



POLYJET BEST PRACTICE

Stratasys J750 Color Selection

SOFTWARE / PRODUCT / FINISHING

Overview

The Stratasys J750 3D Printer™ allows users to print models with full color, including gradients and textures. The placement of colors using PolyJet Studio™ software is different than with its predecessor, Objet Studio™, and the preparation and saving of those files uses different methods. This best practices document provides instructions for color selection with the Stratasys J750 and PolyJet Studio and includes procedures for models designed with SOLIDWORKS, Adobe Photoshop and Rhinoceros software.

1. Options

1.1. Shell-Based File Format

Similar to the Connex workflow, the user can load a shell-based assembly of STL files. With this option the printer operator will need to assign colors, Shore A values and transparencies.

This option also allows the use of Digital ABS™, Digital ABS combined with rubber-like digital materials and other engineering materials, when loaded.

1.2. VRML File Format

When using the VRML file format, the designer chooses colors and color textures. The printer operator has no control over the assigned colors (colors and materials can be changed in PolyJet Studio only with shell-based VRML files). This option enables full-color printing of rigid opaque models. When using a VRML file, the use of clear, flexible or Digital ABS materials is not possible at this time.

There are different ways in which color is designated in a VRML file:

Color Per Object, Mesh or Shell

When designing a model in CAD, each part is assigned with a solid color (usually referred to as diffuse color or material color).

Color Per Face

Each triangle or face of the model has a distinct color. A face can be anything from one triangle in a mesh to as many polygons as selected.

STRATASYS J750 COLOR SELECTION

Color Per Vertex

Each vertex of every triangle has a color value and the color is interpolated across the mesh. The quality of the color is related to the resolution of the model.

Color by Texture / UV Mapping

Texture mapping, also known as UV mapping, is the process of adding an image or graphics to 3D geometry. Color information is stored in a 2D image file, which is related to the coordinates of the mesh. This type of file can show the most detailed color information.

TIP: You can use specialized third-party software, to “unwrap” the 3D mesh into a 2D space. This allows adding color and detail from images that will later be wrapped back into the model.

NOTE: To print a VRML file with texture mapping you will need to put the VRML and the image files in the same folder.

2. PROCESS

2.1. Shell-Based Model File – Assigning Different Colors Per Shell

If the model you wish to print is separated into shells (different parts combined together into one assembly), you can choose the colors, level of transparency and flexibility of each shell. This is similar to the Connex process, with two additions - the ability to choose a specific RGB color with a color picker, and an opacity slider to change the level of a colored part's transparency.

STEP 1: Choosing predefined Digital Materials with color, transparency and Shore A values:

If you know the color, level of transparency and/or Shore A value you wish to choose for each shell, you can choose them from the pre-defined Digital Materials (DM), which are a combination of two or three materials, based on the materials loaded in the printer. In this option, the flexibility and color of each part after printing will be assigned with the selected materials.

STEP 2: Color picker – available only while using shell-based models:

A new option available with the Stratasys J750 is the ability to select a specific color from a color picker, either manually by clicking on any desired area in the color picker box, or by entering a specific RGB value. Each shell in the assembly can be given a certain color, and the printer matches the desired color with the closest color available from the materials loaded in the printer.

All the colors are a combination of red, green and blue (RGB). When choosing a color, you receive 3 numbers that represent the amount of red, green and blue that is used to create the desired color (the range is between 1 and 255).

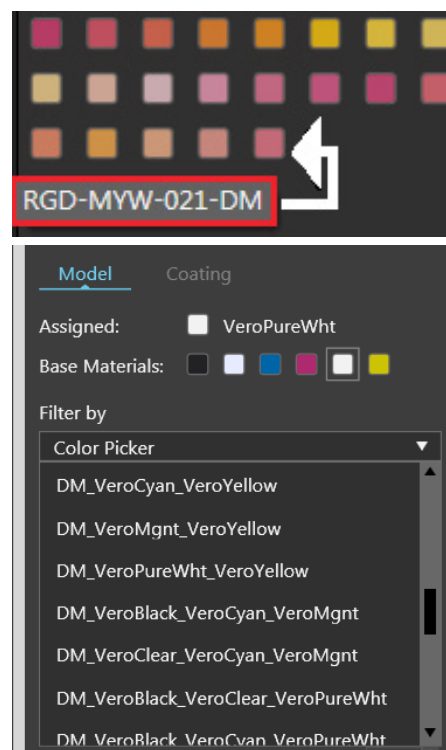


Figure 1: Select the desired DM.

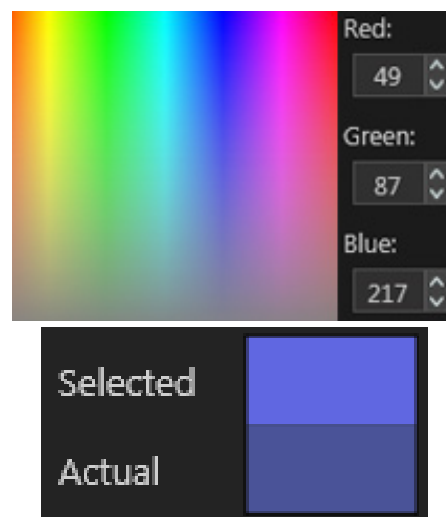


Figure 2: Choosing colors using the color picker.

STRATASYS J750 COLOR SELECTION

NOTE: The difference between the selected and actual color is due to the color limitations of the printer. The actual color is a preview of the closest color available for print.

Before inserting the model into PolyJet Studio, it is recommended to use the Boolean tool function of third-party STL manipulation software, regardless of which method of color choice is used (using color palettes or the color picker). This lets you add, subtract and intersect space within two objects. If the Boolean option is not used, the overlapping parts will be colored with random color selected by PolyJet Studio. This behavior is most relevant when using VeroClear or when printing thin walls or shells of different colors.

Opacity slider – available only while using shell-based models:

Another option available in PolyJet Studio is the ability to choose the level of color transparency, for individual parts and assemblies. For translucent colors, choose the color using the color picker or by specifying the desired RGB. Then change the level of transparency using the opacity slider or by typing the preferred opacity percentage. This slider gives you the ability to go from opaque (100%) all the way to transparent (0%). The model on the tray won't look different, but you can see the change in the **Selected** and **Actual** boxes.

