

1. Создаем новый проект

1) Нажимаем

2) Указываем папку и название проекта

3) Выбираем единицы измерения

4) Нажимаем

В случае двухмерной осевой симметрии осью симметрии является ось X

Folder: D:\Autodyn\11\70mm

Ident: !

Heading:

Description:

Symmetry: 2D 3D

Units:

Length	Mass	Time
<input type="radio"/> μm	<input type="radio"/> pg	<input type="radio"/> μs
<input type="radio"/> mm	<input type="radio"/> mg	<input type="radio"/> ms
<input checked="" type="radio"/> cm	<input checked="" type="radio"/> g	<input type="radio"/> s
<input type="radio"/> m	<input type="radio"/> kg	
<input type="radio"/> in	<input type="radio"/> lbm	
<input type="radio"/> ft		

Folder: D:\Autodyn\Test

Ident: ✓ Test

Heading:

Description:

Symmetry: 2D 3D Axial Planar

Units:

Length	Mass	Time
<input type="radio"/> μm	<input type="radio"/> pg	<input checked="" type="radio"/> μs
<input type="radio"/> mm	<input type="radio"/> mg	<input type="radio"/> ms
<input checked="" type="radio"/> cm	<input checked="" type="radio"/> g	<input type="radio"/> s
<input type="radio"/> m	<input type="radio"/> kg	
<input type="radio"/> in	<input type="radio"/> lbm	
<input type="radio"/> ft		

2. Определяем материалы

1) Нажимаем

2) Выбираем материалы. Можно сразу несколько (удерживая «Control»)

3) Нажимаем

Material Name	Equation of State	Strength Model	Failure Model
24DNUJ1	Lee-Tarver	von Mises	None
ADIPRENE	Shock	None	None
AIR	Ideal Gas	None	None
AL 1100-O	Shock	Steinberg Guinan	None
AL 2024	Shock	None	None
AL 2024-T4	Shock	Steinberg Guinan	None
AL 6061-T6	Shock	Steinberg Guinan	None
AL 7039	Shock	Johnson Cook	None
AL 7075-T6	Shock	Steinberg Guinan	None
AL 921-T	Shock	None	None
AL-2024-T3	Tillotson	None	None
AL2024T351	Shock	Johnson Cook	None
AL203-99.5	Polynomial	Johnson-Holmquist	Johnson Holmquist
AL203-99.7	Polynomial	Johnson-Holmquist	Johnson Holmquist
AL203 CERA	Shock	von Mises	None
AL5083H116	Linear	Johnson Cook	None
AL6061-T6	Puff	von Mises	Hydro (Pmin)
ALUMINIUM	Tillotson	None	None
ALUMINIUM	Shock	von Mises	None
ANB 3066J1	Lee-Tarver	von Mises	None
ANFO	JWL	None	None
ANTIMONY	Shock	None	None
Al/AP HE	JWL	None	None
BARIUM	Shock	None	None
BE (S200)	Puff	von Mises	Hydro (Pmin)
BERYLLIUM	Shock	None	None
BERYLLIUM	Shock	Steinberg Guinan	None
BERYLLIUM	Tillotson	None	None

test
Cycle 0
Time 0.000E+000 μ s
Units cm, g, μ s
Axial symmetry

3. Редактируем свойства материалов

ANSYS Workbench [AUTODYN]

File Import Setup View Options Help

Material Definition

AL 2024-T4
PARAFFIN
STEEL 1006

1) Выбираем материал и нажимаем

Для каждого материала

Material Data Input - AL 2024-T4

Name	AL 2024-T4
Reference Density	2.785000 (g/cm3)
<input checked="" type="checkbox"/> EOS	Shock
Gruneisen coefficient	2.000000 (none)
Parameter C1	0.532800 (cm/us)
Parameter S1	1.338000 (none)
Parameter Quadratic S2	0.000000 (us/cm)
Relative volume, VE/V0	0.000000 (none)
Relative volume, VB/V0	0.000000 (none)
Parameter C2	0.000000 (cm/us)
Parameter S2	0.000000 (none)
Reference Temperature	300.000000 (K)
Specific Heat	8.630001e-006 (Terg/gK)
Thermal Conductivity	0.000000 (Terg/mKus)

2) Разворачиваем и выбираем способ и критерий «эрозии»

Erosion

Erosion Strain	2.000000 (none)
Type of Geometric Strain	Instantaneous

3) Нажимаем

4. Определяем геометрию

ANSYS Workbench [AUTODYN]

[Project] test [AUTODYN]

File Import Setup View Options Help

View

Plots

Settings

History

Slides

View Slides

Setup

Materials

Init. Cond.

Boundaries

Parts

Component

Groups

Joins

Interaction

Detonation

Parallel

Controls

Output

User var.

