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Build Your Own Parametric Parts in Autodesk® Building Systems

Rebecca Richkus – Autodesk, Inc.

BD22-1L Learn how to build parametric parts in the best way possible. Learn tips on how to avoid some problems that you might encounter in Content Builder. We'll build some sample parts to give you a better feel for using this powerful tool in Autodesk Building Systems. This class is designed for anyone who would like to learn more about building parametric parts with the Content Builder in Autodesk Building Systems. Some basic knowledge of Content Builder is helpful. Going through the tutorials included with the product would be a good start.

Who Should Attend
Users of all skill levels interested in Autodesk Building Systems

Topics Covered
* Methods for creating 3D parts using the Content Builder interface
* Best practices for keeping track of design information and model dimensions in complicated parts
* How to use multiple planes and create custom planes
* Part options and information that can be added to parametric parts
* Using other tools (Excel and Catalog Editor) to manage and create large numbers of part sizes

About the Speaker:
Rebecca is a product designer for Autodesk® Building Systems. She's been with Autodesk for 5 years, working on AutoCAD® for 2 years before moving over to her current position. She earned her B.S. from MIT and M.S. from UC Berkeley, both in Mechanical Engineering and product design. This is Rebecca's first Autodesk University® and she's looking forward to helping customers learn more about the content tools in ABS 2005.

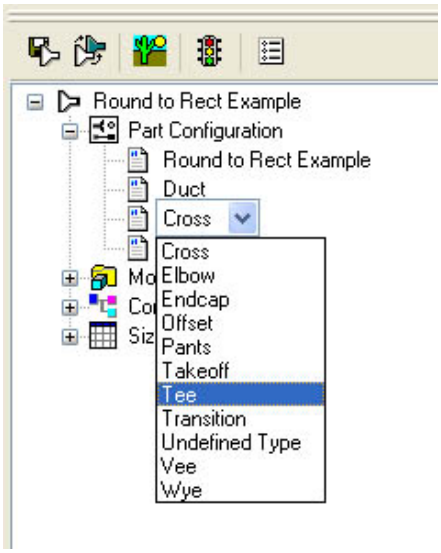
Building a Parametric Fitting, Step by Step

This Lesson will go through building a parametric duct fitting, the Round to Rectangular Tee.

1. In Autodesk Building Systems 2005, select from the MEP Common>Content Builder
2. From the Part Catalog dropdown list, choose Duct
3. Open the Multishape > Slip Joint folder. Select the Tee folder
4. Click New Parametric Part button
5. Create the Part Name: Round to Rect Tee Example and keep the same name for the Description. OK.

The Content Builder will open at this point. It's usually easiest to close the tool palettes to get them out of the way.

6. Open the Part Configuration Branch. Double-Click "Undefined Type" and pick Tee from the list



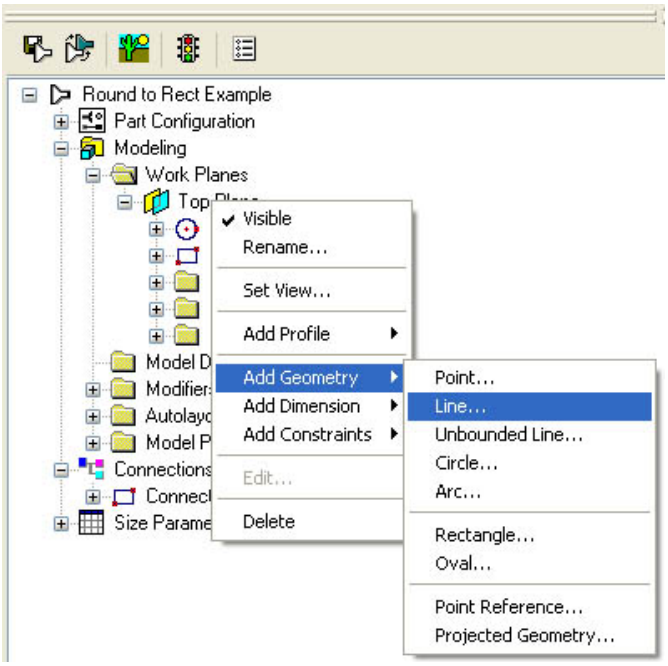
NOTE: A part type must be chosen for the part to be valid and used in a drawing.