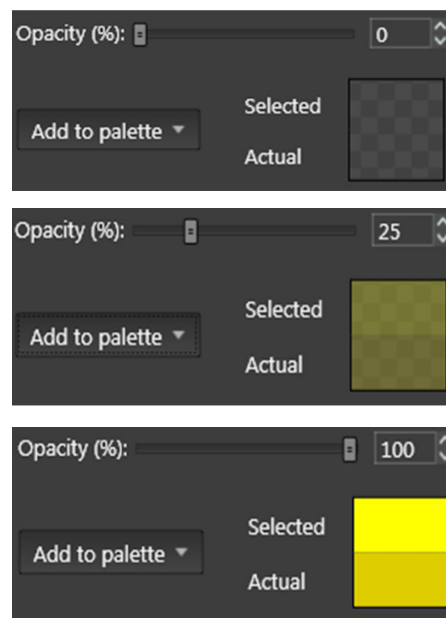


Figure 3: Opacity slider showing different levels from transparent to fully opaque.

2.2. VRML files – Giving Color Textures to the Model

Virtual Reality Modeling Language (VRML) is a standard file format (with the extension .wrl) for representing 3D interactive graphics. It provides the capability to apply colors and texture to a model, enabling it to be 3D printed with those textures.

To design a VRML file, external modeling software is needed. With this software you can either create the model or import it from other CAD software, and then apply the textures and colors before transferring it to PolyJet Studio and sending it to the 3D printer

NOTE: After opening a new tray, make sure the printer is loaded with VeroCyan™, VeroMagenta™, VeroYellow™, VeroBlackPlus™ and Vero PureWhite™, otherwise the VRML insertion button will be disabled.

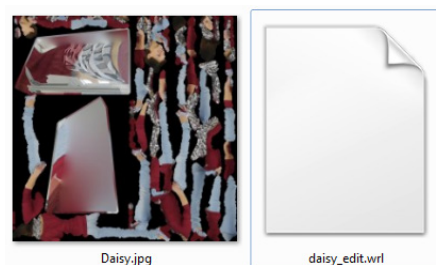


Figure 4: VRML and JPEG (.jpg) files of a model that is ready to print.

2.2.1. Texture Mapped Files -

When designing a texture-mapped model, make sure you have two files: a VRML (.wrl) file and an image file with the texture or images to be included. Make sure all files are in the same folder when importing to PolyJet Studio.

TIP: Image file resolution should be 600 DPI. Lower resolutions reduce print quality and higher resolutions will be lowered to 600 DPI by PolyJet Studio.

TIP: When applying a texture to a model (with any software), a file with the texture is generated. The model geometry is “wrapped” with the texture in a process called UV mapping. For good printing resolution, make sure the UV mapping size matches the model size.



Figure 5: Typical VRML image file.

STRATASYS J750 COLOR SELECTION

NOTE: The image file formats supported by PolyJet Studio are BITMAP, JPEG, TIFF and PNG. When opening the image file it might look random and disorganized, but that is normal. The process separates all the textures applied to the model into a single flat image.

NOTE: When loading VRML files (VRML 2.0 or 97) into PolyJet Studio there is no option to edit or change the colors. The colors are assigned automatically by the software according to the VRML file.

NOTE: There is no ability to print VRML files using transparent, rubber-like material or simulated engineering materials, such as Rigur™, High-Temperature or Digital ABS.

2.2.2. Color Per Object, Face and Vertex –

When designing a model with colors (not textures) and saving the colors per object, face or vertex, all the data regarding the color is stored in the .wrl file. There is no need for an additional image file.

2.3. Color Profiles

Before sending models to print, there is an option to change their color profile. This profile can be applied to all shell-based models, while a different profile can be applied to all VRML models. There are four different color profiles and they can be changed from the **Tray Materials** window.

- Natural Texture (default): a realistic rendering of VRML models. It is also the profile of choice for thin models.
- Vivid Texture: a richer and more detailed rendering of dark colors. Red, green and blue colors are similar in hue to those seen on a monitor.
- Crimson Shells: similar to the default, except that red colors are more similar in hue to those seen on a monitor.
- Natural Shells (default): a realistic rendering of thick shell-based models. Out-of-gamut colors are mapped to the closest printable color.

3. DESIGNING MODELS AND APPLYING COLORS IN DIFFERENT SOFTWARE

3.1 SOLIDWORKS supports saving shell-based, colored model designs in VRML format.

When saving an assembly in SOLIDWORKS you can apply different colors to each part of the assembly and save them. In addition, you can apply different colors to different faces of a model and save all of them together.

However, even though it is possible to apply color textures to models, SOLIDWORKS doesn't export them.

To save the model:

STEP 1: From the **File** menu, click **Save As**. The **Save As** dialog box opens.

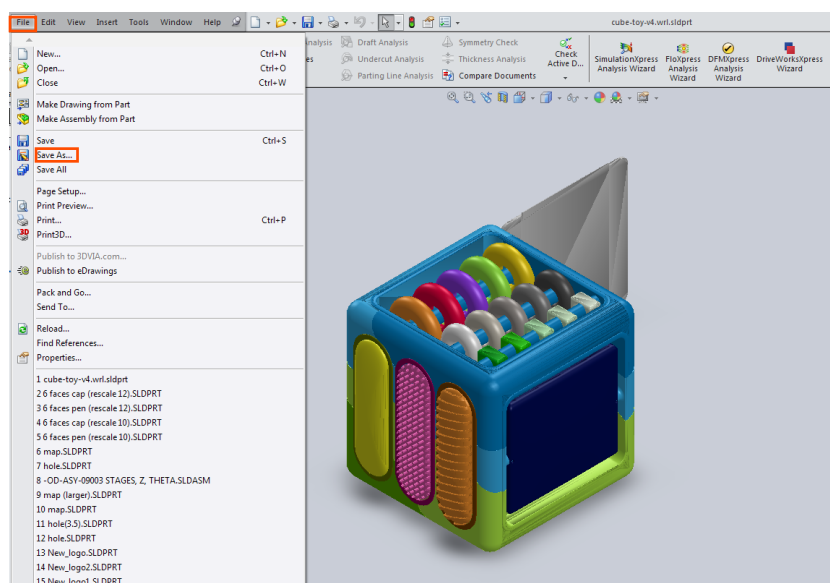


Figure 6: Choose the Save As option from the File tab.

