

Lab Assignment #6: Creative Part Modeling

ME170

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Date Due: One week from Start Day of Lab (turn in deadline – 11pm night before next lab)

Part I. Model a Rubber Grommet, Electrical Terminal, and Plastic Cap.

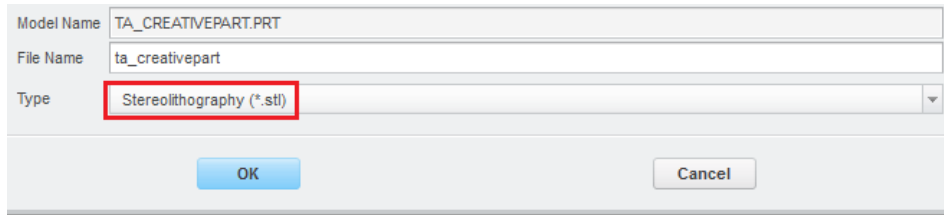
These three parts will be available in the EWS lab during your section and your TA's office hours. Please be considerate of others and do not remove these parts from the lab.

- Create an accurate solid model of each part in millimeter units. Measure all dimensions to within a half-millimeter. A ruler with millimeter markings is sufficient for the measurements; calipers make things easier.
- Use the following file names for your parts: "<netid>_grommet", "<netid>_connector", "<netid>_endcap".
- Creating a hand-drawn sketch with all the important dimensions is an excellent way to begin. Think about the basic geometric shape of the part and the simple extrusions, 'thickens', revolutions, and cuts, which might be employed to achieve the final shape.
- For each part model, start with your '170startpart'.
- You are encouraged to work with a classmate to examine and measure the parts.
- You will be graded on the quality and professionalism of your design, sketches, and resulting model. Your measurements should be reasonably accurate and features should look 'right'. Use logical constraints. Define symmetry and use centerlines where applicable. Use diameter dimensions for complete circular features. Your sketches should contain no weak dimensions or zero dimensions!
- Instructions for creating helical sweeps can be found on the ME 170 course website.

Part II. 'Creative Part' Rapid Prototyping (3D Printing Exercise).

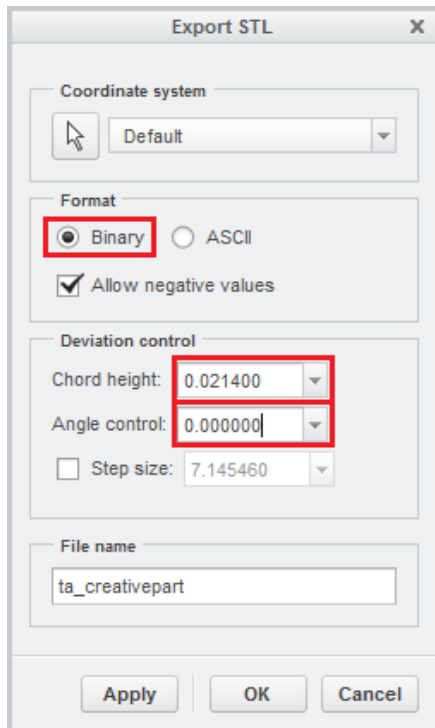
- 1) Use your '170startpart' to create a file named "<netid>_creativepart". Create a small model of an interesting, creative part of your own. Since we must control the cost of making your parts, you must follow the following guidelines (Units in inches are provided for comparison):
 - a. Maximum size: (101.6 mm x 101.6 mm x 101.6 mm) or (4 inches x 4 inches x 4 inches)
 - b. Maximum volume: $1.0488 \times 10^6 \text{ mm}^3$
 - c. Follow the instructions in section II.2 to verify the volume of the model.
 - d. Wall Thickness: 1.0 - 4.0 mm
No more, no less. Do not make any feature/dimension less than about 0.75mm because the material may not be self-supporting during build.
- 2) Prepare the file for rapid prototyping.
 - a. **Verify** that the model units are set correctly.
 - i) Navigate to "File" → "Prepare" → "Mass Properties."
 - ii) Ensure that the model's units are set to "millimeter Newton second".
 - iii) Change the model's units to "millimeter Newton second" if necessary.
 - (1) Click "Change" to the right of "Units".

