

DeskArtes

3Data Expert 14.1

Tutorial 2 - Working with Colors

First Edition

DeskArtes Tutorial: “3Data Expert 14.1: Tutorial 2 - Working with Colors”

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Contact Address

DESKARTES OY

Takomotie 8

FIN-00380 Helsinki

FINLAND

<https://www.deskartes.com>

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Chapter 1 – Foreword

The *3Data Expert 14.1: Tutorial 2 - Working with Colors* document introduces the basic automatic repair, coloring, and texturing functions available with 3Data Expert software for 3D Color Printers. Through this sequence, you will learn how to automatically repair, paint, and texture the *Lamp.wrl* model. In the final step, you will output the model for printing with 3D color printer.

The full tutorial set for 3Data Expert contains several documents which cover different aspects of model repair, coloring and print preparation. The tutorials are available in the software distribution package through the *Help > Tutorial Documents* menu:

- *3Data Expert 14.0: Quick Start Guide* gives a short introduction to model repair and splitting for 3D Printing with all 3Data Expert modules. Estimated completion time 15 minutes.
- *3Data Expert 14.0: Tutorial 1 – Working with 3D Models* introduces basic viewing, measuring, automatic repair, split, connect, hollow, offset, 3D Text, Boolean, cut, reduce, 3D nesting, surface triangulation and other model manipulation functions available for STL files. For 3Data Expert modules. Estimated completion time is 3 hours.
- *3Data Expert 14.1: Tutorial 2 - Working with Colors* introduces basic automatic repair and coloring for 3D Color Printer users. For 3Data Expert Base, Lite and Color modules. Estimated completion time is 1 hour.
- *3Data Expert 14.1: Tutorial 3 – Separating Shells* describes the use of Shell Separation commands in 3Data Expert. These commands enable separating a part into several shells for different material (shore value) or color definitions in a single part. For 3Data Expert Base only. Estimated completion time is 30 minutes.
- *3Data Expert 14.1: Tutorial 4 – Generating Supports for AM* explains the use of the Generic Supports and Sand Supports commands. The support generator can be used to generate supports for DLP, metal, stereolithography and sand-based processes. Adding extra connectors to prevent parts from warping and bending during the build is explained. Also, new slicing, slice preview and slice filling is demonstrated. Estimated completion time 1 hour.
- *3Data Expert 14.0: STL and VRML repair examples* document includes more advanced model repair operations with 3Data Expert. Applies to the 3Data Expert Base module and mostly to 3Data Expert Lite and, Dimensions modules. Estimated completion time with 3Data Expert Base is 2 hours.

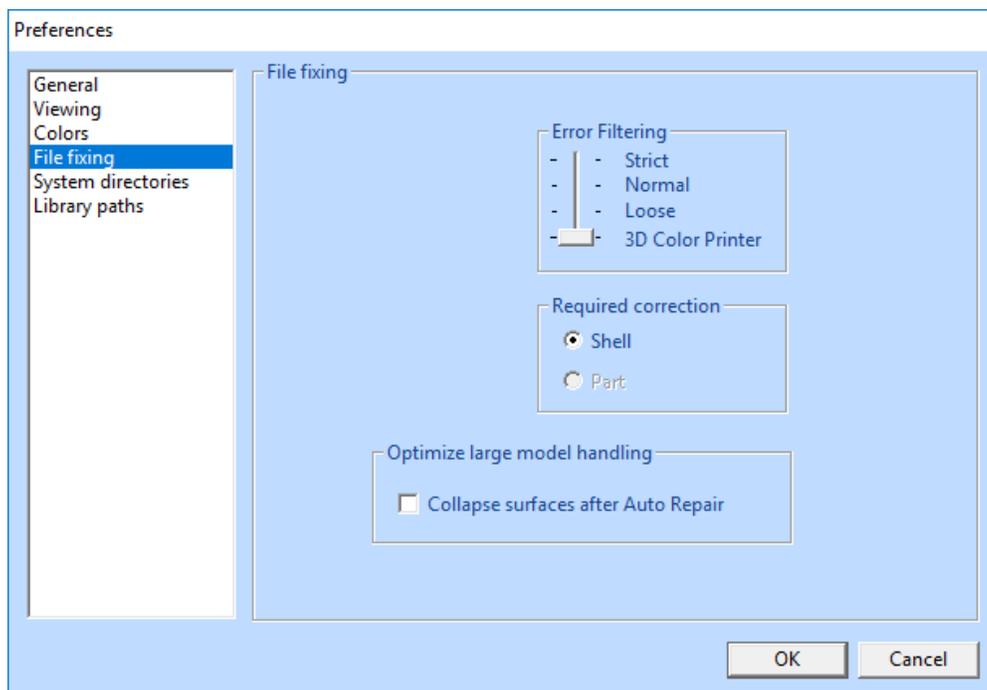
The tutorial documents and the geometry files for the tutorial examples are found in the Tutorials folder and its sub-folders (*GeomFiles, Tutorial 1, Tutorial 2*, etc.) in the 3Data Expert installation directory.

The **boldface** and *italics* used in this tutorial have designated meanings. A **boldfaced command** is a command or operation that alters the model or is otherwise necessary to reach results similar to the example. A statement in *italics* denotes the different parameters and their values; menu commands; mouse clicks; file names; Model Tree items; or any new terms introduced to the reader.

Chapter 2 – Fixing the Lamp model

In this example, you will go through the steps required to fix a simple *Lamp* model. The *Lamp* model is available in VRML format (.wrl) in the 3Data Expert installation directory *Tutorials/GeomFiles*. You will start with a VRML model that has no color or textures attached. After completing model repair, painting, and texturing, you will save and store the model in ZPR or VRML format for 3D color printing.