7. Double-Click "Undefined" to set the Subtype. Select Round to Rectangular Branch Transition

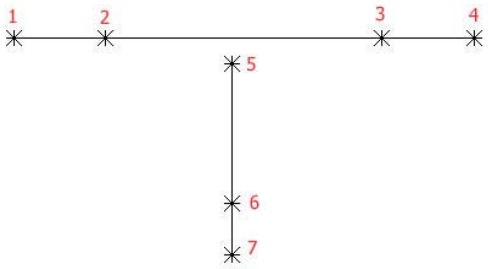
NOTE: You can type in your own subtype or chose an existing one.

8. Open the Modeling branch of the tee
9. Right-Click on Work Planes>Add Work Plane…
10. Select Top. OK.

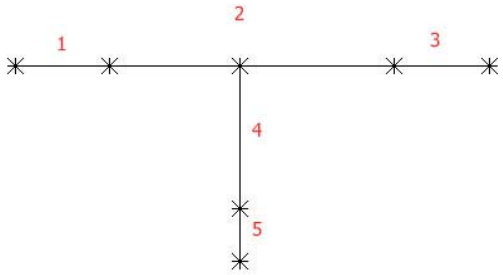
11. Open Work Planes branch on the tree



12. Right-Click on Top Plane>Add Geometry>Line and draw a multi-segment line across the screen. Repeat the command to draw a line going down.



13. Right Click on Top Plane>Add Constraint>Coincident. Select the top point in the branch and the long segment of the horizontal line.
14. Right-Click on Top Plane>Add Constraint>Parallel and select segments 1 and 2 (as shown in following diagram)

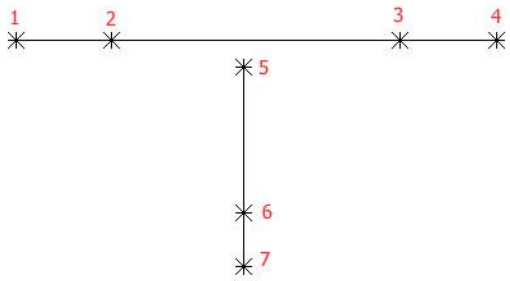


15. Repeat Parallel constraint for segments 2 and 3, and then again for segments 4 and 5.
16. Right-Click on Top Plane>Add Constraint>Perpendicular and select segments 2 and 4.

NOTE: You could also add an Angle dimension to make this a Wye rather than a 90-degree tee.

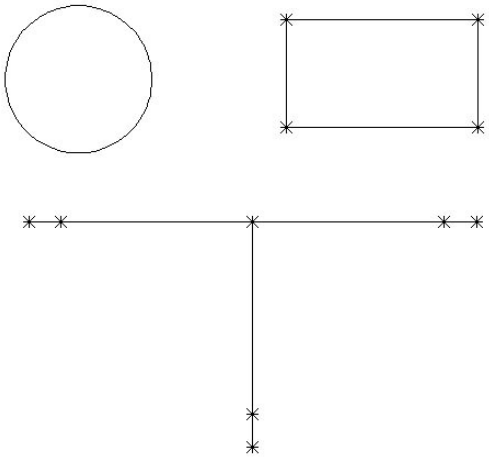
Extra step: If the last few steps resulted in lines that are skewed so they are not horizontal and vertical, you can add a horizontal line, then open up Top Plane>Geometry and right-click on the last line and select Fixed. Now add a constraint to make Segment 2 parallel to the fixed line.

