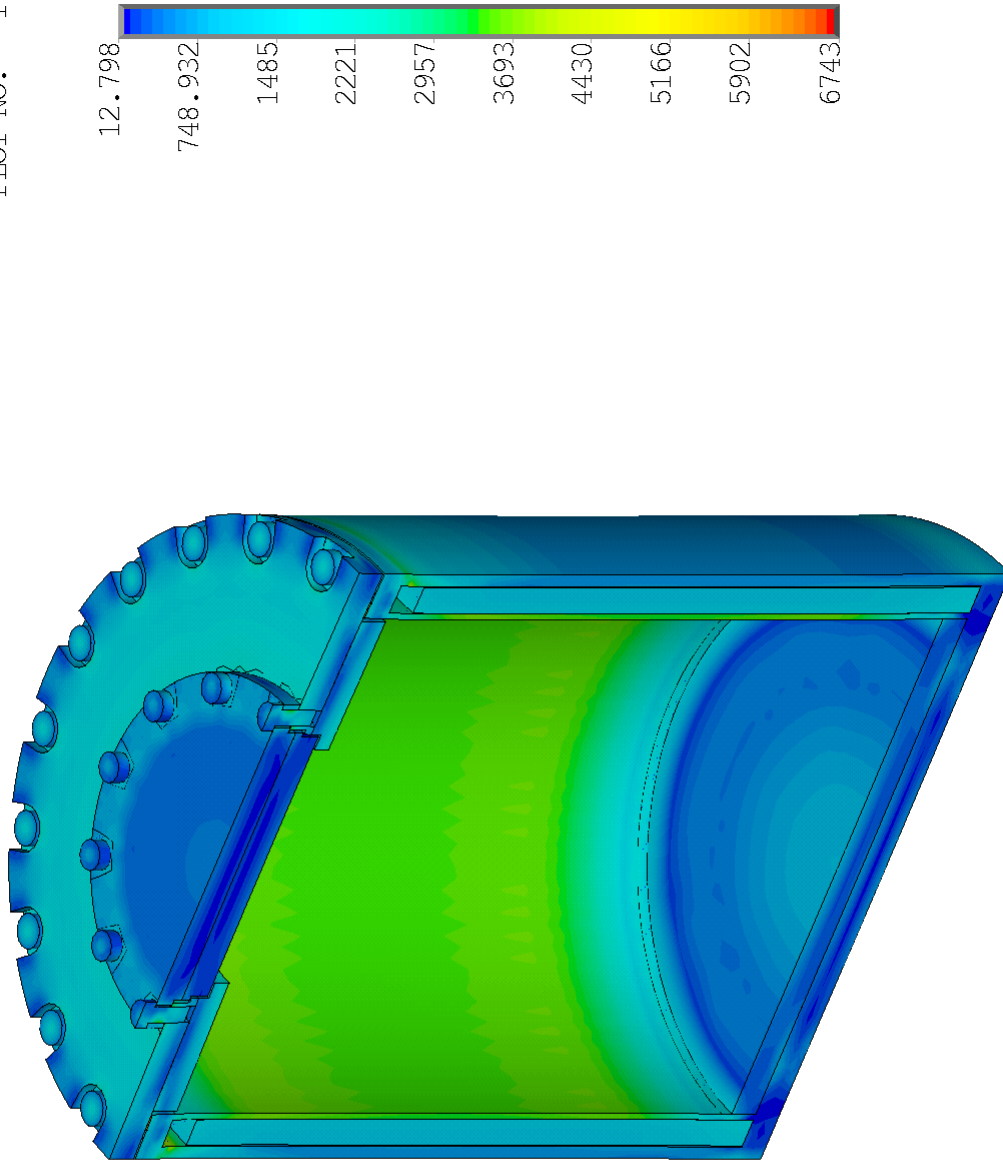
TIME=4

SINT (AVG)

