

Baseball Seam

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Introduction

This is an experimental tutorial. As I have never been happy with the format of the soccer ball tutorial, I have been experimenting with other formats. This is an attempt at a tutorial using an HTML format. Comments, suggestions, and questions about this material are most welcome. Please post them on the [TurboCAD User Forum](#).

Since HTML with graphics doesn't print well, you can [download a PDF version](#) (309KB) of this page.

Discussion

The geometry of the serpentine path of a baseball seam is a good vehicle for demonstrating the TurboCAD's ability to model seemingly complex objects with precision. It also offers the opportunity to demonstrate how workplanes can be used efficiently and how to take advantage of the fact that points in 3D space can be projected on the 2D workplane.

First, the problem needs to be reduced to its essentials. What is known about the geometry? We know that it has a circumference of $9 \frac{1}{8}$ inches, that the closest approach that the seam's center line makes to itself, as it winds around the ball, is an arc length of $1 \frac{3}{16}$ inches, and that there are 108 stitches. Beyond that, we have to make some observations.

Although the shape of the seam's path is not specified, inspection reveals that the path is composed of four circular arc segments and that the points on the ball's surface where the arc segments are joined describe a square that lies on a plane that bisects the ball. The resulting hemispheres are identical except that one is rotated 90° with respect to the other. This is sufficient information to draw the seam's path.

Conventions

- Color: Select the indicated color from the drop-down list on the Property tool bar.
- IBar: Fill in the indicated fields with the given values and ignore all other fields. Finish with the [Enter] key.
- KBD: Push the indicated key(s).
- Local Menu: Right-click the mouse in the Drawing Window and select the indicated option.
- Mouse: Click per instruction.
- Render:
- SEKE: (Single Entry Keyboard Equivalent) Type the given letter to execute the required snap with the mouse positioned as indicated. All snaps will be done this way.
- Tool: Click indicated tool with the mouse.

- The images accompanying each step reflect the drawing as it appears when the step is completed.

Setup

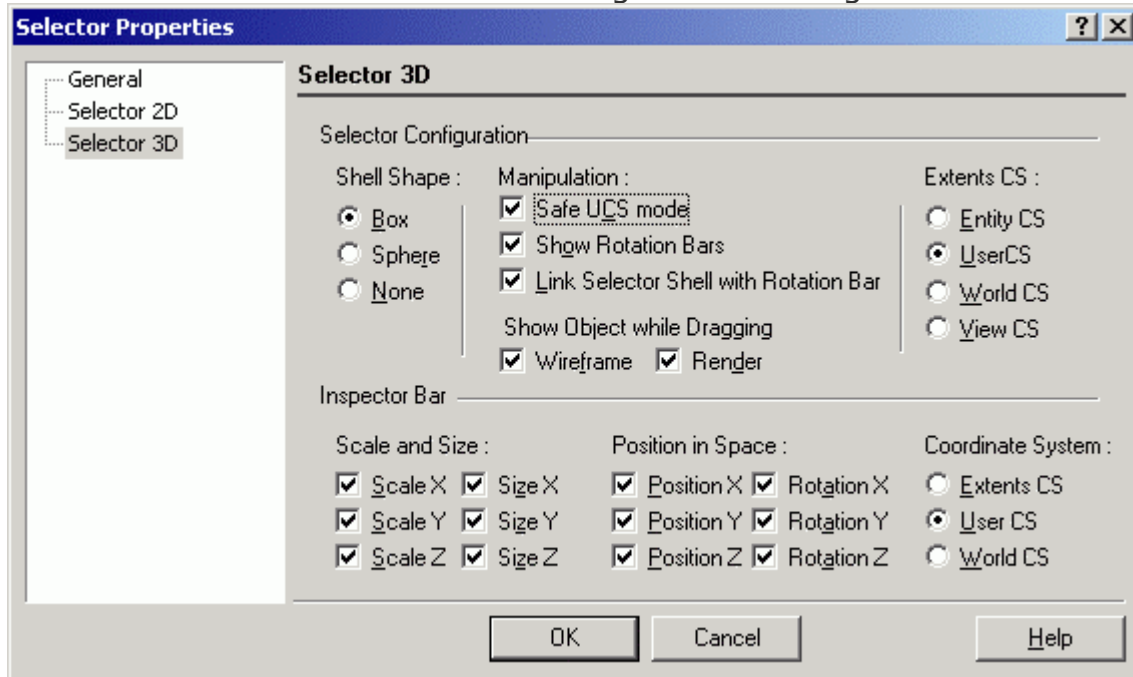
- Start a new drawing using the Normal template.
- Switch from Paper Space to Model space.
- In the Grid Page of the Drawing Setup dialog, turn on "Show grid", set "Type" to Ortho, Set "Style" to Lines, and set X and Y Spacing to 0.25.
- In the Advanced Grid Page of the Drawing Setup dialog, set X and Y Frequency to 1, set Minor X and Minor Y Divisions to 4, set X and Y Origins to 0, and set Base to 0.
- KBD: Shift+S (turns off all snaps).
- Tool: Plane by World
- Tool: Isometric SE
- KBD: Home (pans Drawing Window to World 0,0,0)
- KBD: End (sets zoom to 100%)
- Render Scene Environment: Background/Graduated Inverted