17. Right-Click on Top Plane>Add Constraint>Equal Distance. Do this for

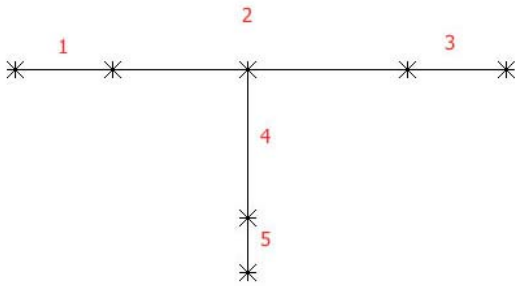


   a. Points 2 to 5 and 3 to 5 (as shown in Figure 1)
   b. Points 1 to 2 and 3 to 4
   c. And Points 3 to 4 and 6 to 7

18. Right-Click on Top Plane>Add Profile>Circular. Draw a circle anywhere to the side of the tee shape.
19. Repeat and add a Rectangular profile.

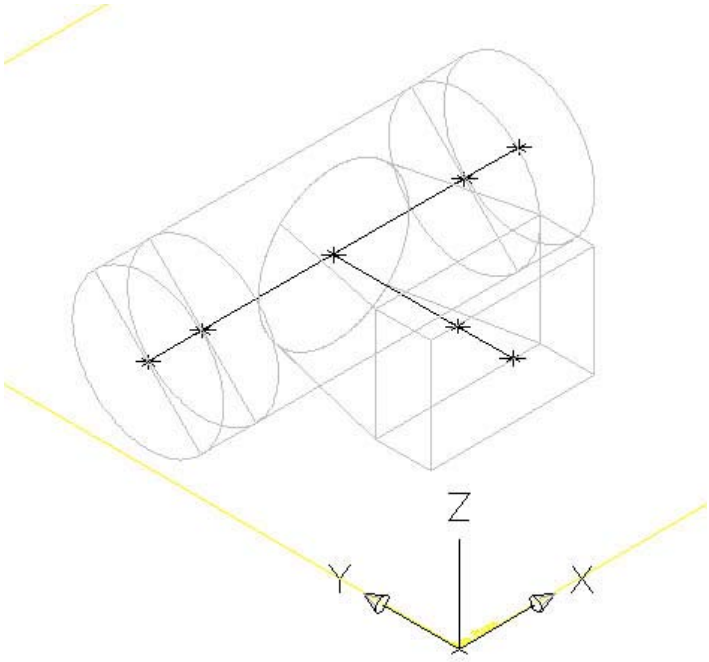


20. Right-Click on the Modifiers section of the tree. Select Path. Repeat this for



    a. Select Segment 1, then the circle, then click enter to create the 3D object.
    b. Select Segment 2, then the circle, then click enter to create the 3D object.
    c. Select Segment 3, then the circle, then click enter to create the 3D object.

21. Right-Click on Modifiers>Path select Segment 4, then the circle, then the rectangle to create a 3D object that transitions from circular to rectangular.
22. Right-Click on Modifiers>Path select Segment 5, then the rectangle, and enter.



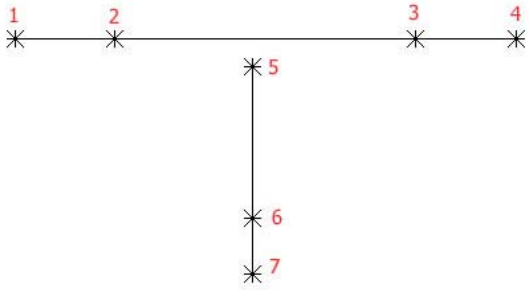
NOTE: You can change the view to Southwest Isometric to see the 3D part that has been created.

23. Right-Click on Connections>Add Connections. Select the left side of the part, <enter> to number the connector as 1. Click near the circle to dimension this value.
24. Repeat for the right side for connector 2. You will not need to dimension the circle this time because it was already dimensioned.
25. Right-Click on Connections>Add Connections. Select the branch end, <enter> to number the connector as 3. The prompt will ask for the height measurement.

a. Select the top and bottom lines of the rectangle and click nearby to place the dimension. The prompt will then ask for the width.

b. Select the left and right lines of the rectangle and click nearby to place the dimension.

