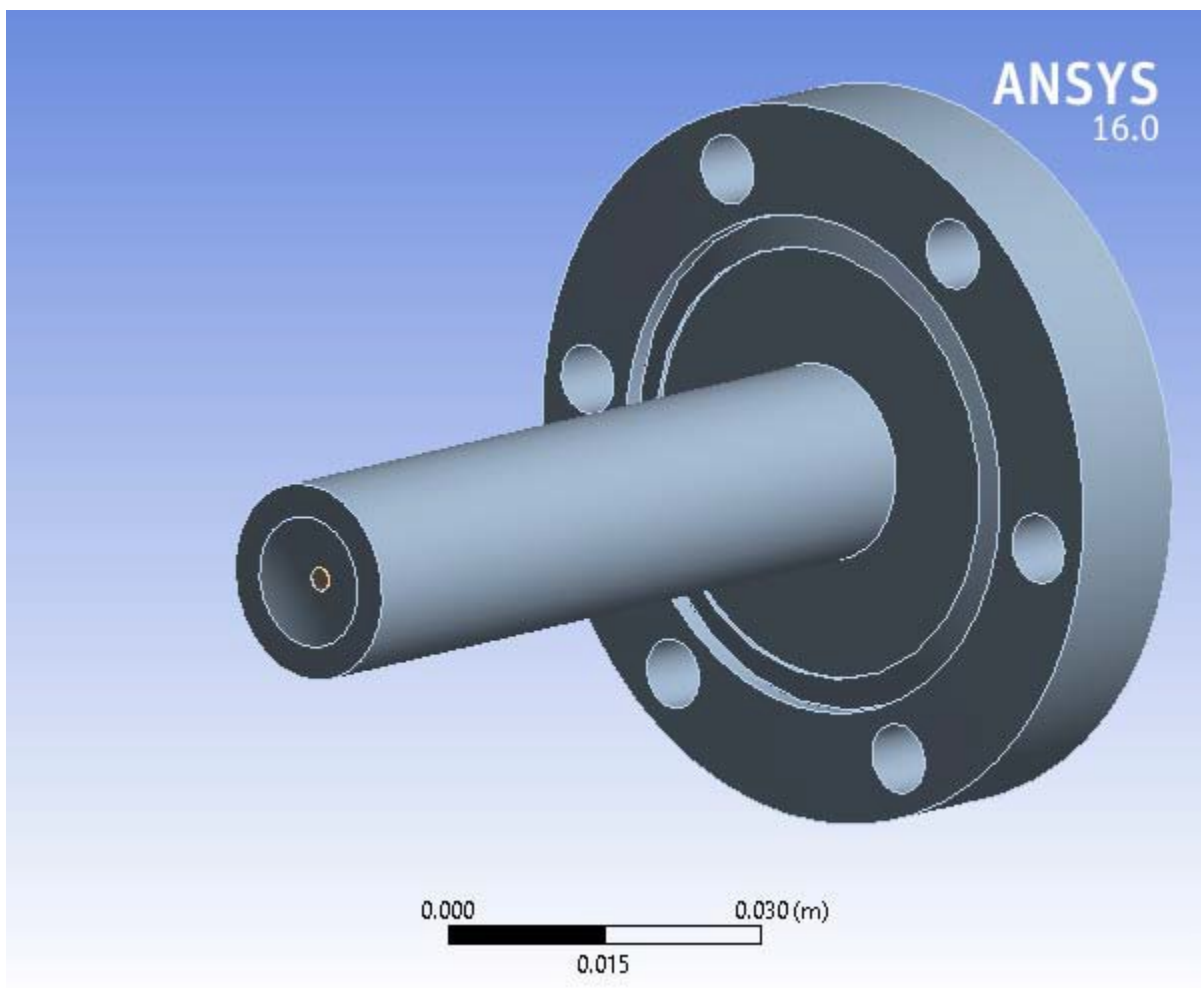




# Entrance window beam heating model

Author	David Meekins
Number	TGT-CALC-103-008
Revision	0
Applicable Code	ASME B31.3 (2012)



## Units

**TABLE 1**

Unit System	Metric (m, kg, N, s, V, A) Degrees rad/s Kelvin
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Kelvin

## Model/Assumptions

TGT-CALC-103-008

Entrance window temperature while in beam. Conditions are:

- beam current 20 microA
- raster 2x2
- heat from beam 3W
- heat flux  $3E+9$  W/m<sup>3</sup>
- Matl model is from MPDB

Reference Drawing: TGT-103-1000-0100

## Model (B4)

## Geometry

**TABLE 2**  
**Model (B4) > Geometry**

Object Name	Geometry
State	Fully Defined
<b>Definition</b>	
Source	D:\Meekins\GoogleDrive\JLAB\Hall A\Trtium\Calculations\ANSYS\cell beam heating\Assembly1.iam
Type	Inventor
Length Unit	Centimeters
Element Control	Program Controlled
Display Style	Body Color
<b>Bounding Box</b>	
Length X	0.33416 m
Length Y	7.0806e-002 m
Length Z	7.62e-002 m
<b>Properties</b>	
Volume	5.3774e-005 m <sup>3</sup>
Mass	0.14624 kg
Scale Factor Value	1.
<b>Statistics</b>	
Bodies	4
Active Bodies	2
Nodes	165099
Elements	109581
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 (B4) > Geometry > Parts**

Object Name	<i>main body:1</i>	<i>entrance:1</i>	<i>exit beam:1</i>	<i>ent beam:1</i>
State	Suppressed	Meshed	Suppressed	Meshed
<b>Graphics Properties</b>				
Visible	No	Yes	No	Yes
Transparency		1		1
<b>Definition</b>				
Suppressed	Yes	No	Yes	No
Stiffness Behavior	Flexible			
Coordinate System	Default Coordinate System			
Reference Temperature	By Environment			
<b>Material</b>				
Assignment		7075 (UNS A97075)		7075 (UNS A97075)
Nonlinear Effects	Yes			
Thermal Strain Effects	Yes			
<b>Bounding Box</b>				
Length X	0.32146 m	8.4557e-002 m	3.5536e-004 m	3.0437e-004 m
Length Y	7.0806e-002 m	6.985e-002 m	2.26e-003 m	
Length Z	7.62e-002 m	6.985e-002 m	2.26e-003 m	
<b>Properties</b>				
Volume	8.0156e-004 m <sup>3</sup>	5.3773e-005 m <sup>3</sup>	1.2217e-009 m <sup>3</sup>	1.0189e-009 m <sup>3</sup>
Mass		0.14624 kg		2.7711e-006 kg
Centroid X	1.2664e-002 m	0.12855 m	-0.19035 m	6.0903e-002 m
Centroid Y	8.7826e-002 m			
Centroid Z	3.3853e-002 m	3.3854e-002 m		
Moment of Inertia Ip1		7.4106e-005 kg·m <sup>2</sup>		1.7625e-012 kg·m <sup>2</sup>
Moment of Inertia Ip2		9.6097e-005 kg·m <sup>2</sup>		8.9668e-013 kg·m <sup>2</sup>
Moment of Inertia Ip3		9.6097e-005 kg·m <sup>2</sup>		8.9668e-013 kg·m <sup>2</sup>
<b>Statistics</b>				
Nodes	0	164609	0	490
Elements	0	109520	0	61
Mesh Metric	None			