The Selector and Inspector Bar have two modes: 2D only and 2D/3D. This exercise requires the 2D/3D mode be invoked. To get access to the switch that controls mode selection, the Select tool must be active (KBD: Spacebar). In addition, there must be at least one object in the drawing to enable the Select tool.

To ensure that you are in the 2D/3D mode, please do the following:

- Tool: Line
- SEKE: G anywhere in the Drawing Window
- SEKE: G somewhere else in the Drawing Window
- KBD: Spacebar
- Local Menu: If you see "2D Selector Properties..." at the top of the lower half of the list, Toggle 2D/3D.

- Local Menu: Selector 3D Properties...
Make the selections shown in the image of the dialog box shown below.



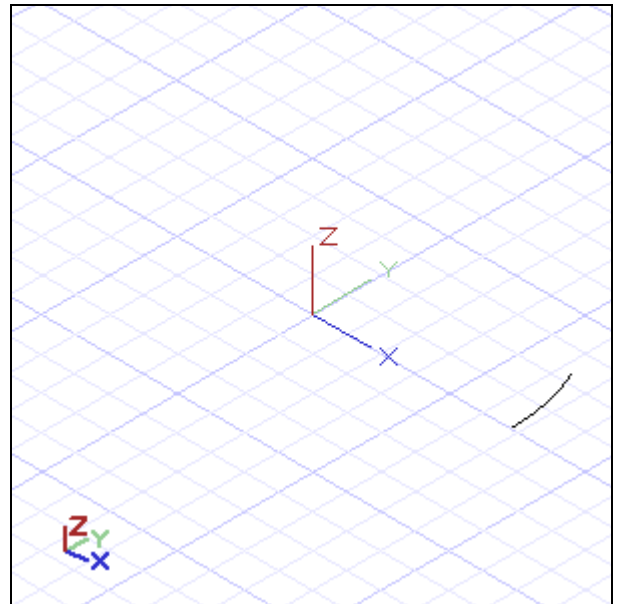
- In the Preference Page of the Program Setup dialog, turn on "Show user CS" and "Show world CS".

Your screen or the central portion of it should look approximately the same as the image that accompanies step 1.

Step-by-step

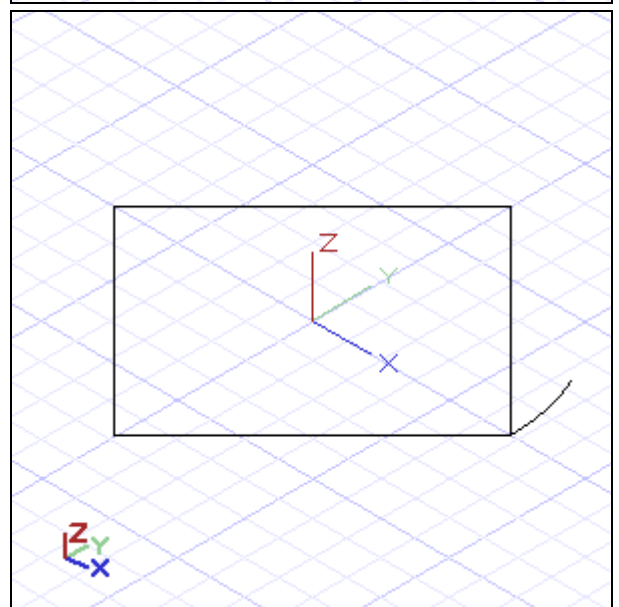
1. Draw the arc that identifies a point that represents the seam's closest approach to itself.