Run

AUTODYN-2D v11.0 from Century Dynamics

Material Location

AL 2024-T4

PAR

STE

test

Cycle 0

Time 0.000E+000 μ s

Units cm, g, μ s

Axial symmetry

2) Нажимаем

3) Даем название и определяем тип элементов

1) Нажимаем

4) Нажимаем

Create New Part

Part name

Solver

Definition

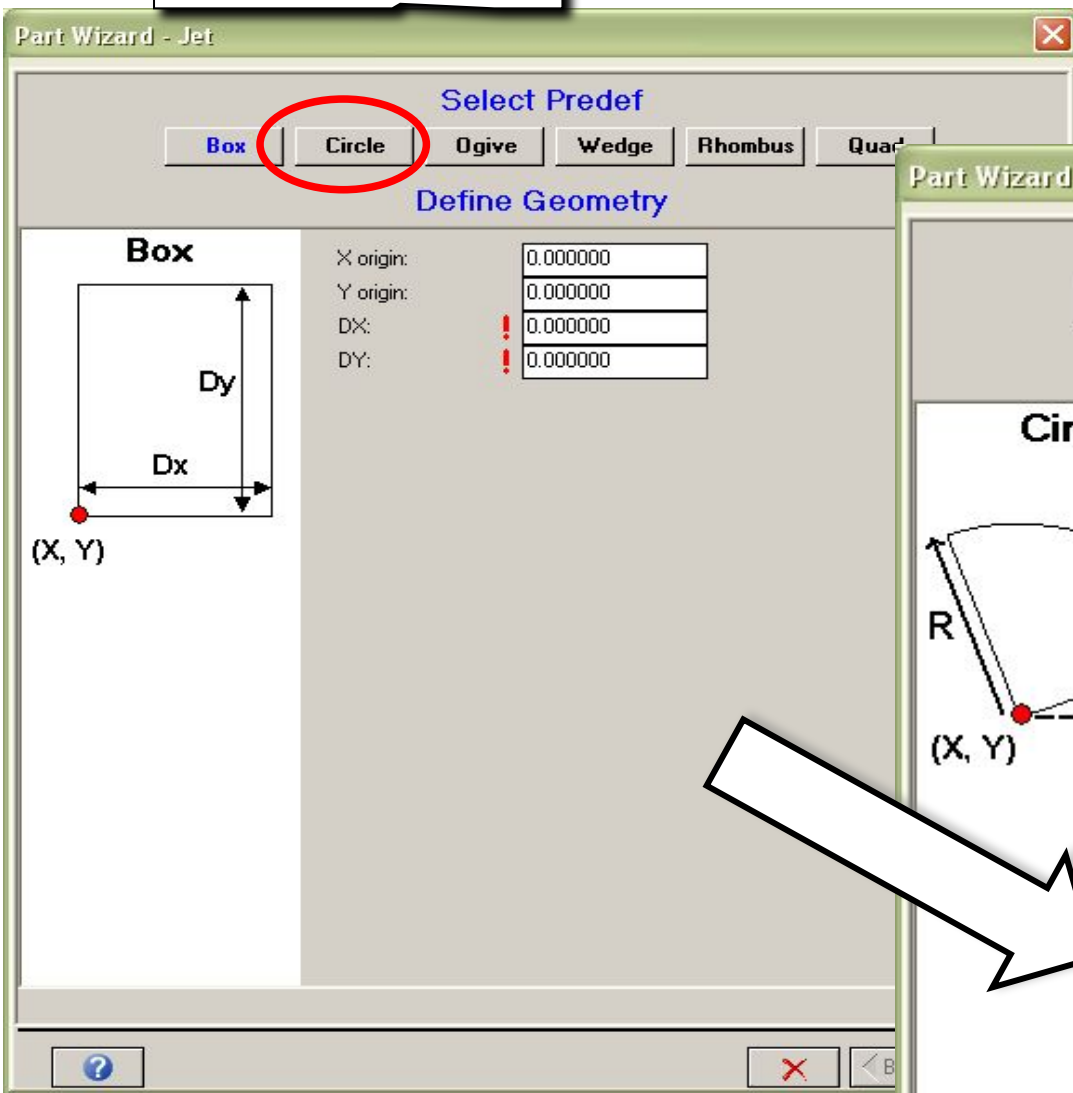
Create New Part

Part name

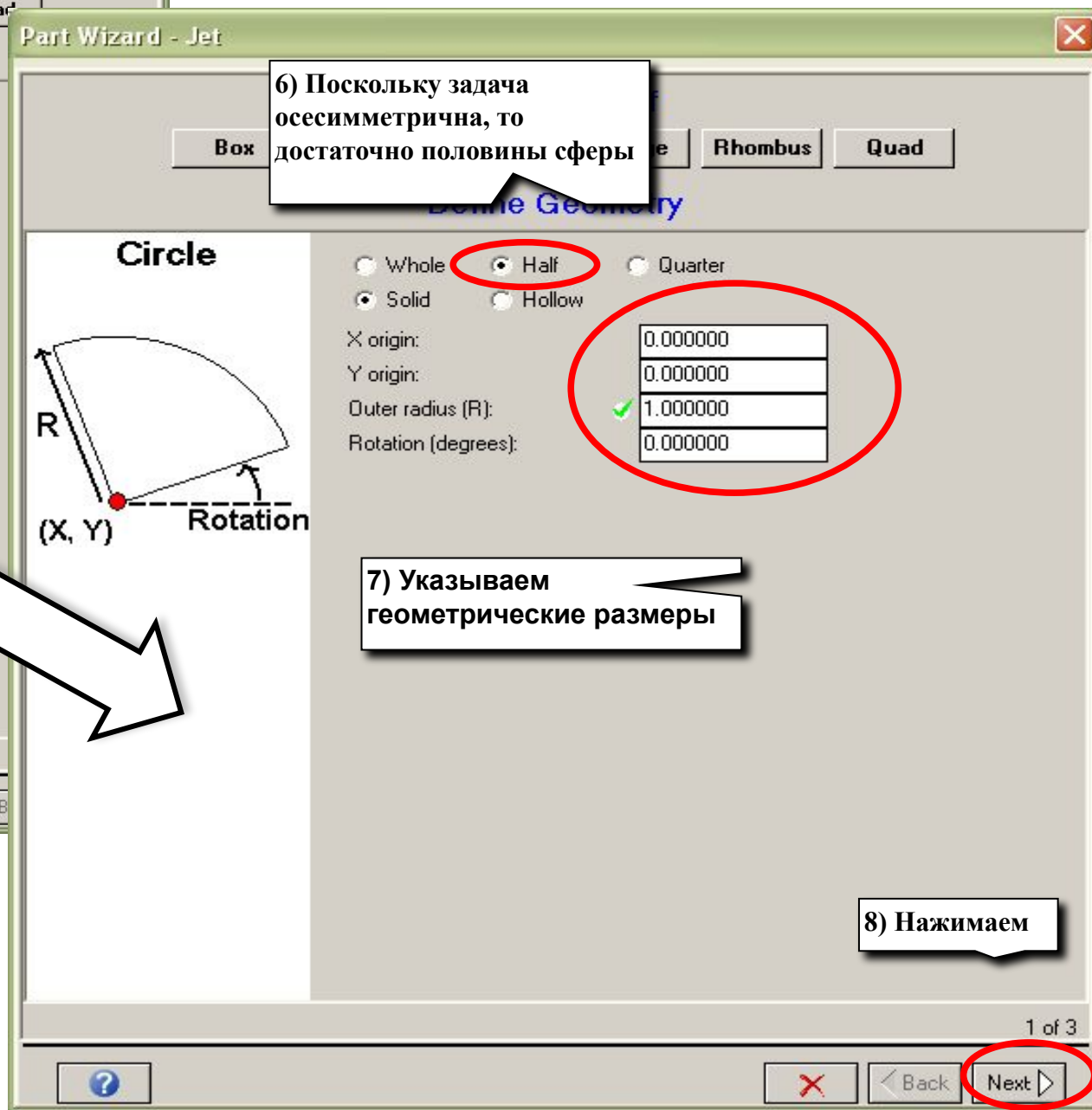
Solver

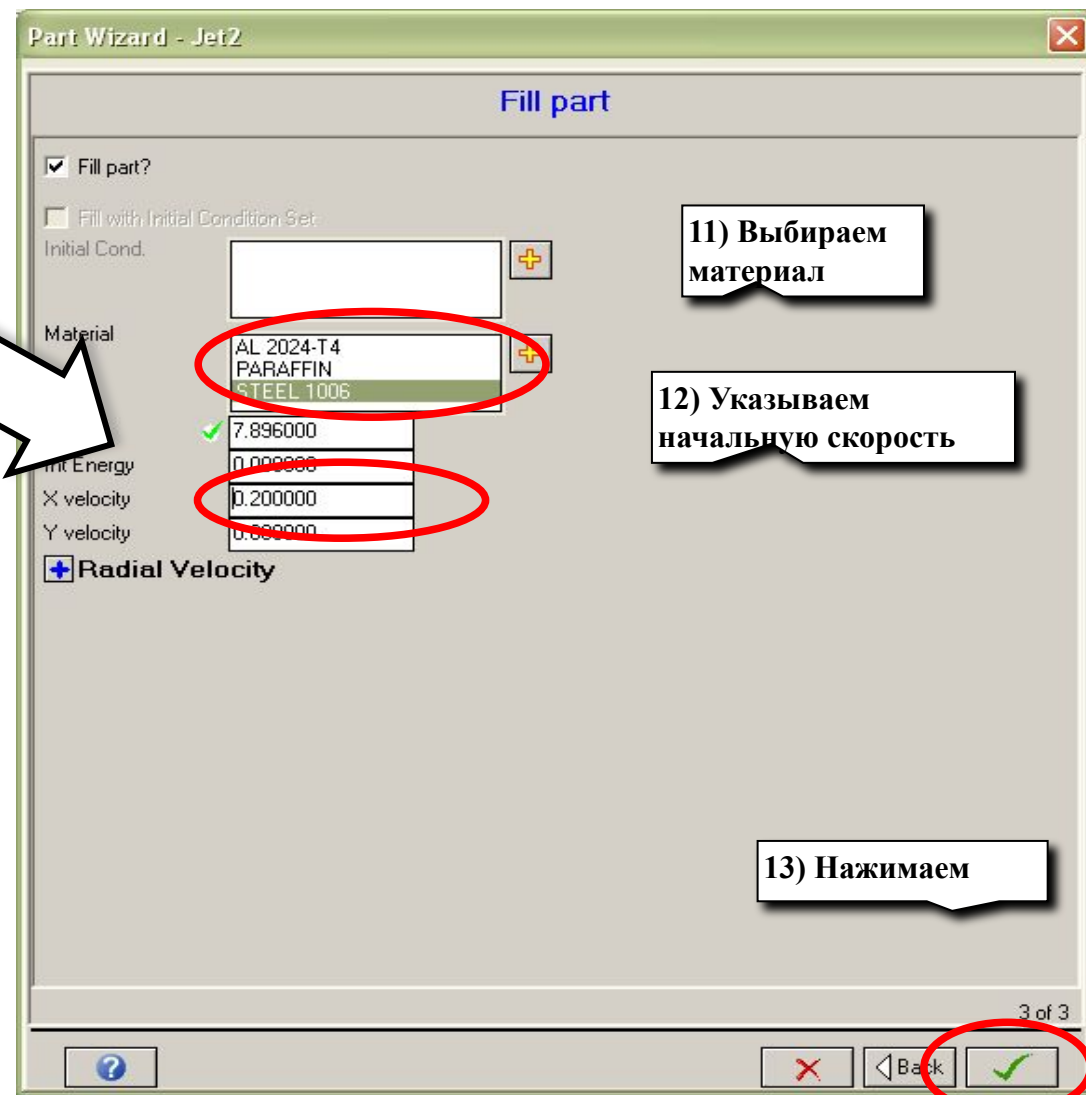
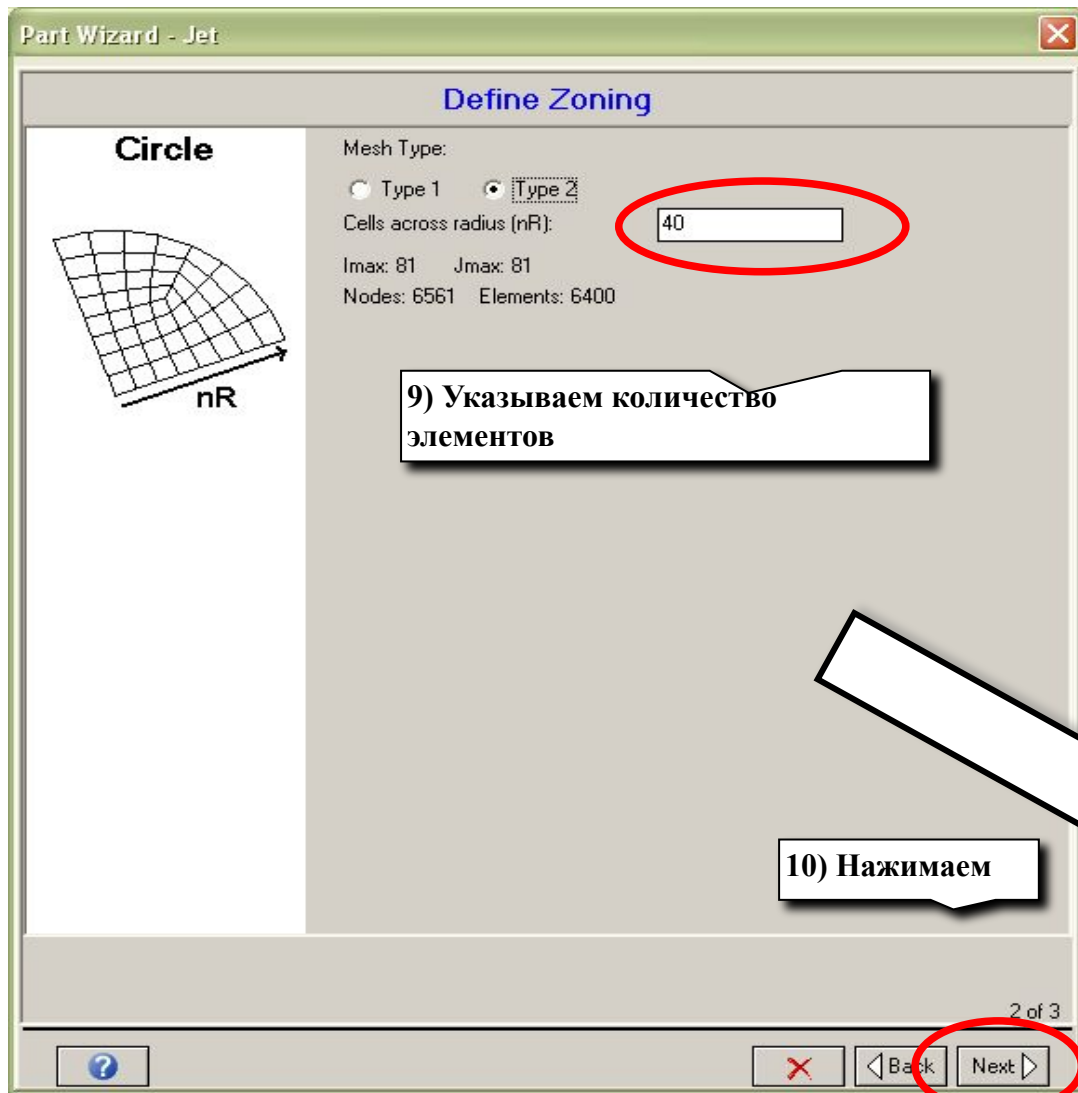
Definition