## Coordinate Systems

**TABLE 4**  
**Model (B4) > 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. m
Origin Y	0. m
Origin Z	0. m
<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 (B4) > 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 (B4) > Connections > Contacts**

Object Name	<i>Contacts</i>
State	Fully Defined
<b>Definition</b>	
Connection Type	Contact
<b>Scope</b>	
Scoping Method	Geometry Selection
Geometry	All Bodies
<b>Auto Detection</b>	
Tolerance Type	Slider
Tolerance Slider	0.
Tolerance Value	8.7494e-004 m
Use Range	No
Face/Face	Yes
Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies
<b>Statistics</b>	
Connections	1
Active Connections	1

**TABLE 7**  
**Model (B4) > Connections > Contacts > Contact Regions**

Object Name	<i>Bonded - entrance:1 To ent beam:1</i>
State	Fully Defined
<b>Scope</b>	
Scoping Method	Geometry Selection

Contact	1 Face
Target	1 Face
Contact Bodies	entrance:1
Target Bodies	ent beam:1
<b>Definition</b>	
Type	Bonded
Scope Mode	Manual
Behavior	Program Controlled
Trim Contact	Program Controlled
Suppressed	No
<b>Advanced</b>	
Formulation	Program Controlled
Detection Method	Program Controlled
Elastic Slip Tolerance	Program Controlled
Thermal Conductance	Program Controlled
Pinball Region	Program Controlled
<b>Geometric Modification</b>	
Contact Geometry Correction	None
Target Geometry Correction	None

## Mesh

**TABLE 8**  
**Model (B4) > 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	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	High
Transition	Slow
Span Angle Center	Fine
Minimum Edge Length	4.9873e-003 m
<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	165099
Elements	109581
Mesh Metric	None

## Steady-State Thermal (B5)

**TABLE 9**  
**Model (B4) > Analysis**

Object Name	<i>Steady-State Thermal (B5)</i>
State	Solved
<b>Definition</b>	
Physics Type	Thermal
Analysis Type	Steady-State
Solver Target	Mechanical APDL
<b>Options</b>	
Generate Input Only	No

**TABLE 10**  
**Model (B4) > Steady-State Thermal (B5) > Initial Condition**

Object Name	<i>Initial Temperature</i>
State	Fully Defined
<b>Definition</b>	
Initial Temperature	Uniform Temperature
Initial Temperature Value	40. K

**TABLE 11**  
**Model (B4) > Steady-State Thermal (B5) > Analysis Settings**

Object Name	<i>Analysis Settings</i>
State	Fully Defined

Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Solver Pivot Checking	Program Controlled
Radiosity Controls	
Radiosity Solver	Program Controlled
Flux Convergence	1.e-004
Maximum Iteration	1000.
Solver Tolerance	0.1 W/m <sup>2</sup>
Over Relaxation	0.1
Hemicube Resolution	10.
Nonlinear Controls	
Heat Convergence	Program Controlled
Temperature Convergence	Program Controlled
Line Search	Program Controlled
Output Controls	
Calculate Thermal Flux	Yes
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	D:\Meekins\GoogleDrive\JLAB\Hall A\Tritium\Calculations\ANSYS\cell beam heating\beam heating_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	mks

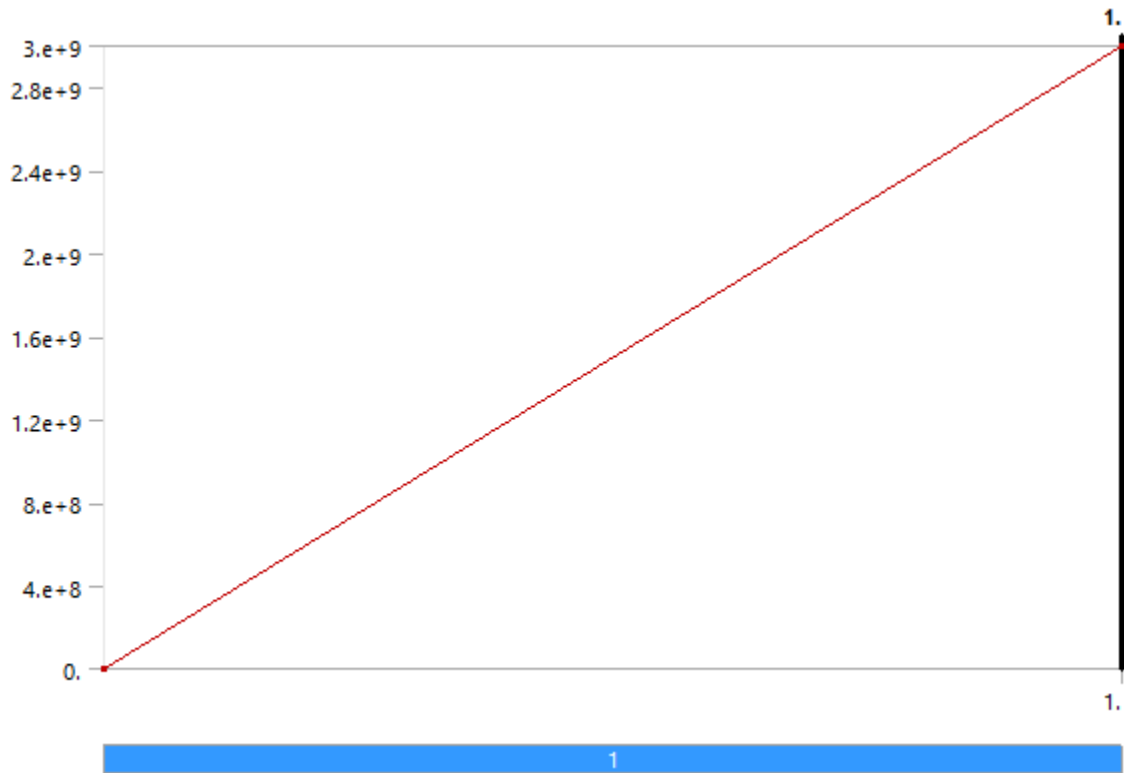
**TABLE 12**  
**Model (B4) > Steady-State Thermal (B5) > Loads**

Object Name	<i>Internal Heat Generation</i>	<i>Temperature</i>
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Body	1 Face
Definition		
Type	Internal Heat Generation	Temperature
Magnitude	3.e+009 W/m <sup>3</sup> (ramped)	40. K (ramped)