- Tool: Arc Center and Radius
- SEKE: G at World 0,0
- IBar: Circumference = $9 \frac{1}{8}$, Length = $\frac{19}{32}$



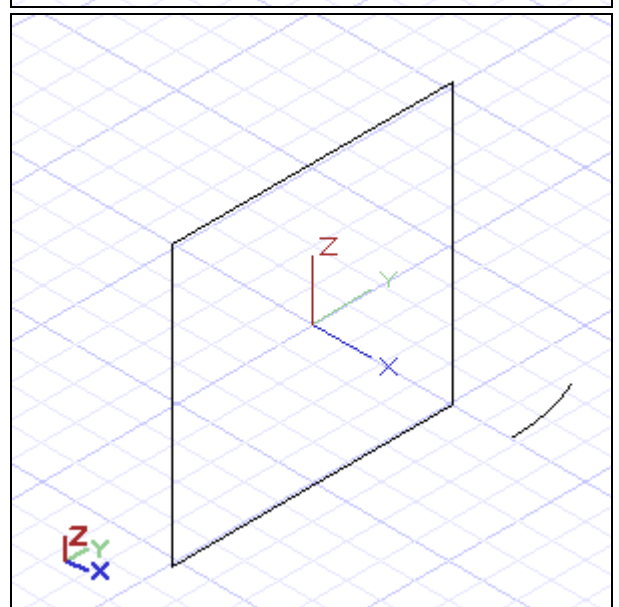
2. Draw the square that identifies the four points where the seam arcs connect to each other.

- Tool: Polygon
- IBar: Sides = 4
- SEKE: C, V at arc-end on x-axis



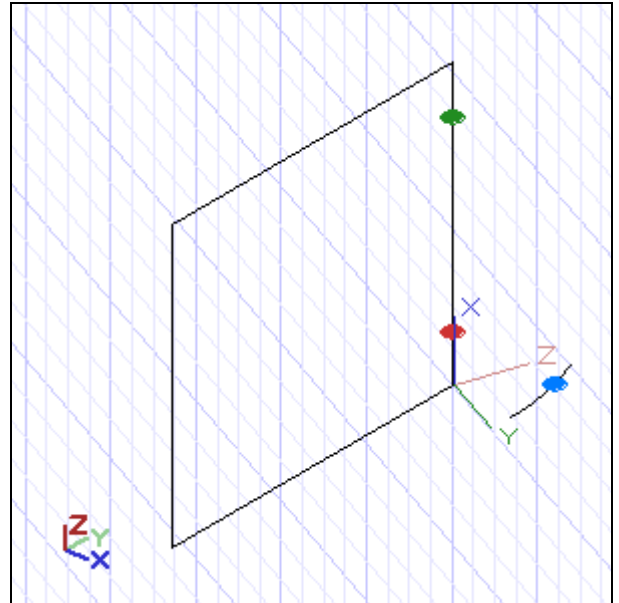
3. Rotate the square to final position.

- KBD: [F7]
- IBar: Rot Y = 90, Rot Z = 45
- KBD: [Esc]



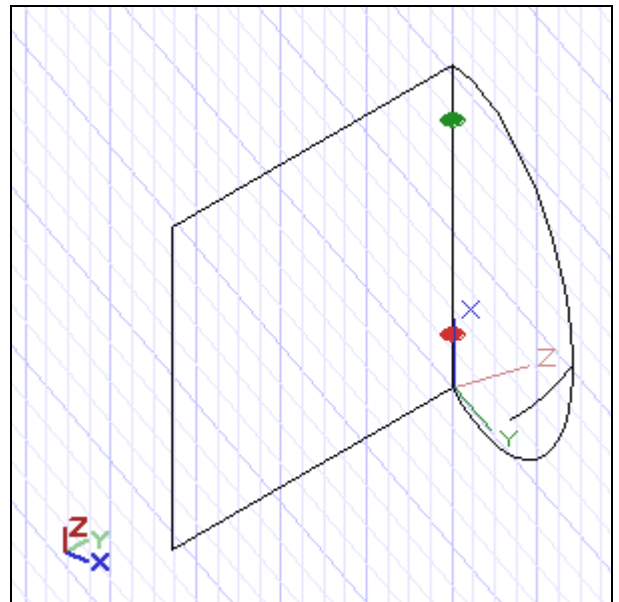
4. Establish the WorkPlane for the first seam arc.