5) Выбираем геометрию детали

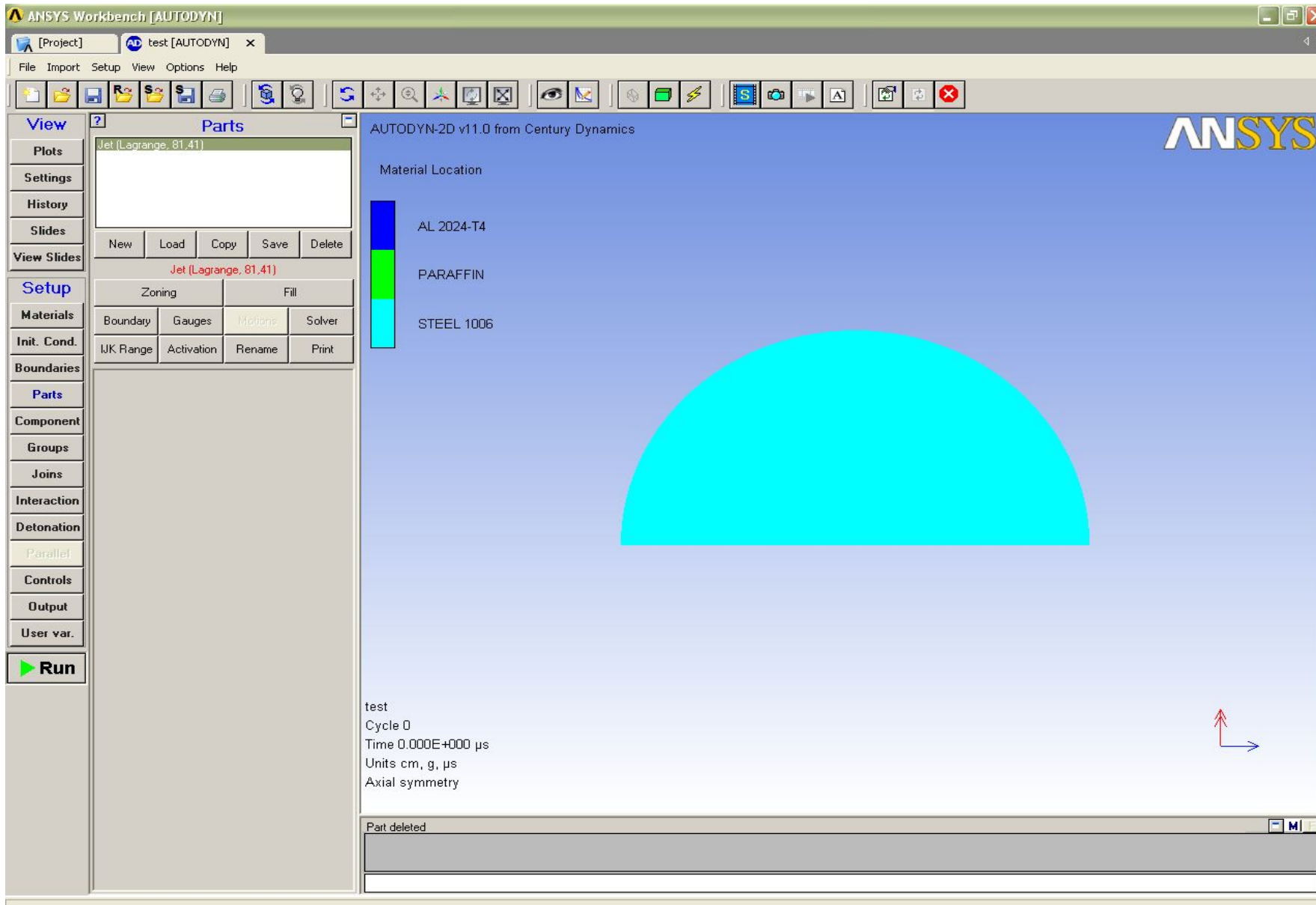


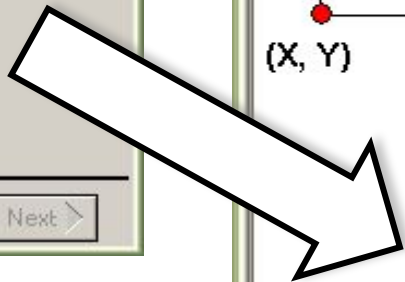
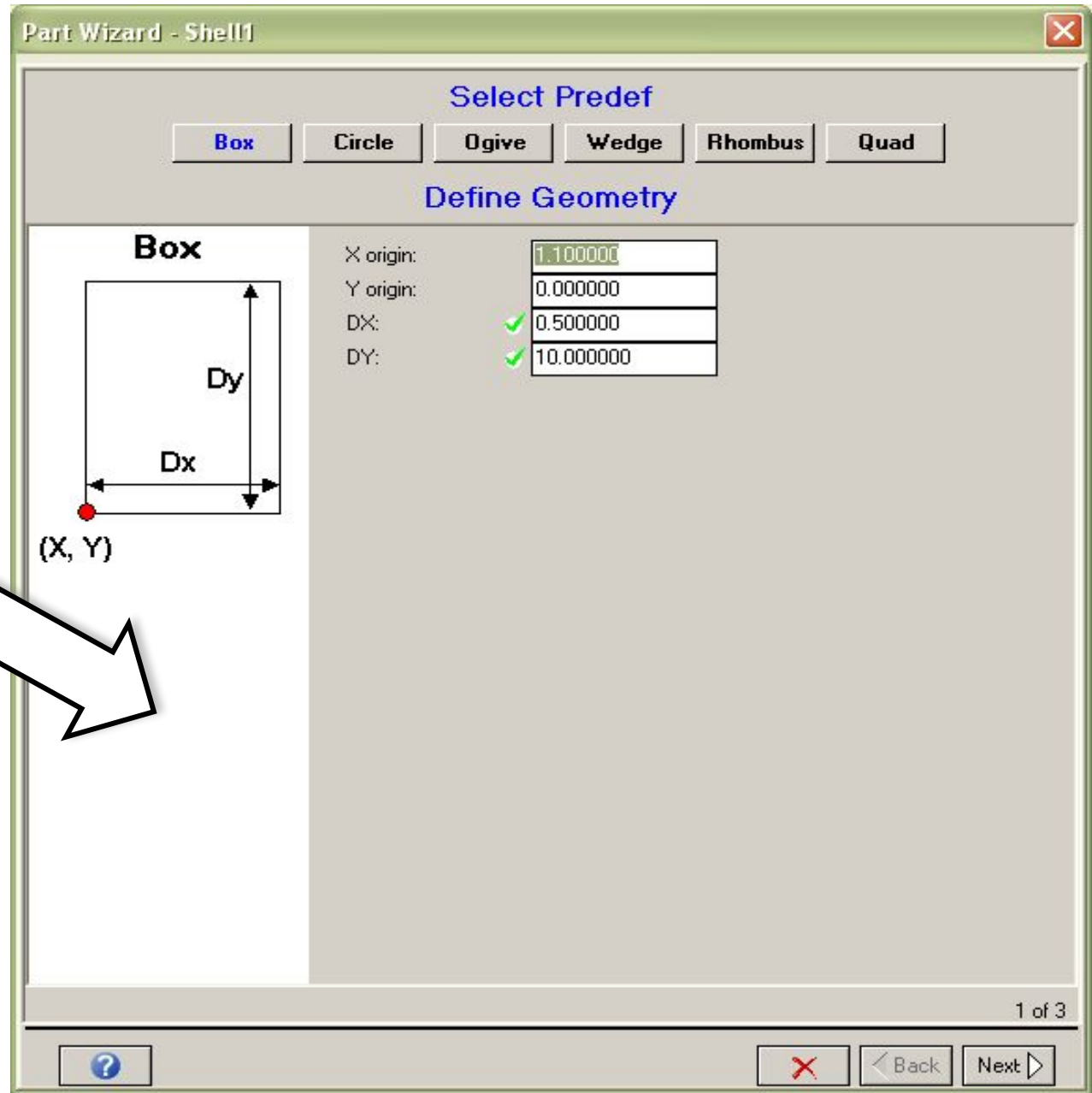
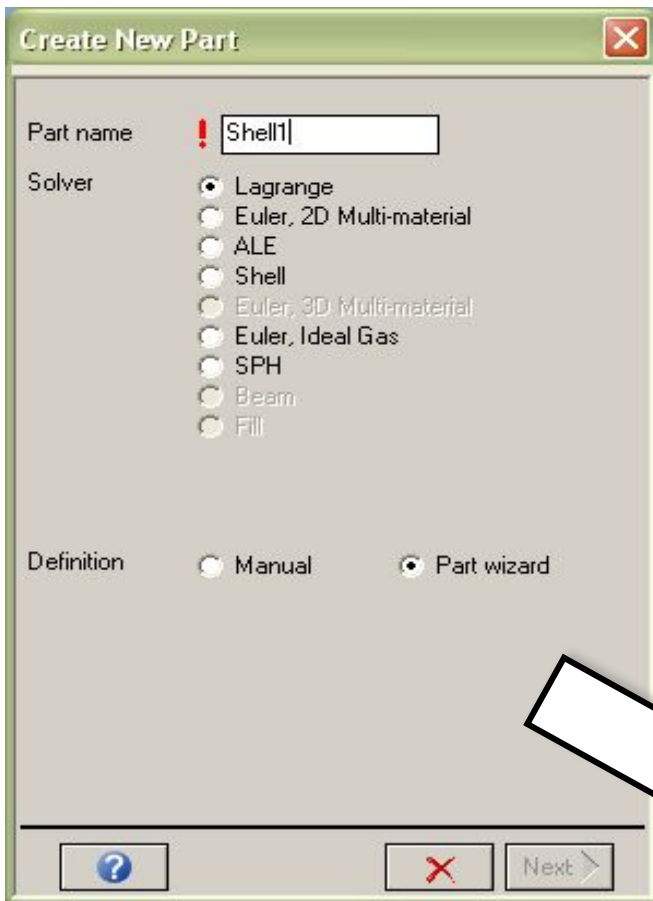
6) Поскольку задача осесимметрична, то достаточно половины сферы





