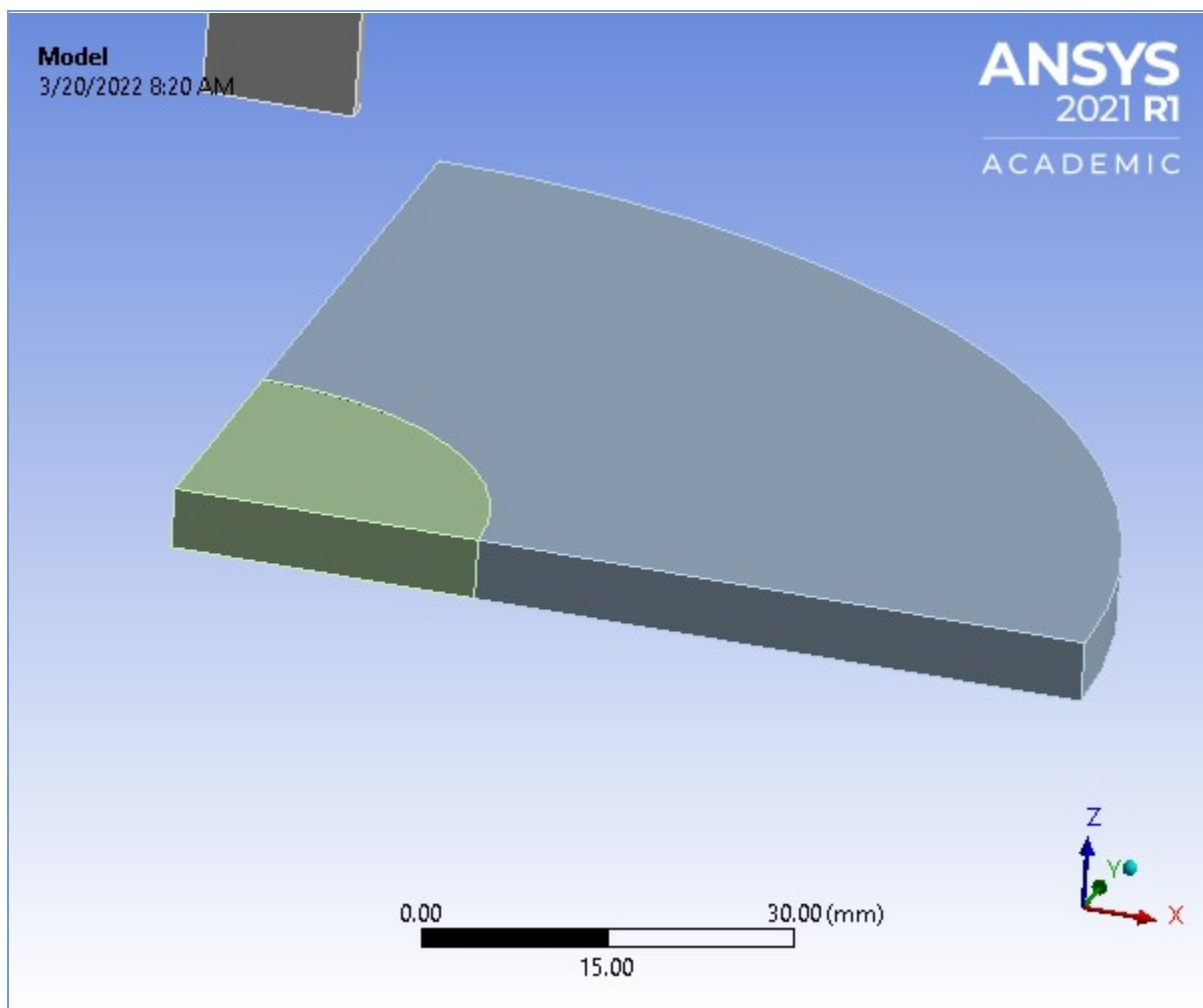




Project*

First Saved	Saturday, December 25, 2021
Last Saved	Saturday, December 25, 2021
Product Version	2021 R1
Save Project Before Solution	No
Save Project After Solution	No



Contents

- [Units](#)
- [Model \(A4\)](#)
 - [Geometry](#)
 - [Cylinder](#)
 - [Plate](#)
 - [Parts](#)
 - [Materials](#)
 - [COPPER Assignment](#)
 - [Coordinate Systems](#)
 - [Symmetry](#)
 - [Symmetry Region](#)
 - [Connections](#)
 - [Body Interactions](#)
 - [Body Interaction](#)
 - [Mesh](#)
 - [Mesh Controls](#)
 - [Named Selections](#)
 - [Explicit Dynamics \(A5\)](#)
 - [Initial Conditions](#)
 - [Initial Condition](#)
 - [Analysis Settings](#)
 - [Loads](#)
 - [Solution \(A6\)](#)
 - [Solution Information](#)
 - [Results](#)
- [Material Data](#)
 - [COPPER](#)
 - [AL 2024-T4](#)

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	Geometry
State	Fully Defined

Definition	
Source	C:\Users\Neeraj Singh\Desktop\Work\ANSYS\Cylinder Impact\Cylinder Impact_files\dp0\SYS\DM\SYS.agdb
Type	DesignModeler
Length Unit	Meters
Display Style	Body Color
Bounding Box	
Length X	76.2 mm
Length Y	76.2 mm
Length Z	90.322 mm
Properties	
Volume	29602 mm ³
Mass	0.12179 kg
Scale Factor Value	1.
Statistics	
Bodies	3
Active Bodies	3
Nodes	8755
Elements	6760
Mesh Metric	None
Update Options	
Assign Default Material	No
Basic Geometry Options	
Parameters	Independent
Parameter Key	
Attributes	Yes
Attribute Key	
Named Selections	Yes
Named Selection Key	
Material Properties	Yes
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	Yes
Coordinate System Key	
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	Yes
Compare Parts On Update	No
Analysis Type	3-D
Import Facet Quality	Source
Clean Bodies On Import	No
Stitch Surfaces On Import	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	Cylinder
State	Meshed
Graphics Properties	

Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Reference Frame	Lagrangian
Material	
Assignment	COPPER
Bounding Box	
Length X	12.7 mm
Length Y	12.7 mm
Length Z	50.8 mm
Properties	
Volume	6435.2 mm ³
Mass	5.7273e-002 kg
Centroid X	5.3764 mm
Centroid Y	5.3764 mm
Centroid Z	64.922 mm
Moment of Inertia Ip1	13.085 kg·mm ²
Moment of Inertia Ip2	12.702 kg·mm ²
Moment of Inertia Ip3	1.2779 kg·mm ²
Statistics	
Nodes	4375
Elements	3468
Mesh Metric	None