- Tool: WorkPlane by 3 Points
- SEKE: V at each colored dot in RGB order (red, green, then blue).



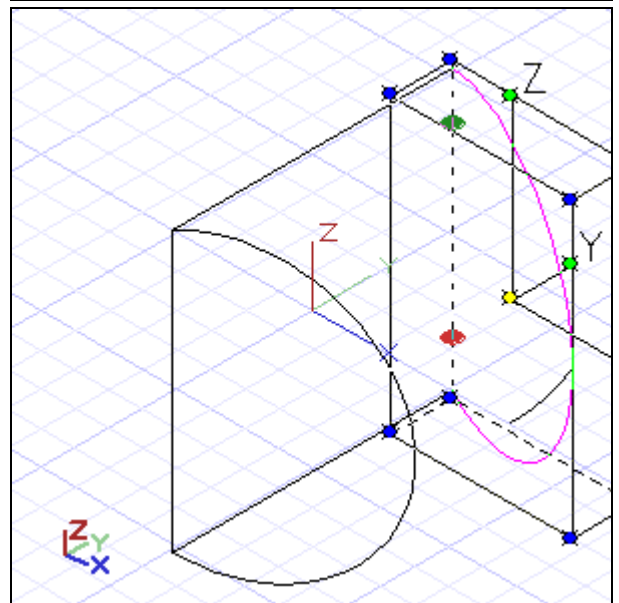
5. Draw the first seam arc.

- Tool: Arc Center and Radius
- SEKE: E, V, V at the green dot
- SEKE: V at the red dot



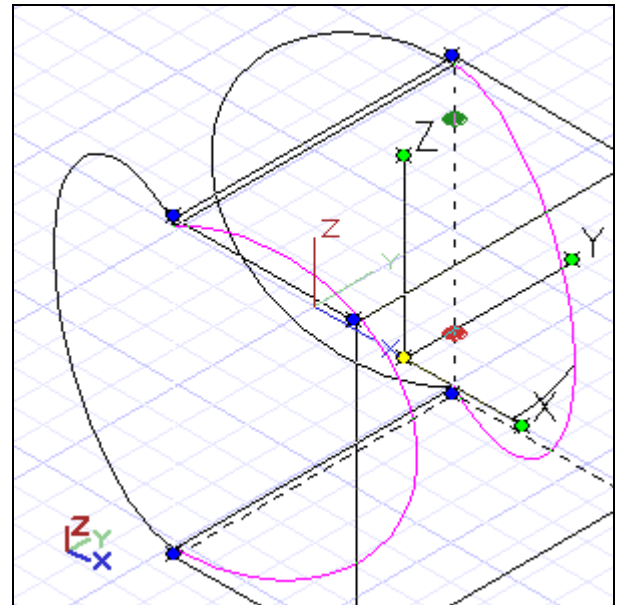
6. Replicate the seam arc.

- Tool: Plane by World
- KBD: [F7]
- Tool: Mirror Copy
- SEKE: E at either colored dot or any other part of the square
- IBar: Angle = 0



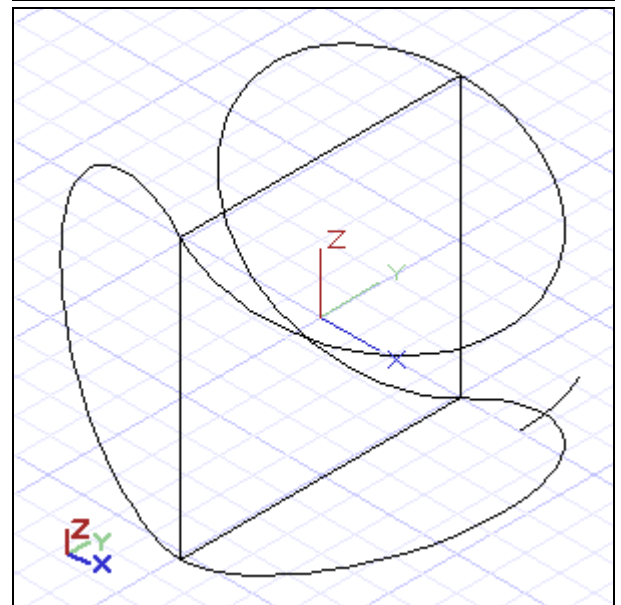
7. Replicate the last two arcs.