4. Первая деталь готова. По аналогии создаем остальные.





Part Wizard - Shell1

Define Zoning

Box

Cells in I direction:
Cells in J direction:

Nodes: 1661 Elements: 1500

Grade zoning in I-direction:
 Grade zoning in J-direction:

Fixed size (dy):
Times (nJ):

Centred Lower J Upper J

Buttons: ? [X] < Back Next >

Part Wizard - Shell1

Fill part

Fill part?
 Fill with Initial Condition Set

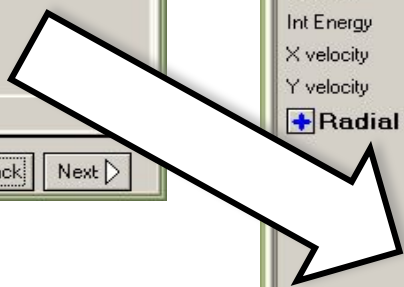
Initial Cond. +

Material +

Density
Int Energy
X velocity
Y velocity
 Radial Velocity

3 of 3

Buttons: ? [X] < Back ✓



Одну из деталей получим копированием существующей

ANSYS Workbench [AUTODYN]

[Project] test [AUTODYN] x

File Import Setup View Options Help

View ? Parts

Plots

Settings

History

Slides

View Slides

Setup

Materials

Init. Cond.

Boundaries

Parts

Component

Groups

Joins

Interaction

Detonation

Parallel

Controls

Output

User var.

Run

Jet (Lagrange, 81,41)
Shell1 (Lagrange, 11,151)

1) Нажимаем

New Load Copy Save Delete

Shell1 (Lagrange, 11,151)

Zoning Fill

Boundary Gauges Motions Solver

IJK Range Activation Rename Print

AUTODYN.2D.v11.0 from Century Dynamics

Copy Part

Select Part to copy:

Jet (Lagrange, 81,41) ML
Shell1 (Lagrange, 11,151) ML

2) Выбираем копируемую деталь

New Part Name !

3) Указываем имя новой детали

4) Нажимаем

test
Cycle 0
Time 0.000E+000 μ s
Units cm, g, μ s
Axial symmetry

Zoning box data

После копирования новая деталь расположена там же где исходная, поэтому перемещаем ее в нужное место

The screenshot displays the ANSYS Workbench [AUTODYN] interface. The main window shows a project named 'test [AUTODYN]'. The 'Parts' list on the left contains 'Jet [Lagrange, 81,41]', 'Shell1 [Lagrange, 11,151]', and 'Shell2 [Lagrange, 11,151]'. The 'Zoning' tab is selected in the 'Setup' panel. The 'Zoning for IJK range' section shows 'From I = 1 To I = 11' and 'From J = 1 To J = 151'. The 'Manual Zoning' section is expanded, and the 'Transformations' sub-section is active, showing 'Translate', 'Rotate', and 'Scale' options. The 'Translate' dialog box is open, showing 'X distance (DX): 1.500000' and 'Y distance (DY): 0.000000'. The 'OK' button is highlighted with a red circle. The 'Output' window at the bottom shows 'test', 'Cycle 0', 'Time 0.000E+000 μs', 'Units cm, g, μs', and 'Axial symmetry'. The 'Zoning box data' window is also visible at the bottom.

