



## Reverse Engineering with T-Splines and Rhino® 4



*Car tuning: creating a custom carbon mirror*



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“I’m always searching for new technologies that can improve my work, in contrast to my colleague who loves to work with tools he knows well and improve his skills with them. When we got this car mirror job, we decided it was a really good opportunity to have a little competition between him using Rhino only vs. me using Rhino + T-Splines, and there was no doubt about the winner. My colleague gave up after I finished my model, while he was far from finishing his.”  
—David Jurda

## Introduction

I have been modeling 3D objects with Rhino3D since 1999. Nowadays, I lead the P&D Studio division at AJ Technology s.r.o., where we specialize in industrial and product design. We closely cooperate with a company that works in the car-tuning industry (modifying a car to improve performance and style), and the complexity of shapes in this area led to the use of T-Splines.

## The problem

In general, modeling in the car-tuning industry is 80% reverse engineering and 20% creative work based on sketches, photos and STL scans of styled car body parts. It is important both to stay within tolerance (approximately  $\pm 0.1$ mm of the original part) and to keep perfect curvature and smoothness of modeled surfaces.

In many cases it is possible to use standard Rhino tools to get the required shapes. However, we often encounter organic shapes that are difficult to model and where every change of shape takes several hours to remodel. These are cases where T-Splines excels.

## The project

Recently we modeled a side-view mirror for a super sports car. Our input was a STL scan of the original part, modified with some clay to show the desired new shape. The request was to make a visually appealing, smooth and accurate model, where the inner surfaces and gripping had to fit the original car parts. The new mirror was to be manufactured from carbon for high surface quality.

## The solution: T-Splines

We had already worked on a similar task using standard Rhino tools and we knew that this would be a sophisticated model where maintaining the geometry while staying in the requested tolerance would be challenging.

So we looked for an alternative method to improve the process of modeling of these organic shapes and T-Splines turned out to be a good choice for a number of reasons:

- The time of modeling with T-Splines was significantly less than that of modeling only with Rhino tools.
- Working with the whole model as a single surface in T-Splines was a great asset compared to the need to smoothly connect a pattern of smaller surfaces in Rhino alone. Geometry changes took minutes instead of hours.
- NURBS surfaces were easily generated from T-Splines at the end of the process without any loss of surface quality, curvature continuity or smoothness.



## The process

1 - A standard car mirror with some clay modifications was the object of modeling, and was scanned into the computer.

2 - Basic surfaces were created around the .stl file by outlining the mesh with a line segment cage (placed by visual control), which was used to generate a T-Splines surface.

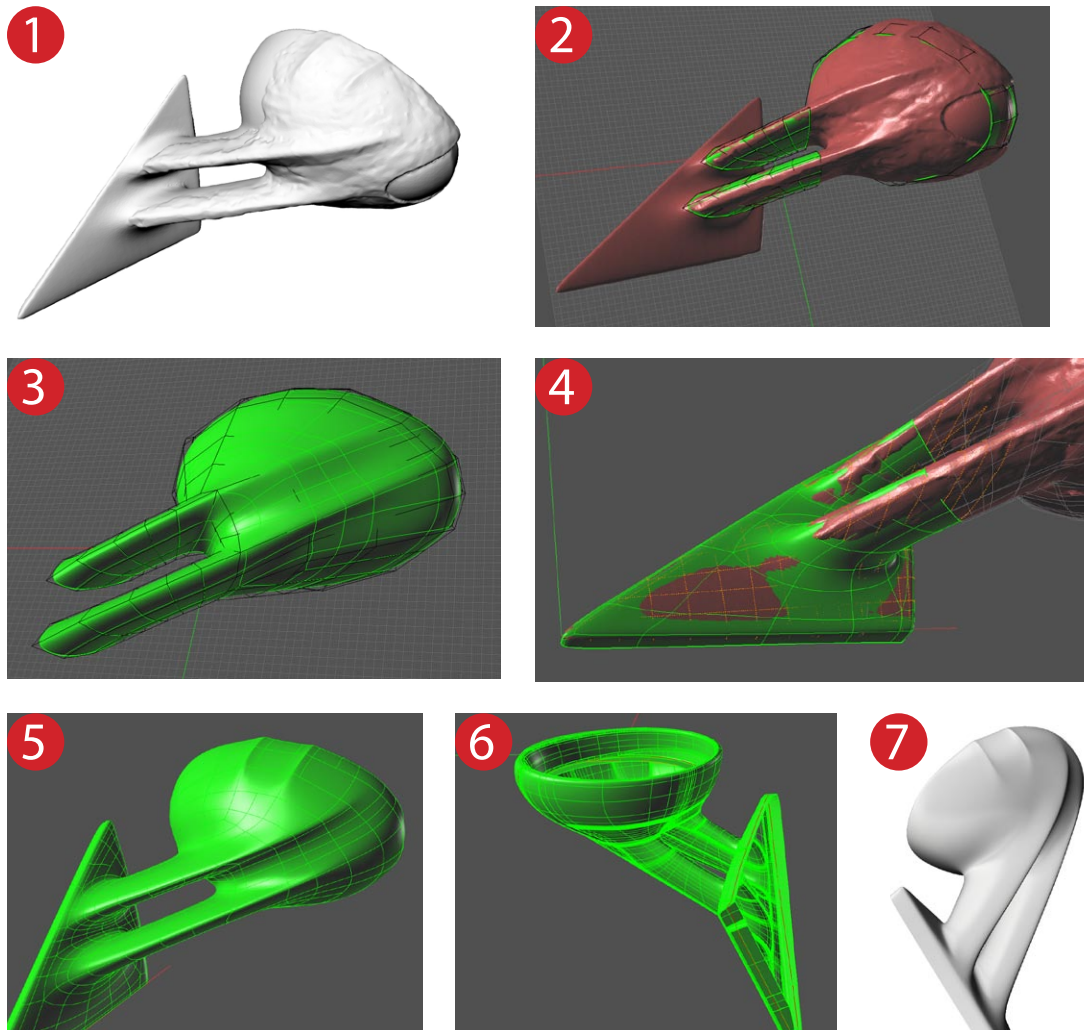
3 - Here is the basic model after the T-Splines surface was generated.

4 - The lower part of mirror was created through the same procedure as above, and was adjusted using the Rhino Point Deviation command.

5 - Both parts of the surface were connected and adjusted to match the .stl mesh. During the adjustment, the surfaces kept their curvature and smoothness. The upper and lower parts of the mirror were then combined to create a single T-Splines surface.

6 - The surface was converted to NURBS. Some additional geometry was created with standard Rhino tools.

7 - The finished model.



A free trial of T-Splines for Rhino can be downloaded at <http://www.tsplines.com>.