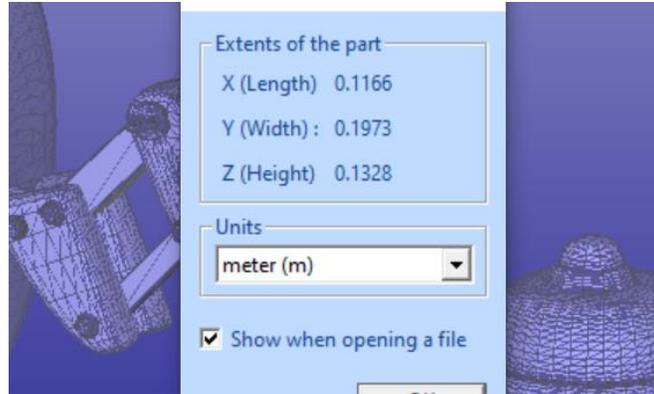
Before inputting the model **make sure that you have set the correct File Fixing settings** for 3D Color Printers. The File Fixing settings are set through the *Edit > Preferences* command, as seen below:



Now you can

- **input the *Lamp* model (*File > Open*)** from the *Lamp.wrl* file.

You should see the following result on your computer screen:



The first 3Data Expert dialog allows you to check and set the units for the inputted part. 3Data Expert uses the following default values for different input file types:

- VRML (.wrl, .wrml) files are in meters.
- STL (.stl) file units are set according to the size of the model, most likely in inches.
- PLY file units are set according to the size of the model, most likely in inches.
- 3DE (.3de) files include the unit information (3DE is a DeskArtes proprietary format that allows you to transfer models easily into other 3Data Expert software, including transfer of real surface data along with faceted triangle data). The compressed variation of the 3DE format (.3dez) packs textures (e.g.) into the same file as the geometry.
- ZPR (.zpr) files include the unit information.

The *Choose units for part* dialog allows you to set the correct unit if the default value is incorrect. The unit will be saved in the 3DE, 3DEZ (or ZPR) file when you save and store the file.

The *Extents of the part* information in the dialog indicates that the *Meters* setting is correct. **Press OK** to continue. The *Operation Mode* window will appear:



Operation Mode

3Data Expert has six main operation modes: *Fix*, *Modify*, *Position*, *Print*, *Color* and *View* mode. The different modes are used for different tasks:

3Data Expert 14.1: Tutorial 2 - Working with Colors

- *Fix* takes you to automatic model verification and repair and contains shortcuts to the main tools used for repair work.
- *Modify* lets you change the model geometry with features which are necessary or useful for production.
- *Position* contains tools which help you optimize the positioning of components on the printing platform.
- *Print* shows tools for preparing a repaired and positioned model for your AM printer, such as creation of support structures and slicing.
- *Color* displays the tools for painting and texturing. These tools check the model for errors and set it to “what you see is what you get” display color mode.
- *View* allows you to examine the model before choosing another Operation Mode.

We strongly advice you to go through the Quick Start Guide first, to get acquainted with the user interface and basic file fixing procedures.

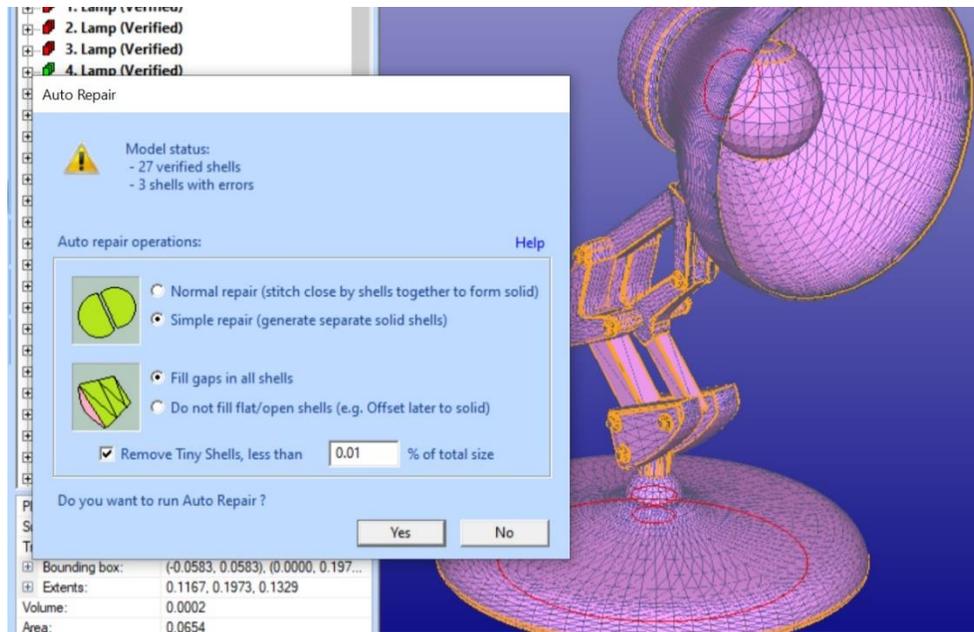
Fixing the Lamp

The normal way to begin repairing a model is to start with the Fix mode. To start fixing

- **press the Fix button** in the Operation Mode dialog now.



3Data Expert will begin automatic model verification (*Fix Model > Verify Shells command*). The screen is erased and a progress toolbar appears. When the analysis is ready, the Auto Repair dialog with *Model status* message box is shown:



The message indicates that there are 27 verified shells, of which three shells contain errors. The display also shows red *Gap curves* through the surfaces. Gaps are an error type you must fix during the repair process. Note that the model is now displayed completely in pink. The pink color indicates that the normals are oriented consistently and correctly outwards.

The model is divided into separate shells during verification. In the case of the Lamp model, the shells include the lamp shade, the bolts, and different joints. The shells are divided into surfaces, and surface borders are shown in orange color in the picture (unless turned off with *View > Show Edge Lines*).