- (2) Select "millimeter Newton second". Click "Set...".
 - (3) Carefully read and understand the two options in the "Changing Model Units" window.
 - (4) Select the appropriate option: "Convert" or "Interpret". Your selection depends on how you modeled your part. Select "OK". Click "Close".
- iv) Close the "Mass Properties" window.
- b. **Verify** the maximum size of the model.
- i) Navigate to the "Analysis" ribbon and use the "Measure" tool to measure the height width and length dimensions of your part.
 - ii) Adjust your part's dimensions so that they do not exceed the maximum size dimensions given above. Instructions for scaling your part are given in section 'd' below.
- c. **Verify** your model's volume.
- i) Navigate to the "Analysis" ribbon. Click "Mass Properties".
 - ii) Select the coordinate system "PRT_CSYS_DEF" from the model tree.
 - iii) Verify that the computed volume is less than the maximum volume listed above.
 - iv) Adjust the design of your part if necessary. Instructions for scaling your part are given in section 'd' below.
- Note** that there should not be any large, solid volumes. Large volumes should be shelled to create a cavity with an appropriate wall thickness. If shelling an interior, the interior hole **MUST** have a hole to the outside of the part so that unfused material can be removed.
- d. Optional instructions for scaling your part (if the size or volume requirements are exceeded).
- i) Navigate to "File" → "Prepare" → "Model Properties".
 - ii) Under the "Tools" header. Select "change" on the "Shrinkage" line.
 - iii) Click "By Scaling". Select the part's coordinate system (eg. "PRT_CSYS_DEF").
 - iv) Define a shrink ratio. Note that the shrink formula is " $1 + S$ ". Therefore, to shrink the part, you must enter a negative value between 0 and -1. "-0.2" will shrink the part by 20%, "-0.4" by 40%, etc.
 - v) Click the check box to confirm.
 - vi) Click "Done/Return". Close the Model Properties box. Save the part.
- e. If you make any significant changes to your part. **Re-verify** that your part's maximum dimensions and volume are within the specified limits.
- 3) Create an STL file, which is required by the rapid prototyping machines. STL is an abbreviation for stereolithography, which is one of many rapid prototyping methods capable of directly manufacturing parts from a solid model file. Your part may be created using a different rapid prototyping process. However, the STL file is a standard file that can be used by most rapid prototyping machines.
- a. Click "File" → "Save As" → "Save a Copy".
 - b. Select "Stereolithography" from the "Type" pull-down menu. (See image below.)



- c. Enter the file name "<netid>_creativepart".
- d. Click OK.
- e. In the "Export STL" box, ensure that "Binary" is selected.
- f. Enter "0" for "Chord height" and "Angle control" (image below). Creo will not allow a zero value for "Chord height", but it will instead default to the smallest allowable value.

These parameters govern the mesh size of the resulting STL file. Smaller deviation control values create a finer mesh, which results in a larger file and a more accurate representation of your model.



- g. Click OK. A "<netid>_creativepart.stl" file will be created and saved to your working directory.

Part III. Term Design Project: Product Design Specification (PDS)

Working in your teams, create a PDS for your selected product concept. Create a WORD document with all 29 of the primary elements numbered the class notes on this; i.e 1. Performance, 2. Environment, 3. Service Life etc. If you don't think that

your product concept has anything relevant for a particular section, then you can simply put N/A (i.e. not applicable).

Part IV. Lab Submission Requirements

1) Create a zip file named "<netid>_lab6.zip" with the following files. Submit it for grading through the my.mechse website. Be sure to include the latest version of each part. You may need to instruct Windows to unhide the file extensions (see Lab 2).

netid_grommet.prt.#	(from Part I)
netid_connector.prt.#	(from Part I)
netid_endcap.prt.#	(from Part I)
netid_creativepart.prt.#	(from Part II)
netid_creativepart.stl	(from Part II)

2) Go to the MechSE Innovation Studio (1009 MEL) and 3D print your creativepart.stl file. Show the printed part to your TA or grader to receive full grade for the Creative Part exercise in Part II (deadline for this is flexible but try to get it done within the next couple of weeks)

3) Team Design Project PDS. Submit the following file:

Team#_PDS.docx (from Part III) – this should be submitted by just one team member from the ‘Presentation/Grading Section’, for grading by the assigned section TA (# in the file name should be your assigned team number, eg AB2_3; do NOT include the PDS in the .zip file for the lab)