1) Выбираем деталь

2) Нажимаем

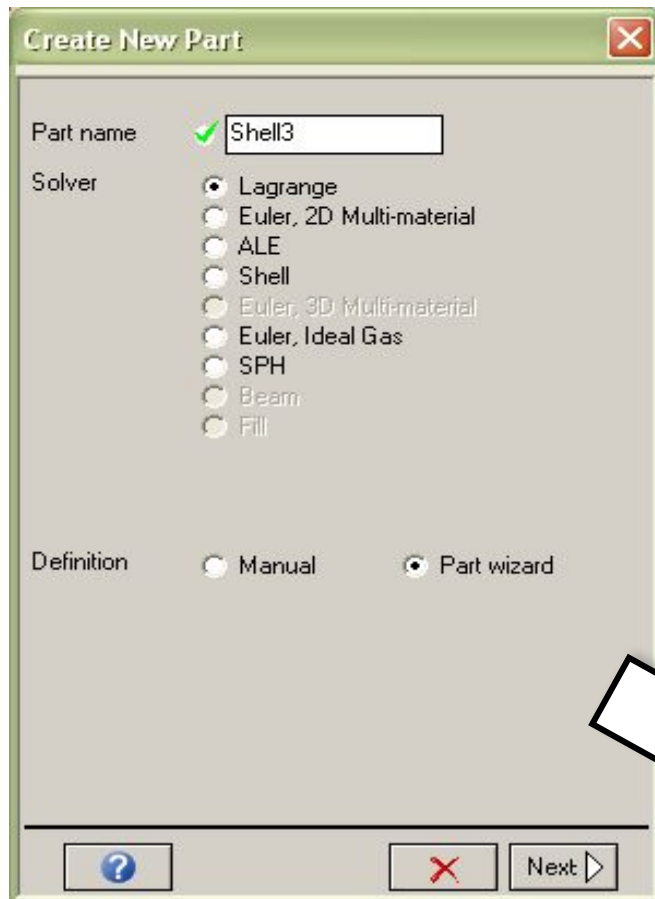
3) Нажимаем

4) Нажимаем

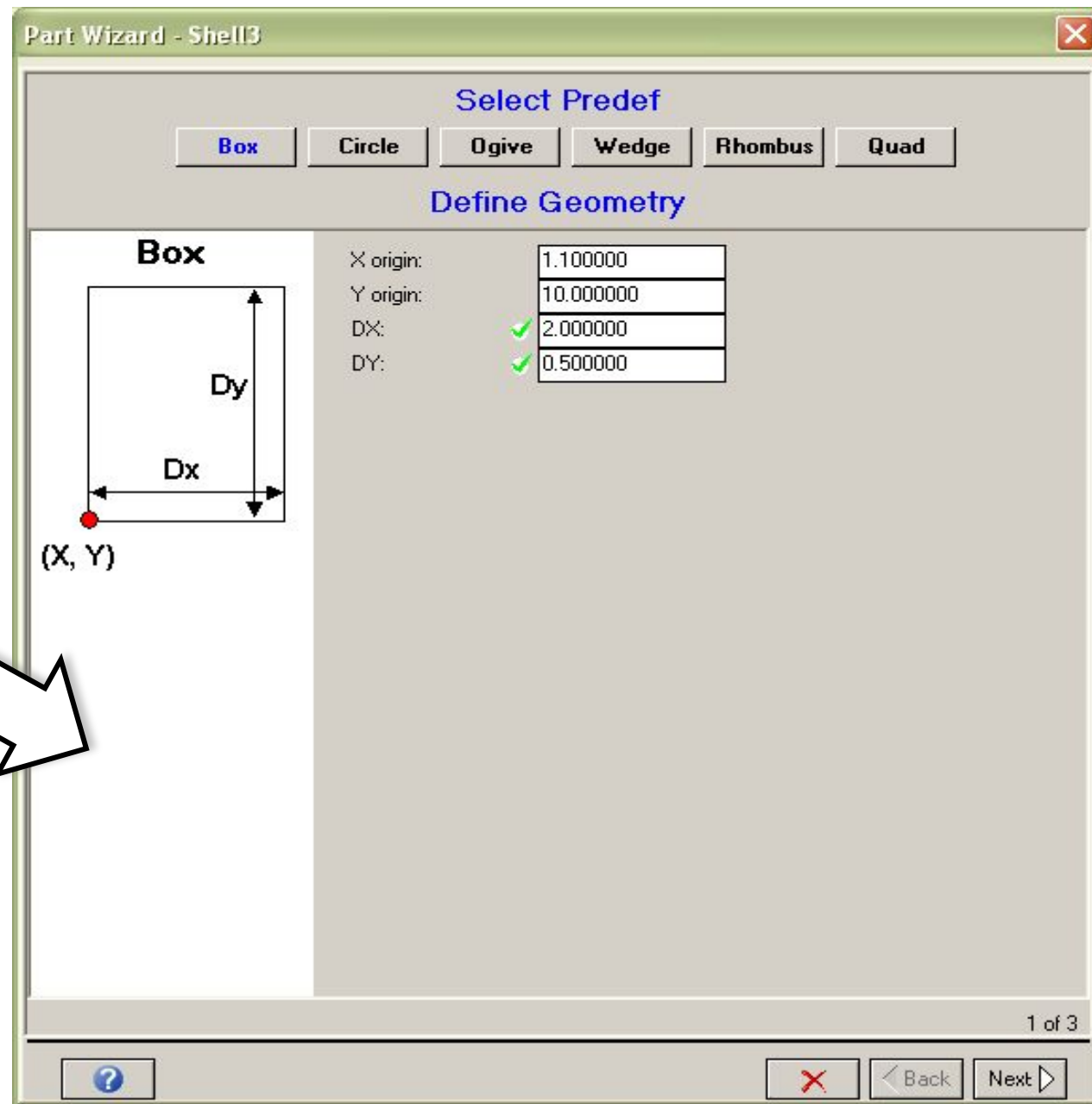
5) Указываем перемещения

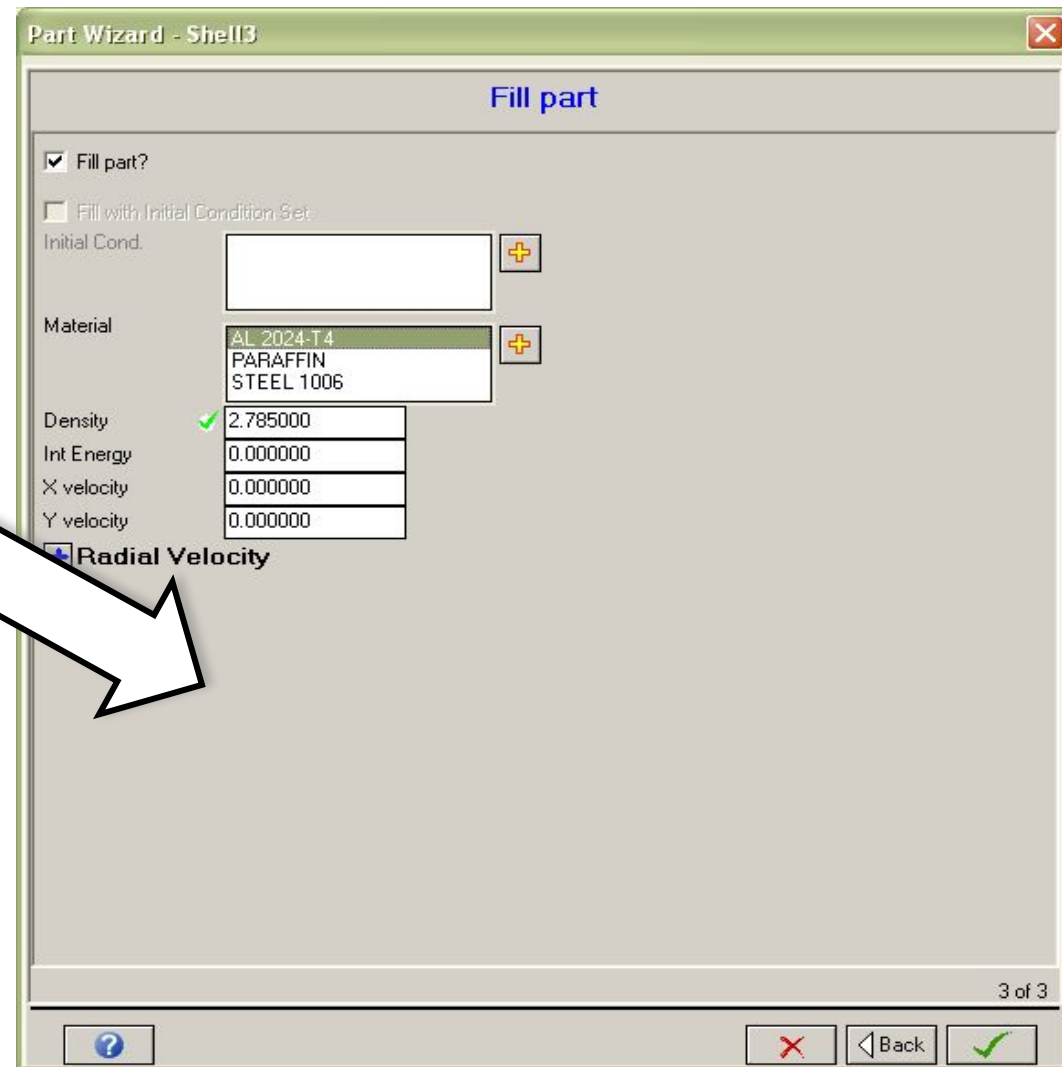
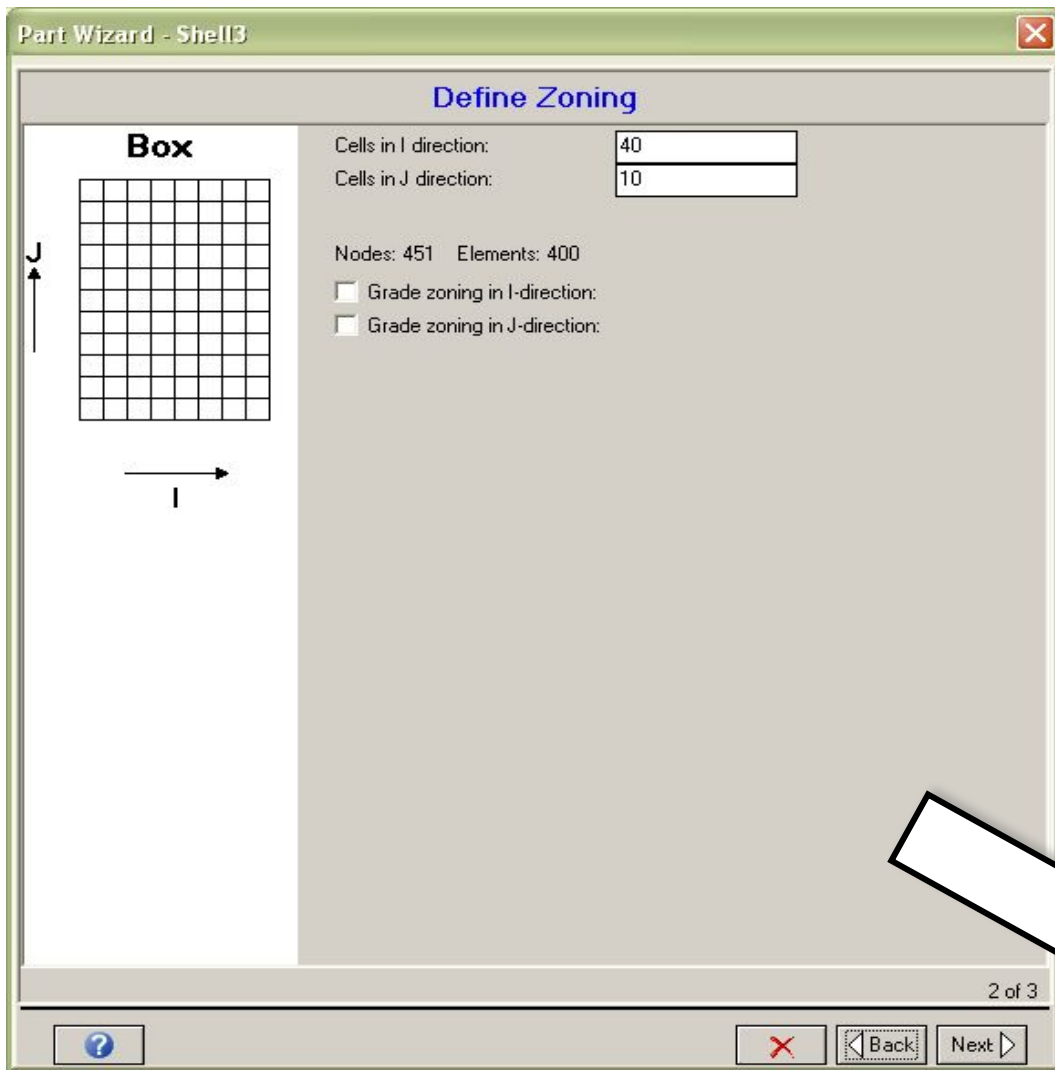
6) Нажимаем

Продолжаем создавать детали



При создании не связанных (не «склеенных») деталей между ними необходимо оставлять зазоры размером 0,1...0,5 размера ячейки (для осуществления алгоритма взаимодействия поверхностей).





Create New Part

Part name PF

Solver

- Lagrange
- Euler, 2D Multi-material
- ALE
- Shell
- Euler, 3D Multi-material
- Euler, Ideal Gas
- SPH
- Beam
- Fill

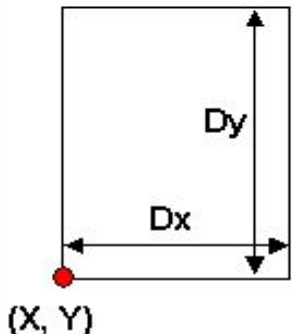
Definition Manual Part wizard

Part Wizard - PF

Select Predef

Define Geometry

Box



X origin: 1.605000
Y origin: 0.000000
DX: 0.990000
DY: 8.995000

1 of 3

Part Wizard - PF

Define Zoning

Box

Cells in I direction:

Cells in J direction:

Nodes: 3171 Elements: 3000

Grade zoning in I-direction:

Grade zoning in J-direction:

Fixed size (dy):

Times (nJ):

Centred Lower J Upper J

Buttons: ? [X] < Back Next >

Part Wizard - PF

Fill part

Fill part?