The error shells have red icons, and the correct shells have green icons in the Model Tree. The *Fix Tab* on the *Tools Window* (on the right-hand side) provides shortcuts to the commands available for repair. The *Help text* window at the lower part of the Fix Model Tab also contains information for repair actions.

You are now in the middle of the automatic verification and repair process. 3Data Expert asks if you wish to continue with *Auto Repair*. Auto Repair is the best path to follow when repairing everyday models, so

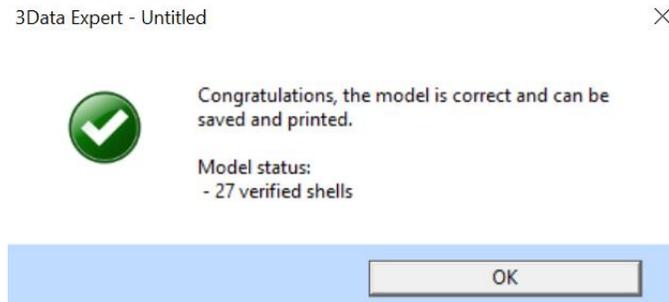
- **press the Yes button** to initiate Auto Repair.

Auto Repair will attempt to fix all shells with errors in the Model Tree.

Auto Repair

When Auto Repair is started each shell is run through the automatic repair command (*Fix Model > Repair Shells* command) using automatically calculated parameters. For each shell, a progress bar shows the progress of the repair (and

this may cause some flickering on the screen when shells with only a few triangles are repaired). You will then receive the following message:



This indicates the model is fully repaired and ready to output for printing. After

- **Press the OK button** to close the message dialog.

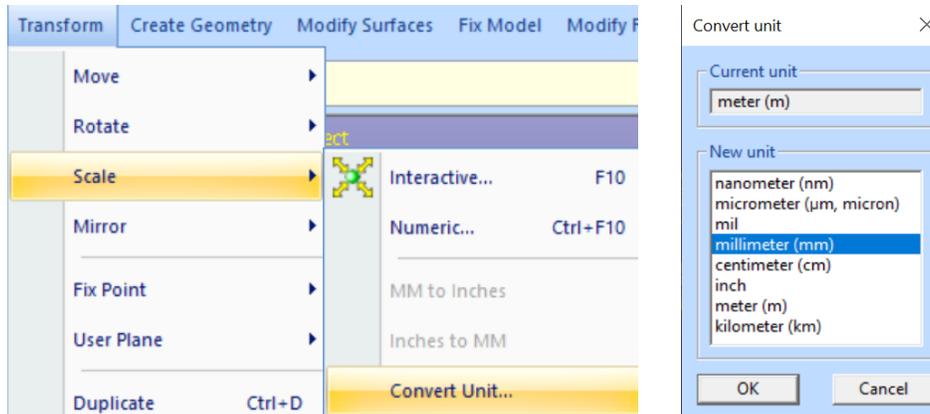
The model is now correct and ready for coloring in *3D Printer Colors* mode. For reference, in *Repair color* mode the model is displayed with colors beneficial to repair work (pink outer surface, red error triangles, etc.) and in the *3D Printer color* mode ("What you see is what you get") the model is displayed as it will look when printed with *3D Printer color* (the *Color Display Mode* can be changed by pressing the  icon).

A *Tip Window* with useful tips on viewing and selection mechanisms may be displayed after Auto Repair. You can just **Close** or **Minimize** the *Tip Window* for later reference during the repair session. You can also permanently turn off these windows when you become more familiar with the use of the repair tools in 3Data Expert through the *Show Command Tips* setting in the dialog. You can restart to show Tip windows through *User Interface > Show Command Tips*.

During Auto Repair, 3Data Expert attempts to fill all gaps and remove non-manifold triangles (overlapping triangles, multi-edge triangles, duplicate triangles, triangles having less than three neighbors, etc.) from the model (to see more about triangle errors, please access the "Triangle errors" page in the Online Help chapter "Handling Faceted Files"). Also, duplicate and overlapping surfaces are analyzed and connected in optimal way into correct shells. The Lamp model only has simple errors, like inverted triangles and gaps, which are all fully repaired during the Auto Repair process. You can now continue painting and texturing the model.

Changing the units

When the Lamp model was read in, its units were meters. However, the workspace defined is typically defined in other units, mostly as millimeters. Therefore, we must convert the model to the workspace units. From the menu, select *Transform > Scale > Convert Unit*, then choose the new unit (same as the workspace unit) from the list:



For more information about the workspace, see the Quick Start Guide and the 3Data Expert Help.

Chapter 3 – Coloring the Lamp model

You should now have the fully repaired Lamp available (if not you can input the *Lamp-repaired.zpr* file from the *Tutorials/Tutorial 2 – Working with Colors* directory in the 3Data Expert installation). To start coloring the model you will use the tools in the *Paint and Texture mode*. Paint and Texture mode is activated by opening the *Color Tab* in the Tools Window.

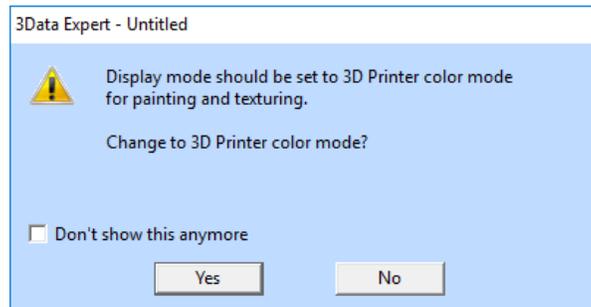
- **Press the Color Tab** now (green circle below). This will switch from the Fix Tab to the Color tab, with the shortcuts to the tools for painting and texturing:



The lowermost window provides Help text on different operations, including Painting, Texturing, and Edge line editing. You can always refer to the Help text to find the correct operation and mouse/keyboard sequences (please see the image that follows).

