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		REV. 0
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Title:	RT-100 Cask Body Analysis	Client: Robatel Technologies, LLC
		Project: RTL-001

Item	Cover Sheet Items	Yes	No
1	Does this calculation contain any open assumptions that require confirmation? (If **YES**, Identify the assumptions) _____	☐	☒
2	Does this calculation serve as an "Alternate Calculation"? (If **YES**, Identify the design verified calculation.) **Design Verified Calculation No.** _____	☐	☒
3	Does this calculation Supersede an existing Calculation? (If **YES**, identify the superseded calculation.) **Superseded Calculation No.**_____	☐	☒

Scope of Revision:

Initial Issue

Revision Impact on Results:

N/A

Study Calculation ☐ **Final Calculation** ☒

Safety-Related ☒ **Non-Safety Related** ☐

(Print Name and Sign)

Originator: Andy Langston Andrew K. Langston	**Date: 10/07/2012**
Design Verifier: John Staples John F. Staples	**Date:** 10/07/2012
Approver: Curt Lindner	**Date:** 10/7/12

ENERCON Excellence—Every project. Every day.	CALCULATION REVISION STATUS SHEET	CALC. NO. RTL-001-CALC-ST-0403
		REV. 0
		PAGE NO. 2 of 30

CALCULATION REVISION STATUS

REVISION	DATE	DESCRIPTION
0	10/07/2012	Initial Issue

PAGE REVISION STATUS

PAGE NO.	REVISION	PAGE NO.	REVISION
1-30	0		

APPENDIX REVISION STATUS

APPENDIX NO.	PAGE NO.	REVISION NO.	APPENDIX NO.	PAGE NO.	REVISION NO.
1	1-37				
2	1-1				
3	1-64				

ENERCON Excellence—Every project. Every day.	**CALCULATION DESIGN VERIFICATION PLAN AND SUMMARY SHEET**	**CALC. NO.** RTL-001-CALC-ST-0403 **REV.** 0 **PAGE NO.** 3 of 30

Calculation Design Verification Plan:

Calculation to be reviewed for correctness of inputs, design criteria, analytical methods, acceptance criteria and numerical accuracy.

Stated objectives and conclusions shall be confirmed to be reasonable and valid.

Any assumptions shall be clearly documented and confirmed to be appropriate and verified based on sound engineering principles and practices.

(Print Name and Sign for Approval – mark "N/A" if not required)

Approver: ~~John Staples~~ Curt Lindner	**Date:** 10/7/12

Calculation Design Verification Summary:

Calculation has been designated as **Safety Related** as noted on the cover sheet.

Calculation has been verified to be mathematically correct and performed in accordance with appropriate design inputs, assumptions, analytical methods, design criteria and acceptance criteria.

The conclusions developed in the calculation are reasonable, valid and consistent with the purpose and scope.

Assumptions are appropriate and correct.

Based On The Above Summary, The Calculation Is Determined To Be Acceptable.

(Print Name and Sign)

Design Verifier: John Staples	**Date:** 10/07/2012
Others:	**Date:**

ENERCON Excellence—Every project. Every day.	CALCULATION DESIGN VERIFICATION CHECKLIST	CALC. NO. RTL-001-CALC-ST-0403 REV. 0 PAGE NO. 4 of 30

Item	CHECKLIST ITEMS	Yes	No	N/A
1	**Design Inputs -** Were the design inputs correctly selected, referenced (latest revision), consistent with the design basis, and incorporated in the calculation?	X		
2	**Assumptions** - Were the assumptions reasonable and adequately described, justified and/or verified, and documented?	X		
3	**Quality Assurance** - Were the appropriate QA classification and requirements assigned to the calculation?	X		
4	**Codes, Standards, and Regulatory Requirements** - Were the applicable codes, standards, and regulatory requirements, including issue and addenda, properly identified and their requirements satisfied?	X		
5	**Construction and Operating Experience** - Have applicable construction and operating experience been considered?	X		
6	**Interfaces** - Have the design-interface requirements been satisfied, including interactions with other calculations?	X		
7	**Methods** - Was the calculation methodology appropriate and properly applied to satisfy the calculation objective?	X		
8	**Design Outputs** - Was the conclusion of the calculation clearly stated, did it correspond directly with the objectives, and are the results reasonable compared to the inputs?	X		
9	**Radiation Exposure** - Has the calculation properly considered radiation exposure to the public and plant personnel?			X
10	**Acceptance Criteria** - Are the acceptance criteria incorporated in the calculation sufficient to allow verification that the design requirements have been satisfactorily accomplished?	X		
11	**Computer Software**- Is a computer program or software used, and if so, are the requirements of CSP 3.02 met?	X		

COMMENTS

(Print Name and Sign)

Design Verifier: John Staples John F. Staples	**Date:** 10/7/2012
Others:	**Date:**

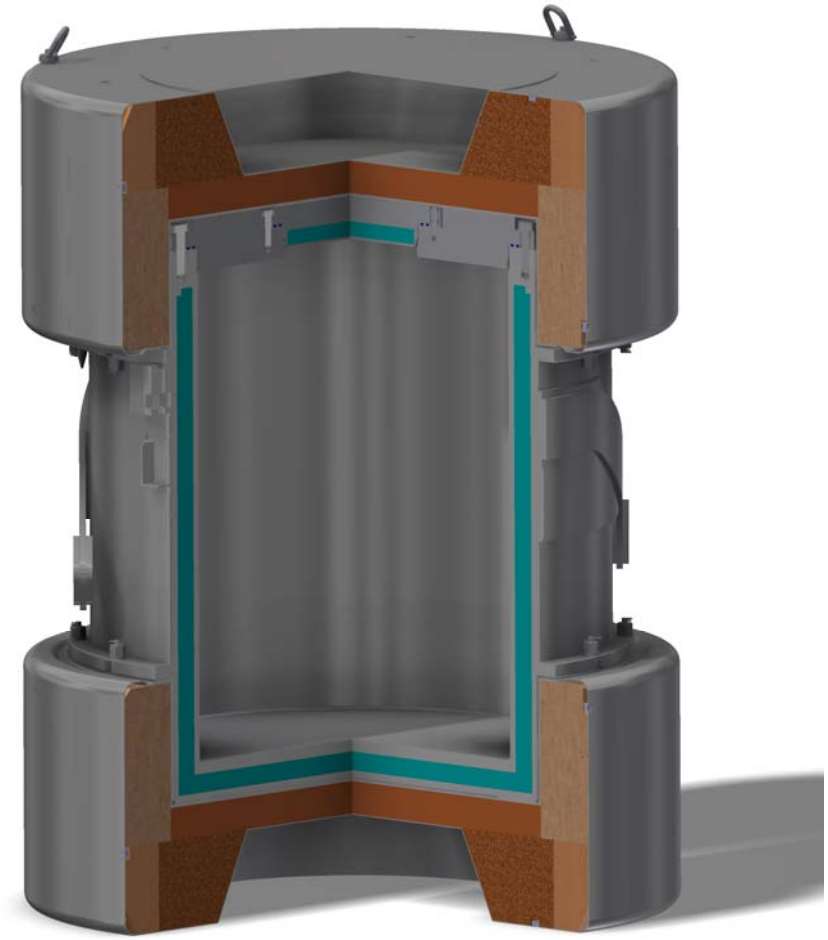
Table of Contents

1.0 Purpose and Scope

The purpose of this report is to document the Robatel Technologies RT-100 cask body analyses and show that the design meets the requirements of 10 CFR Part 71 (1). Specifically, the evaluation addresses the loads associated with the normal conditions of transport (NCT) and hypothetical accident condition (HAC). The loading cases evaluated include:

1. NCT 0.3-meter (1-ft) drop and HAC 9-meter (30-ft) drop conditions in worst cast drop orientations, which includes internal pressure, bolt preload, payload weight, inertia load, and thermal stress.
2. Two thermal conditions are evaluated, a hot and cold case. The hot case represents 38°C (100°F) ambient temperature and maximum insolance and heat load. The cold case represents -40°C (-40°F) with maximum heat load.
3. Pressure stresses during hypothetical accident conditions (HAC).

The results of the analyses for various load cases are presented pictorially in stress intensity contour plots as well as in table form, with the corresponding safety factors in each component of the cask body.



RT-100 Cask

2.0 Summary of Results and Conclusions

Structural analyses were performed for the Robatel Technologies RT-100 cask for the following conditions:

1. Impact (Drop) Loading (Normal and Accident)
2. Hot and Cold ambient conditions (Normal)
3. Pressure Stress (Accident)

To evaluate the RT-100 cask, a 3-D ANSYS model was used to analyze the governing cases for NCT and HAC. All structural members have a positive margin of safety under worst case loading conditions. The following table is a summary of the RT-100 stress evaluation and minimum margins of safety.

Location and Stress State		Case	S1	S2	S3	SINT	Stress Intensity (304)	Allowable Stress	Margin of Safety
			MPa	MPa	MPa	MPa	MPa	MPa	
Inner Lid	Pm	NCT Side	-1.5	-2.6	-56.9	55.4	137.9	137.9	1.5
Inner Lid	Pm+ Pb	NCT Side	-4.2	-19.9	-121.3	117.1	137.9	206.8	0.8
Inner Lid	Pm+ Pb+Q	NCT Side	2.4	-31.7	-161.7	164.1	137.9	413.7	2.4
Inner Lid	Pm	NCT End	5.7	-2.3	-35.4	41.1	137.9	137.9	2.4
Inner Lid	Pm+ Pb	NCT End	-6.5	-10.3	-67.7	61.3	137.9	206.8	2.4
Outer Lid	Pm+ Pb+Q	NCT End	280.5	36.7	-55.4	336.0	137.9	413.7	0.2
Outer Lid	Pm	HAC Side	95.6	0.3	-104.9	200.5	137.9	330.9	0.7
Inner Lid	Pm+ Pb	HAC Side	-20.9	-70.1	-371.6	350.6	137.9	496.4	0.4
Inner Lid	Pm	HAC End	47.0	-14.6	-143.5	190.4	137.9	496.4	1.6
Inner Lid	Pm+ Pb	HAC End	172.0	77.5	33.6	138.4	137.9	496.4	2.6
Inner Lid	Pm	HAC Pressure	0.2	-2.1	-36.5	36.7	111.7	268.1	6.3
Inner Lid	Pm+ Pb	HAC Pressure	-2.1	-6.2	-64.0	61.9	111.7	402.1	5.5

It is concluded that the RT-100 cask is structurally adequate for the aforementioned loading conditions. The requirements of 10 CFR 71 covered by this calculation have been satisfied.

3.0 References

1. **NRC.** *"Title 10, Part 71—Packaging and Transportation of Radioactive Material".* 10 CFR 71.
2. **ENERCON.** *"RT-100 Cask Weight and Center of Gravity Calculation".* RTL-001-CALC-ST-0101.
3. **ASME.** *"2010 ASME Boiler & Pressure Vessel Code, Section II, Part D, Properties (Metric) Materials.*
4. **Rack, H.J., Knorovsky, G.A.** *"An Assessment of Stress-Strain Data Suitable for Finite-Element Elastic Plastic Analysis of Shipping Containers".* 1978. NUREG/CR-0481.
5. **Baumeister T. and Marks, L.S.** *"Standard Handbook for Mechanical Engineers, 7th Edition".* New York : McGraw-Hill Book Co., 1967.
6. **ANSYS:** Release 14.0, ANSYS Inc., Canonsburg, PA, October 2011 (Note: ANSYS is a commercially available computer software that is procured and maintained under the QA program of Enercon Services, Inc.)
7. **ASME.** *"ASME Boiler and Pressure Vessel Code, Division I, Section III, Subsection NB, Class 1 Components," .* 2007.
8. **NRC.** *"Load Combinations for the Structural Analysis of Shipping Casks for Radioactive Materials".* Regulatory Guide 7.8.
9. —. *Interim Staff Guidance - 21, "Use of Computational Modeling Software".* SFPO-ISG-21.
10. **ENERCON.** *"RT-100 Cask Bolting Evaluation".* Calculation. RTL-001-CALC-ST-0203.
11. —. *"RT-100 Cask Hypothetical Accident Condtion Maximum Pressure Calculation".* RTL-001-CALC-TH-0202.
12. **NRC.** *"Load Combinations for the Structural Analysis of Shipping Cask for Radioactive Material".* Regulatory Guide 7.8.
13. **ENERCON.** *"RT-100 Cask Thermal Analyses".* RTL-001-CALC-TH-0201.
14. Wikipedia.org. *http://en.wikipedia.org/wiki/D'Alembert's_principle.* [Online]
15. **ENERCON.** *"RT-100 Cask Impact Limiter Drop Evaluation".* RTL-001-CALC-ST-0401.
16. **NRC.** *"Design Criteria for the Structural Analysis of Shipping Cask Containment Vessels".* 1978. Regulatory Guide 7.6.
17. **Young, Warren C.** *"Roark's Formulas for Stress & Strain".* Sixth Edition. New York : McGraw Hill, 1989.

4.0 Assumptions

4.1 There are no unverified assumptions in this calculation. Other design assumptions used, if any, will be noted and referenced as needed in the body of the calculation.

5.0 Design Inputs

5.1 The maximum payload weight is 6,804 kg (15,000 lb) (1).

5.2 The material properties used for the cask shell, the lead shielding and the lid bolts are given in Tables 1 through 3.

5.3 Cask performance criteria 10 CFR 71.71 and 71.73 (2).

5.4 A value of 9.81 m/s^2 will be used for the gravitational acceleration.

5.5 Robatel Drawings:

- RT100-NM-1000, Rev. D, RT-100 Bill of Materials
- RT100-PE-1001-1, Rev. E, RT-100 General Assembly, Sheet 1
- RT100-PE-1001-2, Rev. E, RT-100 General Assembly, Sheet 2
- RT100-PRS-1011, Rev. A, RT-100 Cask Body Weld Map
- RT100-PRS-1013, Rev. A, RT-100 Secondary Lid Weld Map
- RT100-PRS-1031, Rev. A, RT-100 Lower Impact Limiter Weld Map
- RT100-PRS-1032, Rev. A, RT-100 Upper Impact Limiter Weld Map

Table 1 – Properties of SA-240, Type 304/304L (dual certified), Stainless Steel (3)

Property*	Value									
Temperature (ºC)	-40	21	38	93	149	204	260	343	427	482
Ultimate strength, S_u (MPa)	517.1	517.1	517.1	489.5	456.4	441.3	437.1	437.1	433.0	419.2
Yield strength, S_y (MPa)	206.8	206.8	206.8	172.4	154.4	142.7	133.8	124.1	116.5	111.7
Design Stress Intensity, S_m (MPa)	137.9	137.9	137.9	137.9	137.9	128.2	120.7	111.7	104.8	100.7
Modulus of Elasticity, E (GPa)	198.6	195.1	194.0	190.3	186.2	182.7	177.9	173.1	166.2	162.0
Coefficient of Thermal Expansion, α ($\times 10^{-5}$ m/m/°C)	1.4634	1.5300	1.5480	1.6020	1.6560	1.7100	1.7460	1.7820	1.8180	1.8360
Thermal Conductivity, k (W/m•ºC)	—	15.164	15.410	16.217	17.025	—	—	—	—	—
Poisson's Ratio	0.31									
Density (kg/m^3)	8027.2									

* SA-182, Type 304 stainless steel may be substituted for SA-240 Type 304 stainless steel provided that the SA-182 material yield and ultimate strengths are equal to or greater than those of the SA-240 material. The SA-182 forging material and the SA-240 plate material are both Type 304 austenitic stainless steels. Austenitic stainless steels do not experience a ductile-to-brittle transition for the range of temperatures considered in this Safety Analysis Report. Therefore, fracture toughness is not a concern.

Table 2 – Properties of SA-354, Grade BD, Carbon Steel (3)

Property*	Value									
Temperature (ºC)	-40	21	38	93	149	204	260	343	427	482
Ultimate strength, S_u (MPa)	1034.2	1034.2	1034.2	1034.2	1034.2	1034.2	1034.2	1034.2	946.7	767.4
Yield strength, S_y (MPa)	896.3	896.3	896.3	821.2	792.9	765.3	730.2	663.3	599.8	564.7
Modulus of Elasticity, E (GPa)	206.7	202.7	201.7	198.6	195.1	192.4	188.2	178.9	—	—
Coefficient of Thermal Expansion, α ($\times 10^{-5}$ m/m/°C)	1.1214	1.1520	1.1647	1.2060	1.2420	1.2780	1.3140	1.3140	—	—
Thermal Conductivity, k (W/m•ºC)	—	60.405	60.054	58.327	55.904	—	—	—	—	—
Poisson's Ratio	0.3									
Density (kg/m^3)	8220.9									

Table 3 – Lead Properties

Property*	Value									
Temperature (ºC)	-40	-29	20	21	27	70	77	93	149	316
Modulus of Elasticity, E (GPa) (4)	16.9	16.7	—	15.7	—	—	—	14.2	13.4	10.3
Coefficient of Thermal Expansion, α ($\times 10^{-5}$ m/m/°C) (4)	2.8080	2.8260	—	2.8980	—	—	—	2.9880	3.0960	3.6360
Thermal Conductivity, k (W/m•ºC) (4)	—	—	35.335	—	35.246	34.655	34.565	—	—	—
Specific Heat, (J/kg•ºC) (4)	—	—	127.70	—	128.12	129.79	130.21	—	—	—
Poisson's Ratio (5)	0.4									
Density (kg/m^3) (5)	11340									

6.0 Methodology

The finite element code ANSYS (6) is used to generate a three-dimensional model of the RT-100 cask and determine its response to NCT and HAC conditions. Specifically, a one-half (180°) 3D model of the cask inner and outer shells, outer and inner lids, bottom plate and lead shields is constructed using ANSYS solid elements. The interaction between components is modeled using gap elements. Stability of the model is assured by using weak springs. Boundary conditions are applied to the model simulating the loading conditions the cask will experience during normal and accident transport conditions. Pressure loads are applied to the cask inner shell to simulate bounding contents loads and internal pressurization. Thermal stresses are calculated using input temperatures from the NCT thermal analyses. Bolt preloads are applied to represent the bolt torque at the time the cask is readied for shipment. Post-processing is accomplished by linearizing the stress across locations where maximum stresses are calculated. The calculated stress intensities are compared to appropriate ASME allowables and the margin of safety is calculated.

The RT-100 is designed in accordance with ASME, Section III, Subsection ND for Class 1 components (7). Load combinations for the structural analysis of shipping casks for radioactive materials are defined by Regulatory Guide 7.8 (8). The load combinations for all normal and accident conditions and corresponding ASME service levels are shown in Table 1. This table is developed from the design criteria established in ASME Section III. The table, therefore, defines the cask design and service loadings. ASME service Levels A and D are used for normal and accident conditions, respectively. The analyses methods allowed by the ASME Code are employed. Stress intensities caused by pressure, thermal expansion, and mechanical loads are combined before comparing to ASME code stress allowables, which are listed in Table 2.

Table 6-1. Load Combinations for RT100 Cask Body Analyses.

LOAD		NORMAL		ACCIDENT			
ASME Service Level Load Combinations		A		D			
		1	2	1	2	3	4
Dead Weight	With maximum contents	X	X	X	X	X	X
Thermal Stresses	Hot	X		X		X	
	Cold		X		X		X
Internal Pressure	Normal	X	X	X	X		
	Accident (fire)					X	X
Drop/Impact	0.3 Meters	X	X				
Drop/Impact	9 Meters			X	X		

Table 6-2. Structural Design Criteria for RT100.

ASME Service Level	Stress Criteria
Normal conditions: Service Level A	$P_m \leq S_m$ $P_m + P_b \leq 1.5\ S_m$ $P_m + P_b + Q \leq 3\ S_m$
Accident conditions: Service Level D	$P_m \leq 2.4\ S_m$ or $0.7\ S_u$ (whichever is less) $P_m + P_b \leq 3.6\ S_m$ or $1.0\ S_u$ (whichever is less)

7.0 Calculation

7.1 Model Description

Finite element analysis methods are used to perform the stress evaluation of the RT-100 Cask for normal and accident free drop conditions. Each drop condition is analyzed using a three-dimensional finite element model using the computational modeling software ANSYS (6). Figure 7-1 shows the major components of the cask represented in the model including the inner and outer shells, flange, bottom plate, primary and secondary lids, and closure bolts.

As shown in Figure 7-1, the model, which corresponds to half (180°) of the cask body, is generated by de-featuring the SolidWorks solid model used to develop the manufacturing drawings and exporting the model to a .STEP file format. The .STEP file is imported directly into ANSYS where the finite element model is developed following the guidance presented in ISG-21 (9). The resulting finite element model of the cask body is represented using solid elements, contact elements, mass elements and spring/damper elements (Figure 7-2).

The solid portion of the model is constructed using ANSYS solid (SOLID185) elements. Surface-to-surface contact elements are used to simulate the interaction between adjacent components. Specifically, contact between the cask shells and lead shielding is modeled using CONTAC174/TARGE170 surface-to-surface contact elements with zero friction, which allows the lead to float between the inner and outer shells. Contact elements are also used to bond dissimilarly meshed components. To simulate the impact limiters, the interaction between the cask body and impact limiters is modeled using CONTAC52 gap elements (Figure 7-3), which acts as a compression only element. The size of the CONTAC52 gaps is determined from nominal dimensions between the impact limiter and cask body. Spring elements (COMBIN14) are inserted automatically during the solution to help stabilize the model. ANSYS assigns low spring stiffness so their presence will not adversely affect the accuracy of the solution.

7.2 Boundary Conditions

Boundary conditions are applied to the model simulating the loading conditions the RT-100 will experience during NCT and HAC. The five categories of cask loading considered in the free drop event are closure lid bolt preload, internal pressure load, thermal load, inertial body load and displacement. ANSYS input files are used to apply boundary conditions and loads to the cask model.

7.2.1 Closure Lid Bolt Preload

The required total bolt preloads on the cask outer and inner lid bolts are 130,600 N and 72,200 N, respectively (10). To apply the bolt preload ANSYS pre-tension elements (PRETS179) are used to define the 3-D pre-tension section within the meshed bolt. The PRETS179 element uses a single translation degree of freedom to define pretension direction (Figure 7-4). The pretension section is modeled by a set of pretension elements defined by the bolt shaft.

7.2.2 Pressure Loading

A pressure of 241 KPa (35 psig) is used to envelope the maximum normal operating pressure for all impact loadings considered. For accident conditions a pressure value of 588 kPa (85.3 psig) is used to represent the pressure experienced during fire conditions (11). The internal pressure load is applied as an equivalent static pressure load uniformly applied on the interior surface of the cask.

7.2.2.1 Pressure loading contents—cask end drop

For the end drop analyses, the contents weight is assumed to be uniformly distributed on the cask end, over an area determined by the inside diameter of the cask. Therefore, one-half the contents weight of 6,804 kg (15,000 lb) is applied to the cask inner shell bottom plate. The contents pressure load is multiplied by the appropriate g-load to accurately represent the 1-foot and 30-foot end drop. The pressure value is conservatively multiplied by 1.05 to account for the difference between the solid model surface and the tessellated area of the element mesh.

7.2.2.2 Pressure loading contents—side drop

For the side drop condition, the contact area between the contents and the cask cavity is approximately 180^o (90^o on each side of the drop centerline). The inertial load produced by the 6,804 kg (15,000 lb) contents weight is represented as an equivalent static pressure applied on the interior surface of the cask. The pressure is uniformly distributed along the cavity length and is varied in the circumferential direction as a cosine distribution. The pressure value is conservatively multiplied by 1.05 to account for the difference between the solid model surface and the tessellated area of the element mesh. The maximum pressure occurs at the impact centerline; the pressure decreases to zero at locations that are 90° either side of the impact centerline, as illustrated in Figure 7-5. The following formula is used to determine the contents pressures for the side drop analyses, which vary around the circumference. This method uses a summation scheme to approximate the integration of the cosine-shaped pressure distribution:

$$F_{total} = \sum_{i=1}^{18} P_{max}\, A_i \cos(\theta_i)\cos(\theta'_i)$$

$$F_{total} = 6{,}804/2 \text{ kg}$$

where

P_{max} = maximum pressure (at impact centerline)

θ_i = average angle of subtended arc of i^{th} element measured from centerline at point of impact, to obtain vertical component of pressure

i = i^{th} circumferential sector

θ'_i = normalized angle to peak at 0° and to be zero at 90°

A_i = i^{th} circumferential area over which the pressure is applied

Gap elements are defined at both ends of the cask to simulate the pressure applied by the impact limiters during side drop conditions. This is accomplished by defining the gap stiffness as a cosine function from a maximum value 175×10^6 N/m (1×10^6 lb/in) at the center line to 15.3×10^6 N/m (87,156 lb/in) at 85° from the center line of impact, and a minimal value 175×10^3 N/m (100 lb/in) from 90° to 180°). The load distribution that results from the crushing of the impact limiter is shown in Figure 7-6.

7.2.3 Thermal

According to Regulatory Guide 7.8 (11), four credible thermal conditions must be considered.

Condition 1 – Hot Case 1:

a. Ambient temperature, 38°C
b. Initial temperature, 38°C
c. Heat transfer to ambient by natural convection, still air

d. Heat transfer to ambient by radiation
e. Solar insolation as a periodic heat flux applied as 12-hr on and 12-hr off
f. Internal heat load as a uniform heat flux, 13.04 W/m^2

Condition 2 – Hot Case 2:

a. Ambient temperature, 38°C
b. Initial temperature, 38°C
c. Heat transfer to ambient by natural convection, still air
d. Heat transfer to ambient by radiation
e. No solar insolation, in shade
f. Internal heat load as a uniform heat flux, 13.04 W/m^2

Condition 3 – Cold Case 1:

a. Ambient temperature, -40°C
b. Initial temperature, -40°C
c. Heat transfer to ambient by natural convection, still air
d. Heat transfer to ambient by radiation
e. No solar insolation, in shade
f. Internal heat load as a uniform heat flux, 13.04 W/m^2

Condition 4 – Cold Case 2:

a. Ambient temperature, -29°C
b. Initial temperature, -29°C
c. Heat transfer to ambient by natural convection, still air
d. Heat transfer to ambient by radiation
e. No solar insolation
f. Internal heat load as a uniform heat flux, 13.04 W/m^2

Heat Conditions 1 and 3 bound the differential the worst case thermal expansion between dissimilar materials (12). Therefore, Heat Conditions 2 and 4 are not considered.

The cask temperature distributions calculated for Conditions 1 and 3 are used as inputs to the ANSYS analyses. The ANSYS analyses determines the stresses arising from the thermal expansion of the cask from its initial 21°C condition, including the effects of the differential thermal growth within the components, which are a result of the temperature difference across the cask walls. The cask temperature distributions are also used to determine the values of the temperature-dependent material properties.

The temperatures for the structural analysis are obtained from the results file and database file of the thermal analysis by writing the results to an ASCII file using the ANSYS BFINT command. Nodes for the structural model are transferred to the same coordinate system as used by the thermal run and the thermal results are interpolated for each thermal condition.

7.2.4 Inertial body load

The inertial effects, which occur during impact, are represented by equivalent static forces, in accordance with D'Alembert's principle (13). The inertial body load includes the weight of the empty cask and the weight of the cavity contents. The inertial load is applied to the cask body using the ANSYS ACEL command equivalent to the normal and accident conditions accelerations corresponding to the 0.3 meter and 9 meter drop cases. Since the lead shield is attached to the steel shells with frictionless contact elements, the lead represents the largest physical load applied to the cask structure.

7.2.5 Displacement boundary conditions

Displacement boundary conditions are applied to enforce symmetry at the cut boundary of the 3D model. All nodes on the symmetry plane are fixed in the UZ direction. The overall model is stabilized by the gap elements (CONTAC52) that represent the impact limiter, which are connected to the cask body with the outer nodes or "ground" nodes representing the impact limiter fixed.

7.3 Post-Processing

Post-processing of analysis results is accomplished by determining the maximum nodal stress location and defining linearized sections at the peak stress locations. For each drop orientation or thermal condition, the top five stress locations are identified by sorting the nodal stresses (NSORT) following the PRNSOL command. At each peak stress location, the node is identified including the corresponding node across the shell thickness. The path across the section is defined by using the PPATH command for each node and issuing the PRSECT command to obtain the stress intensity across the section. Each path is identified with a line. Plotting the lines show the positions of each section. Post-processing of the results is included as part of the text input file for each load case. To recreate the analyses a listing of the input files stored on disk are provided in Appendix 2. The output file listing for each case is provided in Appendix 3

8.0 Results

Results of the cask body drop analyses for NCT and HAC are presented in Sections 8.1 through 8.4. The section stresses presented in the summary tables are taken at the location of the peak stress for each part. A total of 5 sections are reported corresponding to the inner shell, outer shell, flange, outer lid and inner lid. The allowable stresses based on the ASME design criteria (Table 6-2) in are presented in Table 8-1.

Table 8-1. Allowable Stresses for SA-240, Type 304/304L (dual certified), Stainless Steel

Temperature	NCT Allowable, MPa			HAC Allowable, MPa	
°C	P_m	$P_m + P_b$	P + Q	P_m	$P_m + P_b$
-40	137.9	206.9	413.7	331.0	496.4
21	137.9	206.9	413.7	331.0	496.4
38	137.9	206.9	413.7	331.0	496.4
93	137.9	206.9	413.7	331.0	496.4
149	137.9	206.9	413.7	331.0	496.4
204	128.2	192.3	384.6	307.7	461.5
260	120.7	181.1	362.1	289.7	434.5
343	111.7	167.6	335.1	268.1	402.1
427	104.8	157.2	314.4	251.5	377.3
482	100.7	151.0	302.0	241.6	362.4

8.1 Cask Body Normal Conditions Drop Results

The free drop scenario outlined by 10 CFR 71.71(c)(7) requires the RT-100 to be structurally adequate for a 0.3 m (1-ft) drop (normal conditions of transport) onto a flat, essentially unyielding horizontal surface in the orientation that inflicts the maximum damage to the cask. In the following subsections, the cask body is evaluated for the end and side orientations. Based on the calculated accelerations, the stresses experienced during a corner-drop are bounded by the end and side orientations.

Four categories of load in accordance with Regulatory Guide 7.8—closure lid bolt preload, internal pressure, temperature dependent material properties, and inertial body loads—are considered on the cask. The inertia loads imposed upon the cask by the impact limiter result from the mass of the entire assembly being acted upon by a design deceleration value of 44 g for the 0.3 meter end drop case and 52 g for the 0.3 meter side drop (14). During normal conditions, the 0.3 meter drop is not a sufficient height to rotate the cask to an oblique orientation following a drop. Therefore, oblique drop orientations are not considered a credible event, and are not included in these analyses. The side drop and end drop evaluations are presented in Sections 8.1.1 and 8.1.2, respectively.

8.1.1 NCT Side Drop Results

In accordance with the requirements of 10 CFR 71.71, the RT-100 Cask is structurally evaluated for the normal condition of transport 0.3 m side-drop. During the 0.3 meter side-drop event, the cask (equipped with an impact limiter over each end) falls a distance of 0.3 meters onto a flat, unyielding, horizontal surface. The cask strikes the surface in a horizontal position, thereby resulting in a side impact of the cask. The types of loading involved in a side-drop event are lid closure bolt preload, internal pressure load, thermal load, and inertial body load.

Stress results for the 0.3-meter side drop combined loading conditions discussed previously are documented in Table 8-2. The table documents the primary membrane (P_m), primary membrane plus primary bending (P_m+P_b), primary membrane plus primary bending plus secondary peak stress (P_m+P_b+Q) in accordance with the criteria presented in Regulatory Guide 7.6 (14).

As shown in Table 8-2, the margins of safety when compared to the stress intensity for each category are positive. The most critically stressed component in the system is the cask flange region where due to ovalization of the cask body and the inertial load of the lead shield. The minimum margin of safety is found to be +0.8 for primary membrane plus bending stress intensity. The locations of the critical sections correspond to the maximum stress location show in Figures 8-1 through 8-6. The minimum margin of safety for primary plus secondary stress intensity is 1.5.

8.1.2 NCT End Drop Results

In accordance with the requirements of 10 CFR 71.71, the Universal Transport Cask is structurally evaluated for the normal condition of transport 0.3 m end-drop. In this event, the cask (equipped with an impact limiter over each end) falls a distance of 0.3 m onto a flat, unyielding, horizontal surface. The cask strikes the surface in a vertical position; consequently, an end impact on the bottom end or top end of the cask occurs.

Stress results for the 1-ft top-and bottom-end drop combined loading conditions discussed previously are documented in Table 8-3. The table documents the primary membrane (P_m), primary membrane plus primary bending (P_m+P_b), primary membrane plus primary bending plus secondary peak stress (P_m+P_b+Q) in accordance with the criteria presented in Regulatory Guide 7.6.

As shown in the table 8-3, the margins of safety for the primary stress intensity category are positive for all of the 0.3 m top-end drop conditions. The most critically stressed component in the system is the cask flange region where due to the bending of the flange due to the inertial load imposed by the cask lids. The minimum margin of safety is found to be +2.4 for primary membrane plus bending stress intensity. The locations of the critical sections correspond to the maximum stress location show in Figures 8-7 through 8-12. The minimum margin of safety for primary plus secondary stress intensity is 0.2.

Table 8-2. NCT Side Drop Stress Summary

Stress State			Location	S1	S2	S3	SINT	SI (304)	Allowable	MS
				MPa	MPa	MPa	MPa	MPa	MPa	
INNER SHELL		Pm		5.0	-3.8	-31.6	36.6	137.9	137.9	2.8
		Pm + Pb	*Inside*	5.3	-3.8	-31.4	36.7	137.9	206.8	4.6
			Center	5.0	-3.8	-31.6	36.6	137.9	206.8	4.7
			Outside	4.7	-3.8	-31.8	36.5	137.9	206.8	4.7
	HOT	Pm + Pb + Q	*Inside*	5.3	-3.8	-31.4	36.7	137.9	413.7	10.3
			Center	5.0	-3.8	-31.6	36.6	137.9	413.7	10.3
			Outside	4.7	-3.8	-31.8	36.5	137.9	413.7	10.3
	COLD	Pm + Pb + Q	*Inside*	5.3	-3.8	-31.4	36.7	137.9	413.7	10.3
			Center	5.0	-3.8	-31.6	36.6	137.9	413.7	10.3
			Outside	4.7	-3.8	-31.8	36.5	137.9	413.7	10.3
OUTER SHELL		Pm		4.3	-3.8	-32.3	36.6	137.9	137.9	2.8
		Pm + Pb	*Inside*	4.4	-3.8	-32.2	36.5	137.9	206.8	4.7
			Center	4.3	-3.8	-32.3	36.6	137.9	206.8	4.7
			Outside	4.2	-3.9	-32.5	36.7	137.9	206.8	4.6
	HOT	Pm + Pb + Q	*Inside*	4.4	-3.8	-32.2	36.5	137.9	413.7	10.3
			Center	4.3	-3.8	-32.3	36.6	137.9	413.7	10.3
			Outside	4.2	-3.9	-32.5	36.7	137.9	413.7	10.3
	COLD	Pm + Pb + Q	*Inside*	4.4	-3.8	-32.2	36.5	137.9	413.7	10.3
			Center	4.3	-3.8	-32.3	36.6	137.9	413.7	10.3
			Outside	4.2	-3.9	-32.5	36.7	137.9	413.7	10.3
FLANGE		Pm		4.1	-3.9	-32.9	37.0	137.9	137.9	2.7
		Pm + Pb	*Inside*	4.1	-3.9	-32.7	36.8	137.9	206.8	4.6
			Center	4.1	-3.9	-32.9	37.0	137.9	206.8	4.6
			Outside	4.1	-4.0	-33.0	37.1	137.9	206.8	4.6
	HOT	Pm + Pb + Q	*Inside*	4.1	-3.9	-32.7	36.8	137.9	413.7	10.23
			Center	4.1	-3.9	-32.9	37.0	137.9	413.7	10.2
			Outside	4.1	-4.0	-33.0	37.1	137.9	413.7	10.2
	COLD	Pm + Pb + Q	*Inside*	4.1	-3.9	-32.7	36.8	137.9	413.7	10.2
			Center	4.1	-3.9	-32.9	37.0	137.9	413.7	10.2
			Outside	4.1	-4.0	-33.0	37.1	137.9	413.7	10.2
OUTER LID		Pm		18.4	-0.3	-18.4	36.8	137.9	137.9	2.7
		Pm + Pb	*Inside*	51.6	9.5	7.4	44.3	137.9	206.8	3.7
			Center	18.4	-0.3	-18.4	36.8	137.9	206.8	4.6
			Outside	-8.9	-12.7	-47.7	38.8	137.9	206.8	4.3
	HOT	Pm + Pb + Q	*Inside*	62.8	-15.8	-41.9	104.7	137.9	413.7	3.0
			Center	11.4	-12.5	-39.4	50.8	137.9	413.7	7.1
			Outside	12.9	-2.4	-41.7	54.5	137.9	413.7	6.6
	COLD	Pm + Pb + Q	*Inside*	116.0	61.8	27.6	88.4	137.9	413.7	3.7
			Center	30.1	5.4	-17.7	47.8	137.9	413.7	7.7
			Outside	-4.4	-13.7	-55.0	50.7	137.9	413.7	7.2
INNER LID		Pm		-1.5	-2.6	-56.9	55.4	137.9	137.9	1.5
		Pm + Pb	*Inside*	-4.2	-19.9	-121.3	117.1	137.9	206.8	0.8
			Center	-1.5	-2.6	-56.9	55.4	137.9	206.8	2.7
			Outside	15.9	7.2	0.3	15.7	137.9	206.8	12.2
	HOT	Pm + Pb + Q	*Inside*	2.4	-31.7	-161.7	164.1	137.9	413.7	1.5
			Center	15.2	2.8	-58.4	73.6	137.9	413.7	4.6
			Outside	13.5	-5.2	-23.7	37.2	137.9	413.7	10.1
	COLD	Pm + Pb + Q	*Inside*	-8.8	-28.7	-148.7	140.0	137.9	413.7	2.0
			Center	4.1	-0.2	-58.8	62.9	137.9	413.7	5.6
			Outside	19.5	4.7	-6.9	26.4	137.9	413.7	14.7

Table 8-3. NCT End Drop Stress Summary

Stress State			Location	S1	S2	S3	SINT	SI (304)	Allowable	MS
				MPa	MPa	MPa	MPa	MPa	MPa	
INNER SHELL		Pm		2.7	1.2	-7.8	10.5	137.9	137.9	12.1
		Pm + Pb	*Inside*	2.7	2.0	-12.2	14.9	137.9	206.8	12.9
			Center	2.7	1.2	-7.8	10.5	137.9	206.8	18.7
			Outside	2.9	0.2	-3.6	6.6	137.9	206.8	30.5
	HOT	Pm + Pb + Q	*Inside*	2.7	2.0	-12.2	14.9	137.9	413.7	26.8
			Center	2.7	1.2	-7.8	10.5	137.9	413.7	38.3
			Outside	2.9	0.2	-3.6	6.6	137.9	413.7	61.9
	COLD	Pm + Pb + Q	*Inside*	2.7	2.0	-12.2	14.9	137.9	413.7	26.8
			Center	2.7	1.2	-7.8	10.5	137.9	413.7	38.3
			Outside	2.9	0.2	-3.6	6.6	137.9	413.7	61.9
OUTER SHELL		Pm		6.5	-0.9	-3.4	9.9	137.9	137.9	12.9
		Pm + Pb	*Inside*	7.5	1.0	-2.7	10.2	137.9	206.8	19.3
			Center	6.5	-0.9	-3.4	9.9	137.9	206.8	19.9
			Outside	6.9	0.7	-9.0	15.9	137.9	206.8	12.0
	HOT	Pm + Pb + Q	*Inside*	113.3	39.9	-63.2	176.5	137.9	413.7	1.3
			Center	22.5	-10.9	-16.7	39.2	137.9	413.7	9.5
			Outside	25.4	0.5	-33.5	58.9	137.9	413.7	6.0
	COLD	Pm + Pb + Q	*Inside*	10.7	0.5	-4.5	15.3	137.9	413.7	26.1
			Center	18.7	5.7	-4.7	23.5	137.9	413.7	16.6
			Outside	10.4	2.4	-9.5	19.9	137.9	413.7	19.8
FLANGE		Pm		5.9	1.5	-12.3	18.1	137.9	137.9	6.6
		Pm + Pb	*Inside*	0.1	-3.3	-19.5	19.6	137.9	206.8	9.5
			Center	5.9	1.5	-12.3	18.1	137.9	206.8	10.4
			Outside	20.1	6.3	-13.6	33.7	137.9	206.8	5.1
	HOT	Pm + Pb + Q	*Inside*	48.0	24.1	-219.4	267.4	137.9	413.7	0.5
			Center	12.9	-5.7	-23.8	36.6	137.9	413.7	10.3
			Outside	74.0	34.2	-53.9	127.9	137.9	413.7	2.2
	COLD	Pm + Pb + Q	*Inside*	32.8	-42.6	-105.1	137.9	137.9	413.7	2.0
			Center	14.2	2.1	-24.1	38.3	137.9	413.7	9.8
			Outside	92.7	71.4	-36.7	129.4	137.9	413.7	2.2
OUTER LID		Pm		-0.9	-4.0	-14.6	13.7	137.9	137.9	9.1
		Pm + Pb	*Inside*	-7.7	-17.0	-52.6	45.0	137.9	206.8	3.6
			Center	-0.9	-4.0	-14.6	13.7	137.9	206.8	14.1
			Outside	24.2	9.0	5.1	19.0	137.9	206.8	9.9
	HOT	Pm + Pb + Q	*Inside*	280.5	36.7	-55.4	336.0	137.9	413.7	0.2
			Center	35.3	20.9	-4.7	40.0	137.9	413.7	9.3
			Outside	41.6	16.7	-56.7	98.3	137.9	413.7	3.2
	COLD	Pm + Pb + Q	*Inside*	-35.0	-71.0	-163.6	128.5	137.9	413.7	2.2
			Center	14.0	4.5	-14.8	28.8	137.9	413.7	13.4
			Outside	21.6	-0.3	-22.2	43.8	137.9	413.7	8.4
INNER LID		Pm		5.7	-2.3	-35.4	41.1	137.9	137.9	2.4
		Pm + Pb	*Inside*	-6.5	-10.3	-67.7	61.3	137.9	206.8	2.4
			Center	5.7	-2.3	-35.4	41.1	137.9	206.8	4.0
			Outside	20.8	6.0	-6.5	27.3	137.9	206.8	6.6
	HOT	Pm + Pb + Q	*Inside*	-14.6	-27.5	-112.1	97.5	137.9	413.7	3.2
			Center	28.9	11.0	-26.3	55.2	137.9	413.7	6.5
			Outside	18.9	-8.7	-36.5	55.3	137.9	413.7	6.5
	COLD	Pm + Pb + Q	*Inside*	-18.9	-23.7	-93.0	74.1	137.9	413.7	4.6
			Center	9.7	-1.3	-39.2	49.0	137.9	413.7	7.4
			Outside	23.4	3.1	-13.5	36.8	137.9	413.7	10.2

8.2 Cask Body Hypothetical Accident Conditions Drop Results

The RT-100 cask is required by 10 CFR 71.73(c)(1) to demonstrate structural adequacy for a free drop through a distance of 9 meters 30 feet) onto a flat, unyielding, horizontal surface. The cask payload is oriented to strike the surface to inflict the maximum damage. In determining the orientation that produces the maximum damage, the cask is evaluated for impact orientations in which the cask strikes the impact surface on its bottom end and side drop orientations. Evaluation of the impact limiter effectiveness shows that the corner drop is bounded by the end and side orientations.