Fill with Initial Condition Set

Initial Cond. +

Material +

Density

Int Energy

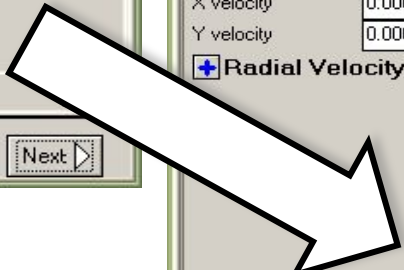
X velocity

Y velocity

Radial Velocity

3 of 3

Buttons: ? [X] < Back ✓



5. Склеиваем части, образуя единую деталь

ANSYS Workbench [AUTODYN]

[Project] test [AUTODYN] x

File Import Setup View Options Help

View Define Joins

Plots **Join** Join All Unjoin Unjoin All

Settings Matrix Review

History

Slides

View Slides

Setup

Materials Plot joined nodes
 Plot joined parts
 Remove joined faces from plot

Init. Cond.

Boundaries

Parts

Component

Groups

Joins

Interaction

Detonation

Parallel

Controls

Output

User var.

Run

Join parts

Select part(s):

Shell1
Jet
Shell2
Shell3
PF

Select part(s) to join to above list:

Shell1
Jet
Shell2
Shell3
PF

Apply X ✓

2) Нажимаем

1) Нажимаем

3) Выбираем склеиваемые части

4) Нажимаем

test
Cycle 0
Time 0.000E+000 μs
Units cm, g, μs
Axial symmetry

Zoning box data

6. Определяем параметры взаимодействия

ANSYS Workbench [AUTODYN]

[Project] test [AUTODYN]

File Import Setup View Options Help

View Interactions

Plots Lagrange/Lagrange Euler/Lagrange

Settings Interaction Gap

History Gap size 0.001217

Slides Gap Type External Internal

View Slides Quick Check

Setup Calculate Create Check

Materials

Init. Cond.

Boundaries Erosion

Parts Retain inertia of eroded nodes

Component Prevent erosion of degenerate cells

Groups Int

Joins Matrix Range Friction Review

Interaction Self-interaction

Detonation

Parallel

Controls

Output

User var. Safety Factor 0.200000

Run

AUTODYN-2D v11.0 from Century Dynamics

Material Location

AL 2024-T4

STEEL 1006

test

Cycle 0

Time 0.000E+000 μ s

Units cm, g, μ s

Axial symmetry

Gap size has been set to: 1.22E-03

2A) Или устанавливаем требуемый размер зазора в ручную.

2) Нажимаем

1) Нажимаем

7. Параметры расчета

ANSYS Workbench [AUTODYN]

File Import Setup View Options Help

Define Solution Controls

Wrapup Criteria

Cycle limit	10000
Time limit	50.000000
Energy fraction	0.050000
Energy ref. cycle	0

2) Указываем

Если минимальный шаг по времени не указан, то он принимается равным 1/10 от начального.

1) Нажимаем

Controls

Timestep Options

Start time	0.000000
Minimum timestep	0.000000
Maximum timestep	1.000000e+008
Initial timestep	0.000000
Safety factor	0.666600

Method of calculating characteristic zone dimension: Diagonals

Damping Options

Global Cutoffs

SPH Cutoffs

Gravity

Transport

Run

test
Cycle 0
Time 0.000E+000 μs
Units cm, g, μs
Axial symmetry

Gap size has been set to: 1.22E-03

7. Результаты

The screenshot displays the ANSYS Workbench [AUTODYN] interface. The main window shows a 3D model of a vertical bar with a blue outer shell and a green inner core. A red arrow points to the 'Output' tab in the left sidebar, which is circled in red. The 'Define Output' panel is also highlighted with a red circle, showing the 'Refresh' button and the 'Display freq.' field set to 25. A callout box points to the 'Refresh' button with the text: "Частота обновления информации на экране в процессе расчета". Another callout box points to the 'Save' button with the text: "Частота сохранения промежуточных результатов в процессе расчета". A third callout box points to the 'History' section with the text: "1) Нажимаем". The bottom status bar shows the following information: test, Cycle 0, Time 0.000E+000 μs, Units cm, g, μs, Axial symmetry.

ANSYS Workbench [AUTODYN]

[Project] test [AUTODYN]

File Import Setup View Options Help

View Define Output

Plots

Settings

History

Slides

View Slides

Setup

Materials

Init. Cond.

Boundaries

Parts

Component

Groups

Joins

Interaction

Detonation

Parallel

Controls

Output

User var.

Run

Interrupt

Refresh

Display freq. 25

Text freq.

Save

Cycles Times

Start cycle 0

End cycle 100000000

Increment 25

Select Variables

Review Variables

History

Capture image

Print

Log file(on)

1) Нажимаем

Частота обновления информации на экране в процессе расчета

Частота сохранения промежуточных результатов в процессе расчета

test

Cycle 0

Time 0.000E+000 μs

Units cm, g, μs

Axial symmetry

Outputs set

8. Изменение представления данных

1) Нажимаем

2) Нажимаем

3) Нажимаем

4) Отключаем сглаживание

5) Показываем границы деталей

6) Нажимаем

7) Нажимаем для начала процесса счета

ANSYS Workbench [AUTODYN] interface showing the 'Plots' section on the left, the 'Contour Plot Settings' dialog box in the center, and the 'Run' button at the bottom left. The dialog box is titled 'Contour Plot Settings' and contains the following options:

- Profile window
- Smoothing
- Grey scales
- Min/Max Value
- Fragment Plot
- Number of contours: 10
- Grid lines:**
 - None
 - Outline
 - Grid
 - Beam sections
 - Shell thickness
 - Profile
 - Legend
 - Mat. direction
 - Marker
 - Shell normals
 - Node/Element
 - Scale
 - Part Highlight
- Contour scales:**
 - Fix scales
 - Min: 0.000000

test
Cycle 0
Time 0.000E+000 µs
Units cm, g, µs
Axial symmetry

Outputs set



View

- Plots
- Settings
- History
- Slides
- View Slides

Setup

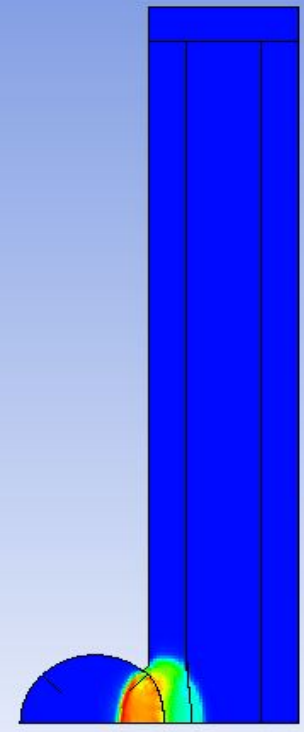
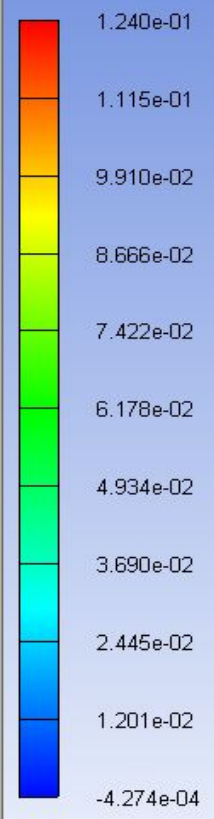
- Materials
- Init. Cond.
- Boundaries
- Parts
- Component
- Groups
- Joins
- Interaction
- Detonation
- Parallel
- Controls
- Output
- User var.

Stop

AUTODYN-2D v11.0 from Century Dynamics



PRESSURE (Mbar)



test
Cycle 1800
Time 1.841E+000 μ s
Units cm, g, μ s
Axial symmetry



CYCLE: 1814, Time: 1.851E+00, Timestep: 7.433E-04 controlled by Interaction, factor: 10





View

- Plots
- Settings
- History
- Slides
- View Slides

Setup

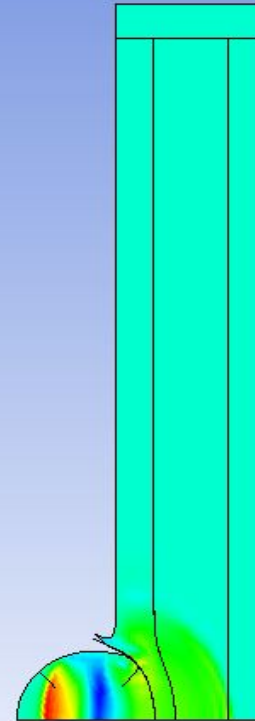
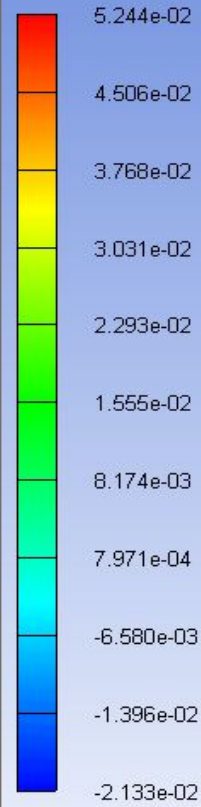
- Materials
- Init. Cond.
- Boundaries
- Parts
- Component
- Groups
- Joins
- Interaction
- Detonation
- Parallel
- Controls
- Output
- User var.