The Model Tree Window closes because it is not required for model coloring (you can hide/show the Model Tree with the *F8* key at any time, the Tools Window with Shift+F8 key).

If the *Repair color* mode was previously set, the color mode should be set to *3D Printer* color mode now (you should **press the Yes button** if the dialog below appears):



Selecting shells, surfaces, and triangles

During model coloring, you will select target objects (whole model, individual shells or surfaces, and triangles) to color from the display area. The selection is done with the *left mouse button (LMB)*, and the selection target is controlled by the *Selection mode* buttons in the Color Tab:



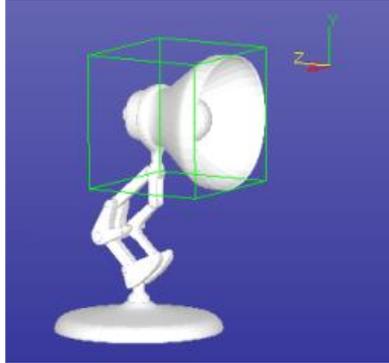
The four *Selection mode* buttons refer to selecting the whole model, one shell, one surface, or one triangle. Now try to select a shell from the display area, such as the Lamp cover. The *Selection mode* is on *Shell selection* by default but if not

- **press the**



Button (second from left) to turn on the Shell selection. Then

- **click with the LMB on the Lamp shade:**



You have now selected the lamp shade, which is a separate shell (if you do not see the green selection box make sure that the show bounding box is turned on with the  icon).

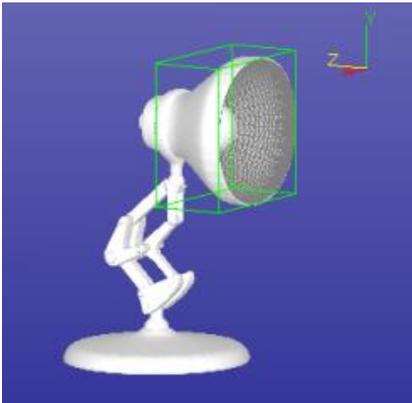
Now try to select a surface in the lamp shade shell. **First**

- **press the**

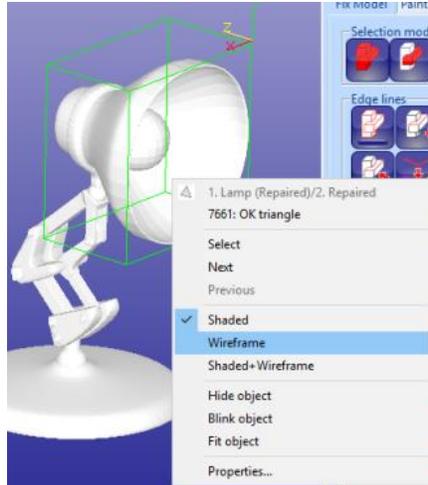


button (third from left) to turn on the *Surface selection* mode. Then

- **select the inner surface** from the Lamp cover **by clicking with the LMB:**



The inner surface of the shade is selected in the image above. Its display style can be changed to wireframe mode for clearer visibility of the selection with the RMB menu on the object



Now

- **press the part selection**



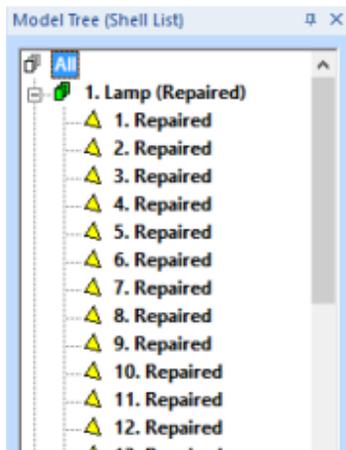
button (the leftmost one) to select the full part and then press the shaded icon with the *LMB* to restore shaded color to the whole model.



You can now

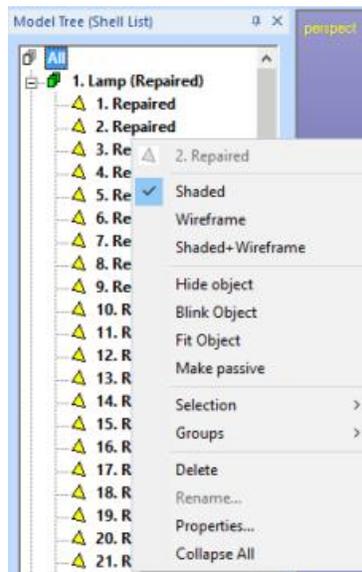
- **press the *F8* key** to display the Model Tree Window again.

All previous selections (whole model, shell, and surface) have a corresponding node in the Model Tree. The Model Tree root *All* should be selected in this instance (i.e., the whole model):



The Model Tree contains the full breakdown of the repaired Lamp model: whole model (*All*), shells (*1. Lamp (Repaired)*, *2. Lamp (Repaired)*, etc.) and surfaces making a shell (*1. Repaired*, *2. Repaired*, etc.). You can select objects freely in

the Model Tree with the *left mouse button (LMB)*, you can open/close shell nodes by pressing the +/- icons and you can use the *RMB* menu to display, hide, and investigate objects in the Model Tree:



Now retry the different graphical *Selection modes* (shell, surface, and part) and see how the selection changes in the Model Tree when corresponding objects are selected from the display area. For example, when hiding shells in the Model Tree they disappear from the display area and their icon turns gray.

- **Press *F8* to close the Model Tree** when finished and
- **turn the *Part selection mode* on** to select the full part again.