- KBD: [Shift] + [F6]
- Tool: Mirror Copy
- SEKE: E at either colored dot or any other part of the square
- IBar: Angle = 90



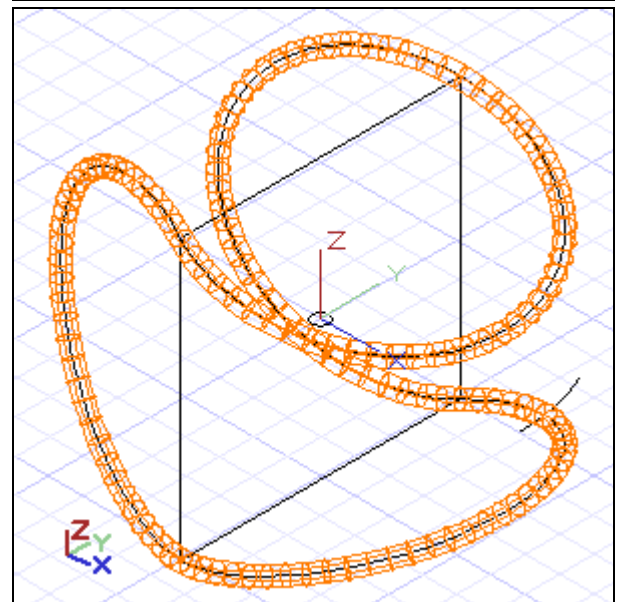
8. Rotate two arcs and join all seam arcs.

- IBar: Rot X = 90
- KBD: [Shift] + ([F6], [F6])
- Tool: Join Polyline
- Local Menu: 3D Polyline
- Local Menu: Finish Join Polyline



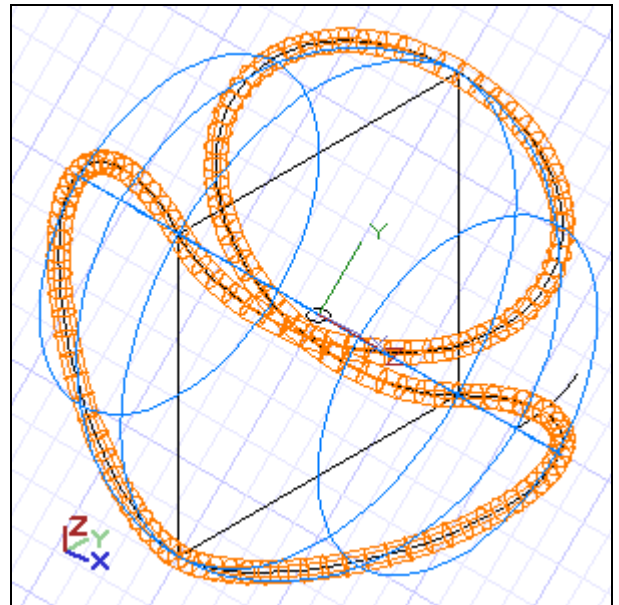
9. Draw a small circle and extrude it along the seam.

- Tool: Circle Center and Point
- Mouse: Click anywhere in the Drawing Window
- IBar: Radius = 1/16
- Tool: Normal Extrude
- Color: Coral
- Local Menu: Select Extrusion Path
- Mouse: Click circle, click seam
- Patience: Wait for operation to complete