STRATASYS J750 COLOR SELECTION

STEP 2: From the **Save As** drop-down menu, select **VRML (*.wrl)**.

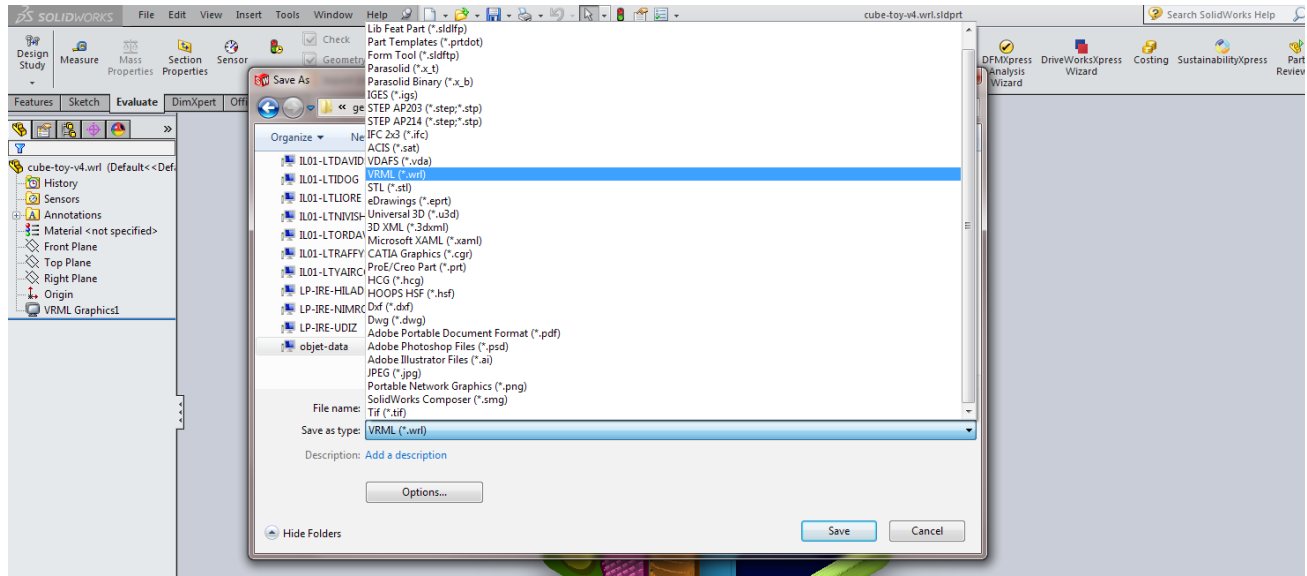


Figure 7: The Save As dialog box in SOLIDWORKS.

STEP 3: Choose the location to save the file.

STEP 4: Click on the **Options** button.

STEP 5: Change the VRML version to **VRML 97**.

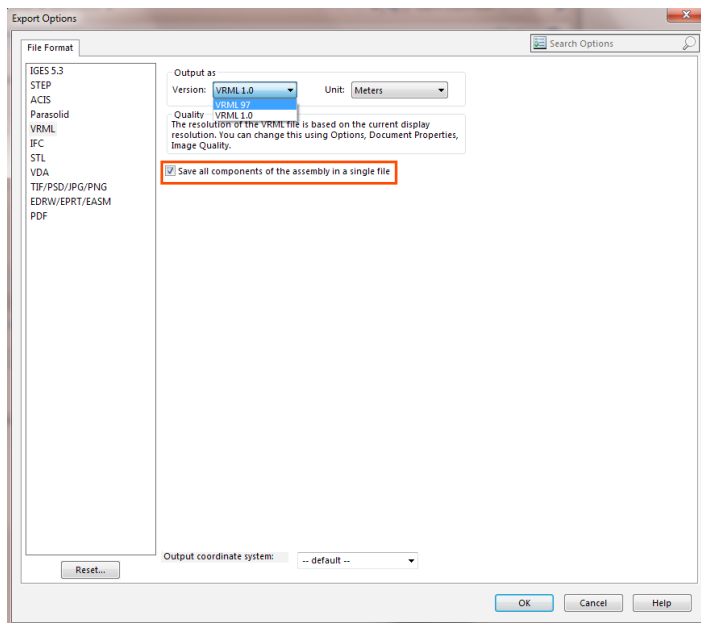


Figure 8: Changing the VRML version.

NOTE: If you create an assembly and apply textures to it, marking the **Save all components of the assembly in a single file** check box will merge all the parts and textures into one VRML file. By not marking this check box, you can save individual parts from the assembly with their color textures.



STRATASYS J750 COLOR SELECTION

STEP 6: Click **OK**.

STEP 7: In the **Save As** dialog box, click **Save**.

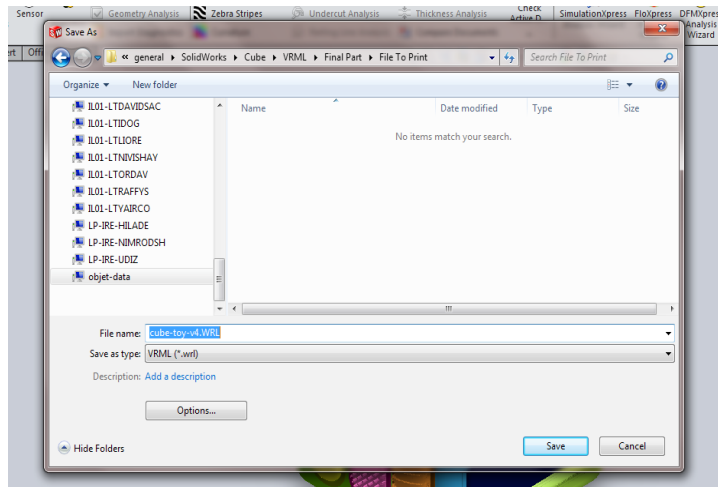


Figure 9: Pressing the Save button to complete the action.

NOTE: The resolution of the mesh in SOLIDWORKS is based on the resolution of the document in which you prepare the part. To change this resolution, go to **Document Properties** and move the slider as marked below.

