

# TGT-CALC-103-007

Author	Dave Meekins
Subject	Tritium Cell and Shipping cover assy
First Saved	Sunday, August 30, 2015
Last Saved	Monday, August 31, 2015
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No

## Model and assumptions

### Geometry

**TABLE 2**  
**Model (A4) > Geometry**

Object Name	<i>Geometry</i>
State	Fully Defined
<b>Definition</b>	
Source	D:\Meekins\GoogleDrive\Vault\Hall A TGT_100\T2_103\Cell_1000\ship full.iam
Type	Inventor
Length Unit	Centimeters
Element Control	Program Controlled
Display Style	Body Color
<b>Bounding Box</b>	
Length X	13.908 in
Length Y	2.7884 in
Length Z	3. in
<b>Properties</b>	
Volume	80.071 in <sup>3</sup>
Mass	7.8671 lbm
Scale Factor Value	1.
<b>Statistics</b>	
Bodies	6
Active Bodies	6
Nodes	155862
Elements	89083
Mesh Metric	None
<b>Basic Geometry Options</b>	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	No

Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
<b>Advanced Geometry Options</b>	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\David\AppData\Local\Temp
Analysis Type	3-D
Mixed Import Resolution	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

**TABLE 3**  
**Model (A4) > Geometry > Parts**

Object Name	<i>TGT-103-1000-0100:1</i>	<i>TGT-103-1000-0106:1</i>	<i>TGT-103-1000-0110:1</i>	<i>TGT-103-1000-0110:2</i>	<i>ship main:1</i>	<i>ent plug:1</i>
State	Meshed					
<b>Graphics Properties</b>						
Visible	Yes					
Transparency	1					
<b>Definition</b>						
Suppressed	No					
Stiffness Behavior	Flexible					
Coordinate System	Default Coordinate System					
Reference Temperature	By Environment					
<b>Material</b>						
Assignment	7075 (UNS A97075)					
Nonlinear Effects	Yes					
Thermal Strain Effects	Yes					
<b>Bounding Box</b>						
Length X	3.329 in	1. in	10.15 in	12.668 in	3.569 in	
Length Y	2.75 in	2.788 in		2.7876 in	1.25 in	
Length Z	2.75 in	1.5 in	0.77315 in	3. in	1.25 in	
<b>Properties</b>						
Volume	3.2739 in <sup>3</sup>	3.8426 in <sup>3</sup>	11.516 in <sup>3</sup>	49.155 in <sup>3</sup>	0.76653 in <sup>3</sup>	
Mass	0.32167 lbm	0.37755 lbm	1.1315 lbm	4.8296 lbm	7.5313e-002 lbm	

Centroid X	5.4163 in	-7.1505 in	-2.3754 in	-2.375 in	0.85932 in	5.0194 in
Centroid Y	0.10779 in		0.10797 in	0.10761 in	0.10779 in	0.10711 in
Centroid Z	2.2556 in		1.5138 in	2.9974 in	2.2556 in	2.2563 in
Moment of Inertia Ip1	0.25305 lbm·in <sup>2</sup>	0.30753 lbm·in <sup>2</sup>	0.52256 lbm·in <sup>2</sup>		6.0769 lbm·in <sup>2</sup>	6.5238e-003 lbm·in <sup>2</sup>
Moment of Inertia Ip2	0.32957 lbm·in <sup>2</sup>	0.10232 lbm·in <sup>2</sup>	9.1141 lbm·in <sup>2</sup>		66.038 lbm·in <sup>2</sup>	0.10213 lbm·in <sup>2</sup>
Moment of Inertia Ip3	0.32957 lbm·in <sup>2</sup>	0.26824 lbm·in <sup>2</sup>	9.5517 lbm·in <sup>2</sup>		67.691 lbm·in <sup>2</sup>	0.10212 lbm·in <sup>2</sup>
<b>Statistics</b>						
Nodes	14764	8203	52152		13415	15176
Elements	8533	4810	29830		7459	8621
Mesh Metric	None					

## Coordinate Systems

**TABLE 4**  
**Model (A4) > Coordinate Systems > Coordinate System**

Object Name	<i>Global Coordinate System</i>
State	Fully Defined
<b>Definition</b>	
Type	Cartesian
Coordinate System ID	0.
<b>Origin</b>	
Origin X	0. in
Origin Y	0. in
Origin Z	0. in
<b>Directional Vectors</b>	
X Axis Data	[ 1. 0. 0. ]
Y Axis Data	[ 0. 1. 0. ]
Z Axis Data	[ 0. 0. 1. ]

## Connections

**TABLE 5**  
**Model (A4) > Connections**

Object Name	<i>Connections</i>
State	Fully Defined
<b>Auto Detection</b>	
Generate Automatic Connection On Refresh	Yes
<b>Transparency</b>	
Enabled	Yes

**TABLE 6**  
**Model (A4) > Connections > Contacts**

Object Name	<i>Contacts</i>
State	Fully Defined
<b>Definition</b>	
Connection Type	Contact

Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Auto Detection	
Tolerance Type	Slider
Tolerance Slider	0.
Tolerance Value	3.6246e-002 in
Use Range	No
Face/Face	Yes
Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies
Statistics	
Connections	10
Active Connections	10

**TABLE 7**  
**Model (A4) > Connections > Contacts > Contact Regions**

Object Name	<i>Left cover to main body shell</i>	<i>left cover to main body bolted</i>	<i>end cap to main body bolted</i>	<i>right cover to main body bolted</i>	<i>right cover to main body shell</i>	<i>end cap to main body shell</i>	<i>ent to main bolted</i>	<i>ent to plug bolted</i>	<i>ent to plug side support</i>	<i>ent to plug window</i>
State	Fully Defined									
Scope										
Scoping Method	Geometry Selection									
Contact	1 Face				2 Faces	1 Face	8 Faces	1 Face		
Target	1 Face	2 Faces			1 Face	2 Faces	1 Face			
Contact Bodies	TGT-103-1000-0110:1	TGT-103-1000-0106:1	TGT-103-1000-0110:2	TGT-103-1000-0106:1	TGT-103-1000-0100:1	ent plug:1				
Target Bodies	ship main:1						TGT-103-1000-0100:1			
Definition										
Type	Bonded									
Scope Mode	Manual									
Behavior	Program Controlled									
Trim Contact	Program Controlled									
Suppressed	No									
Advanced										
Formulation	Program Controlled									
Detection Method	Program Controlled									
Penetration Tolerance	Program Controlled									

Elastic Slip Tolerance	Program Controlled
Normal Stiffness	Program Controlled
Update Stiffness	Program Controlled
Pinball Region	Program Controlled
<b>Geometric Modification</b>	
Contact Geometry Correction	None
Target Geometry Correction	None

## Mesh

**TABLE 8**  
**Model (A4) > Mesh**

Object Name	<i>Mesh</i>
State	Solved
<b>Display</b>	
Display Style	Body Color
<b>Defaults</b>	
Physics Preference	Mechanical
Relevance	0
<b>Sizing</b>	
Use Advanced Size Function	Off
Relevance Center	Medium
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Medium
Minimum Edge Length	6.9052e-002 in
<b>Inflation</b>	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
<b>Patch Conforming Options</b>	
Triangle Surface Mesher	Program Controlled
<b>Patch Independent Options</b>	
Topology Checking	No
<b>Advanced</b>	

Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
<b>Defeaturing</b>	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
<b>Statistics</b>	
Nodes	155862
Elements	89083
Mesh Metric	None

## Named Selections

**TABLE 9**  
**Model (A4) > Named Selections > Named Selections**

Object Name	<i>Problematic Geometry</i>
State	Suppressed
<b>Scope</b>	
Scoping Method	Geometry Selection
Geometry	No Selection
<b>Definition</b>	
Send to Solver	Yes
Visible	Yes
Program Controlled Inflation	Exclude
<b>Statistics</b>	
Type	Manual
Total Selection	No Selection
Suppressed	0
Used by Mesh Worksheet	No

## Static Structural (A5)

**TABLE 10**  
**Model (A4) > Analysis**

Object Name	<i>Static Structural (A5)</i>
State	Solved
<b>Definition</b>	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
<b>Options</b>	

Environment Temperature	71.6 °F
Generate Input Only	No

**TABLE 11**  
**Model (A4) > Static Structural (A5) > Analysis Settings**

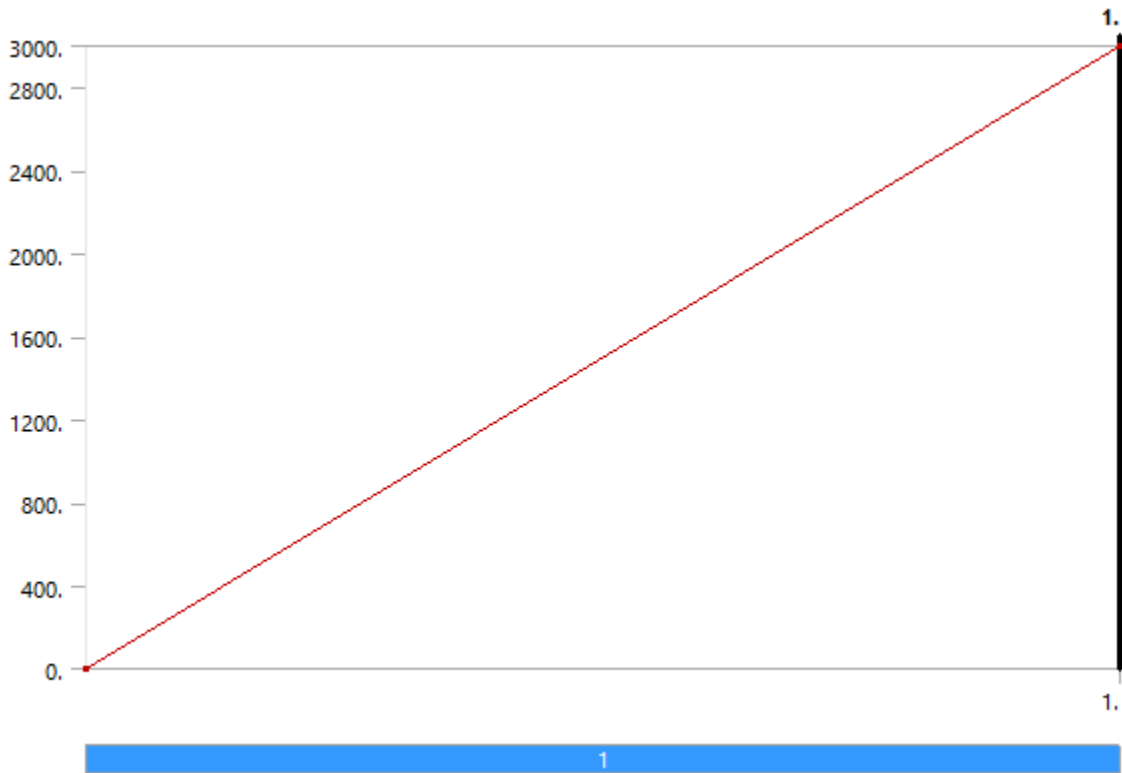
Object Name	<i>Analysis Settings</i>
State	Fully Defined
<b>Step Controls</b>	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
<b>Solver Controls</b>	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	On
Inertia Relief	Off
<b>Restart Controls</b>	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
<b>Nonlinear Controls</b>	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
<b>Output Controls</b>	
Stress	Yes
Strain	Yes
Nodal Forces	Yes
Contact Miscellaneous	Yes
General Miscellaneous	Yes
Store Results At	All Time Points
<b>Analysis Data Management</b>	
Solver Files Directory	D:\Meekins\GoogleDrive\JLAB\Hall A\Trtium\Calculations\ANSYS\Shipping\full ship_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	Yes

Solver Units	Active System
Solver Unit System	Bin

**TABLE 12**  
**Model (A4) > Static Structural (A5) > Loads**

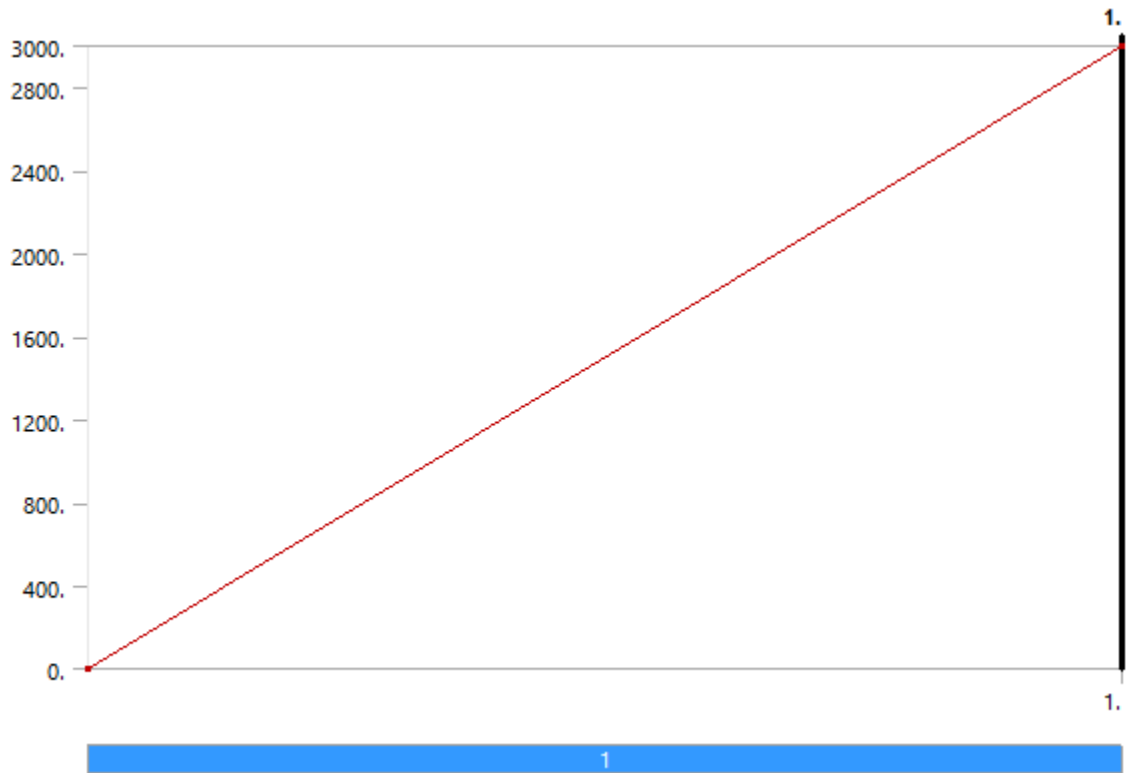
Object Name	<i>Pressure</i>	<i>Pressure 2</i>	<i>Fixed Support</i>
State	Fully Defined		
<b>Scope</b>			
Scoping Method	Geometry Selection		
Geometry	3 Faces	4 Faces	5 Faces
<b>Definition</b>			
Type	Pressure	Fixed Support	
Define By	Normal To		
Magnitude	3000. psi (ramped)		
Suppressed	No		