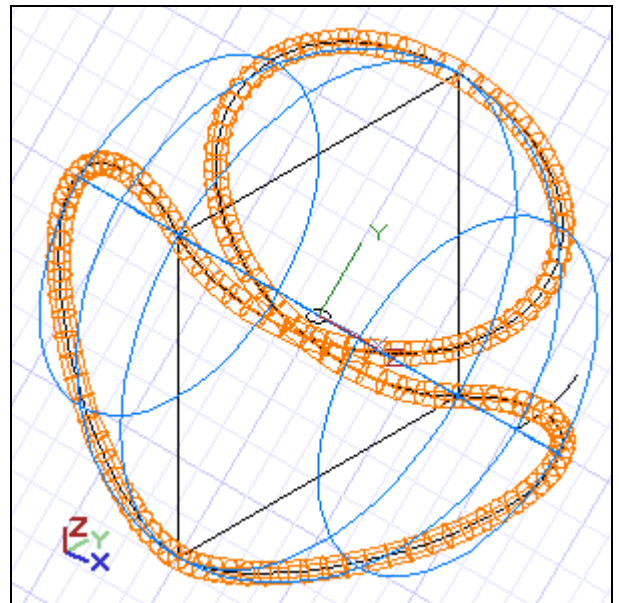
10. Draw the ball.

- Tool: WorkPlane by Entity
- Mouse: Click the square
- Tool: Sphere
- Color: Slate Blue
- SEKE: E, V anywhere on square



11. Replicate sphere and extrusion.

- KBD: [F7], [Shift] + [F7]
- Tool: Linear Copy
- IBar: XStep = YStep = ZStep = 0, Sets = 2
- Patience: Wait for operation to complete
- KBD: [Esc]



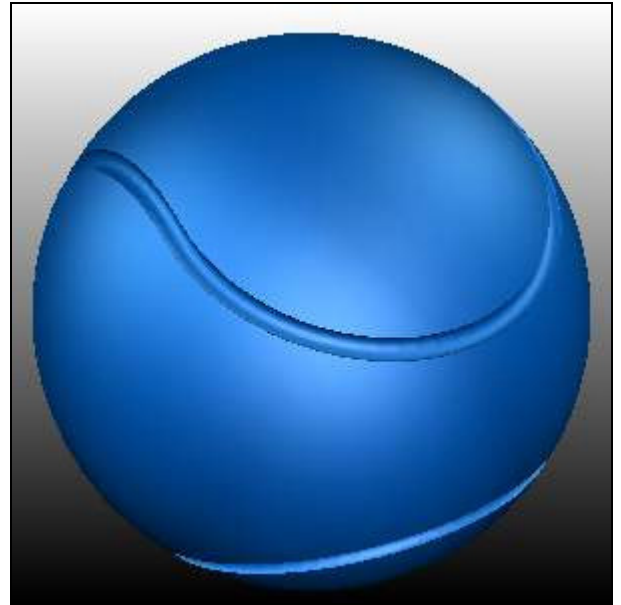
12. Finish seam.

- Tool: 3D Intersect
- Mouse: Click an extrusion and then click a sphere
- Patience: Wait for operation to complete
- KBD: [F7]
- Render: Draft—LightWorks/Smooth OpenGL



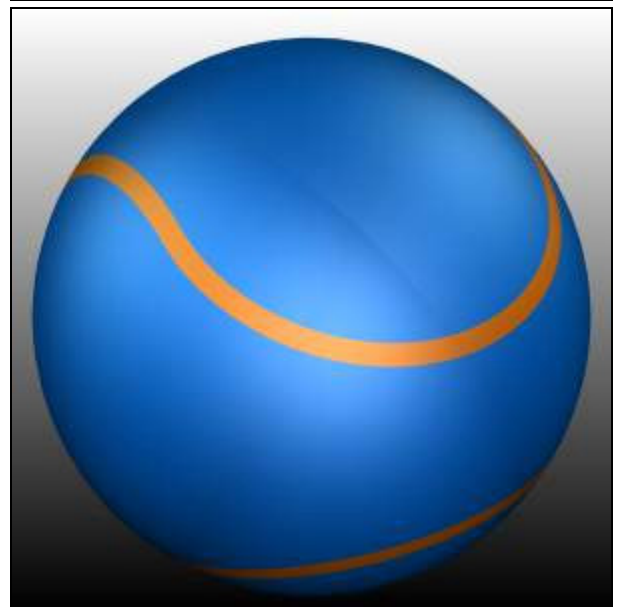
13. Finish Ball

- KBD: [Esc], [Esc]
- Tool: 3D Subtract
- Mouse: Click remaining sphere, click remaining extrusion
- Patience: Wait for operation to complete
- KBD: [F7]
- Render: Draft—LightWorks/Smooth OpenGL



14. Final render.

- KBD: [Esc], [Esc]
- Render: Quality—LightWorks/Raytrace Full



Variations on the Theme

Readers of this tutorial may want to create a somewhat more realistic seam as shown here. This was done by revolving a profile and replicating it as in steps 6, 7, and 8.