■ Stop

AUTODYN-2D v11.0 from Century Dynamics



PRESSURE (Mbar)



test
Cycle 4175
Time 3.821E+000 μ s
Units cm, g, μ s
Axial symmetry



CYCLE: 4199, Time: 3.847E+00, Timestep: 1.091E-03 controlled by Interaction, factor: 4





View

- Plots
- Settings
- History
- Slides
- View Slides

Setup

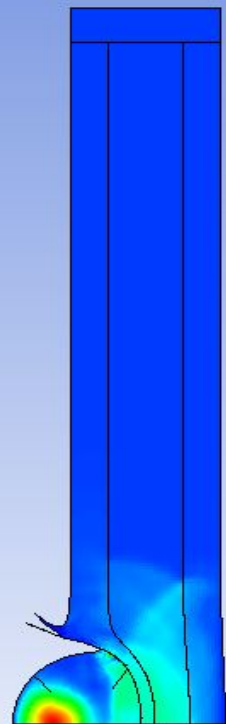
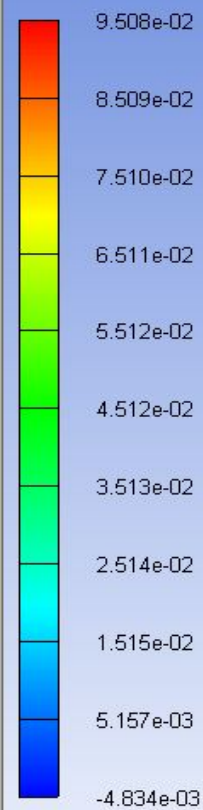
- Materials
- Init. Cond.
- Boundaries
- Parts
- Component
- Groups
- Joins
- Interaction
- Detonation
- Parallel
- Controls
- Output
- User var.

■ Stop

AUTODYN-2D v11.0 from Century Dynamics



PRESSURE (Mbar)



test
Cycle 6525
Time 6.574E+000 μ s
Units cm, g, μ s
Axial symmetry



CYCLE: 6548, Time: 6.603E+00, Timestep: 1.226E-03 controlled by Interaction, factor: 2



View

- Plots
- Settings
- History
- Slides
- View Slides

Setup

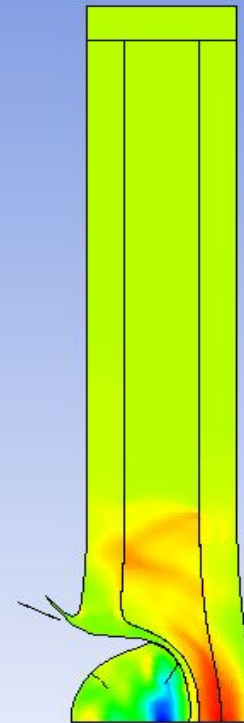
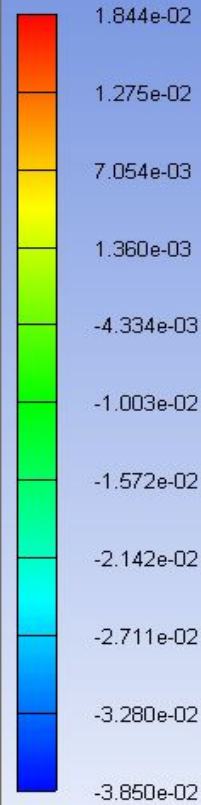
- Materials
- Init. Cond.
- Boundaries
- Parts
- Component
- Groups
- Joins
- Interaction
- Detonation
- Parallel
- Controls
- Output
- User var.

■ Stop

AUTODYN-2D v11.0 from Century Dynamics



PRESSURE (Mbar)



test
Cycle 8875
Time 9.497E+000 μ s
Units cm, g, μ s
Axial symmetry



CYCLE: 8883, Time: 9.507E+00, Timestep: 1.245E-03 controlled by Interaction, factor: 2



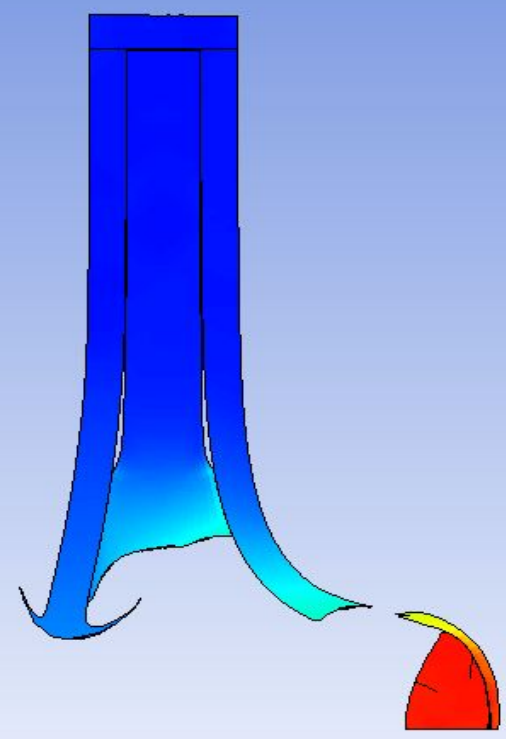
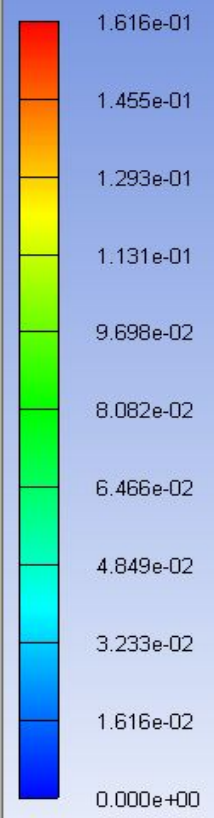


- View
 - Plots
 - Settings
 - History
 - Slides
 - View Slides
- Setup
 - Materials
 - Init. Cond.
 - Boundaries
 - Parts
 - Component
 - Groups
 - Joins
 - Interaction
 - Detonation
 - Parallel
 - Controls
 - Output
 - User var.
- Stop

AUTODYN-2D v11.0 from Century Dynamics

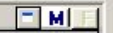


ABS.VEL (cm/us)