**FIGURE 1**  
**Model (A4) > Static Structural (A5) > Pressure**



**FIGURE 2**  
**Model (A4) > Static Structural (A5) > Pressure 2**





### Solution (A6)

**TABLE 13**  
**Model (A4) > Static Structural (A5) > Solution**

Object Name	<i>Solution (A6)</i>
State	Solved
<b>Adaptive Mesh Refinement</b>	
Max Refinement Loops	1.
Refinement Depth	2.
<b>Information</b>	
Status	Done
<b>Post Processing</b>	
Calculate Beam Section Results	No

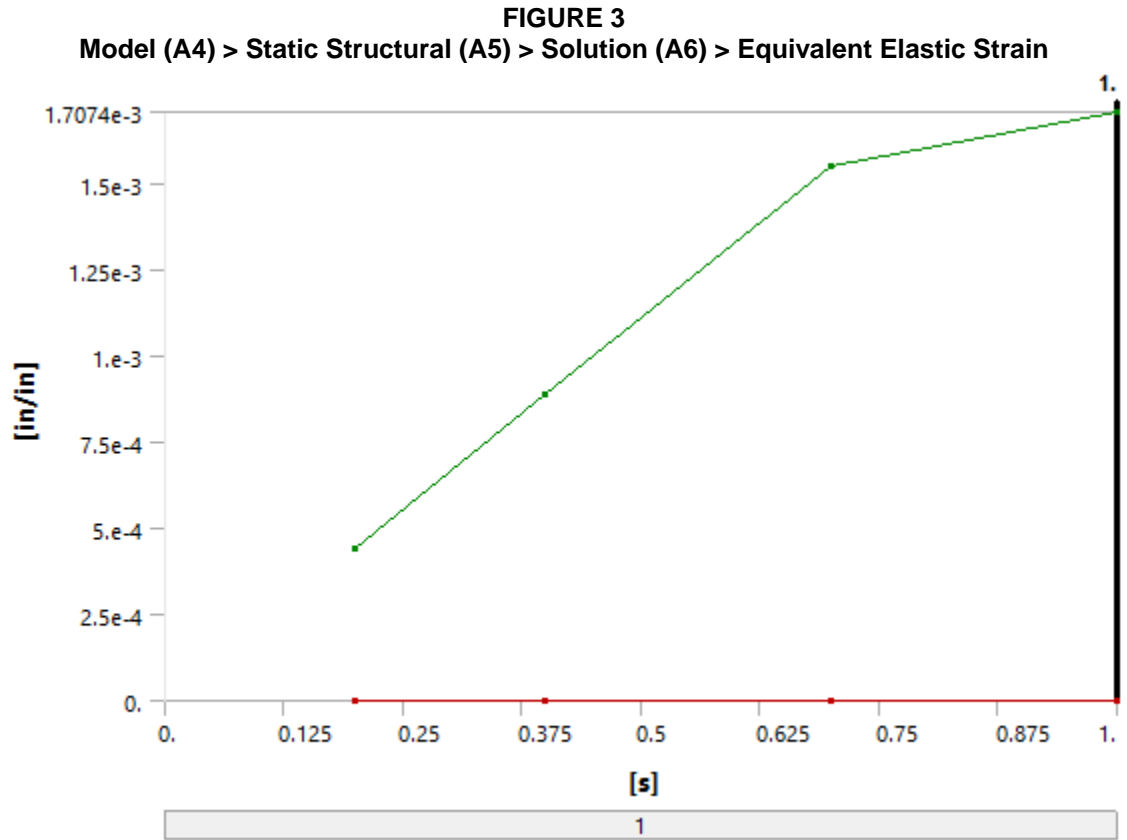
**TABLE 14**  
**Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information**

Object Name	<i>Solution Information</i>
State	Solved
<b>Solution Information</b>	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
<b>FE Connection Visibility</b>	
Activate Visibility	Yes

Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

**TABLE 15**  
**Model (A4) > Static Structural (A5) > Solution (A6) > Results**

Object Name	<i>Equivalent Elastic Strain</i>	<i>Maximum Principal Stress</i>	<i>Maximum Shear Stress</i>	<i>Total Deformation</i>	<i>Equivalent Stress</i>
State	Solved				
<b>Scope</b>					
Scoping Method	Geometry Selection				
Geometry	All Bodies				
<b>Definition</b>					
Type	Equivalent Elastic Strain	Maximum Principal Stress	Maximum Shear Stress	Total Deformation	Equivalent (von-Mises) Stress
By	Time				
Display Time	Last				
Calculate Time History	Yes				
Identifier					
Suppressed	No				
<b>Integration Point Results</b>					
Display Option	Averaged				Averaged
Average Across Bodies	No				No
<b>Results</b>					
Minimum	0. in/in	-4918.9 psi	0. psi	0. in	0. psi
Maximum	1.7074e-003 in/in	19583 psi	9972.8 psi	1.5768e-003 in	17477 psi
Minimum Occurs On	ship main:1	TGT-103-1000-0100:1	ship main:1		
Maximum Occurs On	ship main:1	TGT-103-1000-0100:1	ship main:1	TGT-103-1000-0100:1	ship main:1
<b>Minimum Value Over Time</b>					
Minimum	0. in/in	-4918.9 psi	0. psi	0. in	0. psi
Maximum	0. in/in	-985.86 psi	0. psi	0. in	0. psi
<b>Maximum Value Over Time</b>					
Minimum	4.4311e-004 in/in	5392.3 psi	2367.2 psi	3.1725e-004 in	4160. psi
Maximum	1.7074e-003 in/in	19583 psi	9972.8 psi	1.5768e-003 in	17477 psi
<b>Information</b>					
Time	1. s				
Load Step	1				
Substep	4				
Iteration Number	6				



**TABLE 16**  
**Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain**

Time [s]	Minimum [in/in]	Maximum [in/in]
0.2	0.	4.4311e-004
0.4		8.86e-004
0.7		1.5483e-003
1.		1.7074e-003

**FIGURE 4**  
**Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain > Figure**

**A: shipp full**

Figure

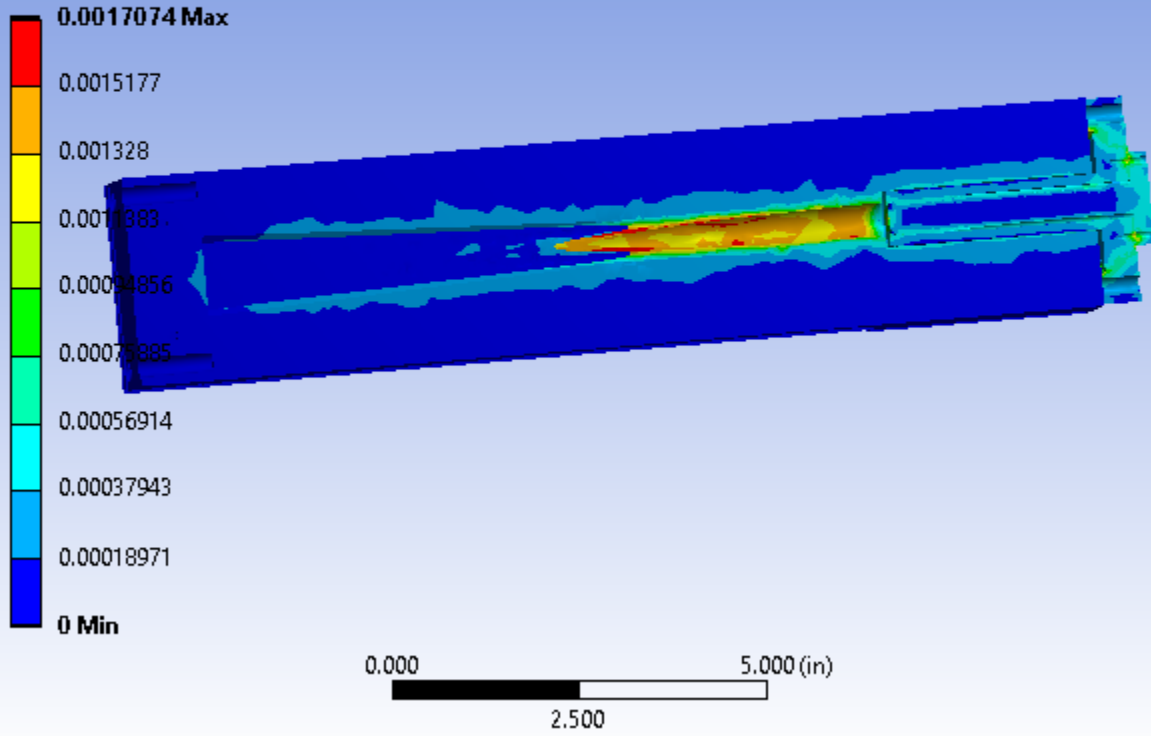
Type: Equivalent Elastic Strain

Unit: in/in

Time: 1

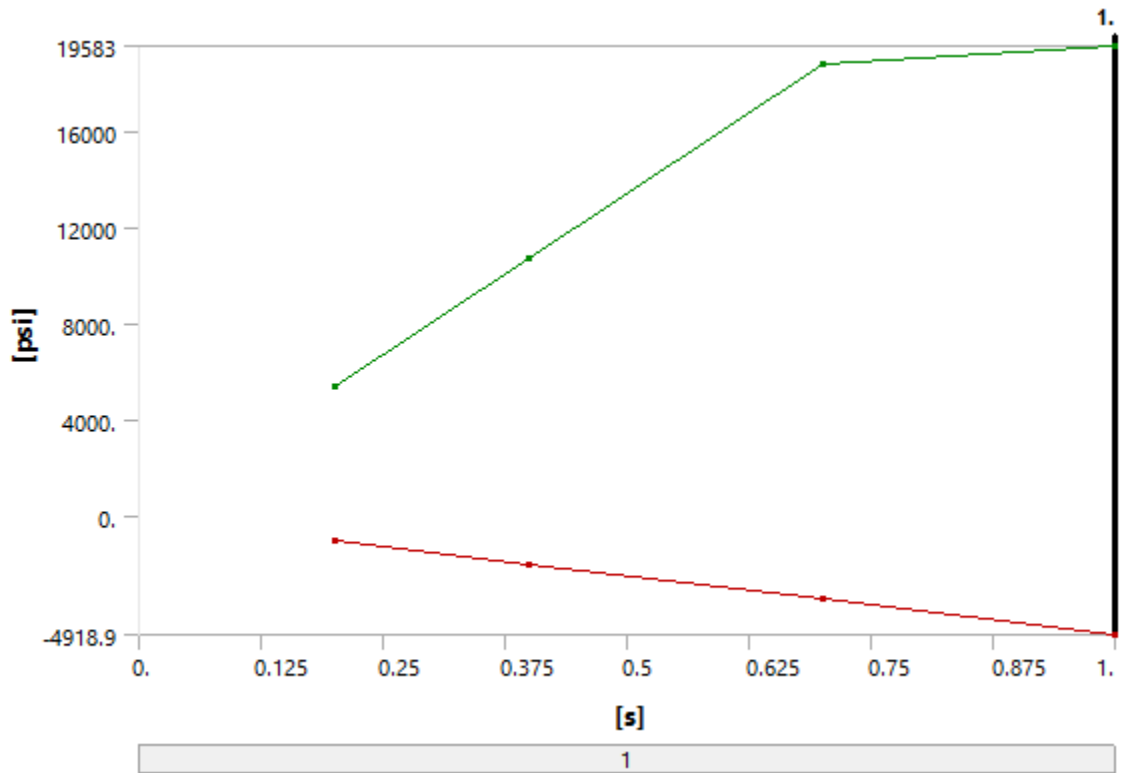
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**FIGURE 5**

**Model (A4) > Static Structural (A5) > Solution (A6) > Maximum Principal Stress**



**TABLE 17**  
**Model (A4) > Static Structural (A5) > Solution (A6) > Maximum Principal Stress**

Time [s]	Minimum [psi]	Maximum [psi]
0.2	-985.86	5392.3
0.4	-1971.6	10781
0.7	-3447.5	18836
1.	-4918.9	19583