DMX =.100847

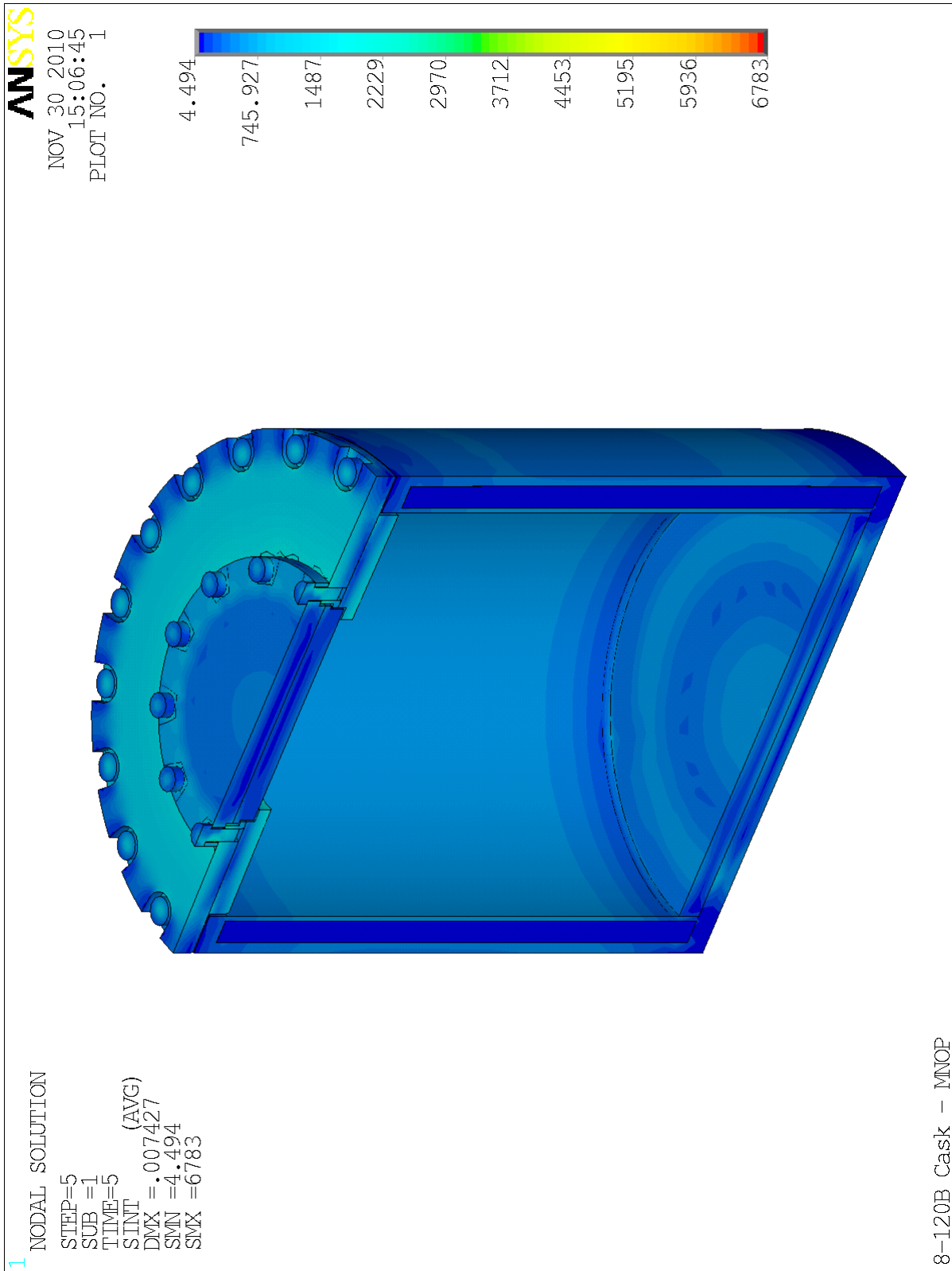
SMN =12.798

SMX =6743



8-120B Cask - Normal Cold

Figure 16
Stress Intensity Contour Plot - Normal Cold Loading



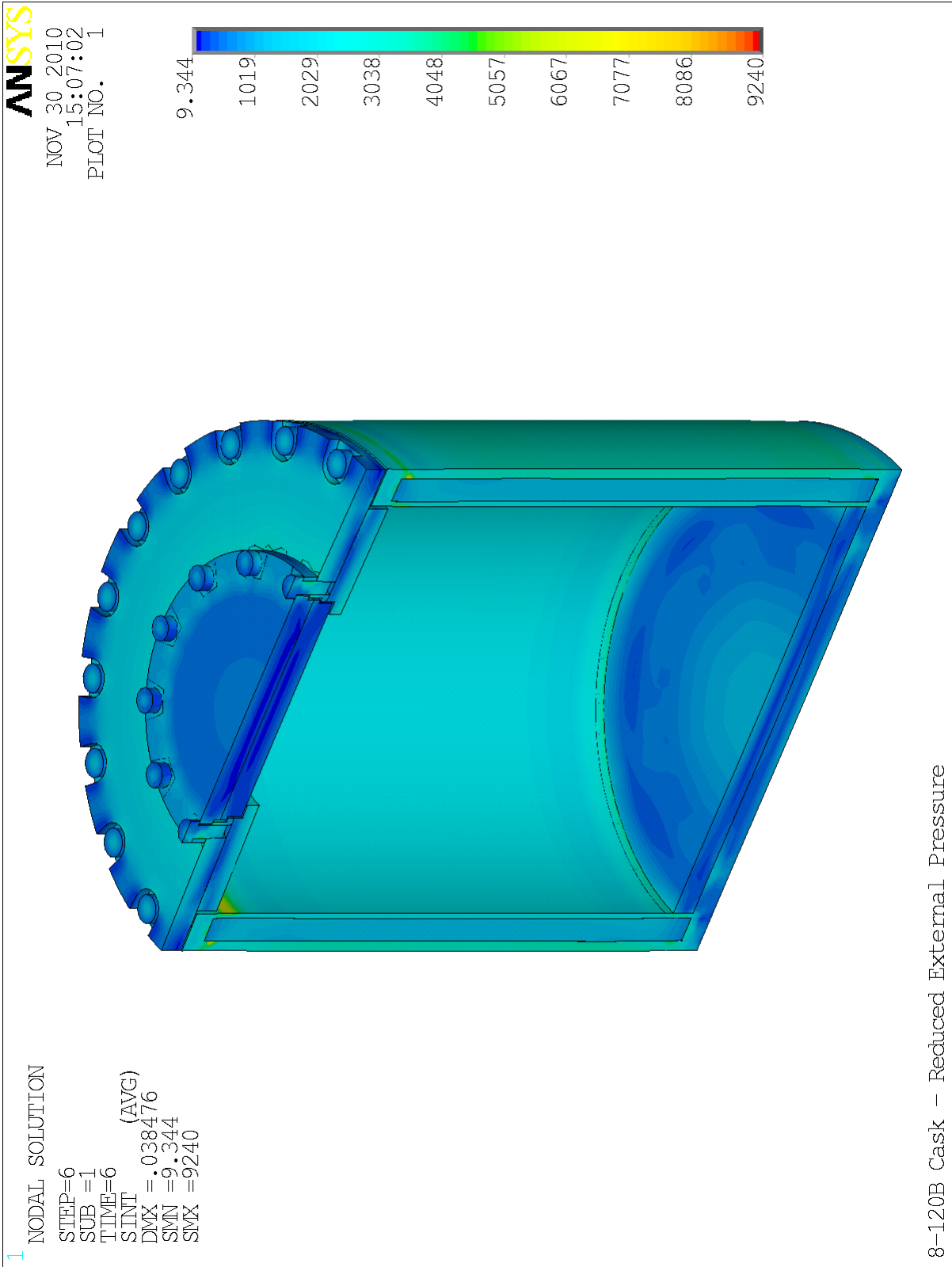


Figure 18
Stress Intensity Contour Plot - Reduced External Pressure Loading

Title Structural Analyses of the 8-120B Cask Under Normal Conditions of Transport

Calc. No. ST-626 (Figures)