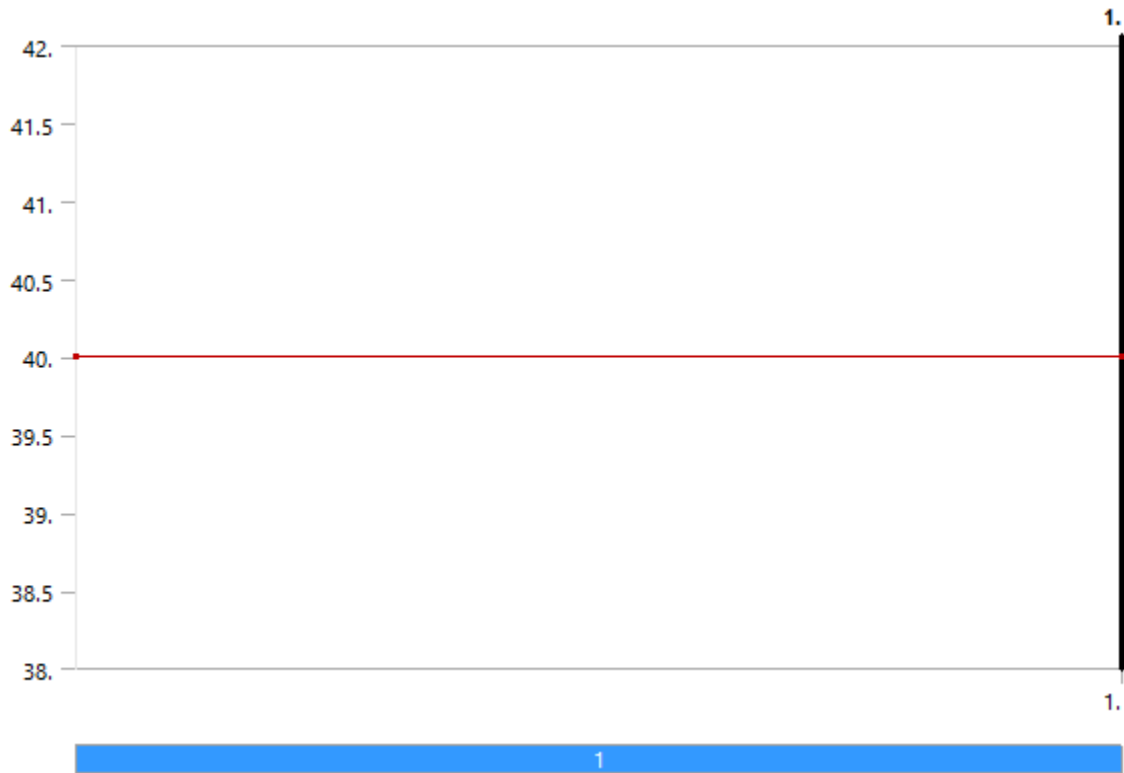


Suppressed	No
------------	----

**FIGURE 1**  
Model (B4) > Steady-State Thermal (B5) > Internal Heat Generation



**FIGURE 2**  
Model (B4) > Steady-State Thermal (B5) > Temperature



**Solution (B6)**

**TABLE 13**  
**Model (B4) > Steady-State Thermal (B5) > Solution**

Object Name	<i>Solution (B6)</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 (B4) > Steady-State Thermal (B5) > Solution (B6) > Solution Information**

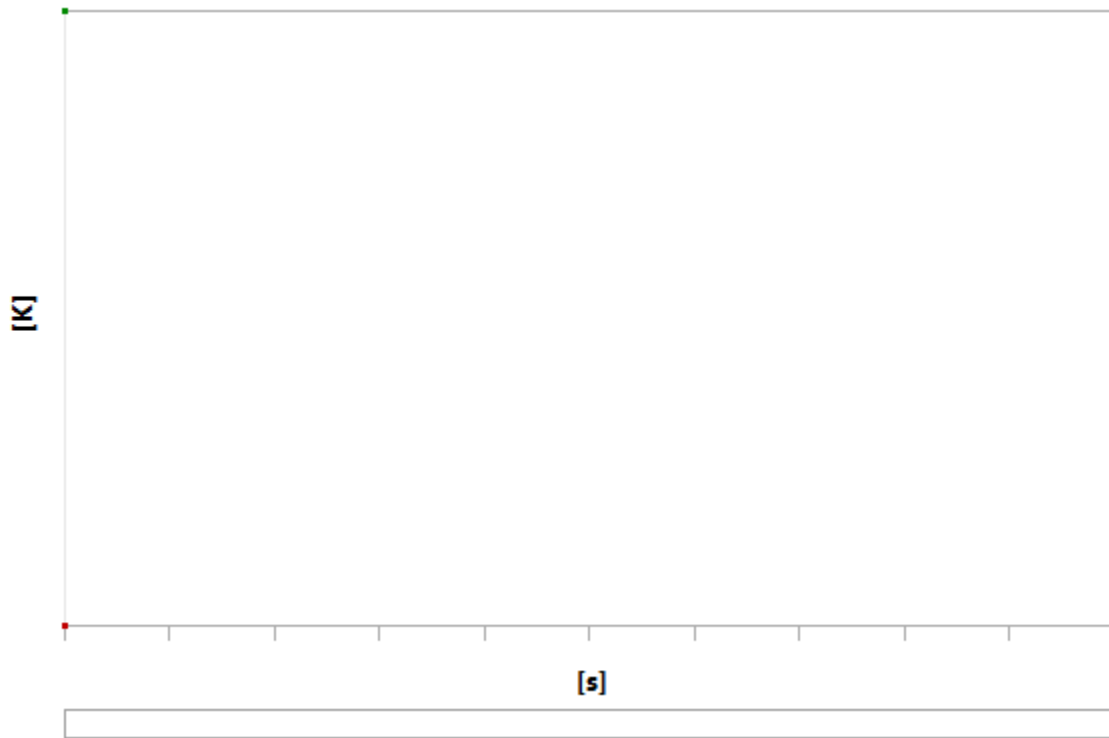
Object Name	<i>Solution Information</i>
State	Solved
<b>Solution Information</b>	
Solution Output	Solver Output
Update Interval	2.5 s
Display Points	All
<b>FE Connection Visibility</b>	
Activate Visibility	Yes
Display	All FE Connectors

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

**TABLE 15**  
**Model (B4) > Steady-State Thermal (B5) > Solution (B6) > Results**

Object Name	<i>Temperature 2</i>
State	Solved
<b>Scope</b>	
Scoping Method	Geometry Selection
Geometry	All Bodies
<b>Definition</b>	
Type	Temperature
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
<b>Results</b>	
Minimum	40. K
Maximum	119.05 K
Minimum Occurs On	entrance:1
Maximum Occurs On	ent beam:1
<b>Information</b>	
Time	1. s
Load Step	1
Substep	1
Iteration Number	2