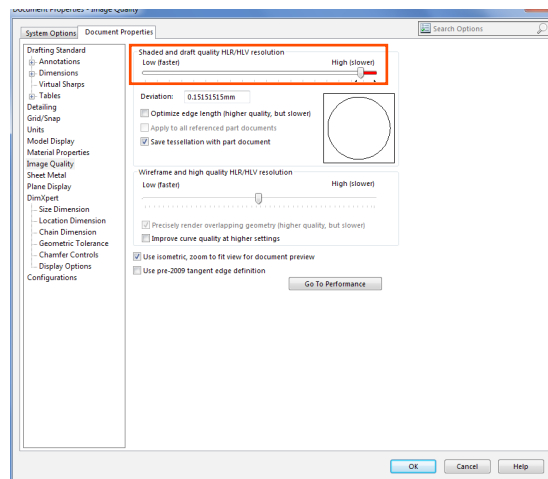


Figure 10: Adjusting the quality of the model.

STRATASYS J750 COLOR SELECTION

3.2. PHOTOSHOP

Adobe Photoshop allows you to apply colors and textures to your model in different ways and export all of them into a VRML file.

STEP 1: From the **3D** menu, click **Export 3D Layer**. The **Export Properties** dialog box opens.

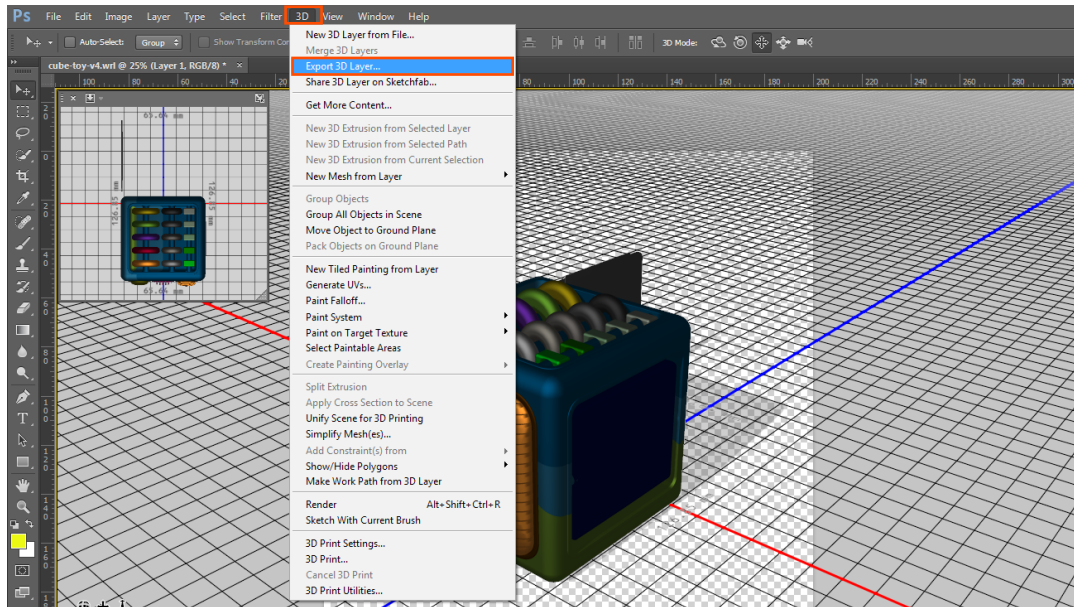


Figure 11: Choose the Export 3D Layer option from the 3D tab.

STEP 2: From the **3D File Format** drop-down menu, select **Virtual Reality Modeling Language - VRML**.

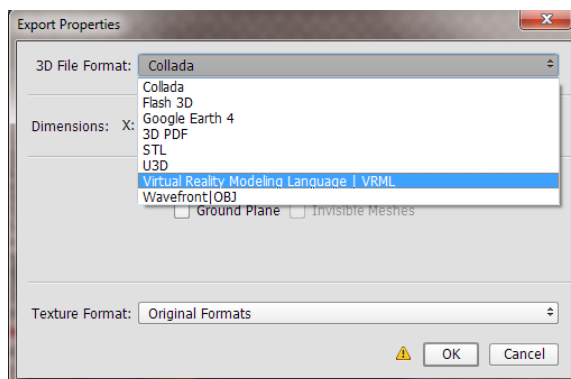


Figure 12: Choosing the VRML file format.



STRATASYS J750 COLOR SELECTION

STEP 3: From the **Texture Format** drop-down menu, select **BMP** (best fit to the VRML format).

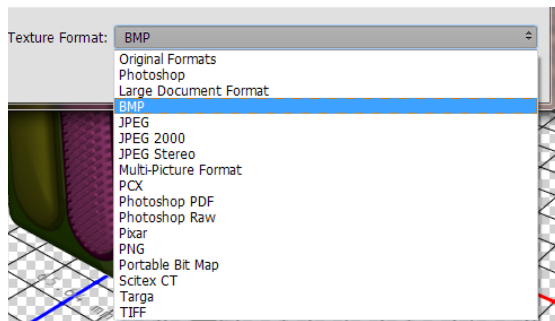


Figure 13: Choose the texture format.

STEP 4: Click **OK**.

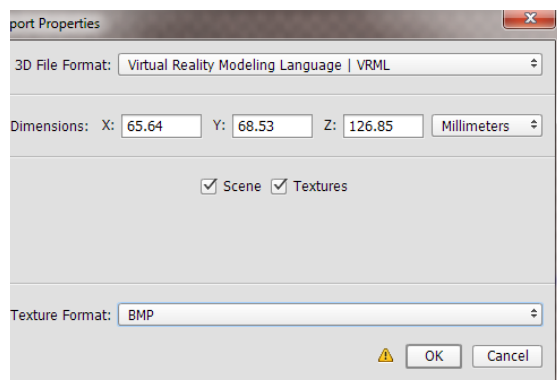


Figure 14: Click the OK button.

STEP 5: Choose the location to save the file.

STEP 6: Click **Save**.

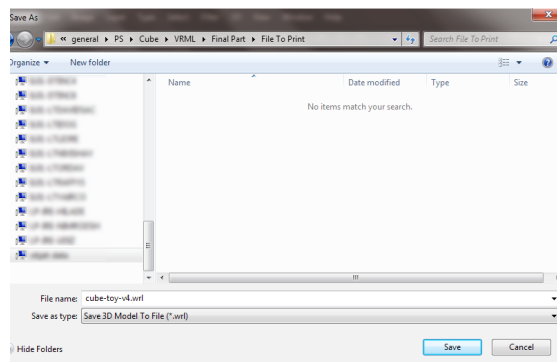


Figure 15: A new Save window opens.