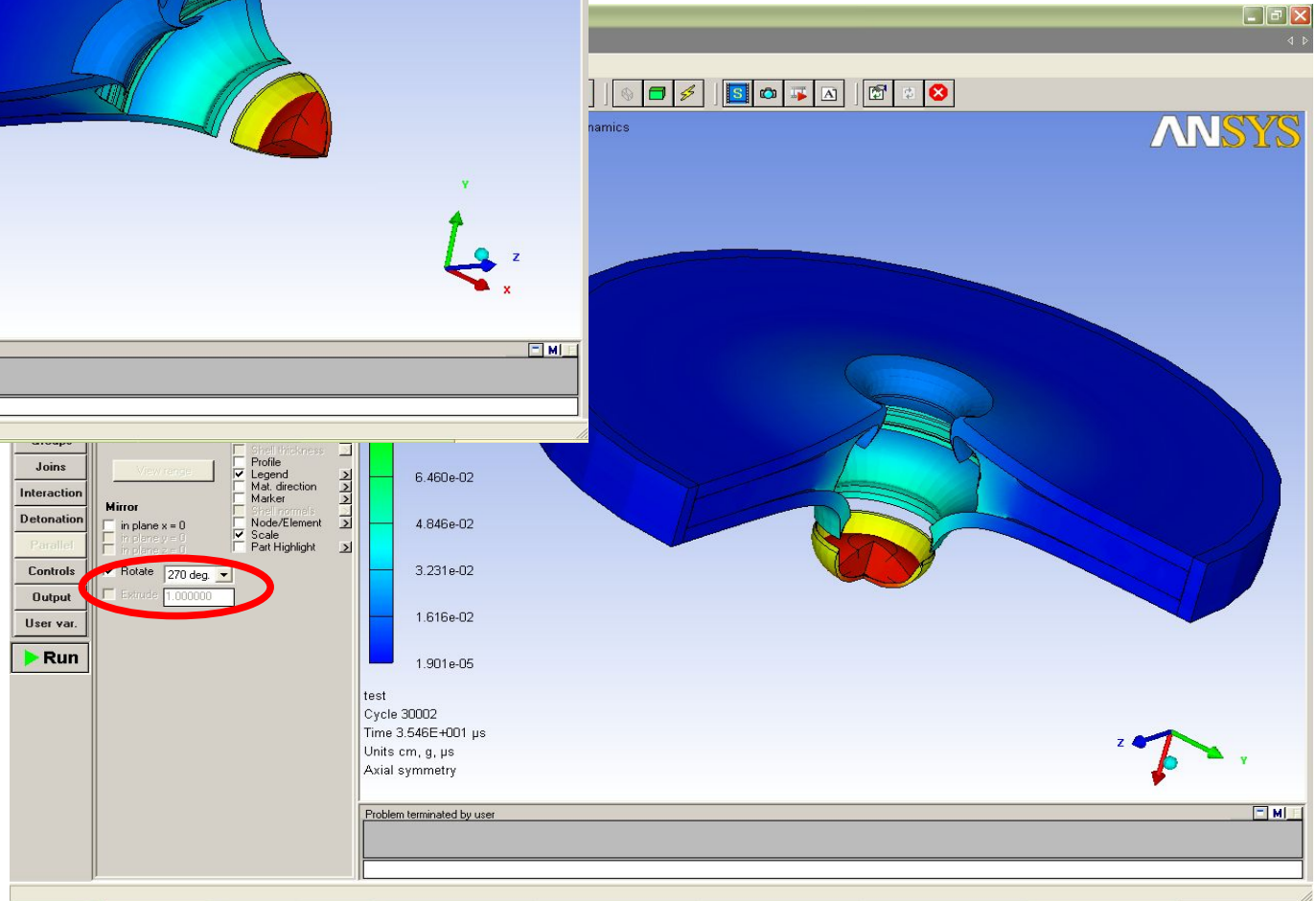
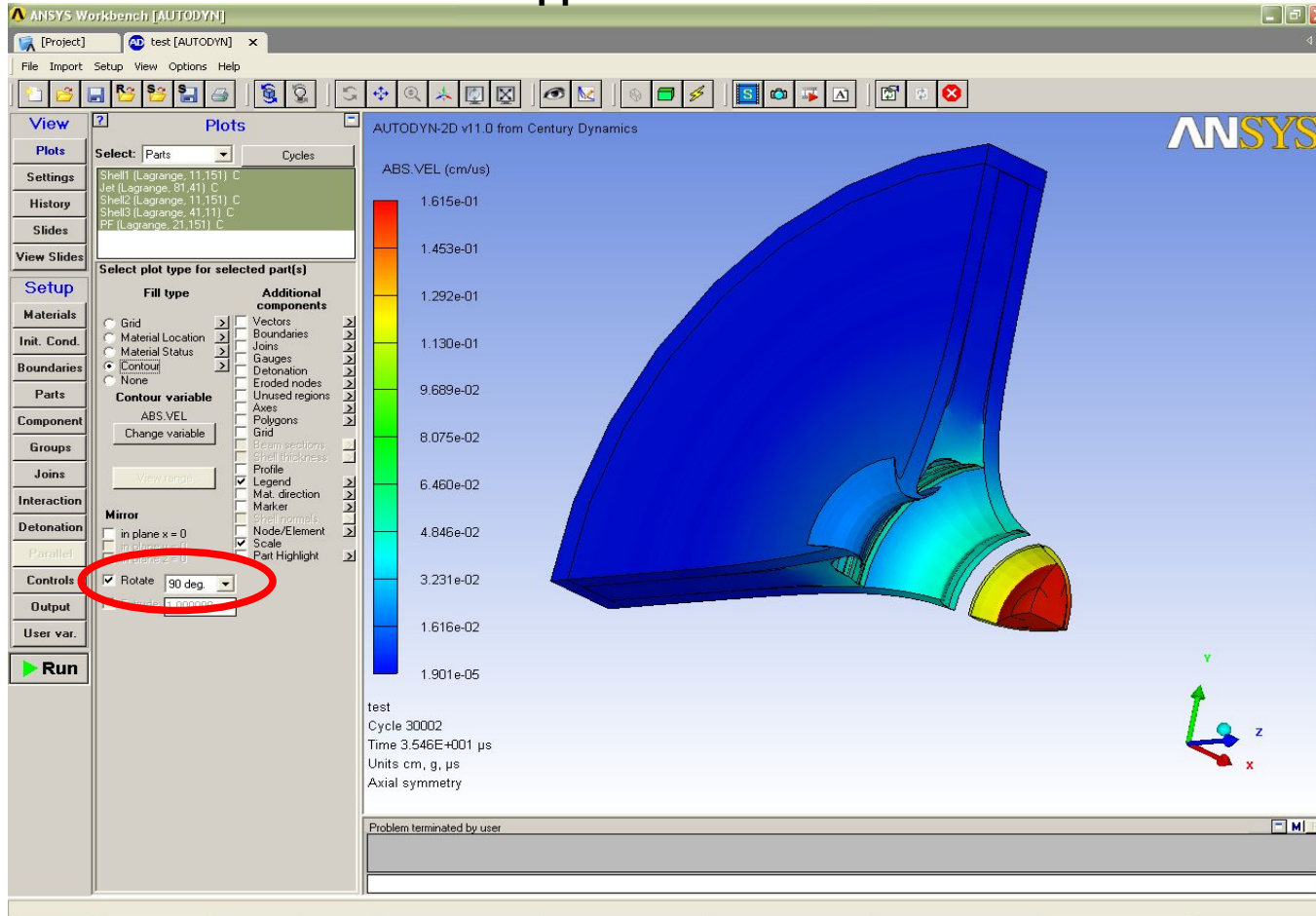


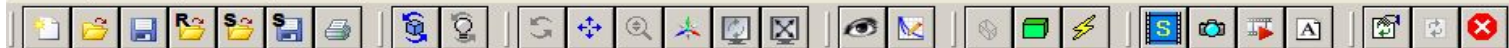
test
Cycle 29725
Time 3.505E+001 μ s
Units cm, g, μ s
Axial symmetry

CYCLE: 29725, Time: 3.505E+01, Timestep: 1.482E-03 controlled by Interaction, factor: 3



Представление в «объемном» виде





View

Plots

Settings

History

Slides

View Slides

Setup

Materials

Init. Cond.

Boundaries

Parts

Component

Groups

Joins

Interaction

Detonation

Parallel

Controls

Output

User var.

Run

Plots

Select: Parts Cycles

Shell1 (Lagrange, 11,151) ML
Jet (Lagrange, 81,41) ML
Shell2 (Lagrange, 11,151) ML
Shell3 (Lagrange, 41,11) ML
PF (Lagrange, 21,151) ML

Select plot type for selected part(s)

Fill type

Grid >
 Material Location >
 Material Status >
 Contour >
 None

Contour variable

PRESSURE
Change Variable

View range

Mirror

in plane x = 0
 in plane y = 0
 in plane z = 0

Rotate 270 deg.
 Extrude 1.000000

Additional components

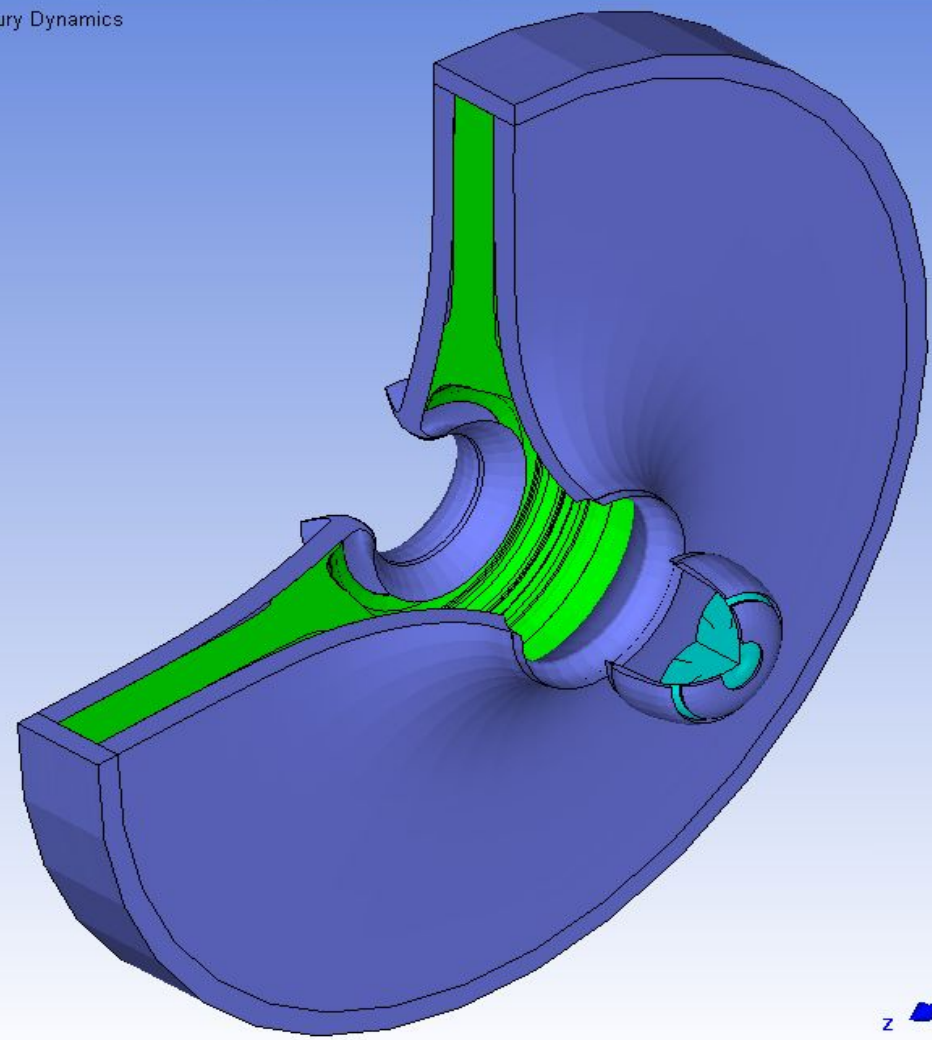
Vectors >
 Boundaries >
 Joins >
 Gauges >
 Detonation >
 Eroded nodes >
 Unused regions >
 Axes >
 Polygons >
 Grid >
 Beam sections >
 Shell thickness >
 Profile >
 Legend >
 Mat. direction >
 Marker >
 Shell normals >
 Node/Element >
 Scale >
 Part Highlight >

AUTODYN-2D v11.0 from Century Dynamics

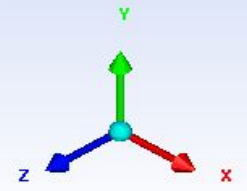


Material Location

AL 2024-T4
PARAFFIN
STEEL 1006



test
Cycle 39561
Time 5.000E+001 μ s
Units cm, g, μ s
Axial symmetry



Problem terminated wrapup time reached