Organic Modeling for Jewelry Design with T-Splines and Rhino® 4

Designing a Ring

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Designing freeform objects can be difficult when working with traditional CAD software. **T-Splines** and **Rhino 4** offer an easy way to create smooth, gap-free organic models for jewelry design.

The best way to read this tutorial about how to model a ring using T-Splines is by looking at the 3D model at the same time. You can follow the model’s progress by selecting the different layers in the file. The model can be downloaded at www.tsplines.com.

In this tutorial, anything in **Blue** is a Rhino command, while anything in **Red** is a T-Splines command. Type these commands in the command line of Rhino to run them.

1. **Wireframe**

**Ring Profile**
First, draw the main profile of the ring using **Curve**. For me, the best way to get the right profile is by designing it undeveloped.
This particular design consists of two hearts connected by the body of the ring. The idea is to have a smooth transition between the body and the hearts, with no sharp edges.
2 Wireframe

**Control Polygon**
Use `ExtractControlPolygon` to extract the control polygons of the curves.

In step 5, we will use this control polygon to generate a T-Splines surface with the same profile of the native curves.

3 Wireframe

**Inner Lines**
Once we have the control polygon profile, we need to connect the points. Remember that the ideal thing is to have rectangular regions (keep that rule of thumb in mind when you draw the curves.)

Each line intersection will determine where the control points will be on the surface.
4 Wireframe

Extrude Lines
Now we need to extrude these lines with tsScriptExtrudeControlPolygon (Thanks JB and T-Splines for this amazing tool!) in order to get a 3D control polygon. Remember to delete all the internal lines after extruding. These inner lines are not necessary for the tsControlPolygonToSrf command (next step).

5 T-Splines surface

Transform to T-Splines Surface
Before generating the T-Splines surface, we need to be sure that we only have the lines we need; for this, I usually use: first, ungroup all, then split selected curves against each other (tsSplitCurves), select duplicate curves (SelDup) and Delete them. Now the curves are ready to be transformed to a T-Splines surface. Select all lines and enter the tsControlPolygonToSrf command.
Check the preview option to ensure the surface is correct. Now we have a T-Splines surface.

6 T-Splines modification

**Body Profile**

To get the desired body profile, we need to make some changes by moving control points of the T-Spline surface using tsManip.

First, scale -X (in the negative “X” direction) the twelve selected points shown on the screenshot. Scaling points is a way of moving them symmetrically.

Second, move these same points -Z in order to get a smoother curvature on the outside part of the ring body.
T-Splines modification

**Face Extrude**

For the ring design we need a flat face on the inner part of the ring body that will touch the finger. One way to do it is by extruding faces. With `tsExtrude`, select the faces to be extruded, in this case all the ones that comprise the inner body. Do not select faces that touch a star point, this will result in the addition of control points that we don't want right now.

The extrusion must be very small to get a small radius transition to a flat surface. In this case, 0.3 mm.
After we extrude these faces and exit the command, points associated with the extruded faces will remain selected. Scale these points to get the flat surface closer to the ends of the hearts in a smoother transition.

It's important to pay a lot of attention to how the T-Splines surface react to these control points movements in order to understand it and use it on future projects.
T-Splines modification

Heart Modification

The idea of the design is that the two hearts are thinner on the interior tip and thicker on the body. To achieve this we just need to select the control points on the parts of the hearts shown and scale them -Z. (Scale the points of both hearts at once to ensure a symmetrical scaling).

Next, unselect the outermost loop of control points and repeat the -Z scale. Do this with every loop of points (shown below).

Now we have the final shape of the unfolded ring.
Adjustments

Curvature Analysis
One way to know if our surface has the correct curvature and smoothness is with the Curvature Analysis tool. For example, here I used the Gaussian Style to see clearly which surfaces have a negative (blue) and positive (red) radius.

I detected a surface area where the curvature changes from negative to positive in an unintended location, which breaks the smoothness. I selected the control points that affect that area and scaled them (-X) to smooth the surface. Notice that you can manipulate the surface while keeping the analysis on, this gives immediate feedback.

Once the curvature is fixed, the T-Splines surface is done!
Surface conversion

Set Smoothness
Once we are satisfied with our design, we transform our T-Splines surface to NURBS surfaces. We need to do this because for the next steps we will use some Rhino tools that only work on NURBS, not T-Splines. Before converting to NURBS, use the `tsSetStarSmoothness` command to smooth the surface at star points. I used a smoothing value of 5.

Transform
Next, use the `tsConvertToRhinosurf` command to turn the T-Spline into a NURBS surface.
Body inscription

Preparing Surfaces

You can add some inscriptions on the object in many different ways (e.g. Boolean operations). In this case I prefer to do it by managing surfaces instead of “solids.” This way I have more control at each part of the process, and also have less geometry to manage, which results in faster operations.

First, Explode the NURBS surface and Hide all the surfaces except the one we need (see the screenshot).

Follow this process:

1-Create a solid TextObject.

2-Fillet the text.

3-Scale the text to fit it on the surface (tsManip).

4-Trim the letters’ surfaces and then Join them all together.

5-Fillet the text with the ring.

6-Ones we have all the letters filleted, Unhide and Join all the surfaces together to yield a closed polysurface, like we had before the inscriptions.
Final transformation

Flow Along Surface

Finally, we need to deform the undeveloped ring surface to get a circular ring. For this, we will use the UDT Rhino tool *FlowAlongSurface*.

First, draw an arc that represents the side ring profile, extrude it using *ExtrudeCrv* (the distance will be the width of the ring) and finally unroll it (*UnrollSrf*) to get the base surface needed for the UDT operation.

Now that we have got all the surfaces needed, just use the *FlowAlongSurface* tool using the unrolled surface as the Base surface and the arc extrude as the Target surface.
The result is a perfectly smooth, high detail 3D model of a ring ready to be manufactured.

Good luck in your modeling!
Any questions, write to my e-mail below.

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*A free trial of T-Splines for Rhino may be downloaded at www.tsplines.com.*