26. Right-Click on Top Plane>Add Dimension>Distance… Select points 2 and 5, then place the dimension.



27. Repeat for points 1 and 2.

28. Repeat for points 5 and 6.

NOTE: Dimensions are not needed for the other segments because of the Equal Distance constraints placed on those segments.

29. Save the part by clicking on the Save Part button.  At this point a dialog will come up. Click Yes to allow the part to be seen in the catalog so it can be added into a drawing.

NOTE: The Hide Part flag (which can be set in the Options area and is on by default when creating a part) can be used so that an incomplete part will not accidentally be added into a drawing.

30. Right-Click on Model Parameters>Edit…

a. Double Click the Equation area for LenA3 and set to “(D1/2) + 2”

b. Set LenA1 equal to “(RW3/2) + 2.

c. Click OK to close the dialog

31. Right-Click on Connections>Edit Connections… and change the Type to Slip Joint for each one. OK.

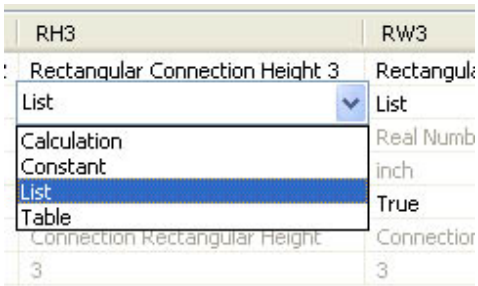
32. In ABS, go to menu MEP Common>Catalog Editor

a. In Catalog Editor, open Duct Catalog (C:\Documents and Settings\All Users\Application Data\Autodesk\ABS 2005\enu\Aecb Catalogs\Duct US Imperial)

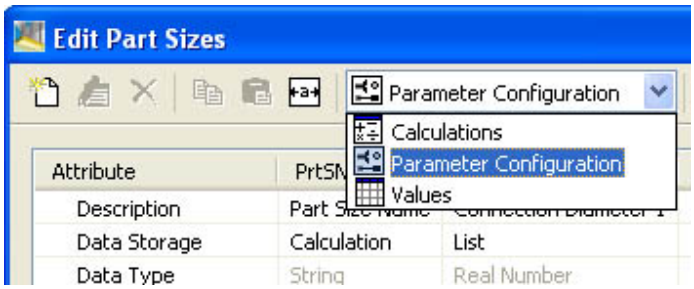
b. Open up Multi-Shape>Banded>Tees>Rectangular Duct to Round Conical Tap Tee Banded. Select the Constant Lists branch

33. Back in Content Builder, Right-Click on Size Parameters>Edit Configuration…

a. Change the Storage Type of D1, RH3, RW3, and LenA2 to List by first double-clicking on the field, then selecting List in the dropdown value for each.



b. Use the dropdown at the top of the dialog to choose the Values view.



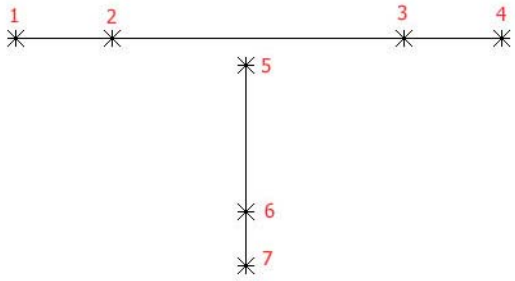
34. Go to the Catalog Editor, select the column of numbers of RW1 values and Copy.
35. Back to Edit Size Parameters dialog, click once in the RH3 value box and Paste. Click in RW3 value box and Paste. You should now be able to double-click on the value field and see the list of values.
36. Repeat this for copying the D3 values in Catalog Editor to D1 in Content Builder.
37. Click on the LenA2 value, click the Edit icon in the top left of the dialog. 
    a. Click on the existing value and change it to 1". OK.
38. OK to close Edit Size Parameters dialog.
39. Save the part.
40. Right-Click Size Parameters>Edit Values. Change the RH3 value to 6, the RW3 value to 8, and D1 to 5. Click on the Preview Part icon. 