TABLE 4
Model (A4) > Geometry > Body Groups

Object Name	<i>Plate</i>
State	Meshed
Graphics Properties	
Visible	Yes
Definition	
Suppressed	No
Assignment	AL 2024-T4
Coordinate System	Default Coordinate System
Bounding Box	
Length X	76.2 mm
Length Y	76.2 mm
Length Z	5.08 mm
Properties	
Volume	23167 mm ³
Mass	6.4519e-002 kg
Centroid X	32.308 mm
Centroid Y	32.308 mm
Centroid Z	2.54 mm
Moment of Inertia Ip1	34.062 kg·mm ²
Moment of Inertia Ip2	18.428 kg·mm ²
Moment of Inertia Ip3	52.214 kg·mm ²
Statistics	

Nodes	4380
Elements	3292
Mesh Metric	None

TABLE 5
Model (A4) > Geometry > Plate > Parts

Object Name		
State	Meshed	
Graphics Properties		
Visible	Yes	
Transparency	1	
Definition		
Suppressed	No	
Stiffness Behavior	Flexible	
Coordinate System	Default Coordinate System	
Reference Temperature	By Environment	
Reference Frame	Lagrangian	
Material		
Assignment	AL 2024-T4	
Bounding Box		
Length X	76.2 mm	25.4 mm
Length Y	76.2 mm	25.4 mm
Length Z	5.08 mm	
Properties		
Volume	20593 mm³	2574.1 mm³
Mass	5.735e-002 kg	7.1688e-003 kg
Centroid X	35.001 mm	10.758 mm
Centroid Y	35.001 mm	10.758 mm
Centroid Z	2.54 mm	
Moment of Inertia Ip1	33.63 kg·mm²	0.43208 kg·mm²
Moment of Inertia Ip2	10.698 kg·mm²	0.23967 kg·mm²
Moment of Inertia Ip3	44.082 kg·mm²	0.64105 kg·mm²
Statistics		
Nodes	3190	1335
Elements	2352	940
Mesh Metric	None	

FIGURE 1
Model (A4) > Geometry > CylinderImpactGeometry

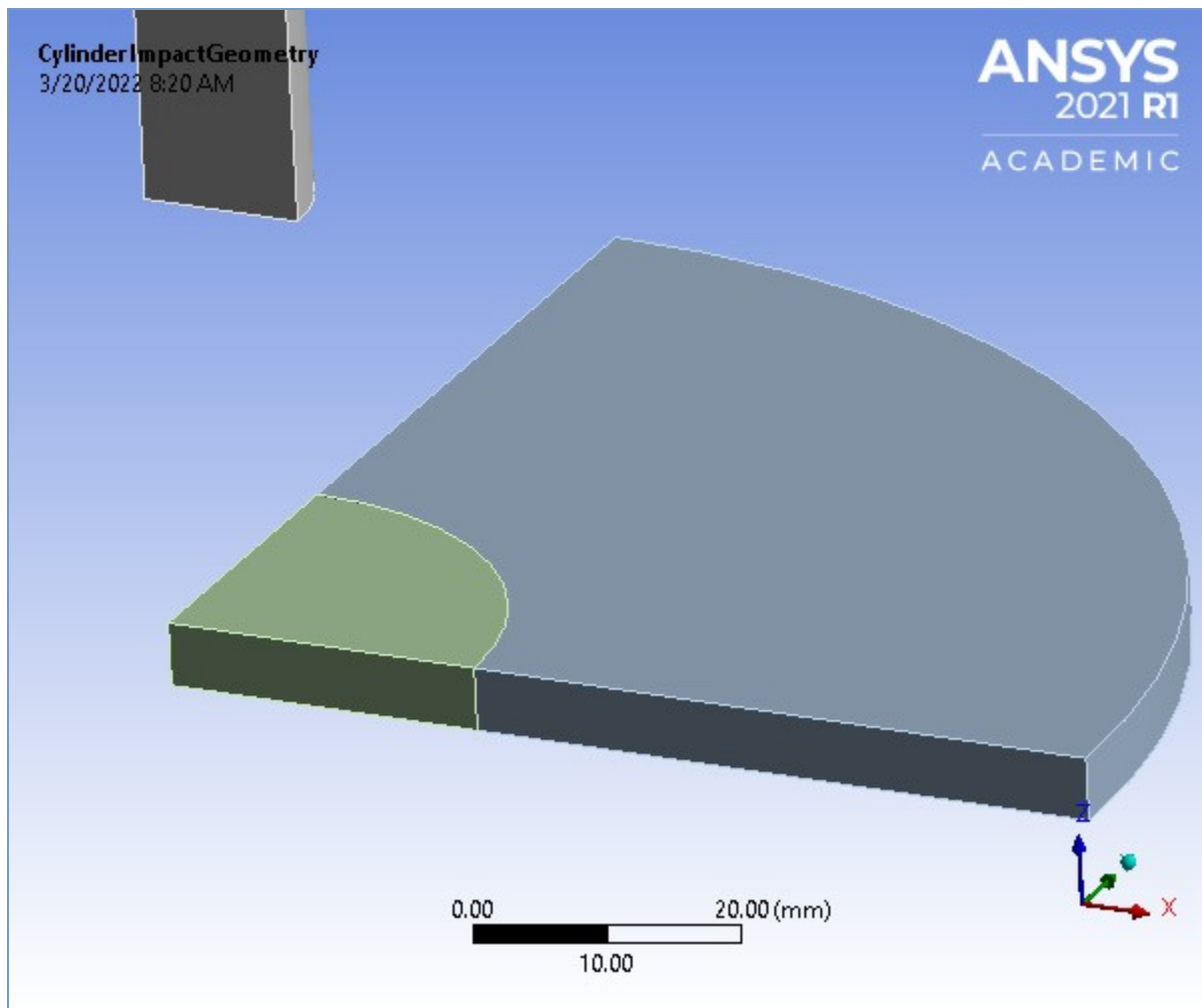


TABLE 6
Model (A4) > Materials

Object Name	<i>Materials</i>
State	Fully Defined
Statistics	
Materials	3
Material Assignments	2

TABLE 7
Model (A4) > Materials > COPPER Assignment

Object Name	<i>COPPER Assignment</i>	<i>AL 2024-T4 Assignment</i>
State	Fully Defined	

Coordinate Systems

TABLE 8
Model (A4) > Coordinate Systems > Coordinate System

Model (A1) - Coordinate Systems - Coordinate System			
Object Name	Global Coordinate System	ZXPlane	YZPlane
State	Fully Defined		
Definition			
Type	Cartesian		
Suppressed			No

Origin			
Origin X	0. mm		
Origin Y	0. mm		
Origin Z	0. mm		
Define By		Global Coordinates	
Location		Defined	
Directional Vectors			
X Axis Data	[1. 0. 0.]	[0. 0. 1.]	[0. 1. 0.]
Y Axis Data	[0. 1. 0.]	[1. 0. 0.]	[0. 0. 1.]
Z Axis Data	[0. 0. 1.]	[0. 1. 0.]	[1. 0. 0.]
Principal Axis			
Axis		X	
Define By		Fixed Vector	
Orientation About Principal Axis			
Axis		Y	
Define By		Fixed Vector	
Transformations			
Base Configuration		Absolute	
Transformed Configuration		[0. 0. 0.]	