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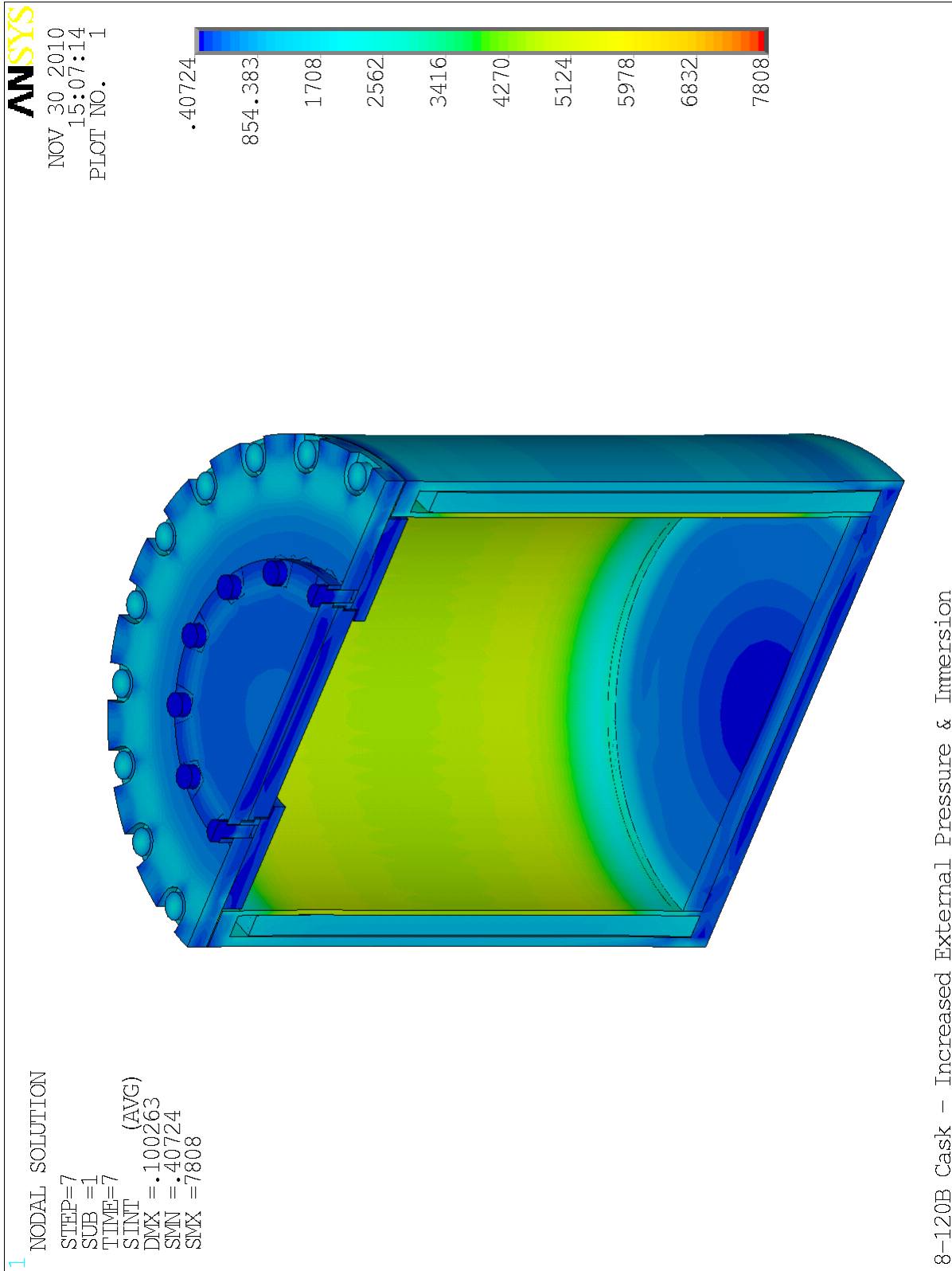


Figure 19
Stress Intensity Contour Plot - Increased External Pressure and Immersion Loading

Title _____ Structural Analyses of the 8-120B Cask Under Normal Conditions of Transport _____

Calc. No. _____ ST-626 _____

Rev. _____ 0 _____

Sheet _____ 12 _____ **of** _____ 14 _____

Appendix 1

Printout of the ANSYS Model Data

(32 Pages)

ANSYS Finite Element Model Partial Printout

(Note: The complete data printout is included on the file Model.out, which is included on the electronic media included in the package)

```

***** TITLES *****

*** YOU ARE IN   ANSYS - ENGINEERING ANALYSIS SYSTEM ***
ANSYS Mechanical
RELEASE  12.1      UPDATE 20091102   CUSTOMER  00222442

INITIAL JOBNAME = file
CURRENT JOBNAME = file

Current Working Directory: D:\ANSYS Analyses\8-120B\Assembly\Regulatory

TITLE= 8-120B Cask - Increased External Pressure & Immersion

MENULIST File: C:\Program Files\ANSYS Inc\v121\ANSYS\gui\en-
us\UIDL\menulist121.ans

                G L O B A L   S T A T U S

ANSYS - Engineering Analysis System          Nov 24, 2010          11:49
Release 12.1                                00222442          WINDOWS x64 Version

Current working directory: D:\ANSYS Analyses\8-120B\Assembly\Regulatory

MENULIST File: C:\Program Files\ANSYS Inc\v121\ANSYS\gui\en-
us\UIDL\menulist121.ans

Product(s) enabled: ANSYS Mechanical

Total connect time. . . . . 0 hours  1 minutes
Total CP usage. . . . . 0 hours  0 minutes  2.0 seconds

J O B   I N F O R M A T I O N  -----
8-120B Cask - Increased External Pressure & Immersion

Current jobname . . . . . .file
Initial jobname . . . . . .file

Units . . . . . .unknown

                Available                Used
Scratch Memory Space. . . . . 512.000 mb      31.133 mb ( 6.1%)
Database space . . . . . 65535.750 mb      147.057 mb ( 0.2%)

User menu file in use . . . .%ANSYS121_DIR%\gui\en-us\UIDL\UIMENU.GRN
User menu file in use . . . .%ANSYS121_DIR%\gui\en-us\UIDL\UIFUNC1.GRN
User menu file in use . . . .%ANSYS121_DIR%\gui\en-us\UIDL\UIFUNC2.GRN

```

User menu file in use . . . %ANSYS121_DIR%\gui\en-us\UIDL\MECHTOOL.AUI
 Beta features are not shown in the user interface

M O D E L I N F O R M A T I O N -----

Solid model summary:

	Largest Number	Number Defined	Number Selected
Keypoints	0	0	0
Lines	0	0	0
Areas	0	0	0
Volumes	0	0	0

Finite element model summary:

	Largest Number	Number Defined	Number Selected
Nodes	37896	37896	37896
Elements.	39115	38144	38144
Element types	148	137	n.a.
Real constant sets.	87	67	n.a.
Material property sets. . .	4	3	n.a.
Coupling.	0	0	n.a.
Constraint equations. . . .	0	0	n.a.
Master DOFs	0	0	n.a.
Dynamic gap conditions. . .	0	0	n.a.

B O U N D A R Y C O N D I T I O N I N F O R M A T I O N -----

	Number Defined
Constraints on nodes.	2355
Constraints on keypoints.	0
Constraints on lines.	0
Constraints on areas.	0
Forces on nodes	0
Forces on keypoints	0
Surface loads on elements	5164
Number of element flagged surfaces . . .	0
Surface loads on lines.	0
Surface loads on areas.	0
Body loads on elements.	656
Body loads on areas	0
Body loads on lines	0
Body loads on nodes	37896
Body loads on keypoints	0
Temperatures	
Uniform temperature.	70.000
Reference temperature.	70.000
Offset from absolute scale	0.000

	X	Y	Z
Linear acceleration	0.0000	0.0000	1.0300
Angular velocity (about global CS)	0.0000	0.0000	0.0000
Angular acceleration (about global CS) . .	0.0000	0.0000	0.0000
Location of reference CS.	0.0000	0.0000	0.0000
Angular velocity (about reference CS) . .	0.0000	0.0000	0.0000
Angular acceleration (about reference CS)	0.0000	0.0000	0.0000

ROUTINE INFORMATION -----

Current routine.Preprocessing (PREP7)

Active coordinate system 1 (Cylindrical)

Display coordinate system. 0 (Cartesian)

Current element attributes:

Type number	2 (SOLID45)
Real number	6
Material number	4
Element coordinate system number. .	0

Current mesher type.based on default element shape

Current element meshing shape 2D . . .use default element shape.

Current element meshing shape 3D . . .use default element shape.