NOTE: You can move the Preview to the side and click through possible values for each parameter and see the part update. This displays how the part will look in an ABS drawing.

41. Close the part preview and Size Parameters dialog.
42. In Content Builder, click the Generate Bitmap icon above the part tree.  Choose a view and click OK to use that image for the bitmap that appears in the Add Duct Fitting dialog.
43. Click the Option Button, above the part tree.  Check the Auto Layout check box.

NOTE: The Autolayout flag allows the part to be used during duct add. The part can be chosen to be used automatically when a branch is added to an existing duct.

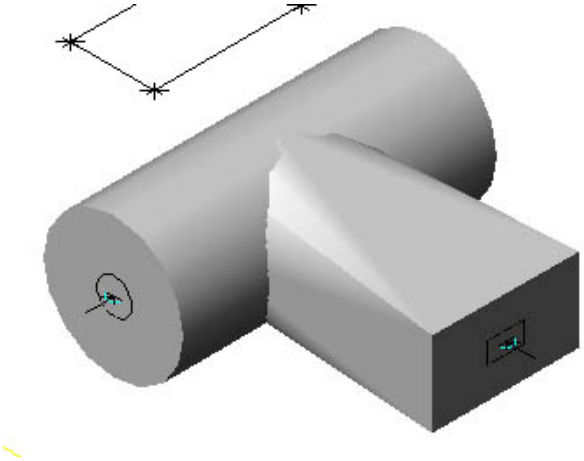
44. Right-Click the Autolayout Data>Layout Data branch in the tree. Choose Add Trim Length. Select the circles around point 1 and then point 5.



45. Repeat for the point 4 to point 5. Then repeat for point 6 to point 5.

NOTE: The trim lengths tell the program how to place the part when inserted on to parts. The segments can be thought of as where the ducts would meet from each connector if the tee was not there.

46. Right-Click on Autolayout Data>Layout Data>Select Placement Point. Pick the center circle around point 5.
47. Save the part. Close Content Builder with the X at the top of the tree view.
48. Use DUCTFITTINGADD command to add the part to your drawing and test the part.



Content Builder Tips and Tricks

- **What a part needs in order to be valid**
  - A Part Type specified (Part Configuration Branch)
  - Appropriate number of connectors (2 for elbow, 3 for tee, etc). All parts need at least 1 connector.
  - Properly constrained/dimensioned
  - Hide Part flag off (will happen automatically the first time you save it and it's valid)
  - For fittings with Autolayout: Trim lengths and Placement Point selected (see "If Autolayout is on")
  - For MvParts: Placement Point Selected.
- **Best practices for making parts**
  - Use constraints rather than dimensions when possible
    - Use "Equal Distance" for several segments that are the same length
    - Use "Equal Distance" for centering a rectangle or oval around a point
    - Use "Concentric" to center a circle around a point
    - Use "Perpendicular" for keeping lines perpendicular
    - Use "Parallel" for keeping line segments along the same line from skewing to be not linear
  - Use the Description field for Model Parameters to help keep track of what variables represent. This helps in complicated parts, but also helps if you need to look at the part months down the road and remember how it was built.
  - If a part is very similar to another part, open up the original and use the "Save As…"  to create a copy of the part. Modify that part to create the new one.
  - Also, if there are several parts with a similar starting point, save that starting point as a base part, and use Save As… to create the multiple versions.
  - For large numbers of sizes or tables of information, keep everything in a spreadsheet format and just copy and paste into Size Parameters, rather than trying to type in all the values.
  - Be careful about changing the data storage type (Size Parameters>Edit Configuration). If a full list of values is stored and then the data type is changed to "Constant", the list will be lost.
- **If Autolayout is on**
  - Add trim lengths. Trim lengths can be thought of as the markings where pipe/duct would be trimmed off to place the part in.
  - Add a placement point. This adds an insertion point (in addition to the connector points) and is generally the intersection of the trim lengths.