**FIGURE 6**  
**Model (A4) > Static Structural (A5) > Solution (A6) > Maximum Principal Stress > Figure**

**A: shipp full**

Figure

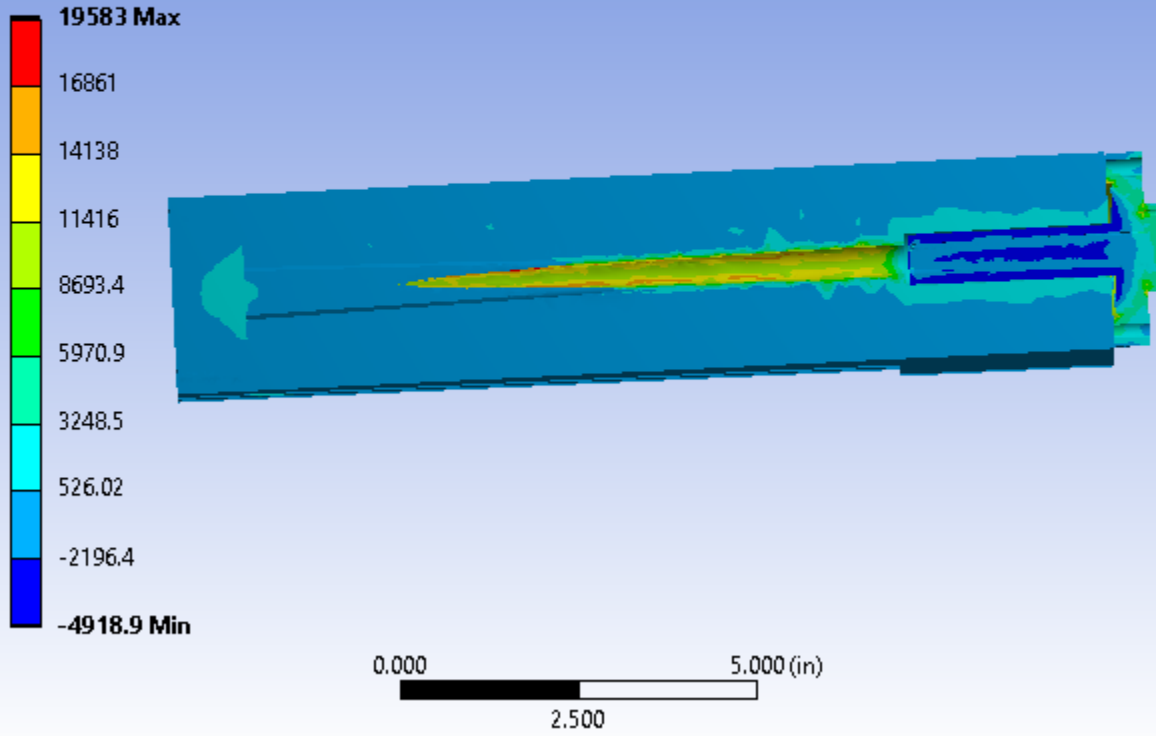
Type: Maximum Principal Stress

Unit: psi

Time: 1

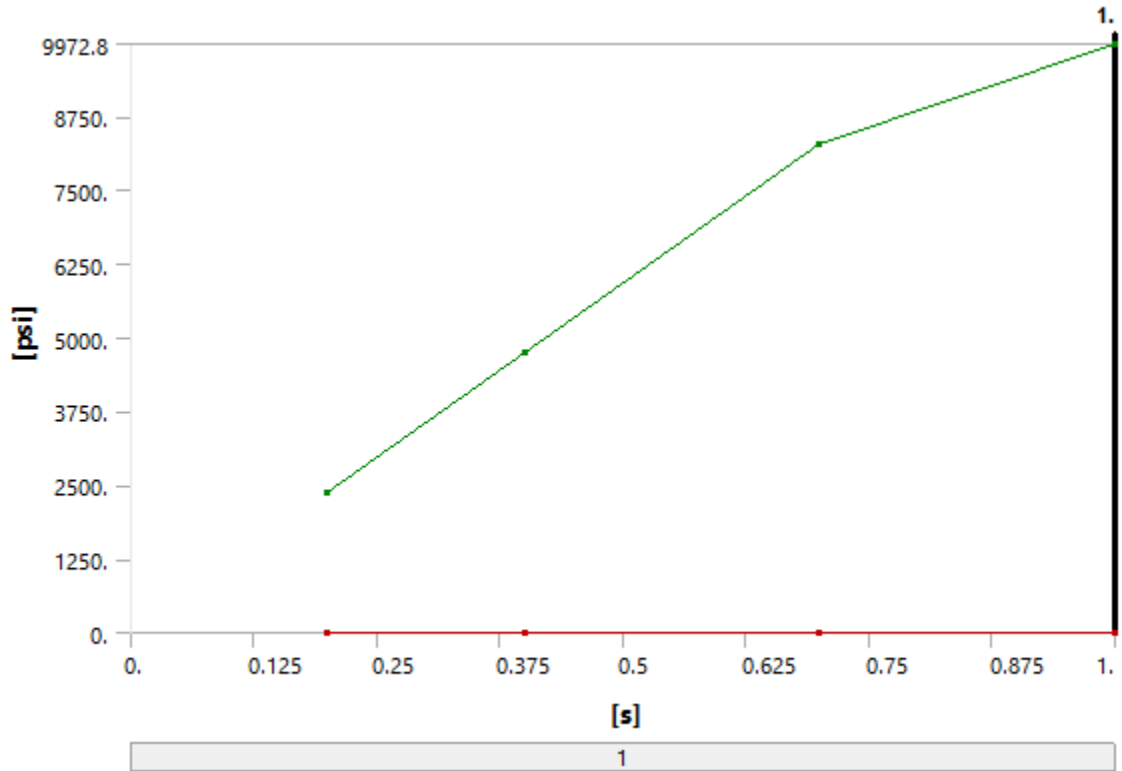
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**FIGURE 7**

**Model (A4) > Static Structural (A5) > Solution (A6) > Maximum Shear Stress**



**TABLE 18**  
**Model (A4) > Static Structural (A5) > Solution (A6) > Maximum Shear Stress**

Time [s]	Minimum [psi]	Maximum [psi]
0.2	0.	2367.2
0.4		4734.8
0.7		8287.5
1.		9972.8

**FIGURE 8**  
**Model (A4) > Static Structural (A5) > Solution (A6) > Maximum Shear Stress > Figure**

**A: shipp full**

Figure

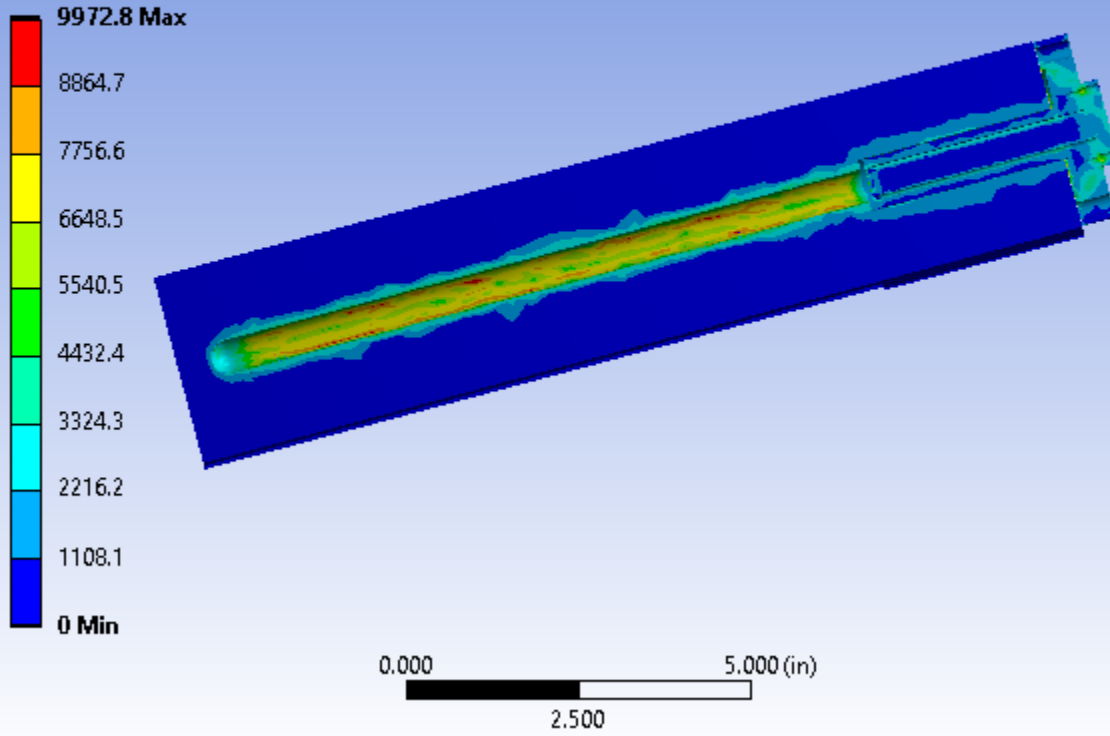
Type: Maximum Shear Stress

Unit: psi

Time: 1

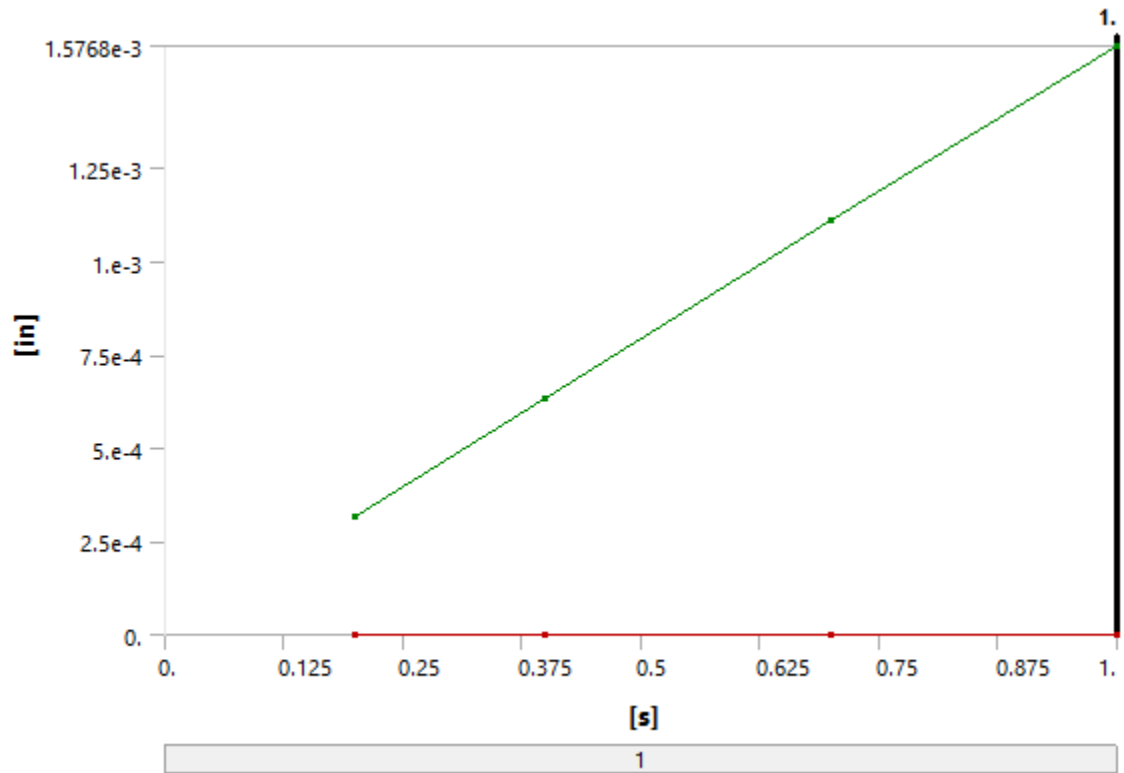
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**FIGURE 9**  
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation





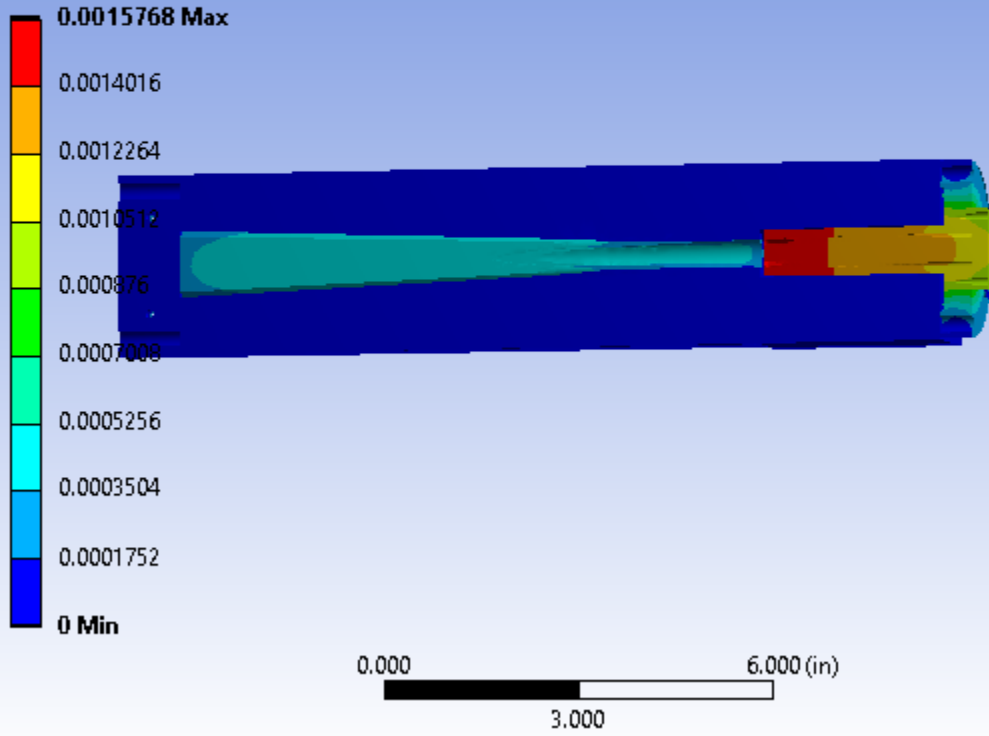
**TABLE 19**  
**Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation**

Time [s]	Minimum [in]	Maximum [in]
0.2	0.	3.1725e-004
0.4		6.3439e-004
0.7		1.1076e-003
1.		1.5768e-003