SmrtSize Level OFF

Global element size. 0 divisions per line

Active coordinate system 1 (Cylindrical)

Display coordinate system. 0 (Cartesian)

Analysis type.Static (steady-state)

Active options for this analysis type:

Large deformation effectsNot included
Plasticity.Not included
CreepNot included
Equation solver to use.Program Chosen

Results filefile.rst

Load step number 8

Number of substeps 1

Step change boundary conditions . .No

SOLUTION OPTIONS

PROBLEM DIMENSIONALITY.3-D

DEGREES OF FREEDOM. UX UY UZ ROTX ROTY ROTZ

ANALYSIS TYPESTATIC (STEADY-STATE)

```

NEWTON-RAPHSON OPTION . . . . .PROGRAM CHOSEN
GLOBALLY ASSEMBLED MATRIX . . . . .SYMMETRIC

```

LOAD STEP OPTIONS

```

LOAD STEP NUMBER. . . . . 8
TIME AT END OF THE LOAD STEP. . . . . 8.0000
NUMBER OF SUBSTEPS. . . . . 1
MAXIMUM NUMBER OF EQUILIBRIUM ITERATIONS. . . . 15
STEP CHANGE BOUNDARY CONDITIONS . . . . . NO
TERMINATE ANALYSIS IF NOT CONVERGED . . . . . YES (EXIT)
CONVERGENCE CONTROLS. . . . . USE DEFAULTS
INERTIA LOADS . . . . . X Y Z
    ACEL . . . . . 0.0000 0.0000 1.0300
PRINT OUTPUT CONTROLS . . . . . NO PRINTOUT
DATABASE OUTPUT CONTROLS. . . . . ALL DATA WRITTEN
                                FOR THE LAST SUBSTEP

```

LIST ELEMENT TYPES FROM 1 TO 148 BY 1

ELEMENT TYPE	1	IS	SHELL63	ELASTIC	SHELL	
KEYOPT(1- 6)=	0		0	0	0	0
KEYOPT(7-12)=	0		0	0	0	0
KEYOPT(13-18)=	0		0	0	0	0

ELEMENT TYPE	2	IS	SOLID45	3-D	STRUCTURAL	SOLID
KEYOPT(1- 6)=	0		0	0	0	0
KEYOPT(7-12)=	0		0	0	0	0
KEYOPT(13-18)=	0		0	0	0	0

ELEMENT TYPE	3	IS	SOLSH190	3-D	8-NODE	SOLID	SHELL
KEYOPT (1- 6)=	0		0			0	0
KEYOPT (7-12)=	0		0			0	0
KEYOPT (13-18)=	0		0			0	0

ELEMENT TYPE	7 IS	TARGET170	3-D	TARGET	SEGMENT	
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0

ELEMENT TYPE	8	IS	CONTA174	3D	8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=		0	0	0		3	0
KEYOPT(7-12)=		0	0	1	2	0	0
KEYOPT(13-18)=		0	0	0	0	0	0

ELEMENT TYPE	11	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT (1- 6)=			0	0	0	0
KEYOPT (7-12)=			0	0	0	0
KEYOPT (13-18)=			0	0	0	0

ELEMENT	TYPE	12	IS	CONTA174	3D	8-NODE	SURF-SURF	CONTACT
KEYOPT (1- 6) =		0		0	0		3	0
KEYOPT (7-12) =		0		0	1	2	0	0
KEYOPT (13-18) =		0		0	0	0	0	0

ELEMENT TYPE 15 IS TARGE170 3-D TARGET SEGMENT

KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 16 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 17 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 18 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 19 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 20 IS CONTA175 NODE-TO-SURFACE CONTACT						
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 21 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 22 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 23 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 24 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 25 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 26 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3

KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	27	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	28	IS	CONTA174	3D	8-NODE	SURF-SURF CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	29	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	30	IS	CONTA174	3D	8-NODE	SURF-SURF CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	31	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	32	IS	CONTA174	3D	8-NODE	SURF-SURF CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	33	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	34	IS	CONTA174	3D	8-NODE	SURF-SURF CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	35	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	36	IS	CONTA174	3D	8-NODE	SURF-SURF CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	37	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0

ELEMENT TYPE	38	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0 3	0
KEYOPT(7-12)=			0 0	1	2 0	0
KEYOPT(13-18)=			0 0	0	0 0	0
ELEMENT TYPE	39	IS	TARGE170	3-D TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0 0	0
KEYOPT(7-12)=			0 0	0	0 0	0
KEYOPT(13-18)=			0 0	0	0 0	0
ELEMENT TYPE	40	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0 3	0
KEYOPT(7-12)=			0 0	1	2 0	0
KEYOPT(13-18)=			0 0	0	0 0	0
ELEMENT TYPE	41	IS	TARGE170	3-D TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0 0	0
KEYOPT(7-12)=			0 0	0	0 0	0
KEYOPT(13-18)=			0 0	0	0 0	0
ELEMENT TYPE	42	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0 3	0
KEYOPT(7-12)=			0 0	1	2 0	0
KEYOPT(13-18)=			0 0	0	0 0	0
ELEMENT TYPE	43	IS	TARGE170	3-D TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0 0	0
KEYOPT(7-12)=			0 0	0	0 0	0
KEYOPT(13-18)=			0 0	0	0 0	0
ELEMENT TYPE	44	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0 3	0
KEYOPT(7-12)=			0 0	1	2 0	0
KEYOPT(13-18)=			0 0	0	0 0	0
ELEMENT TYPE	45	IS	TARGE170	3-D TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0 0	0
KEYOPT(7-12)=			0 0	0	0 0	0
KEYOPT(13-18)=			0 0	0	0 0	0
ELEMENT TYPE	46	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0 3	0
KEYOPT(7-12)=			0 0	1	2 0	0
KEYOPT(13-18)=			0 0	0	0 0	0
ELEMENT TYPE	47	IS	TARGE170	3-D TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0 0	0
KEYOPT(7-12)=			0 0	0	0 0	0
KEYOPT(13-18)=			0 0	0	0 0	0
ELEMENT TYPE	48	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0 3	0
KEYOPT(7-12)=			0 0	1	2 0	3
KEYOPT(13-18)=			0 0	0	0 0	0
ELEMENT TYPE	49	IS	TARGE170	3-D TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0 0	0

KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	50	IS	CONTA174	3D	8-NODE	SURF-SURF CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	51	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	52	IS	CONTA174	3D	8-NODE	SURF-SURF CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	53	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	54	IS	CONTA174	3D	8-NODE	SURF-SURF CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	55	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	56	IS	CONTA174	3D	8-NODE	SURF-SURF CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	57	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	58	IS	CONTA174	3D	8-NODE	SURF-SURF CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	59	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	60	IS	CONTA174	3D	8-NODE	SURF-SURF CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0