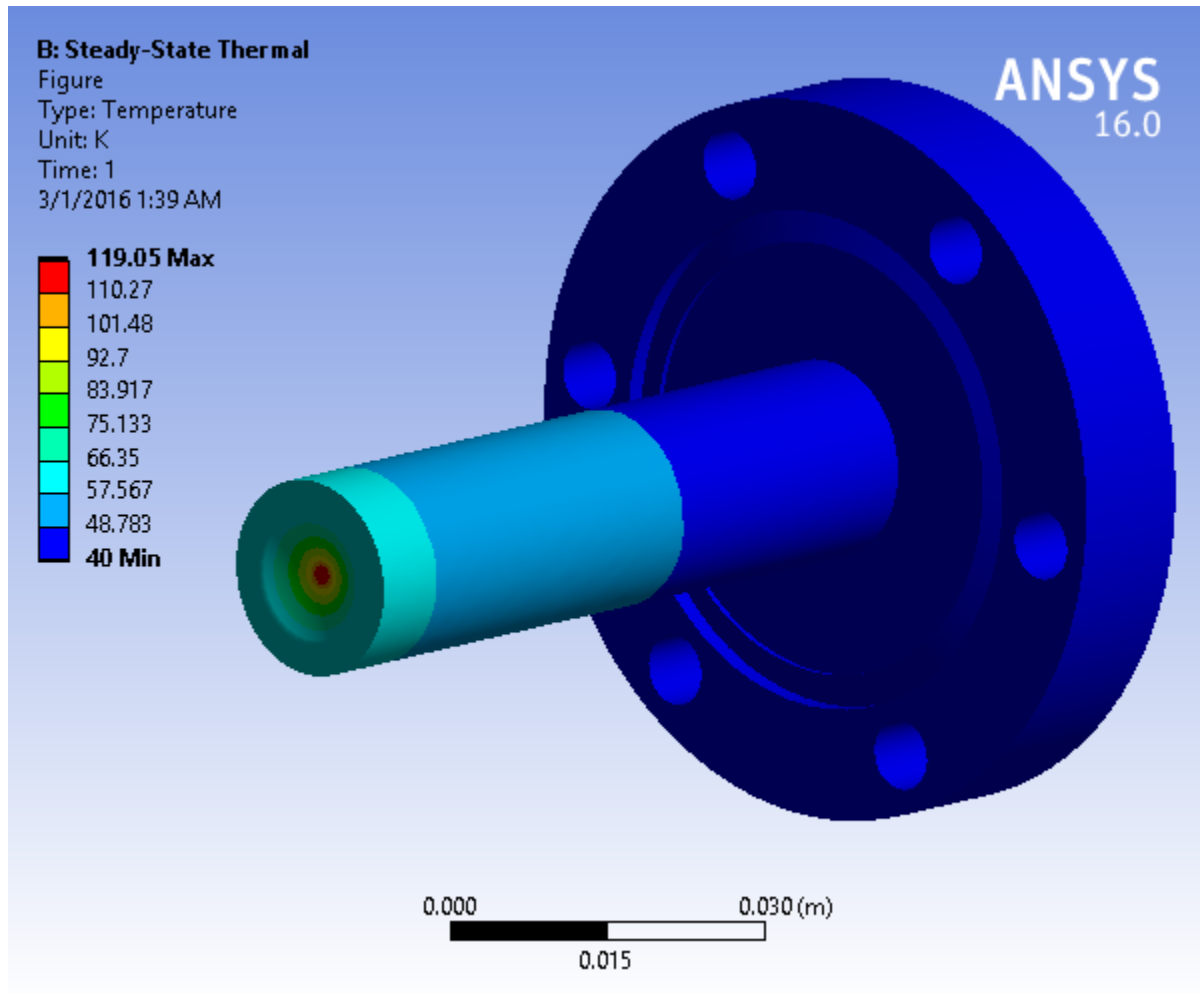
**FIGURE 3**  
**Model (B4) > Steady-State Thermal (B5) > Solution (B6) > Temperature 2**



**TABLE 16**  
**Model (B4) > Steady-State Thermal (B5) > Solution (B6) > Temperature 2**

Time [s]	Minimum [K]	Maximum [K]
1.	40.	119.05

**FIGURE 4**  
**Model (B4) > Steady-State Thermal (B5) > Solution (B6) > Temperature 2 > Figure Temperature of Exit window**



## Material Data

**7075 (UNS A97075)**

**TABLE 17**  
**7075 (UNS A97075) > Density**

Density kg m <sup>-3</sup>	Temperature C
2754.3	-273.15
2754.3	-266.08
2754.2	-259.01
2754.2	-251.94
2754.3	-244.87
2754.2	-237.8
2754.1	-230.73
2753.9	-223.66
2753.6	-216.58
2753.2	-209.51
2752.7	-202.44

2752.2	-195.37
2751.7	-188.3
2751	-181.23
2750.4	-174.16
2749.6	-167.09
2748.8	-160.02
2748	-152.95
2747.2	-145.88
2746.2	-138.81
2745.3	-131.74
2744.3	-124.67
2743.3	-117.59
2742.3	-110.52
2741.2	-103.45
2740.1	-96.382
2739	-89.312
2737.9	-82.241
2736.7	-75.17
2735.6	-68.099
2734.4	-61.029
2733.2	-53.958
2732	-46.887
2730.7	-39.817
2729.5	-32.746
2728.2	-25.675
2727	-18.605
2725.7	-11.534
2724.4	-4.4631
2723.2	2.6076
2721.9	9.6783
2720.6	16.749
2719.3	23.82
2718	30.89
2716.6	37.961
2715.3	45.032
2714	52.103
2712.7	59.173
2711.3	66.244
2710	73.315
2708.7	80.385
2707.3	87.456
2706	94.527
2704.6	101.6
2703.3	108.67
2701.9	115.74
2700.5	122.81
2699.2	129.88
2697.8	136.95

2696.4	144.02
2695	151.09
2693.6	158.16
2692.2	165.23
2690.8	172.3
2689.4	179.38
2688	186.45
2686.5	193.52
2685.1	200.59
2683.6	207.66
2682.2	214.73
2680.7	221.8
2679.3	228.87
2677.8	235.94
2676.3	243.01
2674.8	250.08
2673.3	257.15
2671.7	264.22
2670.2	271.29
2668.7	278.37
2667.1	285.44
2665.6	292.51
2664	299.58
2662.4	306.65
2660.8	313.72
2659.2	320.79
2657.6	327.86
2656	334.93
2654.4	342
2652.8	349.07
2651.1	356.14
2649.5	363.21
2647.8	370.28
2646.2	377.36
2644.5	384.43
2642.9	391.5
2641.2	398.57
2639.6	405.64
2637.9	412.71
2636.3	419.78
2634.6	426.85

**TABLE 18**  
**7075 (UNS A97075) > Tensile Yield Strength**

Tensile Yield Strength Pa	Temperature C
6.56e+008	-269.15
6.3812e+008	-260.98
6.2069e+008	-252.81
6.1153e+008	-244.63