Painting the Lamp

Now you know how to select objects for painting. Your next task is to add new colors and textures to the Lamp. You will start by giving a light-blue coloring (cyan) to the Lamp frame.

- **Turn the *Part selection mode* on** first and
- **set the light-blue color as the *Foreground color*** (click with *RMB* on the circled *Foreground color* button and select the color from the standard Windows color palette):



Then

- **press the *Paint***



button on the Paint & Texture Tab to color the whole part with the light-blue color (shown in the left-hand image below). The whole model should be light blue now.

Now

- **turn on the *Shell selection mode*** and
- set the **green *Foreground*** color:

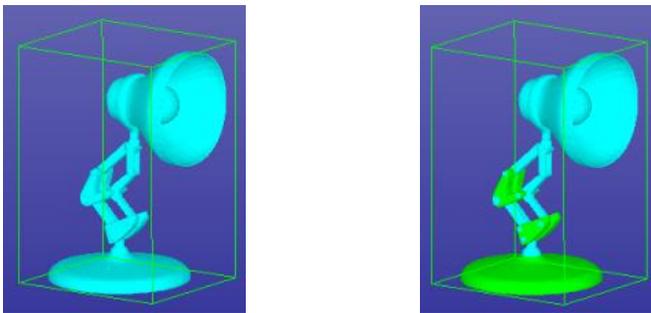


- **Press the Paint button** in the Paint & Texture Tab again and
- **select** the joints in the steel frame and the base **with the *LMB***.

Every time you select a shell, it is painted with green color. When ready

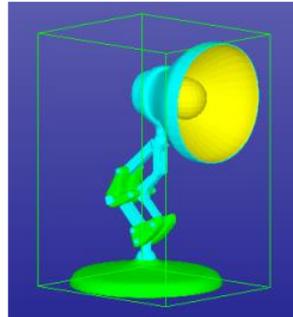
- **press the *RMB*** on the display area to finish the Paint command for shells.

If you selected the wrong shell, you can **press the *ESC* key** to undo the last shell painting. Your lamp should now have the following appearance (right-hand image):



Now also

- **turn on the *Surface selection mode*** to set the color for the inner side of the cover
- set the **yellow *Foreground*** color:
- **paint the light bulb and the inner cover surface yellow**



Now, to provide the final touch, paint a few triangles red in the bulb.

- Turn the **Triangle selection** mode on and select the **red Foreground color**.



Then

- Press the **Paint** command



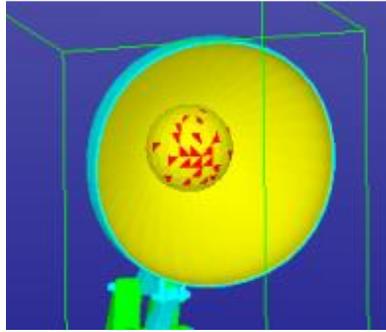
button and

- select individual triangles from the screen with the **LMB**.

Each triangle immediately changes to red. If the wrong triangle is selected, **press the ESC key** to undo triangle painting. When you are

- ready **press the RMB** to accept and finish painting triangles.
- try also **dragging a line** while keeping the **LMB** down, this will "paint" triangles below the line drawn when LMB is released

The result should look similar to the result on the image that follows.



Editing edge lines

During model verification and repair, shells are divided into surfaces. Sometimes these surfaces are insufficient for correct coloring or texturing of the model. In a case such as this, use the *Edge lines* commands to show, add, delete, and sketch new edge lines on shells. The main purpose for editing edge lines is to define new surface areas on the model for accurate texturing and painting.

To see the surface edges, you must

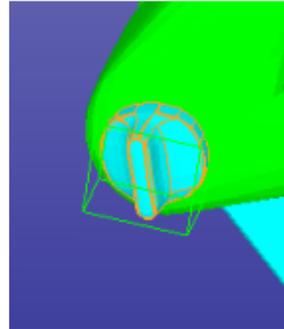
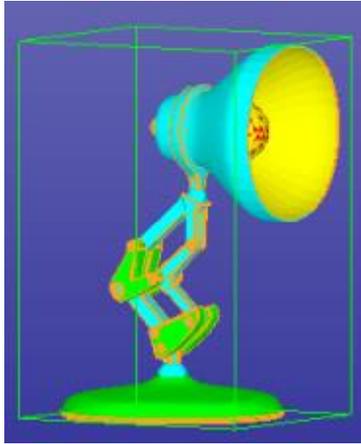
- **turn on *Show edge lines*** in the *Edge lines* group:



The edge lines are always displayed for the selected object (i.e., the whole model, shell, or surface). Now try to

- **select the whole model** (*Part selection* mode) and then
- **a small knob shell** (*Shell selection* mode) in the frame.

The *orange edge lines* appear according to the selection (see the image that follows).



Any edge line editing command (add, remove, split, or merge) operates on a *single shell* until you end the command with a *RMB* click. The shell to operate is set when you pick the first edge from the displayed shells. After completing an Edge line command and before starting a new command, you need to select the shell to operate again (this can be the same shell as the previous shell).

Now imagine you want a red area on the small knob (seen on the right-hand image above).

- **Select the shell** (if not already selected) and

- **Fit it on the display area** by pressing the  icon with the *LMB*.

It also may be a good idea to show the model in Shaded and wireframe mode by

- **pressing the Shaded+wireframe**  icon

to see the individual triangles more clearly.

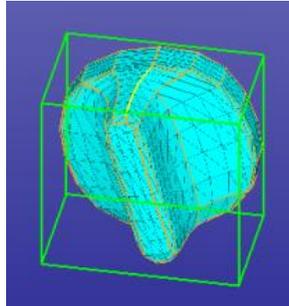
You can first investigate the length of the different surface edge lines with the *Pick edge line* command.