ELEMENT TYPE	61	IS	TARGE170	3-D	TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	62	IS	CONTA174	3D	8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	3	0
KEYOPT(7-12)=			0 0	1	2	0	3
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	63	IS	TARGE170	3-D	TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	64	IS	CONTA174	3D	8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	3	0
KEYOPT(7-12)=			0 0	1	2	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	65	IS	TARGE170	3-D	TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	66	IS	CONTA174	3D	8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	3	0
KEYOPT(7-12)=			0 0	1	2	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	67	IS	TARGE170	3-D	TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	68	IS	CONTA174	3D	8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	3	0
KEYOPT(7-12)=			0 0	1	2	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	69	IS	TARGE170	3-D	TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	70	IS	CONTA174	3D	8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	3	0
KEYOPT(7-12)=			0 0	1	2	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	71	IS	TARGE170	3-D	TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	72	IS	CONTA174	3D	8-NODE	SURF-SURF	CONTACT

KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 73 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 74 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 75 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 76 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 77 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 78 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 79 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 80 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 81 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 82 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 83 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0

KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	84	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	85	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	86	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	89	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	90	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	91	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	92	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	93	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	94	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	95	IS	TARGE170	3-D	TARGET	SEGMENT
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE	96	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=	0	0	0	0	3	0
KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0

ELEMENT TYPE	97	IS	TARGE170	3-D	TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	98	IS	CONTA174	3D	8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	3	0
KEYOPT(7-12)=			0 0	1	2	0	3
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	99	IS	TARGE170	3-D	TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	100	IS	CONTA174	3D	8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	3	0
KEYOPT(7-12)=			0 0	1	2	0	3
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	101	IS	TARGE170	3-D	TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	102	IS	CONTA174	3D	8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	3	0
KEYOPT(7-12)=			0 0	1	2	0	3
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	103	IS	TARGE170	3-D	TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	104	IS	CONTA174	3D	8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	3	0
KEYOPT(7-12)=			0 0	1	2	0	3
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	105	IS	TARGE170	3-D	TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	106	IS	CONTA174	3D	8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	3	0
KEYOPT(7-12)=			0 0	1	2	0	3
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	109	IS	TARGE170	3-D	TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0	0
ELEMENT TYPE	110	IS	CONTA174	3D	8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	3	0

KEYOPT(7-12)=	0	0	1	2	0	3
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 111 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 112 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 113 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 114 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 115 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 116 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 117 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 118 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 119 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 120 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 121 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0

ELEMENT TYPE	122	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	0
KEYOPT(7-12)=			0 0	1	2	0
KEYOPT(13-18)=			0 0	0	0	0
ELEMENT TYPE	123	IS	TARGE170	3-D TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0
ELEMENT TYPE	124	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	0
KEYOPT(7-12)=			0 0	1	2	0
KEYOPT(13-18)=			0 0	0	0	0
ELEMENT TYPE	125	IS	TARGE170	3-D TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0
ELEMENT TYPE	126	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	0
KEYOPT(7-12)=			0 0	1	2	0
KEYOPT(13-18)=			0 0	0	0	0
ELEMENT TYPE	127	IS	TARGE170	3-D TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0
ELEMENT TYPE	128	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	0
KEYOPT(7-12)=			0 0	1	2	0
KEYOPT(13-18)=			0 0	0	0	0
ELEMENT TYPE	129	IS	TARGE170	3-D TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0
ELEMENT TYPE	130	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	0
KEYOPT(7-12)=			0 0	1	2	0
KEYOPT(13-18)=			0 0	0	0	0
ELEMENT TYPE	131	IS	TARGE170	3-D TARGET	SEGMENT	
KEYOPT(1- 6)=			0 0	0	0	0
KEYOPT(7-12)=			0 0	0	0	0
KEYOPT(13-18)=			0 0	0	0	0
ELEMENT TYPE	132	IS	CONTA174	3D 8-NODE	SURF-SURF	CONTACT
KEYOPT(1- 6)=			0 0	0	0	0
KEYOPT(7-12)=			0 0	1	2	0
KEYOPT(13-18)=			0 0	0	0	0
ELEMENT TYPE	133	IS	TARGE170	3-D TARGET	SEGMENT	

KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 134 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 135 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 136 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 137 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 138 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 139 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 140 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 141 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 142 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	1	2	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 143 IS TARGE170 3-D TARGET SEGMENT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	0	0	0	0
KEYOPT(13-18)=	0	0	0	0	0	0
ELEMENT TYPE 144 IS CONTA174 3D 8-NODE SURF-SURF CONTACT						
KEYOPT(1- 6)=	0	0	0	0	0	0
KEYOPT(7-12)=	0	0	1	2	0	0

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KEYOPT(13-18)=          0          0          0          0          0          0

ELEMENT TYPE      145 IS TARGE170      3-D TARGET SEGMENT
KEYOPT( 1- 6)=      0          0          0          0          0          0
KEYOPT( 7-12)=      0          0          0          0          0          0
KEYOPT(13-18)=      0          0          0          0          0          0

ELEMENT TYPE      146 IS CONTA174      3D 8-NODE SURF-SURF CONTACT
KEYOPT( 1- 6)=      0          0          0          0          0          0
KEYOPT( 7-12)=      0          0          1          2          0          0
KEYOPT(13-18)=      0          0          0          0          0          0

ELEMENT TYPE      147 IS TARGE170      3-D TARGET SEGMENT
KEYOPT( 1- 6)=      0          0          0          0          0          0
KEYOPT( 7-12)=      0          0          0          0          0          0
KEYOPT(13-18)=      0          0          0          0          0          0

ELEMENT TYPE      148 IS CONTA174      3D 8-NODE SURF-SURF CONTACT
KEYOPT( 1- 6)=      0          0          0          0          3          0
KEYOPT( 7-12)=      0          0          1          2          0          3
KEYOPT(13-18)=      0          0          0          0          0          0