6.029e+008	-236.46
5.9478e+008	-228.29
5.8716e+008	-220.12
5.8e+008	-211.95
5.7329e+008	-203.78
5.67e+008	-195.6
5.6111e+008	-187.43
5.5559e+008	-179.26
5.5041e+008	-171.09
5.4557e+008	-162.92
5.4103e+008	-154.75
5.3676e+008	-146.57
5.3275e+008	-138.4
5.2898e+008	-130.23
5.2541e+008	-122.06
5.2202e+008	-113.89
5.188e+008	-105.72
5.1571e+008	-97.544
5.1274e+008	-89.372
5.0986e+008	-81.201
5.0704e+008	-73.029
5.0427e+008	-64.857
5.0151e+008	-56.685
4.9876e+008	-48.514
4.9597e+008	-40.342
4.9313e+008	-32.17
4.9022e+008	-23.998
4.8721e+008	-15.827
4.8407e+008	-7.6551
4.8079e+008	0.51667
4.7735e+008	8.6884
4.737e+008	16.86
4.6985e+008	25.032
4.6575e+008	33.204
4.6138e+008	41.375
4.5673e+008	49.547
4.5177e+008	57.719
4.4648e+008	65.89
4.4082e+008	74.062
4.3479e+008	82.234
4.2835e+008	90.406
4.2148e+008	98.577
3.8152e+008	106.75
3.3689e+008	114.92
2.9467e+008	123.09
2.5601e+008	131.26
2.2171e+008	139.44
1.9223e+008	147.61



1.6771e+008	155.78
1.4794e+008	163.95
1.324e+008	172.12
1.2022e+008	180.29
1.1018e+008	188.47
1.0141e+008	196.64
9.3918e+007	204.81
8.7157e+007	212.98
8.1071e+007	221.15
7.5603e+007	229.32
7.07e+007	237.5
6.631e+007	245.67
6.2384e+007	253.84
5.8876e+007	262.01
5.574e+007	270.18
5.2935e+007	278.36
5.042e+007	286.53
4.8157e+007	294.7
4.611e+007	302.87
4.4247e+007	311.04
4.2537e+007	319.21
4.095e+007	327.39
3.946e+007	335.56
3.8043e+007	343.73
3.6676e+007	351.9
3.5341e+007	360.07
3.4019e+007	368.24
3.2695e+007	376.42
3.1357e+007	384.59
2.9994e+007	392.76
2.8597e+007	400.93
2.716e+007	409.1
2.568e+007	417.27
2.4154e+007	425.45
2.2584e+007	433.62
2.0972e+007	441.79
1.9324e+007	449.96
1.7646e+007	458.13
1.595e+007	466.3
1.4245e+007	474.48
1.2548e+007	482.65
1.0874e+007	490.82
9.2425e+006	498.99
7.674e+006	507.16
6.192e+006	515.33
4.8221e+006	523.51
3.5922e+006	531.68
2.5322e+006	539.85

**TABLE 19**  
**7075 (UNS A97075) > Tensile Ultimate Strength**

Tensile Ultimate Strength Pa	Temperature C
7.65e+008	-269.15
7.6245e+008	-260.98
7.5936e+008	-252.81
7.4368e+008	-244.63
7.29e+008	-236.46
7.1529e+008	-228.29
7.0251e+008	-220.12
6.906e+008	-211.95
6.7953e+008	-203.78
6.6925e+008	-195.6
6.5973e+008	-187.43
6.5093e+008	-179.26
6.4279e+008	-171.09
6.3528e+008	-162.92
6.2836e+008	-154.75
6.2198e+008	-146.57
6.1611e+008	-138.4
6.107e+008	-130.23
6.057e+008	-122.06
6.0109e+008	-113.89
5.9681e+008	-105.72
5.9283e+008	-97.544
5.8909e+008	-89.372
5.8557e+008	-81.201
5.8221e+008	-73.029
5.7899e+008	-64.857
5.7584e+008	-56.685
5.7274e+008	-48.514
5.6964e+008	-40.342
5.665e+008	-32.17
5.6328e+008	-23.998
5.5993e+008	-15.827
5.5642e+008	-7.6551
5.527e+008	0.51667
5.4873e+008	8.6884
5.4446e+008	16.86
5.3986e+008	25.032
5.3489e+008	33.204
5.295e+008	41.375
5.2365e+008	49.547
5.173e+008	57.719
5.104e+008	65.89
5.0293e+008	74.062
4.9482e+008	82.234
4.8605e+008	90.406
4.7656e+008	98.577

4.3469e+008	106.75
3.871e+008	114.92
3.4111e+008	123.09
2.9795e+008	131.26
2.5859e+008	139.44
2.2374e+008	147.61
1.9383e+008	155.78
1.6904e+008	163.95
1.4931e+008	172.12
1.3428e+008	180.29
1.2335e+008	188.47
1.1565e+008	196.64
1.0933e+008	204.81
1.03e+008	212.98
9.7132e+007	221.15
9.1691e+007	229.32
8.6652e+007	237.5
8.1988e+007	245.67
7.7674e+007	253.84
7.3684e+007	262.01
6.9995e+007	270.18
6.6583e+007	278.36
6.3426e+007	286.53
6.0502e+007	294.7
5.779e+007	302.87
5.527e+007	311.04
5.2923e+007	319.21
5.073e+007	327.39
4.8674e+007	335.56
4.6738e+007	343.73
4.4905e+007	351.9
4.3161e+007	360.07
4.149e+007	368.24
3.9879e+007	376.42
3.8316e+007	384.59
3.6787e+007	392.76
3.5282e+007	400.93
3.3791e+007	409.1
3.2302e+007	417.27
3.0808e+007	425.45
2.9301e+007	433.62
2.7772e+007	441.79
2.6215e+007	449.96
2.4625e+007	458.13
2.2997e+007	466.3
2.1326e+007	474.48
1.961e+007	482.65
1.7845e+007	490.82

1.6029e+007	498.99
1.4162e+007	507.16
1.2244e+007	515.33
1.0275e+007	523.51
8.2565e+006	531.68
6.1907e+006	539.85

**TABLE 20**  
**7075 (UNS A97075) > Isotropic Secant Coefficient of Thermal Expansion**

Coefficient of Thermal Expansion C <sup>-1</sup>	Temperature C
1.4225e-005	-273.15
1.4583e-005	-266.08
1.494e-005	-259.01
1.5309e-005	-251.94
1.5736e-005	-244.87
1.6143e-005	-237.8
1.6531e-005	-230.73
1.6902e-005	-223.66
1.7254e-005	-216.58
1.759e-005	-209.51
1.7909e-005	-202.44
1.8213e-005	-195.37
1.8501e-005	-188.3
1.8775e-005	-181.23
1.9035e-005	-174.16
1.9281e-005	-167.09
1.9514e-005	-160.02
1.9735e-005	-152.95
1.9944e-005	-145.88
2.0142e-005	-138.81
2.0329e-005	-131.74
2.0506e-005	-124.67
2.0673e-005	-117.59
2.083e-005	-110.52
2.0978e-005	-103.45
2.1118e-005	-96.382
2.125e-005	-89.312
2.1375e-005	-82.241
2.1492e-005	-75.17
2.1603e-005	-68.099
2.1707e-005	-61.029
2.1805e-005	-53.958
2.1898e-005	-46.887
2.1985e-005	-39.817
2.2068e-005	-32.746
2.2146e-005	-25.675
2.222e-005	-18.605
2.229e-005	-11.534
2.2357e-005	-4.4631