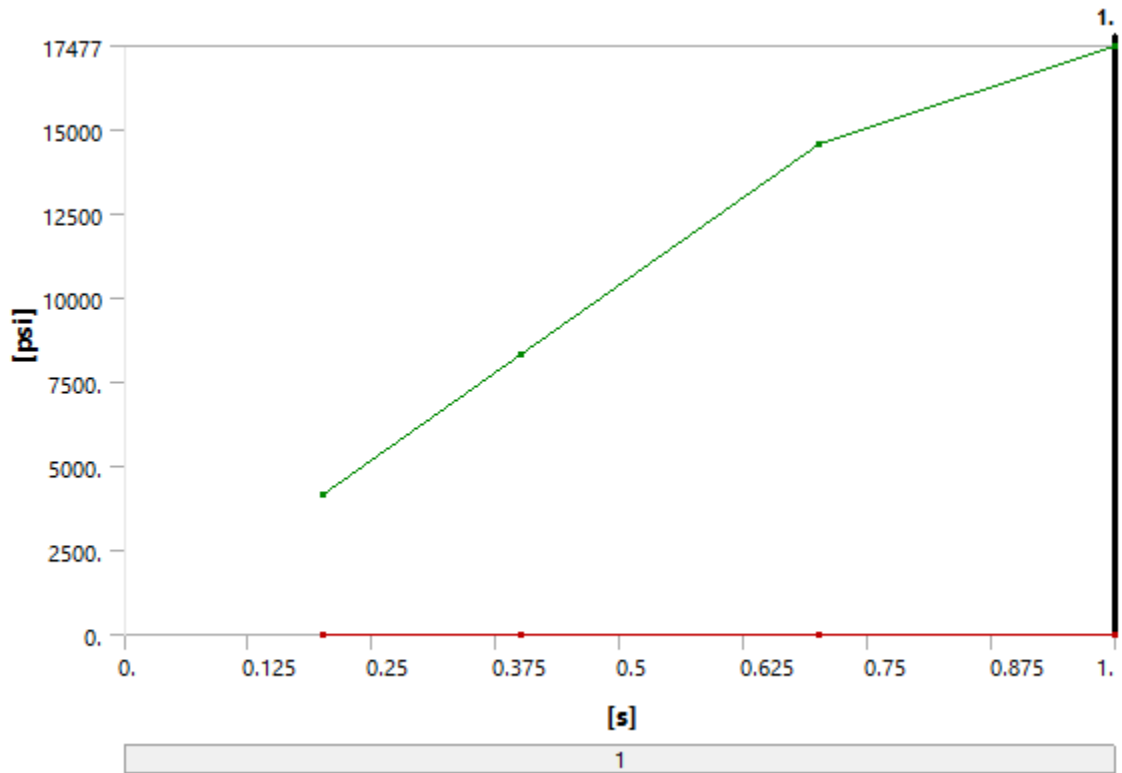
**FIGURE 10**  
**Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation > Figure**

**A: shipp full**  
Figure  
Type: Total Deformation  
Unit: in  
Time: 1  
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**FIGURE 11**  
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress



**TABLE 20**  
**Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress**

Time [s]	Minimum [psi]	Maximum [psi]
0.2	0.	4160.
0.4		8321.1
0.7		14565
1.		17477

**FIGURE 12**  
**Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress > Figure**

**A: shipp full**

Figure

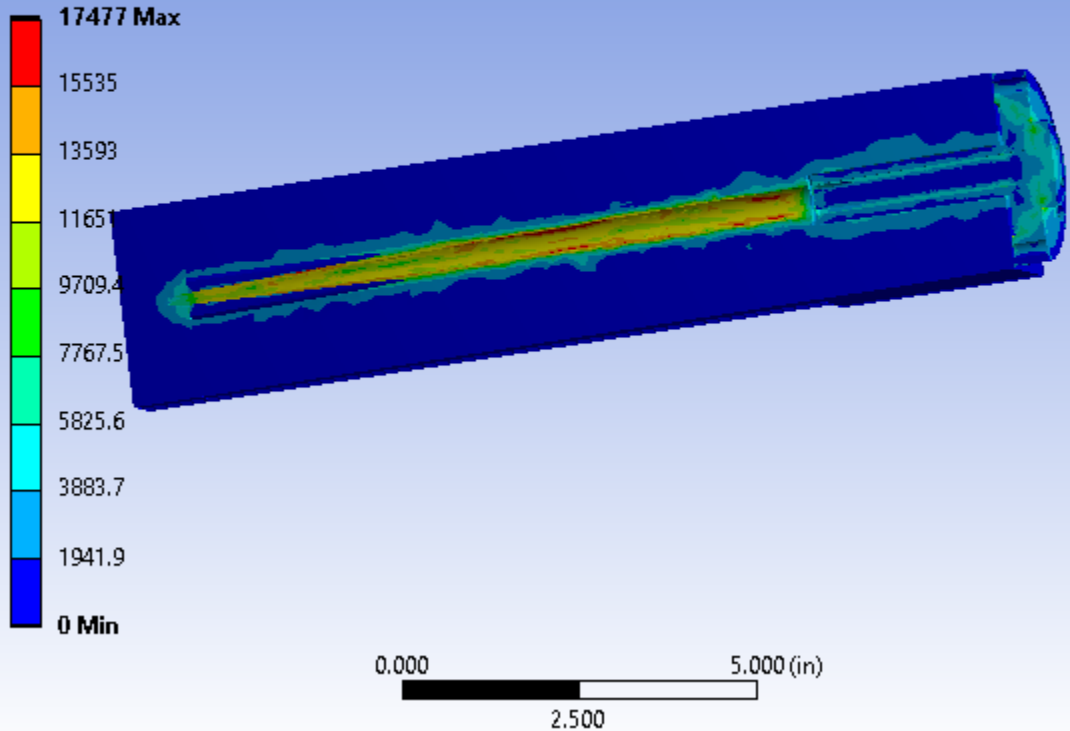
Type: Equivalent (von-Mises) Stress

Unit: psi

Time: 1

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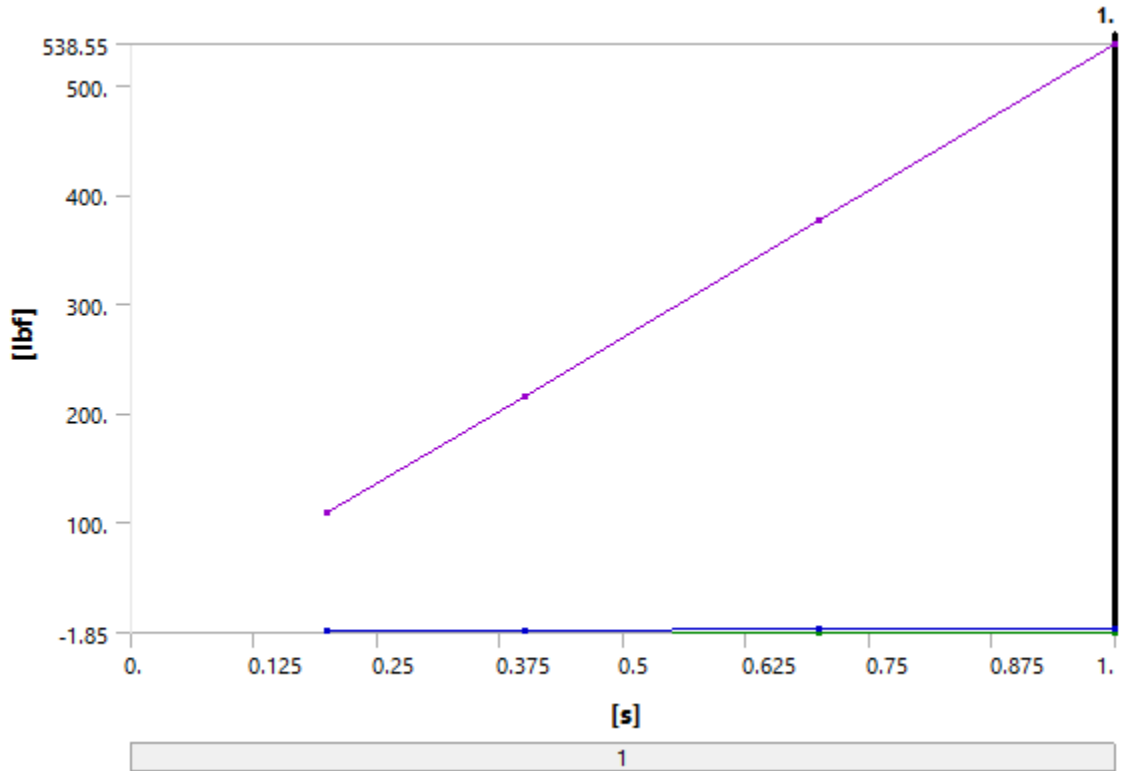


**TABLE 21**  
**Model (A4) > Static Structural (A5) > Solution (A6) > Probes**

Object Name	<i>All - Force Reaction - end cap to main body bolted - Contact (Underlying Element)</i>	<i>All - Force Reaction - left cover to main body bolted - Contact (Underlying Element)</i>	<i>All - Force Reaction - right cover to main body bolted - Contact (Underlying Element)</i>	<i>All - Force Reaction - ent to main bolted - Contact (Underlying Element)</i>	<i>All - Force Reaction - ent to plug bolted - Contact (Underlying Element)</i>
State	Solved				
<b>Definition</b>					
Type	Force Reaction				
Location Method	Contact Region				
Contact Region	end cap to main body bolted	left cover to main body bolted	right cover to main body bolted	ent to main bolted	ent to plug bolted
Orientation	Global Coordinate System				
Extraction	Contact (Underlying Element)				
Suppressed	No				
<b>Options</b>					

Result Selection	All				
Display Time	End Time				
<b>Results</b>					
X Axis	538.54 lbf	92.73 lbf	98.525 lbf	-6410.5 lbf	-363.06 lbf
Y Axis	-1.85 lbf	-5.9204 lbf	1.6408 lbf	2.1938e-003 lbf	-1.8433 lbf
Z Axis	1.7583 lbf	3912.2 lbf	-3933.7 lbf	9.6987e-004 lbf	1.8011 lbf
Total	538.55 lbf	3913.3 lbf	3934.9 lbf	6410.5 lbf	363.07 lbf
<b>Maximum Value Over Time</b>					
X Axis	538.54 lbf	92.73 lbf	98.525 lbf	-1282.8 lbf	-73.219 lbf
Y Axis	-0.3696 lbf	-0.99439 lbf	4.0622 lbf	2.1938e-003 lbf	-0.36054 lbf
Z Axis	1.7583 lbf	3912.2 lbf	-782.08 lbf	9.6987e-004 lbf	1.8011 lbf
Total	538.55 lbf	3913.3 lbf	3934.9 lbf	6410.5 lbf	363.07 lbf
<b>Minimum Value Over Time</b>					
X Axis	107.63 lbf	18.494 lbf	19.597 lbf	-6410.5 lbf	-363.06 lbf
Y Axis	-1.85 lbf	-5.9204 lbf	1.1673 lbf	9.2625e-005 lbf	-1.8433 lbf
Z Axis	0.33475 lbf	777.31 lbf	-3933.7 lbf	3.1852e-005 lbf	0.35586 lbf
Total	107.63 lbf	777.53 lbf	782.32 lbf	1282.8 lbf	73.221 lbf
<b>Information</b>					
Time	1. s				
Load Step	1				
Substep	4				
Iteration Number	6				

**FIGURE 13**  
**Model (A4) > Static Structural (A5) > Solution (A6) > All - Force Reaction - end cap to main body bolted - Contact (Underlying Element)**



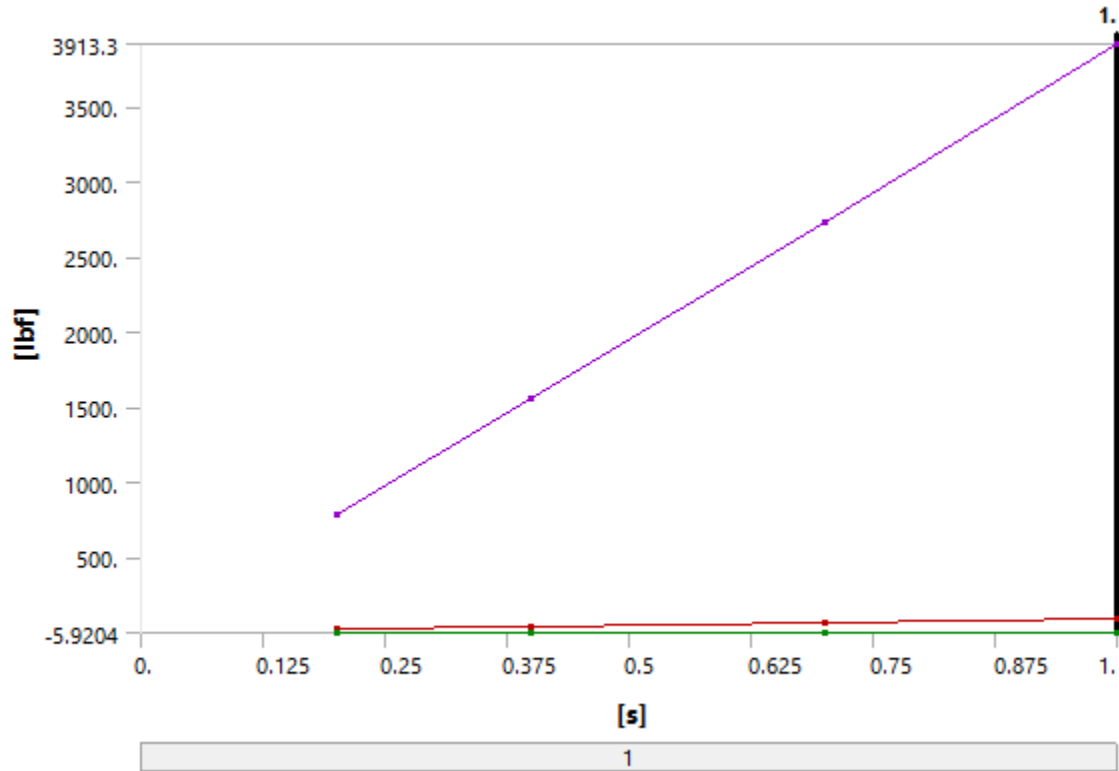
**TABLE 22**

**Model (A4) > Static Structural (A5) > Solution (A6) > All - Force Reaction - end cap to main body bolted - Contact (Underlying Element)**