Four categories of load in accordance with Regulatory Guide 7.8—closure lid bolt preload, internal pressure, temperature dependent material properties, and inertial body loads—are considered on the cask. The inertia loads imposed upon the cask by the impact limiter result from the mass of the entire assembly being acted upon by a design deceleration value of 123 g for the 9 meter end drop case and 226 g for the 9 meter side drop (14). The closure lid bolt preload, internal pressure load and temperatures for the 9 meter drop conditions are similar to those considered for 0.3 meter drop condition in Section 8.1, with the exception that no thermal stresses are considered for accident conditions. The side drop and end drop evaluations are presented in Sections 8.2.1 and 8.2.2, respectively. The accident pressure is considered as a separate case in Section 8.2.3.

8.2.1 HAC Side Drop Results

In accordance with the requirements of 10 CFR 71.73, the RT-100 Cask is structurally evaluated for the hypothetical accident conditions 9 meter side-drop. During the 9 meter side-drop event, the cask (equipped with an impact limiter over each end) falls a distance of 9 meters onto a flat, unyielding, horizontal surface. The cask strikes the surface in a horizontal position, thereby resulting in a side impact of the cask.

Stress results for the 9-meter side drop combined loading conditions discussed previously are documented in Table 8-3. The table documents the primary membrane (P_m), primary membrane plus primary bending (P_m+P_b), stresses in accordance with the criteria presented in Regulatory Guide 7.6.

As shown in Table 8-3, the margins of safety when compared to the stress intensity for each category are positive. The most critically stressed component in the system is the cask outer shell, which is due to ovalization of the cask body and the inertial load of the lead shield. The minimum margin of safety is found to be +0.2 for primary membrane plus bending stress intensity. The locations of the critical sections correspond to the maximum stress location show in Figures 8-13 through 8-18.

8.2.2 HAC End Drop Results

In accordance with the requirements of 10 CFR 71.73, the RT-100 Cask is structurally evaluated for the hypothetical accident conditions 9 meter end-drop. During the 9 meter end-drop event, the cask (equipped with an impact limiter over each end) falls a distance of 9 meters onto a flat, unyielding, horizontal surface. The cask strikes the surface in a vertical position, thereby resulting in a side impact of the cask.

Stress results for the 9-meter side drop combined loading conditions discussed previously are documented in Table 8-4. The table documents the primary membrane (P_m), primary membrane plus primary bending (P_m+P_b) stresses in accordance with the criteria presented in Regulatory Guide 7.6.

As shown in Table 8-4, the margins of safety when compared to the stress intensity for each category are positive. The most critically stressed component in the system is the inner lid, which is caused by the lead shield inertial load. The minimum margin of safety is found to be +2.9 for primary membrane plus bending stress intensity. The locations of the critical sections correspond to the maximum stress location show in Figures 8-19 through 8-24.

8.2.3 HAC Pressure Stress Results

In accordance with the requirements of 10 CFR 71.73, the RT-100 Cask is structurally evaluated when subjected to an accident internal pressure of 588 kPa (85.3 psig) (11). Stress results for the accident pressure case are presented in Table 8-5. The table documents the primary membrane (P_m), primary membrane and plus primary bending (P_m+P_b) stresses in accordance with the criteria presented in Regulatory Guide 7.6. The pressure is based upon an average cask temperature of 110°C. For conservatism, the stress intensity values are compared to allowable stress values at 149°C.

As shown in Table 8-5, the margins of safety when compared to the stress intensity for each category are positive. The most critically stressed component in the system is the inner lid, which is due to prying load at the interface of the closure bolt and lid. The minimum margin of safety is found to be +5.5 for primary membrane plus bending stress intensity. The locations of the critical sections correspond to the maximum stress location show in Figures 8-25 through 8-30.

8.2.4 Lead Slump Evaluation

The RT-100 Cask experiences the largest acceleration during the end drop orientation. Because of the cask geometry, maximum lead slump occurs during the previously analyzed bottom end drop. From the finite element model analysis the relative displacement at the lead-steel interface is obtained. Figure 8-31 shows the exaggerated displacement plot under this drop condition. The total displacement of the lead column is 1.62 mm. However, elastic recovery of the lead and steel has been conservatively neglected.

Table 8-3. HAC Side Drop Stress Summary

Stress State	Location	S1	S2	S3	SINT	Stress Intensity (304)	Allowable Stress	Margin of Safety
INNER SHELL		MPa	MPa	MPa	MPa	MPa	MPa	
Pm		19.1	-13.7	-140.4	159.6	137.9	330.9	1.1
Pm + Pb	*Inside*	20.0	-13.9	-139.7	159.7	137.9	496.4	2.1
	Center	19.1	-13.7	-140.4	159.6	137.9	496.4	2.1
	Outside	18.3	-13.5	-141.3	159.6	137.9	496.4	2.1
OUTER SHELL		MPa	MPa	MPa	MPa	MPa	MPa	
Pm		-14.2	-129.8	-201.4	187.1	137.9	330.9	0.8
Pm + Pb	*Inside*	-66.9	-166.2	-472.2	405.3	137.9	496.4	0.2
	Center	-14.2	-129.8	-201.4	187.1	137.9	496.4	1.7
	Outside	73.5	36.5	-95.5	169.0	137.9	496.4	1.9
FLANGE		MPa	MPa	MPa	MPa	MPa	MPa	
Pm		17.1	-12.5	-145.1	162.2	137.9	330.9	1.0
Pm + Pb	*Inside*	16.9	-12.6	-144.6	161.5	137.9	496.4	2.1
	Center	17.1	-12.5	-145.1	162.2	137.9	496.4	2.1
	Outside	17.3	-12.4	-145.5	162.8	137.9	496.4	2.0
OUTER LID		MPa	MPa	MPa	MPa	MPa	MPa	
Pm		95.6	0.3	-104.9	200.5	137.9	330.9	0.7
Pm + Pb	*Inside*	289.3	35.4	-7.0	296.3	137.9	496.4	0.7
	Center	95.6	0.3	-104.9	200.5	137.9	496.4	1.5
	Outside	-34.4	-94.7	-206.7	172.3	137.9	496.4	1.9
INNER LID		MPa	MPa	MPa	MPa	MPa	MPa	
Pm		-4.3	-14.3	-164.4	160.1	137.9	330.9	1.1
Pm + Pb	*Inside*	-20.9	-70.1	-371.6	350.6	137.9	496.4	0.4
	Center	-4.3	-14.3	-164.4	160.1	137.9	496.4	2.1
	Outside	64.8	33.1	-1.4	66.3	137.9	496.4	6.5

Table 8-4. HAC End Drop Stress Summary

Stress State	Location	S1	S2	S3	SINT	Stress Intensity (304)	Allowable Stress	Margin of Safety
INNER SHELL		MPa	MPa	MPa	MPa	MPa	MPa	
Pm		7.5	5.7	-30.9	38.4	137.9	330.9	7.6
Pm + Pb	*Inside*	12.8	6.5	-51.3	64.1	137.9	496.4	6.7
	Center	7.5	5.7	-30.9	38.4	137.9	496.4	11.9
	Outside	8.2	-0.5	-11.2	19.4	137.9	496.4	24.6
OUTER SHELL		MPa	MPa	MPa	MPa	MPa	MPa	
Pm		10.7	0.1	-22.0	32.8	137.9	330.9	9.1
Pm + Pb	*Inside*	7.2	-0.2	-26.3	33.5	137.9	496.4	13.8
	Center	10.7	0.1	-22.0	32.8	137.9	496.4	14.2
	Outside	14.2	0.5	-17.8	32.0	137.9	496.4	14.5
FLANGE		MPa	MPa	MPa	MPa	MPa	MPa	
Pm		-5.2	-11.9	-19.5	14.3	137.9	330.9	22.2
Pm + Pb	*Inside*	-5.9	-13.2	-20.2	14.2	137.9	496.4	33.8
	Center	-5.2	-11.9	-19.5	14.3	137.9	496.4	33.8
	Outside	4.7	-14.9	-23.9	28.6	137.9	496.4	16.3
OUTER LID		MPa	MPa	MPa	MPa	MPa	MPa	
Pm		10.1	-2.3	-30.1	40.3	137.9	330.9	7.2
Pm + Pb	*Inside*	-29.7	-48.1	-104.5	74.8	137.9	496.4	5.6
	Center	10.1	-2.3	-30.1	40.3	137.9	496.4	11.3
	Outside	68.5	45.1	24.1	44.4	137.9	496.4	10.2
INNER LID		MPa	MPa	MPa	MPa	MPa	MPa	
Pm		45.2	31.4	9.3	35.9	137.9	330.9	8.2
Pm + Pb	*Inside*	47.0	-14.6	-143.5	190.4	137.9	496.4	1.6
	Center	45.2	31.4	9.3	35.9	137.9	496.4	12.8
	Outside	172.0	77.5	33.6	138.4	137.9	496.4	2.6

Table 8-5. HAC Pressure Stress Summary

Stress State	Location	S1	S2	S3	SINT	Stress Intensity (304)	Allowable Stress	Margin of Safety
INNER SHELL		MPa	MPa	MPa	MPa	MPa	MPa	
Pm		1.2	0.0	-1.0	2.2	111.7	268.1	Large
Pm + Pb	*Inside*	1.2	0.0	-1.1	2.3	111.7	402.1	Large
	Center	1.2	0.0	-1.0	2.2	111.7	402.1	Large
	Outside	1.2	0.0	-0.9	2.1	111.7	402.1	Large
OUTER SHELL		MPa	MPa	MPa	MPa	MPa	MPa	
Pm		1.2	0.0	-0.7	1.9	111.7	268.1	Large
Pm + Pb	*Inside*	1.2	0.0	-0.7	2.0	111.7	402.1	Large
	Center	1.2	0.0	-0.7	1.9	111.7	402.1	Large
	Outside	1.2	0.0	-0.6	1.8	111.7	402.1	Large
FLANGE		MPa	MPa	MPa	MPa	MPa	MPa	
Pm		1.2	0.0	-0.4	1.6	111.7	268.1	Large
Pm + Pb	*Inside*	1.2	0.0	-0.5	1.7	111.7	402.1	Large
	Center	1.2	0.0	-0.4	1.6	111.7	402.1	Large
	Outside	1.2	0.0	-0.4	1.5	111.7	402.1	Large
OUTER LID		MPa	MPa	MPa	MPa	MPa	MPa	
Pm		1.1	0.1	-0.2	1.3	111.7	268.1	Large
Pm + Pb	*Inside*	1.1	0.1	-0.3	1.4	111.7	402.1	Large
	Center	1.1	0.1	-0.2	1.3	111.7	402.1	Large
	Outside	1.0	0.1	-0.2	1.2	111.7	402.1	Large
INNER LID		MPa	MPa	MPa	MPa	MPa	MPa	
Pm		0.2	-2.1	-36.5	36.7	111.7	268.1	6.3
Pm + Pb	*Inside*	-2.1	-6.2	-64.0	61.9	111.7	402.1	5.5
	Center	0.2	-2.1	-36.5	36.7	111.7	402.1	10.0
	Outside	4.1	2.0	-10.6	14.7	111.7	402.1	26.3

9.0 Fabrication Stresses

Proprietary Information
Text Withheld Under 10 CFR 2.390

9.1 Lead Pour

Proprietary Information
Text Withheld Under 10 CFR 2.390

Proprietary Information
Text Withheld Under 10 CFR 2.390

9.1.3 Cool-down

9.1.3.1 Hoop (Circumferential) Stresses

Proprietary Information
Text Withheld Under 10 CFR 2.390

9.1.3.2 Axial Stresses

Proprietary Information
Text Withheld Under 10 CFR 2.390

9.1.3.3 Effects of Temperature Differential during Cool-down

Proprietary Information
Text Withheld Under 10 CFR 2.390

9.1.3.4 Lead Creep

Proprietary Information

Text Withheld Under 10 CFR 2.390

APPENDIX 1—Figures

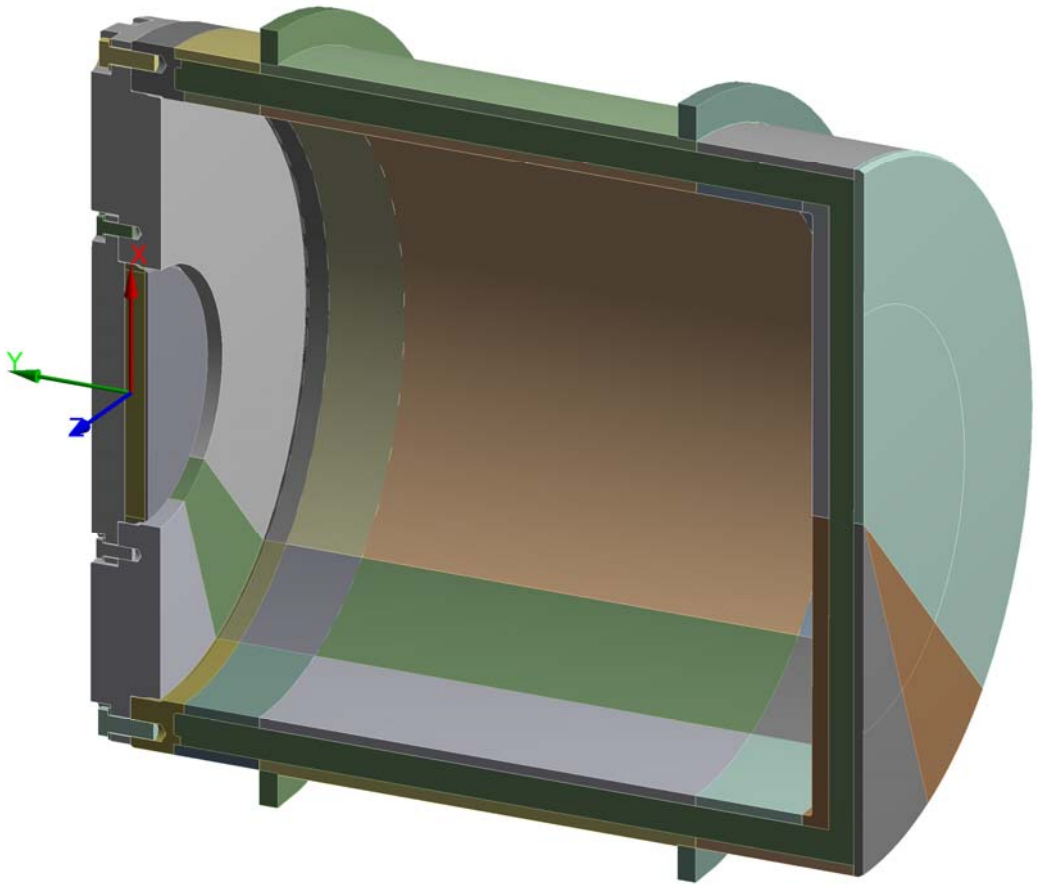


Figure 7-1. RT-100 Solid Model.

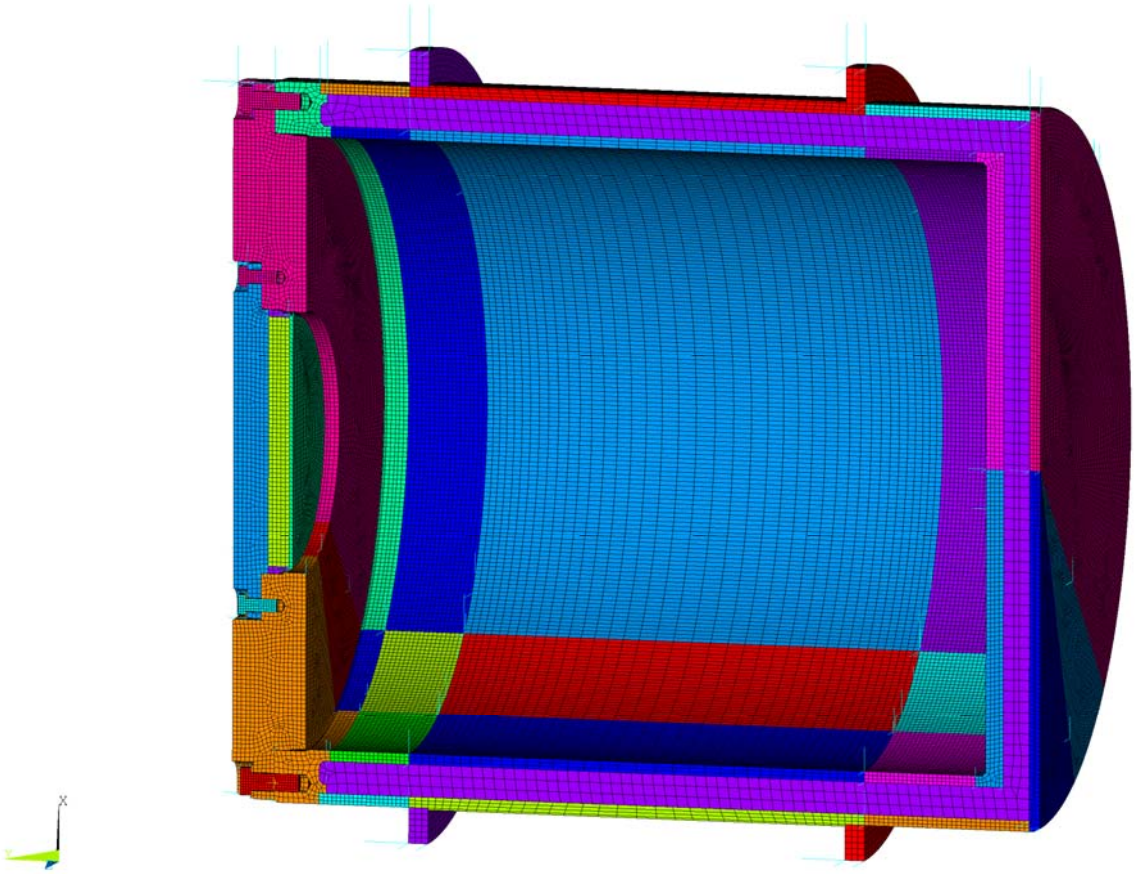


Figure 7-2. RT-100 ANSYS Finite Element Model.

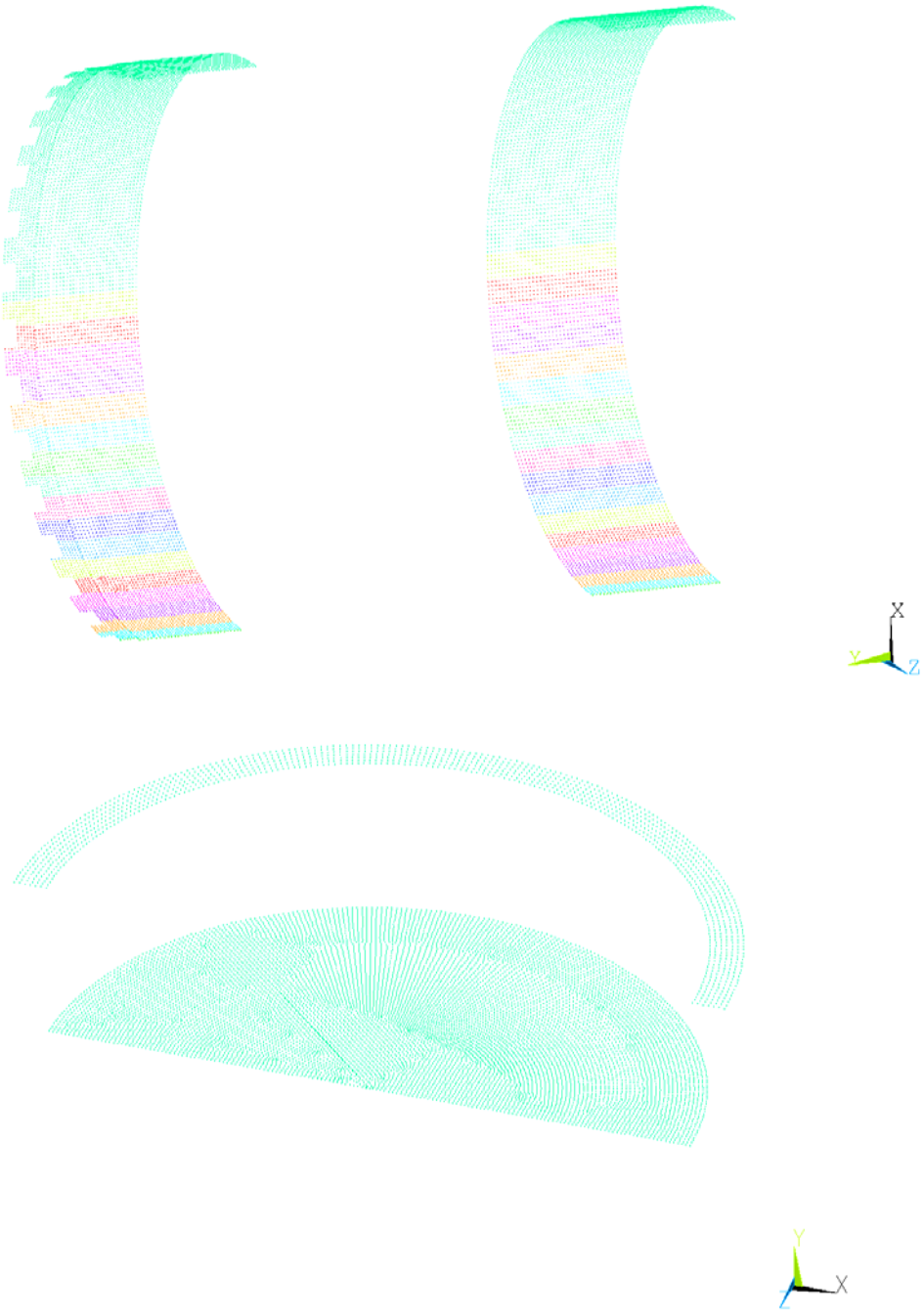


Figure 7-3. Gap Elements used to Represent the Impact Limiters for side and end drop configurations.

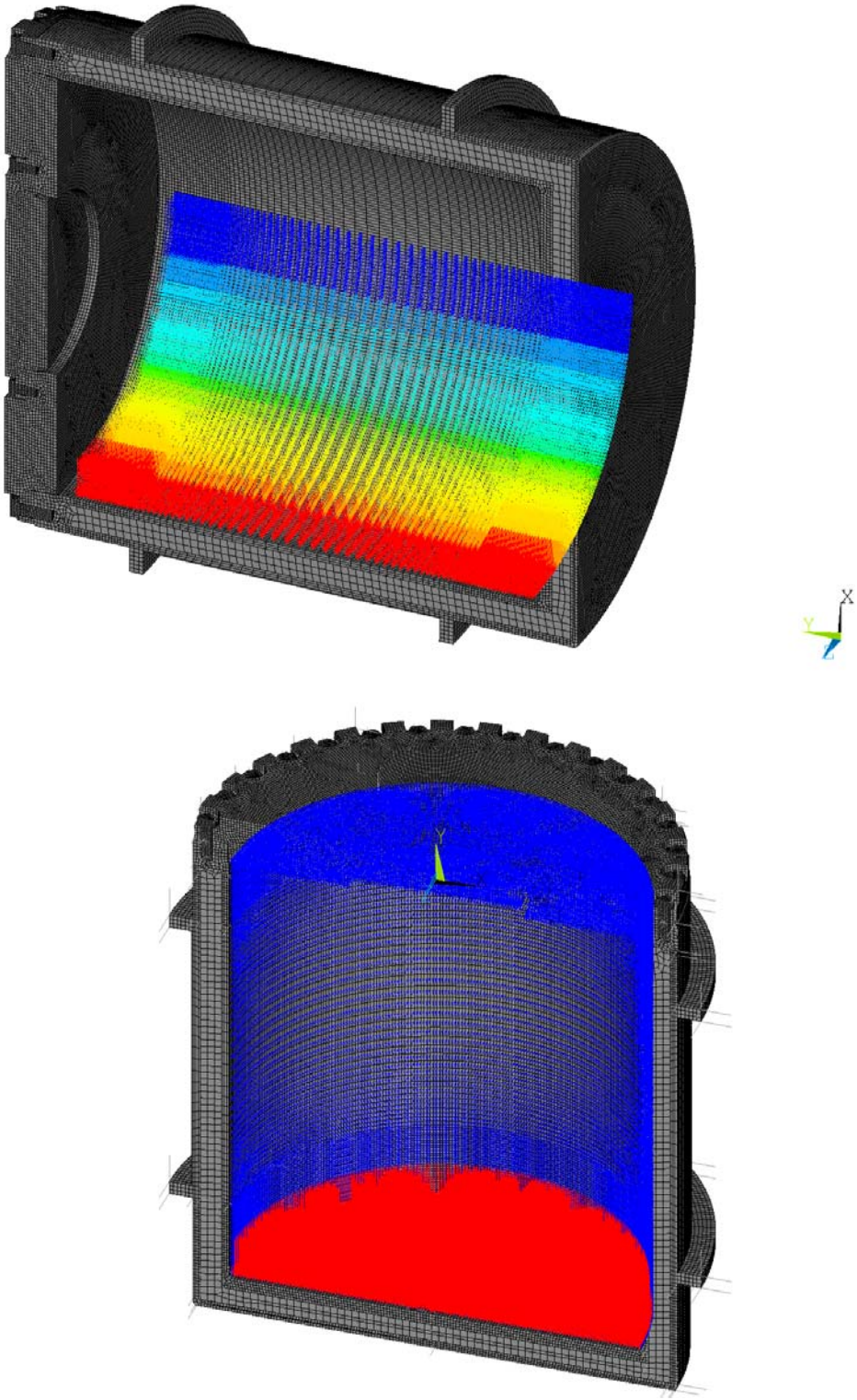


Figure 7-4. Pressure Distribution used to Simulate the Contents.

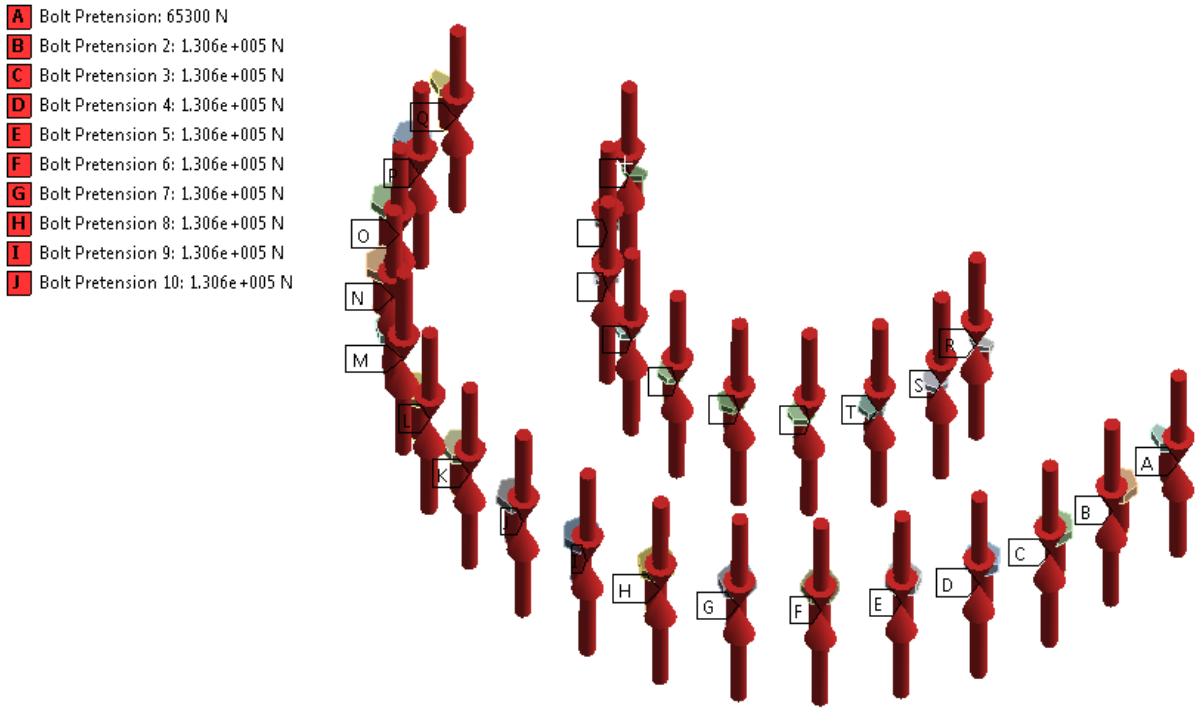


Figure 7-5. Bolt Pre-load using ANSYS Pre-Tension Elements (PRETS179).

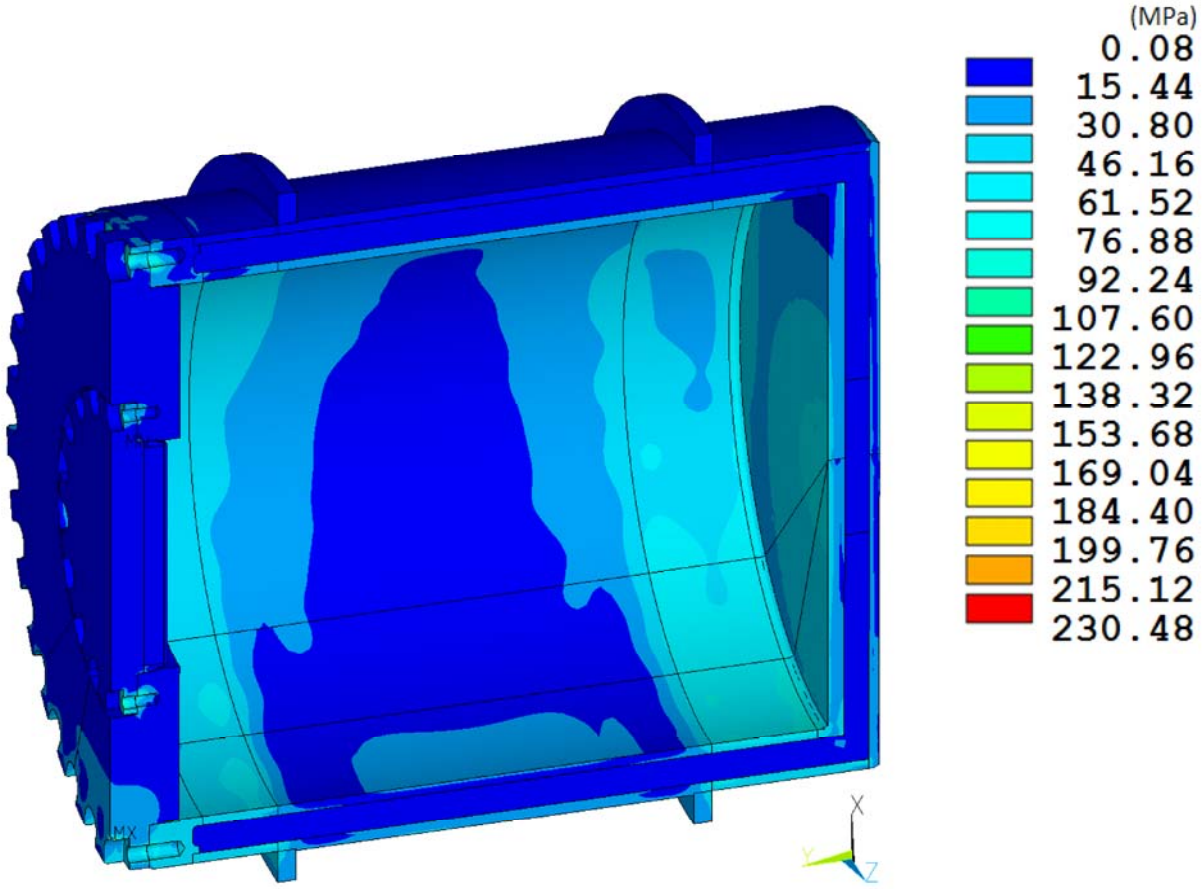


Figure 8-1. RT-100 NCT Side Drop Stress Intensity Results.

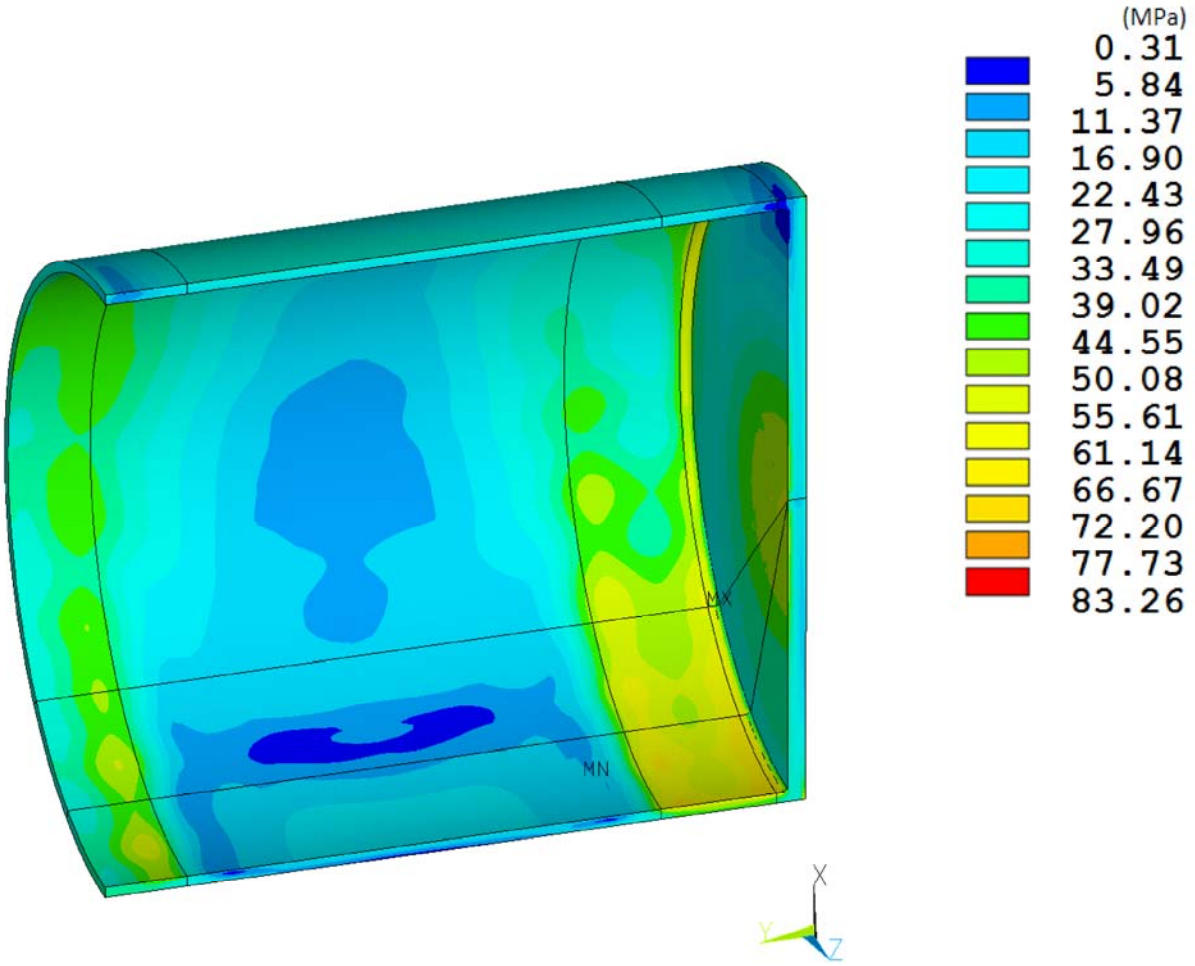


Figure 8-2. RT-100 Inner Shell NCT Side Drop Stress Intensity Results.