STEP 7: Choose **Windows** file format and **24 Bit**.

STRATASYS J750 COLOR SELECTION

STEP 8: Click **OK**.

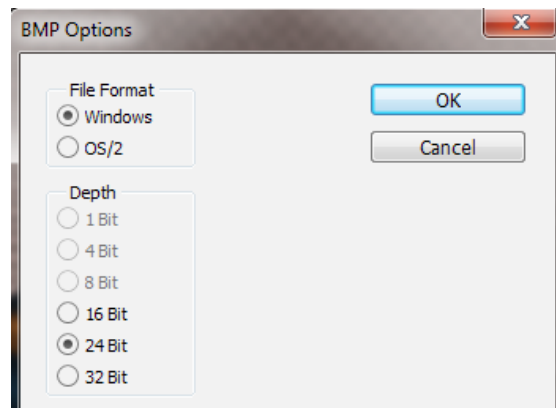


Figure 16: Press OK to save.

If your model is an assembly or if it has multiple textures, you can combine all the parts and color textures into one VRML file using the following steps.

STEP 9: From the **3D** menu, click **Unify Scene for 3D Printing**. This will combine all the parts of the assembly into one mesh.

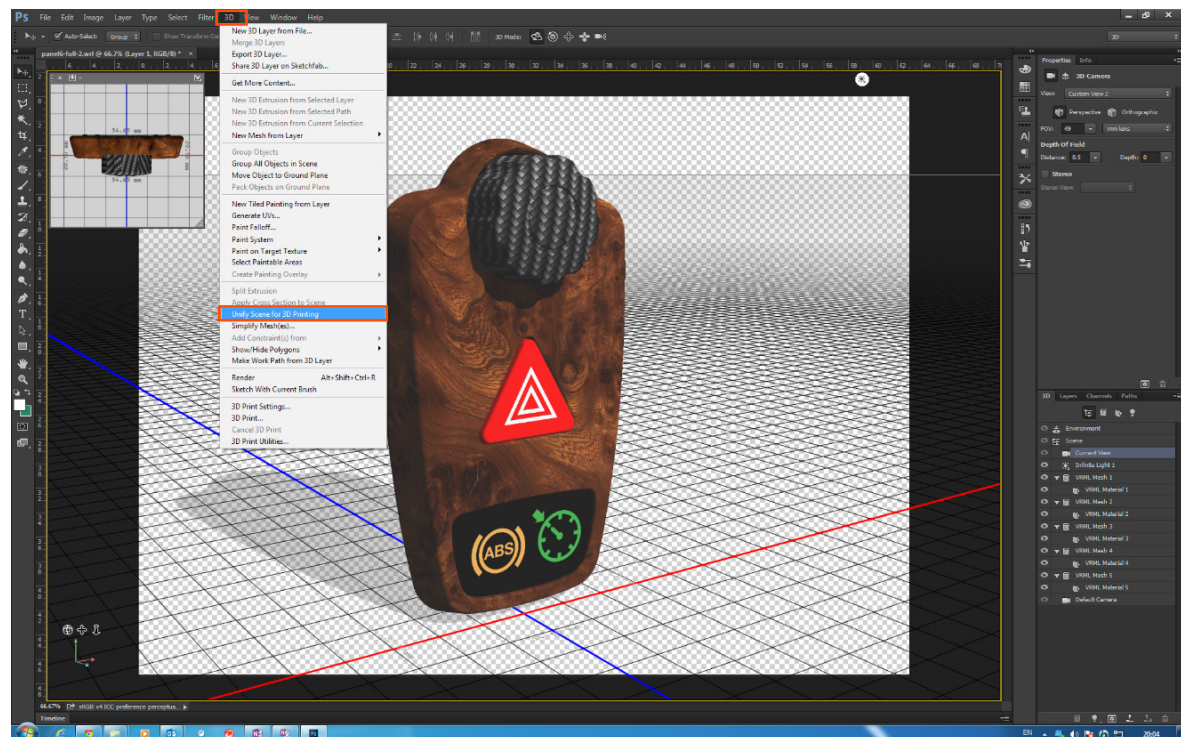


Figure 17: Combining several parts into one mesh.

STRATASYS J750 COLOR SELECTION

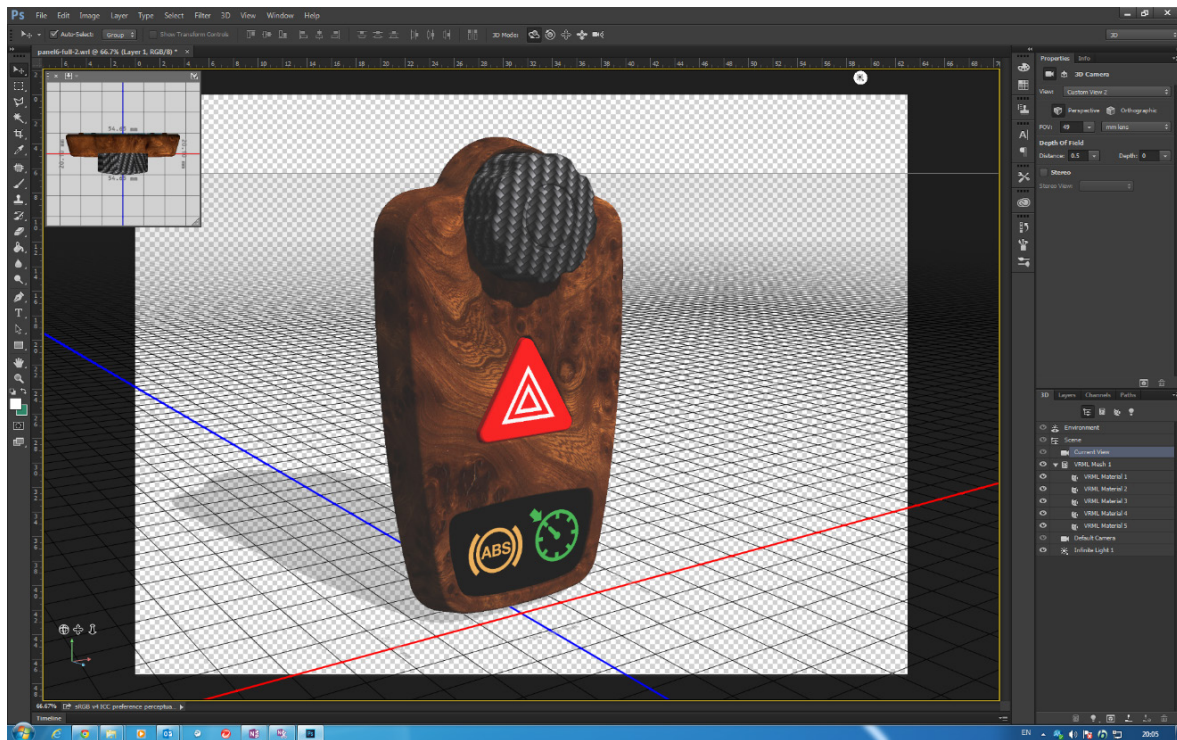


Figure 18: One mesh with several color textures.