2.2421e-005	2.6076
2.2482e-005	9.6783
2.254e-005	16.749
2.2596e-005	23.82
2.265e-005	30.89
2.2702e-005	37.961
2.2753e-005	45.032
2.2803e-005	52.103
2.2851e-005	59.173
2.2899e-005	66.244
2.2946e-005	73.315
2.2993e-005	80.385
2.304e-005	87.456
2.3086e-005	94.527
2.3133e-005	101.6
2.318e-005	108.67
2.3227e-005	115.74
2.3276e-005	122.81
2.3325e-005	129.88
2.3374e-005	136.95
2.3425e-005	144.02
2.3477e-005	151.09
2.353e-005	158.16
2.3584e-005	165.23
2.364e-005	172.3
2.3697e-005	179.38
2.3755e-005	186.45
2.3815e-005	193.52
2.3876e-005	200.59
2.3939e-005	207.66
2.4003e-005	214.73
2.4069e-005	221.8
2.4136e-005	228.87
2.4205e-005	235.94
2.4275e-005	243.01
2.4347e-005	250.08
2.442e-005	257.15
2.4494e-005	264.22
2.4569e-005	271.29
2.4646e-005	278.37
2.4724e-005	285.44
2.4802e-005	292.51
2.4882e-005	299.58
2.4962e-005	306.65
2.5042e-005	313.72
2.5124e-005	320.79
2.5205e-005	327.86
2.5286e-005	334.93

2.5368e-005	342
2.5449e-005	349.07
2.5529e-005	356.14
2.5609e-005	363.21
2.5688e-005	370.28
2.5766e-005	377.36
2.5843e-005	384.43
2.5918e-005	391.5
2.5991e-005	398.57
2.6062e-005	405.64
2.6131e-005	412.71
2.6197e-005	419.78
2.626e-005	426.85
Reference Temperature C	
19.85	

**TABLE 21**  
**7075 (UNS A97075) > Specific Heat**

Specific Heat J kg <sup>-1</sup> C <sup>-1</sup>	Temperature C
572.12	-157.15
586.75	-151.25
600.86	-145.35
614.47	-139.45
627.58	-133.55
640.21	-127.66
652.39	-121.76
664.12	-115.86
675.41	-109.96
686.29	-104.06
696.77	-98.16
706.86	-92.261
716.57	-86.362
725.92	-80.463
734.93	-74.564
743.6	-68.665
751.94	-62.766
759.98	-56.867
767.73	-50.968
775.18	-45.069
782.37	-39.17
789.3	-33.271
795.98	-27.372
802.42	-21.473
808.64	-15.574
814.64	-9.6753
820.44	-3.7763
826.05	2.1227
831.48	8.0217
836.74	13.921

841.83	19.82
846.78	25.719
851.58	31.618
856.25	37.517
860.8	43.416
865.23	49.315
869.56	55.214
873.8	61.113
877.95	67.012
882.01	72.911
886.01	78.81
889.94	84.709
893.82	90.608
897.65	96.507
901.44	102.41
905.2	108.3
908.92	114.2
912.63	120.1
916.33	126
920.01	131.9
923.7	137.8
927.39	143.7
931.09	149.6
934.8	155.5
938.53	161.4
942.29	167.29
946.08	173.19
949.91	179.09
953.77	184.99
957.68	190.89
961.64	196.79
965.64	202.69
969.7	208.59
973.82	214.49
978	220.39
982.25	226.28
986.56	232.18
990.94	238.08
995.39	243.98
999.91	249.88
1004.5	255.78
1009.2	261.68
1014	267.58
1018.8	273.48
1023.7	279.38
1028.7	285.27
1033.8	291.17
1039	297.07

1044.2	302.97
1049.5	308.87
1055	314.77
1060.5	320.67
1066	326.57
1071.7	332.47
1077.5	338.37
1083.3	344.26
1089.2	350.16
1095.2	356.06
1101.2	361.96
1107.4	367.86
1113.6	373.76
1119.8	379.66
1126.2	385.56
1132.5	391.46
1139	397.36
1145.5	403.25
1152.1	409.15
1158.7	415.05
1165.4	420.95
1172.1	426.85

**TABLE 22**  
**7075 (UNS A97075) > Isotropic Thermal Conductivity**

Thermal Conductivity W m <sup>-1</sup> C <sup>-1</sup>	Temperature C
77.555	-157.15
79.962	-151.25
82.281	-145.35
84.514	-139.45
86.664	-133.55
88.735	-127.66
90.73	-121.76
92.651	-115.86
94.501	-109.96
96.284	-104.06
98.002	-98.16
99.659	-92.261
101.26	-86.362
102.8	-80.463
104.29	-74.564
105.73	-68.665
107.13	-62.766
108.48	-56.867
109.79	-50.968
111.06	-45.069
112.3	-39.17
113.51	-33.271
114.69	-27.372



115.84	-21.473
116.97	-15.574
118.08	-9.6753
119.18	-3.7763
120.26	2.1227
121.33	8.0217
122.4	13.921
123.46	19.82
124.51	25.719
125.57	31.618
126.64	37.517
127.71	43.416
128.79	49.315
129.89	55.214
131	61.113
132.14	67.012
133.29	72.911
134.47	78.81
135.68	84.709
136.93	90.608
138.2	96.507
139.52	102.41
140.87	108.3
142.27	114.2
143.72	120.1
145.21	126
146.76	131.9
148.36	137.8
150.03	143.7
151.75	149.6
153.54	155.5
155.39	161.4
157.32	167.29
159.32	173.19
161.4	179.09
163.56	184.99
165.8	190.89
168.13	196.79
170.54	202.69
171.5	208.59
172.09	214.49
172.65	220.39
173.17	226.28
173.64	232.18
174.08	238.08
174.48	243.98
174.84	249.88
175.17	255.78

175.45	261.68
175.69	267.58
175.9	273.48
176.06	279.38
176.19	285.27
176.28	291.17
176.33	297.07
176.34	302.97
176.31	308.87
176.24	314.77
176.13	320.67
175.99	326.57
175.8	332.47
175.58	338.37
175.32	344.26
175.01	350.16
174.67	356.06
174.29	361.96
173.87	367.86
173.41	373.76
172.92	379.66
172.38	385.56
171.8	391.46
171.19	397.36
170.54	403.25
169.84	409.15
169.11	415.05
168.34	420.95
167.53	426.85