- **Press the Pick edge line**



button and then

- **pick the orange edge lines** displayed on the image below:



The picked edge lines are shown in yellow. Practice picking different edge lines and you will see that edge lines always (after Auto Repair) end at an intersection where more than two edge lines meet.

- When ready **press the RMB to quit** the edge-line picking.

Any set of connected edge lines with no internal edges define a surface in the shell. The edge lines can be separate (i.e., not merged) but must have common end points to close the loop defining a surface area.

Now you are ready to delete a few edge lines.

- Give the Delete edge lines command by **pressing the Delete edge**



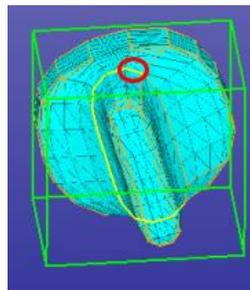
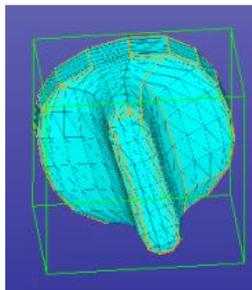
lines button

- **Pick the edge lines with the LMB** on the narrow side of the knob.

They are immediately deleted (do similar deletions on the other side of the shell).

- **Press the RMB when ready** or the **ESC key to cancel** an unintended deletion.

The result should look like the left-hand image below:



After deleting the necessary edges, you can

- **add new edges by pressing the Add edge line**  **button** and then

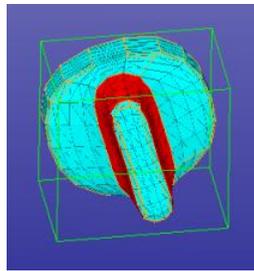
- **carefully picking triangle edges that provide the correct starting direction for the added edge.**

When a triangle edge is picked the edge line is extended until another edge line is crossed, following the most probable sequence of triangle edges. For example, you can create the correct edge line (yellow when picked) shown on the right-hand image by single picking on the triangle edge circled in red. When ready to pick new edges

- **press the *RMB* to accept the new edges** or the ***ESC* key to cancel** one edge at a time.

When the *RMB* is pressed, new surfaces are created (also in the Model Tree).

After creating a new surface, you can paint or texture it as a single entity. In the image below the new surface is painted with red:



You can now

- **turn off the *Show Edge lines*** and
- **turn on the *Shaded display mode***



Texturing with chessboard bitmap

Texturing allows you to add images in different formats (.bmp, .gif, .jpg, .pcx, .png, .ras, .pic, .tga, and .tif) on top of faceted models. For example, you can use a cloth texture to make a garment look more realistic or you can add a text annotation to provide information on the required manufacturing tolerances.

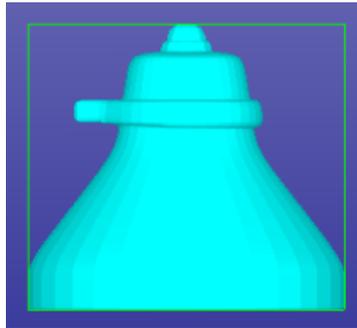
The texturing commands are accessed through the *Painting and annotating group* in the Color Tab:



Now you will add three textures to the Lamp model: a cylindrical chessboard texture around the lamp cover, an engineering template on the bottom of the part, and a drawn circle on the model.

To add the chessboard texture first

- **select the Lamp cover** from the screen in the Shell selection mode,
- fit it in the display area () , and **view it from the X axis direction** (press  icon):



Begin texture addition by

- **pressing the Add texture**



button which generates a *File Open* window so you can browse for the texture image file. The texture open dialog includes a preview window for the image files on the right-hand side of the window. This helps you to select the correct image for the texturing command easily.

Now you will

- select the *chessboard.bmp* in the *Tutorial/Tutorial 2 – Working with Colors* directory.
- **Press OK to input the image.**

Soon you will see the Lamp and the image in front of the lamp on the display area. The image may appear smaller or bigger than in the image below when compared to the lamp, we will soon scale it to correct size.



In this case, you want to generate a cylindrical projection around the cylindrical lamp cover.

- **First, you will scale the chessboard image to the correct size on top of the cover.**

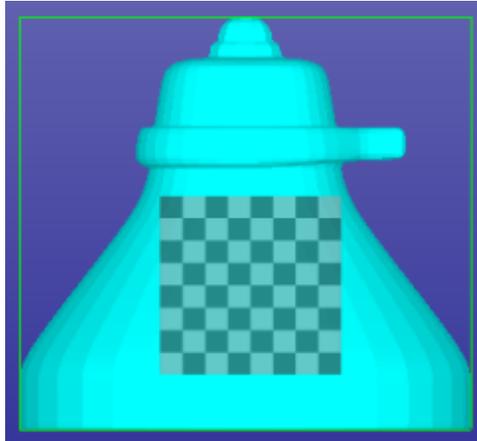
Immediately after inputting the image, the Help text window displays detailed information on how to zoom, pan, and rotate the image and the model.

Image transformations are performed by the following commands using the **left mouse button (LMB)**:

- Move image: *left mouse button (LMB)*
- Scale image: *Ctrl+LMB*
- Rotate image: *Ctrl+Shift+LMB*
- You can also use Arrow keys (with the same modifiers)

You can rotate, pan, or zoom the model with the same modifiers **using the middle mouse button (MMB)**.