Time [s]	All - Force Reaction - end cap to main body bolted - Contact (Underlying Element) (X) [lbf]	All - Force Reaction - end cap to main body bolted - Contact (Underlying Element) (Y) [lbf]	All - Force Reaction - end cap to main body bolted - Contact (Underlying Element) (Z) [lbf]	All - Force Reaction - end cap to main body bolted - Contact (Underlying Element) (Total) [lbf]
0.2	107.63	-0.3696	0.33475	107.63
0.4	215.31	-0.73881	0.66991	215.31
0.7	376.92	-1.2919	1.1735	376.92
1.	538.54	-1.85	1.7583	538.55

**FIGURE 14**

**Model (A4) > Static Structural (A5) > Solution (A6) > All - Force Reaction - left cover to main body bolted - Contact (Underlying Element)**



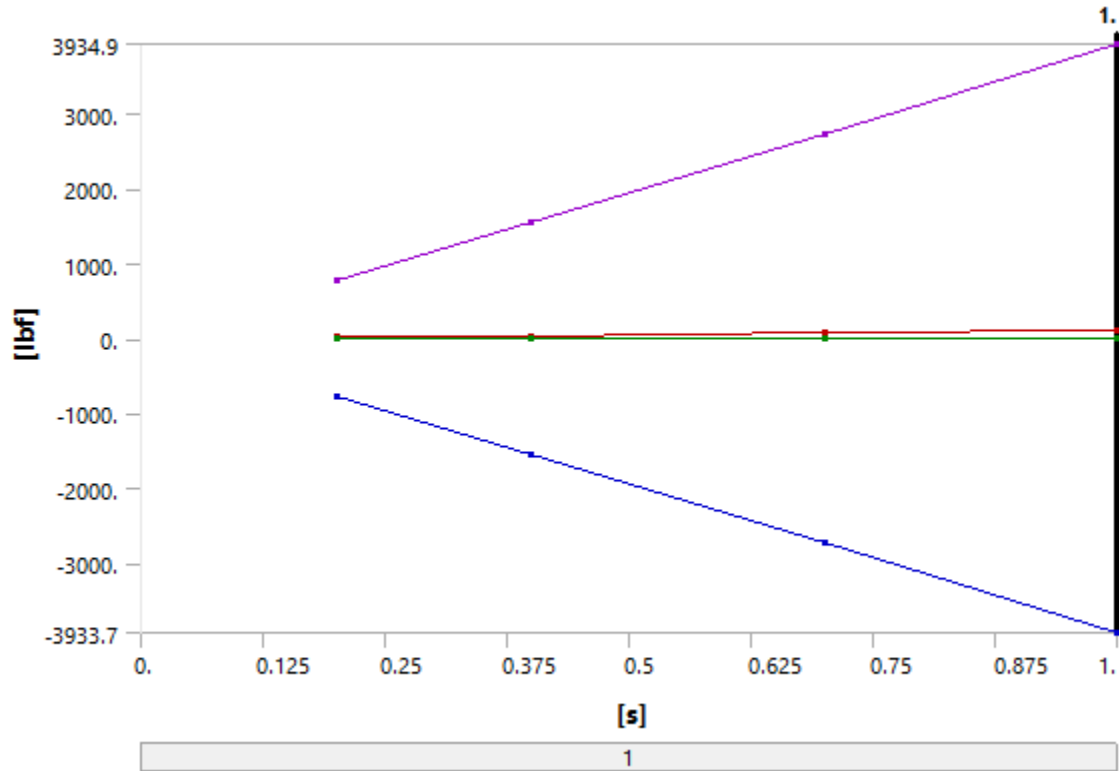
**TABLE 23**

**Model (A4) > Static Structural (A5) > Solution (A6) > All - Force Reaction - left cover to main body bolted - Contact (Underlying Element)**

Time [s]	All - Force Reaction - left cover to main body bolted - Contact (Underlying Element) (X) [lbf]	All - Force Reaction - left cover to main body bolted - Contact (Underlying Element) (Y) [lbf]	All - Force Reaction - left cover to main body bolted - Contact (Underlying Element) (Z) [lbf]	All - Force Reaction - left cover to main body bolted - Contact (Underlying Element) (Total) [lbf]
0.2	18.494	-0.99439	777.31	777.53
0.4	36.991	-1.9885	1554.7	1555.1
0.7	64.742	-3.4818	2720.9	2721.6
1.0	92.73	-5.9204	3912.2	3913.3

**FIGURE 15**

**Model (A4) > Static Structural (A5) > Solution (A6) > All - Force Reaction - right cover to main body bolted - Contact (Underlying Element)**



**TABLE 24**

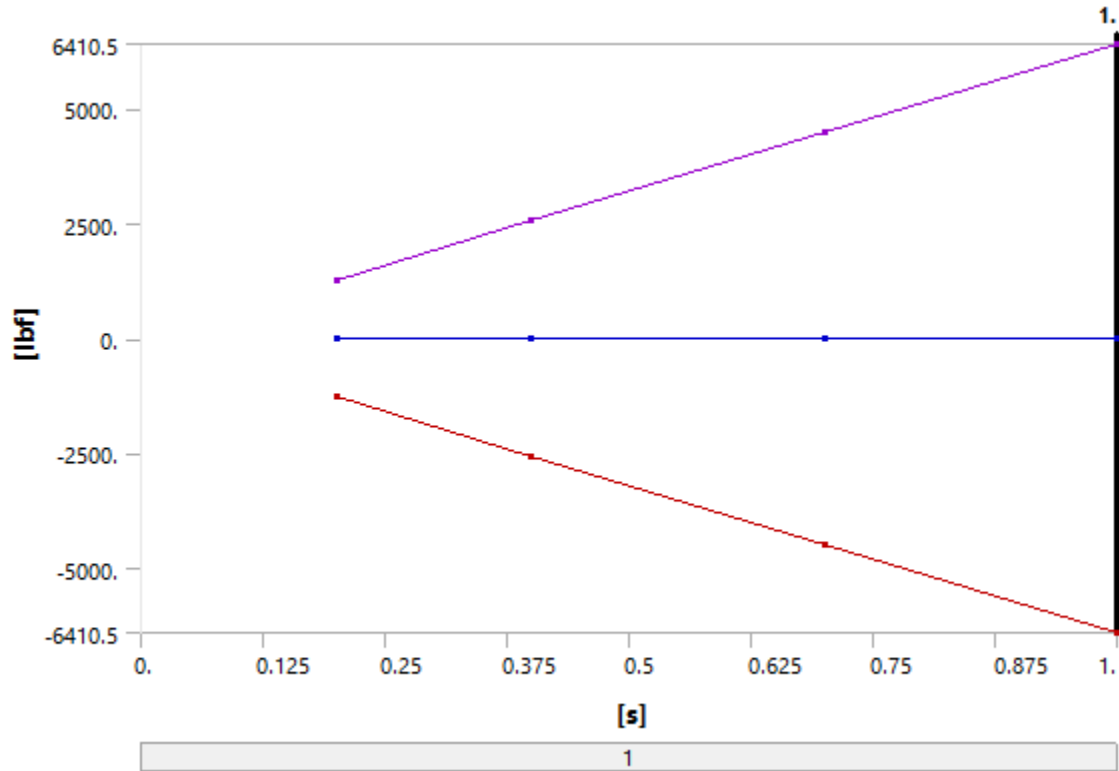
**Model (A4) > Static Structural (A5) > Solution (A6) > All - Force Reaction - right cover to main body bolted - Contact (Underlying Element)**

Time [s]	All - Force Reaction - right cover to main body bolted - Contact (Underlying Element) (X) [lbf]	All - Force Reaction - right cover to main body bolted - Contact (Underlying Element) (Y) [lbf]	All - Force Reaction - right cover to main body bolted - Contact (Underlying Element) (Z) [lbf]	All - Force Reaction - right cover to main body bolted - Contact (Underlying Element) (Total) [lbf]
0.2	19.597	1.1673	-782.08	782.32
0.4	39.195	2.33	-1564.2	1564.7
0.7	68.594	4.0622	-2737.6	2738.4
1.	98.525	1.6408	-3933.7	3934.9

**FIGURE 16**

**Model (A4) > Static Structural (A5) > Solution (A6) > All - Force Reaction - ent to main bolted - Contact (Underlying Element)**





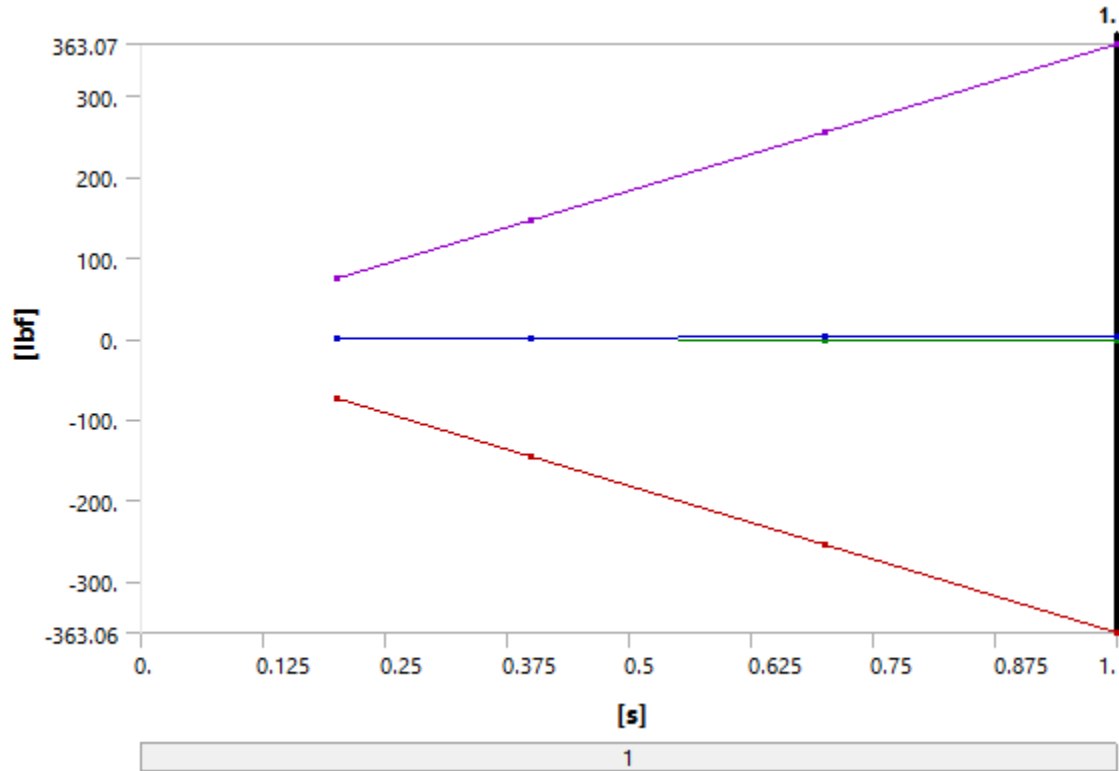
**TABLE 25**

**Model (A4) > Static Structural (A5) > Solution (A6) > All - Force Reaction - ent to main bolted - Contact (Underlying Element)**

Time [s]	All - Force Reaction - ent to main bolted - Contact (Underlying Element) (X) [lbf]	All - Force Reaction - ent to main bolted - Contact (Underlying Element) (Y) [lbf]	All - Force Reaction - ent to main bolted - Contact (Underlying Element) (Z) [lbf]	All - Force Reaction - ent to main bolted - Contact (Underlying Element) (Total) [lbf]
0.2	-1282.8	9.2625e-005	3.1852e-005	1282.8
0.4	-2565.2	3.6999e-004	1.2723e-004	2565.2
0.7	-4488.2	1.0907e-003	2.9168e-004	4488.2
1.	-6410.5	2.1938e-003	9.6987e-004	6410.5

**FIGURE 17**

**Model (A4) > Static Structural (A5) > Solution (A6) > All - Force Reaction - ent to plug bolted - Contact (Underlying Element)**



**TABLE 26**

**Model (A4) > Static Structural (A5) > Solution (A6) > All - Force Reaction - ent to plug bolted - Contact (Underlying Element)**

Time [s]	All - Force Reaction - ent to plug bolted - Contact (Underlying Element) (X) [lbf]	All - Force Reaction - ent to plug bolted - Contact (Underlying Element) (Y) [lbf]	All - Force Reaction - ent to plug bolted - Contact (Underlying Element) (Z) [lbf]	All - Force Reaction - ent to plug bolted - Contact (Underlying Element) (Total) [lbf]
0.2	-73.219	-0.36054	0.35586	73.221
0.4	-146.44	-0.72105	0.71141	146.45
0.7	-255.25	-1.2668	1.2512	255.25
1.	-363.06	-1.8433	1.8011	363.07