Symmetry

TABLE 9
Model (A4) > Symmetry

Object Name	<i>Symmetry</i>
State	Fully Defined

TABLE 10
Model (A4) > Symmetry > Symmetry Region

Object Name	Symmetry Region	Symmetry Region 2
State	Fully Defined	
Scope		
Scoping Method	Named Selection	
Named Selection	Symmetry:ZXPlane	Symmetry:YZPlane
Definition		
Scope Mode	Automatic	
Type	Symmetric	
Coordinate System	ZXPlane	YZPlane
Symmetry Normal	Z Axis	
Suppressed	No	

Connections

TABLE 11
Model (A4) > Connections

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

TABLE 12
Model (A4) > Connections > Body Interactions

Object Name	<i>Body Interactions</i>
State	Fully Defined
Advanced	
Contact Detection	Trajectory
Formulation	Penalty
Sliding Contact	Discrete Surface
Body Self Contact	Program Controlled
Element Self Contact	Program Controlled
Tolerance	0.2

TABLE 13
Model (A4) > Connections > Body Interactions > Body Interaction

Object Name	<i>Body Interaction</i>
State	Fully Defined
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Frictional
Friction Coefficient	0.3
Dynamic Coefficient	0.
Decay Constant	0.
Suppressed	No

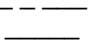
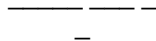
Mesh

TABLE 14
Model (A4) > Mesh

Object Name	<i>Mesh</i>
State	Solved
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Explicit
Element Order	Linear
Element Size	2.54 mm
Sizing	
Use Adaptive Sizing	Yes
Resolution	Default (4)
Mesh Defeaturing	Yes
Defeature Size	Default
Transition	Slow
Span Angle Center	Coarse
Initial Size Seed	Assembly
Bounding Box Diagonal	140.61 mm
Average Surface Area	840.47 mm ²
Minimum Edge Length	5.08 mm
Quality	
Check Mesh Quality	Yes, Errors
Target Quality	Default (0.050000)
Smoothing	High

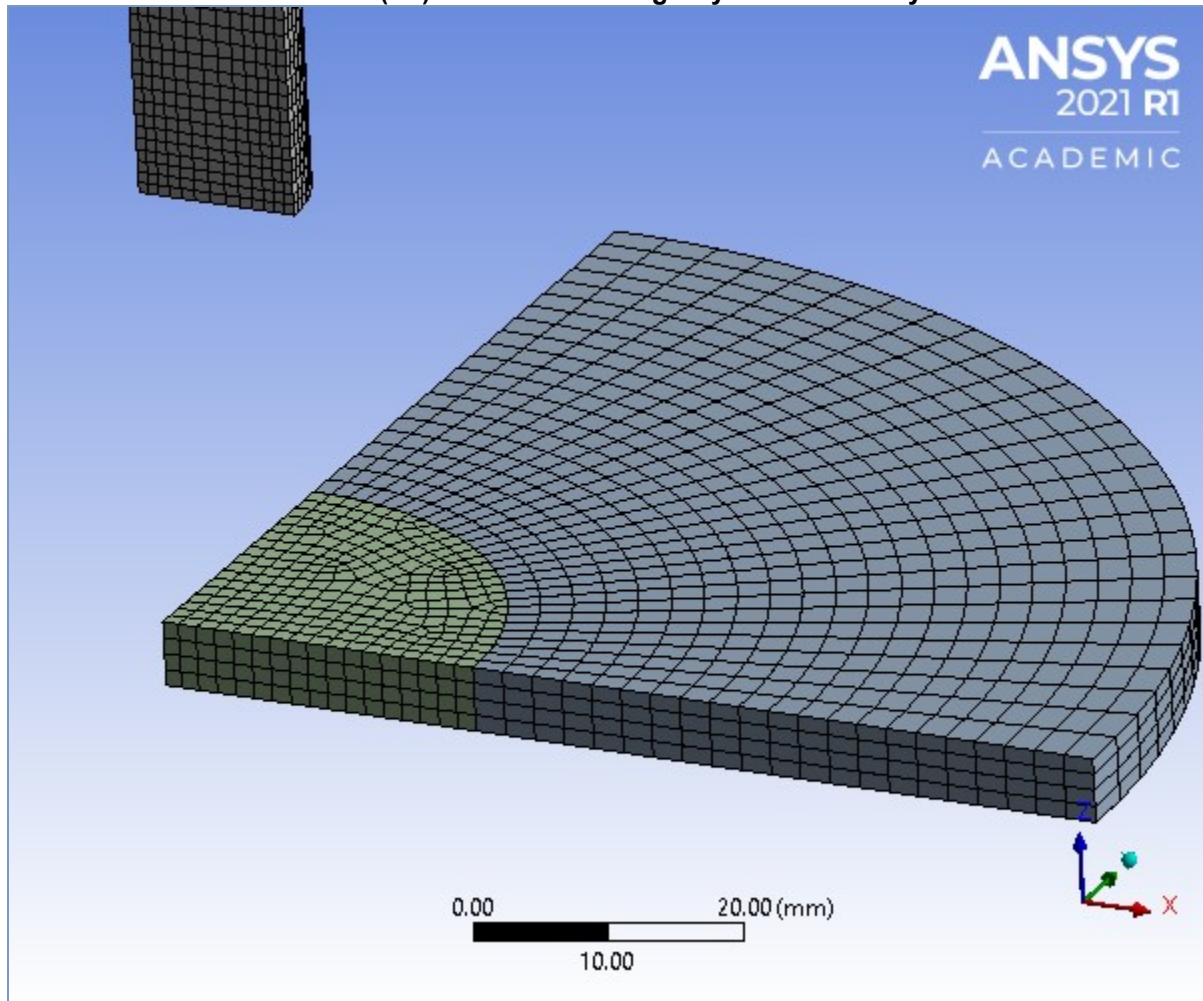
Mesh Metric	None
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Straight Sided Elements	
Rigid Body Behavior	Full Mesh
Triangle Surface Mesher	Program Controlled
Topology Checking	Yes
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Statistics	
Nodes	8755
Elements	6760