CURRENT NODAL DOF SET IS  UX      UY      UZ      ROTX  ROTY  ROTZ
THREE-DIMENSIONAL MODEL

LIST REAL SETS          1 TO          87 BY          1

REAL CONSTANT SET      17  ITEMS  1 TO    6
0.0000      0.0000          1.0000      0.10000      -0.10000      0.0000

REAL CONSTANT SET      17  ITEMS  7 TO   12
0.0000      0.0000      0.10000E+21      0.0000          1.0000      0.0000

REAL CONSTANT SET      17  ITEMS 13 TO   18
0.0000      0.0000          0.0000      0.0000          0.0000      0.0000

REAL CONSTANT SET      17  ITEMS 19 TO   24
0.0000      0.0000          1.0000      0.0000          0.0000      0.0000

REAL CONSTANT SET      19  ITEMS  1 TO    6
0.0000      0.0000          1.0000      0.10000      -0.10000      0.0000

REAL CONSTANT SET      19  ITEMS  7 TO   12
0.0000      0.0000      0.10000E+21      0.0000          1.0000      0.0000

REAL CONSTANT SET      19  ITEMS 13 TO   18
0.0000      0.0000          1.0000      0.0000          1.0000      0.50000

REAL CONSTANT SET      19  ITEMS 19 TO   24
0.0000      1.0000          1.0000      0.0000          0.0000      1.0000

REAL CONSTANT SET      21  ITEMS  1 TO    6
0.0000      0.0000          1.0000      0.10000      -0.10000      0.0000

REAL CONSTANT SET      21  ITEMS  7 TO   12
0.0000      0.0000      0.10000E+21      0.0000          1.0000      0.0000

```

REAL CONSTANT SET	21	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	21	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	22	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	22	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	22	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	22	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	23	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	23	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	23	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	23	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	23	ITEMS 25 TO 30			
10.000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	24	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	24	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	24	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	24	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	25	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	25	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	25	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	25	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	

REAL CONSTANT SET	26	ITEMS 1 TO 6	0.0000	0.0000	1.0000	0.10000	-0.10000	0.0000
REAL CONSTANT SET	26	ITEMS 7 TO 12	0.0000	0.0000	0.10000E+21	0.0000	1.0000	0.0000
REAL CONSTANT SET	26	ITEMS 13 TO 18	0.0000	0.0000	1.0000	0.0000	1.0000	0.50000
REAL CONSTANT SET	26	ITEMS 19 TO 24	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000
REAL CONSTANT SET	27	ITEMS 1 TO 6	0.0000	0.0000	1.0000	0.10000	-0.10000	0.0000
REAL CONSTANT SET	27	ITEMS 7 TO 12	0.0000	0.0000	0.10000E+21	0.0000	1.0000	0.0000
REAL CONSTANT SET	27	ITEMS 13 TO 18	0.0000	0.0000	1.0000	0.0000	1.0000	0.50000
REAL CONSTANT SET	27	ITEMS 19 TO 24	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000
REAL CONSTANT SET	28	ITEMS 1 TO 6	0.0000	0.0000	1.0000	0.10000	-0.10000	0.0000
REAL CONSTANT SET	28	ITEMS 7 TO 12	0.0000	0.0000	0.10000E+21	0.0000	1.0000	0.0000
REAL CONSTANT SET	28	ITEMS 13 TO 18	0.0000	0.0000	1.0000	0.0000	1.0000	0.50000
REAL CONSTANT SET	28	ITEMS 19 TO 24	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000
REAL CONSTANT SET	29	ITEMS 1 TO 6	0.0000	0.0000	1.0000	0.10000	-0.10000	0.0000
REAL CONSTANT SET	29	ITEMS 7 TO 12	0.0000	0.0000	0.10000E+21	0.0000	1.0000	0.0000
REAL CONSTANT SET	29	ITEMS 13 TO 18	0.0000	0.0000	1.0000	0.0000	1.0000	0.50000
REAL CONSTANT SET	29	ITEMS 19 TO 24	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000
REAL CONSTANT SET	30	ITEMS 1 TO 6	0.0000	0.0000	1.0000	0.10000	-0.10000	0.0000
REAL CONSTANT SET	30	ITEMS 7 TO 12	0.0000	0.0000	0.10000E+21	0.0000	1.0000	0.0000
REAL CONSTANT SET	30	ITEMS 13 TO 18	0.0000	0.0000	1.0000	0.0000	1.0000	0.50000

REAL CONSTANT SET	30	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	0.0000	1.0000
REAL CONSTANT SET	31	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	31	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	31	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	31	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	32	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	32	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	32	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	32	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	33	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	33	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	33	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	33	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	34	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	34	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	34	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	34	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	35	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	35	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	

REAL CONSTANT SET	35	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	35	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	36	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	36	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	36	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	36	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	37	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	37	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	37	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	37	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	38	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	38	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	38	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	38	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	39	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	39	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	39	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	39	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	40	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	

REAL CONSTANT SET	40	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	40	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	40	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	41	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	41	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	41	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	41	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	42	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	42	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	42	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	42	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	43	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	43	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	43	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	43	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	44	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	44	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	44	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	44	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	

REAL CONSTANT SET	45	ITEMS 1 TO 6	0.0000	0.0000	1.0000	0.10000	-0.10000	0.0000
REAL CONSTANT SET	45	ITEMS 7 TO 12	0.0000	0.0000	0.10000E+21	0.0000	1.0000	0.0000
REAL CONSTANT SET	45	ITEMS 13 TO 18	0.0000	0.0000	1.0000	0.0000	1.0000	0.50000
REAL CONSTANT SET	45	ITEMS 19 TO 24	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000
REAL CONSTANT SET	46	ITEMS 1 TO 6	0.0000	0.0000	1.0000	0.10000	0.0000	0.0000
REAL CONSTANT SET	46	ITEMS 7 TO 12	0.0000	0.0000	0.10000E+21	0.0000	1.0000	0.0000
REAL CONSTANT SET	46	ITEMS 13 TO 18	0.0000	0.0000	1.0000	0.0000	1.0000	0.50000
REAL CONSTANT SET	46	ITEMS 19 TO 24	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000