**TABLE 23**  
**7075 (UNS A97075) > Isotropic Resistivity**

Resistivity ohm m	Temperature C
2.76e-008	-269.15
2.7632e-008	-264.08
2.7665e-008	-259.01
2.7697e-008	-253.94
2.7775e-008	-248.87
2.7892e-008	-243.8
2.8042e-008	-238.73
2.8226e-008	-233.66
2.8441e-008	-228.59
2.8687e-008	-223.52
2.8963e-008	-218.45
2.9267e-008	-213.38
2.9599e-008	-208.31
2.9957e-008	-203.24
3.034e-008	-198.17
3.0747e-008	-193.1

3.1177e-008	-188.03
3.1629e-008	-182.96
3.2101e-008	-177.89
3.2593e-008	-172.82
3.3103e-008	-167.75
3.3631e-008	-162.68
3.4174e-008	-157.61
3.4733e-008	-152.54
3.5306e-008	-147.47
3.5891e-008	-142.4
3.6488e-008	-137.33
3.7095e-008	-132.26
3.7712e-008	-127.19
3.8337e-008	-122.11
3.8969e-008	-117.04
3.9607e-008	-111.97
4.025e-008	-106.9
4.0896e-008	-101.83
4.1545e-008	-96.764
4.2196e-008	-91.694
4.2847e-008	-86.624
4.3497e-008	-81.554
4.4145e-008	-76.483
4.4791e-008	-71.413
4.5432e-008	-66.343
4.6068e-008	-61.273
4.6697e-008	-56.203
4.7319e-008	-51.132
4.7932e-008	-46.062
4.8535e-008	-40.992
4.9128e-008	-35.922
4.9708e-008	-30.852
5.0275e-008	-25.782
5.0828e-008	-20.711
5.1365e-008	-15.641
5.1886e-008	-10.571
5.2389e-008	-5.5009
5.2874e-008	-0.4307
5.3338e-008	4.6395
5.3781e-008	9.7096
5.4203e-008	14.78
5.46e-008	19.85

**TABLE 24**  
**7075 (UNS A97075) > Isotropic Elasticity**

Temperature C	Young's Modulus Pa	Poisson's Ratio	Bulk Modulus Pa	Shear Modulus Pa
-273.15	7.8813e+010	0.32387	7.4577e+010	2.9766e+010
-265.34	7.8818e+010	0.32391	7.46e+010	2.9767e+010
-257.53	7.88e+010	0.32398	7.4612e+010	2.9759e+010

-249.73	7.8762e+010	0.32407	7.4614e+010	2.9742e+010
-241.92	7.8704e+010	0.32418	7.4606e+010	2.9718e+010
-234.11	7.8626e+010	0.32431	7.4589e+010	2.9686e+010
-226.3	7.8532e+010	0.32446	7.4563e+010	2.9647e+010
-218.49	7.842e+010	0.32463	7.4528e+010	2.9601e+010
-210.69	7.8293e+010	0.32481	7.4485e+010	2.9549e+010
-202.88	7.8152e+010	0.32501	7.4433e+010	2.9491e+010
-195.07	7.7997e+010	0.32521	7.4374e+010	2.9428e+010
-187.26	7.7829e+010	0.32543	7.4306e+010	2.936e+010
-179.45	7.765e+010	0.32566	7.4231e+010	2.9287e+010
-171.64	7.7459e+010	0.32589	7.4148e+010	2.921e+010
-163.84	7.7259e+010	0.32613	7.4058e+010	2.9129e+010
-156.03	7.7049e+010	0.32637	7.3961e+010	2.9045e+010
-148.22	7.683e+010	0.32662	7.3857e+010	2.8957e+010
-140.41	7.6604e+010	0.32687	7.3746e+010	2.8866e+010
-132.6	7.6371e+010	0.32713	7.3629e+010	2.8773e+010
-124.8	7.6131e+010	0.32738	7.3505e+010	2.8677e+010
-116.99	7.5886e+010	0.32763	7.3376e+010	2.8579e+010
-109.18	7.5635e+010	0.32788	7.324e+010	2.848e+010
-101.37	7.538e+010	0.32813	7.3098e+010	2.8378e+010
-93.564	7.5121e+010	0.32838	7.2951e+010	2.8275e+010
-85.756	7.4858e+010	0.32862	7.2798e+010	2.8171e+010
-77.948	7.4592e+010	0.32885	7.2639e+010	2.8066e+010
-70.14	7.4324e+010	0.32908	7.2476e+010	2.796e+010
-62.332	7.4053e+010	0.32931	7.2307e+010	2.7854e+010
-54.524	7.378e+010	0.32953	7.2134e+010	2.7747e+010
-46.716	7.3506e+010	0.32974	7.1956e+010	2.7639e+010
-38.908	7.3231e+010	0.32995	7.1773e+010	2.7532e+010
-31.099	7.2955e+010	0.33014	7.1586e+010	2.7424e+010
-23.291	7.2679e+010	0.33033	7.1394e+010	2.7316e+010
-15.483	7.2402e+010	0.33052	7.1199e+010	2.7208e+010
-7.6753	7.2124e+010	0.33069	7.0999e+010	2.71e+010
0.13283	7.1847e+010	0.33086	7.0796e+010	2.6993e+010
7.9409	7.157e+010	0.33102	7.0589e+010	2.6885e+010
15.749	7.1293e+010	0.33117	7.0379e+010	2.6778e+010
23.557	7.1016e+010	0.33131	7.0166e+010	2.6671e+010
31.365	7.0739e+010	0.33145	6.995e+010	2.6565e+010
39.173	7.0463e+010	0.33158	6.973e+010	2.6458e+010
46.981	7.0187e+010	0.33171	6.9509e+010	2.6352e+010
54.789	6.9911e+010	0.33183	6.9284e+010	2.6246e+010
62.597	6.9635e+010	0.33194	6.9058e+010	2.614e+010
70.406	6.9359e+010	0.33205	6.8829e+010	2.6035e+010
78.214	6.9083e+010	0.33216	6.8598e+010	2.5929e+010
86.022	6.8806e+010	0.33226	6.8366e+010	2.5823e+010
93.83	6.8529e+010	0.33236	6.8132e+010	2.5717e+010
101.64	6.8251e+010	0.33246	6.7896e+010	2.5611e+010
109.45	6.7971e+010	0.33257	6.766e+010	2.5504e+010
117.25	6.769e+010	0.33267	6.7422e+010	2.5397e+010