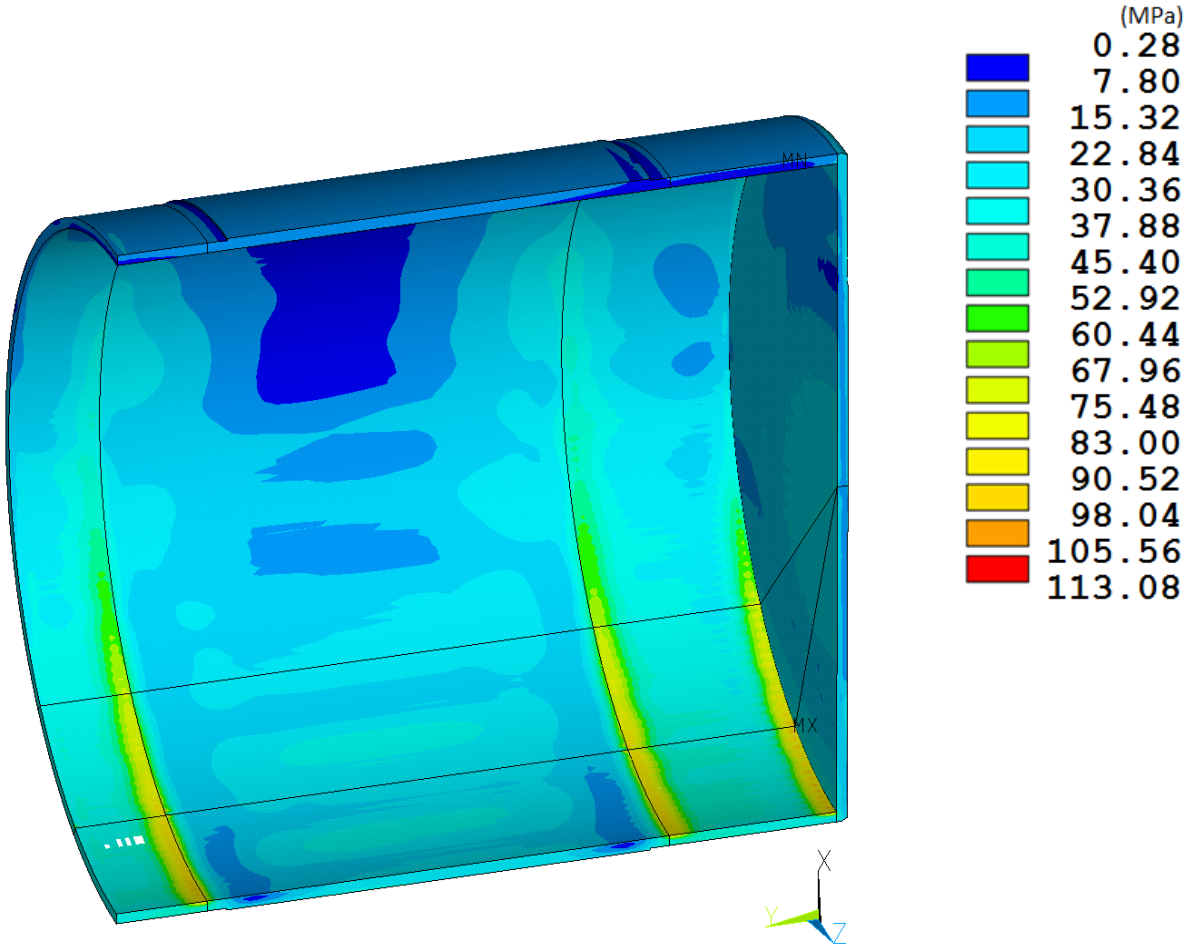


Figure 8-3. RT-100 Outer Shell NCT Side Drop Stress Intensity Results.

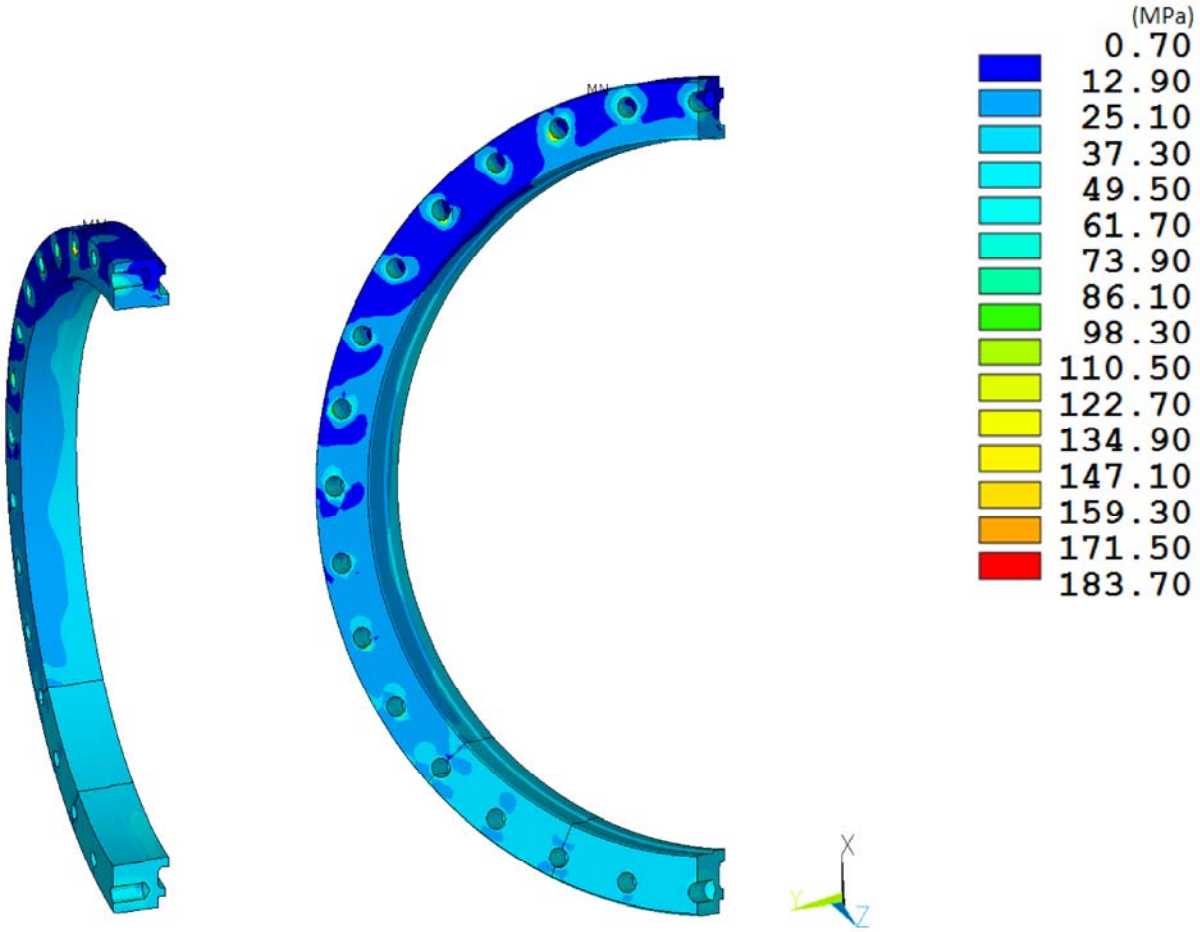


Figure 8-4. RT-100 Flange NCT Side Drop Stress Intensity Results.

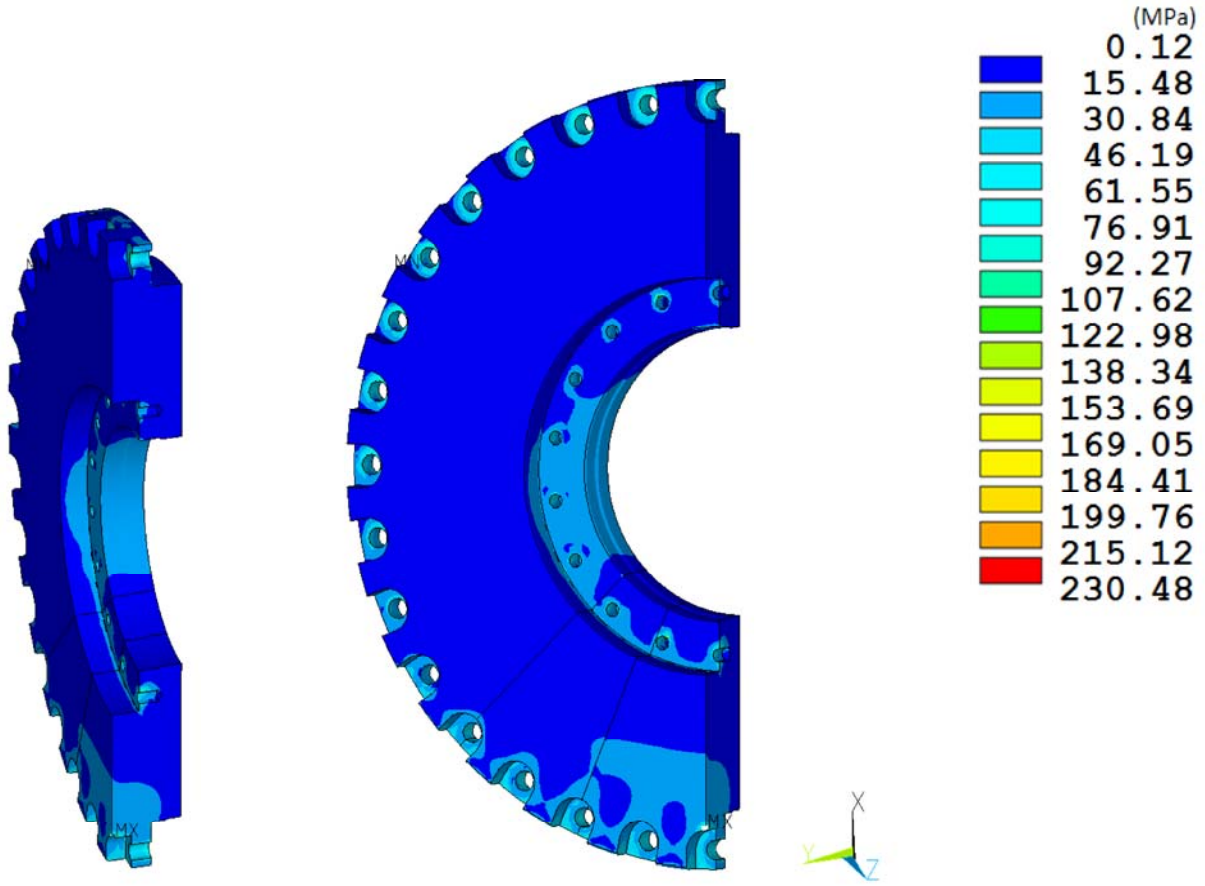


Figure 8-5. RT-100 Outer Lid NCT Side Drop Stress Intensity Results.

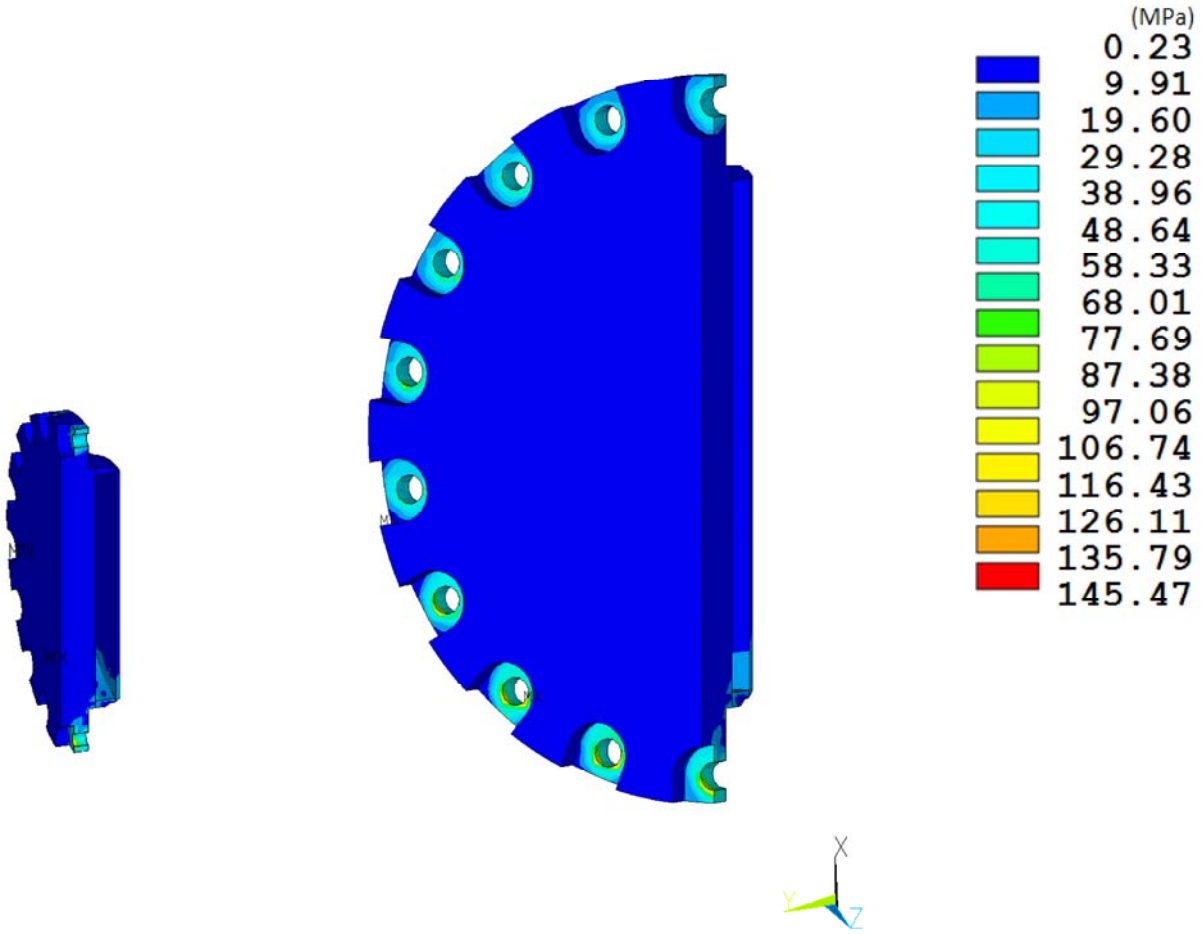


Figure 8-6. RT-100 Inner Lid NCT Side Drop Stress Intensity Results.

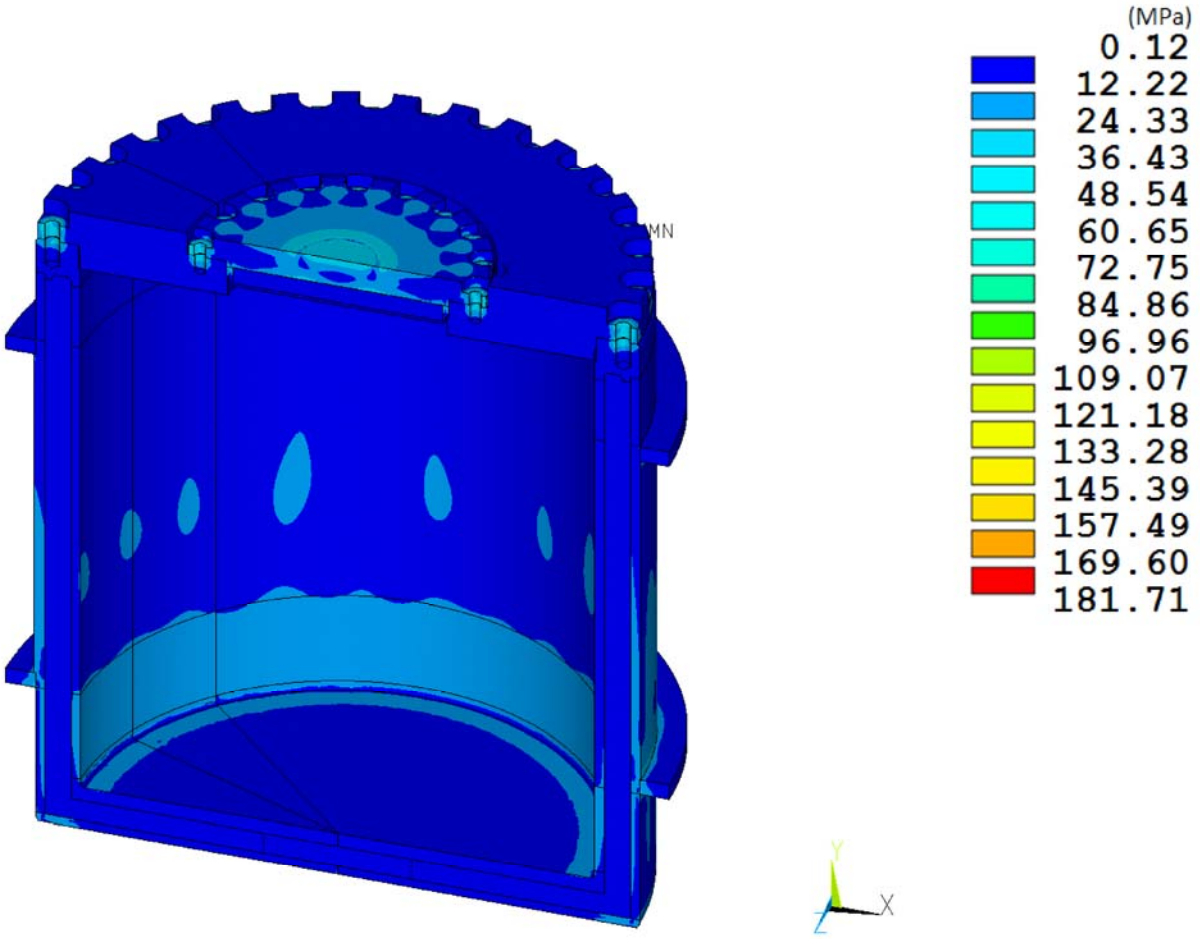


Figure 8-7. RT-100 NCT Bottom Drop Stress Intensity Results.

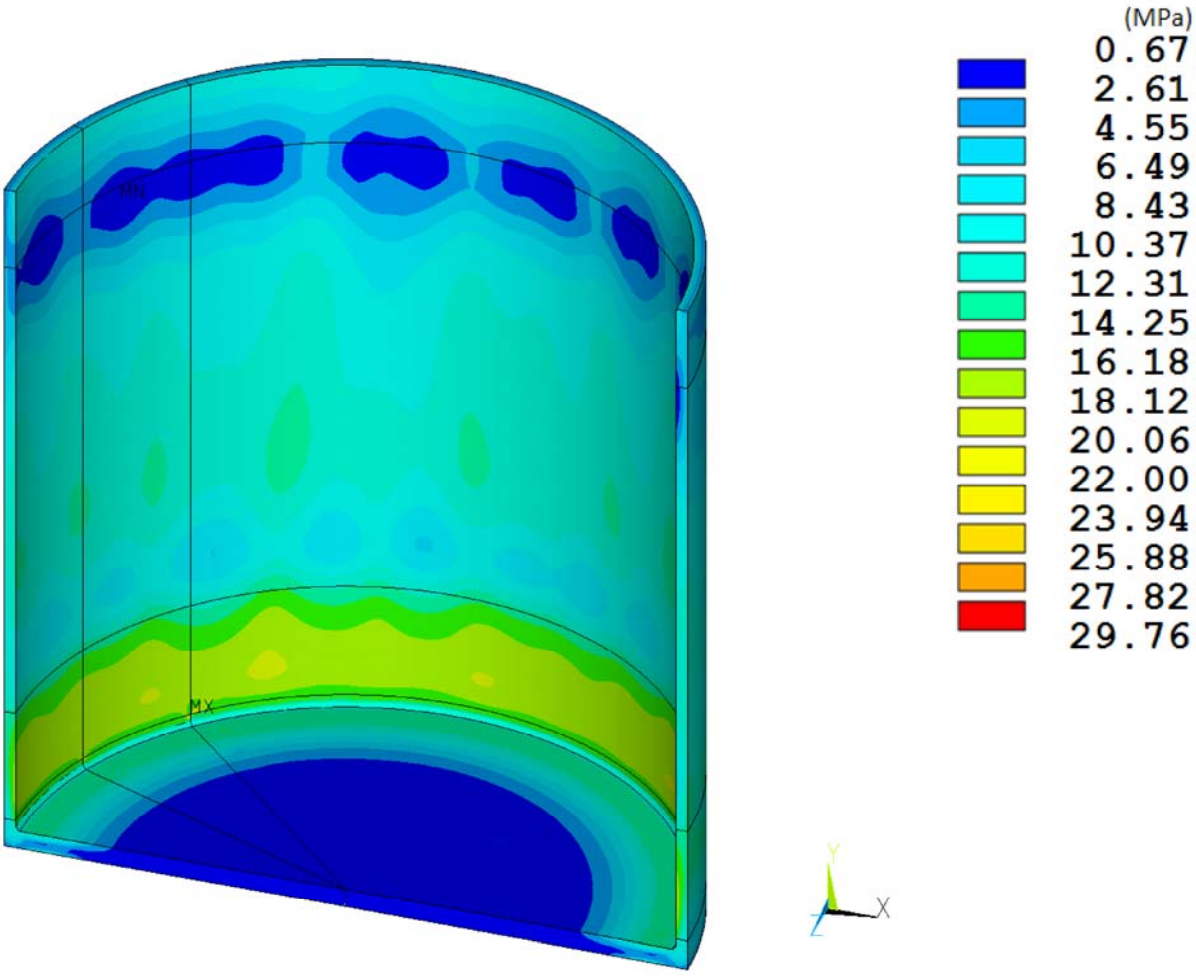


Figure 8-8. RT-100 Inner Shell NCT End Drop Stress Intensity Results.

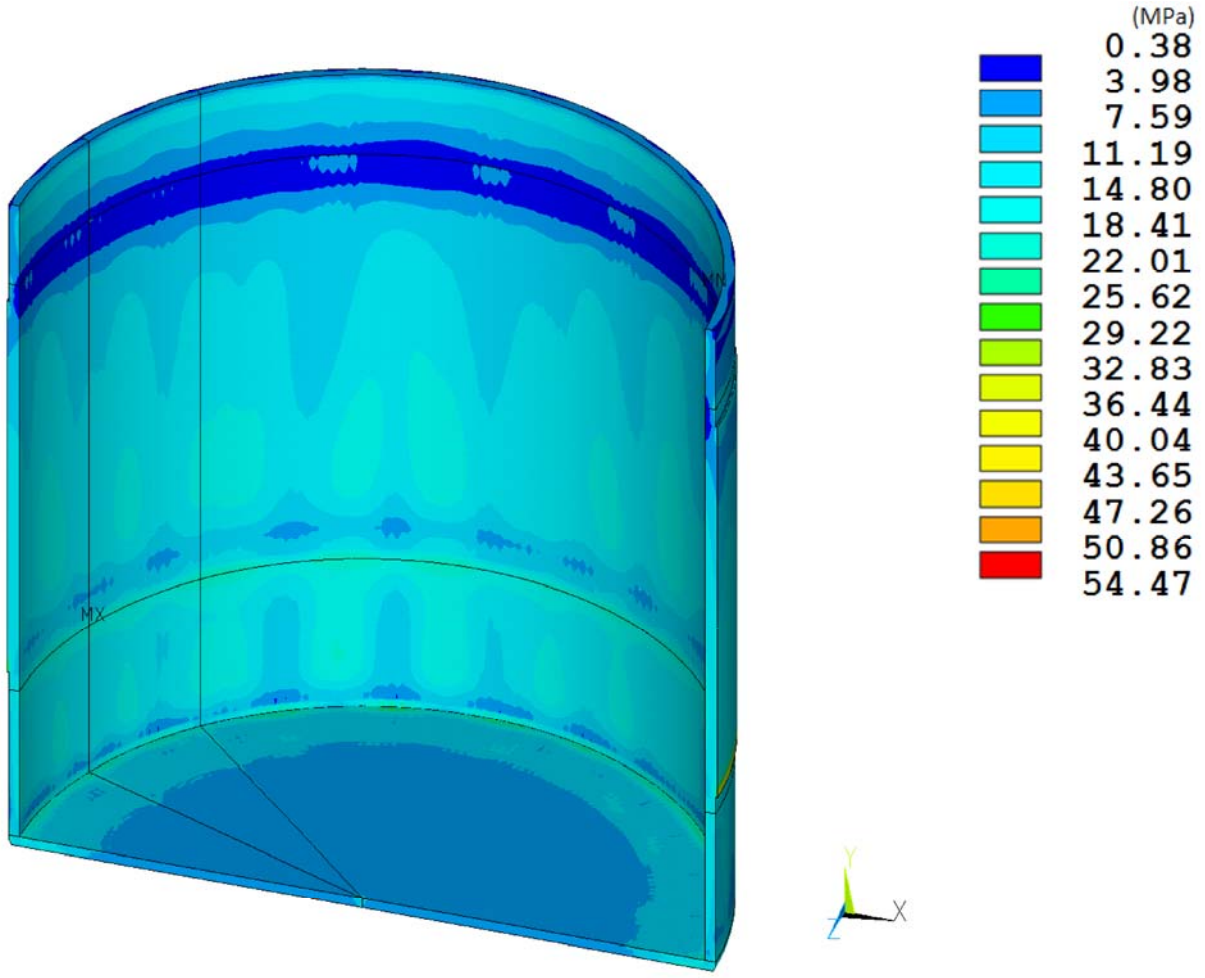


Figure 8-9. RT-100 Outer Shell NCT End Drop Stress Intensity Results.

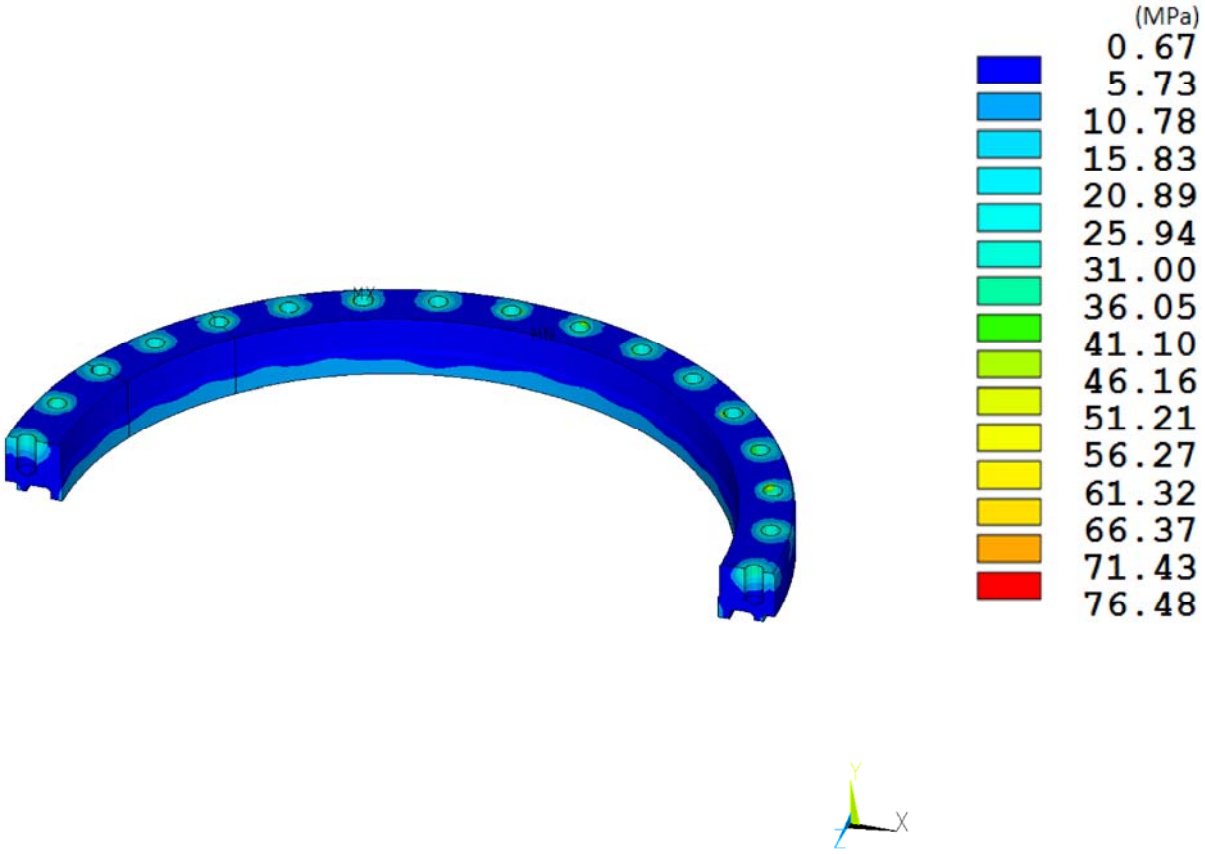


Figure 8-10. RT-100 Flange NCT End Drop Stress Intensity Results.

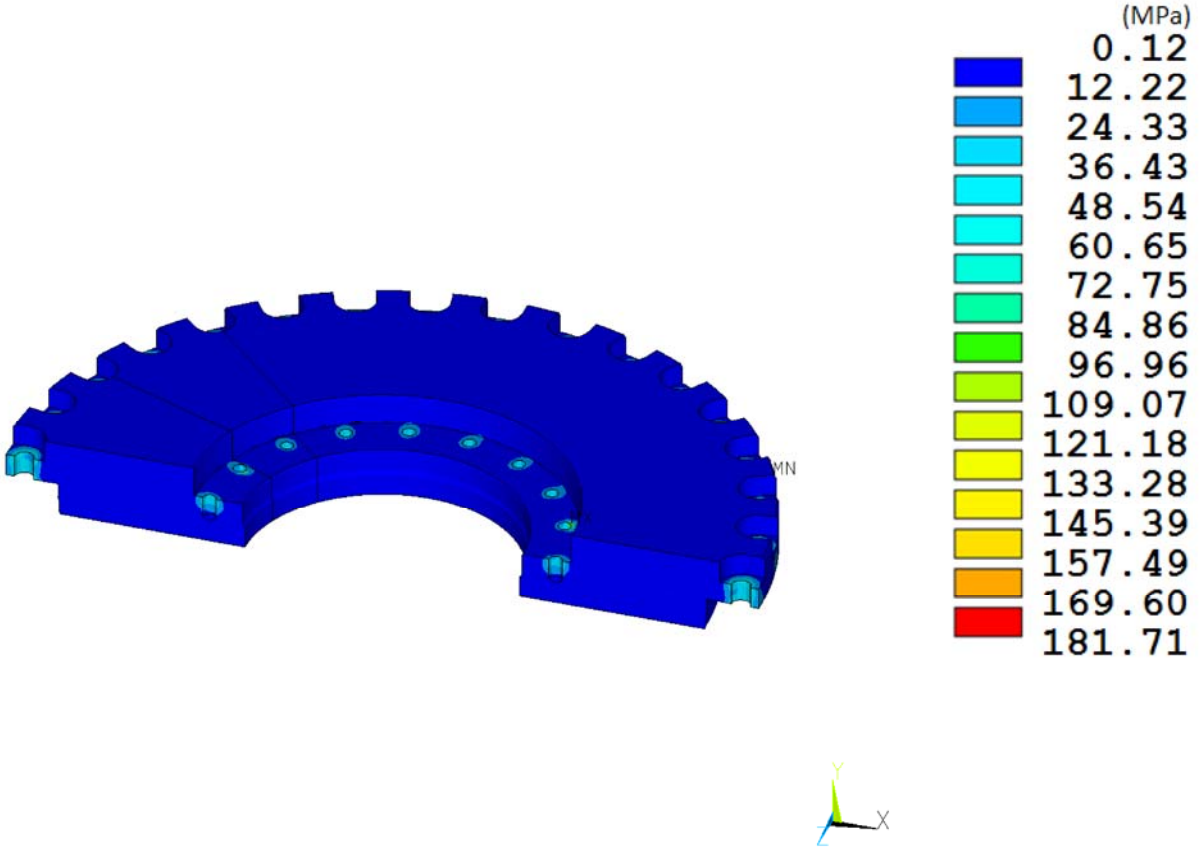


Figure 8-11. RT-100 Outer Lid NCT End Drop Stress Intensity Results.

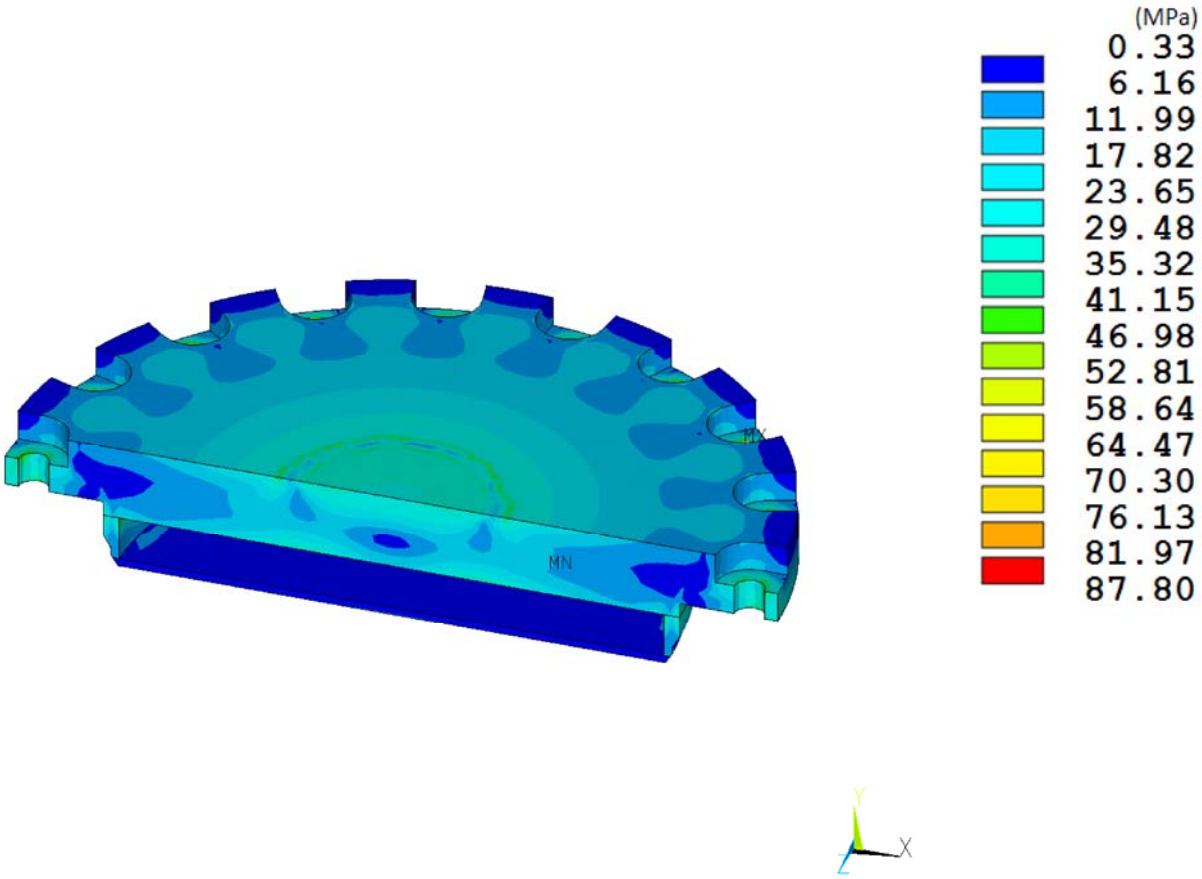


Figure 8-12. RT-100 Inner Lid NCT End Drop Stress Intensity Results.

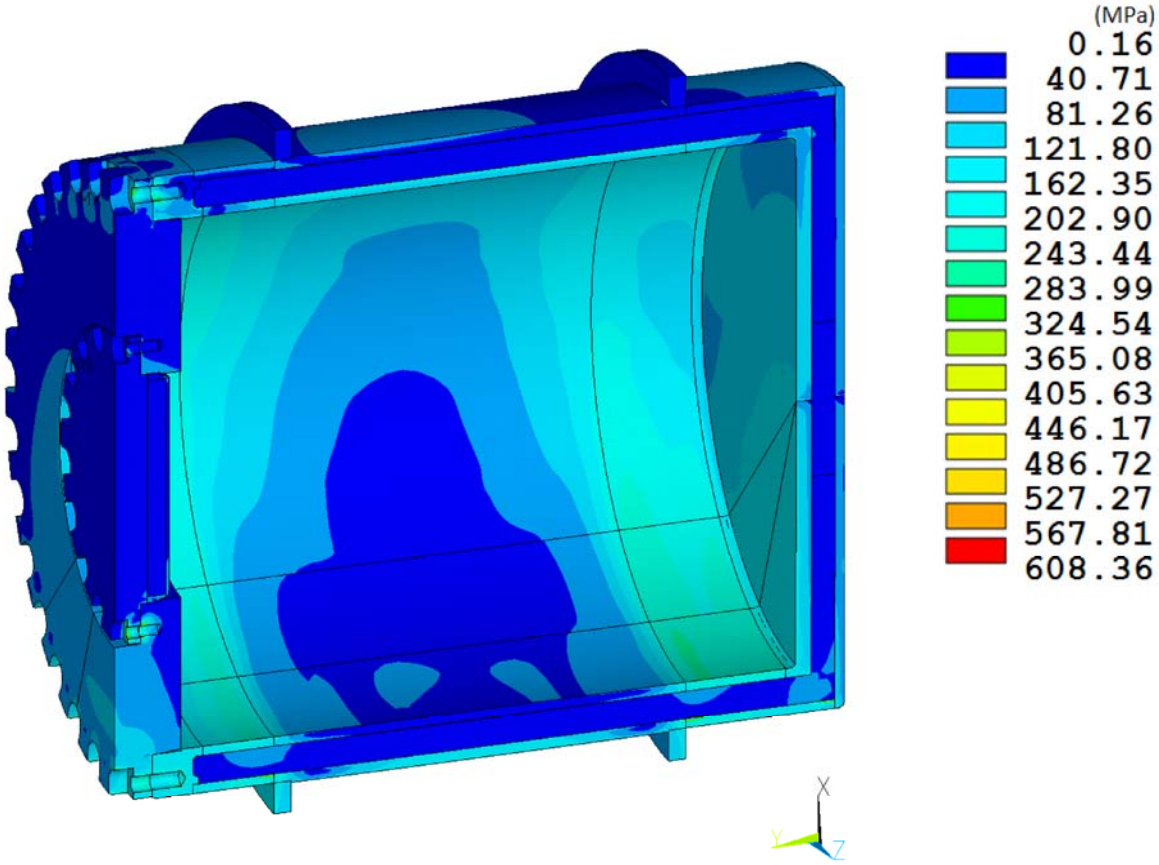


Figure 8-13. RT-100 HAC Side Drop Stress Intensity Results.