TABLE 15
Model (A4) > Mesh > Mesh Controls

Model (A4) > Mesh > Mesh Controls					
Object Name	Body Sizing	Edge Sizing	Edge Sizing 2	Edge Sizing 3	MultiZone
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Geometry	2 Bodies	1 Edge		2 Edges	3 Bodies
Definition					
Suppressed	No				
Type	Element Size	Number of Divisions	Element Size		
Element Size	1.524 mm		1.524 mm		
Number of Divisions		4			
Method					MultiZone
Mapped Mesh Type					Hexa
Surface Mesh Method					Program Controlled
Free Mesh Type					Not Allowed
Element Order					Use Global Setting
Src/Trg Selection					Automatic
Source Scoping Method					Program Controlled
Source					Program Controlled
Sweep Size Behavior					Sweep Element Size
Sweep Element Size					Default
Advanced					
Defeature Size	Default				
Behavior	Soft				
Bias Type		No Bias			
Bias Option			Bias Factor		
Bias Factor			3.0		
Reverse Bias			No Selection		

Preserve Boundaries		Protected
Mesh Based Defeaturing		Off
Minimum Edge Length		5.08 mm
Write ICEM CFD Files		No

FIGURE 2
Model (A4) > Mesh > MeshingInCylinderGeometry



Named Selections

TABLE 16
Model (A4) > Named Selections > Named Selections

Object Name		Symmetry:ZXPlane	Symmetry:YZPlane
State		Fully Defined	
Scope			
Scoping Method		Geometry Selection	
Geometry		3 Faces	
Definition			
Send to Solver		No	
Protected		Program Controlled	
Visible		Yes	
Program Controlled Inflation		Exclude	

Statistics	
Type	Imported
Total Selection	3 Faces
Surface Area	1032.3 mm ²
Suppressed	0
Used by Mesh Worksheet	No

Explicit Dynamics (A5)

TABLE 17

Model (A4) > Analysis

Object Name	<i>Explicit Dynamics (A5)</i>
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Explicit Dynamics
Solver Target	AUTODYN
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 18

Model (A4) > Explicit Dynamics (A5) > Initial Conditions

Object Name	<i>Initial Conditions</i>
State	Fully Defined

TABLE 19

Model (A4) > Explicit Dynamics (A5) > Initial Conditions > Initial Condition

Object Name	Pre-Stress (None)	Velocity
State	Fully Defined	
Definition		
Pre-Stress Environment	None Available	
Pressure Initialization	From Deformed State	
Input Type		Velocity
Define By		Vector
Total		5.08e+005 mm/s
Direction		Defined
Suppressed		No
Scope		
Scoping Method		Geometry Selection
Geometry		1 Body

TABLE 20

Model (A4) > Explicit Dynamics (A5) > Analysis Settings

Object Name	<i>Analysis Settings</i>
State	Fully Defined
Analysis Settings Preference	
Type	Custom
Step Controls	
Number Of Steps	1
Current Step Number	1
Load Step Type	Explicit Time Integration

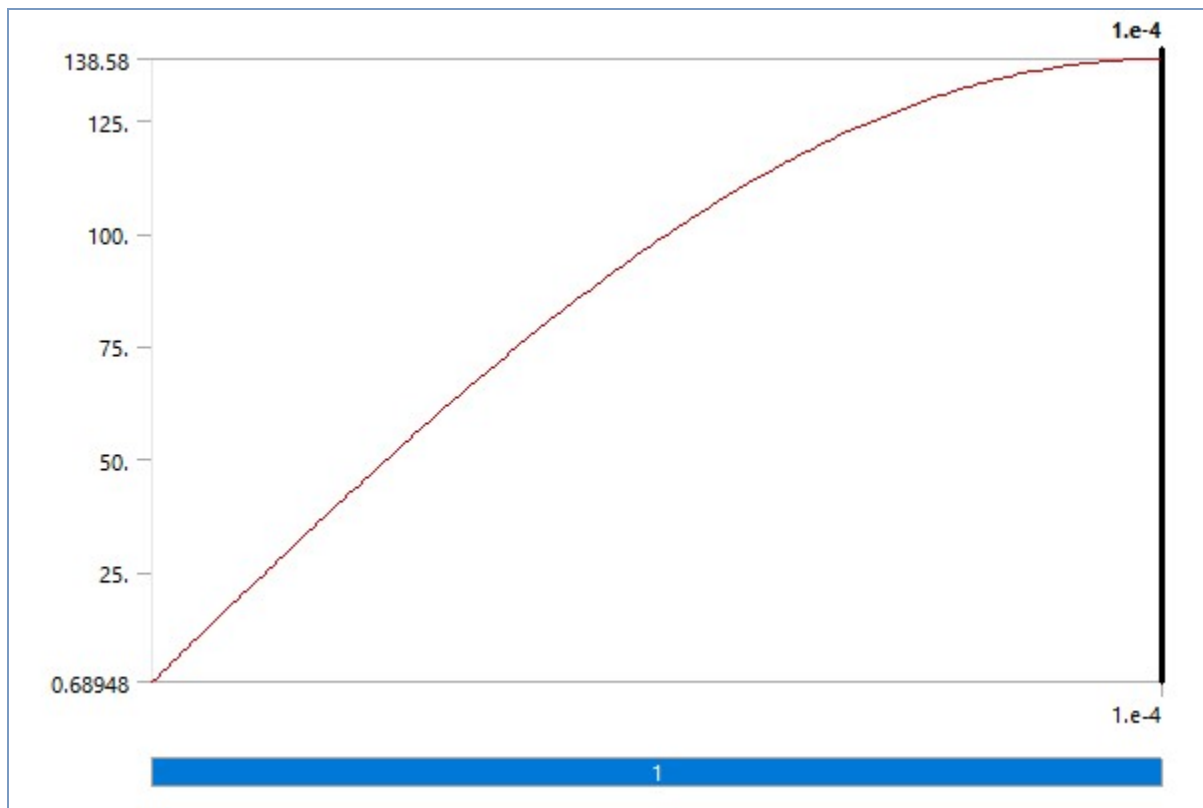
End Time	1.e-004
Resume From Cycle	0
Maximum Number of Cycles	1e+07
Maximum Energy Error	0.1
Reference Energy Cycle	0
Initial Time Step	Program Controlled
Minimum Time Step	Program Controlled
Maximum Time Step	Program Controlled
Time Step Safety Factor	0.9
Characteristic Dimension	Diagonals
Automatic Mass Scaling	No
Solver Controls	
Solve Units	mm, mg, ms
Beam Solution Type	Bending
Beam Time Step Safety Factor	0.5
Hex Integration Type	Exact
Shell Sublayers	3
Shell Shear Correction Factor	0.8333
Shell BWC Warp Correction	Yes
Shell Thickness Update	Nodal
Tet Integration	Average Nodal Pressure
Shell Inertia Update	Recompute
Density Update	Program Controlled
Minimum Timestep for SPH	1.e-010 s
Minimum Density Factor for SPH	0.2
Maximum Density Factor for SPH	3.
Density Cutoff Option For SPH	Limit Density
Minimum Velocity	1.e-003 mm s ⁻¹
Maximum Velocity	1.e+013 mm s ⁻¹
Radius Cutoff	1.e-003
Minimum Strain Rate Cutoff	1.e-010
Euler Domain Controls	
Domain Size Definition	Program Controlled
Display Euler Domain	Yes
Scope	All Bodies
X Scale factor	1.2
Y Scale factor	1.2
Z Scale factor	1.2
Domain Resolution Definition	Total Cells
Total Cells	2.5e+05
Lower X Face	Flow Out
Lower Y Face	Flow Out
Lower Z Face	Flow Out
Upper X Face	Flow Out
Upper Y Face	Flow Out
Upper Z Face	Flow Out
Euler Tracking	By Body
Damping Controls	