Using the above commands to position the image on top of the model as shown in the image below:



In this case, you want to position the image only on the outer surface of the Lamp cover. First,

- **turn on the Surface selection mode**



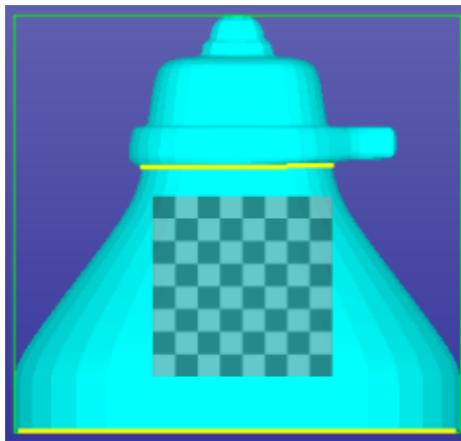
and then proceed to selecting the correct surface after

- **pressing the select target**



button in the Paint & Texture Tab. Then

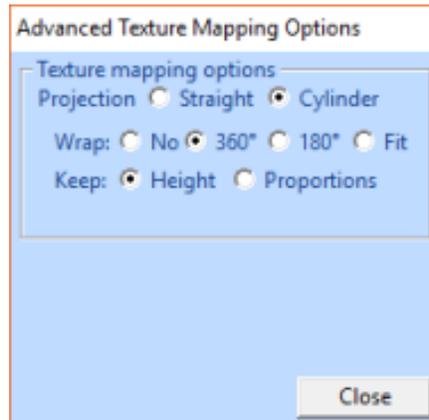
- **click on the cover with the *LMB*** to select the outer surface for the texturing operation (the surface edge lines are highlighted in yellow)



You can select any number of surfaces or shells for texturing but here you will work with the single selected cylindrical surface. If you select the wrong surfaces, **press the *ESC* key to cancel the last selection.**

You want to generate a cylindrical texturing for this model using *Advanced options* in the Painting and annotating group.

- **Press Advanced options** and fill in the parameters below:



Now

- **press the *Preview***

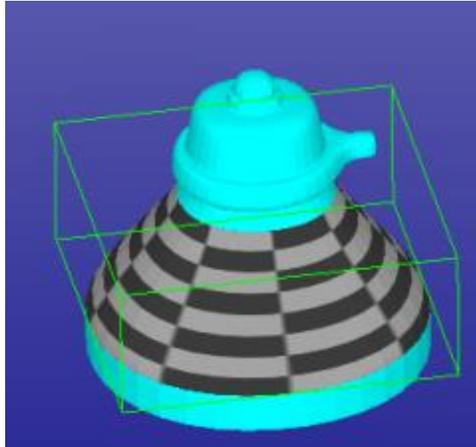


button (or *RMB*) to see how the textures fit on the model. If you are not satisfied with the preview results, you can **press the *ESC* key to cancel** the previous operations one by one. If you are satisfied,

- **press the *Accept texturing***



button (or *RMB* again) to see the final texturing on the model. After selecting the textures surface, the final texturing for the cover should look like the example below:



After clicking the *RMB* button, a larger selection box displays because the whole model is selected, although not yet displayed, after accepting a texture.

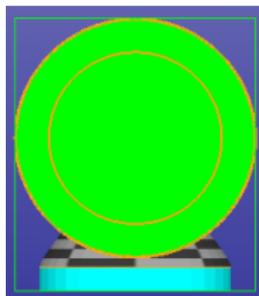
Adding an engineering template

Applying an *Engineering template* (and *Text*) represents a special case of the normal image texture operation described above. With normal texture addition, the texture image is read from the image file. With an engineering template, the image is first generated with the HTML editor that is built into the software.

- **Start by taking a view from the Lamp model bottom** (-Y axis direction, with



icon, make sure the *Show Edge lines* is turned on):



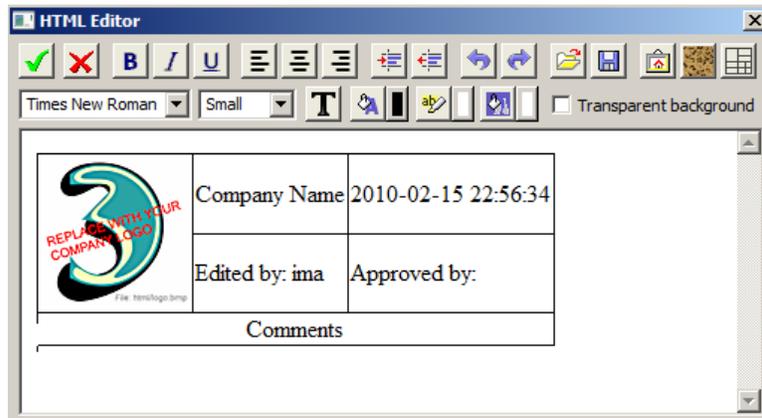
Then

- **press the Apply Engineering template**



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button. This opens the HTML Editor for inputting text into predefined fields in the template:



When done editing the text

press the OK  **icon.**

Now you will see a texture image in front of the model as you did with the previous exercise using the chessboard image.

- Use the **pan, rotate and zoom** commands (see Help Text) to position the texture correctly on top of the model, as shown below:

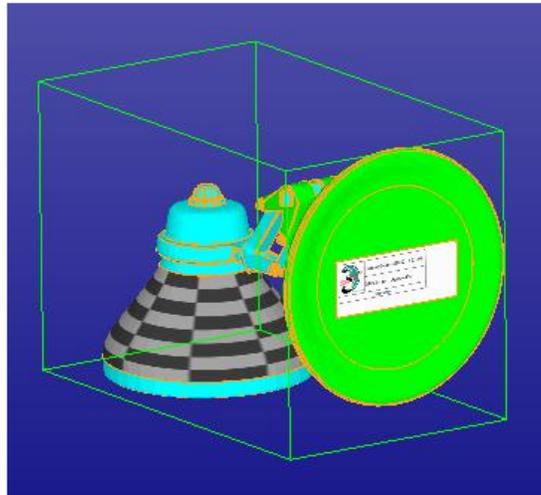


- **Pick the surface to add the texture** (in *Surface selection mode*):



After

- **pressing the *Preview* and *Accept* buttons**, you should see the following result on the screen when all is displayed:



User-defined engineering templates in HTML format provide ultimate flexibility and can be loaded by pressing the Open  in the HTML editor. You can also generate a basic table template by pressing the Insert Table .