STEP 10: From the **3D** menu, click **Generate UVs**. This will combine all the textures into one.

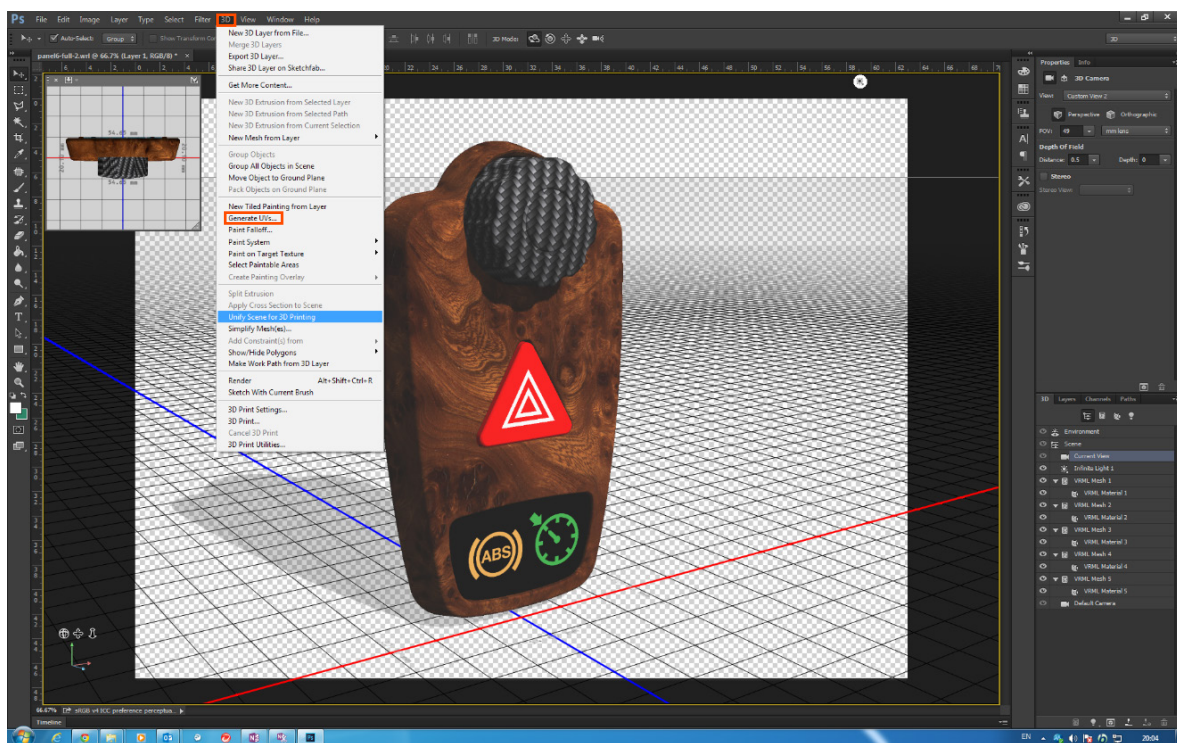


Figure 19: Combining textures.

STRATASYS J750 COLOR SELECTION

STEP 11: In the window that appears on the screen, click **OK**.

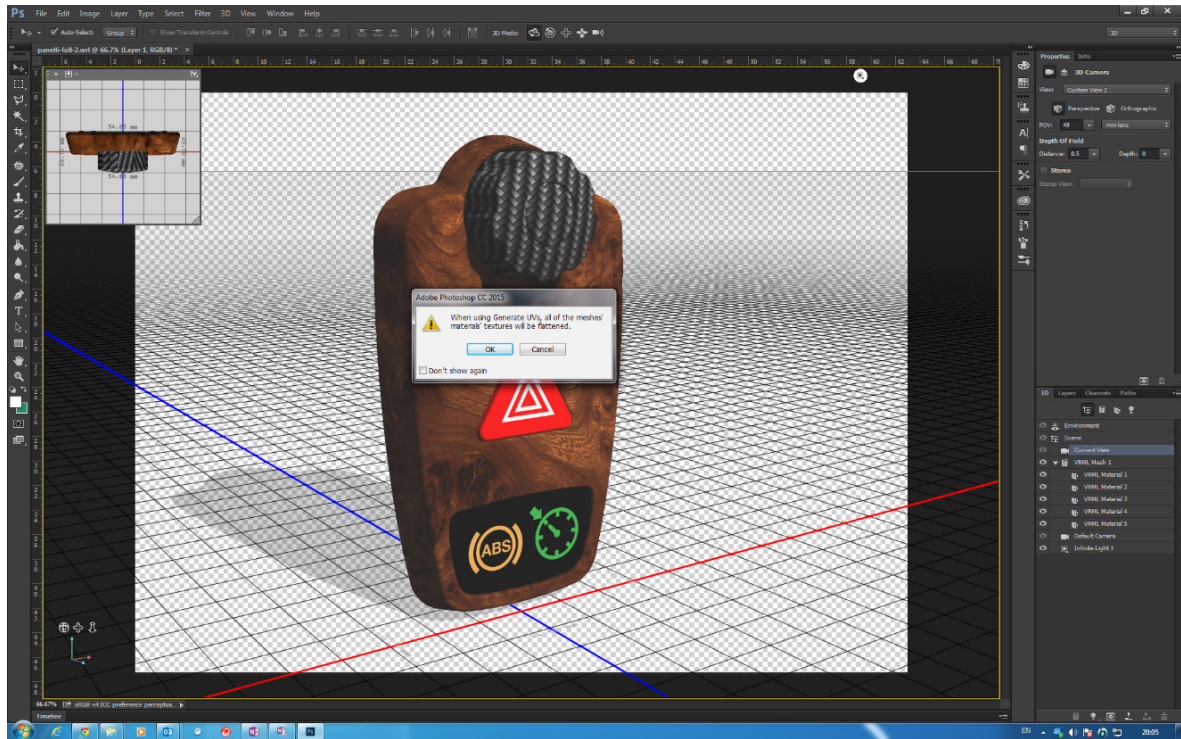


Figure 20: Approve texture combination.