REAL CONSTANT SET	47	ITEMS 1 TO 6	0.0000	0.0000	1.0000	0.10000	0.0000	0.0000
REAL CONSTANT SET	47	ITEMS 7 TO 12	0.0000	0.0000	0.10000E+21	0.0000	1.0000	0.0000
REAL CONSTANT SET	47	ITEMS 13 TO 18	0.0000	0.0000	1.0000	0.0000	1.0000	0.50000
REAL CONSTANT SET	47	ITEMS 19 TO 24	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000
REAL CONSTANT SET	48	ITEMS 1 TO 6	0.0000	0.0000	1.0000	0.10000	0.0000	0.0000
REAL CONSTANT SET	48	ITEMS 7 TO 12	0.0000	0.0000	0.10000E+21	0.0000	1.0000	0.0000
REAL CONSTANT SET	48	ITEMS 13 TO 18	0.0000	0.0000	1.0000	0.0000	1.0000	0.50000
REAL CONSTANT SET	48	ITEMS 19 TO 24	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000
REAL CONSTANT SET	49	ITEMS 1 TO 6	0.0000	0.0000	1.0000	0.10000	0.0000	0.0000
REAL CONSTANT SET	49	ITEMS 7 TO 12	0.0000	0.0000	0.10000E+21	0.0000	1.0000	0.0000
REAL CONSTANT SET	49	ITEMS 13 TO 18	0.0000	0.0000	1.0000	0.0000	1.0000	0.50000

REAL CONSTANT SET	49	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	0.0000	1.0000
REAL CONSTANT SET	50	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	0.0000	0.0000	0.0000
REAL CONSTANT SET	50	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	0.0000
REAL CONSTANT SET	50	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	50	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	51	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	0.0000	0.0000	0.0000
REAL CONSTANT SET	51	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	0.0000
REAL CONSTANT SET	51	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	51	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	52	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	0.0000	0.0000	0.0000
REAL CONSTANT SET	52	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	0.0000
REAL CONSTANT SET	52	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	52	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	53	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	0.0000	0.0000	0.0000
REAL CONSTANT SET	53	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	0.0000
REAL CONSTANT SET	53	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	53	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	54	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	0.0000	0.0000	0.0000
REAL CONSTANT SET	54	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	0.0000

REAL CONSTANT SET	54	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	54	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	55	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	0.0000	0.0000	
REAL CONSTANT SET	55	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	55	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	55	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	56	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	56	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	56	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	56	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	58	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	58	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	58	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	58	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	59	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	59	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	59	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	59	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	60	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	

REAL CONSTANT SET	60	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	60	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	60	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	61	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	61	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	61	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	61	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	62	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	62	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	62	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	62	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	63	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	63	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	63	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	63	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	
REAL CONSTANT SET	64	ITEMS 1 TO 6			
0.0000 0.0000		1.0000 0.10000	-0.10000	0.0000	
REAL CONSTANT SET	64	ITEMS 7 TO 12			
0.0000 0.0000		0.10000E+21 0.0000	1.0000	0.0000	
REAL CONSTANT SET	64	ITEMS 13 TO 18			
0.0000 0.0000		1.0000 0.0000	1.0000	0.50000	
REAL CONSTANT SET	64	ITEMS 19 TO 24			
0.0000 1.0000		1.0000 0.0000	0.0000	1.0000	

REAL CONSTANT SET	70	ITEMS 19 TO 24			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	71	ITEMS 1 TO 6			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	71	ITEMS 7 TO 12			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	71	ITEMS 13 TO 18			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	71	ITEMS 19 TO 24			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	72	ITEMS 1 TO 6			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	72	ITEMS 7 TO 12			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	72	ITEMS 13 TO 18			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	72	ITEMS 19 TO 24			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	73	ITEMS 1 TO 6			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	73	ITEMS 7 TO 12			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	73	ITEMS 13 TO 18			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	73	ITEMS 19 TO 24			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	74	ITEMS 1 TO 6			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	74	ITEMS 7 TO 12			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	74	ITEMS 13 TO 18			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	74	ITEMS 19 TO 24			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	75	ITEMS 1 TO 6			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	75	ITEMS 7 TO 12			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	

REAL CONSTANT SET	75	ITEMS 13 TO	18			
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	75	ITEMS 19 TO	24			
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	76	ITEMS 1 TO	6			
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	76	ITEMS 7 TO	12			
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	76	ITEMS 13 TO	18			
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	76	ITEMS 19 TO	24			
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	77	ITEMS 1 TO	6			
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	77	ITEMS 7 TO	12			
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	77	ITEMS 13 TO	18			
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	77	ITEMS 19 TO	24			
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	78	ITEMS 1 TO	6			
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REAL CONSTANT SET	78	ITEMS 7 TO	12			
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REAL CONSTANT SET	78	ITEMS 13 TO	18			
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REAL CONSTANT SET	78	ITEMS 19 TO	24			
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REAL CONSTANT SET	79	ITEMS 1 TO	6			
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REAL CONSTANT SET	79	ITEMS 7 TO	12			
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	79	ITEMS 13 TO	18			
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	79	ITEMS 19 TO	24			
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	80	ITEMS 1 TO	6			