Linear Artificial Viscosity	0.2
Quadratic Artificial Viscosity	1.
Linear Viscosity in Expansion	No
Artificial Viscosity For Shells	Yes
Linear Artificial Viscosity for SPH	1.
Quadratic Artificial Viscosity for SPH	1.
Hourglass Damping	AUTODYN Standard
Viscous Coefficient	0.1
Static Damping	0.
Erosion Controls	
On Geometric Strain Limit	No
On Material Failure	Yes
On Minimum Element Time Step	No
Retain Inertia of Eroded Material	Yes
Output Controls	
Step-aware Output Controls	No
Save Results on	Equally Spaced Points
Result Number Of Points	80
Save Restart Files on	Equally Spaced Points
Restart Number Of Points	5
Save Result Tracker Data on	Cycles
Tracker Cycles	1
Output Contact Forces	Off
Analysis Data Management	
Solver Files Directory	C:\Users\Neeraj Singh\Desktop\Work\ANSYS\Cylinder Impact\Cylinder Impact_files\dp0\SYS\MECH\
Scratch Solver Files Directory	

TABLE 21
Model (A4) > Explicit Dynamics (A5) > Loads

Object Name	Fixed Support	Pressure
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Pressure
Suppressed	No	
Define By		Normal To
Magnitude		= 20000*sin(90*time/0.0001)+100
Function		
Unit System		U.S. Customary (in, lbm, lbf, °F, s, V, A) Degrees rad/s Fahrenheit
Angular Measure		Degrees
Graph Controls		
Number Of Segments		200.

FIGURE 3
Model (A4) > Explicit Dynamics (A5) > Pressure



Solution (A6)

TABLE 22
Model (A4) > Explicit Dynamics (A5) > Solution

Object Name	<i>Solution (A6)</i>
State	Solved
Information	
Status	Done
Post Processing	
Beam Section Results	No

TABLE 23
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Solution Information

Object Name	<i>Solution Information</i>
State	Solved
Solution Information	
Solution Output	Solver Output
Update Interval	2.5 s
Display Points	All
Display Filter During Solve	Yes

TABLE 24
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Results

Object Name	Equivalent Plastic Strain	Normal Stress
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Body	All Bodies

Definition		
Type	Equivalent Plastic Strain	Normal Stress
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Orientation		Z Axis
Coordinate System		Global Coordinate System
Integration Point Results		
Display Option	Averaged	
Average Across Bodies	No	
Results		
Minimum	2.4855e-002 mm/mm	-632.74 MPa
Maximum	0.94311 mm/mm	391.36 MPa
Average	0.14139 mm/mm	-81.007 MPa
Minimum Occurs On		Cylinder
Maximum Occurs On		Cylinder
Minimum Value Over Time		
Minimum	0. mm/mm	-6049.1 MPa
Maximum	2.4855e-002 mm/mm	0. MPa
Maximum Value Over Time		
Minimum	0. mm/mm	0. MPa
Maximum	0.94311 mm/mm	5454.1 MPa
Information		
Time	1.0001e-004 s	
Set	81	
Cycle Number	2885	

FIGURE 4
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Equivalent Plastic Strain