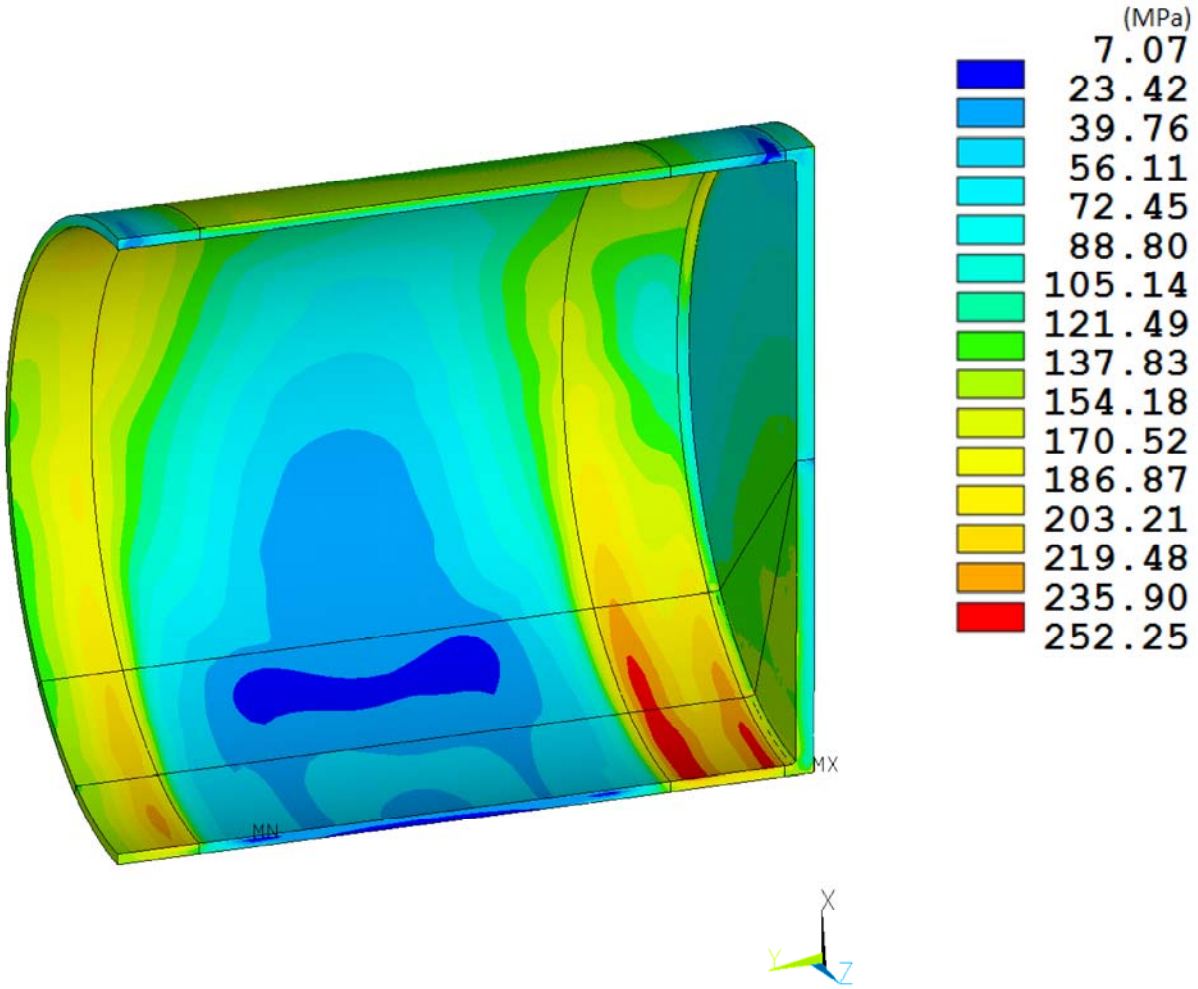


Figure 8-14. RT-100 Inner Shell HAC Side Drop Stress Intensity Results.

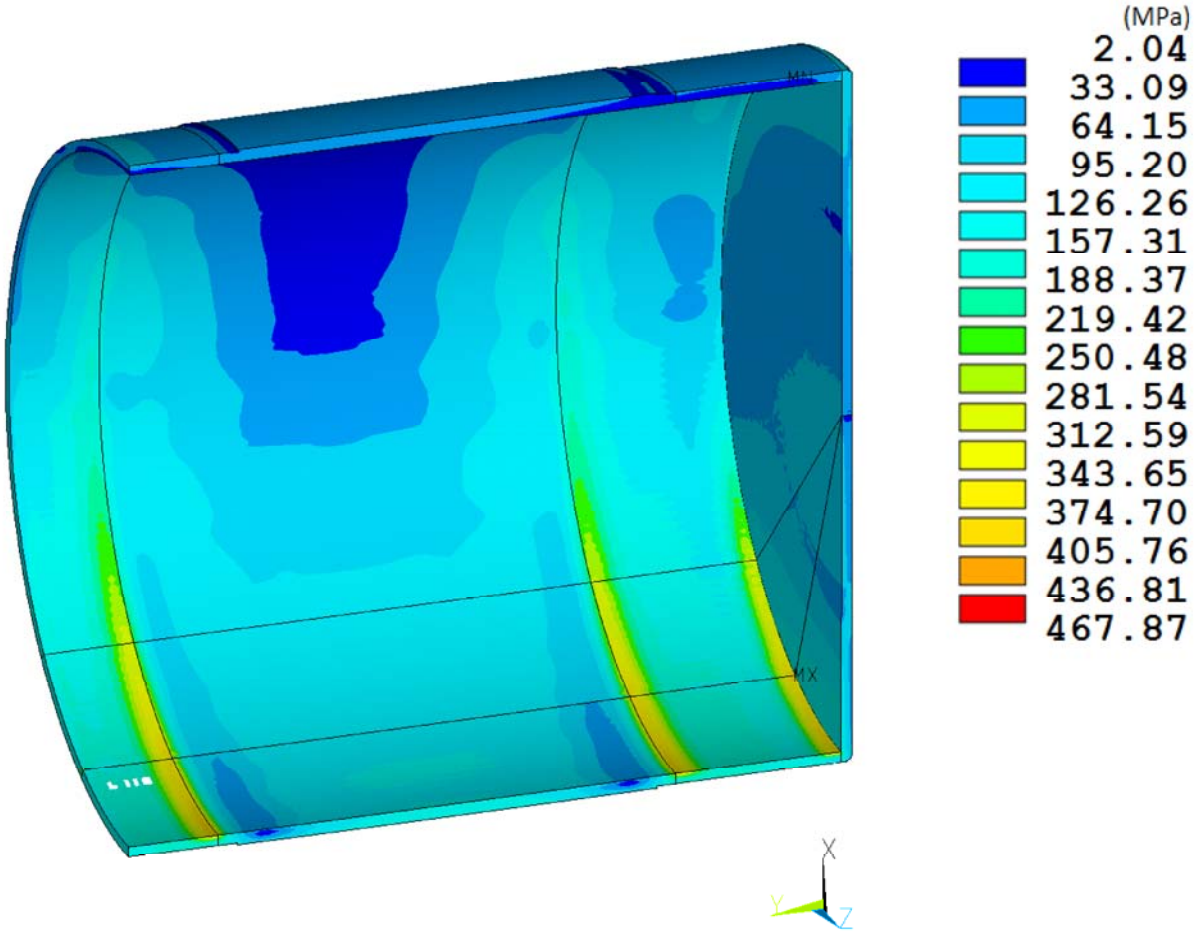


Figure 8-15. RT-100 Outer Shell HAC Side Drop Stress Intensity Results.

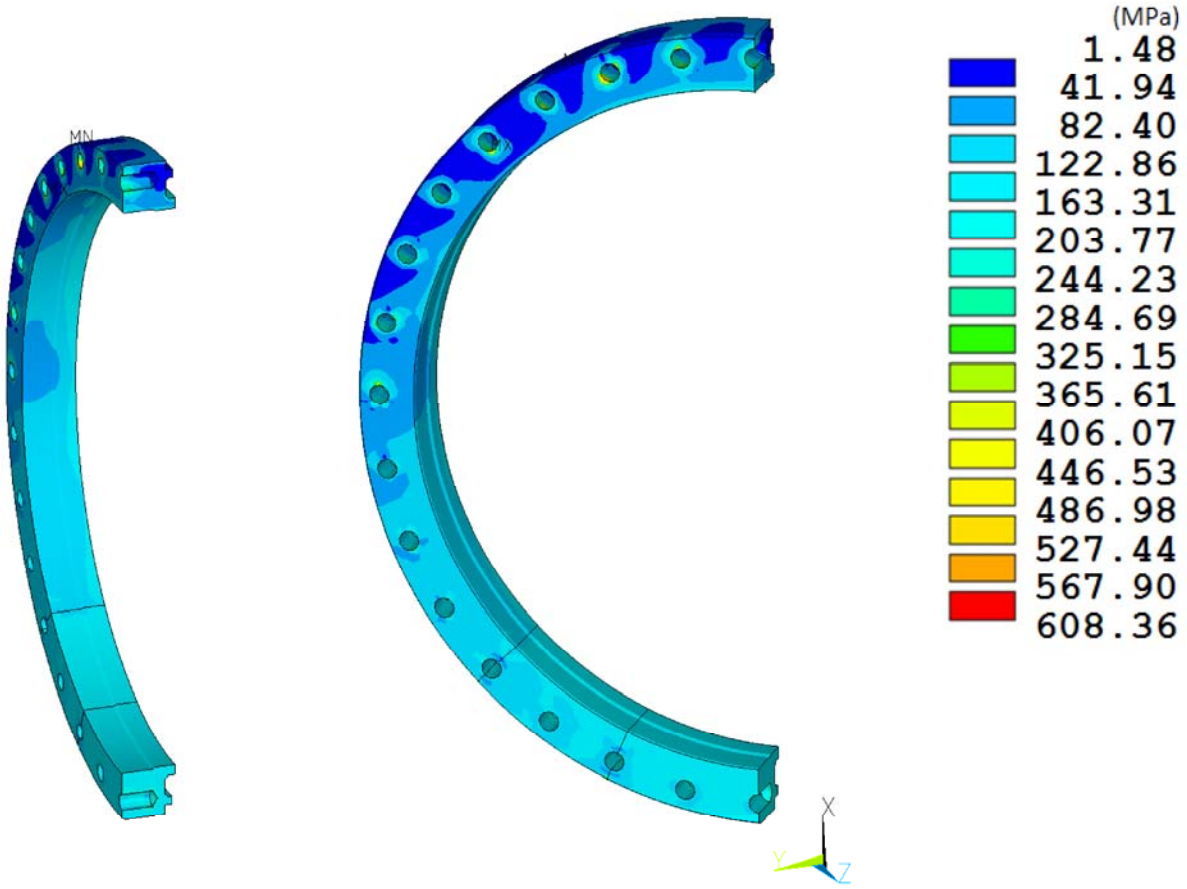


Figure 8-16. RT-100 Flange HAC Side Drop Stress Intensity Results.

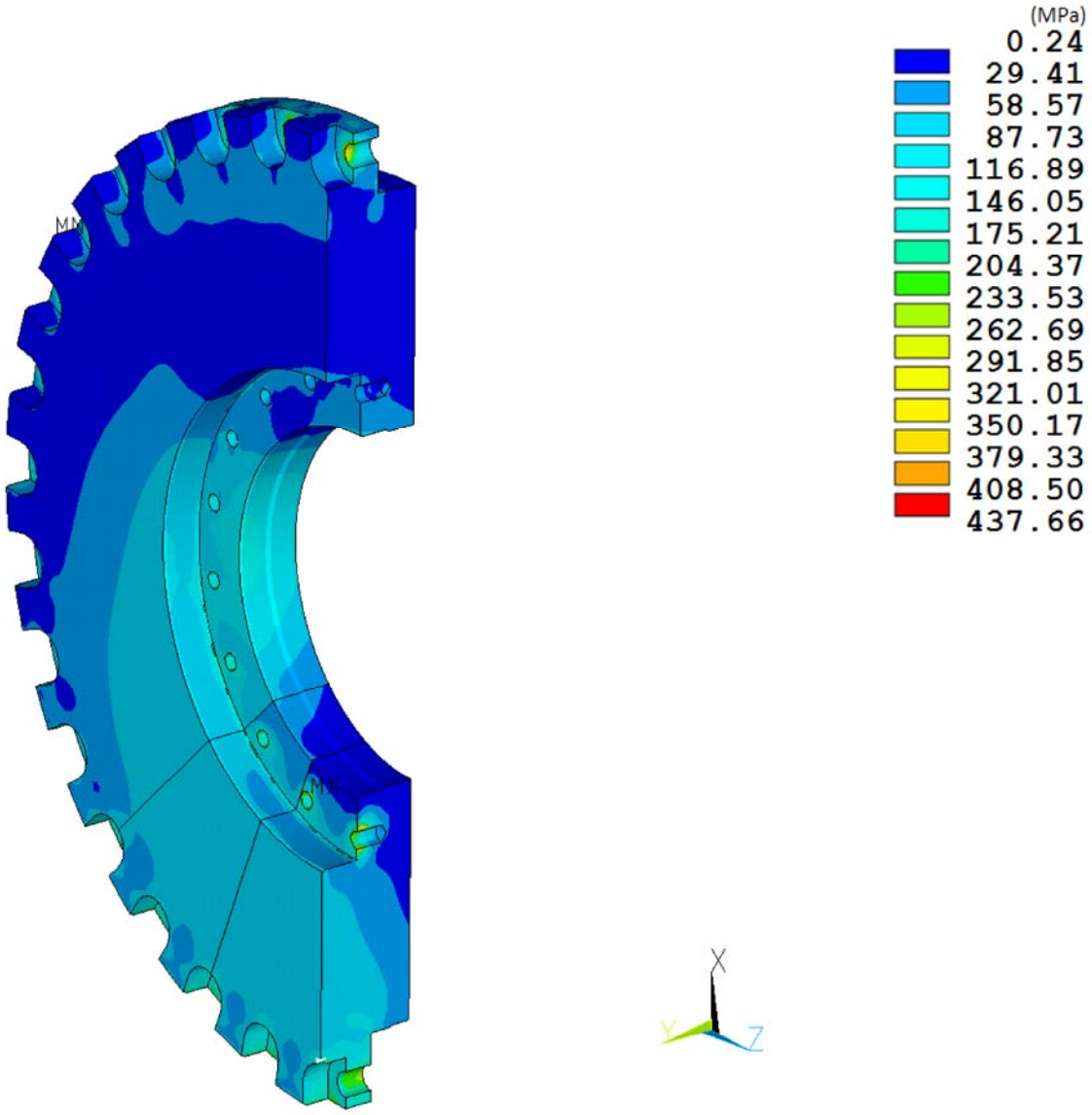


Figure 8-17. RT-100 Outer Lid HAC Side Drop Stress Intensity Results.

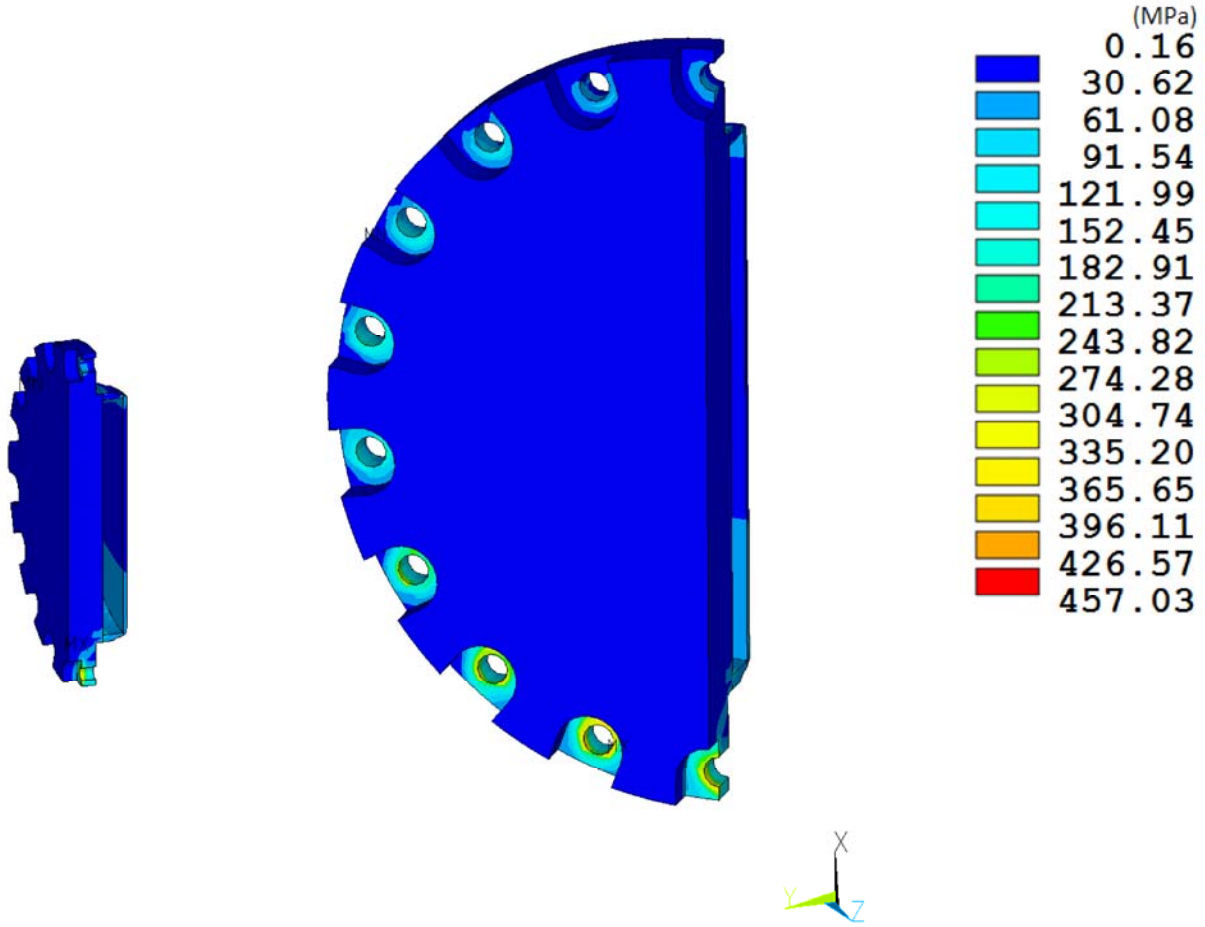


Figure 8-18. RT-100 Inner Lid HAC Side Drop Stress Intensity Results.

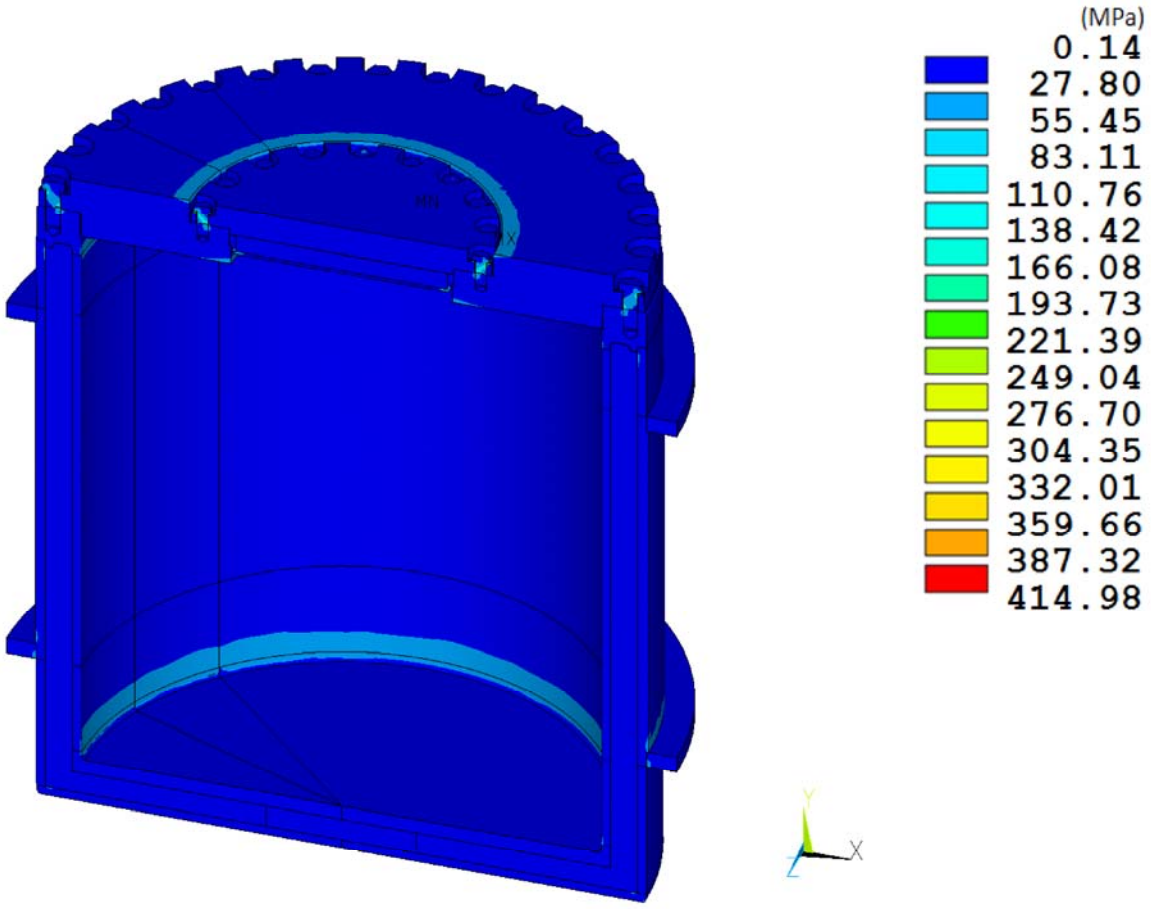


Figure 8-19. RT-100 HAC End Drop Stress Intensity Results.

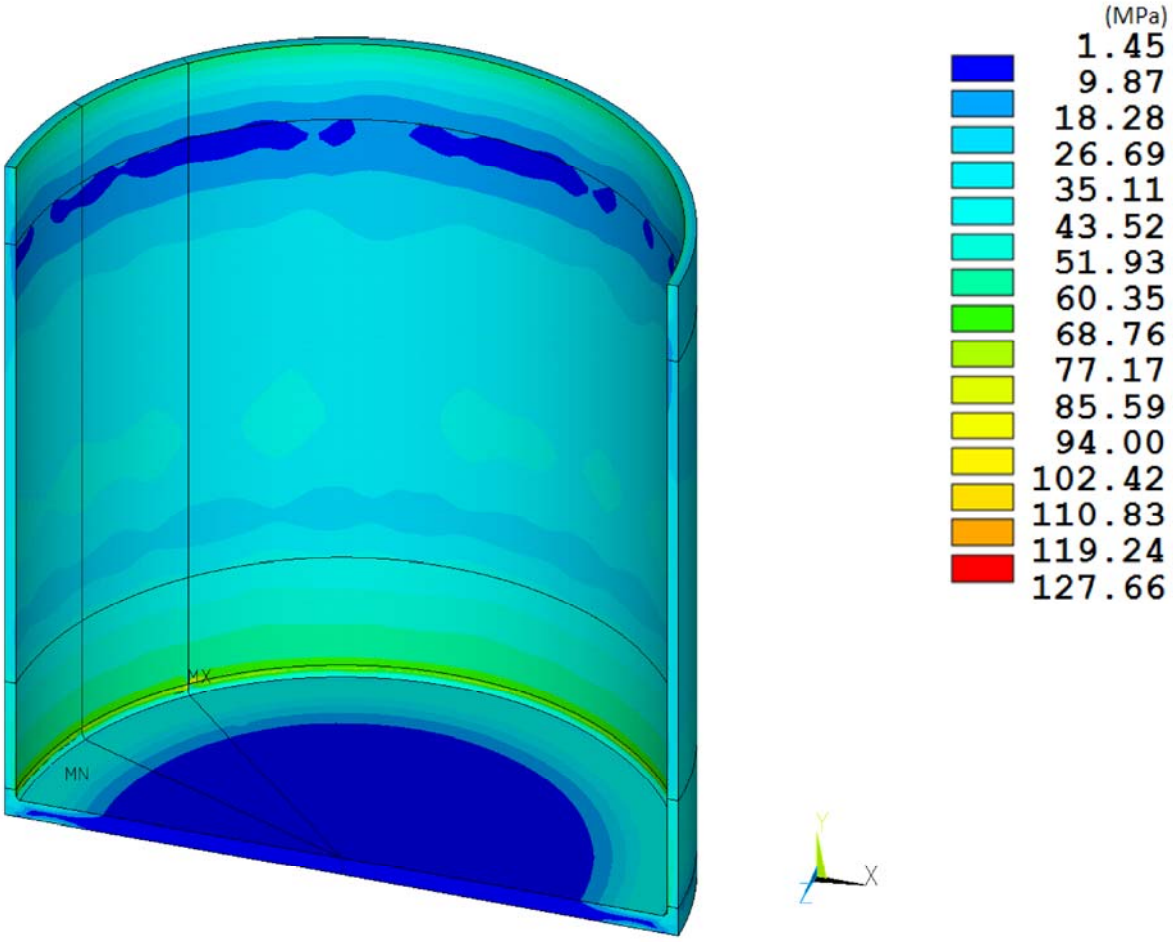


Figure 8-20. RT-100 Inner Shell HAC End Drop Stress Intensity Results.

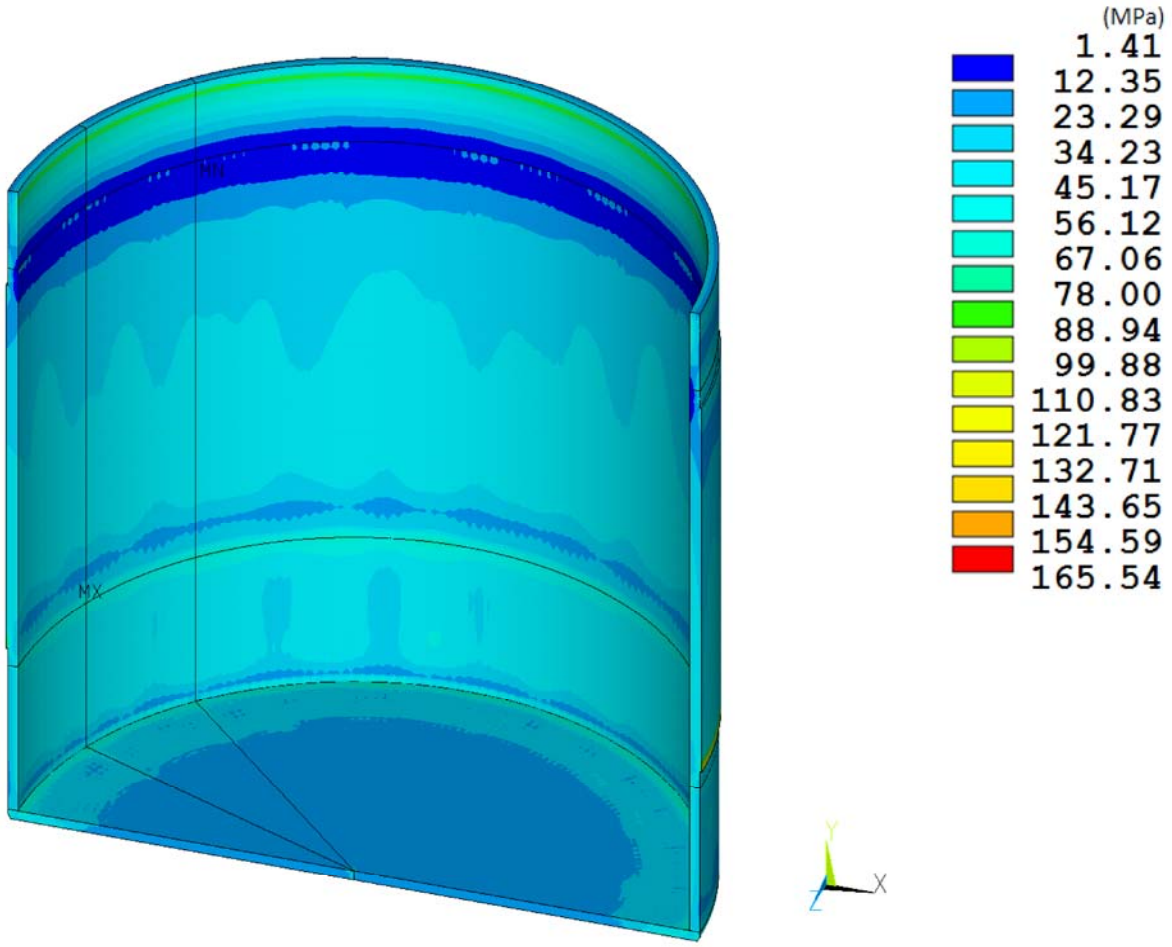


Figure 8-21. RT-100 Outer Shell HAC End Drop Stress Intensity Results.

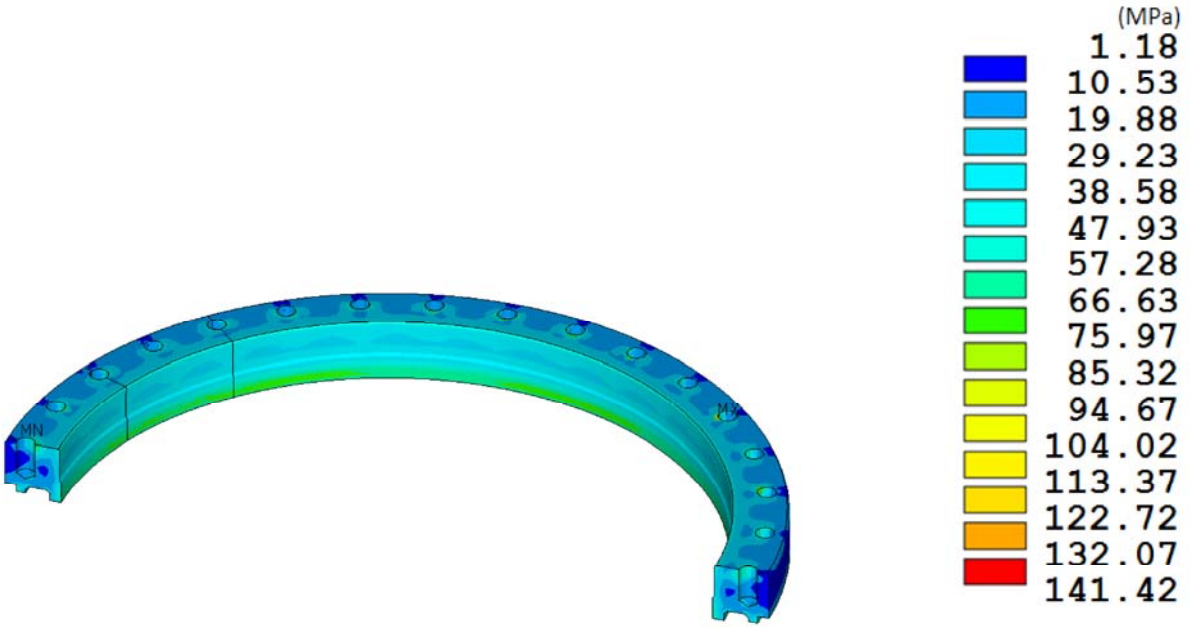


Figure 8-22. RT-100 Flange HAC End Drop Stress Intensity Results.

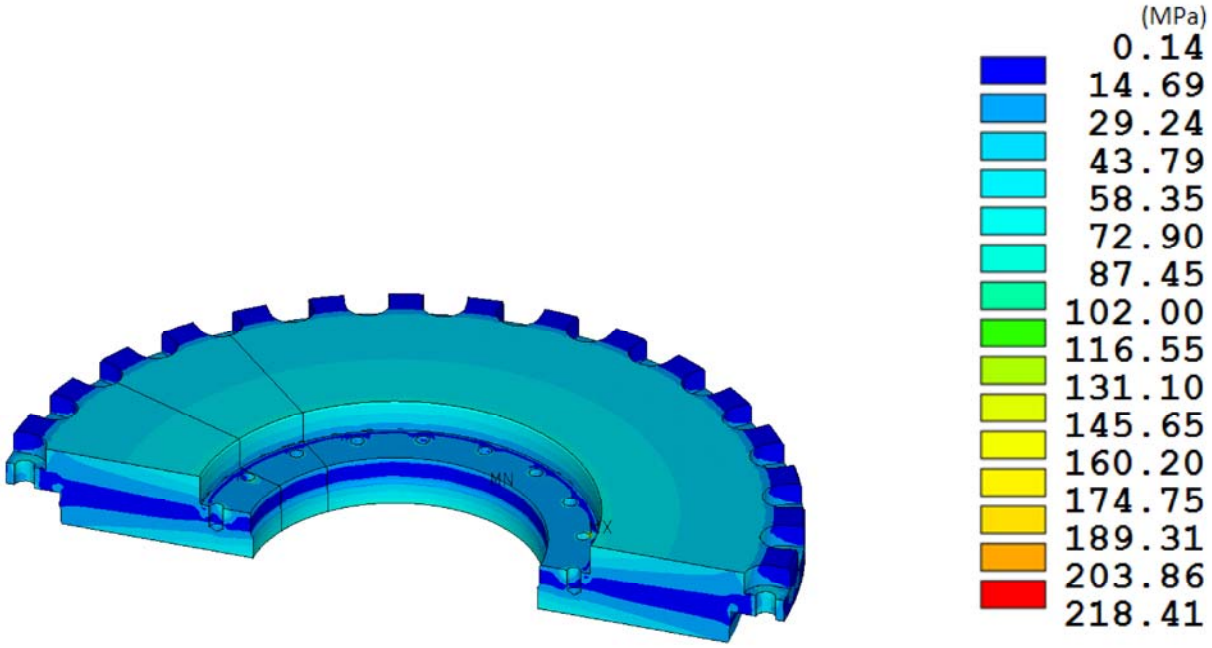


Figure 8-23. RT-100 Outer Lid HAC End Drop Stress Intensity Results.

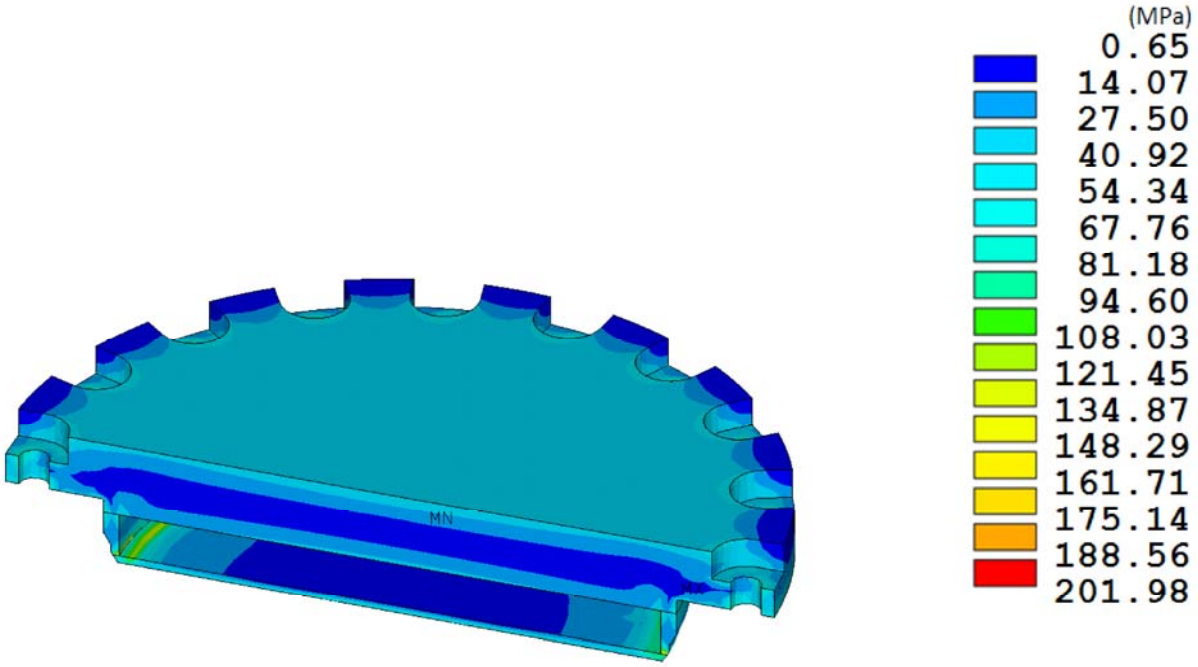


Figure 8-24. RT-100 Inner Lid HAC End Drop Stress Intensity Results.

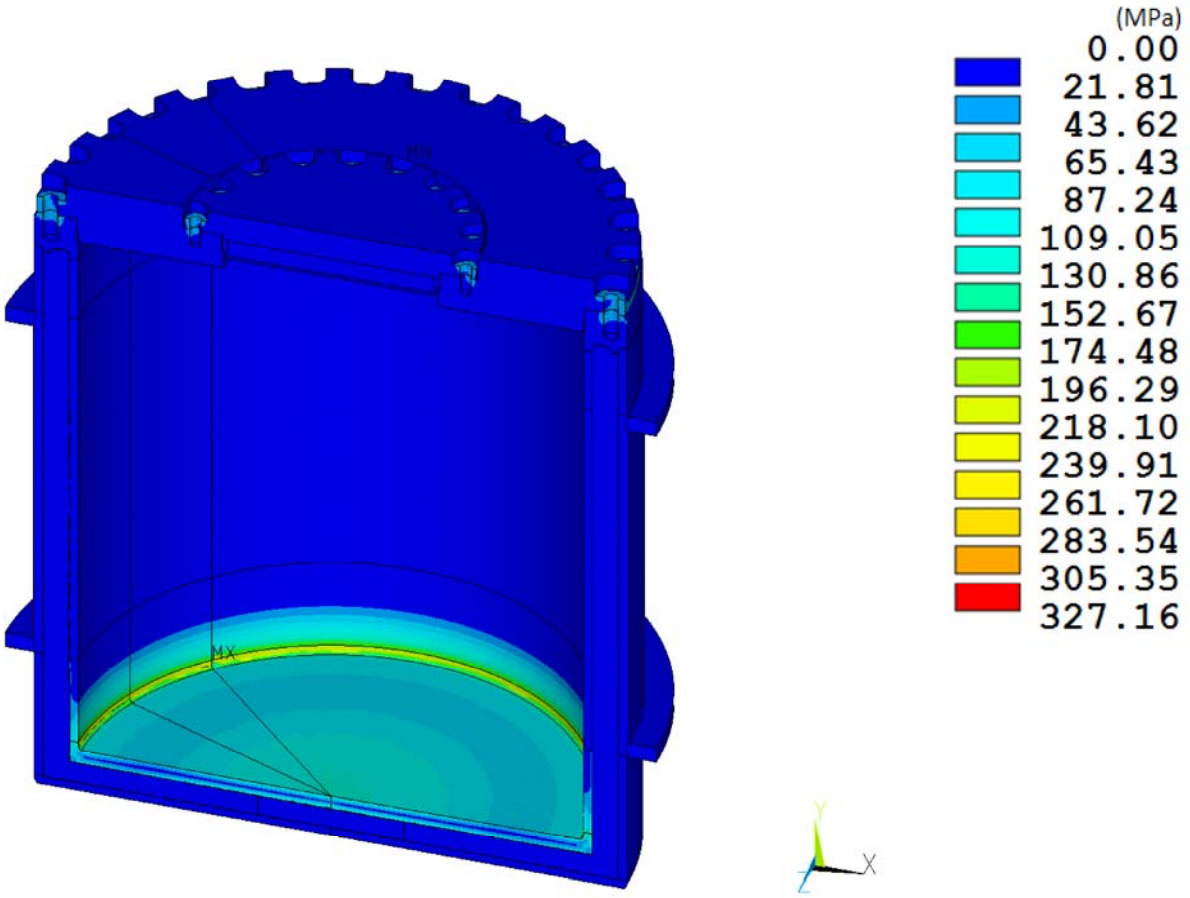


Figure 8-25. RT-100 HAC Pressure Stress Intensity Results.