The holes in the seam and cover are subtractions of a pair of cylinders radial copied around one seam arc and then replicated.

Also, the sphere was shelled and then filled with a slightly smaller one to produce the tan color at the bottom of the holes.

Stitches can then be added in a manner similar to that used to make the holes.

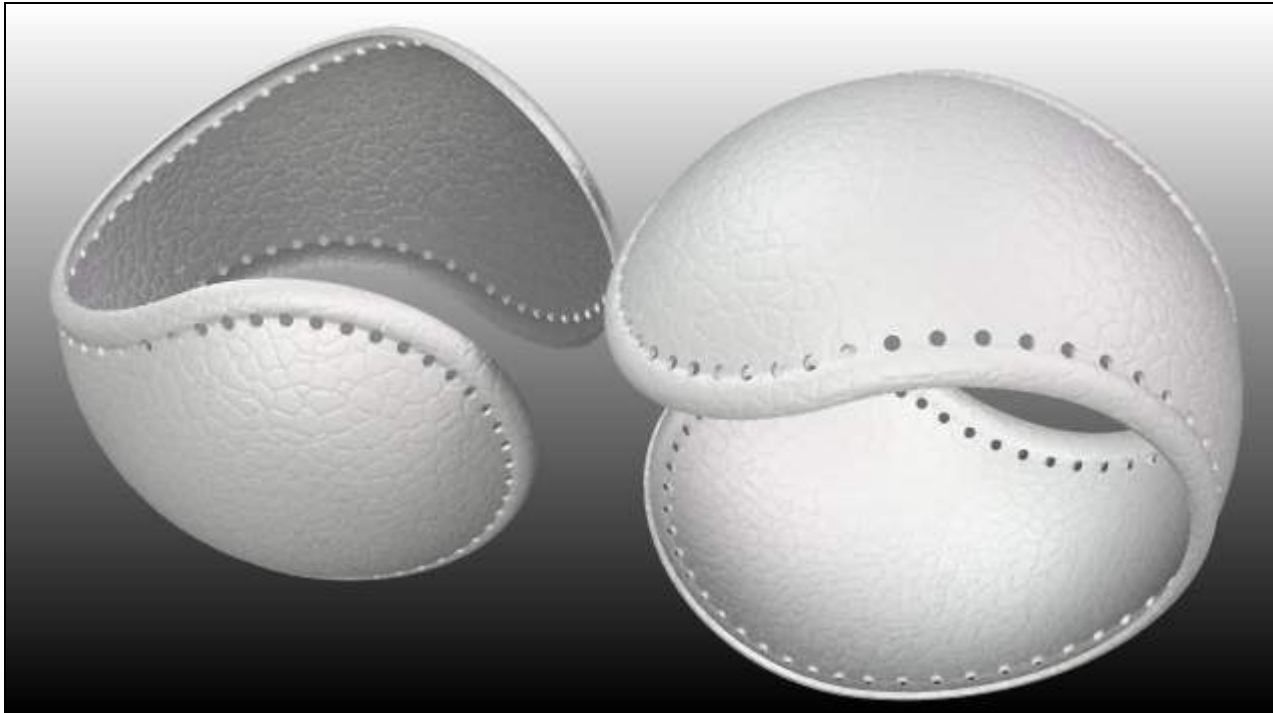


Separating the halves of the cover requires a little different methodology. Only one cover is drawn and then replicated.

Referring to the cover on the right, it was made with cones instead of arcs. The right half of the cover was made by subtracting two cones from a hemisphere and the left half was made by intersecting two cones with a sphere. The halves were then added.

Then, after adding the seam, the cover was shelled by subtracting a slightly scaled-down copy. The standard shelling operation does not seem to work on this object.

All that was left to do was drill the holes, replicate the result, and position the copy.



Revisions:

8/13/02

Original post.

9/13/02

Added "Turn off all snaps" to the setup instructions and an email link.

9/22/02

Re-wrote of the Setup section and added a link to the user forum in the Introduction.

10/24/02

Some detail rework of "Setup" and steps 4 through 7.

10/9/02

Added PDF download.