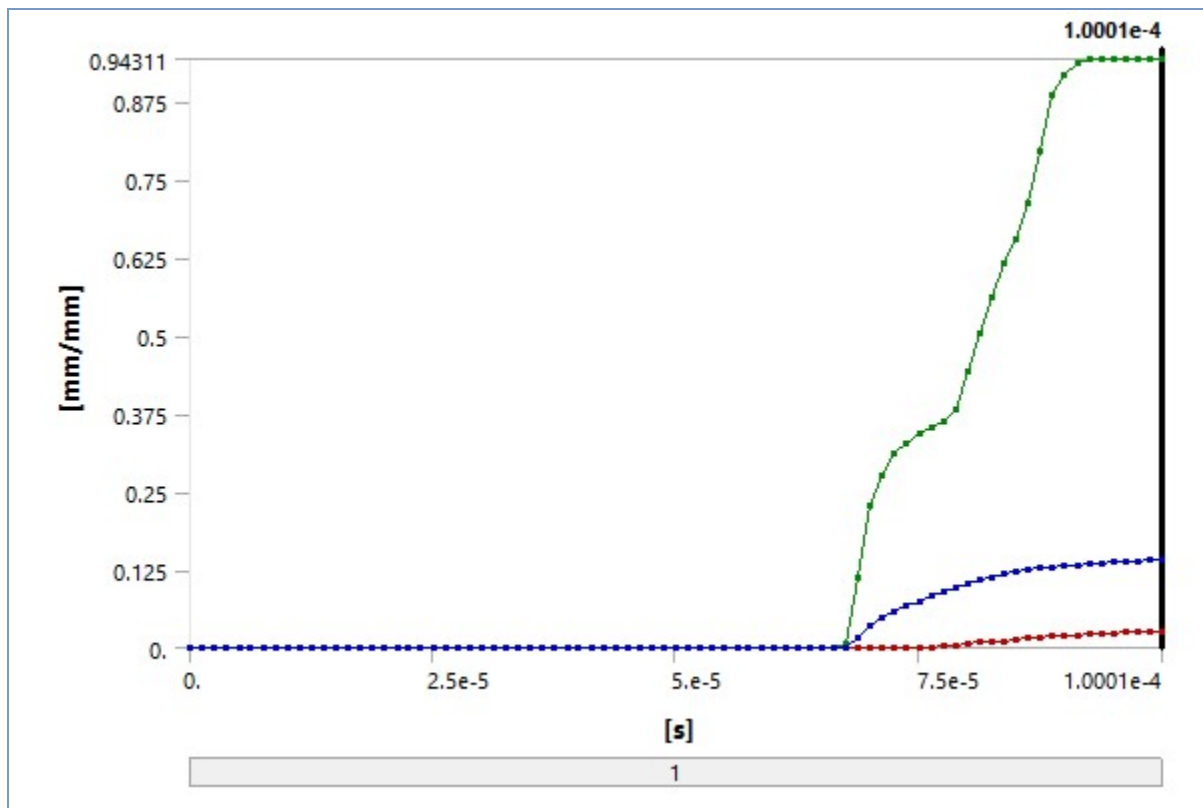
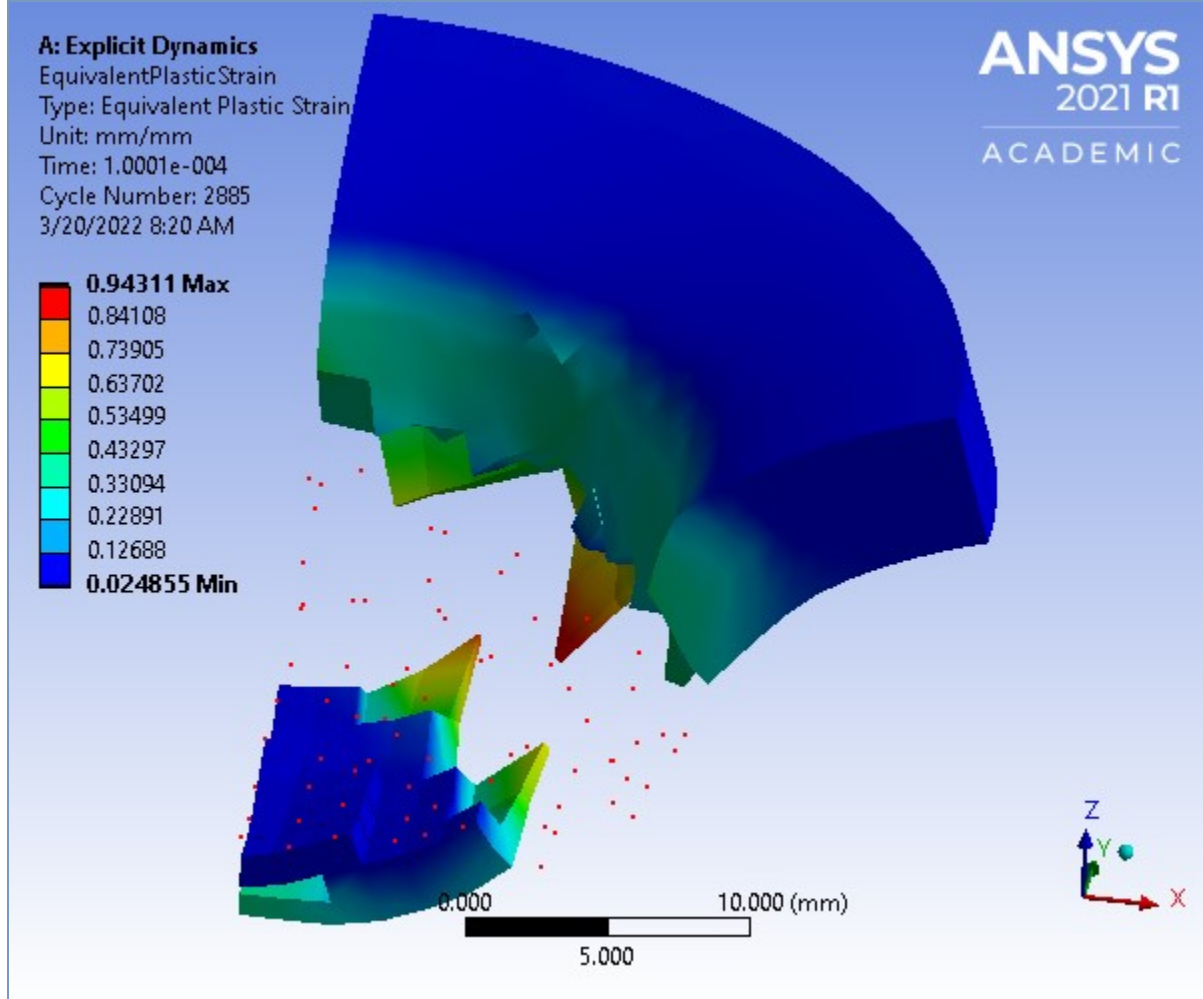


TABLE 25
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Equivalent Plastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]	Average [mm/mm]
1.1755e-038			
1.2621e-006			
2.541e-006			
3.7668e-006			
5.0458e-006			
6.2716e-006			
7.5508e-006			
8.7766e-006			
1.0003e-005			
1.1282e-005			
1.2508e-005			
1.3787e-005			
1.5013e-005			
1.6292e-005			
1.7518e-005			
1.8797e-005			
2.0024e-005			
2.1303e-005			
2.2529e-005			
2.3755e-005			
2.5035e-005			
2.6261e-005			
2.754e-005			
2.8767e-005			
3.0046e-005			

3.1272e-005			
3.2552e-005			
3.3778e-005			
3.5005e-005			
3.6284e-005			
3.7511e-005			
3.8791e-005			
4.0017e-005			
4.1297e-005			
4.2523e-005			
4.3803e-005			
4.503e-005			
4.6256e-005			
4.7536e-005			
4.8763e-005		0.	0.
5.0042e-005	0.		
5.1269e-005			
5.2549e-005			
5.3776e-005			
5.5002e-005			
5.6282e-005			
5.7509e-005			
5.8789e-005			
6.0016e-005			
6.1296e-005			
6.2523e-005			
6.3803e-005			
6.5029e-005			
6.6256e-005			
6.7536e-005		7.2759e-003	4.6881e-004
6.8763e-005		0.11183	1.7603e-002
7.0043e-005		0.22898	3.5095e-002
7.1257e-005	1.1073e-004	0.2763	4.7148e-002
7.2512e-005	7.4325e-004	0.31026	5.7996e-002
7.3767e-005	1.1111e-003	0.32838	6.6981e-002
7.5016e-005		0.34175	7.5008e-002
7.627e-005	1.0262e-003	0.35419	8.2861e-002
7.7518e-005	2.0584e-003	0.36266	9.0826e-002
7.8751e-005	4.3816e-003	0.38186	9.6492e-002
8.0015e-005	7.1964e-003	0.44329	0.10252
8.1259e-005	9.3585e-003	0.50215	0.10809
8.2516e-005	9.8922e-003	0.5598	0.11319
8.3762e-005	1.0655e-002	0.61508	0.11754
8.5001e-005	1.2358e-002	0.65281	0.12104
8.6256e-005	1.4511e-002	0.71249	0.125
8.7508e-005	1.6758e-002	0.7953	0.12815
8.8755e-005	1.8739e-002	0.88696	0.12983
9.0003e-005	1.9764e-002	0.91843	0.13096
9.1273e-005	2.0203e-002	0.936	0.13249
9.2507e-005	2.1398e-002	0.94298	0.13382
9.3757e-005	2.1962e-002	0.94303	0.13507
9.5e-005	2.3589e-002	0.94304	0.13659