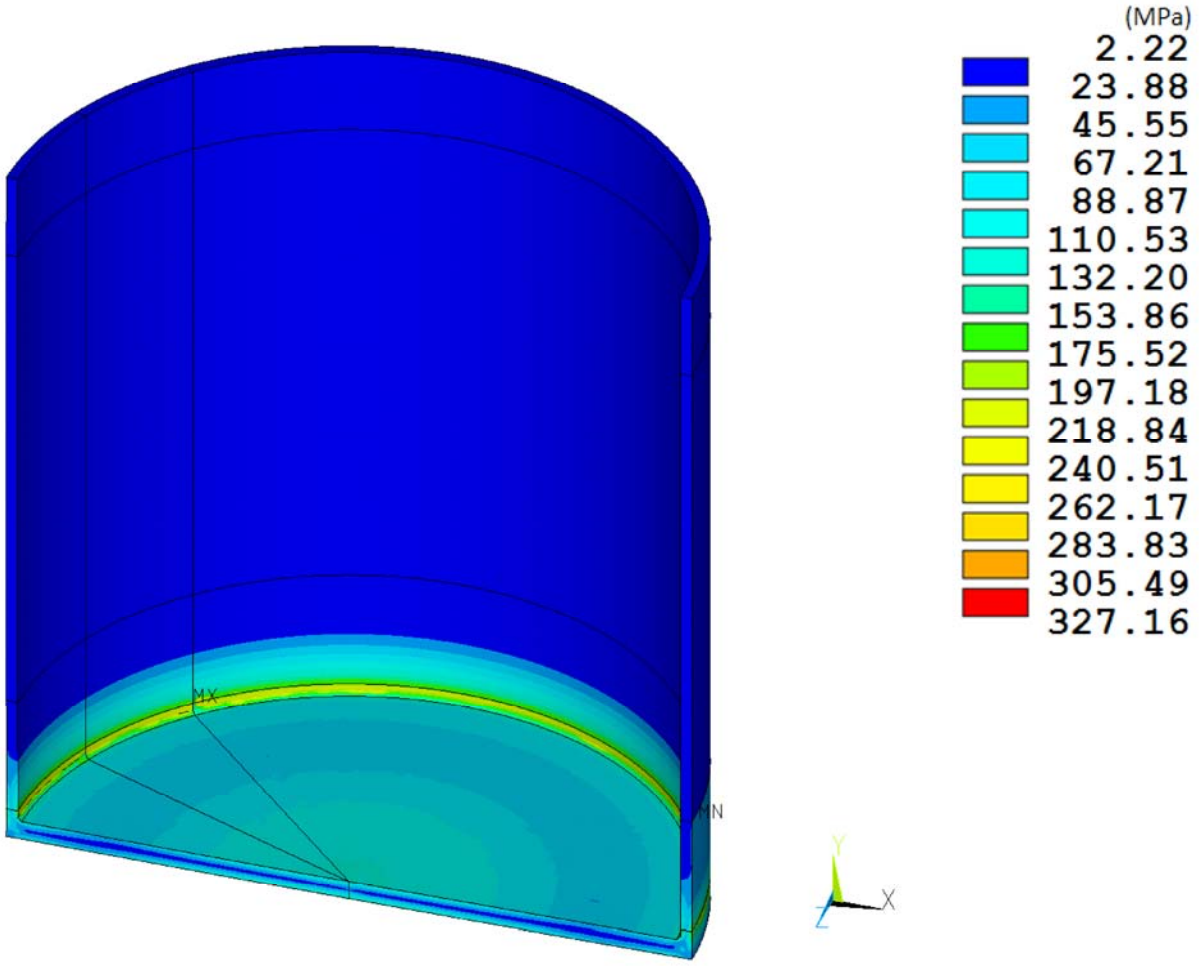


Figure 8-26. RT-100 HAC Inner Shell Pressure Stress Intensity Results.

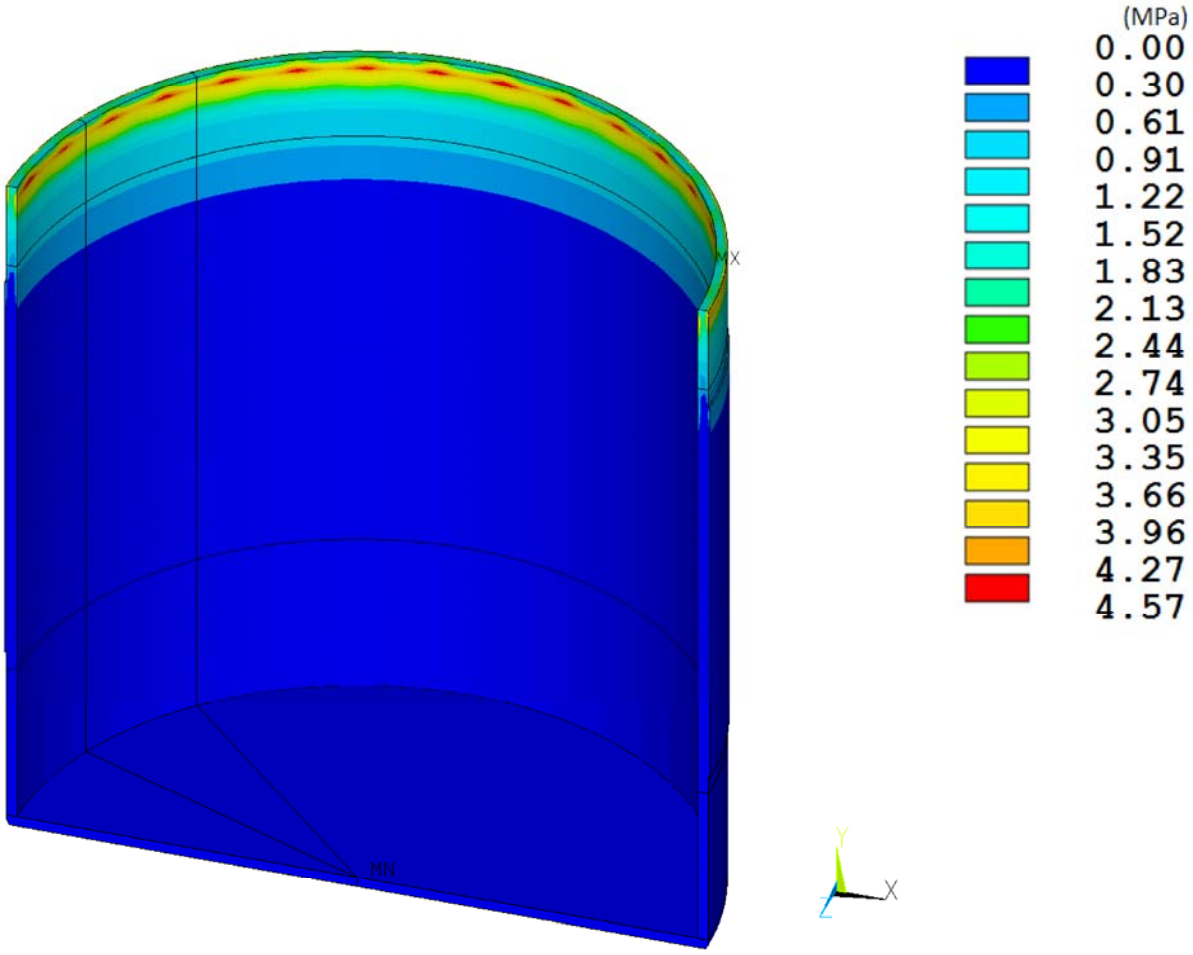


Figure 8-27. RT-100 HAC Outer Shell Pressure Stress Intensity Results.

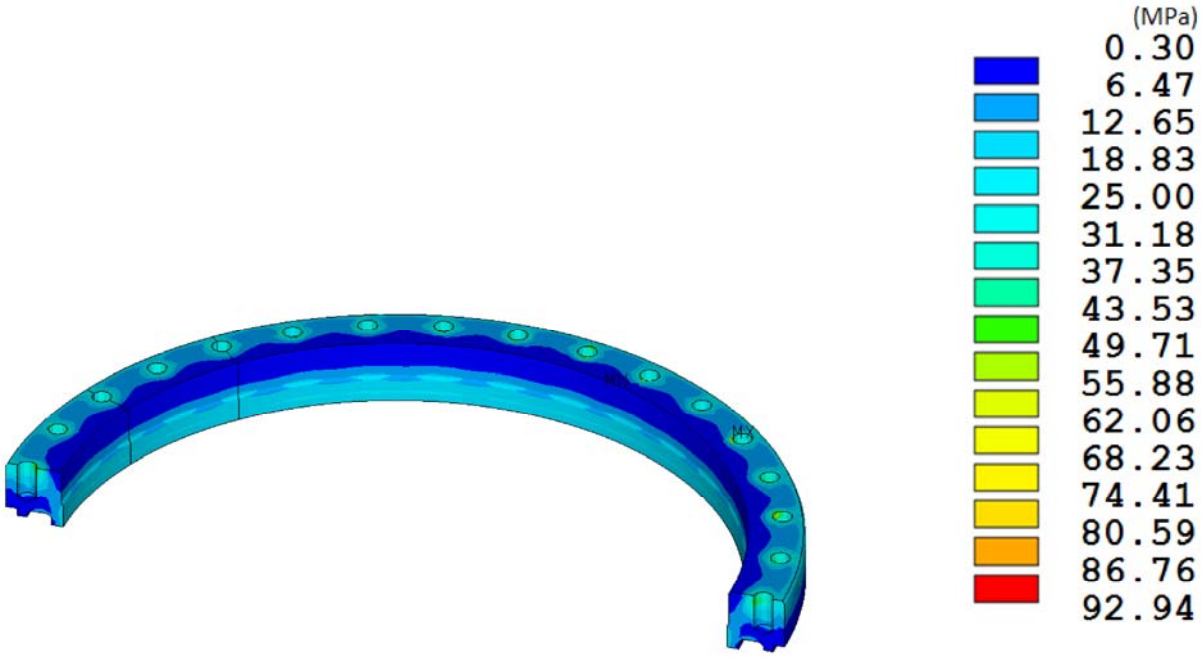


Figure 8-28. RT-100 HAC Flange Pressure Stress Intensity Results.

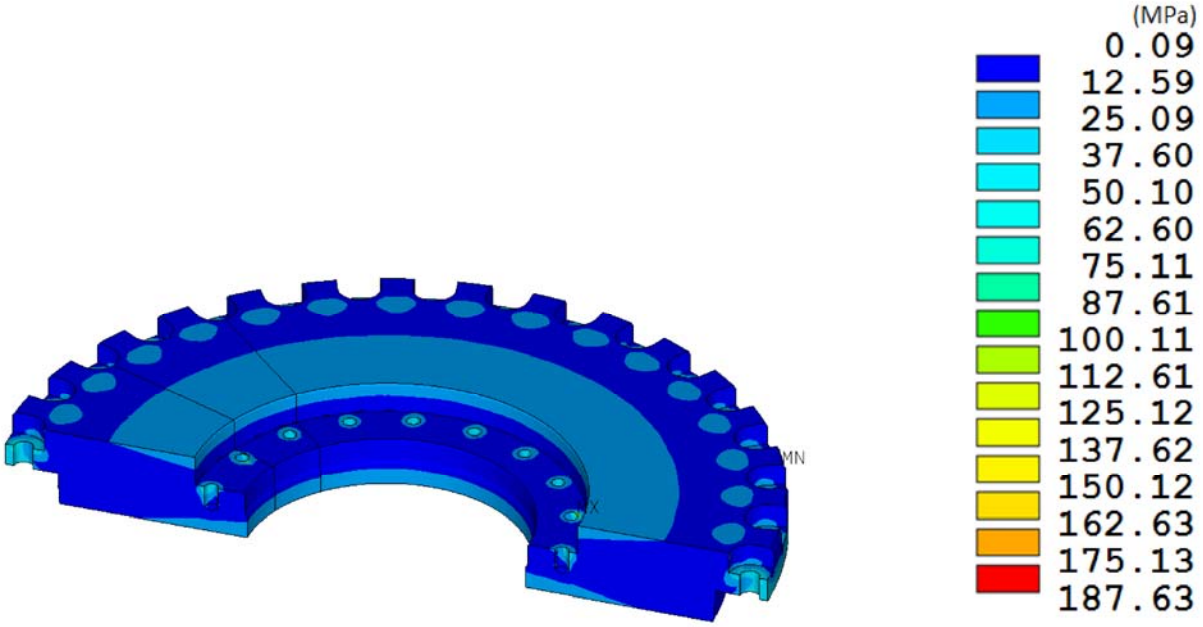


Figure 8-29. RT-100 HAC Outer Lid Stress Intensity Results.

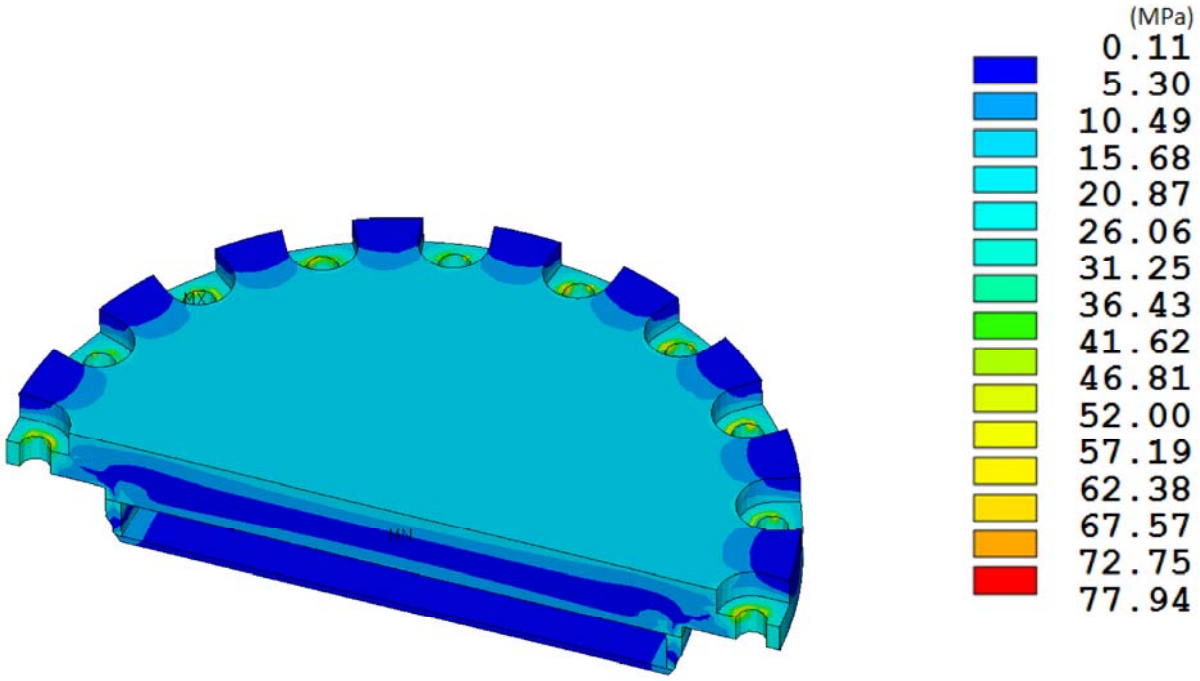


Figure 8-30. RT-100 HAC Inner Lid Stress Intensity Results.

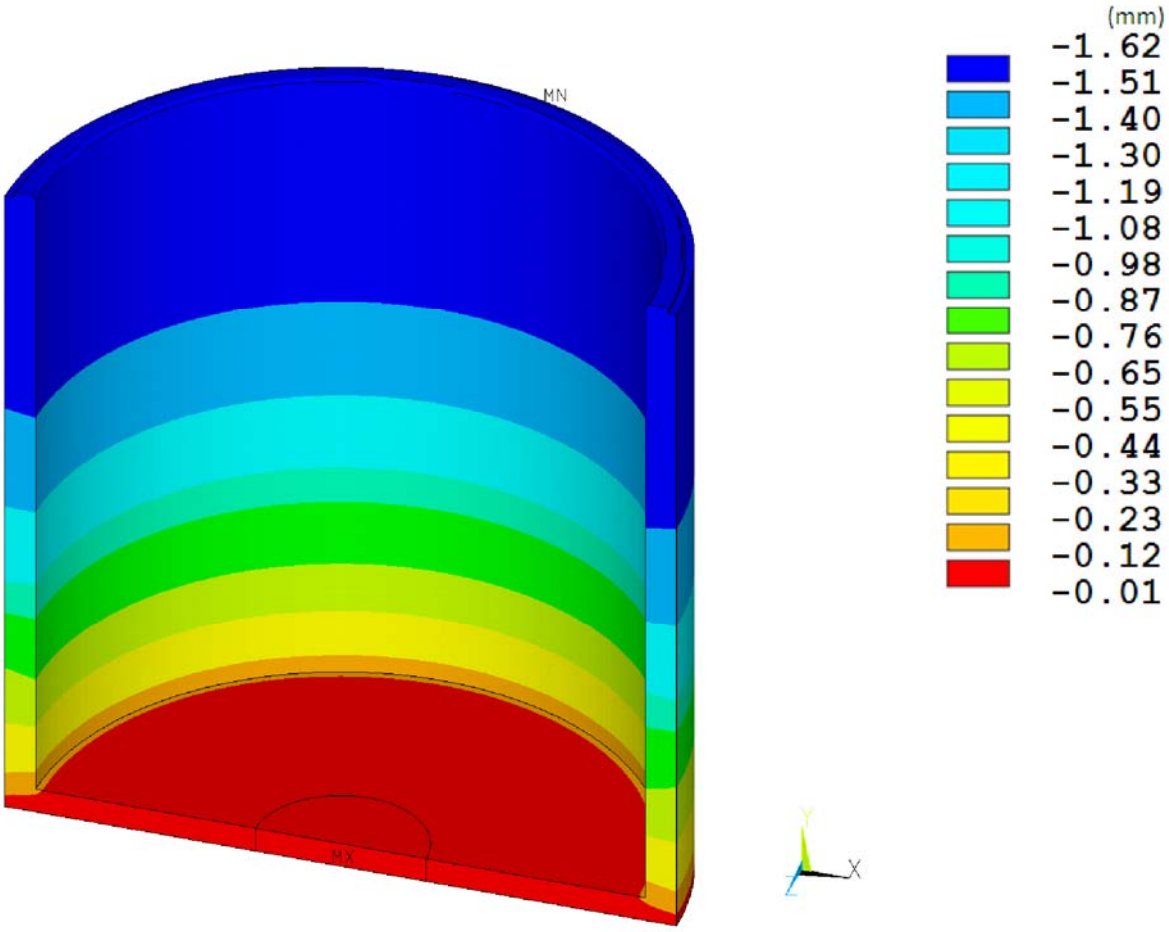


Figure 8-31. Lead Slump.

APPENDIX 2—Input and Output File Organization

The following table shows the call sequence and which files are created during the ANSYS solution process.

First Tier	Second Tier	Output File
RT100_HAC_Pressure.inp		stress_pressure_hac.txt
RT100_HAC_End_Drop.inp		stress_end_hac.txt
RT100_NCT_End_Drop.inp		stress_end_nct.txt
RT100_HAC_Side_Drop.inp		stress_side_hac.txt
RT100_NCT_Side_Drop.inp		stress_side_nct.txt
RT100_Thermal_Condition1.inp	thermcase1.mac	stress_end_nct_tc1.txt
		stress_side_nct_tc1.txt
RT100_Thermal_Condition3.inp	thermcase3.mac	stress_end_nct_tc3.txt
		stress_side_nct_tc3.txt

10/6/2012	2:11	PM	160,299,963	RT100_HAC_End_Drop.inp
10/6/2012	7:20	AM	157,421,184	RT100_HAC_Pressure.inp
10/5/2012	3:09	PM	157,708,639	RT100_HAC_Side_Drop.inp
10/6/2012	2:33	PM	160,299,745	RT100_NCT_End_Drop.inp
10/5/2012	6:53	PM	157,708,630	RT100_NCT_Side_Drop.inp
10/7/2012	7:11	AM	157,422,327	RT100_Thermal_Condition1.inp
10/7/2012	7:12	AM	157,422,327	RT100_Thermal_Condition3.inp
9/30/2012	2:55	PM	19,898	stress_end_hac.txt
10/6/2012	2:38	PM	19,780	stress_end_nct.txt
10/6/2012	7:36	PM	19,780	stress_end_nct_tc1.txt
10/6/2012	6:27	PM	19,780	stress_end_nct_tc3.txt
10/6/2012	7:25	AM	19,780	stress_pressure_hac.txt
10/5/2012	3:23	PM	18,735	stress_side_hac.txt
10/5/2012	6:56	PM	18,615	stress_side_nct.txt
10/6/2012	7:33	PM	19,780	stress_side_nct_tc1.txt
10/6/2012	6:26	PM	19,780	stress_side_nct_tc3.txt
9/30/2012	1:57	AM	30,293,622	thermcase1.mac
9/30/2012	8:43	PM	30,292,374	thermcase3.mac

APPENDIX 3—Output File Listing

Stress_side_nct.txt

```
****************************** Section 1 ********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE = 120002     OUTSIDE NODE = 120003

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -915.5       702.9      -4198.       173.2      -237.2       1161.
     S1          S2          S3          SINT        SEQV
  724.4      -553.0      -4582.       5306.       4797.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   3.832       41.62       31.77       17.84       4.653      -8.385
C   0.000       0.000       0.000       0.000       0.000       0.000
O  -3.832      -41.62      -31.77      -17.84      -4.653       8.385
     S1          S2          S3          SINT        SEQV
I   48.81       34.09      -5.673       54.48       48.82
C   0.000       0.000       0.000       0.000       0.000
O   5.673      -34.09      -48.81       54.48       48.82

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -911.7       744.6      -4166.       191.0      -232.5       1153.
C  -915.5       702.9      -4198.       173.2      -237.2       1161.
O  -919.4       661.3      -4229.       155.3      -241.9       1170.
     S1          S2          S3          SINT        SEQV
I   768.8      -554.0      -4548.       5316.       4794.
C   724.4      -553.0      -4582.       5306.       4797.
O   680.5      -552.3      -4616.       5296.       4800.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  0.1664E-02  0.1807E-01  0.1380E-01  0.7745E-02  0.2020E-02 -0.3641E-02
C  0.3047E-09 -0.3399E-10  0.1464E-09  0.4263E-11  0.4746E-11  0.1005E-09
O -0.1664E-02 -0.1807E-01 -0.1380E-01 -0.7745E-02 -0.2020E-02  0.3641E-02
     S1          S2          S3          SINT        SEQV
I  0.2119E-01  0.1480E-01 -0.2463E-02  0.2366E-01  0.2120E-01
C  0.3536E-09  0.9769E-10 -0.3413E-10  0.3877E-09  0.3414E-09
O  0.2463E-02 -0.1480E-01 -0.2119E-01  0.2366E-01  0.2120E-01

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -911.7       744.6      -4166.       191.0      -232.5       1153.
C  -915.5       702.9      -4198.       173.2      -237.2       1161.
O  -919.4       661.3      -4229.       155.3      -241.9       1170.
     S1          S2          S3          SINT        SEQV        TEMP
I   768.8      -554.0      -4548.       5316.       4794.       71.60
C   724.4      -553.0      -4582.       5306.       4797.
O   680.4      -552.3      -4616.       5296.       4800.       71.60


***** PATH VARIABLE SUMMARY *****

    S           PATH1
  0.0000      5316.4
 0.59043E-01  5315.3
 0.11809      5314.3
 0.17713      5313.2
 0.23617      5312.2
```

```
 0.29522      5311.1
 0.35426      5310.1
 0.41330      5309.1
 0.47235      5308.0
 0.53139      5307.0
 0.59043      5306.0
 0.64948      5305.0
 0.70852      5304.0
 0.76756      5303.0
 0.82661      5301.9
 0.88565      5300.9
 0.94469      5299.9
  1.0037      5298.9
  1.0628      5298.0
  1.1218      5297.0
  1.1809      5296.0

****************************** Section 2 *********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE = 120004     OUTSIDE NODE = 120005

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -930.0       603.2      -4297.       126.5      -258.1       1186.
     S1          S2          S3          SINT        SEQV
  620.1      -555.7      -4688.       5308.       4829.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   5.231       13.05       20.29       7.511       5.722      -4.330
C   0.000       0.000       0.000       0.000       0.000       0.000
O  -5.231      -13.05      -20.29      -7.511      -5.722       4.330
     S1          S2          S3          SINT        SEQV
I   23.44       16.54      -1.412       24.85       22.22
C   0.000       0.000       0.000       0.000       0.000
O   1.412      -16.54      -23.44       24.85       22.22

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -924.8       616.3      -4276.       134.0      -252.4       1182.
C  -930.0       603.2      -4297.       126.5      -258.1       1186.
O  -935.3       590.2      -4317.       119.0      -263.9       1190.
     S1          S2          S3          SINT        SEQV
I   633.5      -552.3      -4666.       5300.       4817.
C   620.1      -555.7      -4688.       5308.       4829.
O   606.8      -559.3      -4710.       5316.       4840.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  0.2271E-02  0.5667E-02  0.8808E-02  0.3261E-02  0.2485E-02 -0.1880E-02
C -0.4547E-12  0.1398E-10  0.2183E-10  0.8271E-11  0.6310E-11 -0.9322E-11
O -0.2271E-02 -0.5667E-02 -0.8808E-02 -0.3261E-02 -0.2485E-02  0.1880E-02
     S1          S2          S3          SINT        SEQV
I  0.1018E-01  0.7182E-02 -0.6132E-03  0.1079E-01  0.9649E-02
C  0.2628E-10  0.1739E-10 -0.8318E-11  0.3460E-10  0.3112E-10
O  0.6132E-03 -0.7182E-02 -0.1018E-01  0.1079E-01  0.9649E-02

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -924.8       616.3      -4276.       134.0      -252.4       1182.
C  -930.0       603.2      -4297.       126.5      -258.1       1186.
O  -935.3       590.2      -4317.       119.0      -263.9       1190.
```

```
     S1          S2          S3          SINT        SEQV        TEMP
I   633.5       -552.3      -4666.       5300.       4817.       71.60
C   620.1       -555.7      -4688.       5308.       4829.
O   606.8       -559.3      -4710.       5316.       4840.       71.60


***** PATH VARIABLE SUMMARY *****

    S           PATH2
  0.0000       5299.6
 0.29550E-01   5300.4
 0.59100E-01   5301.2
 0.88650E-01   5302.0
 0.11820       5302.9
 0.14775       5303.7
 0.17730       5304.5
 0.20685       5305.4
 0.23640       5306.2
 0.26595       5307.0
 0.29550       5307.9
 0.32505       5308.7
 0.35460       5309.5
 0.38415       5310.4
 0.41370       5311.2
 0.44325       5312.1
 0.47280       5312.9
 0.50235       5313.7
 0.53190       5314.6
 0.56145       5315.4
 0.59100       5316.3

****************************** Section 3 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE = 120006     OUTSIDE NODE = 120007

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -951.9       578.7      -4370.       100.1      -283.7       1201.
     S1          S2          S3          SINT        SEQV
  595.7       -572.2      -4766.       5362.       4884.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   5.628      -0.7629      16.56       6.912       7.209      -3.304
C   0.000        0.000       0.000       0.000       0.000       0.000
O  -5.628       0.7629      -16.56      -6.912      -7.209       3.304
     S1          S2          S3          SINT        SEQV
I   19.22        9.934      -7.729       26.95       23.71
C   0.000        0.000       0.000       0.000       0.000
O   7.729       -9.934      -19.22       26.95       23.71

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -946.3       577.9      -4353.       107.0      -276.5       1198.
C  -951.9       578.7      -4370.       100.1      -283.7       1201.
O  -957.5       579.5      -4386.       93.16      -290.9       1204.
     S1          S2          S3          SINT        SEQV
I   594.7       -567.7      -4749.       5343.       4867.
C   595.7       -572.2      -4766.       5362.       4884.
O   596.9       -576.8      -4784.       5381.       4901.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
```

```
     SX          SY          SZ          SXY         SYZ         SXZ
I  0.2444E-02 -0.3313E-03  0.7191E-02  0.3001E-02  0.3130E-02 -0.1435E-02
C -0.5883E-08 -0.2357E-08 -0.2605E-08 -0.1363E-09  0.9027E-10 -0.2815E-08
O -0.2444E-02  0.3313E-03 -0.7191E-02 -0.3001E-02 -0.3130E-02  0.1435E-02
     S1          S2          S3          SINT        SEQV
I  0.8346E-02  0.4314E-02 -0.3356E-02  0.1170E-01  0.1030E-01
C -0.9713E-09 -0.2371E-08 -0.7502E-08  0.6531E-08  0.5956E-08
O  0.3356E-02 -0.4314E-02 -0.8346E-02  0.1170E-01  0.1030E-01

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -946.3       577.9      -4353.       107.0      -276.4       1198.
C  -951.9       578.7      -4370.       100.1      -283.7       1201.
O  -957.5       579.5      -4386.       93.16      -290.9       1204.
     S1          S2          S3          SINT        SEQV        TEMP
I   594.7      -567.7      -4749.       5343.       4867.       71.60
C   595.7      -572.2      -4766.       5362.       4884.
O   596.9      -576.8      -4784.       5381.       4901.       71.60


***** PATH VARIABLE SUMMARY *****

    S           PATH3
  0.0000      5343.2
 0.12808      5345.1
 0.25616      5347.0
 0.38424      5348.9
 0.51232      5350.8
 0.64040      5352.7
 0.76848      5354.6
 0.89656      5356.5
  1.0246      5358.4
  1.1527      5360.3
  1.2808      5362.2
  1.4089      5364.1
  1.5370      5366.0
  1.6650      5367.9
  1.7931      5369.8
  1.9212      5371.7
  2.0493      5373.6
  2.1773      5375.5
  2.3054      5377.5
  2.4335      5379.4
  2.5616      5381.3

******************************** Section 4 **********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE = 120008     OUTSIDE NODE = 120009

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -280.3       2649.      -2425.      -199.2       133.7       763.3
     S1          S2          S3          SINT        SEQV
  2663.      -44.59      -2675.       5339.       4624.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   1527.       4572.       3889.      -594.8       873.8      -764.0
C   0.000       0.000       0.000       0.000       0.000       0.000
O  -1527.      -4572.      -3889.       594.8      -873.8       764.0
     S1          S2          S3          SINT        SEQV
I   5391.       3331.       1266.       4125.       3572.
```

```
C   0.000       0.000       0.000       0.000       0.000
O  -1266.      -3331.      -5391.       4125.       3572.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   1247.       7221.       1464.      -794.0       1008.     -0.6717
C  -280.3       2649.      -2425.      -199.2       133.7       763.3
O  -1808.      -1923.      -6314.       395.6      -740.2       1527.
     S1          S2          S3          SINT        SEQV
I   7490.       1371.       1071.       6419.       6275.
C   2663.      -44.59      -2675.       5339.       4624.
O  -1288.      -1838.      -6919.       5630.       5377.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -3456.       1934.      -1665.       432.0      -539.2       320.1
C  -704.1      -2025.      -2006.       251.9      -453.7       446.0
O   811.1       2571.       1869.      -361.6       408.7      -317.6
     S1          S2          S3          SINT        SEQV
I   2040.      -1665.      -3562.       5602.       4935.
C  -557.3      -1579.      -2598.       2041.       1768.
O   2863.       1699.       689.3       2174.       1884.

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -2209.       9155.      -201.0      -362.0       468.4       319.4
C  -984.5       623.6      -4431.       52.73      -320.0       1209.
O  -996.4       647.4      -4445.       34.02      -331.4       1210.
     S1          S2          S3          SINT        SEQV        TEMP
I   9189.      -169.0      -2275.      0.1146E+05  0.1057E+05   71.60
C   644.2      -604.1      -4832.       5476.       4971.
O   670.3      -617.9      -4846.       5517.       4999.       71.60


***** PATH VARIABLE SUMMARY *****

    S           PATH4
  0.0000      11464.
 0.26719      12191.
 0.53438      9217.5
 0.80157      6620.5
  1.0688      6533.1
  1.3360      4504.5
  1.6031      2574.9
  1.8703      2058.4
  2.1375      5467.9
  2.4047      5471.9
  2.6719      5476.0
  2.9391      5480.0
  3.2063      5484.1
  3.4735      5488.1
  3.7407      5492.1
  4.0079      5496.2
  4.2750      5500.3
  4.5422      5504.3
  4.8094      5508.4
  5.0766      5512.5
  5.3438      5516.6

******************************** Section 5 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE = 120010     OUTSIDE NODE = 120011

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.
```

```
             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -397.1      -7828.      -622.0       557.5       1699.      -186.8
     S1          S2          S3          SINT        SEQV
 -215.2      -379.8      -8252.       8037.       7956.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -976.1       -9090.      -2182.       74.84       1368.      -1023.
C   0.000        0.000       0.000       0.000       0.000       0.000
O   976.1        9090.       2182.      -74.84      -1368.       1023.
     S1          S2          S3          SINT        SEQV
I  -345.3       -2543.      -9360.       9014.       8141.
C   0.000        0.000       0.000       0.000       0.000
O   9360.        2543.       345.3       9014.       8141.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -1373.     -0.1692E+05  -2804.       632.3       3068.      -1210.
C  -397.1       -7828.      -622.0       557.5       1699.      -186.8
O   579.1        1262.       1559.       482.6       330.9       836.0
     S1          S2          S3          SINT        SEQV
I  -611.9       -2881.     -0.1760E+05  0.1699E+05  0.1598E+05
C  -215.2       -379.8      -8252.       8037.       7956.
O   2311.        1049.       40.47       2270.       1970.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   2958.       -3652.      -3001.       1954.      -1294.       1729.
C   143.2        2283.       604.6      -63.81      -243.6       234.9
O   108.3       -3191.      -937.3       37.94       547.3      -265.7
     S1          S2          S3          SINT        SEQV
I   3767.       -1995.      -5467.       9234.       8078.
C   2322.        664.8       44.10       2278.       2039.
O   174.5       -875.0      -3320.       3494.       3106.

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   1585.     -0.2057E+05  -5805.       2586.       1773.       519.3
C  -253.9       -5545.      -17.42       493.6       1456.       48.06
O   687.4       -1929.       622.2       520.6       878.2       570.3
     S1          S2          S3          SINT        SEQV        TEMP
I   1950.       -5682.     -0.2106E+05  0.2301E+05  0.2030E+05   71.60
C   387.4       -260.3      -5943.       6331.       6033.
O   1511.        110.7      -2241.       3751.       3284.       71.60


***** PATH VARIABLE SUMMARY *****

    S           PATH5
  0.0000       23008.
 0.78740E-01   19097.
 0.15748       17184.
 0.23622       15379.
 0.31496       13692.
 0.39370       12150.
 0.47244       10809.
 0.55118       9548.2
 0.62992       8326.4
 0.70866       7148.2
 0.78740       6330.8
 0.86614       5849.9
 0.94488       5369.4
  1.0236       4889.9
  1.1024       4411.9
  1.1811       4051.0
  1.2598       3963.6
```

```
  1.3386      3892.4
  1.4173      3835.2
  1.4961      3789.1
  1.5748      3751.5

PRINT ITERATION SUMMARY

          **** POST1 ITERATION SUMMARY ****

LOAD STEP    6  SUBSTEP    1        CUMULATIVE ITERATION   12
TIME =    6.00000               TIME INCREMENT =    1.00000
 NUMBER OF EQUILIBRIUM ITERATIONS =          3
 CONVERGENCE INDICATOR = 1
 MAXIMUM DEGREE OF FREEDOM VALUE =  -0.453256E-01
 RESPONSE FREQUENCY FOR 2ND ORDER SYSTEMS =    0.00000
 DESCENT PARAMETER =    0.00000
 FORCE CONVERGENCE VALUE =    8922.31
 MOMENT CONVERGENCE VALUE =    0.00000
 DISPLACEMENT CONVERGENCE VALUE =    0.00000
 ROTATION CONVERGENCE VALUE =    0.00000


NUMBER OF WARNING MESSAGES ENCOUNTERED=        163
NUMBER OF ERROR   MESSAGES ENCOUNTERED=          0
```