Draw circle on surface

Drawing a circle (or arrow) on a surface is once again a special case of the normal texture addition (see the chessboard example). To apply a circle the circle (arrow) is first drawn on the model. When ready the normal image texture commands apply to the positioning, surface picking, previewing, and completion of adding the texture on the part.

Now you will add a circle on the back side of the Lamp cover. **First,**

- **take a view from the Z axis direction** ( icon and *LMB*, *Show Edge lines* turned off):



Then

- **set the *Selection mode* and *Foreground color* as shown** in the image below:



Now

- **press the *Apply Circle***

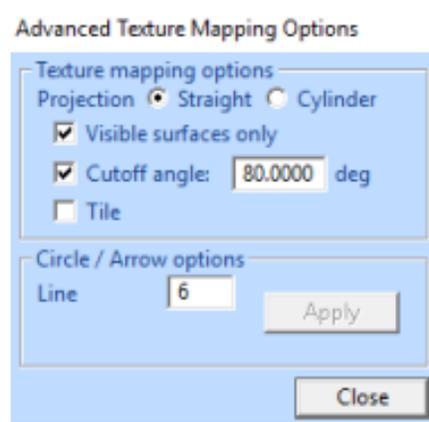


button. You can now

- draw the circle on the back side of the cover and position it in the middle near the top by dragging with the *LMB*:



You do not need to place the circle in the exact location immediately; only the size and the thickness matter at this stage. You can change the *Line width* through the Advanced options if it is not correct already. The **Advanced** button must be pressed separately to invoke the options dialog:



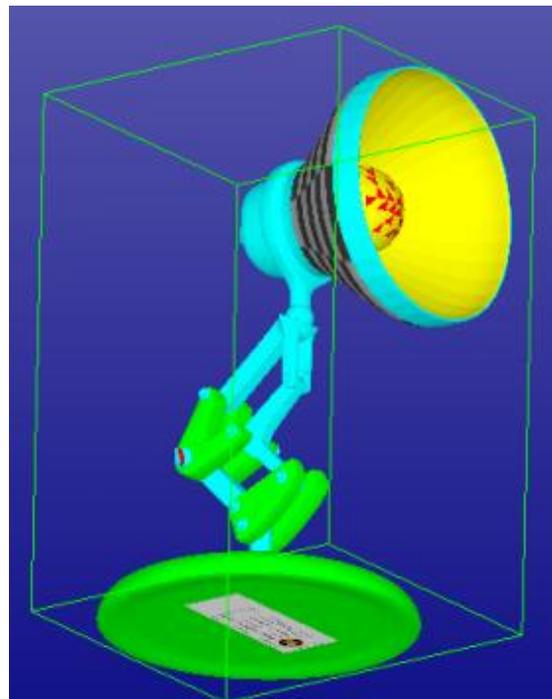
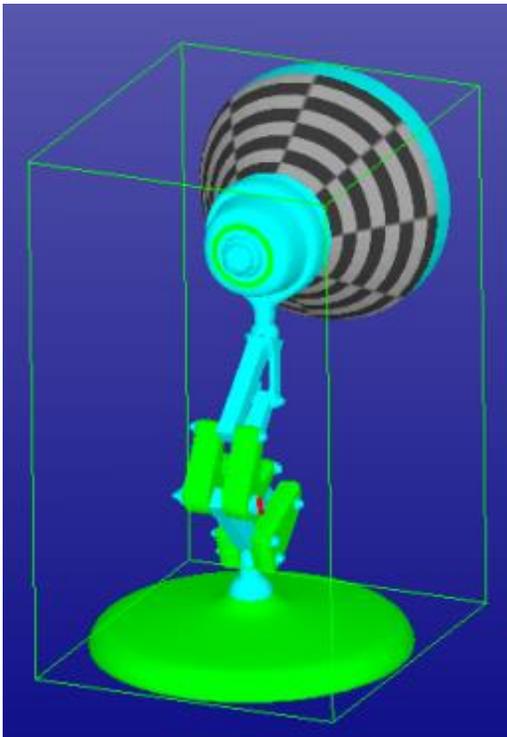
After the parameters are set, you can position the circle correctly (*Shift+LMB*) and then

- **select the surface** as seen in the image that follows:



Now

- **press the *Preview* and *Accept* buttons** to add the circle texture to the model (the result appears in the left-hand image below):



The *Lamp-colored.zpr* file represents the final result.

Saving the file

When saving the file to VRML or ZPR format with the *File > Save As* command you must take some care. The final model contains several shells (27) that can all be outputted separately without making the whole model. The best practice is to display the Model Tree (*F8* key) and **select the whole model first**, (i.e., the Model Tree root *All*). When *All* is selected, every shell will be written to the output file. If something other than the *All* root is selected a warning is issued before the file is written.

If the model is to be outputted to some other than 3D Color Printer you must check that the receiving system will accept multi shell parts (= parts made of several shells intersecting in 3D space). If not, please use the *Modify Faceted > Boolean* and *Boolean Multiple* commands to connect the separate shells into a single shell before outputting the part. Also, you can use the new Solidify command to create “shrink wrap” around the whole model.

Chapter 4 – Conclusions

Congratulations for reaching the end of this tutorial! The process and commands you have just learned will help you through the automatic repair needed for the majority of 3D models with 3D Color Printers. Also, you are now familiar with most of the coloring and texturing commands. For more information on texturing and painting, please see the “Color and Texture menu” Help pages in the Online Help “Menus and Commands” chapter.