9.6265e-005	2.4143e-002	0.94306	0.13784
9.751e-005	2.4344e-002	0.94308	0.13902
9.8762e-005	2.4507e-002	0.94309	0.1403
1.0001e-004	2.4855e-002	0.94311	0.14139

FIGURE 5**Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Equivalent Plastic Strain > EquivalentPlasticStrain****FIGURE 6****Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Normal Stress**

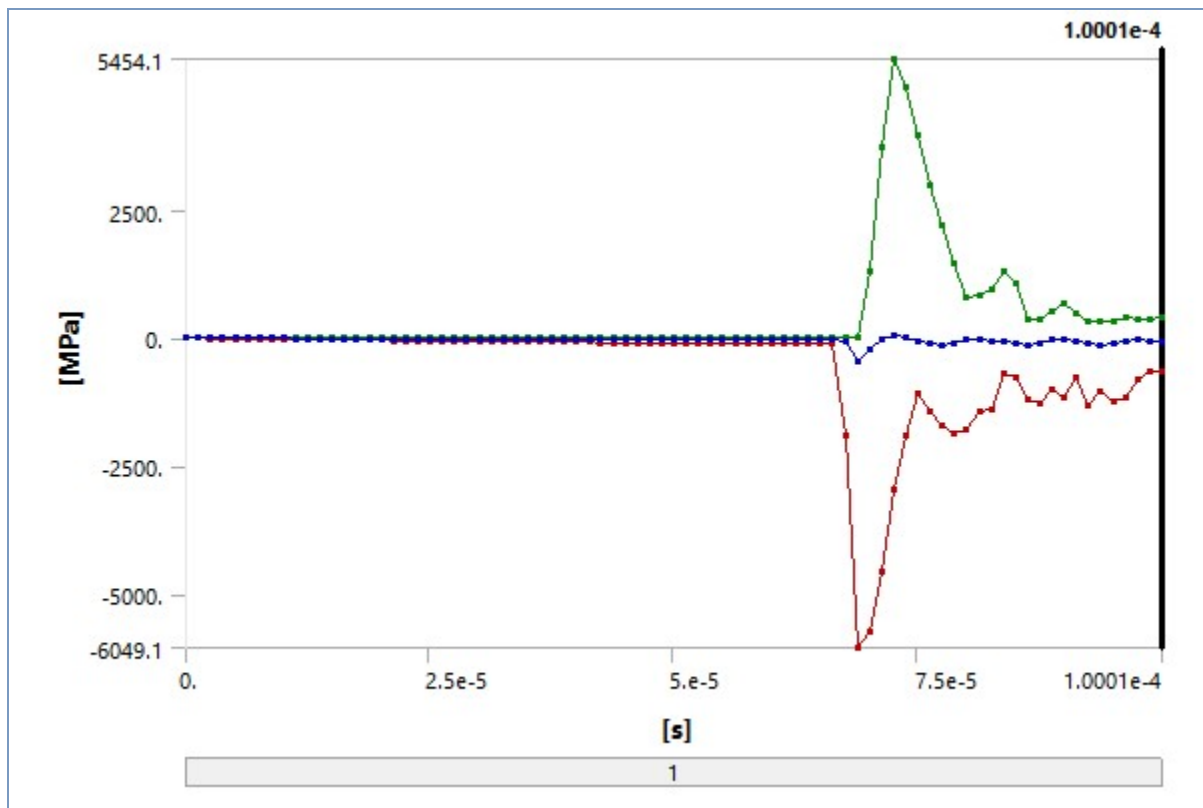
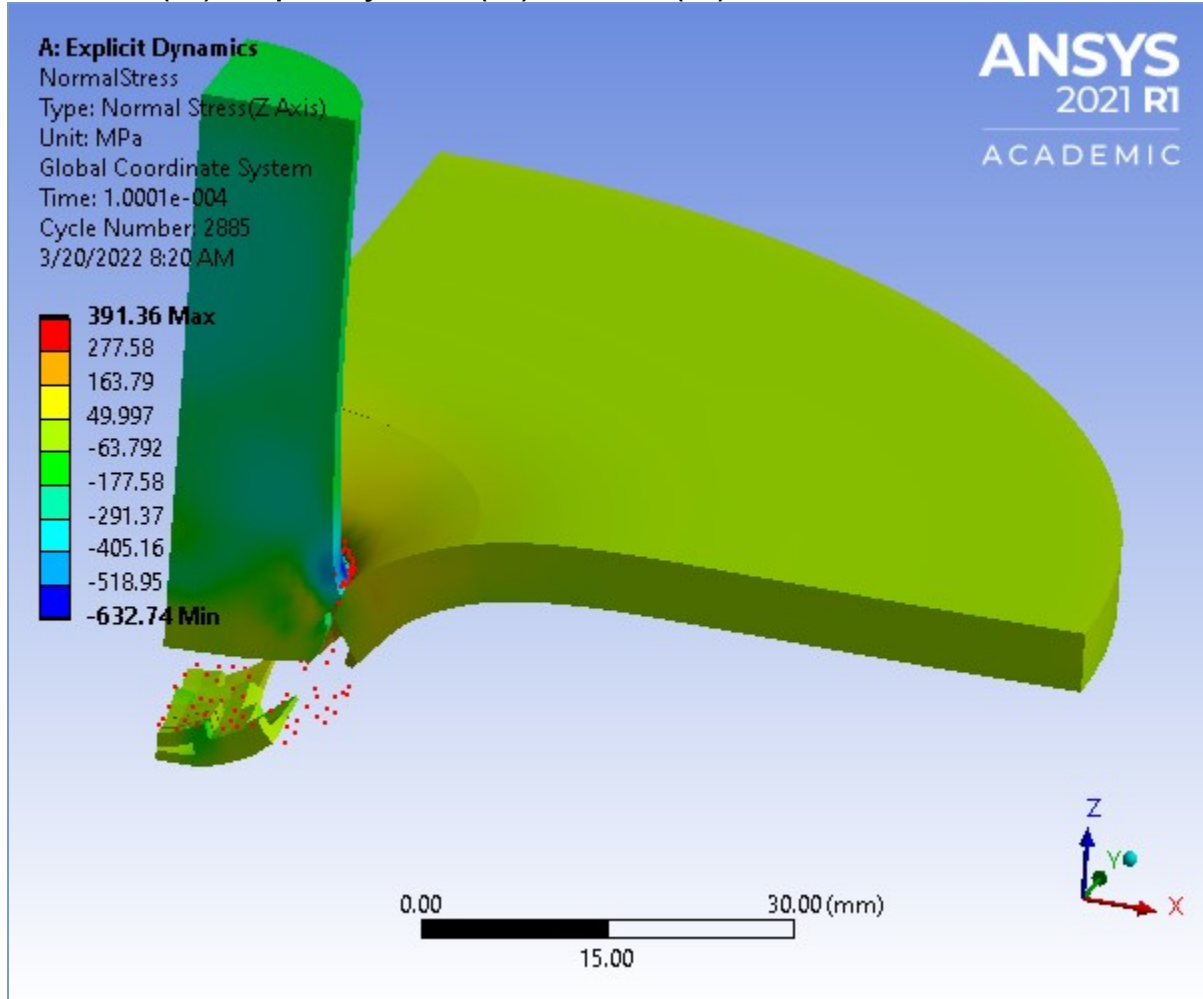