Stress_end_nct.txt

```
****************************** Section 1 ********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE =1000000     OUTSIDE NODE =1000001

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  269.8       -1129.       281.3       -111.4       4.012      -106.3
     S1          S2          S3          SINT        SEQV
  386.3        173.7       -1138.       1525.       1430.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   95.14       -603.6       9.160      -139.6      -5.593       90.05
C   0.000        0.000       0.000       0.000       0.000       0.000
O  -95.14        603.6      -9.160       139.6       5.593      -90.05
     S1          S2          S3          SINT        SEQV
I   171.4       -40.04      -630.6       802.0       720.0
C   0.000        0.000       0.000       0.000       0.000
O   630.6        40.04      -171.4       802.0       720.0

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   365.0       -1733.       290.5      -251.0      -1.581      -16.24
C   269.8       -1129.       281.3      -111.4       4.012      -106.3
O   174.7       -525.9       272.2       28.21       9.606      -196.3
     S1          S2          S3          SINT        SEQV
I   397.0        288.1      -1763.       2160.       2107.
C   386.3        173.7      -1138.       1525.       1430.
O   425.8        22.56      -527.4       953.2       828.8

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   98.10        171.9       74.12      -51.19       34.49       3.067
C  -41.25       -69.91      -30.89       20.24      -9.194      -2.841
O  -451.1       -904.3      -534.5      -27.96      -9.032       464.2
     S1          S2          S3          SINT        SEQV
I   204.8        87.77       51.55       153.3       138.8
C  -23.67       -37.06      -81.33       57.66       52.27
O  -25.90       -902.4      -961.5       935.6       907.5

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   463.1       -1561.       364.6      -302.2       32.91      -13.17
C   228.6       -1199.       250.4      -91.15      -5.181      -109.1
O  -276.4       -1430.      -262.3      0.2459      0.5737       267.9
     S1          S2          S3          SINT        SEQV        TEMP
I   509.4        362.9      -1606.       2115.       2046.       0.000
C   351.3        133.6      -1205.       1557.       1460.
O  -1.411       -537.4      -1430.       1429.       1250.       0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH1
  0.0000       2115.1
 0.59043E-01   2054.0
 0.11809       1995.5
 0.17713       1940.1
 0.23617       1888.4
```

```
 0.29522      1840.4
 0.35426      1795.9
 0.41330      1746.5
 0.47235      1682.9
 0.53139      1619.6
 0.59043      1556.6
 0.64948      1493.7
 0.70852      1430.9
 0.76756      1368.4
 0.82661      1301.7
 0.88565      1233.1
 0.94469      1164.6
  1.0037      1096.1
  1.0628      1027.8
  1.1218      959.64
  1.1809      1428.7

****************************** Section 2 *********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE =1000002     OUTSIDE NODE =1000003

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  60.94       -460.8       724.7       -17.22       166.8      -424.0
     S1          S2          S3          SINT        SEQV
  948.9       -136.1      -487.9        1437.       1297.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -210.4        829.1      -105.2       -153.0       201.1      -66.31
C   0.000        0.000       0.000       0.000        0.000       0.000
O   210.4       -829.1       105.2       153.0       -201.1       66.31
     S1          S2          S3          SINT        SEQV
I   894.7       -135.3      -245.9       1141.       1090.
C   0.000        0.000       0.000       0.000       0.000
O   245.9        135.3      -894.7       1141.       1090.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -149.4        368.4       619.5       -170.3       367.9      -490.3
C   60.94       -460.8       724.7       -17.22       166.8      -424.0
O   271.3       -1290.       829.9        135.8       -34.30     -357.7
     S1          S2          S3          SINT        SEQV
I   1087.        139.8      -388.1       1475.       1294.
C   948.9       -136.1      -487.9       1437.       1297.
O   1008.        105.0      -1302.       2310.       2016.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   820.6       -2389.       143.2       41.37      -269.7       231.8
C  -27.25       0.9971      -28.16       11.18       30.52      -13.61
O   22.92       -37.58       31.80      -30.60      -27.77       8.311
     S1          S2          S3          SINT        SEQV
I   892.9        100.7      -2418.       3311.       2995.
C   20.35       -17.25      -57.52       77.87       67.45
O   54.52        18.93      -56.31       110.8       98.01

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   671.2       -2020.       762.7       -128.9       98.21      -258.5
C   33.69       -459.8       696.5       -6.042       197.3      -437.6
O   294.2       -1327.       861.7        105.2      -62.08      -349.4
```

```
     S1          S2          S3          SINT        SEQV        TEMP
I   987.8        455.0       -2029.      3017.       2789.       0.000
C   937.2       -163.0       -503.7      1441.       1304.
O   1032.        131.1       -1335.      2367.       2070.       0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH2
  0.0000       3016.8
 0.59046E-01   1395.5
 0.11809       1365.2
 0.17714       1340.9
 0.23619       1322.6
 0.29523       1312.2
 0.35428       1316.8
 0.41332       1332.4
 0.47237       1344.2
 0.53142       1384.5
 0.59046       1440.9
 0.64951       1507.1
 0.70856       1580.4
 0.76760       1659.3
 0.82665       1751.4
 0.88569       1850.6
 0.94474       1951.5
  1.0038       2053.9
  1.0628       2157.4
  1.1219       2262.0
  1.1809       2367.4

****************************** Section 3 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE =1000004     OUTSIDE NODE =1000005

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
   704.6       -1641.       217.0       557.4       -145.4      147.4
     S1          S2          S3          SINT        SEQV
   850.4        212.2       -1782.      2632.       2378.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -1104.       -820.5      -652.4      -1433.      407.3       150.9
C   0.000        0.000       0.000       0.000       0.000       0.000
O   1104.        820.5       652.4       1433.      -407.3      -150.9
     S1          S2          S3          SINT        SEQV
I   514.0       -606.8      -2484.      2998.       2624.
C   0.000        0.000       0.000       0.000       0.000
O   2484.        606.8       -514.0      2998.       2624.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -399.6       -2461.      -435.4      -875.9      262.0       298.3
C   704.6       -1641.       217.0       557.4      -145.4       147.4
O   1809.       -820.3       869.5       1991.      -552.7      -3.537
     S1          S2          S3          SINT        SEQV
I   11.50       -473.6      -2834.      2846.       2637.
C   850.4        212.2       -1782.      2632.       2378.
O   2915.        917.5       -1974.      4889.       4258.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
```

```
     SX          SY          SZ          SXY         SYZ         SXZ
I   218.1      0.1255E+05   1024.       439.2       20.36       288.9
C  -275.4      -486.9      -213.2      -350.5       208.8       108.8
O   3402.       8511.       3987.       3039.      -1471.      -366.1
     S1          S2          S3          SINT        SEQV
I  0.1256E+05   1115.       111.5      0.1245E+05  0.1198E+05
C  -4.898      -136.1      -834.5       829.6       772.4
O  0.1028E+05   3682.       1939.       8339.       7619.

            ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -181.5      0.1009E+05   588.6      -436.7       282.3       587.3
C   429.2      -2128.       3.850       206.9       63.41       256.2
O   5210.       7691.       4857.       5029.      -2024.      -369.6
     S1          S2          S3          SINT        SEQV        TEMP
I  0.1011E+05   905.6      -524.0      0.1064E+05   9998.       0.000
C   566.6      -116.0      -2145.       2712.       2443.
O  0.1209E+05   4652.       1011.      0.1108E+05   9784.       0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH3
  0.0000      10636.
 0.96458E-01  2435.8
 0.19292      2397.4
 0.28937      2363.1
 0.38583      2332.9
 0.48229      2307.1
 0.57875      2285.5
 0.67520      2342.3
 0.77166      2450.3
 0.86812      2572.4
 0.96458      2711.8
  1.0610      3004.8
  1.1575      3599.8
  1.2540      4247.8
  1.3504      4568.2
  1.4469      4903.6
  1.5433      5262.6
  1.6398      5655.7
  1.7362      5841.6
  1.8327      8151.6
  1.9292      11082.

******************************** Section 4 **********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE =1000006     OUTSIDE NODE =1000007

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

            ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -346.2      -2026.      -459.8      -392.9       48.63      -198.0
     S1          S2          S3          SINT        SEQV
 -132.1      -586.5      -2113.       1981.       1798.

            ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -1322.      -5505.      -1554.      -349.6      -191.5      -467.4
C   0.000       0.000       0.000       0.000       0.000       0.000
O   1322.       5505.       1554.       349.6       191.5       467.4
     S1          S2          S3          SINT        SEQV
I  -950.9      -1883.      -5547.       4597.       4209.
```

```
C   0.000       0.000       0.000       0.000       0.000
O   5547.       1883.       950.9       4597.       4209.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -1668.      -7531.      -2014.      -742.5      -142.9      -665.3
C  -346.2      -2026.      -459.8      -392.9       48.63      -198.0
O   975.7       3479.       1094.      -43.26       240.2       269.4
     S1          S2          S3          SINT        SEQV
I  -1113.      -2467.      -7633.       6520.       5959.
C  -132.1      -586.5      -2113.       1981.       1798.
O   3503.       1300.       746.6       2756.       2526.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   2125.      0.1900E+05   2625.       1332.       382.1       301.0
C   163.8       2064.       335.9       124.2       49.12       276.9
O  -620.6      -3511.      -785.9       1.010      -222.0      -285.9
     S1          S2          S3          SINT        SEQV
I  0.1911E+05   2719.       1916.      0.1719E+05  0.1681E+05
C   2075.       531.5      -42.50       2118.       1897.
O  -399.7      -988.7      -3529.       3130.       2881.

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   456.8      0.1147E+05   610.9       589.3       239.2      -364.4
C  -182.3       38.29      -123.9      -268.7       97.76       78.93
O   355.1      -32.22       308.6      -42.25       18.16      -16.56
     S1          S2          S3          SINT        SEQV        TEMP
I  0.1150E+05   903.2       128.7      0.1137E+05  0.1101E+05   0.000
C   222.7      -77.99      -412.7       635.4       550.5
O   365.6       303.3      -37.55       403.2       375.9       0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH4
  0.0000      11373.
 0.25197      18223.
 0.50394      11262.
 0.75591      5756.5
  1.0079      3204.7
  1.2599      2617.9
  1.5118      2241.7
  1.7638      1841.2
  2.0158      1378.7
  2.2677      960.51
  2.5197      635.41
  2.7717      469.91
  3.0236      434.54
  3.2756      395.19
  3.5276      390.35
  3.7796      373.10
  4.0315      364.79
  4.2835      355.53
  4.5355      359.58
  4.7874      378.90
  5.0394      403.19

******************************** Section 5 **********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE =1000008     OUTSIDE NODE =1000009

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.
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```
             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  529.2       -4935.      -248.3       682.3      -809.3      -353.7
     S1          S2          S3          SINT        SEQV
  821.5       -337.7      -5138.       5960.       5473.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -2090.       -4300.      -1207.       85.90      -1256.       500.7
C   0.000        0.000       0.000       0.000       0.000       0.000
O   2090.        4300.       1207.      -85.90       1256.      -500.7
     S1          S2          S3          SINT        SEQV
I  -625.9       -2202.      -4770.       4144.       3623.
C   0.000        0.000       0.000       0.000       0.000
O   4770.        2202.       625.9       4144.       3623.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -1561.       -9236.      -1456.       768.1      -2066.       147.0
C   529.2       -4935.      -248.3       682.3      -809.3      -353.7
O   2619.       -634.7       959.1       596.4       447.0      -854.4
     S1          S2          S3          SINT        SEQV
I  -937.9       -1490.      -9824.       8886.       8623.
C   821.5       -337.7      -5138.       5960.       5473.
O   3021.        863.0      -940.2       3961.       3435.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -1663.       -5066.      -1619.      -155.6      -213.0       140.9
C   326.9        1475.       310.9       140.9       283.5       84.74
O  -701.3       -2207.      -248.7      -224.0      -529.6       68.67
     S1          S2          S3          SINT        SEQV
I  -1479.       -1783.      -5085.       3606.       3464.
C   1560.        335.4       217.1       1343.       1288.
O  -89.83       -702.0      -2366.       2276.       2040.

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -3224.     -0.1430E+05   -3074.       612.6      -2279.       287.9
C   856.0       -3460.       62.60       823.2      -525.8      -269.0
O   1918.       -2842.       710.4       372.3      -82.58      -785.7
     S1          S2          S3          SINT        SEQV        TEMP
I  -2584.       -3232.     -0.1478E+05  0.1220E+05  0.1189E+05   0.000
C   1134.       -4.468       -3671.       4805.       4349.
O   2331.        325.7       -2871.       5203.       4545.       0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH5
  0.0000       12199.
 0.78740E-01   11130.
 0.15748       9642.5
 0.23622       8329.0
 0.31496       7322.8
 0.39370       6569.9
 0.47244       6252.2
 0.55118       5865.0
 0.62992       5478.9
 0.70866       5094.5
 0.78740       4805.1
 0.86614       4781.9
 0.94488       4762.6
  1.0236       4747.3
  1.1024       4736.4
  1.1811       4750.7
  1.2598       4831.9
```

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  1.3386      4917.8
  1.4173      5008.4
  1.4961      5103.4
  1.5748      5202.6

PRINT ITERATION SUMMARY

          **** POST1 ITERATION SUMMARY ****

LOAD STEP    6  SUBSTEP    1        CUMULATIVE ITERATION   14
TIME =    6.00000               TIME INCREMENT =    1.00000
 NUMBER OF EQUILIBRIUM ITERATIONS =          5
 CONVERGENCE INDICATOR = 1
 MAXIMUM DEGREE OF FREEDOM VALUE =  -0.226573E-01
 RESPONSE FREQUENCY FOR 2ND ORDER SYSTEMS =    0.00000
 DESCENT PARAMETER =    0.00000
 FORCE CONVERGENCE VALUE =    9747.97
 MOMENT CONVERGENCE VALUE =    0.00000
 DISPLACEMENT CONVERGENCE VALUE =    0.00000
 ROTATION CONVERGENCE VALUE =    0.00000


NUMBER OF WARNING MESSAGES ENCOUNTERED=        166
NUMBER OF ERROR   MESSAGES ENCOUNTERED=          0
```

Stress_side_hac.txt

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******************************** Section 1 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE = 120002     OUTSIDE NODE = 120003

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -3714.       2679.     -0.1855E+05   674.2      -1248.       5369.
     S1          S2          S3          SINT        SEQV
  2777.       -1989.     -0.2037E+05  0.2315E+05  0.2117E+05

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -14.20       114.0       98.53       42.97       12.01      -41.66
C   0.000       0.000       0.000       0.000       0.000       0.000
O   14.20      -114.0      -98.53      -42.97      -12.01       41.66
     S1          S2          S3          SINT        SEQV
I   127.1       112.0      -40.77       167.8       160.8
C   0.000       0.000       0.000       0.000       0.000
O   40.77      -112.0      -127.1       167.8       160.8

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -3728.       2793.     -0.1845E+05   717.2      -1236.       5327.
C  -3714.       2679.     -0.1855E+05   674.2      -1248.       5369.
O  -3699.       2565.     -0.1865E+05   631.2      -1260.       5410.
     S1          S2          S3          SINT        SEQV
I   2896.      -2021.     -0.2026E+05  0.2316E+05  0.2113E+05
C   2777.      -1989.     -0.2037E+05  0.2315E+05  0.2117E+05
O   2659.      -1957.     -0.2049E+05  0.2315E+05  0.2122E+05

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I -0.6165E-02  0.4948E-01  0.4279E-01  0.1866E-01  0.5215E-02 -0.1809E-01
C  0.2242E-08  0.4159E-08  0.4246E-08  0.1559E-08  0.4320E-09  0.9095E-10
O  0.6165E-02 -0.4948E-01 -0.4279E-01 -0.1866E-01 -0.5215E-02  0.1809E-01
     S1          S2          S3          SINT        SEQV
I  0.5517E-01  0.4863E-01 -0.1770E-01  0.7287E-01  0.6983E-01
C  0.5215E-08  0.4068E-08  0.1364E-08  0.3851E-08  0.3425E-08
O  0.1770E-01 -0.4863E-01 -0.5517E-01  0.7287E-01  0.6983E-01

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -3728.       2793.     -0.1845E+05   717.2      -1236.       5327.
C  -3714.       2679.     -0.1855E+05   674.2      -1248.       5369.
O  -3699.       2565.     -0.1865E+05   631.2      -1260.       5410.
     S1          S2          S3          SINT        SEQV        TEMP
I   2896.      -2021.     -0.2026E+05  0.2316E+05  0.2113E+05   71.60
C   2777.      -1989.     -0.2037E+05  0.2315E+05  0.2117E+05
O   2659.      -1957.     -0.2049E+05  0.2315E+05  0.2122E+05   71.60


***** PATH VARIABLE SUMMARY *****

    S           PATH1
  0.0000      23158.
 0.12607      23158.
 0.25214      23157.
 0.37821      23156.
 0.50429      23156.
```

```
 0.63036      23155.
 0.75643      23154.
 0.88250      23154.
  1.0086      23153.
  1.1346      23152.
  1.2607      23152.
  1.3868      23151.
  1.5129      23150.
  1.6389      23150.
  1.7650      23149.
  1.8911      23149.
  2.0171      23148.
  2.1432      23147.
  2.2693      23147.
  2.3954      23146.
  2.5214      23145.

****************************** Section 2 *********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE = 120004     OUTSIDE NODE = 120005

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX           SY           SZ          SXY          SYZ         SXZ
-0.1523E+05 -0.1554E+05 -0.1933E+05  0.1250E+05   5113.       173.2
     S1           S2           S3          SINT         SEQV
 -2062.     -0.1883E+05 -0.2921E+05  0.2714E+05  0.2372E+05

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX           SY           SZ          SXY          SYZ         SXZ
I -0.1986E+05 -0.2168E+05 -0.1067E+05  0.1375E+05   7085.      -9530.
C   0.000        0.000        0.000       0.000       0.000       0.000
O  0.1986E+05  0.2168E+05  0.1067E+05 -0.1375E+05  -7085.       9530.
     S1           S2           S3          SINT         SEQV
I  -4405.       -8466.      -0.3933E+05  0.3493E+05  0.3309E+05
C   0.000        0.000        0.000       0.000       0.000
O  0.3933E+05   8466.        4405.       0.3493E+05  0.3309E+05

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX           SY           SZ          SXY          SYZ         SXZ
I -0.3509E+05 -0.3722E+05 -0.3000E+05  0.2625E+05  0.1220E+05  -9357.
C -0.1523E+05 -0.1554E+05 -0.1933E+05  0.1250E+05   5113.       173.2
O   4630.        6142.       -8669.      -1249.      -1972.       9703.
     S1           S2           S3          SINT         SEQV
I  -9703.      -0.2411E+05 -0.6849E+05  0.5879E+05  0.5308E+05
C  -2062.      -0.1883E+05 -0.2921E+05  0.2714E+05  0.2372E+05
O  0.1066E+05   5292.      -0.1385E+05  0.2451E+05  0.2232E+05

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX           SY           SZ          SXY          SYZ         SXZ
I  0.3143E+05  0.3966E+05  0.1120E+05 -0.2567E+05 -0.1349E+05  0.1483E+05
C   7225.        2991.        8717.      -729.0       -228.4       4972.
O  -8273.       -3763.      -0.1027E+05   1788.        633.6      -4173.
     S1           S2           S3          SINT         SEQV
I  0.6846E+05  0.1047E+05   3359.       0.6510E+05  0.6186E+05
C  0.1304E+05   3349.        2544.       0.1050E+05  0.1012E+05
O  -3002.       -5484.      -0.1382E+05  0.1082E+05   9818.

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX           SY           SZ          SXY          SYZ         SXZ
I  -3662.        2444.      -0.1880E+05   580.4       -1295.       5476.
C  -8006.      -0.1255E+05 -0.1062E+05  0.1177E+05   4885.       5145.
O  -3643.        2379.      -0.1894E+05   539.0       -1338.       5530.
```

```
     S1          S2          S3          SINT        SEQV        TEMP
I   2536.       -1894.     -0.2066E+05  0.2320E+05  0.2133E+05   71.60
C   4934.     -0.1381E+05 -0.2229E+05  0.2722E+05  0.2413E+05
O   2470.       -1855.     -0.2082E+05  0.2329E+05  0.2146E+05   71.60


***** PATH VARIABLE SUMMARY *****

    S           PATH2
  0.0000      23198.
 0.61507E-01  62567.
 0.12301      57531.
 0.18452      52742.
 0.24603      48192.
 0.30754      43884.
 0.36904      39832.
 0.43055      36068.
 0.49206      32645.
 0.55356      29649.
 0.61507      27221.
 0.67658      25123.
 0.73809      22983.
 0.79959      20807.
 0.86110      18599.
 0.92261      16395.
 0.98411      14382.
  1.0456      23277.
  1.1071      23282.
  1.1686      23287.
  1.2301      23291.

****************************** Section 3 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE = 120006     OUTSIDE NODE = 120007

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -3625.       2384.     -0.1913E+05   466.1      -1420.       5603.
     S1          S2          S3          SINT        SEQV
  2479.       -1813.     -0.2104E+05  0.2352E+05  0.2169E+05

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -3.704      -20.91       60.55       30.45       30.81      -22.76
C   0.000       0.000       0.000       0.000       0.000       0.000
O   3.704       20.91      -60.55      -30.45      -30.81       22.76
     S1          S2          S3          SINT        SEQV
I   73.08       19.33      -56.48       129.6       112.7
C   0.000       0.000       0.000       0.000       0.000
O   56.48      -19.33      -73.08       129.6       112.7

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -3629.       2363.     -0.1907E+05   496.6      -1389.       5580.
C  -3625.       2384.     -0.1913E+05   466.1      -1420.       5603.
O  -3621.       2405.     -0.1919E+05   435.7      -1450.       5626.
     S1          S2          S3          SINT        SEQV
I   2456.      -1824.     -0.2097E+05  0.2343E+05  0.2161E+05
C   2479.      -1813.     -0.2104E+05  0.2352E+05  0.2169E+05
O   2502.      -1802.     -0.2111E+05  0.2361E+05  0.2178E+05

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
```

```
     SX          SY          SZ          SXY         SYZ         SXZ
I -0.1608E-02 -0.9080E-02  0.2629E-01  0.1322E-01  0.1338E-01 -0.9881E-02
C -0.1637E-07 -0.6579E-08 -0.8611E-08 -0.8133E-09  0.4891E-09 -0.1036E-07
O  0.1608E-02  0.9080E-02 -0.2629E-01 -0.1322E-01 -0.1338E-01  0.9881E-02
     S1          S2          S3          SINT        SEQV
I  0.3173E-01  0.8394E-02 -0.2453E-01  0.5626E-01  0.4896E-01
C -0.1289E-08 -0.6712E-08 -0.2356E-07  0.2227E-07  0.2012E-07
O  0.2453E-01 -0.8394E-02 -0.3173E-01  0.5626E-01  0.4896E-01

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -3629.       2363.     -0.1907E+05   496.6      -1389.       5580.
C  -3625.       2384.     -0.1913E+05   466.1      -1420.       5603.
O  -3621.       2405.     -0.1919E+05   435.7      -1450.       5626.
     S1          S2          S3          SINT        SEQV        TEMP
I   2456.      -1824.     -0.2097E+05  0.2343E+05  0.2161E+05   71.60
C   2479.      -1813.     -0.2104E+05  0.2352E+05  0.2169E+05
O   2502.      -1802.     -0.2111E+05  0.2361E+05  0.2178E+05   71.60


***** PATH VARIABLE SUMMARY *****

    S           PATH3
  0.0000      23426.
 0.12808      23435.
 0.25616      23444.
 0.38424      23454.
 0.51232      23463.
 0.64040      23472.
 0.76848      23481.
 0.89656      23491.
  1.0246      23500.
  1.1527      23509.
  1.2808      23519.
  1.4089      23528.
  1.5370      23537.
  1.6650      23546.
  1.7931      23556.
  1.9212      23565.
  2.0493      23574.
  2.1773      23584.
  2.3054      23593.
  2.4335      23603.
  2.5616      23612.

******************************** Section 4 **********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE = 120008     OUTSIDE NODE = 120009

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -1341.      0.1374E+05 -0.1372E+05  -1010.      -830.0       4548.
     S1          S2          S3          SINT        SEQV
 0.1386E+05   41.42     -0.1522E+05  0.2908E+05  0.2520E+05

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   6246.       0.2772E+05  0.1344E+05  -3284.       1348.      -2612.
C   0.000        0.000       0.000       0.000       0.000       0.000
O  -6246.      -0.2772E+05 -0.1344E+05   3284.      -1348.       2612.
     S1          S2          S3          SINT        SEQV
I  0.2841E+05  0.1392E+05   5065.      0.2334E+05  0.2041E+05
```

```
C   0.000       0.000       0.000       0.000       0.000
O  -5065.     -0.1392E+05 -0.2841E+05  0.2334E+05  0.2041E+05

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   4905.      0.4146E+05  -289.6      -4294.       517.6       1936.
C  -1341.      0.1374E+05 -0.1372E+05  -1010.      -830.0       4548.
O  -7587.     -0.1397E+05 -0.2716E+05   2274.      -2178.       7160.
     S1          S2          S3          SINT        SEQV
I  0.4196E+05   5132.       -1016.      0.4297E+05  0.4025E+05
C  0.1386E+05   41.42      -0.1522E+05  0.2908E+05  0.2520E+05
O  -4993.     -0.1374E+05 -0.2998E+05  0.2499E+05  0.2196E+05

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -8536.     -0.3893E+05 -0.1901E+05   4627.      -2046.       3726.
C  -2311.     -0.1109E+05  -5626.       1257.      -750.2       1125.
O   3914.      0.1676E+05   7762.      -2112.       546.0      -1477.
     S1          S2          S3          SINT        SEQV
I  -6887.     -0.1965E+05 -0.3994E+05  0.3305E+05  0.2887E+05
C  -1857.      -5760.     -0.1141E+05   9548.       8314.
O  0.1716E+05   8111.       3163.      0.1400E+05  0.1229E+05

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -3631.       2531.     -0.1930E+05   333.2      -1529.       5662.
C  -3652.       2657.     -0.1935E+05   247.2      -1580.       5673.
O  -3673.       2783.     -0.1940E+05   161.2      -1632.       5683.
     S1          S2          S3          SINT        SEQV        TEMP
I   2638.      -1805.     -0.2124E+05  0.2388E+05  0.2199E+05   71.60
C   2775.      -1830.     -0.2129E+05  0.2406E+05  0.2212E+05
O   2914.      -1859.     -0.2134E+05  0.2426E+05  0.2226E+05   71.60


***** PATH VARIABLE SUMMARY *****

    S           PATH4
  0.0000      23875.
 0.34037     0.10089E+06
 0.68075      55155.
  1.0211      38595.
  1.3615      25835.
  1.7019      23969.
  2.0422      23988.
  2.3826      24007.
  2.7230      24026.
  3.0634      24045.
  3.4037      24064.
  3.7441      24084.
  4.0845      24103.
  4.4249      24122.
  4.7652      24141.
  5.1056      24160.
  5.4460      24180.
  5.7864      24199.
  6.1267      24218.
  6.4671      24238.
  6.8075      24257.

******************************** Section 5 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE = 120010     OUTSIDE NODE = 120011

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.
```

```
             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -2442.     -0.1989E+05  -4212.       2614.       8271.      -1336.
     S1          S2          S3          SINT        SEQV
 -629.1      -2068.     -0.2385E+05  0.2322E+05  0.2253E+05

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -3630.     -0.2769E+05  -9215.       53.31       7152.      -3400.
C   0.000       0.000       0.000       0.000       0.000       0.000
O   3630.      0.2769E+05   9215.      -53.31      -7152.       3400.
     S1          S2          S3          SINT        SEQV
I  -1602.      -8748.     -0.3019E+05  0.2859E+05  0.2577E+05
C   0.000       0.000       0.000       0.000       0.000
O  0.3019E+05   8748.       1602.      0.2859E+05  0.2577E+05

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -6072.     -0.4758E+05 -0.1343E+05   2667.      0.1542E+05  -4736.
C  -2442.     -0.1989E+05  -4212.       2614.       8271.      -1336.
O   1187.       7803.       5003.       2560.       1120.       2064.
     S1          S2          S3          SINT        SEQV
I  -3036.     -0.1016E+05 -0.5389E+05  0.5085E+05  0.4769E+05
C  -629.1      -2068.     -0.2385E+05  0.2322E+05  0.2253E+05
O   9402.       4799.      -206.9       9609.       8324.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   7955.      -5636.      -2186.      0.1401E+05   1067.       3336.
C  -247.6       5626.       1270.       94.92      -1542.       536.2
O   2639.      -9054.      -1672.      -276.2       2078.      -68.61
     S1          S2          S3          SINT        SEQV
I  0.1733E+05  -2714.     -0.1448E+05  0.3180E+05  0.2785E+05
C   6117.       1011.      -479.7       6597.       5992.
O   2649.      -1132.      -9603.      0.1225E+05  0.1087E+05

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   1882.     -0.5322E+05 -0.1561E+05  0.1668E+05  0.1649E+05  -1400.
C  -2690.     -0.1426E+05  -2943.       2708.       6730.      -799.6
O   3826.      -1250.       3331.       2284.       3198.       1996.
     S1          S2          S3          SINT        SEQV        TEMP
I   7051.     -0.1058E+05 -0.6342E+05  0.7047E+05  0.6352E+05   71.60
C   260.2      -2247.     -0.1791E+05  0.1817E+05  0.1706E+05
O   7326.       1685.      -3104.      0.1043E+05   9043.       71.60


***** PATH VARIABLE SUMMARY *****

    S           PATH5
  0.0000      70472.
 0.78747E-01  59346.
 0.15749      52458.
 0.23624      45671.
 0.31499      39087.
 0.39373      33537.
 0.47248      30324.
 0.55123      27113.
 0.62998      23951.
 0.70872      20857.
 0.78747      18170.
 0.86622      16707.
 0.94496      15289.
  1.0237      13931.
  1.1025      12661.
  1.1812      11711.
  1.2600      11226.
```

```
  1.3387      10853.
  1.4174      10598.
  1.4962      10459.
  1.5749      10430.

PRINT ITERATION SUMMARY

          **** POST1 ITERATION SUMMARY ****

LOAD STEP    6  SUBSTEP    1        CUMULATIVE ITERATION   17
TIME =    6.00000               TIME INCREMENT =    1.00000
 NUMBER OF EQUILIBRIUM ITERATIONS =          3
 CONVERGENCE INDICATOR = 1
 MAXIMUM DEGREE OF FREEDOM VALUE =  -0.129537
 RESPONSE FREQUENCY FOR 2ND ORDER SYSTEMS =    0.00000
 DESCENT PARAMETER =    0.00000
 FORCE CONVERGENCE VALUE =    9674.99
 MOMENT CONVERGENCE VALUE =    0.00000
 DISPLACEMENT CONVERGENCE VALUE =    0.00000
 ROTATION CONVERGENCE VALUE =    0.00000


NUMBER OF WARNING MESSAGES ENCOUNTERED=        409
NUMBER OF ERROR   MESSAGES ENCOUNTERED=          0
```

Stress_end_hac.txt

```
******************************** Section 1 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE =1000000     OUTSIDE NODE =1000001

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  965.2       -4448.       908.8       -425.9       145.2       -111.5
     S1          S2          S3          SINT        SEQV
  1085.        825.5       -4485.       5570.       5445.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   559.8       -2860.       226.4       -651.1       83.45       518.0
C   0.000        0.000       0.000        0.000       0.000       0.000
O  -559.8        2860.      -226.4        651.1      -83.45      -518.0
     S1          S2          S3          SINT        SEQV
I   999.1       -83.30      -2990.       3989.       3573.
C   0.000        0.000       0.000        0.000       0.000
O   2990.        83.30      -999.1       3989.       3573.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   1525.       -7308.       1135.       -1077.       228.6       406.5
C   965.2       -4448.       908.8       -425.9       145.2       -111.5
O   405.4       -1588.       682.4        225.3       61.74       -629.5
     S1          S2          S3          SINT        SEQV
I   1854.        944.7      -7447.       9300.       8881.
C   1085.        825.5      -4485.       5570.       5445.
O   1192.       -70.58      -1622.       2813.       2441.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   471.6        776.5       330.2       -278.7       104.1       5.016
C  -194.0       -295.8      -134.1        107.8      -13.07      -18.14
O  -1122.       -2341.      -1391.       -232.1      -71.35       1338.
     S1          S2          S3          SINT        SEQV
I   953.9        369.3       255.1        698.8       649.3
C  -107.2       -152.6      -364.2        257.0       237.6
O   107.7       -2323.      -2639.        2747.       2603.

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   1997.       -6532.       1465.       -1356.       332.7       411.5
C   771.2       -4744.       774.7       -318.0       132.1       -129.7
O  -716.9       -3929.      -708.6       -6.831      -9.610       708.3
     S1          S2          S3          SINT        SEQV        TEMP
I   2352.        1339.      -6761.       9113.       8651.       0.000
C   920.6        646.3      -4765.       5686.       5554.
O  -4.406       -1421.      -3929.       3925.       3442.       0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH1
  0.0000       9113.2
 0.59043E-01   8768.7
 0.11809       8427.9
 0.17713       8091.2
 0.23617       7759.0
```

```
 0.29522      7432.0
 0.35426      7110.7
 0.41330      6753.0
 0.47235      6332.6
 0.53139      5995.0
 0.59043      5685.9
 0.64948      5380.5
 0.70852      5076.3
 0.76756      4773.2
 0.82661      4457.8
 0.88565      4136.8
 0.94469      3816.8
  1.0037      3498.2
  1.0628      3181.3
  1.1218      2866.8
  1.1809      3924.5

****************************** Section 2 *********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE =1000002     OUTSIDE NODE =1000003

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  247.6       -3197.       1324.       5.577      -7.851      -549.2
     S1          S2          S3          SINT        SEQV
  1555.        16.91       -3197.       4752.       4200.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -117.3       -618.8      -443.3      -42.27       23.94       159.0
C   0.000        0.000       0.000       0.000       0.000       0.000
O   117.3        618.8       443.3       42.27      -23.94      -159.0
     S1          S2          S3          SINT        SEQV
I  -51.02       -496.4      -632.1       581.1       526.5
C   0.000        0.000       0.000       0.000       0.000
O   632.1        496.4       51.02       581.1       526.5

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   130.3       -3816.       880.8      -36.69       16.08      -390.2
C   247.6       -3197.       1324.       5.577      -7.851      -549.2
O   365.0       -2578.       1767.       47.84      -31.79      -708.2
     S1          S2          S3          SINT        SEQV
I   1047.       -35.60      -3816.       4863.       4422.
C   1555.        16.91      -3197.       4752.       4200.
O   2063.        69.96      -2579.       4642.       4034.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -5.554        1078.      -175.9       35.62      -19.40       90.18
C   1.970       -615.3       71.51     -0.1801       16.48      -37.90
O   677.9       -1503.       658.2       305.5      -218.4      -211.3
     S1          S2          S3          SINT        SEQV
I   1080.        32.72      -215.6       1295.       1191.
C   88.51       -14.63      -615.7       704.2       658.7
O   936.4        457.7      -1561.       2498.       2296.

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   124.7       -2737.       704.9      -1.071      -3.320      -300.0
C   249.6       -3812.       1396.       5.397       8.629      -587.1
O   1043.       -4081.       2426.       353.3      -250.1      -919.5
```

```
     S1          S2          S3          SINT        SEQV        TEMP
I   832.1       -2.489      -2737.       3569.       3234.       0.000
C   1643.        2.256      -3812.       5455.       4848.
O   2906.        592.6      -4111.       7017.       6193.       0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH2
  0.0000      3569.4
  2.0114      3906.7
  4.0229      4198.4
  6.0343      4443.8
  8.0458      4647.9
  10.057      4818.7
  12.069      4966.8
  14.080      5100.4
  16.092      5225.6
  18.103      5344.7
  20.114      5455.2
  22.126      5550.3
  24.137      5619.2
  26.149      5643.8
  28.160      5617.7
  30.172      5506.7
  32.183      5240.0
  34.195      4550.1
  36.206      2909.1
  38.218      3559.1
  40.229      7016.9

****************************** Section 3 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE =1000004     OUTSIDE NODE =1000005

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -877.4      -2742.      -1697.       386.0      -154.9      -167.4
     S1          S2          S3          SINT        SEQV
 -760.0      -1725.      -2831.       2071.       1795.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -1145.       479.5       285.9      -153.1      -463.0       829.8
C   0.000       0.000       0.000       0.000       0.000       0.000
O   1145.      -479.5      -285.9       153.1       463.0      -829.8
     S1          S2          S3          SINT        SEQV
I   1067.       80.29      -1526.       2593.       2267.
C   0.000       0.000       0.000       0.000       0.000
O   1526.      -80.29      -1067.       2593.       2267.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -2022.      -2262.      -1411.       232.9      -617.9       662.4
C  -877.4      -2742.      -1697.       386.0      -154.9      -167.4
O   267.4      -3221.      -1983.       539.1       308.0      -997.2
     S1          S2          S3          SINT        SEQV
I  -860.1      -1909.      -2926.       2066.       1789.
C  -760.0      -1725.      -2831.       2071.       1795.
O   686.3      -2156.      -3467.       4153.       3678.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
```

```
     SX          SY          SZ          SXY         SYZ         SXZ
I   1380.       1151.       739.9       1705.      -1356.      -422.5
C  -225.9        606.3       184.1      -500.8       261.7       237.1
O  0.1402E+05  0.1914E+05  0.1165E+05   9103.      -2215.      -2274.
     S1          S2          S3          SINT        SEQV
I   3543.       582.6      -855.1       4398.       3884.
C   871.8       291.5      -598.8       1471.       1283.
O  0.2669E+05  0.1105E+05   7069.      0.1962E+05  0.1797E+05

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -642.2      -1112.      -671.4       1938.      -1974.       239.9
C  -1103.      -2136.      -1513.      -114.8       106.8       69.72
O  0.1429E+05  0.1592E+05   9667.       9642.      -1907.      -3272.
     S1          S2          S3          SINT        SEQV        TEMP
I   1764.      -416.7      -3773.       5537.       4831.       0.000
C  -1083.      -1501.      -2168.       1085.       948.1
O  0.2561E+05   9164.       5106.      0.2050E+05  0.1880E+05   0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH3
  0.0000      5536.7
 0.12808      3992.4
 0.25616      2660.5
 0.38424      2178.3
 0.51232      1808.2
 0.64040      1461.0
 0.76848      1222.0
 0.89656      1153.7
  1.0246      1098.1
  1.1527      1066.8
  1.2808      1085.3
  1.4089      1227.7
  1.5370      1411.6
  1.6650      1618.6
  1.7931      1851.2
  1.9212      2139.6
  2.0493      2472.4
  2.1773      2837.9
  2.3054      4910.9
  2.4335      7188.5
  2.5616      20499.

******************************** Section 4 **********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE =1000006     OUTSIDE NODE =1000007

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -242.8      -4228.       1246.       557.3      -516.5       592.8
     S1          S2          S3          SINT        SEQV
  1470.      -327.2      -4368.       5838.       5179.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -5237.     -0.1010E+05  -7869.       1621.      -1344.      -1368.
C   0.000       0.000       0.000       0.000       0.000       0.000
O   5237.      0.1010E+05   7869.      -1621.       1344.       1368.
     S1          S2          S3          SINT        SEQV
I  -3981.      -8326.     -0.1090E+05   6919.       6057.
```

```
C   0.000       0.000       0.000       0.000       0.000
O  0.1090E+05   8326.       3981.       6919.       6057.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -5480.     -0.1433E+05  -6623.       2178.      -1860.      -775.2
C  -242.8      -4228.       1246.       557.3      -516.5       592.8
O   4995.       5872.       9115.      -1064.       827.2       1961.
     S1          S2          S3          SINT        SEQV
I  -4303.      -6974.     -0.1515E+05  0.1085E+05   9793.
C   1470.      -327.2      -4368.       5838.       5179.
O   9936.       6548.       3498.       6438.       5578.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I -0.1640E+05  -61.62      -3420.      0.1938E+05  -2018.       4920.
C   1156.       3711.       1312.      -574.6       482.7       238.6
O  -1898.      -5909.      -1750.       1056.      -827.2      -77.61
     S1          S2          S3          SINT        SEQV
I  0.1287E+05  -2475.     -0.3027E+05  0.4314E+05  0.3787E+05
C   3904.       1484.       791.0       3113.       2831.
O  -1356.      -1896.      -6306.       4950.       4703.

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I -0.2188E+05 -0.1439E+05 -0.1004E+05  0.2155E+05  -3879.       4145.
C   913.4      -517.3       2558.      -17.35      -33.80       831.4
O   3096.      -36.89       7365.      -7.817     -0.8153E-01   1883.
     S1          S2          S3          SINT        SEQV        TEMP
I   3748.      -9013.     -0.4105E+05  0.4480E+05  0.3997E+05   0.000
C   2906.       566.4      -517.8       3423.       3030.
O   8077.       2384.      -36.92       8114.       7215.       0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH4
  0.0000      44797.
 0.25197      23303.
 0.50394      17164.
 0.75591      9029.3
  1.0079      2469.0
  1.2599      1906.4
  1.5118      1515.2
  1.7638      1885.1
  2.0158      2485.1
  2.2677      3084.4
  2.5197      3423.3
  2.7717      3505.3
  3.0236      3990.2
  3.2756      4421.0
  3.5276      4738.5
  3.7796      5321.3
  4.0315      5893.6
  4.2835      6445.3
  4.5355      6996.7
  4.7874      7555.2
  5.0394      8113.7

******************************** Section 5 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE =1000008     OUTSIDE NODE =1000009

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.
```

```
             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  6077.       1518.       4876.       835.8      -363.2      -695.4
     S1          S2          S3          SINT        SEQV
  6560.       4558.       1353.       5207.       4549.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -967.8     -0.2187E+05  -5752.      -4123.       1708.      -2293.
C   0.000       0.000       0.000       0.000       0.000       0.000
O   967.8      0.2187E+05   5752.       4123.      -1708.       2293.
     S1          S2          S3          SINT        SEQV
I   830.9      -6674.     -0.2274E+05  0.2357E+05  0.2086E+05
C   0.000       0.000       0.000       0.000       0.000
O  0.2274E+05   6674.      -830.9      0.2357E+05  0.2086E+05

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   5109.     -0.2035E+05  -876.8      -3287.       1345.      -2988.
C   6077.       1518.       4876.       835.8      -363.2      -695.4
O   7045.      0.2338E+05  0.1063E+05   4959.      -2071.       1597.
     S1          S2          S3          SINT        SEQV
I   6810.      -2113.     -0.2081E+05  0.2762E+05  0.2442E+05
C   6560.       4558.       1353.       5207.       4549.
O  0.2494E+05  0.1124E+05   4877.      0.2007E+05  0.1776E+05

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -5156.      0.1976E+05   806.8       3287.      -1348.       2989.
C  -91.14       -231.4      -153.8       54.27      -74.12       75.88
O   4594.     -0.2307E+05  -3793.      -5004.       2053.      -3888.
     S1          S2          S3          SINT        SEQV
I  0.2023E+05   2047.      -6870.      0.2710E+05  0.2393E+05
C  -40.27      -125.3      -310.8       270.5       239.6
O   7089.      -5318.     -0.2404E+05  0.3113E+05  0.2714E+05

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -46.72      -587.9      -69.97     -0.4284      -2.873      0.7207
C   5986.       1286.       4722.       890.1      -437.4      -619.6
O  0.1164E+05   315.4       6835.      -45.40      -18.82      -2291.
     S1          S2          S3          SINT        SEQV        TEMP
I  -46.70      -69.97      -587.9       541.2       530.0       0.000
C   6429.       4470.       1095.       5335.       4674.
O  0.1256E+05   5918.       315.1      0.1224E+05  0.1061E+05   0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH5
  0.0000      541.21
 0.17143E-01  26843.
 0.34286E-01  24358.
 0.51429E-01  21875.
 0.68572E-01  19398.
 0.85715E-01  16929.
 0.10286      14475.
 0.12000      12047.
 0.13714      9666.5
 0.15429      7384.8
 0.17143      5334.6
 0.18857      3907.3
 0.20572      3874.9
 0.22286      5268.6
 0.24000      7318.8
 0.25715      9617.6
 0.27429      12026.
```

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 0.29143      14491.
 0.30858      16991.
 0.32572      19514.
 0.34286      12241.