**TABLE 27**

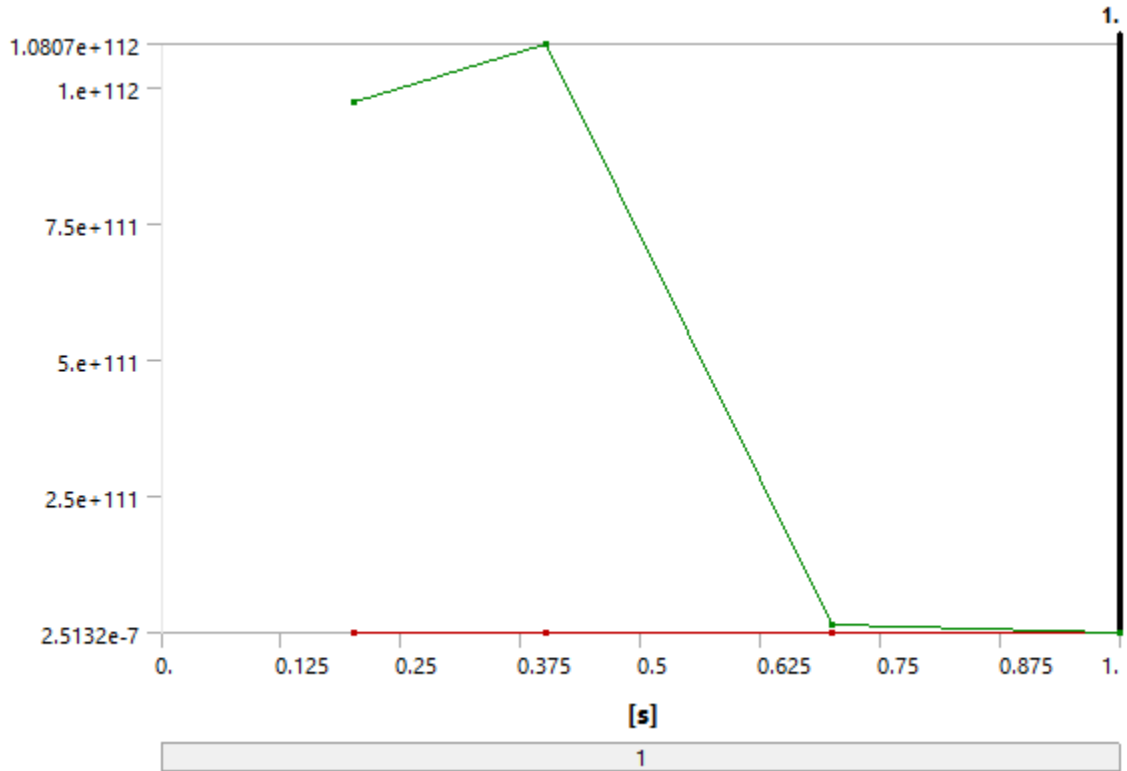
**Model (A4) > Static Structural (A5) > Solution (A6) >  $EL = 0.069 \cdot 2.72^{(-2.06 \cdot (S1+S2+S3)/(3 \cdot SEQV) - 0.333)}$**

Object Name	$EL = 0.069 \cdot 2.72^{(-2.06 \cdot (S1+S2+S3)/(3 \cdot SEQV) - 0.333)}$	$Delta = EL - EPPLEQV\_RST$
State	Solved	
<b>Scope</b>		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
<b>Definition</b>		
Type	User Defined Result	
Expression	$= 0.069 \cdot 2.72^{(-2.06 \cdot (S1+S2+S3)/(3 \cdot SEQV) - 0.333)}$	$= EL - EPPLEQV\_RST$
Input Unit System	Metric (m, kg, N, s, V, A)	
Output Unit		

By	Time	
Display Time	Last	
Coordinate System	Global Coordinate System	
Calculate Time History	Yes	
Identifier	EL	Delta
Suppressed	No	
<b>Integration Point Results</b>		
Display Option	Averaged	
Average Across Bodies	No	
<b>Results</b>		
Minimum	2.5636e-007	
Maximum	7.9966e+085	
Minimum Occurs On	TGT-103-1000-0110:1	
Maximum Occurs On	ent plug:1	
<b>Minimum Value Over Time</b>		
Minimum	2.5132e-007	
Maximum	2.5636e-007	
<b>Maximum Value Over Time</b>		
Minimum	7.9966e+085	
Maximum	1.0807e+112	
<b>Information</b>		
Time	1. s	
Load Step	1	
Substep	4	
Iteration Number	6	

**FIGURE 18**

**Model (A4) > Static Structural (A5) > Solution (A6) > EL =  $0.069 \cdot 2.72^{(-2.06 \cdot (S1+S2+S3)) / (3 \cdot \text{SEQV} - 0.333)}$**



**TABLE 28**

**Model (A4) > Static Structural (A5) > Solution (A6) > EL =  $0.069 \cdot 2.72^{(-2.06 \cdot (S1+S2+S3)) / (3 \cdot SEQV) - 0.333}$**

Time [s]	Minimum	Maximum
0.2	$2.5199 \times 10^{-007}$	$9.7389 \times 10^{111}$
0.4	$2.5167 \times 10^{-007}$	$1.0807 \times 10^{112}$
0.7	$2.5132 \times 10^{-007}$	$1.5653 \times 10^{110}$
1.	$2.5636 \times 10^{-007}$	$7.9966 \times 10^{085}$

**FIGURE 19**

**Model (A4) > Static Structural (A5) > Solution (A6) > EL =  $0.069 \cdot 2.72^{(-2.06 \cdot (S1+S2+S3)) / (3 \cdot SEQV) - 0.333}$  > Figure**

**A: shipp full**

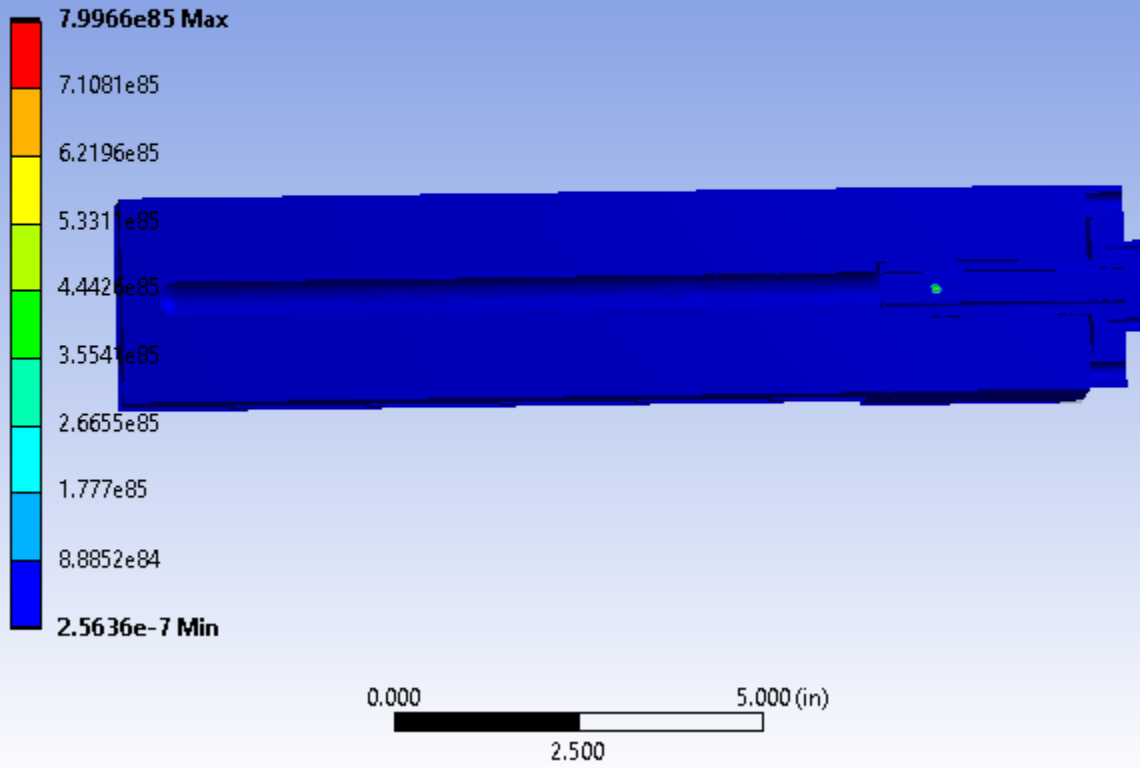
Figure

Expression:  $EL = 0.069 \cdot 2.72^{(-2.06 \cdot (S1 + S2 + S3) / (3 \cdot SEQV) - 0.333)}$

Time: 1

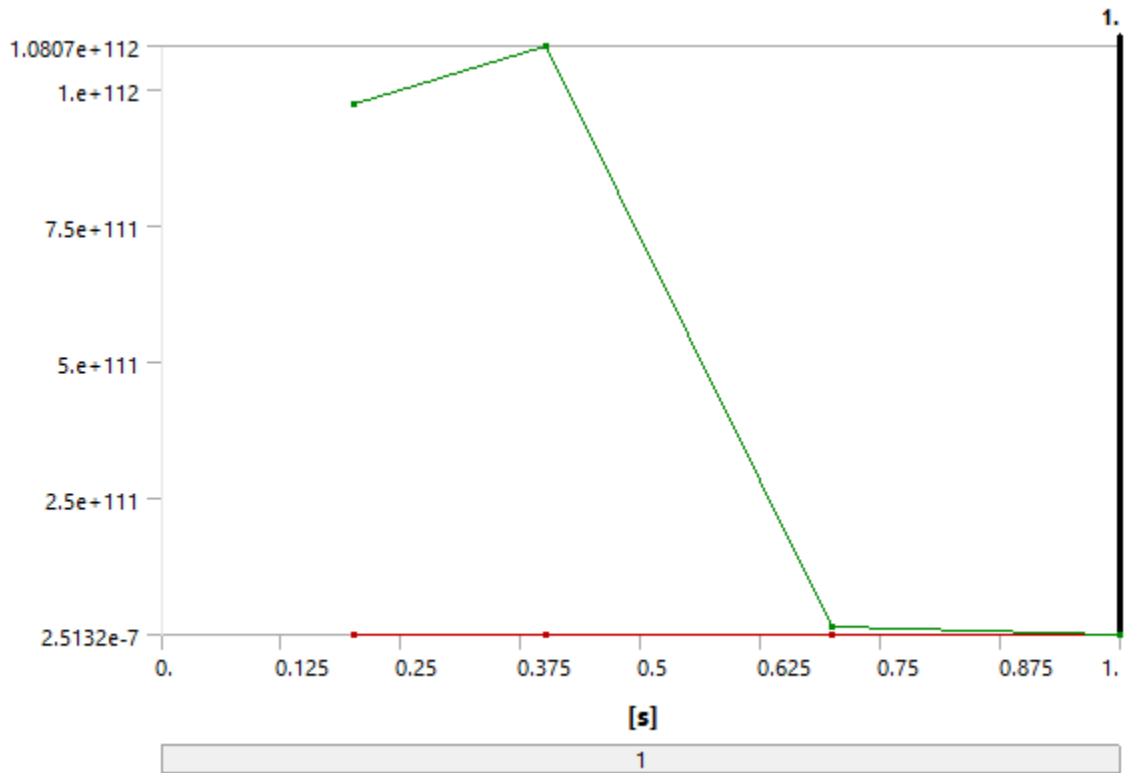
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**ANSYS**  
16.0



**FIGURE 20**

**Model (A4) > Static Structural (A5) > Solution (A6) > Delta = EL-EPPLEQV\_RST**



**TABLE 29**  
**Model (A4) > Static Structural (A5) > Solution (A6) > Delta = EL-EPPLEQV\_RST**

Time [s]	Minimum	Maximum
0.2	2.5199e-007	9.7389e+111
0.4	2.5167e-007	1.0807e+112
0.7	2.5132e-007	1.5653e+110
1.	2.5636e-007	7.9966e+085

As can be seen from above the local collapse criteria have been met.

**FIGURE 21**  
**Model (A4) > Static Structural (A5) > Solution (A6) > Delta = EL-EPPLEQV\_RST > Figure**

A: shipp full

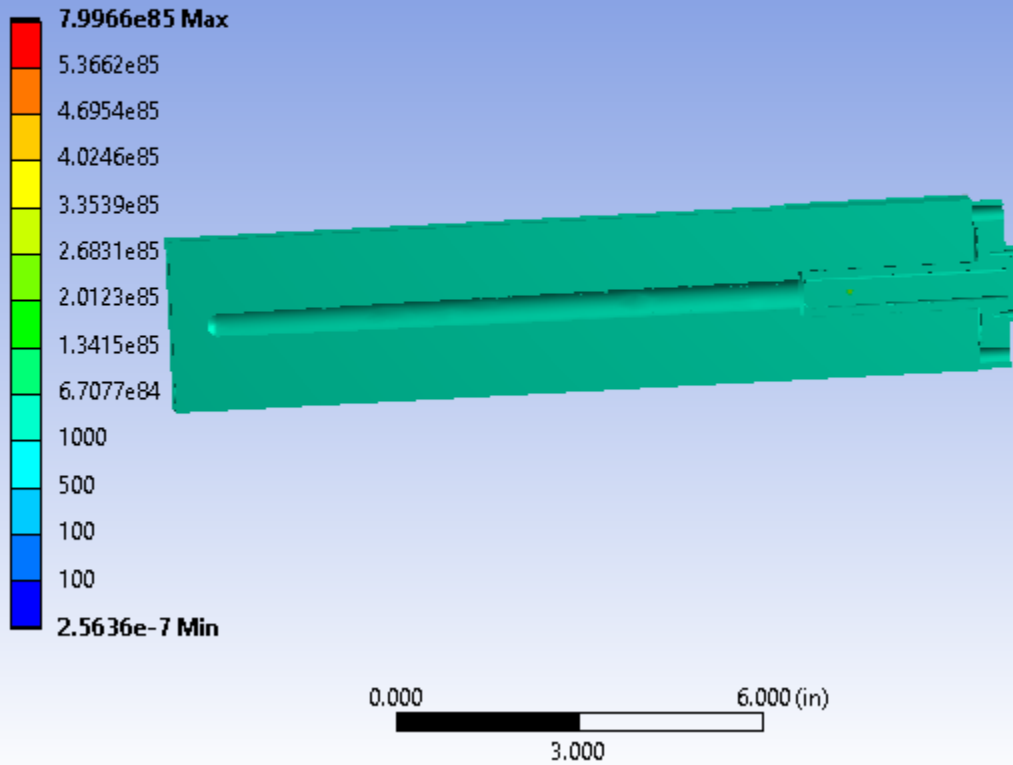
Figure

Expression: Delta = EL-EPPLEQV\_RST

Time: 1

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16.0



## Material Data

7075 (UNS A97075)

TABLE 30  
7075 (UNS A97075) > Density

Density lbm in <sup>-3</sup>	Temperature F
9.9505e-002	-459.67
9.9504e-002	-446.94
9.9503e-002	-434.22
9.9503e-002	-421.49
9.9505e-002	-408.76
9.9503e-002	-396.03
9.9498e-002	-383.31
9.949e-002	-370.58
9.9479e-002	-357.85
9.9465e-002	-345.12
9.9449e-002	-332.4