TABLE 26
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Normal Stress

Time [s]	Minimum [MPa]	Maximum [MPa]	Average [MPa]
1.1755e-038	0.		0.
1.2621e-006	-2.8106		-7.3864e-002
2.541e-006	-5.2852		-0.23762
3.7668e-006	-7.8546		-0.47148
5.0458e-006	-10.618		-0.7967
6.2716e-006	-13.342		-1.197
7.5508e-006	-16.185		-1.7332
8.7766e-006	-18.828		-2.3789
1.0003e-005	-21.492		-3.1604
1.1282e-005	-24.181		-4.0828
1.2508e-005	-26.704		-5.0432
1.3787e-005	-29.439		-6.084
1.5013e-005	-32.063		-7.0709
1.6292e-005	-34.718		-8.0918
1.7518e-005	-37.262		-9.0332
1.8797e-005	-40.08		-9.916
2.0024e-005	-42.758		-10.595
2.1303e-005	-45.355		-11.062
2.2529e-005	-47.706		-11.286
2.3755e-005	-49.978		-11.404
2.5035e-005	-52.531		-11.533
2.6261e-005	-54.822		-11.636
2.754e-005	-57.101		-11.684
2.8767e-005	-59.229		-11.731
3.0046e-005	-61.604		-11.845

3.1272e-005	-63.905		-12.041
3.2552e-005	-66.144		-12.331
3.3778e-005	-68.25		-12.683
3.5005e-005	-70.377		-13.107
3.6284e-005	-72.607		-13.649
3.7511e-005	-74.899		-14.283
3.8791e-005	-77.361		-15.072
4.0017e-005	-79.789		-15.932
4.1297e-005	-82.114		-16.888
4.2523e-005	-84.344		-17.819
4.3803e-005	-86.663		-18.751
4.503e-005	-88.564		-19.559
4.6256e-005	-90.247		-20.251
4.7536e-005	-92.188		-20.826
4.8763e-005	-94.062	0.	-21.215
5.0042e-005	-95.944		-21.444
5.1269e-005	-97.79		-21.519
5.2549e-005	-99.722		-21.505
5.3776e-005	-101.56		-21.435
5.5002e-005	-103.36		-21.338
5.6282e-005	-104.91		-21.228
5.7509e-005	-106.3		-21.14
5.8789e-005	-107.74		-21.1
6.0016e-005	-109.08		-21.151
6.1296e-005	-110.47		-21.34
6.2523e-005	-111.87		-21.671
6.3803e-005	-113.4		-22.159
6.5029e-005	-114.94		-22.721
6.6256e-005	-116.57		-23.333
6.7536e-005	-1920.	0.56298	-77.943
6.8763e-005	-6049.1	2.9046	-440.46
7.0043e-005	-5733.2	1294.4	-204.1
7.1257e-005	-4564.2	3740.2	-42.344
7.2512e-005	-2960.8	5454.1	42.693
7.3767e-005	-1902.5	4910.2	23.84
7.5016e-005	-1078.8	3947.8	-52.989
7.627e-005	-1434.4	2992.1	-120.46
7.7518e-005	-1689.8	2212.5	-132.49
7.8751e-005	-1848.6	1454.8	-91.713
8.0015e-005	-1786.7	815.34	-36.432
8.1259e-005	-1449.4	848.68	-27.545
8.2516e-005	-1403.5	951.69	-51.248
8.3762e-005	-699.73	1287.1	-66.217
8.5001e-005	-775.21	1065.4	-107.94
8.6256e-005	-1198.7	371.93	-127.42
8.7508e-005	-1270.5	382.22	-89.501
8.8755e-005	-1018.	519.69	-39.465
9.0003e-005	-1177.	664.31	-23.715
9.1273e-005	-753.1	491.93	-50.651
9.2507e-005	-1302.4	327.06	-117.55
9.3757e-005	-1041.7	341.5	-123.12
9.5e-005	-1253.7	345.18	-96.097

9.6265e-005	-1145.1	387.63	-48.318
9.751e-005	-794.04	380.54	-38.367
9.8762e-005	-631.82	373.13	-67.397
1.0001e-004	-632.74	391.36	-81.007

FIGURE 7**Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Normal Stress > NormalStress**

Material Data

COPPER

TABLE 27
COPPER > Constants

Density	8.9e-006 kg mm ⁻³
Specific Heat	1.e-009 mJ kg ⁻¹ C ⁻¹

TABLE 28
COPPER > Shock EOS Linear

Gruneisen Coefficient	Parameter C1 mm s ⁻¹	Parameter S1	Parameter Quadratic S2 s mm ⁻¹
2	3.958e+006	1.497	0

TABLE 29

COPPER > Shear Modulus

Shear Modulus MPa
46400

TABLE 30
COPPER > Multilinear Isotropic Hardening

Stress MPa	Plastic Strain mm mm ⁻¹	Temperature C
120	0	0
450	0.3	0
450	1.e+020	0

TABLE 31
COPPER > Color

Red	Green	Blue
181	155	130

AL 2024-T4

TABLE 32
AL 2024-T4 > Constants

Density	2.785e-006 kg mm ⁻³
Specific Heat	8.63e+005 mJ kg ⁻¹ C ⁻¹

TABLE 33
AL 2024-T4 > Shock EOS Linear

Gruneisen Coefficient	Parameter C1 mm s ⁻¹	Parameter S1	Parameter Quadratic S2 s mm ⁻¹
2	5.328e+006	1.338	0

TABLE 34
AL 2024-T4 > Steinberg Guinan Strength

Initial Yield Stress Y MPa	Maximum Yield Stress Ymax MPa	Hardening Constant B	Hardening Exponent n	Derivative dG/dP G'P	Derivative dG/dT G'T MPa C ⁻¹	Derivative dY/dP Y'P	Melting Temperature Tmelt C
260	760	310	0.185	1.8647	-17.62	1.695e-002	946.85

TABLE 35
AL 2024-T4 > Shear Modulus

Shear Modulus MPa
28600

TABLE 36
AL 2024-T4 > Color

Red	Green	Blue
182	229	228

TABLE 37
AL 2024-T4 > Principal Stress Failure

Maximum Tensile Stress MPa	Maximum Shear Stress MPa
1000	1000