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REAL CONSTANT SET	80	ITEMS 7 TO 12			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	80	ITEMS 13 TO 18			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	80	ITEMS 19 TO 24			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	81	ITEMS 1 TO 6			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	81	ITEMS 7 TO 12			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	81	ITEMS 13 TO 18			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	81	ITEMS 19 TO 24			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	82	ITEMS 1 TO 6			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	82	ITEMS 7 TO 12			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	82	ITEMS 13 TO 18			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	82	ITEMS 19 TO 24			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	83	ITEMS 1 TO 6			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	83	ITEMS 7 TO 12			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	83	ITEMS 13 TO 18			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	83	ITEMS 19 TO 24			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	84	ITEMS 1 TO 6			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	84	ITEMS 7 TO 12			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	84	ITEMS 13 TO 18			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	
REAL CONSTANT SET	84	ITEMS 19 TO 24			
0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	

REAL CONSTANT SET	85	ITEMS 1 TO	6		
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	85	ITEMS 7 TO	12		
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	85	ITEMS 13 TO	18		
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	85	ITEMS 19 TO	24		
0.0000 0.0000		0.0000	0.0000	0.0000	0.0000
REAL CONSTANT SET	86	ITEMS 1 TO	6		
0.0000 0.0000		1.0000	0.10000	0.0000	0.0000
REAL CONSTANT SET	86	ITEMS 7 TO	12		
0.0000 0.0000		0.10000E+21	0.0000	1.0000	0.0000
REAL CONSTANT SET	86	ITEMS 13 TO	18		
0.0000 0.0000		1.0000	0.0000	1.0000	0.50000
REAL CONSTANT SET	86	ITEMS 19 TO	24		
0.0000 1.0000		1.0000	0.0000	0.0000	1.0000
REAL CONSTANT SET	87	ITEMS 1 TO	6		
0.0000 0.0000		1.0000	0.10000	0.0000	0.0000
REAL CONSTANT SET	87	ITEMS 7 TO	12		
0.0000 0.0000		0.10000E+21	0.0000	1.0000	0.0000
REAL CONSTANT SET	87	ITEMS 13 TO	18		
0.0000 0.0000		1.0000	0.0000	1.0000	0.50000
REAL CONSTANT SET	87	ITEMS 19 TO	24		
0.0000 1.0000		1.0000	0.0000	0.0000	1.0000
LIST MATERIALS	1 TO	4 BY	1		
PROPERTY= ALL					

MATERIAL NUMBER 1

TEMP	EX
-100.00	0.30300E+08
70.000	0.29400E+08
200.00	0.28800E+08
300.00	0.28300E+08
400.00	0.27900E+08
500.00	0.27300E+08
600.00	0.26500E+08

TEMP	NUXY
	0.3000000

TEMP	ALPX	REFERENCE TEMP. = 70.00
70.000	0.64000E-05	
100.00	0.65000E-05	
150.00	0.66000E-05	

200.00	0.67000E-05
250.00	0.68000E-05
300.00	0.69000E-05
350.00	0.70000E-05
400.00	0.71000E-05
450.00	0.72000E-05
500.00	0.73000E-05
550.00	0.73000E-05
600.00	0.74000E-05

TEMP	DENS
	0.2830000

MATERIAL NUMBER	2
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TEMP	EX
-40.000	0.24600E+07
-20.000	0.24300E+07
70.000	0.22700E+07
100.00	0.22100E+07
200.00	0.20100E+07
300.00	0.18500E+07
400.00	0.17000E+07
500.00	0.15200E+07

TEMP	NUXY
	0.4000000

TEMP	ALPX	REFERENCE TEMP. = 70.00
-40.000	0.15560E-04	
-20.000	0.15650E-04	
70.000	0.16060E-04	
100.00	0.16220E-04	
200.00	0.16700E-04	
300.00	0.17330E-04	
400.00	0.18160E-04	
500.00	0.19120E-04	

TEMP	DENS
	0.4100000

MATERIAL NUMBER	4
-----------------	---

TEMP	EX
-100.00	0.29200E+08
70.000	0.28300E+08
200.00	0.27500E+08
300.00	0.27000E+08
400.00	0.26400E+08
500.00	0.25900E+08
600.00	0.25300E+08

TEMP	NUXY
	0.3000000

TEMP	ALPX	REFERENCE TEMP. = 70.00
70.000	0.85000E-05	

100.00	0.86000E-05
150.00	0.88000E-05
200.00	0.89000E-05
250.00	0.91000E-05
300.00	0.92000E-05
350.00	0.94000E-05
400.00	0.95000E-05
450.00	0.96000E-05
500.00	0.97000E-05
550.00	0.98000E-05
600.00	0.98000E-05

TEMP	DENS
	0.283000

**** CENTER OF MASS, MASS, AND MASS MOMENTS OF INERTIA ****

CALCULATIONS ASSUME ELEMENT MASS AT ELEMENT CENTROID

TOTAL MASS = 23938.

CENTER OF MASS	MOM. OF INERTIA ABOUT ORIGIN	MOM. OF INERTIA ABOUT CENTER OF MASS
XC = 0.77768E-06	IXX = 0.7933E+08	IXX = 0.2363E+08
YC = 19.491	IYY = 0.7933E+08	IYY = 0.3272E+08
ZC = -44.124	IZZ = 0.2352E+08	IZZ = 0.1443E+08
	IXY = 0.1906	IXY = 0.5535
	IYZ = 0.2069E+08	IYZ = 0.1049E+06
	IZX = 1.132	IZX = 0.3106

*** MASS SUMMARY BY ELEMENT TYPE ***

TYPE	MASS
2	18544.5
3	5393.98

Title Structural Analyses of the 8-120B Cask Under Normal Conditions of Transport

Calc. No. ST-626

Rev. 0

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Appendix 2

Stress Summary Print-out

(2 Pages)

ANSYS FEM Analyses Result Summary

8-120B Cask - Hot Environment

	Max. S.I.	Max. Sig1	Max. Sig3
Primary Lid	3989.	3647.	725.
Secondary Lid	2255.	1387.	116.
Bolting Ring	16385.	14905.	4835.
Inner Shell	13872.	16500.	3620.
Outer Shell	14314.	16821.	3652.
Baseplates	9919.	6943.	3124.
Primary Lid Bolts	12516.	16017.	3500.
Secondary Lid Bolts	4189.	3948.	1276.

8-120B Cask - Cold Environment

	Max. S.I.	Max. Sig1	Max. Sig3
Primary Lid	3695.	3392.	660.
Secondary Lid	2102.	1296.	108.
Bolting Ring	4177.	3530.	727.
Inner Shell	5075.	1701.	58.
Outer Shell	4778.	5298.	921.
Baseplates	2312.	1168.	131.
Primary Lid Bolts	6197.	5813.	1450.
Secondary Lid Bolts	3904.	3683.	1179.

8-120B Cask - Normal Hot

	Max. S.I.	Max. Sig1	Max. Sig3
Primary Lid	3083.	2839.	545.
Secondary Lid	1803.	1125.	94.
Bolting Ring	7827.	7057.	2317.
Inner Shell	6161.	7179.	1544.
Outer Shell	6966.	8131.	1754.
Baseplates	4505.	3005.	1422.
Primary Lid Bolts	5914.	7557.	1643.
Secondary Lid Bolts	3332.	3151.	987.

8-120B Cask - Normal Cold

	Max. S.I.	Max. Sig1	Max. Sig3
Primary Lid	3516.	3231.	626.
Secondary Lid	2014.	1245.	104.
Bolting Ring	3632.	3053.	619.
Inner Shell	3686.	1316.	82.
Outer Shell	4153.	4591.	780.
Baseplates	2234.	1084.	56.
Primary Lid Bolts	5306.	4978.	1244.
Secondary Lid Bolts	3736.	3527.	1123.

8-120B Cask - MNOP

	Max. S.I.	Max. Sig1	Max. Sig3
Primary Lid	3049.	2829.	531.
Secondary Lid	1754.	1042.	91.
Bolting Ring	1272.	1645.	600.

Inner Shell	1591.	1696.	105.
Outer Shell	556.	602.	58.
Baseplates	1626.	729.	65.
Primary Lid Bolts	6783.	6430.	1332.
Secondary Lid Bolts	3247.	3069.	970.

8-120B Cask - Reduced External Pressure

	Max. S.I.	Max. Sig1	Max. Sig3
Primary Lid	4488.	4145.	792.
Secondary Lid	2612.	1606.	136.
Bolting Ring	8215.	7136.	2320.
Inner Shell	6199.	7199.	1530.
Outer Shell	7133.	8361.	1772.
Baseplates	4476.	2968.	1440.
Primary Lid Bolts	5997.	7659.	1662.
Secondary Lid Bolts	4832.	4568.	1437.

8-120B Cask - Increased External Pressure & Immersion

	Max. S.I.	Max. Sig1	Max. Sig3
Primary Lid	2743.	2415.	209.
Secondary Lid	1077.	719.	284.
Bolting Ring	3027.	2013.	662.
Inner Shell	4877.	1145.	45.
Outer Shell	2554.	2256.	33.
Baseplates	2812.	1250.	92.
Primary Lid Bolts	6466.	6066.	1454.
Secondary Lid Bolts	1018.	457.	114.

Notes:

- (1) The detail print-out of the stress components for each load case are included in files ls1post.out, ls2post.out, ls3post.out, ls4post.out, ls5post.out, ls6post.out, and, ls7post.out. These files are included in the electronic media attached with this document.

Title Structural Analyses of the 8-120B Cask Under Normal Conditions of Transport

Calc. No. ST-626

Rev. 0

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Appendix 3

Electronic Data on CDROM

(1 Page & 1 DVD)

Volume in drive F is My Disc
 Volume Serial Number is 62ED-F961

Directory of F:\

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11/09/2010	05:01 PM	716,308,480	file.rst
11/23/2010	03:47 PM	176,975	file001.png
11/23/2010	03:48 PM	112,006	file002.png
12/01/2010	03:40 PM	206,226	file003.png
11/30/2010	02:47 PM	114,565	file007.png
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11/30/2010	02:52 PM	191,274	file009.png
11/30/2010	02:52 PM	212,647	file010.png
11/30/2010	02:53 PM	198,195	file011.png
11/30/2010	02:53 PM	218,080	file012.png
11/30/2010	03:06 PM	175,001	file014.png
11/30/2010	03:07 PM	207,601	file015.png
11/30/2010	03:07 PM	200,676	file016.png
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12/01/2010	02:58 PM	27,503	file023.png
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11/09/2010	05:02 PM	2,964,560	ls3post.out
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11/09/2010	05:03 PM	2,964,487	ls6post.out
11/09/2010	05:03 PM	2,964,487	ls7post.out
11/24/2010	11:49 AM	2,998,616	model.out
12/02/2010	10:26 AM	5,096	summary.out
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	0 Dir(s)	0	bytes free