STEP 12: To make the color texture resolution as high as possible, change the value in the drop-down menu to **4096x4096**, then click **OK**.

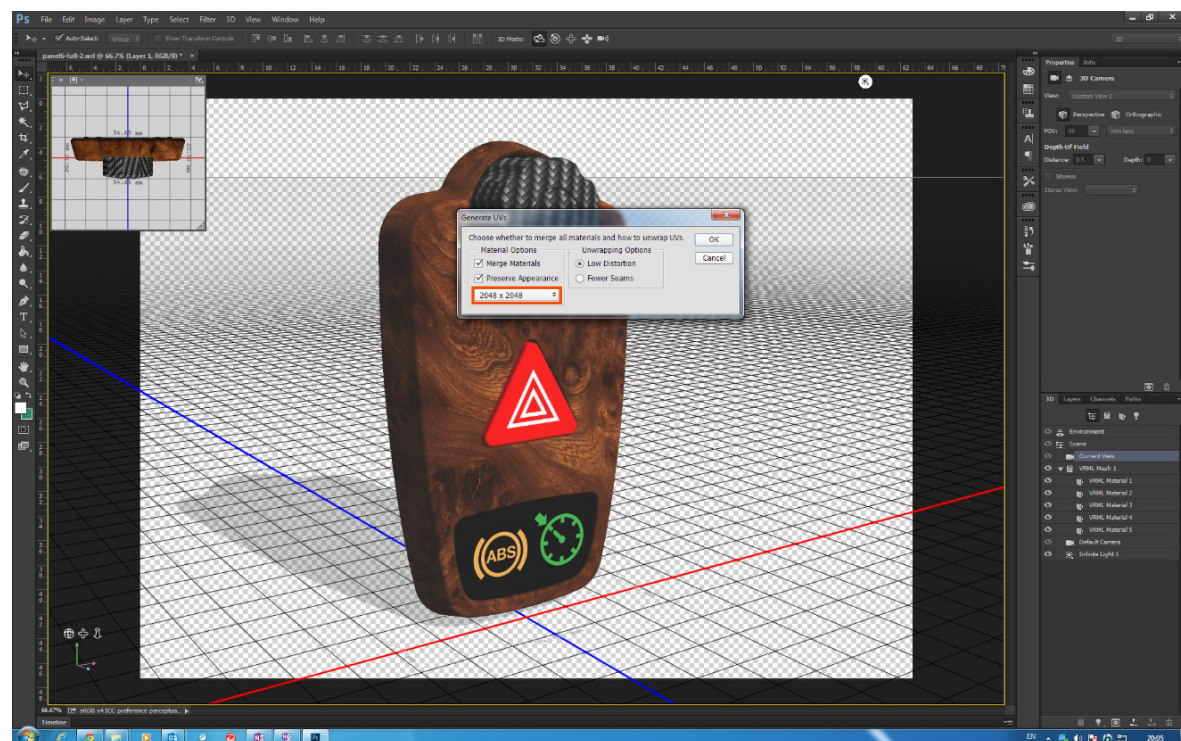


Figure 21: Change color texture resolution.

STRATASYS J750 COLOR SELECTION

3.3. RHINOCEROS

In Rhinoceros 3D, you are able to design models and apply different colors and colored textures. There are two ways of saving a VRML file.

3.3.1. Saving all the parts of the models:

STEP 1: From the **File** tab, click **Save As**. The **Save As** dialog box opens.

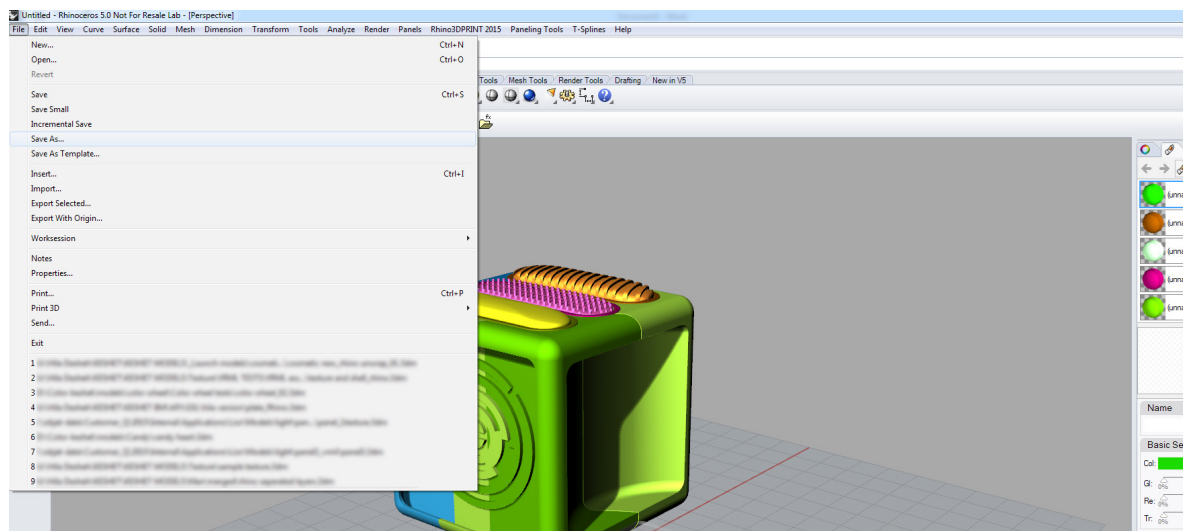


Figure 22: Choose the Save As option from File tab.

STEP 2: From the **Save As** drop-down menu, select **VRML (*.vrl)**.