9.9431e-002	-319.67
9.941e-002	-306.94
9.9388e-002	-294.22
9.9363e-002	-281.49
9.9336e-002	-268.76
9.9308e-002	-256.03
9.9278e-002	-243.31
9.9247e-002	-230.58
9.9214e-002	-217.85
9.918e-002	-205.12
9.9145e-002	-192.4
9.9109e-002	-179.67
9.9071e-002	-166.94
9.9033e-002	-154.22
9.8994e-002	-141.49
9.8953e-002	-128.76
9.8912e-002	-116.03
9.8871e-002	-103.31
9.8829e-002	-90.579
9.8786e-002	-77.852
9.8742e-002	-65.125
9.8698e-002	-52.397
9.8654e-002	-39.67
9.8609e-002	-26.943
9.8564e-002	-14.215
9.8519e-002	-1.4882
9.8473e-002	11.239
9.8427e-002	23.966
9.838e-002	36.694
9.8334e-002	49.421
9.8287e-002	62.148
9.824e-002	74.875
9.8192e-002	87.603
9.8145e-002	100.33
9.8097e-002	113.06
9.805e-002	125.78
9.8002e-002	138.51
9.7954e-002	151.24
9.7905e-002	163.97
9.7857e-002	176.69
9.7808e-002	189.42
9.776e-002	202.15
9.7711e-002	214.88
9.7662e-002	227.6
9.7612e-002	240.33
9.7563e-002	253.06
9.7513e-002	265.78
9.7464e-002	278.51



9.7414e-002	291.24
9.7363e-002	303.97
9.7313e-002	316.69
9.7262e-002	329.42
9.7211e-002	342.15
9.716e-002	354.88
9.7109e-002	367.6
9.7057e-002	380.33
9.7005e-002	393.06
9.6953e-002	405.78
9.69e-002	418.51
9.6847e-002	431.24
9.6794e-002	443.97
9.674e-002	456.69
9.6687e-002	469.42
9.6632e-002	482.15
9.6578e-002	494.88
9.6523e-002	507.6
9.6467e-002	520.33
9.6412e-002	533.06
9.6356e-002	545.78
9.6299e-002	558.51
9.6243e-002	571.24
9.6186e-002	583.97
9.6128e-002	596.69
9.6071e-002	609.42
9.6013e-002	622.15
9.5954e-002	634.88
9.5896e-002	647.6
9.5837e-002	660.33
9.5778e-002	673.06
9.5719e-002	685.78
9.5659e-002	698.51
9.56e-002	711.24
9.554e-002	723.97
9.548e-002	736.69
9.542e-002	749.42
9.5361e-002	762.15
9.5301e-002	774.88
9.5241e-002	787.6
9.5182e-002	800.33

**TABLE 31**  
**7075 (UNS A97075) > Tensile Yield Strength**

Tensile Yield Strength psi	Temperature F
18130	-321.07
17998	-310.78
17864	-300.49
17730	-290.2

17594	-279.91
17458	-269.62
17320	-259.32
17181	-249.03
17041	-238.74
16900	-228.45
16758	-218.16
16614	-207.87
16470	-197.58
16324	-187.29
16178	-177
16030	-166.71
15881	-156.42
15731	-146.12
15579	-135.83
15427	-125.54
15274	-115.25
15119	-104.96
14963	-94.67
14806	-84.379
14649	-74.088
14489	-63.797
14329	-53.506
14168	-43.215
14005	-32.925
13842	-22.634
13779	-12.343
13779	-2.0518
13779	8.2391
13779	18.53
13779	28.821
13779	39.112
13779	49.403
13779	59.694
13779	69.985
13779	80.275
13779	90.566
13779	100.86
13779	111.15
13779	121.44
13779	131.73
13779	142.02
13779	152.31
13779	162.6
13779	172.89
13779	183.18
13779	193.48
13775	203.77

13764	214.06
13742	224.35
13708	234.64
13660	244.93
13598	255.22
13520	265.51
13426	275.8
13316	286.09
13188	296.38
13043	306.68
12880	316.97
12699	327.26
12501	337.55
12287	347.84
12055	358.13
11808	368.42
11546	378.71
11270	389
10982	399.29
10681	409.58
10376	419.88
10132	430.17
9883.6	440.46
9630.9	450.75
9374.7	461.04
9115.9	471.33
8855.2	481.62
8593.5	491.91
8331.4	502.2
8069.9	512.49
7809.6	522.78
7551.4	533.08
7296	543.37
7044.3	553.66
6796.9	563.95
6554.8	574.24
6318.6	584.53
6089.2	594.82
5867.3	605.11
5653.8	615.4
5449.4	625.69
5254.9	635.98
5071	646.28
4898.6	656.57
4738.5	666.86
4591.4	677.15
4458.1	687.44
4339.5	697.73

**TABLE 32**  
**7075 (UNS A97075) > Tensile Ultimate Strength**

Tensile Ultimate Strength psi	Temperature F
47918	-321.07
46755	-310.78
45660	-300.49
44631	-290.2
43666	-279.91
42762	-269.62
41916	-259.32
41127	-249.03
40393	-238.74
39710	-228.45
39077	-218.16
38491	-207.87
37950	-197.58
37452	-187.29
36995	-177
36575	-166.71
36192	-156.42
35841	-146.12
35522	-135.83
35232	-125.54
34968	-115.25
34729	-104.96
34511	-94.67
34313	-84.379
34133	-74.088
33967	-63.797
33814	-53.506
33672	-43.215
33537	-32.925
33409	-22.634
33283	-12.343
33159	-2.0518
33034	8.2391
32906	18.53
32771	28.821
32629	39.112
32476	49.403
32311	59.694
32130	69.985
31932	80.275
31715	90.566
31476	100.86
31212	111.15
30922	121.44
30603	131.73
30253	142.02

29869	152.31
29450	162.6
28993	172.89
28495	183.18
27954	193.48
27369	203.77
26686	214.06
26003	224.35
25293	234.64
24560	244.93
23808	255.22
23041	265.51
22263	275.8
21477	286.09
20690	296.38
19904	306.68
19126	316.97
18361	327.26
17613	337.55
16889	347.84
16193	358.13
15532	368.42
14913	378.71
14340	389
13822	399.29
13490	409.58
13189	419.88
12885	430.17
12578	440.46
12270	450.75
11960	461.04
11650	471.33
11340	481.62
11030	491.91
10721	502.2
10415	512.49
10111	522.78
9809.9	533.08
9512.8	543.37
9220.1	553.66
8932.5	563.95
8650.6	574.24
8375	584.53
8106.3	594.82
7845.2	605.11
7592.3	615.4
7348.3	625.69
7113.7	635.98

6889.3	646.28
6675.5	656.57
6473.2	666.86
6282.8	677.15
6105.1	687.44
5940.6	697.73

**TABLE 33**  
**7075 (UNS A97075) > Isotropic Secant Coefficient of Thermal Expansion**

Coefficient of Thermal Expansion F <sup>-1</sup>	Temperature F
7.9029e-006	-459.67
8.1015e-006	-446.94
8.3002e-006	-434.22
8.505e-006	-421.49
8.7421e-006	-408.76
8.9684e-006	-396.03
9.1842e-006	-383.31
9.3898e-006	-370.58
9.5857e-006	-357.85
9.7722e-006	-345.12
9.9496e-006	-332.4
1.0118e-005	-319.67
1.0278e-005	-306.94
1.0431e-005	-294.22
1.0575e-005	-281.49
1.0712e-005	-268.76
1.0841e-005	-256.03
1.0964e-005	-243.31
1.108e-005	-230.58
1.119e-005	-217.85
1.1294e-005	-205.12
1.1392e-005	-192.4
1.1485e-005	-179.67
1.1572e-005	-166.94
1.1655e-005	-154.22
1.1732e-005	-141.49
1.1806e-005	-128.76
1.1875e-005	-116.03
1.194e-005	-103.31
1.2001e-005	-90.579
1.2059e-005	-77.852
1.2114e-005	-65.125
1.2165e-005	-52.397
1.2214e-005	-39.67
1.226e-005	-26.943
1.2303e-005	-14.215
1.2345e-005	-1.4882
1.2384e-005	11.239
1.2421e-005	23.966

1.2456e-005	36.694
1.249e-005	49.421
1.2522e-005	62.148
1.2553e-005	74.875
1.2583e-005	87.603
1.2612e-005	100.33
1.2641e-005	113.06
1.2668e-005	125.78
1.2695e-005	138.51
1.2722e-005	151.24
1.2748e-005	163.97
1.2774e-005	176.69
1.28e-005	189.42
1.2826e-005	202.15
1.2852e-005	214.88
1.2878e-005	227.6
1.2904e-005	240.33
1.2931e-005	253.06
1.2958e-005	265.78
1.2986e-005	278.51
1.3014e-005	291.24
1.3043e-005	303.97
1.3072e-005	316.69
1.3102e-005	329.42
1.3133e-005	342.15
1.3165e-005	354.88
1.3197e-005	367.6
1.323e-005	380.33
1.3264e-005	393.06
1.3299e-005	405.78
1.3335e-005	418.51
1.3372e-005	431.24
1.3409e-005	443.97
1.3447e-005	456.69
1.3486e-005	469.42
1.3526e-005	482.15
1.3567e-005	494.88
1.3608e-005	507.6
1.365e-005	520.33
1.3692e-005	533.06
1.3735e-005	545.78
1.3779e-005	558.51
1.3823e-005	571.24
1.3868e-005	583.97
1.3912e-005	596.69
1.3958e-005	609.42
1.4003e-005	622.15
1.4048e-005	634.88

1.4093e-005	647.6
1.4138e-005	660.33
1.4183e-005	673.06
1.4227e-005	685.78
1.4271e-005	698.51
1.4315e-005	711.24
1.4357e-005	723.97
1.4399e-005	736.69
1.444e-005	749.42
1.4479e-005	762.15
1.4517e-005	774.88
1.4554e-005	787.6
1.4589e-005	800.33
Reference Temperature F	
67.73	

**TABLE 34**  
**7075 (UNS A97075) > Specific Heat**

Specific Heat BTU lbm <sup>-1</sup> F <sup>-1</sup>	Temperature F
0.13665	-250.87
0.14014	-240.25
0.14351	-229.63
0.14676	-219.02
0.14989	-208.4
0.15291	-197.78
0.15582	-187.16
0.15862	-176.54
0.16132	-165.92
0.16392	-155.31
0.16642	-144.69
0.16883	-134.07
0.17115	-123.45
0.17338	-112.83
0.17553	-102.22
0.1776	-91.597
0.1796	-80.979
0.18152	-70.361
0.18337	-59.743
0.18515	-49.125
0.18687	-38.506
0.18852	-27.888
0.19012	-17.27
0.19165	-6.6518
0.19314	3.9664
0.19457	14.585
0.19596	25.203
0.1973	35.821
0.1986	46.439
0.19985	57.057



0.20107	67.675
0.20225	78.294
0.2034	88.912
0.20451	99.53
0.2056	110.15
0.20666	120.77
0.20769	131.38
0.2087	142
0.20969	152.62
0.21066	163.24
0.21162	173.86
0.21256	184.48
0.21348	195.09
0.2144	205.71
0.2153	216.33
0.2162	226.95
0.21709	237.57
0.21798	248.18
0.21886	258.8
0.21974	269.42
0.22062	280.04
0.2215	290.66
0.22239	301.28
0.22327	311.89
0.22416	322.51
0.22506	333.13
0.22597	343.75
0.22688	354.37
0.2278	364.98
0.22874	375.6
0.22968	386.22
0.23064	396.84
0.23161	407.46
0.23259	418.08
0.23359	428.69
0.2346	439.31
0.23563	449.93
0.23668	460.55
0.23774	471.17
0.23882	481.78
0.23992	492.4
0.24104	503.02
0.24218	513.64
0.24333	524.26
0.24451	534.88
0.2457	545.49
0.24692	556.11
0.24815	566.73

0.2494	577.35
0.25068	587.97
0.25197	598.58
0.25329	609.2
0.25462	619.82
0.25597	630.44
0.25735	641.06
0.25874	651.68
0.26015	662.29
0.26158	672.91
0.26302	683.53
0.26449	694.15
0.26597	704.77
0.26746	715.38
0.26898	726
0.2705	736.62
0.27205	747.24
0.2736	757.86
0.27517	768.48
0.27675	779.09
0.27834	789.71
0.27994	800.33

**TABLE 35**  
**7075 (UNS A97075) > Isotropic Thermal Conductivity**

Thermal Conductivity BTU s <sup>-1</sup> in <sup>-1</sup> F <sup>-1</sup>	Temperature F
1.0373e-003	-250.87
1.0695e-003	-240.25
1.1005e-003	-229.63
1.1303e-003	-219.02
1.1591e-003	-208.4
1.1868e-003	-197.78
1.2135e-003	-187.16
1.2392e-003	-176.54
1.2639e-003	-165.92
1.2878e-003	-155.31
1.3108e-003	-144.69
1.3329e-003	-134.07
1.3543e-003	-123.45
1.3749e-003	-112.83
1.3949e-003	-102.22
1.4141e-003	-91.597
1.4328e-003	-80.979
1.4509e-003	-70.361
1.4684e-003	-59.743
1.4854e-003	-49.125
1.502e-003	-38.506
1.5181e-003	-27.888
1.5339e-003	-17.27