PRINT ITERATION SUMMARY

          **** POST1 ITERATION SUMMARY ****

LOAD STEP    6  SUBSTEP    1        CUMULATIVE ITERATION   20
TIME =    6.00000               TIME INCREMENT =    1.00000
 NUMBER OF EQUILIBRIUM ITERATIONS =          1
 CONVERGENCE INDICATOR = 1
 MAXIMUM DEGREE OF FREEDOM VALUE =  -0.797152E-01
 RESPONSE FREQUENCY FOR 2ND ORDER SYSTEMS =    0.00000
 DESCENT PARAMETER =    0.00000
 FORCE CONVERGENCE VALUE =    4775.24
 MOMENT CONVERGENCE VALUE =    0.00000
 DISPLACEMENT CONVERGENCE VALUE =    0.00000
 ROTATION CONVERGENCE VALUE =    0.00000
 NUMBER OF NONCONVERGED 2D CONTACT ELEMENTS =          0
 NUMBER OF NONCONVERGED 3D CONTACT ELEMENTS =          0


NUMBER OF WARNING MESSAGES ENCOUNTERED=         12
NUMBER OF ERROR   MESSAGES ENCOUNTERED=          1
```

Stress_pressure_hac.txt

```
******************************** Section 1 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE = 120002     OUTSIDE NODE = 120003

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  17.17       -141.0       159.5       -25.23      -21.33      -51.70
     S1          S2          S3          SINT        SEQV
  176.8        6.667       -147.8       324.6       281.2

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I -0.1941      -16.02      -2.607      -0.7284      -2.319      0.9318
C   0.000       0.000       0.000       0.000       0.000       0.000
O  0.1941       16.02       2.607      0.7284       2.319     -0.9318
     S1          S2          S3          SINT        SEQV
I  0.2610      -2.653      -16.43       16.69       15.44
C   0.000       0.000       0.000       0.000       0.000
O   16.43       2.653     -0.2610       16.69       15.44

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   16.98      -157.1       156.9      -25.95      -23.64      -50.76
C   17.17      -141.0       159.5      -25.23      -21.33      -51.70
O   17.36      -125.0       162.1      -24.50      -19.01      -52.63
     S1          S2          S3          SINT        SEQV
I   174.0       6.698      -163.9       337.9       292.7
C   176.8       6.667      -147.8       324.6       281.2
O   179.6       6.683      -131.8       311.4       270.2

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I -0.8427E-04 -0.6957E-02 -0.1132E-02 -0.3163E-03 -0.1007E-02  0.4046E-03
C  0.1102E-10  0.3473E-09  0.8492E-10 -0.1190E-11 -0.1766E-11 -0.2836E-10
O  0.8427E-04  0.6957E-02  0.1132E-02  0.3163E-03  0.1007E-02 -0.4046E-03
     S1          S2          S3          SINT        SEQV
I  0.1133E-03 -0.1152E-02 -0.7134E-02  0.7248E-02  0.6705E-02
C  0.3473E-09  0.9454E-10  0.1385E-11  0.3459E-09  0.3100E-09
O  0.7134E-02  0.1152E-02 -0.1133E-03  0.7248E-02  0.6705E-02

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   16.98      -157.1       156.9      -25.95      -23.64      -50.76
C   17.17      -141.0       159.5      -25.23      -21.33      -51.70
O   17.36      -125.0       162.1      -24.50      -19.01      -52.63
     S1          S2          S3          SINT        SEQV        TEMP
I   174.0       6.698      -163.9       337.9       292.7       71.60
C   176.8       6.667      -147.8       324.6       281.2
O   179.6       6.683      -131.8       311.4       270.2       71.60


***** PATH VARIABLE SUMMARY *****

    S           PATH1
  0.0000       337.92
 0.59043E-01   336.59
 0.11809       335.26
 0.17713       333.93
 0.23617       332.60
```

```
 0.29522      331.26
 0.35426      329.94
 0.41330      328.61
 0.47235      327.28
 0.53139      325.95
 0.59043      324.62
 0.64948      323.30
 0.70852      321.97
 0.76756      320.65
 0.82661      319.32
 0.88565      318.00
 0.94469      316.68
  1.0037      315.36
  1.0628      314.03
  1.1218      312.72
  1.1809      311.40

****************************** Section 2 **********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE = 120004     OUTSIDE NODE = 120005

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX           SY           SZ          SXY         SYZ         SXZ
  16.66       -91.08        161.7       -22.50      -14.65      -52.94
     S1           S2           S3          SINT        SEQV
  179.2        6.282       -98.14        277.3       242.6

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX           SY           SZ          SXY         SYZ         SXZ
I -0.2376E-01  -10.29       0.8666      -0.9193      -1.252      -0.2701
C   0.000        0.000        0.000        0.000       0.000       0.000
O  0.2376E-01    10.29      -0.8666       0.9193       1.252       0.2701
     S1           S2           S3          SINT        SEQV
I   1.034       0.3265E-01  -10.51        11.54       11.08
C   0.000        0.000        0.000        0.000       0.000
O   10.51      -0.3265E-01   -1.034        11.54       11.08

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX           SY           SZ          SXY         SYZ         SXZ
I   16.64       -101.4        162.6       -23.41      -15.90      -53.21
C   16.66       -91.08        161.7       -22.50      -14.65      -52.94
O   16.68       -80.79        160.9       -21.58      -13.40      -52.67
     S1           S2           S3          SINT        SEQV
I   180.2        6.152       -108.4        288.6       251.7
C   179.2        6.282       -98.14        277.3       242.6
O   178.2        6.452       -87.89        266.1       233.7

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX           SY           SZ          SXY         SYZ         SXZ
I -0.1032E-04 -0.4467E-02  0.3763E-03 -0.3992E-03 -0.5437E-03 -0.1173E-03
C -0.1136E-08 -0.5928E-07 -0.1383E-07 -0.5251E-09 -0.1131E-08  0.3896E-08
O  0.1032E-04  0.4467E-02 -0.3763E-03  0.3992E-03  0.5437E-03  0.1173E-03
     S1           S2           S3          SINT        SEQV
I  0.4489E-03  0.1418E-04 -0.4564E-02  0.5013E-02  0.4810E-02
C -0.2465E-10 -0.1491E-07 -0.5931E-07  0.5929E-07  0.5342E-07
O  0.4564E-02 -0.1418E-04 -0.4490E-03  0.5013E-02  0.4810E-02

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX           SY           SZ          SXY         SYZ         SXZ
I   16.64       -101.4        162.6       -23.42      -15.90      -53.21
C   16.66       -91.08        161.7       -22.50      -14.65      -52.94
O   16.68       -80.79        160.9       -21.58      -13.40      -52.67
```

```
     S1          S2          S3          SINT        SEQV        TEMP
I   180.2        6.152      -108.4       288.6       251.7       71.60
C   179.2        6.282      -98.14       277.3       242.6
O   178.2        6.452      -87.89       266.1       233.7       71.60


***** PATH VARIABLE SUMMARY *****

    S           PATH2
  0.0000       288.60
 0.59046E-01   287.47
 0.11809       286.34
 0.17714       285.21
 0.23618       284.08
 0.29523       282.95
 0.35427       281.82
 0.41332       280.70
 0.47236       279.57
 0.53141       278.44
 0.59046       277.32
 0.64950       276.19
 0.70855       275.06
 0.76759       273.94
 0.82664       272.81
 0.88568       271.69
 0.94473       270.57
  1.0038       269.44
  1.0628       268.32
  1.1219       267.20
  1.1809       266.08

****************************** Section 3 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE = 120006     OUTSIDE NODE = 120007

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  16.20       -54.48       154.1       -18.59      -10.62      -50.49
     S1          S2          S3          SINT        SEQV
  170.7        6.854       -61.72       232.4       206.9

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  0.2446       -8.085       2.831      -0.9992     -0.7950     -0.9197
C   0.000        0.000       0.000        0.000       0.000       0.000
O -0.2446        8.085      -2.831       0.9992      0.7950      0.9197
     S1          S2          S3          SINT        SEQV
I   3.144       0.1231      -8.276       11.42       10.25
C   0.000        0.000       0.000       0.000       0.000
O   8.276      -0.1231      -3.144       11.42       10.25

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   16.45       -62.57       157.0       -19.59      -11.42      -51.41
C   16.20       -54.48       154.1       -18.59      -10.62      -50.49
O   15.96       -46.40       151.3       -17.59      -9.827      -49.57
     S1          S2          S3          SINT        SEQV
I   173.9        6.726       -69.74       243.6       215.8
C   170.7        6.854       -61.72       232.4       206.9
O   167.6        7.050       -53.77       221.4       198.1

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
```

```
     SX          SY          SZ          SXY         SYZ         SXZ
I  0.1062E-03 -0.3511E-02  0.1229E-02 -0.4339E-03 -0.3452E-03 -0.3993E-03
C -0.2389E-10  0.1104E-09  0.4650E-10  0.3915E-11  0.1708E-10  0.2763E-10
O -0.1062E-03  0.3511E-02 -0.1229E-02  0.4339E-03  0.3452E-03  0.3993E-03
     S1          S2          S3          SINT        SEQV
I  0.1365E-02  0.5344E-04 -0.3594E-02  0.4959E-02  0.4450E-02
C  0.1155E-09  0.5094E-10 -0.3346E-10  0.1490E-09  0.1294E-09
O  0.3594E-02 -0.5344E-04 -0.1365E-02  0.4959E-02  0.4450E-02

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   16.45       -62.57       157.0      -19.59      -11.42      -51.41
C   16.20       -54.48       154.1      -18.59      -10.62      -50.49
O   15.96       -46.39       151.3      -17.59      -9.827      -49.57
     S1          S2          S3          SINT        SEQV        TEMP
I   173.9        6.726      -69.74       243.6       215.8       71.60
C   170.7        6.854      -61.72       232.4       206.9
O   167.6        7.050      -53.77       221.3       198.1       71.60


***** PATH VARIABLE SUMMARY *****

    S           PATH3
  0.0000       243.60
 0.12808       242.48
 0.25616       241.36
 0.38424       240.25
 0.51232       239.13
 0.64040       238.01
 0.76848       236.90
 0.89656       235.78
  1.0246       234.67
  1.1527       233.55
  1.2808       232.44
  1.4089       231.33
  1.5370       230.21
  1.6650       229.10
  1.7931       227.99
  1.9212       226.88
  2.0493       225.77
  2.1773       224.67
  2.3054       223.56
  2.4335       222.45
  2.5616       221.35

******************************** Section 4 **********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE = 120008     OUTSIDE NODE = 120009

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  14.88       -25.92       140.1       -14.68      -7.978      -45.91
     S1          S2          S3          SINT        SEQV
  155.2        7.841      -33.95        189.1       172.1

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  0.4026       -6.226       4.093      -0.9458     -0.5434      -1.343
C   0.000        0.000       0.000        0.000       0.000       0.000
O -0.4026        6.226      -4.093       0.9458      0.5434       1.343
     S1          S2          S3          SINT        SEQV
I   4.535       0.1443      -6.409        10.94       9.539
```

```
C   0.000       0.000       0.000       0.000       0.000
O   6.409     -0.1443      -4.535       10.94       9.539

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   15.29      -32.15       144.2      -15.63      -8.521      -47.25
C   14.88      -25.92       140.1      -14.68      -7.978      -45.91
O   14.48      -19.69       136.0      -13.73      -7.435      -44.57
     S1          S2          S3          SINT        SEQV
I   159.7       7.529      -39.91       199.6       180.6
C   155.2       7.841      -33.95       189.1       172.1
O   150.7       8.306      -28.16       178.8       163.7

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  0.1748E-03 -0.2703E-02  0.1777E-02 -0.4107E-03 -0.2360E-03 -0.5830E-03
C -0.5329E-14  0.1066E-13  0.2842E-13   0.000      0.2665E-14 -0.1421E-13
O -0.1748E-03  0.2703E-02 -0.1777E-02  0.4107E-03  0.2360E-03  0.5830E-03
     S1          S2          S3          SINT        SEQV
I  0.1969E-02  0.6268E-04 -0.2783E-02  0.4752E-02  0.4142E-02
C  0.3388E-13  0.1043E-13 -0.1056E-13  0.4443E-13  0.3850E-13
O  0.2783E-02 -0.6268E-04 -0.1969E-02  0.4752E-02  0.4142E-02

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   15.29      -32.15       144.2      -15.63      -8.522      -47.25
C   14.88      -25.92       140.1      -14.68      -7.978      -45.91
O   14.48      -19.69       136.0      -13.73      -7.434      -44.57
     S1          S2          S3          SINT        SEQV        TEMP
I   159.7       7.528      -39.91       199.6       180.7       71.60
C   155.2       7.841      -33.95       189.1       172.1
O   150.7       8.306      -28.15       178.8       163.7       71.60


***** PATH VARIABLE SUMMARY *****

    S           PATH4
  0.0000      199.64
 0.25197      198.58
 0.50394      197.53
 0.75591      196.48
  1.0079      195.42
  1.2599      194.37
  1.5118      193.33
  1.7638      192.28
  2.0158      191.23
  2.2677      190.19
  2.5197      189.14
  2.7717      188.10
  3.0236      187.06
  3.2756      186.02
  3.5276      184.99
  3.7796      183.95
  4.0315      182.92
  4.2835      181.89
  4.5355      180.86
  4.7874      179.83
  5.0394      178.81

******************************** Section 5 **********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE = 120010     OUTSIDE NODE = 120011

 LOAD STEP     6  SUBSTEP=     1
 TIME=    6.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.
```

```
             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -311.9      -5246.      -14.93      -499.1      -49.75       109.6
     S1          S2          S3          SINT        SEQV
  29.92      -306.5      -5296.       5326.       5166.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -804.9      -3808.      -303.7      -861.5       198.4      -30.02
C   0.000       0.000       0.000       0.000       0.000       0.000
O   804.9       3808.       303.7       861.5      -198.4       30.02
     S1          S2          S3          SINT        SEQV
I  -273.5      -596.5      -4047.       3773.       3622.
C   0.000       0.000       0.000       0.000       0.000
O   4047.       596.5       273.5       3773.       3622.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -1117.      -9054.      -318.6      -1361.       148.6       79.63
C  -311.9      -5246.      -14.93      -499.1      -49.75       109.6
O   493.0      -1438.       288.8       362.4      -248.1       139.7
     S1          S2          S3          SINT        SEQV
I  -310.7      -895.1      -9284.       8973.       8695.
C   29.92      -306.5      -5296.       5326.       5166.
O   591.2       296.0      -1544.       2135.       2004.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -2924.      -5192.      -3303.      -563.1      -1418.      -468.9
C   492.2       1661.       588.3       215.6       49.37       212.0
O  -678.5      -1993.      -724.1      -413.8       116.0      -477.0
     S1          S2          S3          SINT        SEQV
I  -2472.      -2834.      -6113.       3640.       3474.
C   1706.       727.1       308.2       1398.       1243.
O  -144.2      -1139.      -2112.       1968.       1705.

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -4041.     -0.1425E+05  -3622.      -1924.      -1269.      -389.2
C   180.3      -3585.       573.4      -283.5     -0.3859       321.6
O  -185.5      -3431.      -435.3      -51.39      -132.2      -337.3
     S1          S2          S3          SINT        SEQV        TEMP
I  -3387.      -3769.     -0.1475E+05  0.1137E+05  0.1118E+05   71.60
C   758.3       16.76      -3607.       4365.       4045.
O   49.60      -663.2      -3438.       3488.       3192.       71.60


***** PATH VARIABLE SUMMARY *****

    S           PATH5
  0.0000       11365.
 0.78740E-01   10183.
 0.15748       9165.2
 0.23622       8331.9
 0.31496       7804.9
 0.39370       7411.4
 0.47244       6723.1
 0.55118       6049.8
 0.62992       5393.7
 0.70866       4757.7
 0.78740       4364.9
 0.86614       4210.2
 0.94488       4058.9
  1.0236       3911.7
  1.1024       3769.4
  1.1811       3622.7
  1.2598       3457.2
```

```
  1.3386      3330.5
  1.4173      3366.2
  1.4961      3425.9
  1.5748      3487.6

PRINT ITERATION SUMMARY

          **** POST1 ITERATION SUMMARY ****

LOAD STEP    6  SUBSTEP    1        CUMULATIVE ITERATION   11
TIME =    6.00000               TIME INCREMENT =    1.00000
 NUMBER OF EQUILIBRIUM ITERATIONS =          4
 CONVERGENCE INDICATOR = 1
 MAXIMUM DEGREE OF FREEDOM VALUE =  -0.164418
 RESPONSE FREQUENCY FOR 2ND ORDER SYSTEMS =    0.00000
 DESCENT PARAMETER =    0.00000
 FORCE CONVERGENCE VALUE =    5383.50
 MOMENT CONVERGENCE VALUE =    0.00000
 DISPLACEMENT CONVERGENCE VALUE =    0.00000
 ROTATION CONVERGENCE VALUE =    0.00000


NUMBER OF WARNING MESSAGES ENCOUNTERED=        142
NUMBER OF ERROR   MESSAGES ENCOUNTERED=          0
```

Stress_end _nct_tc1.txt

```
****************************** Section 1 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE =1000000     OUTSIDE NODE =1000001

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  63.25       206.5      -621.3       140.7      -396.2       182.8
     S1          S2          S3          SINT        SEQV
  379.8       104.1      -835.4       1215.       1104.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   58.91       12.46       189.9       14.97      -31.11      -61.37
C   0.000       0.000       0.000       0.000       0.000       0.000
O  -58.91      -12.46      -189.9      -14.97       31.11       61.37
     S1          S2          S3          SINT        SEQV
I   219.9       34.86       6.528       213.3       200.7
C   0.000       0.000       0.000       0.000       0.000
O  -6.528      -34.86      -219.9       213.3       200.7

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   122.2       218.9      -431.4       155.7      -427.3       121.4
C   63.25       206.5      -621.3       140.7      -396.2       182.8
O   4.332       194.0      -811.2       125.8      -365.1       244.2
     S1          S2          S3          SINT        SEQV
I   454.8       137.7      -682.8       1138.       1017.
C   379.8       104.1      -835.4       1215.       1104.
O   320.2       69.81      -1003.       1323.       1217.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  0.2558E-01  0.5409E-02  0.8245E-01  0.6498E-02 -0.1351E-01 -0.2665E-01
C -0.2091E-09  0.1949E-08  0.3936E-09  0.9922E-10 -0.2587E-09 -0.2324E-09
O -0.2558E-01 -0.5409E-02 -0.8245E-01 -0.6498E-02  0.1351E-01  0.2665E-01
     S1          S2          S3          SINT        SEQV
I  0.9547E-01  0.1514E-01  0.2835E-02  0.9264E-01  0.8714E-01
C  0.1999E-08  0.4226E-09 -0.2883E-09  0.2287E-08  0.2027E-08
O -0.2835E-02 -0.1514E-01 -0.9547E-01  0.9264E-01  0.8714E-01

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   122.2       218.9      -431.3       155.7      -427.3       121.4
C   63.25       206.5      -621.3       140.7      -396.2       182.8
O   4.307       194.0      -811.2       125.8      -365.1       244.2
     S1          S2          S3          SINT        SEQV        TEMP
I   454.9       137.7      -682.8       1138.       1017.       0.000
C   379.8       104.1      -835.4       1215.       1104.
O   320.2       69.79      -1003.       1323.       1217.       0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH1
  0.0000      1137.7
 0.59043E-01  1143.9
 0.11809      1150.4
 0.17713      1157.4
 0.23617      1164.6
```

```
 0.29522      1172.2
 0.35426      1180.2
 0.41330      1188.5
 0.47235      1197.1
 0.53139      1206.0
 0.59043      1215.2
 0.64948      1224.8
 0.70852      1234.6
 0.76756      1244.7
 0.82661      1255.1
 0.88565      1265.8
 0.94469      1276.7
  1.0037      1288.0
  1.0628      1299.4
  1.1218      1311.2
  1.1809      1323.1

****************************** Section 2 *********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE =1000002     OUTSIDE NODE =1000003

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  617.3       1801.      -2673.       334.0      -922.6       1794.
     S1          S2          S3          SINT        SEQV
  1984.       1399.      -3638.       5622.       5354.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   1306.       -2271.       692.2       523.6      -1108.       250.2
C   0.000        0.000       0.000       0.000       0.000       0.000
O  -1306.        2271.      -692.2      -523.6       1108.      -250.2
     S1          S2          S3          SINT        SEQV
I   1403.       1046.      -2722.       4125.       3959.
C   0.000        0.000       0.000       0.000       0.000
O   2722.       -1046.      -1403.       4125.       3959.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   1923.       -471.0      -1981.       857.7      -2031.       2044.
C   617.3        1801.      -2673.       334.0      -922.6       1794.
O  -688.5        4072.      -3365.      -189.6       185.5       1544.
     S1          S2          S3          SINT        SEQV
I   2798.       843.0      -4169.       6967.       6224.
C   1984.       1399.      -3638.       5622.       5354.
O   4082.       14.36      -4078.       8159.       7066.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -6149.       5605.      0.1276E+05  -877.7      -12.78      -7448.
C  -743.0       -1816.       1495.      -248.9       638.2      -1444.
O   566.3       -3510.       2031.       245.7      -448.0      -1113.
     S1          S2          S3          SINT        SEQV
I  0.1535E+05   5645.      -8779.      0.2413E+05  0.2103E+05
C   2316.       -1444.      -1936.       4251.       4028.
O   2673.       -33.58      -3552.       6226.       5407.

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -4226.       5134.      0.1078E+05  -20.06      -2044.      -5404.
C  -125.7      -15.93       -1177.       85.08      -284.5       350.7
O  -122.2       562.0       -1334.       56.13      -262.5       431.2
```

```
     S1          S2          S3          SINT        SEQV        TEMP
I  0.1300E+05   4693.      -6008.      0.1901E+05  0.1650E+05   0.000
C   50.20      -19.50      -1350.       1400.       1366.
O   597.7       14.42      -1506.       2104.       1881.       0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH2
  0.0000      19007.
 0.59046E-01  8346.0
 0.11809      7991.9
 0.17714      7669.8
 0.23619      7379.8
 0.29523      7121.4
 0.35428      6893.0
 0.41332      6705.3
 0.47237      6596.6
 0.53142      1525.0
 0.59046      1399.9
 0.64951      1355.8
 0.70856      8170.8
 0.76760      8606.8
 0.82665      9005.5
 0.88569      9388.0
 0.94474      9777.2
  1.0038      10172.
  1.0628      10573.
  1.1219      1993.1
  1.1809      2103.7

****************************** Section 3 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE =1000004     OUTSIDE NODE =1000005

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  150.2       -2037.       3320.       336.3       211.4       -538.6
     S1          S2          S3          SINT        SEQV
  3414.        123.0       -2103.       5517.       4808.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   3484.       -1638.      -3686.      -906.7      -859.8       293.9
C   0.000        0.000       0.000       0.000       0.000       0.000
O  -3484.        1638.       3686.       906.7       859.8       -293.9
     S1          S2          S3          SINT        SEQV
I   3666.       -1506.      -4000.       7666.       6772.
C   0.000        0.000       0.000       0.000       0.000
O   4000.        1506.      -3666.       7666.       6772.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   3634.       -3675.      -366.0      -570.5      -648.3      -244.7
C   150.2       -2037.       3320.       336.3       211.4       -538.6
O  -3334.       -399.4       7007.       1243.       1071.       -832.5
     S1          S2          S3          SINT        SEQV
I   3688.       -248.0      -3846.       7534.       6527.
C   3414.        123.0      -2103.       5517.       4808.
O   7200.       -13.79      -3912.      0.1111E+05   9765.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
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```
     SX          SY          SZ          SXY         SYZ         SXZ
I   3916.     -0.2835E+05   6357.       3820.       -2734.      -704.0
C   789.5      -980.0      -1502.      -347.4       -158.7       618.9
O  -5306.       4565.       6758.       2362.       -1649.      -390.9
     S1          S2          S3          SINT        SEQV
I   6950.       3965.     -0.2899E+05  0.3594E+05  0.3455E+05
C   1017.      -1043.      -1666.       2683.       2432.
O   7816.       4043.      -5843.      0.1366E+05  0.1222E+05

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   7550.     -0.3202E+05   5991.       3249.       -3383.      -948.7
C   939.7      -3017.       1818.      -11.19       52.73       80.31
O  -8640.       4165.      0.1376E+05   3605.       -577.9      -1223.
     S1          S2          S3          SINT        SEQV        TEMP
I   8484.       5604.     -0.3257E+05  0.4105E+05  0.3969E+05   0.000
C   1826.       932.5      -3018.       4844.       4465.
O  0.1390E+05   5025.      -9631.      0.2353E+05  0.2058E+05   0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH3
  0.0000      41055.
 0.96458E-01  3010.8
 0.19292      3147.1
 0.28937      3302.3
 0.38583      3478.9
 0.48229      3680.2
 0.57875      3908.5
 0.67520      4109.0
 0.77166      4314.5
 0.86812      4560.1
 0.96458      4843.9
  1.0610      5100.5
  1.1575      5356.6
  1.2540      5834.9
  1.3504      5868.5
  1.4469      6053.2
  1.5433      6408.4
  1.6398      6958.1
  1.7362      17803.
  1.8327      20156.
  1.9292      23528.

******************************** Section 4 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE =1000006     OUTSIDE NODE =1000007

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -1844.      -3612.      -3418.      -163.1      -27.15      -1226.
     S1          S2          S3          SINT        SEQV
 -1168.      -3598.      -4109.       2941.       2722.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -1508.      -8488.      -1495.       961.7      -337.8      -1620.
C   0.000       0.000       0.000       0.000       0.000       0.000
O   1508.       8488.       1495.      -961.7       337.8       1620.
     S1          S2          S3          SINT        SEQV
I   216.2      -3087.      -8620.       8836.       7733.
```

```
C   0.000       0.000       0.000       0.000       0.000
O   8620.       3087.      -216.2       8836.       7733.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -3352.     -0.1210E+05  -4913.       798.6      -364.9      -2846.
C  -1844.      -3612.      -3418.      -163.1      -27.15      -1226.
O  -335.6      4875.      -1923.      -1125.       310.7       394.8
     S1          S2          S3          SINT        SEQV
I  -1115.      -7076.     -0.1217E+05  0.1106E+05   9587.
C  -1168.      -3598.      -4109.       2941.       2722.
O   5115.      -433.2      -2065.       7180.       6519.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   4551.      0.3764E+05   6986.      0.1024E+05  -7286.       1674.
C   2481.       5197.       2625.      -341.5      -60.40       1106.
O   2169.      -8910.       1422.       704.4      -403.0      -567.9
     S1          S2          S3          SINT        SEQV
I  0.4180E+05   7788.      -409.1      0.4221E+05  0.3877E+05
C   5257.       3613.       1433.       3824.       3322.
O   2533.       1116.      -8967.      0.1150E+05  0.1086E+05

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   1198.      0.2554E+05   2073.      0.1104E+05  -7651.      -1172.
C   636.7       1585.      -792.5      -504.6      -87.55      -119.7
O   1834.      -4034.      -500.9      -420.5      -92.36      -173.1
     S1          S2          S3          SINT        SEQV        TEMP
I  0.3174E+05   813.9      -3736.      0.3547E+05  0.3343E+05   0.000
C   1804.       435.6      -810.0       2614.       2264.
O   1875.      -509.4      -4068.       5943.       5180.       0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH4
  0.0000      35472.
 0.25197      25464.
 0.50394      11607.
 0.75591      8029.5
  1.0079      8870.1
  1.2599      6675.3
  1.5118      7374.2
  1.7638      5077.7
  2.0158      3935.8
  2.2677      4286.8
  2.5197      2613.8
  2.7717      3091.2
  3.0236      4905.8
  3.2756      5442.4
  3.5276      5018.6
  3.7796      5001.6
  4.0315      5089.8
  4.2835      4847.6
  4.5355      4292.6
  4.7874      2301.1
  5.0394      5942.9

******************************** Section 5 **********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE =1000008     OUTSIDE NODE =1000009

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.
```

```
             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  137.9       -6988.      -212.2      -126.7      -1108.      -197.9
     S1          S2          S3          SINT        SEQV
  249.3       -143.6      -7168.       7417.       7229.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -3025.      -7463.      -701.1      -836.2      -1827.       216.6
C   0.000       0.000       0.000       0.000       0.000       0.000
O   3025.       7463.       701.1       836.2       1827.      -216.6
     S1          S2          S3          SINT        SEQV
I  -177.1      -2972.      -8040.       7863.       6904.
C   0.000       0.000       0.000       0.000       0.000
O   8040.       2972.       177.1       7863.       6904.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -2887.     -0.1445E+05  -913.4      -962.9      -2935.       18.68
C   137.9       -6988.      -212.2      -126.7      -1108.      -197.9
O   3163.        475.4       488.9       709.5       718.4      -414.5
     S1          S2          S3          SINT        SEQV
I  -286.4      -2833.     -0.1513E+05  0.1485E+05  0.1375E+05
C   249.3      -143.6      -7168.       7417.       7229.
O   3359.       1183.      -414.6       3773.       3280.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -2490.      -5750.      -1871.       108.2       1767.       45.48
C   1928.       3285.       1398.      -65.15       392.8      -48.76
O  -2034.      -4168.      -552.5      -229.9      -810.1       363.3
     S1          S2          S3          SINT        SEQV
I  -1182.      -2493.      -6436.       5254.       4736.
C   3367.       1926.       1317.       2049.       1823.
O  -286.0      -2118.      -4351.       4065.       3526.

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -5378.     -0.2020E+05  -2784.      -854.7      -1168.       64.16
C   2065.       -3703.       1186.      -191.9      -715.5      -246.7
O   1129.       -3693.      -63.66       479.6      -91.69      -51.16
     S1          S2          S3          SINT        SEQV        TEMP
I  -2700.      -5335.     -0.2033E+05  0.1763E+05  0.1647E+05   0.000
C   2130.       1233.      -3814.       5944.       5550.
O   1179.      -64.53      -3742.       4921.       4432.       0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH5
  0.0000      17626.
 0.78740E-01  17910.
 0.15748      15666.
 0.23622      13564.
 0.31496      11610.
 0.39370      10058.
 0.47244      9232.0
 0.55118      8304.1
 0.62992      7384.2
 0.70866      6470.6
 0.78740      5944.0
 0.86614      5633.7
 0.94488      5337.5
  1.0236      5058.1
  1.1024      4799.3
  1.1811      4633.9
  1.2598      4683.9
```

```
  1.3386      4736.6
  1.4173      4792.8
  1.4961      4853.7
  1.5748      4920.8

PRINT ITERATION SUMMARY

          **** POST1 ITERATION SUMMARY ****

LOAD STEP    4  SUBSTEP    1        CUMULATIVE ITERATION   16
TIME =    4.00000               TIME INCREMENT =    1.00000
 NUMBER OF EQUILIBRIUM ITERATIONS =         12
 CONVERGENCE INDICATOR = 1
 MAXIMUM DEGREE OF FREEDOM VALUE =    1.75112
 RESPONSE FREQUENCY FOR 2ND ORDER SYSTEMS =    0.00000
 DESCENT PARAMETER =    0.00000
 FORCE CONVERGENCE VALUE =    9976.35
 MOMENT CONVERGENCE VALUE =    0.00000
 DISPLACEMENT CONVERGENCE VALUE =    0.00000
 ROTATION CONVERGENCE VALUE =    0.00000


NUMBER OF WARNING MESSAGES ENCOUNTERED=        114
NUMBER OF ERROR   MESSAGES ENCOUNTERED=          0
```

Stress_side_nct_tc1.txt

```
******************************** Section 1 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE = 120002     OUTSIDE NODE = 120003

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  63.25       206.5      -621.3       140.7      -396.2       182.8
     S1          S2          S3          SINT        SEQV
  379.8       104.1      -835.4       1215.       1104.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   58.91       12.46       189.9       14.97      -31.11      -61.37
C   0.000       0.000       0.000       0.000       0.000       0.000
O  -58.91      -12.46      -189.9      -14.97       31.11       61.37
     S1          S2          S3          SINT        SEQV
I   219.9       34.86       6.528       213.3       200.7
C   0.000       0.000       0.000       0.000       0.000
O  -6.528      -34.86      -219.9       213.3       200.7

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   122.2       218.9      -431.4       155.7      -427.3       121.4
C   63.25       206.5      -621.3       140.7      -396.2       182.8
O   4.332       194.0      -811.2       125.8      -365.1       244.2
     S1          S2          S3          SINT        SEQV
I   454.8       137.7      -682.8       1138.       1017.
C   379.8       104.1      -835.4       1215.       1104.
O   320.2       69.81      -1003.       1323.       1217.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  0.2558E-01  0.5409E-02  0.8245E-01  0.6498E-02 -0.1351E-01 -0.2665E-01
C -0.2091E-09  0.1949E-08  0.3936E-09  0.9922E-10 -0.2587E-09 -0.2324E-09
O -0.2558E-01 -0.5409E-02 -0.8245E-01 -0.6498E-02  0.1351E-01  0.2665E-01
     S1          S2          S3          SINT        SEQV
I  0.9547E-01  0.1514E-01  0.2835E-02  0.9264E-01  0.8714E-01
C  0.1999E-08  0.4226E-09 -0.2883E-09  0.2287E-08  0.2027E-08
O -0.2835E-02 -0.1514E-01 -0.9547E-01  0.9264E-01  0.8714E-01

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   122.2       218.9      -431.3       155.7      -427.3       121.4
C   63.25       206.5      -621.3       140.7      -396.2       182.8
O   4.307       194.0      -811.2       125.8      -365.1       244.2
     S1          S2          S3          SINT        SEQV        TEMP
I   454.9       137.7      -682.8       1138.       1017.       155.1
C   379.8       104.1      -835.4       1215.       1104.
O   320.2       69.79      -1003.       1323.       1217.       155.4


***** PATH VARIABLE SUMMARY *****

    S           PATH1
  0.0000      1137.7
 0.59043E-01  1143.9
 0.11809      1150.4
 0.17713      1157.4
 0.23617      1164.6
```

```
 0.29522      1172.2
 0.35426      1180.2
 0.41330      1188.5
 0.47235      1197.1
 0.53139      1206.0
 0.59043      1215.2
 0.64948      1224.8
 0.70852      1234.6
 0.76756      1244.7
 0.82661      1255.1
 0.88565      1265.8
 0.94469      1276.7
  1.0037      1288.0
  1.0628      1299.4
  1.1218      1311.2
  1.1809      1323.1

****************************** Section 2 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE = 120004     OUTSIDE NODE = 120005

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX           SY           SZ          SXY          SYZ          SXZ
 -123.7        228.3       -1264.        64.22       -262.5        392.3
     S1           S2           S3          SINT         SEQV
  273.1       -2.698       -1430.        1703.        1583.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX           SY           SZ          SXY          SYZ          SXZ
I   4.058       -59.70        126.6        21.89       -41.71       -57.22
C   0.000        0.000        0.000        0.000        0.000        0.000
O  -4.058        59.70       -126.6       -21.89        41.71        57.22
     S1           S2           S3          SINT         SEQV
I   159.2       -18.04       -70.20        229.4        208.3
C   0.000        0.000        0.000        0.000        0.000
O   70.20        18.04       -159.2        229.4        208.3

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX           SY           SZ          SXY          SYZ          SXZ
I  -119.6        168.6       -1138.        86.12       -304.2        335.1
C  -123.7        228.3       -1264.        64.22       -262.5        392.3
O  -127.7        288.0       -1391.        42.33       -220.8        449.6
     S1           S2           S3          SINT         SEQV
I   236.4       -19.27       -1306.        1542.        1432.
C   273.1       -2.698       -1430.        1703.        1583.
O   317.3        13.59       -1562.        1879.        1747.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX           SY           SZ          SXY          SYZ          SXZ
I  0.1762E-02 -0.2592E-01  0.5497E-01  0.9507E-02 -0.1811E-01 -0.2485E-01
C  0.7944E-11 -0.2848E-10  0.1532E-09  0.2494E-10 -0.5036E-10 -0.6759E-10
O -0.1762E-02  0.2592E-01 -0.5497E-01 -0.9507E-02  0.1811E-01  0.2485E-01
     S1           S2           S3          SINT         SEQV
I  0.6912E-01 -0.7832E-02 -0.3048E-01  0.9960E-01  0.9043E-01
C  0.1939E-09 -0.1777E-10 -0.4344E-10  0.2374E-09  0.2256E-09
O  0.3048E-01  0.7832E-02 -0.6912E-01  0.9960E-01  0.9043E-01

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX           SY           SZ          SXY          SYZ          SXZ
I  -119.6        168.5       -1138.        86.13       -304.3        335.1
C  -123.7        228.3       -1264.        64.22       -262.5        392.3
O  -127.7        288.0       -1391.        42.32       -220.8        449.6
```

```
     S1          S2          S3          SINT        SEQV        TEMP
I   236.4       -19.28      -1306.       1542.       1432.       155.3
C   273.1       -2.698      -1430.       1703.       1583.
O   317.3        13.60      -1562.       1879.       1747.       155.2


***** PATH VARIABLE SUMMARY *****

    S           PATH2
  0.0000       1542.3
 0.29550E-01   1557.6
 0.59100E-01   1573.1
 0.88650E-01   1588.7
 0.11820       1604.6
 0.14775       1620.6
 0.17730       1636.8
 0.20685       1653.2
 0.23640       1669.7
 0.26595       1686.4
 0.29550       1703.2
 0.32505       1720.2
 0.35460       1737.3
 0.38415       1754.6
 0.41370       1772.0
 0.44325       1789.5
 0.47280       1807.1
 0.50235       1824.9
 0.53190       1842.8
 0.56145       1860.8
 0.59100       1878.9

******************************** Section 3 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE = 120006     OUTSIDE NODE = 120007

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -145.3       366.3       -1872.      -17.57      -153.0       627.3
     S1          S2          S3          SINT        SEQV
  386.7       46.08       -2084.       2471.       2319.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   76.59       47.61       242.6       22.07      -17.26      -67.90
C   0.000       0.000       0.000       0.000       0.000       0.000
O  -76.59      -47.61      -242.6      -22.07       17.26       67.90
     S1          S2          S3          SINT        SEQV
I   269.3       64.03       33.38       236.0       222.2
C   0.000       0.000       0.000       0.000       0.000
O  -33.38      -64.03      -269.3       236.0       222.2

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -68.75       413.9      -1630.       4.490      -170.3       559.4
C  -145.3       366.3      -1872.      -17.57      -153.0       627.3
O  -221.9       318.7      -2115.      -39.64      -135.8       695.2
     S1          S2          S3          SINT        SEQV
I   432.9       104.0      -1821.       2254.       2109.
C   386.7       46.08      -2084.       2471.       2319.
O   342.7      -12.94      -2348.       2690.       2531.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
```

```
     SX          SY          SZ          SXY         SYZ         SXZ
I  0.3326E-01  0.2067E-01  0.1053      0.9581E-02 -0.7496E-02 -0.2948E-01
C -0.8328E-09 -0.2094E-08 -0.1578E-08 -0.2539E-09  0.4524E-09 -0.3790E-09
O -0.3326E-01 -0.2067E-01 -0.1053     -0.9581E-02  0.7496E-02  0.2948E-01
     S1          S2          S3          SINT        SEQV
I  0.1170      0.2780E-01  0.1449E-01  0.1025      0.9650E-01
C -0.5583E-09 -0.1589E-08 -0.2357E-08  0.1799E-08  0.1563E-08
O -0.1449E-01 -0.2780E-01 -0.1170      0.1025      0.9650E-01

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -68.71       413.9      -1629.       4.500      -170.3       559.4
C  -145.3       366.3      -1872.      -17.57      -153.0       627.3
O  -222.0       318.7      -2115.      -39.65      -135.8       695.3
     S1          S2          S3          SINT        SEQV        TEMP
I   432.9       104.0      -1821.       2254.       2109.       155.0
C   386.7       46.08      -2084.       2471.       2319.
O   342.7      -12.96      -2348.       2691.       2532.       155.5


***** PATH VARIABLE SUMMARY *****

    S           PATH3
  0.0000      2254.2
 0.12808      2275.6
 0.25616      2297.2
 0.38424      2318.7
 0.51232      2340.3
 0.64040      2362.0
 0.76848      2383.7
 0.89656      2405.4
  1.0246      2427.1
  1.1527      2448.9
  1.2808      2470.7
  1.4089      2492.6
  1.5370      2514.5
  1.6650      2536.4
  1.7931      2558.3
  1.9212      2580.3
  2.0493      2602.3
  2.1773      2624.3
  2.3054      2646.4
  2.4335      2668.4
  2.5616      2690.6

******************************** Section 4 **********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE = 120008     OUTSIDE NODE = 120009

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  796.5       3195.      -731.7      -146.6       453.0       592.3
     S1          S2          S3          SINT        SEQV
  3250.       999.1      -988.5       4238.       3673.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   2037.       5828.       3628.       1.630       792.3      -457.6
C   0.000       0.000       0.000       0.000       0.000       0.000
O  -2037.      -5828.      -3628.      -1.630      -792.3       457.6
     S1          S2          S3          SINT        SEQV
I   6088.       3501.       1903.       4185.       3658.
```

```
C   0.000       0.000       0.000       0.000       0.000
O  -1903.      -3501.      -6088.       4185.       3658.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   2833.       9023.       2896.      -145.0       1245.       134.7
C   796.5       3195.      -731.7      -146.6       453.0       592.3
O  -1240.      -2632.      -4359.      -148.3      -339.3       1050.
     S1          S2          S3          SINT        SEQV
I   9269.       2925.       2559.       6710.       6534.
C   3250.       999.1      -988.5       4238.       3673.
O  -886.4      -2628.      -4718.       3832.       3323.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -6230.       477.9      -3430.       2565.      -1233.     -0.9385
C  -1103.      -2760.      -1947.       29.68      -531.3       282.1
O   903.2       3108.       1511.       4.729       283.2      -123.1
     S1          S2          S3          SINT        SEQV
I   1618.      -3658.      -7142.       8760.       7639.
C  -1007.      -1768.      -3035.       2028.       1774.
O   3157.       1487.       877.5       2279.       2044.