125.06	6.7407e+010	0.33278	6.7183e+010	2.5288e+010
132.87	6.7122e+010	0.33289	6.6944e+010	2.5179e+010
140.68	6.6834e+010	0.33301	6.6704e+010	2.5069e+010
148.49	6.6543e+010	0.33313	6.6464e+010	2.4958e+010
156.29	6.6249e+010	0.33327	6.6223e+010	2.4844e+010
164.1	6.595e+010	0.33342	6.5982e+010	2.473e+010
171.91	6.5646e+010	0.33358	6.5742e+010	2.4613e+010
179.72	6.5338e+010	0.33375	6.5502e+010	2.4494e+010
187.53	6.5023e+010	0.33394	6.5262e+010	2.4372e+010
195.33	6.4702e+010	0.33416	6.5022e+010	2.4248e+010
203.14	6.4373e+010	0.33439	6.4784e+010	2.4121e+010
210.95	6.4037e+010	0.33465	6.4546e+010	2.399e+010
218.76	6.3692e+010	0.33493	6.4309e+010	2.3856e+010
226.57	6.3337e+010	0.33525	6.4073e+010	2.3717e+010
234.38	6.2972e+010	0.33559	6.3839e+010	2.3575e+010
242.18	6.2596e+010	0.33598	6.3605e+010	2.3427e+010
249.99	6.2209e+010	0.3364	6.3374e+010	2.3275e+010
257.8	6.1808e+010	0.33686	6.3143e+010	2.3117e+010
265.61	6.1394e+010	0.33736	6.2915e+010	2.2953e+010
273.42	6.0964e+010	0.33792	6.2688e+010	2.2783e+010
281.22	6.0519e+010	0.33852	6.2463e+010	2.2607e+010
289.03	6.0058e+010	0.33918	6.224e+010	2.2423e+010
296.84	5.9578e+010	0.33989	6.202e+010	2.2232e+010
304.65	5.908e+010	0.34067	6.1801e+010	2.2034e+010
312.46	5.8561e+010	0.34152	6.1585e+010	2.1826e+010
320.26	5.8021e+010	0.34243	6.1371e+010	2.161e+010
328.07	5.7459e+010	0.34342	6.1159e+010	2.1385e+010
335.88	5.6873e+010	0.34448	6.095e+010	2.1151e+010
343.69	5.6262e+010	0.34563	6.0744e+010	2.0906e+010
351.5	5.5625e+010	0.34687	6.0541e+010	2.065e+010
359.3	5.4961e+010	0.34819	6.034e+010	2.0383e+010
367.11	5.4268e+010	0.34961	6.0143e+010	2.0105e+010
374.92	5.3544e+010	0.35114	5.9948e+010	1.9815e+010
382.73	5.2789e+010	0.35277	5.9757e+010	1.9512e+010
390.54	5.2001e+010	0.35451	5.9569e+010	1.9196e+010
398.34	5.1178e+010	0.35636	5.9384e+010	1.8866e+010
406.15	5.0319e+010	0.35834	5.9203e+010	1.8522e+010
413.96	4.9423e+010	0.36045	5.9026e+010	1.8164e+010
421.77	4.8487e+010	0.36269	5.8853e+010	1.7791e+010
429.58	4.7511e+010	0.36507	5.8684e+010	1.7402e+010
437.39	4.6492e+010	0.36759	5.8519e+010	1.6998e+010
445.19	4.5429e+010	0.37026	5.8359e+010	1.6577e+010
453	4.432e+010	0.37309	5.8204e+010	1.6139e+010
460.81	4.3164e+010	0.37608	5.8054e+010	1.5683e+010
468.62	4.1958e+010	0.37925	5.7911e+010	1.521e+010
476.43	4.0701e+010	0.38258	5.7773e+010	1.4719e+010
484.23	3.9391e+010	0.38611	5.7643e+010	1.4209e+010
492.04	3.8027e+010	0.38982	5.7521e+010	1.368e+010

499.85	3.6605e+010	0.39373	5.7407e+010	1.3132e+010
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**TABLE 25**  
**7075 (UNS A97075) > Multilinear Isotropic Hardening**

Stress Pa	Plastic Strain m m <sup>-1</sup>	Temperature C
4.9711e+008	0	19.85
5.1103e+008	5.7895e-003	19.85
5.233e+008	1.1579e-002	19.85
5.3415e+008	1.7368e-002	19.85
5.4377e+008	2.3158e-002	19.85
5.5236e+008	2.8947e-002	19.85
5.6009e+008	3.4737e-002	19.85
5.6711e+008	4.0526e-002	19.85
5.7356e+008	4.6316e-002	19.85
5.7956e+008	5.2105e-002	19.85
5.8521e+008	5.7895e-002	19.85
5.9061e+008	6.3684e-002	19.85
5.9582e+008	6.9474e-002	19.85
6.009e+008	7.5263e-002	19.85
6.0589e+008	8.1053e-002	19.85
6.1081e+008	8.6842e-002	19.85
6.1566e+008	9.2632e-002	19.85
6.2043e+008	9.8421e-002	19.85
6.2509e+008	0.10421	19.85
6.296e+008	0.11	19.85

**TABLE 26**  
**7075 (UNS A97075) > Alternating Stress R-Ratio**

Alternating Stress Pa	Cycles	R-Ratio
3.4779e+008	4000	-1
3.4027e+008	4677.6	-1
3.3275e+008	5469.9	-1
3.252e+008	6396.4	-1
3.1762e+008	7479.9	-1
3.1e+008	8746.9	-1
3.0236e+008	10229	-1
2.9467e+008	11961	-1
2.8696e+008	13987	-1
2.7923e+008	16356	-1
2.7148e+008	19127	-1
2.6373e+008	22367	-1
2.5599e+008	26156	-1
2.4828e+008	30586	-1
2.406e+008	35767	-1
2.3297e+008	41826	-1
2.2542e+008	48910	-1
2.1796e+008	57195	-1
2.1061e+008	66883	-1
2.0338e+008	78213	-1

1.963e+008	91461	-1
1.8939e+008	1.0695e+005	-1
1.8266e+008	1.2507e+005	-1
1.7614e+008	1.4626e+005	-1
1.6983e+008	1.7103e+005	-1
1.6377e+008	2.e+005	-1
1.5796e+008	2.3388e+005	-1
1.5243e+008	2.7349e+005	-1
1.4717e+008	3.1982e+005	-1
1.4222e+008	3.7399e+005	-1
1.3757e+008	4.3734e+005	-1
1.3324e+008	5.1143e+005	-1
1.2923e+008	5.9806e+005	-1
1.2555e+008	6.9936e+005	-1
1.222e+008	8.1782e+005	-1
1.1918e+008	9.5635e+005	-1
1.1648e+008	1.1183e+006	-1
1.141e+008	1.3078e+006	-1
1.1202e+008	1.5293e+006	-1
1.1024e+008	1.7884e+006	-1
1.0874e+008	2.0913e+006	-1
1.0749e+008	2.4455e+006	-1
1.0647e+008	2.8598e+006	-1
1.0566e+008	3.3442e+006	-1
1.0501e+008	3.9106e+006	-1
1.0449e+008	4.5731e+006	-1
1.0406e+008	5.3477e+006	-1
1.0366e+008	6.2535e+006	-1
1.0325e+008	7.3128e+006	-1
1.0215e+008	1.e+007	-1