1.5493e-003	-6.6518
1.5645e-003	3.9664
1.5793e-003	14.585
1.594e-003	25.203
1.6084e-003	35.821
1.6228e-003	46.439
1.637e-003	57.057
1.6512e-003	67.675
1.6653e-003	78.294
1.6795e-003	88.912
1.6938e-003	99.53
1.7081e-003	110.15
1.7226e-003	120.77
1.7373e-003	131.38
1.7521e-003	142
1.7673e-003	152.62
1.7828e-003	163.24
1.7986e-003	173.86
1.8147e-003	184.48
1.8314e-003	195.09
1.8484e-003	205.71
1.866e-003	216.33
1.8841e-003	226.95
1.9028e-003	237.57
1.9222e-003	248.18
1.9422e-003	258.8
1.9629e-003	269.42
1.9843e-003	280.04
2.0065e-003	290.66
2.0296e-003	301.28
2.0535e-003	311.89
2.0784e-003	322.51
2.1041e-003	333.13
2.1309e-003	343.75
2.1587e-003	354.37
2.1876e-003	364.98
2.2175e-003	375.6
2.2486e-003	386.22
2.2809e-003	396.84
2.2937e-003	407.46
2.3017e-003	418.08
2.3091e-003	428.69
2.316e-003	439.31
2.3224e-003	449.93
2.3283e-003	460.55
2.3337e-003	471.17
2.3385e-003	481.78
2.3428e-003	492.4

2.3466e-003	503.02
2.3499e-003	513.64
2.3526e-003	524.26
2.3548e-003	534.88
2.3565e-003	545.49
2.3577e-003	556.11
2.3583e-003	566.73
2.3585e-003	577.35
2.3581e-003	587.97
2.3572e-003	598.58
2.3557e-003	609.2
2.3538e-003	619.82
2.3513e-003	630.44
2.3483e-003	641.06
2.3448e-003	651.68
2.3407e-003	662.29
2.3362e-003	672.91
2.3311e-003	683.53
2.3255e-003	694.15
2.3194e-003	704.77
2.3127e-003	715.38
2.3055e-003	726
2.2978e-003	736.62
2.2896e-003	747.24
2.2809e-003	757.86
2.2716e-003	768.48
2.2618e-003	779.09
2.2515e-003	789.71
2.2407e-003	800.33

**TABLE 36**  
**7075 (UNS A97075) > Isotropic Resistivity**

Resistivity ohm cmil in <sup>-1</sup>	Temperature F
1.3838	-452.47
1.3854	-443.34
1.3871	-434.22
1.3887	-425.09
1.3926	-415.96
1.3984	-406.84
1.406	-397.71
1.4152	-388.59
1.426	-379.46
1.4383	-370.33
1.4521	-361.21
1.4674	-352.08
1.484	-342.95
1.502	-333.83
1.5212	-324.7
1.5416	-315.58

1.5632	-306.45
1.5858	-297.32
1.6095	-288.2
1.6342	-279.07
1.6597	-269.94
1.6862	-260.82
1.7134	-251.69
1.7415	-242.56
1.7702	-233.44
1.7995	-224.31
1.8294	-215.19
1.8599	-206.06
1.8908	-196.93
1.9221	-187.81
1.9538	-178.68
1.9858	-169.55
2.018	-160.43
2.0505	-151.3
2.083	-142.18
2.1156	-133.05
2.1483	-123.92
2.1809	-114.8
2.2134	-105.67
2.2457	-96.544
2.2779	-87.417
2.3097	-78.291
2.3413	-69.165
2.3725	-60.038
2.4032	-50.912
2.4335	-41.786
2.4632	-32.659
2.4923	-23.533
2.5207	-14.407
2.5484	-5.2805
2.5754	3.8458
2.6015	12.972
2.6267	22.098
2.651	31.225
2.6743	40.351
2.6965	49.477
2.7176	58.604
2.7376	67.73

**TABLE 37**  
**7075 (UNS A97075) > Isotropic Elasticity**

Temperature F	Young's Modulus psi	Poisson's Ratio	Bulk Modulus psi	Shear Modulus psi
-459.67	1.1431e+007	0.32387	1.0817e+007	4.3172e+006
-445.62	1.1432e+007	0.32391	1.082e+007	4.3174e+006
-431.56	1.1429e+007	0.32398	1.0822e+007	4.3162e+006

-417.51	1.1423e+007	0.32407	1.0822e+007	4.3138e+006
-403.45	1.1415e+007	0.32418	1.0821e+007	4.3102e+006
-389.4	1.1404e+007	0.32431	1.0818e+007	4.3056e+006
-375.34	1.139e+007	0.32446	1.0814e+007	4.2999e+006
-361.29	1.1374e+007	0.32463	1.0809e+007	4.2932e+006
-347.23	1.1355e+007	0.32481	1.0803e+007	4.2857e+006
-333.18	1.1335e+007	0.32501	1.0796e+007	4.2773e+006
-319.12	1.1312e+007	0.32521	1.0787e+007	4.2682e+006
-305.07	1.1288e+007	0.32543	1.0777e+007	4.2583e+006
-291.02	1.1262e+007	0.32566	1.0766e+007	4.2478e+006
-276.96	1.1234e+007	0.32589	1.0754e+007	4.2366e+006
-262.91	1.1205e+007	0.32613	1.0741e+007	4.2249e+006
-248.85	1.1175e+007	0.32637	1.0727e+007	4.2126e+006
-234.8	1.1143e+007	0.32662	1.0712e+007	4.1999e+006
-220.74	1.1111e+007	0.32687	1.0696e+007	4.1867e+006
-206.69	1.1077e+007	0.32713	1.0679e+007	4.1732e+006
-192.63	1.1042e+007	0.32738	1.0661e+007	4.1593e+006
-178.58	1.1006e+007	0.32763	1.0642e+007	4.1451e+006
-164.52	1.097e+007	0.32788	1.0623e+007	4.1306e+006
-150.47	1.0933e+007	0.32813	1.0602e+007	4.1159e+006
-136.42	1.0895e+007	0.32838	1.0581e+007	4.101e+006
-122.36	1.0857e+007	0.32862	1.0558e+007	4.0859e+006
-108.31	1.0819e+007	0.32885	1.0535e+007	4.0707e+006
-94.252	1.078e+007	0.32908	1.0512e+007	4.0553e+006
-80.197	1.074e+007	0.32931	1.0487e+007	4.0399e+006
-66.143	1.0701e+007	0.32953	1.0462e+007	4.0243e+006
-52.088	1.0661e+007	0.32974	1.0436e+007	4.0088e+006
-38.034	1.0621e+007	0.32995	1.041e+007	3.9931e+006
-23.979	1.0581e+007	0.33014	1.0383e+007	3.9775e+006
-9.9245	1.0541e+007	0.33033	1.0355e+007	3.9618e+006
4.13	1.0501e+007	0.33052	1.0326e+007	3.9462e+006
18.185	1.0461e+007	0.33069	1.0298e+007	3.9306e+006
32.239	1.0421e+007	0.33086	1.0268e+007	3.915e+006
46.294	1.038e+007	0.33102	1.0238e+007	3.8994e+006
60.348	1.034e+007	0.33117	1.0208e+007	3.8839e+006
74.403	1.03e+007	0.33131	1.0177e+007	3.8684e+006
88.457	1.026e+007	0.33145	1.0145e+007	3.8529e+006
102.51	1.022e+007	0.33158	1.0114e+007	3.8375e+006
116.57	1.018e+007	0.33171	1.0081e+007	3.8221e+006
130.62	1.014e+007	0.33183	1.0049e+007	3.8067e+006
144.68	1.01e+007	0.33194	1.0016e+007	3.7914e+006
158.73	1.006e+007	0.33205	9.9828e+006	3.776e+006
172.78	1.002e+007	0.33216	9.9493e+006	3.7607e+006
186.84	9.9795e+006	0.33226	9.9156e+006	3.7453e+006
200.89	9.9393e+006	0.33236	9.8817e+006	3.7299e+006
214.95	9.8989e+006	0.33246	9.8475e+006	3.7145e+006
229	9.8584e+006	0.33257	9.8132e+006	3.699e+006
243.06	9.8176e+006	0.33267	9.7787e+006	3.6835e+006

257.11	9.7766e+006	0.33278	9.7441e+006	3.6678e+006
271.17	9.7353e+006	0.33289	9.7094e+006	3.6519e+006
285.22	9.6935e+006	0.33301	9.6746e+006	3.636e+006
299.28	9.6513e+006	0.33313	9.6397e+006	3.6198e+006
313.33	9.6086e+006	0.33327	9.6048e+006	3.6034e+006
327.38	9.5652e+006	0.33342	9.5699e+006	3.5867e+006
341.44	9.5212e+006	0.33358	9.535e+006	3.5698e+006
355.49	9.4764e+006	0.33375	9.5002e+006	3.5525e+006
369.55	9.4308e+006	0.33394	9.4654e+006	3.5349e+006
383.6	9.3842e+006	0.33416	9.4307e+006	3.5169e+006
397.66	9.3365e+006	0.33439	9.3961e+006	3.4984e+006
411.71	9.2877e+006	0.33465	9.3616e+006	3.4795e+006
425.77	9.2377e+006	0.33493	9.3272e+006	3.46e+006
439.82	9.1863e+006	0.33525	9.293e+006	3.4399e+006
453.88	9.1334e+006	0.33559	9.259e+006	3.4192e+006
467.93	9.0788e+006	0.33598	9.2252e+006	3.3978e+006
481.98	9.0226e+006	0.3364	9.1916e+006	3.3757e+006
496.04	8.9645e+006	0.33686	9.1582e+006	3.3528e+006
510.09	8.9044e+006	0.33736	9.125e+006	3.3291e+006
524.15	8.8421e+006	0.33792	9.0921e+006	3.3044e+006
538.2	8.7776e+006	0.33852	9.0595e+006	3.2788e+006
552.26	8.7106e+006	0.33918	9.0272e+006	3.2522e+006
566.31	8.6411e+006	0.33989	8.9952e+006	3.2245e+006
580.37	8.5688e+006	0.34067	8.9635e+006	3.1957e+006
594.42	8.4935e+006	0.34152	8.9321e+006	3.1657e+006
608.48	8.4153e+006	0.34243	8.9011e+006	3.1343e+006
622.53	8.3337e+006	0.34342	8.8704e+006	3.1017e+006
636.58	8.2487e+006	0.34448	8.8401e+006	3.0676e+006
650.64	8.1602e+006	0.34563	8.8102e+006	3.0321e+006
664.69	8.0678e+006	0.34687	8.7807e+006	2.995e+006
678.75	7.9714e+006	0.34819	8.7516e+006	2.9563e+006
692.8	7.8709e+006	0.34961	8.7229e+006	2.916e+006
706.86	7.7659e+006	0.35114	8.6947e+006	2.8739e+006
720.91	7.6564e+006	0.35277	8.667e+006	2.8299e+006
734.97	7.5421e+006	0.35451	8.6397e+006	2.7841e+006
749.02	7.4228e+006	0.35636	8.6129e+006	2.7363e+006
763.08	7.2982e+006	0.35834	8.5867e+006	2.6864e+006
777.13	7.1682e+006	0.36045	8.561e+006	2.6345e+006
791.18	7.0325e+006	0.36269	8.5359e+006	2.5804e+006
805.24	6.8908e+006	0.36507	8.5113e+006	2.524e+006
819.29	6.7431e+006	0.36759	8.4875e+006	2.4653e+006
833.35	6.5889e+006	0.37026	8.4642e+006	2.4042e+006
847.4	6.4281e+006	0.37309	8.4418e+006	2.3407e+006
861.46	6.2603e+006	0.37608	8.4201e+006	2.2747e+006
875.51	6.0855e+006	0.37925	8.3992e+006	2.2061e+006
889.57	5.9032e+006	0.38258	8.3793e+006	2.1348e+006
903.62	5.7132e+006	0.38611	8.3604e+006	2.0609e+006
917.68	5.5153e+006	0.38982	8.3427e+006	1.9842e+006

931.73	5.3092e+006	0.39373	8.3262e+006	1.9047e+006
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**TABLE 38**  
**7075 (UNS A97075) > Multilinear Isotropic Hardening**

Stress psi	Plastic Strain in in <sup>-1</sup>	Temperature F
16249	0	67.73
19107	4.7368e-003	67.73
21701	9.4737e-003	67.73
24046	1.4211e-002	67.73
26154	1.8947e-002	67.73
28039	2.3684e-002	67.73
29714	2.8421e-002	67.73
31193	3.3158e-002	67.73
32488	3.7895e-002	67.73
33612	4.2632e-002	67.73
34580	4.7368e-002	67.73
35405	5.2105e-002	67.73
36099	5.6842e-002	67.73
36676	6.1579e-002	67.73
37150	6.6316e-002	67.73
37533	7.1053e-002	67.73
37840	7.5789e-002	67.73
38082	8.0526e-002	67.73
38274	8.5263e-002	67.73
38429	9.e-002	67.73

**TABLE 39**  
**7075 (UNS A97075) > Alternating Stress R-Ratio**

Alternating Stress psi	Cycles	R-Ratio
50442	4000	-1
49352	4677.6	-1
48261	5469.9	-1
47166	6396.4	-1
46067	7479.9	-1
44962	8746.9	-1
43853	10229	-1
42739	11961	-1
41620	13987	-1
40499	16356	-1
39375	19127	-1
38251	22367	-1
37129	26156	-1
36010	30586	-1
34896	35767	-1
33790	41826	-1
32695	48910	-1
31612	57195	-1
30546	66883	-1
29498	78213	-1



28471	91461	-1
27468	1.0695e+005	-1
26492	1.2507e+005	-1
25546	1.4626e+005	-1
24632	1.7103e+005	-1
23753	2.e+005	-1
22911	2.3388e+005	-1
22108	2.7349e+005	-1
21346	3.1982e+005	-1
20627	3.7399e+005	-1
19953	4.3734e+005	-1
19325	5.1143e+005	-1
18744	5.9806e+005	-1
18210	6.9936e+005	-1
17724	8.1782e+005	-1
17285	9.5635e+005	-1
16894	1.1183e+006	-1
16548	1.3078e+006	-1
16247	1.5293e+006	-1
15989	1.7884e+006	-1
15771	2.0913e+006	-1
15590	2.4455e+006	-1
15442	2.8598e+006	-1
15324	3.3442e+006	-1
15230	3.9106e+006	-1
15155	4.5731e+006	-1
15092	5.3477e+006	-1
15035	6.2535e+006	-1
14976	7.3128e+006	-1
14816	1.e+007	-1