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -3397.       9501.      -534.5       2420.       11.95       133.7
C  -306.8       435.3      -2678.      -116.9      -78.27       874.3
O  -337.3       475.5      -2849.      -143.5      -56.11       926.8
     S1          S2          S3          SINT        SEQV        TEMP
I   9940.      -529.5      -3841.      0.1378E+05  0.1246E+05   155.7
C   473.1      -56.61      -2966.       3439.       3207.
O   518.5      -75.32      -3154.       3672.       3414.       155.6


***** PATH VARIABLE SUMMARY *****

    S           PATH4
  0.0000      13781.
 0.26719      11072.
 0.53438      10251.
 0.80157      7512.2
  1.0688      7621.4
  1.3360      6975.7
  1.6031      5156.8
  1.8703      4874.4
  2.1375      3392.8
  2.4047      3416.0
  2.6719      3439.2
  2.9391      3462.5
  3.2063      3485.8
  3.4735      3509.1
  3.7407      3532.3
  4.0079      3555.6
  4.2750      3579.0
  4.5422      3602.3
  4.8094      3625.6
  5.0766      3649.0
  5.3438      3672.3

******************************** Section 5 **********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE = 120010     OUTSIDE NODE = 120011

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.
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```
             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -804.8      -8455.      -939.3      -116.6       892.2      -502.5
     S1          S2          S3          SINT        SEQV
 -306.7      -1332.      -8560.       8253.       7791.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -1778.      -7587.      -2421.      -480.1       1042.      -1168.
C   0.000       0.000       0.000       0.000       0.000       0.000
O   1778.       7587.       2421.       480.1      -1042.       1168.
     S1          S2          S3          SINT        SEQV
I  -735.8      -3251.      -7800.       7064.       6202.
C   0.000       0.000       0.000       0.000       0.000
O   7800.       3251.       735.8       7064.       6202.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -2583.     -0.1604E+05  -3361.      -596.7       1934.      -1671.
C  -804.8      -8455.      -939.3      -116.6       892.2      -502.5
O   973.6      -867.9       1482.       363.5      -149.7       665.8
     S1          S2          S3          SINT        SEQV
I  -1066.      -4581.     -0.1634E+05  0.1527E+05  0.1385E+05
C  -306.7      -1332.      -8560.       8253.       7791.
O   1943.       614.4      -969.7       2913.       2526.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   621.7      -4694.      -2533.       1357.      -1659.       168.5
C   112.2       2407.       463.3       34.35      -105.2       471.0
O  -786.8      -3410.      -1440.      -140.1       368.0      -654.2
     S1          S2          S3          SINT        SEQV
I   964.4      -1723.      -5846.       6810.       5942.
C   2413.       787.6      -217.9       2631.       2299.
O  -349.8      -1810.      -3477.       3127.       2710.

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -1962.     -0.2074E+05  -5893.       759.9       275.1      -1502.
C  -692.6      -6048.      -476.0      -82.28       787.1      -31.53
O   186.8      -4278.       42.35       223.4       218.3       11.56
     S1          S2          S3          SINT        SEQV        TEMP
I  -1433.      -6384.     -0.2077E+05  0.1934E+05  0.1740E+05   155.3
C  -361.5      -697.0      -6158.       5797.       5636.
O   201.3       49.85      -4300.       4502.       4428.       155.1


***** PATH VARIABLE SUMMARY *****

    S           PATH5
  0.0000       19341.
 0.78740E-01   17766.
 0.15748       15975.
 0.23622       14331.
 0.31496       12851.
 0.39370       11547.
 0.47244       10211.
 0.55118       8908.0
 0.62992       7648.1
 0.70866       6457.5
 0.78740       5796.5
 0.86614       5607.5
 0.94488       5423.6
  1.0236       5245.3
  1.1024       5072.5
  1.1811       4921.2
  1.2598       4810.1
```

```
  1.3386      4702.5
  1.4173      4604.9
  1.4961      4538.9
  1.5748      4501.7

PRINT ITERATION SUMMARY

          **** POST1 ITERATION SUMMARY ****

LOAD STEP    4  SUBSTEP    1        CUMULATIVE ITERATION   16
TIME =    4.00000               TIME INCREMENT =    1.00000
 NUMBER OF EQUILIBRIUM ITERATIONS =         12
 CONVERGENCE INDICATOR = 1
 MAXIMUM DEGREE OF FREEDOM VALUE =    1.75112
 RESPONSE FREQUENCY FOR 2ND ORDER SYSTEMS =    0.00000
 DESCENT PARAMETER =    0.00000
 FORCE CONVERGENCE VALUE =    9976.35
 MOMENT CONVERGENCE VALUE =    0.00000
 DISPLACEMENT CONVERGENCE VALUE =    0.00000
 ROTATION CONVERGENCE VALUE =    0.00000


NUMBER OF WARNING MESSAGES ENCOUNTERED=        105
NUMBER OF ERROR   MESSAGES ENCOUNTERED=          0
```

Stress_end_nct_tc3.txt

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******************************** Section 1 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE =1000000     OUTSIDE NODE =1000001

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -395.4       1945.       1009.       27.70      -76.97      -452.6
     S1          S2          S3          SINT        SEQV
  1953.       1134.      -528.6       2482.       2190.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -131.6      -44.67      -37.02      -43.32       4.540       11.45
C   0.000       0.000       0.000       0.000       0.000       0.000
O   131.6       44.67       37.02       43.32      -4.540      -11.45
     S1          S2          S3          SINT        SEQV
I  -26.76      -35.69      -150.8       124.1       119.9
C   0.000       0.000       0.000       0.000       0.000
O   150.8       35.69       26.76       124.1       119.9

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -527.1       1900.       972.2      -15.62      -72.43      -441.1
C  -395.4       1945.       1009.       27.70      -76.97      -452.6
O  -263.8       1989.       1046.       71.03      -81.51      -464.0
     S1          S2          S3          SINT        SEQV
I   1906.       1087.      -647.7       2553.       2258.
C   1953.       1134.      -528.6       2482.       2190.
O   2002.       1182.      -412.3       2415.       2127.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I -0.5715E-01 -0.1939E-01 -0.1608E-01 -0.1881E-01  0.1971E-02  0.4970E-02
C -0.4414E-09 -0.2434E-08 -0.1950E-08  0.1227E-10  0.1855E-09  0.1212E-08
O  0.5715E-01  0.1939E-01  0.1608E-01  0.1881E-01 -0.1971E-02 -0.4970E-02
     S1          S2          S3          SINT        SEQV
I -0.1162E-01 -0.1550E-01 -0.6550E-01  0.5388E-01  0.5205E-01
C  0.2354E-09 -0.2349E-08 -0.2712E-08  0.2947E-08  0.2784E-08
O  0.6550E-01  0.1550E-01  0.1162E-01  0.5388E-01  0.5205E-01

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -527.1       1900.       972.2      -15.64      -72.42      -441.1
C  -395.4       1945.       1009.       27.70      -76.97      -452.6
O  -263.8       1989.       1046.       71.05      -81.51      -464.0
     S1          S2          S3          SINT        SEQV        TEMP
I   1906.       1087.      -647.7       2554.       2258.       0.000
C   1953.       1134.      -528.6       2482.       2190.
O   2002.       1182.      -412.2       2415.       2127.       0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH1
  0.0000       2553.5
 0.59043E-01   2546.1
 0.11809       2538.7
 0.17713       2531.4
 0.23617       2524.2
```

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 0.29522      2516.9
 0.35426      2509.8
 0.41330      2502.7
 0.47235      2495.6
 0.53139      2488.5
 0.59043      2481.6
 0.64948      2474.6
 0.70852      2467.8
 0.76756      2460.9
 0.82661      2454.1
 0.88565      2447.4
 0.94469      2440.7
  1.0037      2434.1
  1.0628      2427.5
  1.1218      2421.0
  1.1809      2414.6

****************************** Section 2 *********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE =1000002     OUTSIDE NODE =1000003

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -69.32       386.2       330.3       -20.73      -75.68      -125.9
     S1          S2          S3          SINT        SEQV
  445.9       310.5      -109.1        555.0       501.2

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   150.2       -771.4      -108.0      -7.849      -22.69       141.2
C   0.000        0.000       0.000       0.000       0.000       0.000
O  -150.2        771.4       108.0       7.849       22.69      -141.2
     S1          S2          S3          SINT        SEQV
I   212.8       -169.7      -772.2       984.9       860.0
C   0.000        0.000       0.000       0.000       0.000
O   772.2        169.7      -212.8       984.9       860.0

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   80.93       -385.2       222.3      -28.57      -98.37       15.30
C  -69.32        386.2       330.3      -20.73      -75.68      -125.9
O  -219.6        1158.       438.3      -12.88      -52.99      -267.2
     S1          S2          S3          SINT        SEQV
I   240.3        79.89      -402.1       642.3       579.1
C   445.9        310.5      -109.1       555.0       501.2
O   1161.        529.8      -315.0       1477.       1283.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -63.52        412.6      -223.3       75.60       167.6       54.67
C  -55.53        1758.       833.2       103.2      -28.19      -379.0
O  -26.38        340.7       351.0       104.7      -97.96      -129.5
     S1          S2          S3          SINT        SEQV
I   468.1       -71.46      -270.9       739.1       662.3
C   1766.        968.0      -199.1       1966.       1712.
O   496.7        248.2      -79.54       576.2       500.6

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   17.41        27.42      -0.9990      47.02       69.18       69.98
C  -124.9        2144.       1164.       82.50      -103.9      -504.9
O  -246.0        1498.       789.3       91.82      -150.9      -396.6
```

```
     S1          S2          S3          SINT        SEQV        TEMP
I   138.8       -24.45      -70.53       209.4       190.5       0.000
C   2164.        1319.      -299.9       2464.       2168.
O   1547.        876.1      -381.2       1928.       1695.       0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH2
  0.0000       209.35
 0.59046E-01   779.49
 0.11809       708.89
 0.17714       638.89
 0.23619       569.68
 0.29523       501.53
 0.35428       434.95
 0.41332       374.11
 0.47237       323.56
 0.53142       2259.8
 0.59046       2463.6
 0.64951       2650.1
 0.70856       229.49
 0.76760       249.98
 0.82665       294.33
 0.88569       350.07
 0.94474       410.36
  1.0038       473.01
  1.0628       537.09
  1.1219       2086.8
  1.1809       1928.0

****************************** Section 3 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE =1000004     OUTSIDE NODE =1000005

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
  168.6       85.38       554.8       649.0      -68.11       571.1
     S1          S2          S3          SINT        SEQV
  1099.       401.0      -691.5       1791.       1563.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -1047.      -3960.      -2414.      -2359.       622.4      -767.2
C   0.000       0.000       0.000       0.000       0.000       0.000
O   1047.       3960.       2414.       2359.      -622.4       767.2
     S1          S2          S3          SINT        SEQV
I   585.8      -2720.      -5287.       5872.       5099.
C   0.000       0.000       0.000       0.000       0.000
O   5287.       2720.      -585.8       5872.       5099.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -878.2      -3874.      -1859.      -1710.       554.3      -196.1
C   168.6       85.38       554.8       649.0      -68.11       571.1
O   1215.       4045.       2969.       3008.      -690.5       1338.
     S1          S2          S3          SINT        SEQV
I  -10.74      -1887.      -4714.       4703.       4100.
C   1099.       401.0      -691.5       1791.       1563.
O   5961.       3498.      -1230.       7192.       6330.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
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     SX          SY          SZ          SXY         SYZ         SXZ
I   555.8      -5717.      -8214.       471.1       141.5      -7358.
C   848.1       273.5      -1527.      -367.7       382.2      -591.8
O  -735.1       8981.       8359.       3500.      -1820.       3798.
     S1          S2          S3          SINT        SEQV
I   4747.      -5710.     -0.1241E+05  0.1716E+05  0.1498E+05
C   1207.       97.40      -1709.       2916.       2550.
O  0.1053E+05   9431.      -3355.      0.1388E+05  0.1337E+05

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -322.4      -9592.     -0.1007E+05  -1239.       695.8      -7554.
C   1017.       358.9      -971.9       281.2       314.0      -20.77
O   480.3      0.1303E+05  0.1133E+05   6508.      -2511.       5137.
     S1          S2          S3          SINT        SEQV        TEMP
I   3942.      -9741.     -0.1419E+05  0.1813E+05  0.1637E+05   0.000
C   1125.       324.7      -1046.       2170.       1901.
O  0.1583E+05  0.1337E+05  -4364.      0.2019E+05  0.1908E+05   0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH3
  0.0000      18131.
 0.96458E-01  6948.8
 0.19292      5402.9
 0.28937      3951.4
 0.38583      2654.3
 0.48229      1834.0
 0.57875      2008.2
 0.67520      2258.9
 0.77166      2222.1
 0.86812      2189.4
 0.96458      2170.2
  1.0610      2216.0
  1.1575      2490.2
  1.2540      3047.5
  1.3504      3259.0
  1.4469      3485.7
  1.5433      3814.7
  1.6398      4526.1
  1.7362      12916.
  1.8327      15203.
  1.9292      20190.

******************************** Section 4 **********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE =1000006     OUTSIDE NODE =1000007

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -140.6      -2087.       102.6       7.068      -205.7       747.0
     S1          S2          S3          SINT        SEQV
  746.0      -761.5      -2110.       2856.       2474.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -953.0      -6015.      -1176.       98.24      -549.6       1044.
C   0.000       0.000       0.000       0.000       0.000       0.000
O   953.0       6015.       1176.      -98.24       549.6      -1044.
     S1          S2          S3          SINT        SEQV
I  0.4449      -2059.      -6086.       6087.       5362.
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C   0.000       0.000       0.000       0.000       0.000
O   6086.       2059.     -0.4449       6087.       5362.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -1094.      -8102.      -1074.       105.3      -755.3       1791.
C  -140.6      -2087.       102.6       7.068      -205.7       747.0
O   812.4       3928.       1279.      -91.17       343.9      -297.5
     S1          S2          S3          SINT        SEQV
I   732.2      -2806.      -8196.       8928.       7787.
C   746.0      -761.5      -2110.       2856.       2474.
O   3977.       1376.       666.1       3311.       3019.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -8695.      -8422.     -0.1076E+05  -746.3       3263.       5051.
C   654.5       2145.       585.7      -6.860       172.8      -642.2
O  -869.5      -3918.      -884.7       75.23      -332.2       502.3
     S1          S2          S3          SINT        SEQV
I  -3964.      -7825.     -0.1609E+05  0.1212E+05  0.1073E+05
C   2168.       1246.      -29.75       2198.       1912.
O  -365.5      -1347.      -3960.       3594.       3218.

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -9788.     -0.1652E+05 -0.1183E+05  -641.0       2508.       6843.
C   513.9       57.58       688.3      0.2078      -32.91       104.8
O  -57.15       9.775       394.1      -15.94       11.72       204.8
     S1          S2          S3          SINT        SEQV        TEMP
I  -3785.     -0.1481E+05 -0.1955E+05  0.1577E+05  0.1401E+05   0.000
C   738.7       465.3       55.79       682.9       595.3
O   473.3       12.17      -138.7       612.0       552.3       0.000


***** PATH VARIABLE SUMMARY *****

    S           PATH4
  0.0000      15770.
 0.25197      18841.
 0.50394      13091.
 0.75591      6386.0
  1.0079      4432.7
  1.2599      4525.4
  1.5118      4140.7
  1.7638      2992.4
  2.0158      1994.4
  2.2677      1041.0
  2.5197      682.93
  2.7717      386.87
  3.0236      399.00
  3.2756      425.02
  3.5276      435.60
  3.7796      459.40
  4.0315      487.60
  4.2835      508.26
  4.5355      534.18
  4.7874      571.43
  5.0394      612.02

******************************** Section 5 **********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE =1000008     OUTSIDE NODE =1000009

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.
```

```
                ** MEMBRANE **
      SX            SY            SZ           SXY           SYZ           SXZ
   2390.         548.4         304.1         205.5        -106.1        -111.9
      S1            S2            S3          SINT          SEQV
   2420.         558.8         263.9         2156.         2025.

                ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
      SX            SY            SZ           SXY           SYZ           SXZ
I    2350.         342.3         460.7        -798.0        -88.54        -627.6
C    0.000         0.000         0.000         0.000         0.000         0.000
O   -2350.        -342.3        -460.7         798.0         88.54         627.6
      S1            S2            S3          SINT          SEQV
I    2768.         503.3        -118.2         2887.         2631.
C    0.000         0.000         0.000         0.000         0.000
O    118.2        -503.3        -2768.         2887.         2631.

                ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
      SX            SY            SZ           SXY           SYZ           SXZ
I    4740.         890.7         764.8        -592.5        -194.6        -739.5
C    2390.         548.4         304.1         205.5        -106.1        -111.9
O    39.55         206.0        -156.6         1004.        -17.53         515.8
      S1            S2            S3          SINT          SEQV
I    4948.         1032.         415.9         4532.         4258.
C    2420.         558.8         263.9         2156.         2025.
O    1217.        -64.53        -1063.         2280.         1980.

                ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
      SX            SY            SZ           SXY           SYZ           SXZ
I   -1936.        -3520.        -1967.         55.50        -504.1        -30.07
C    527.1         130.6        -460.6         122.7         241.2         108.0
O   -851.6        -40.72        -167.3        -262.5        -320.6         342.0
      S1            S2            S3          SINT          SEQV
I   -1803.        -1950.        -3671.         1868.         1799.
C    591.7         155.4        -550.0         1142.         997.9
O    368.8        -417.4        -1011.         1380.         1199.

                ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
      SX            SY            SZ           SXY           SYZ           SXZ
I    2804.        -2629.        -1202.        -537.0        -698.8        -769.5
C    2917.         679.0        -156.5         328.2         135.1        -3.828
O   -812.0         165.3        -323.9         741.1        -338.2         857.8
      S1            S2            S3          SINT          SEQV          TEMP
I    2976.        -980.5        -3023.         6000.         5283.         0.000
C    2964.         654.1        -178.8         3143.         2820.
O    590.7         224.9        -1786.         2377.         2217.         0.000


***** PATH VARIABLE SUMMARY *****

     S            PATH5
   0.0000        5999.8
 0.78740E-01     4009.0
 0.15748         3750.1
 0.23622         3538.4
 0.31496         3372.2
 0.39370         3237.3
 0.47244         3105.1
 0.55118         3086.5
 0.62992         3115.8
 0.70866         3173.5
 0.78740         3143.1
 0.86614         2736.9
 0.94488         2348.7
  1.0236         2006.5
  1.1024         1852.6
  1.1811         1737.9
  1.2598         1563.3
```

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  1.3386      1590.0
  1.4173      1767.8
  1.4961      2041.6
  1.5748      2376.9

PRINT ITERATION SUMMARY

          **** POST1 ITERATION SUMMARY ****

LOAD STEP    4  SUBSTEP    1        CUMULATIVE ITERATION    6
TIME =    4.00000               TIME INCREMENT =    1.00000
 NUMBER OF EQUILIBRIUM ITERATIONS =          2
 CONVERGENCE INDICATOR = 1
 MAXIMUM DEGREE OF FREEDOM VALUE =   0.966718E-01
 RESPONSE FREQUENCY FOR 2ND ORDER SYSTEMS =    0.00000
 DESCENT PARAMETER =    0.00000
 FORCE CONVERGENCE VALUE =    6868.72
 MOMENT CONVERGENCE VALUE =    0.00000
 DISPLACEMENT CONVERGENCE VALUE =    0.00000
 ROTATION CONVERGENCE VALUE =    0.00000


NUMBER OF WARNING MESSAGES ENCOUNTERED=        119
NUMBER OF ERROR   MESSAGES ENCOUNTERED=          1
```

Stress_side_nct_tc3.txt

```
******************************** Section 1 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE = 120002     OUTSIDE NODE = 120003

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -395.4       1945.       1009.       27.70      -76.97      -452.6
     S1          S2          S3          SINT        SEQV
  1953.       1134.      -528.6       2482.       2190.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -131.6      -44.67      -37.02      -43.32       4.540       11.45
C   0.000       0.000       0.000       0.000       0.000       0.000
O   131.6       44.67       37.02       43.32      -4.540      -11.45
     S1          S2          S3          SINT        SEQV
I  -26.76      -35.69      -150.8       124.1       119.9
C   0.000       0.000       0.000       0.000       0.000
O   150.8       35.69       26.76       124.1       119.9

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -527.1       1900.       972.2      -15.62      -72.43      -441.1
C  -395.4       1945.       1009.       27.70      -76.97      -452.6
O  -263.8       1989.       1046.       71.03      -81.51      -464.0
     S1          S2          S3          SINT        SEQV
I   1906.       1087.      -647.7       2553.       2258.
C   1953.       1134.      -528.6       2482.       2190.
O   2002.       1182.      -412.3       2415.       2127.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I -0.5715E-01 -0.1939E-01 -0.1608E-01 -0.1881E-01  0.1971E-02  0.4970E-02
C -0.4414E-09 -0.2434E-08 -0.1950E-08  0.1227E-10  0.1855E-09  0.1212E-08
O  0.5715E-01  0.1939E-01  0.1608E-01  0.1881E-01 -0.1971E-02 -0.4970E-02
     S1          S2          S3          SINT        SEQV
I -0.1162E-01 -0.1550E-01 -0.6550E-01  0.5388E-01  0.5205E-01
C  0.2354E-09 -0.2349E-08 -0.2712E-08  0.2947E-08  0.2784E-08
O  0.6550E-01  0.1550E-01  0.1162E-01  0.5388E-01  0.5205E-01

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -527.1       1900.       972.2      -15.64      -72.42      -441.1
C  -395.4       1945.       1009.       27.70      -76.97      -452.6
O  -263.8       1989.       1046.       71.05      -81.51      -464.0
     S1          S2          S3          SINT        SEQV        TEMP
I   1906.       1087.      -647.7       2554.       2258.      -33.35
C   1953.       1134.      -528.6       2482.       2190.
O   2002.       1182.      -412.2       2415.       2127.      -33.36


***** PATH VARIABLE SUMMARY *****

    S           PATH1
  0.0000      2553.5
 0.59043E-01  2546.1
 0.11809      2538.7
 0.17713      2531.4
 0.23617      2524.2
```

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 0.29522      2516.9
 0.35426      2509.8
 0.41330      2502.7
 0.47235      2495.6
 0.53139      2488.5
 0.59043      2481.6
 0.64948      2474.6
 0.70852      2467.8
 0.76756      2460.9
 0.82661      2454.1
 0.88565      2447.4
 0.94469      2440.7
  1.0037      2434.1
  1.0628      2427.5
  1.1218      2421.0
  1.1809      2414.6

****************************** Section 2 *********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE = 120004     OUTSIDE NODE = 120005

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -186.9       1885.       1023.       91.98      -112.1      -522.0
     S1          S2          S3          SINT        SEQV
  1913.       1190.      -381.9       2295.       2032.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -7.107       8.985      -9.019       2.102       9.679       26.31
C   0.000       0.000       0.000       0.000       0.000       0.000
O   7.107      -8.985       9.019      -2.102      -9.679      -26.31
     S1          S2          S3          SINT        SEQV
I   23.21       4.746      -35.10       58.31       51.61
C   0.000       0.000       0.000       0.000       0.000
O   35.10      -4.746      -23.21       58.31       51.61

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -194.0       1894.       1014.       94.08      -102.4      -495.7
C  -186.9       1885.       1023.       91.98      -112.1      -522.0
O  -179.8       1876.       1032.       89.87      -121.7      -548.3
     S1          S2          S3          SINT        SEQV
I   1918.       1169.      -372.6       2290.       2023.
C   1913.       1190.      -381.9       2295.       2032.
O   1909.       1211.      -391.7       2300.       2043.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I -0.3086E-02  0.3901E-02 -0.3916E-02  0.9129E-03  0.4203E-02  0.1142E-01
C -0.2578E-10 -0.3843E-10 -0.3934E-10  0.4107E-11  0.8413E-11  0.3661E-10
O  0.3086E-02 -0.3901E-02  0.3916E-02 -0.9129E-03 -0.4203E-02 -0.1142E-01
     S1          S2          S3          SINT        SEQV
I  0.1008E-01  0.2061E-02 -0.1524E-01  0.2532E-01  0.2241E-01
C  0.6309E-11 -0.3958E-10 -0.7026E-10  0.7657E-10  0.6675E-10
O  0.1524E-01 -0.2061E-02 -0.1008E-01  0.2532E-01  0.2241E-01

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -194.0       1894.       1014.       94.08      -102.4      -495.6
C  -186.9       1885.       1023.       91.98      -112.1      -522.0
O  -179.8       1876.       1032.       89.87      -121.7      -548.3
```

```
     S1          S2          S3          SINT        SEQV        TEMP
I   1918.        1169.       -372.6      2290.       2023.       -33.36
C   1913.        1190.       -381.9      2295.       2032.
O   1909.        1211.       -391.7      2300.       2043.       -33.37


***** PATH VARIABLE SUMMARY *****

    S           PATH2
  0.0000       2290.3
 0.29550E-01   2290.7
 0.59100E-01   2291.1
 0.88650E-01   2291.5
 0.11820       2292.0
 0.14775       2292.4
 0.17730       2292.8
 0.20685       2293.3
 0.23640       2293.8
 0.26595       2294.3
 0.29550       2294.7
 0.32505       2295.3
 0.35460       2295.8
 0.38415       2296.3
 0.41370       2296.8
 0.44325       2297.4
 0.47280       2297.9
 0.50235       2298.5
 0.53190       2299.1
 0.56145       2299.7
 0.59100       2300.3

****************************** Section 3 **********************************

         ***** POST1 LINEARIZED STRESS LISTING *****
        INSIDE NODE = 120006     OUTSIDE NODE = 120007

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -168.3       1861.       1151.       79.71      -126.4      -637.6
     S1          S2          S3          SINT        SEQV
  1905.       1366.       -426.3      2331.       2114.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -11.13       -37.11      -71.46      -4.531      -0.8825      34.01
C   0.000        0.000       0.000       0.000       0.000       0.000
O   11.13        37.11       71.46       4.531       0.8825      -34.01
     S1          S2          S3          SINT        SEQV
I   4.655       -37.57      -86.78      91.43       79.26
C   0.000        0.000       0.000       0.000       0.000
O   86.78        37.57      -4.655       91.43       79.26

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -179.5       1824.       1080.       75.17      -127.3      -603.6
C  -168.3       1861.       1151.       79.71      -126.4      -637.6
O  -157.2       1898.       1223.       84.24      -125.6      -671.6
     S1          S2          S3          SINT        SEQV
I   1863.       1283.       -422.2      2286.       2058.
C   1905.       1366.       -426.3      2331.       2114.
O   1947.       1447.       -430.5      2377.       2171.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
```

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     SX          SY          SZ          SXY         SYZ         SXZ
I -0.4831E-02 -0.1611E-01 -0.3103E-01 -0.1967E-02 -0.3832E-03  0.1477E-01
C -0.4614E-08 -0.3686E-09  0.1403E-08  0.4570E-09 -0.5554E-10 -0.6737E-08
O  0.4831E-02  0.1611E-01  0.3103E-01  0.1967E-02  0.3832E-03 -0.1477E-01
     S1          S2          S3          SINT        SEQV
I  0.2021E-02 -0.1631E-01 -0.3768E-01  0.3970E-01  0.3442E-01
C  0.5787E-08 -0.3683E-09 -0.8997E-08  0.1478E-07  0.1286E-07
O  0.3768E-01  0.1631E-01 -0.2021E-02  0.3970E-01  0.3442E-01

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -179.5       1824.       1080.       75.17      -127.3      -603.6
C  -168.3       1861.       1151.       79.71      -126.4      -637.6
O  -157.2       1898.       1223.       84.24      -125.6      -671.6
     S1          S2          S3          SINT        SEQV        TEMP
I   1863.       1283.      -422.2       2286.       2058.      -33.38
C   1905.       1366.      -426.3       2331.       2114.
O   1947.       1447.      -430.5       2377.       2171.      -33.38


***** PATH VARIABLE SUMMARY *****

    S           PATH3
  0.0000      2285.6
 0.12808      2290.1
 0.25616      2294.7
 0.38424      2299.2
 0.51232      2303.7
 0.64040      2308.3
 0.76848      2312.8
 0.89656      2317.4
  1.0246      2322.0
  1.1527      2326.5
  1.2808      2331.1
  1.4089      2335.7
  1.5370      2340.3
  1.6650      2344.9
  1.7931      2349.5
  1.9212      2354.1
  2.0493      2358.8
  2.1773      2363.4
  2.3054      2368.1
  2.4335      2372.7
  2.5616      2377.4

******************************** Section 4 **********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE = 120008     OUTSIDE NODE = 120009

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.

             ** MEMBRANE **
     SX          SY          SZ          SXY         SYZ         SXZ
 -997.2       1673.      -35.68      -31.59       164.9      -383.4
     S1          S2          S3          SINT        SEQV
  1691.       81.15      -1132.       2822.       2452.

             ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -1687.       201.1      -2431.      -461.6       647.9       607.1
C   0.000       0.000       0.000       0.000       0.000       0.000
O   1687.      -201.1       2431.       461.6      -647.9      -607.1
     S1          S2          S3          SINT        SEQV
I   402.4      -1350.      -2969.       3371.       2920.
```

```
C   0.000       0.000       0.000       0.000       0.000
O   2969.       1350.      -402.4       3371.       2920.

             ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I  -2684.       1874.      -2467.      -493.2       812.8       223.8
C  -997.2       1673.      -35.68      -31.59       164.9      -383.4
O   689.4       1472.       2395.       430.0      -483.0      -990.5
     S1          S2          S3          SINT        SEQV
I   2063.      -2358.      -2982.       5045.       4764.
C   1691.       81.15      -1132.       2822.       2452.
O   3088.       1266.       203.3       2885.       2527.

             ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   3875.       8357.       7638.       2252.       287.8       10.08
C   996.9       175.1       1472.       169.9      -261.4      -324.3
O  -331.0       493.9      -718.1      -300.8       396.0       332.3
     S1          S2          S3          SINT        SEQV
I   9336.       7597.       2937.       6399.       5731.
C   1700.       833.9       110.6       1589.       1378.
O   654.5      -144.2      -1065.       1720.       1491.

             ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
     SX          SY          SZ          SXY         SYZ         SXZ
I   1191.      0.1023E+05   5171.       1759.       1101.       233.8
C -0.3105       1848.       1437.       138.3      -96.57      -707.7
O   358.5       1966.       1677.       129.2      -87.08      -658.2
     S1          S2          S3          SINT        SEQV        TEMP
I  0.1079E+05   4946.       861.0       9926.       8641.      -33.39
C   1944.       1634.      -294.2       2239.       2101.
O   2090.       1830.       82.22       2008.       1891.      -33.40


***** PATH VARIABLE SUMMARY *****

    S           PATH4
  0.0000      9925.8
 0.26719      10251.
 0.53438      4561.6
 0.80157      6205.1
  1.0688      5665.6
  1.3360      3845.8
  1.6031      3616.9
  1.8703      5515.7
  2.1375      2286.4
  2.4047      2262.4
  2.6719      2238.5
  2.9391      2214.8
  3.2063      2191.1
  3.4735      2167.6
  3.7407      2144.2
  4.0079      2121.0
  4.2750      2098.0
  4.5422      2075.1
  4.8094      2052.5
  5.0766      2030.0
  5.3438      2007.7

******************************** Section 5 **********************************

        ***** POST1 LINEARIZED STRESS LISTING *****
       INSIDE NODE = 120010     OUTSIDE NODE = 120011

 LOAD STEP     4  SUBSTEP=     1
 TIME=    4.0000         LOAD CASE=  0

THE FOLLOWING X,Y,Z STRESSES ARE IN THE GLOBAL COORDINATE SYSTEM.
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```
                ** MEMBRANE **
      SX            SY            SZ           SXY           SYZ           SXZ
   830.0         441.7         1520.         18.16        -62.63         932.9
      S1            S2            S3          SINT          SEQV
   2171.         450.2         170.9         2000.         1876.

                ** BENDING **  I=INSIDE C=CENTER O=OUTSIDE
      SX            SY            SZ           SXY           SYZ           SXZ
I    1417.        -326.7         2464.         749.6         929.9         1658.
C    0.000         0.000         0.000         0.000         0.000         0.000
O   -1417.         326.7        -2464.        -749.6        -929.9        -1658.
      S1            S2            S3          SINT          SEQV
I    4008.         204.9        -658.3         4666.         4300.
C    0.000         0.000         0.000         0.000         0.000
O    658.3        -204.9        -4008.         4666.         4300.

                ** MEMBRANE PLUS BENDING **  I=INSIDE C=CENTER O=OUTSIDE
      SX            SY            SZ           SXY           SYZ           SXZ
I    2247.         115.0         3984.         767.8         867.2         2591.
C    830.0         441.7         1520.         18.16        -62.63         932.9
O   -587.1         768.3        -943.7        -731.4        -992.5        -725.2
      S1            S2            S3          SINT          SEQV
I    6072.         408.3        -133.4         6205.         5953.
C    2171.         450.2         170.9         2000.         1876.
O    1308.        -19.32        -2051.         3359.         2930.

                ** PEAK **  I=INSIDE C=CENTER O=OUTSIDE
      SX            SY            SZ           SXY           SYZ           SXZ
I   -2108.        -2325.        -1473.        -1552.        -489.6        -513.3
C    520.6        -66.64         433.7         104.2        -301.3         311.5
O   -655.9         142.9        -388.0        -7.553         529.6        -403.7
      S1            S2            S3          SINT          SEQV
I   -658.0        -1275.        -3973.         3315.         3054.
C    810.8         355.1        -278.2         1089.         947.2
O    514.2        -374.2        -1041.         1555.         1351.

                ** TOTAL **  I=INSIDE C=CENTER O=OUTSIDE
      SX            SY            SZ           SXY           SYZ           SXZ
I    138.7        -2210.         2511.        -784.4         377.6         2078.
C    1351.         375.0         1954.         122.3        -363.9         1244.
O   -1243.         911.2        -1332.        -739.0        -462.9        -1129.
      S1            S2            S3          SINT          SEQV          TEMP
I    3718.        -599.9        -2678.         6397.         5652.        -33.41
C    2950.         684.8         44.61         2906.         2644.
O    1146.        -189.1        -2621.         3767.         3308.        -33.42


***** PATH VARIABLE SUMMARY *****

     S            PATH5
   0.0000        6396.7
 0.78740E-01     5013.3
  0.15748        4759.9
  0.23622        4525.0
  0.31496        4310.8
  0.39370        4104.7
  0.47244        3831.1
  0.55118        3593.1
  0.62992        3390.0
  0.70866        3226.8
  0.78740        2905.6
  0.86614        2413.5
  0.94488        1983.8
   1.0236        1664.6
   1.1024        1550.1
   1.1811        1647.8
   1.2598        1828.4
```

```
  1.3386      2192.1
  1.4173      2662.3
  1.4961      3195.4
  1.5748      3767.2

PRINT ITERATION SUMMARY

          **** POST1 ITERATION SUMMARY ****

LOAD STEP    4  SUBSTEP    1        CUMULATIVE ITERATION    6
TIME =    4.00000               TIME INCREMENT =    1.00000
 NUMBER OF EQUILIBRIUM ITERATIONS =          2
 CONVERGENCE INDICATOR = 1
 MAXIMUM DEGREE OF FREEDOM VALUE =   0.966718E-01
 RESPONSE FREQUENCY FOR 2ND ORDER SYSTEMS =    0.00000
 DESCENT PARAMETER =    0.00000
 FORCE CONVERGENCE VALUE =    6868.72
 MOMENT CONVERGENCE VALUE =    0.00000
 DISPLACEMENT CONVERGENCE VALUE =    0.00000
 ROTATION CONVERGENCE VALUE =    0.00000


NUMBER OF WARNING MESSAGES ENCOUNTERED=        110
NUMBER OF ERROR   MESSAGES ENCOUNTERED=          1
```