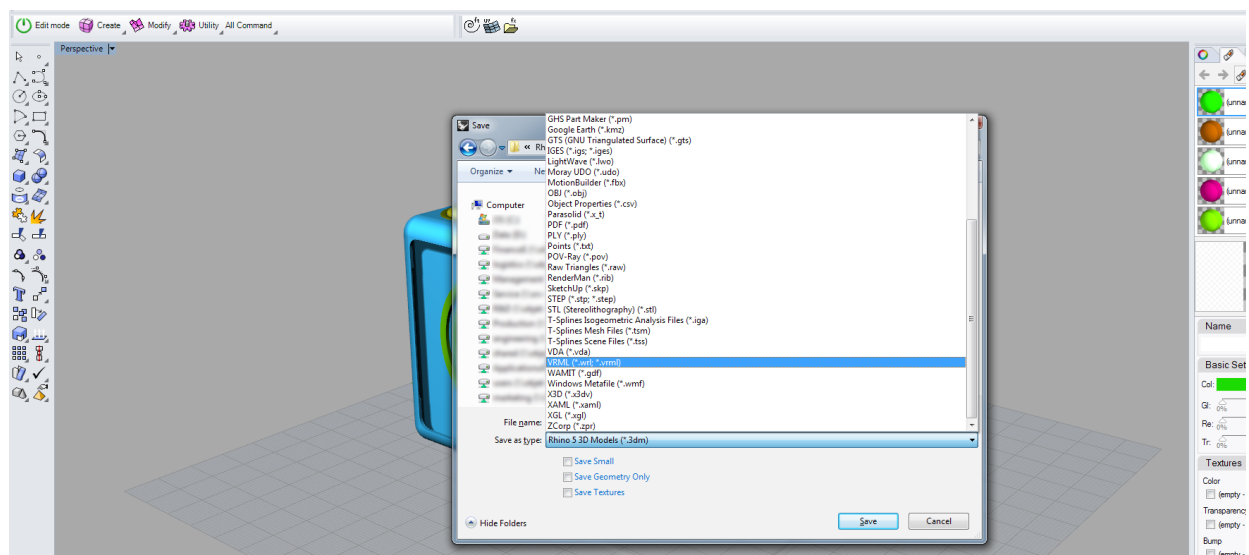


Figure 23: Save As dialog box in Rhinoceros.

STEP 3: Choose the location to save the file.

STRATASYS J750 COLOR SELECTION

STEP 4: In the **Save As** dialog box, click **Save**.

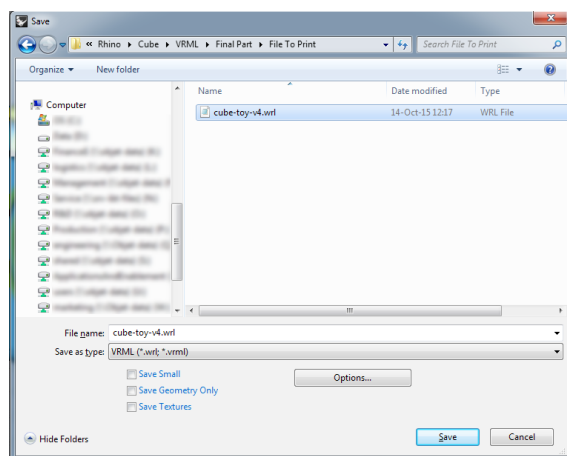


Figure 24: Press the Save button to complete the action.

STEP 5: After pressing the **Save** button, a new window opens.

STEP 6: Verify that version 2.0 is selected and if textures were applied to the model, mark the **Texture Coordinates** as well.

STEP 7: Click **OK**.

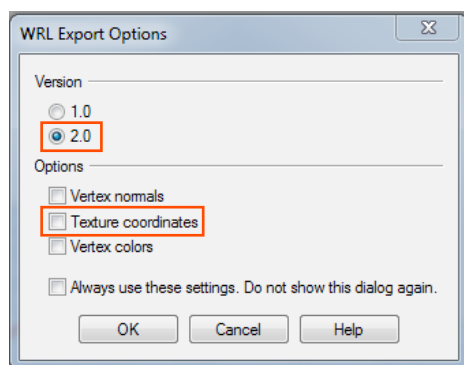


Figure 25: VRML export options.

3.3.2. Saving specific parts from the models:

STEP 1: Select the relevant part you wish to export from the model.

STRATASYS J750 COLOR SELECTION

STEP 2: From the **File** tab, click **Export Selected**.

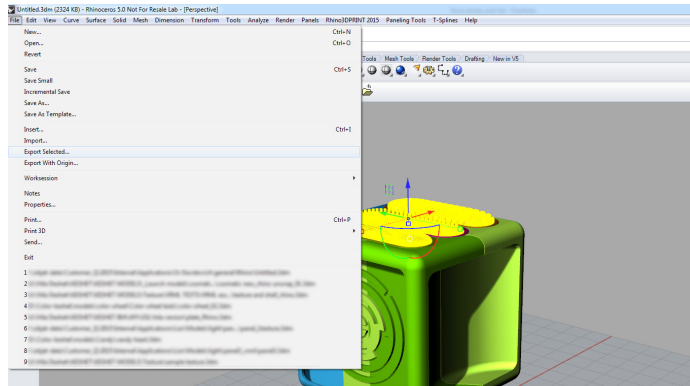


Figure 26: Choose the Export Selected option from the File tab.

STEP 3: Proceed with steps 2-7 from section 3.3.1 above.

NOTE: When saving a VRML file in Rhino, the texture file (image file) is not saved again in the folder with the .wrl file. Make sure when saving a VRML file to save a copy of the texture file in the same folder.

TABLE 1: SUMMARY OF VRML DATA

VRML file extension	.wrl
Version of VRML allowed	VRML 2.0 (VRML97)
Image file formats	BITMAP, JPEG, TIFF and PNG
Number of image files allowed	Single or multiple image files are supported
Printing materials needed to print VRML files	Vero materials – VeroCyan, VeroMagenta, VeroYellow, Vero PureWhite and VeroBlackPlus
Materials not supported in VRML prints	Transparent, rubber-like material and simulated engineering material, such as Rigur, High-Temp or Digital ABS
File resolution	600 DPI
Third party editing software versions tested	SolidWorks 2014 Photoshop 2015.0.1 Rhinoceros 5.0 Magics 20 Blender 2.76b ZBrush 4R7 3D Studio Max 18.0

4. TOOLS & SUPPLIES

4.1. Software:

- PolyJet Studio



STRATASYS J750 COLOR SELECTION

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