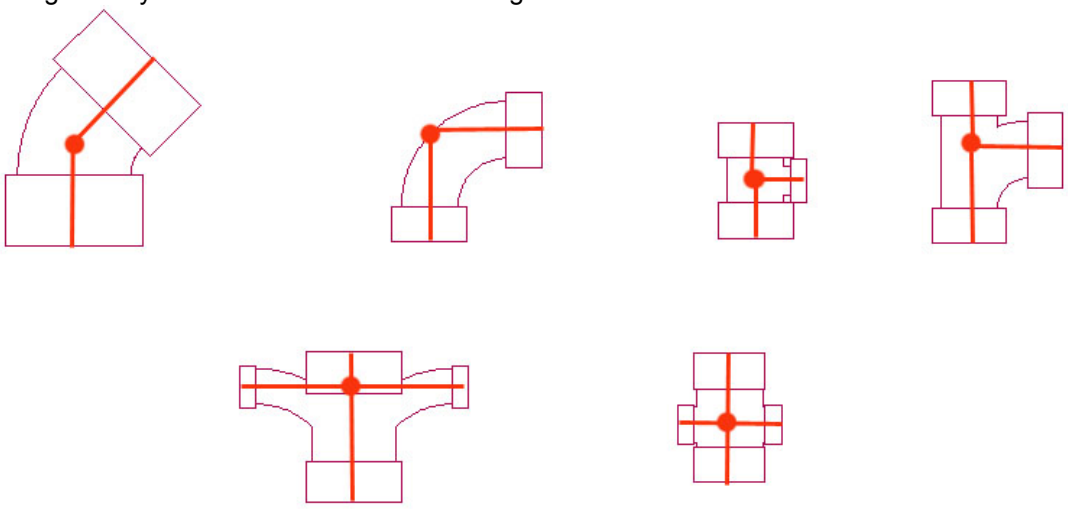


Figure 1: Trim Lengths and Placement Point for Pipe Parts

- **Troubleshooting**
  - Everything gets moved around on your screen
    - Use the undo command
    - Draw a Geometry>Line horizontal or vertical off to the side
    - Select that line in the part tree, right-click, select “Fixed”
    - Now add a constraint of “Parallel” (or “Perpendicular”), selecting one of the lines defining the part and the fixed line.
    - Also, make sure to have a “Parallel” constraint for keeping line segments collinear, if they were meant to be.
  - “Nothing moves at all when I change values!”
    - If you change the values of model parameters (or in the part preview or between different part sizes when added to a drawing) and the part doesn’t change at all, that means the part is over-constrained. This is due to a combination of constraints and dimensions.
    - Check dimensions to make sure segments aren’t dimensioned more than once.
    - Check constraints to make sure constraints are used twice or repeating dimensions (if you select a constraint in the part tree, the constrained elements will highlight in the DWG window).
  - The connector is sticking out at a weird angle or won’t appear at all
    - Connectors can only be added on to the ends of modifiers
    - Sometimes Path modifiers based on arcs, or Transition modifiers can cause connectors on the ends to be skewed. To solve this problem, add a small straight segment to the end of the Path or a small Extrusion modifier to the end of the Transition. You can make the length of this piece as small as .00001 and still correct the problem.
  - It says the part is under-constrained by *n* items
    - The message you see as you add profiles, constraints, etc, is not really an accurate representation of what you need to do. What is accurate is if it says that the part is fully constrained, that means the Content Builder will allow the part to be marked as “OK” to insert into a DWG file.
    - Don’t worry too much about the specific number it says in that message, just realize that the part still needs more constraints or dimensions if you see that message.
    - Also, if it says the part is fully constrained, it may not be accurate. Content Builder can sometimes make assumptions which allow it to view a part as valid and constrained, but which leave the part not really finished.
- **Handy things within Content Builder**
  - Options dialog 
    - Access the Autolayout Flag
    - Turn on/off the Hide Part flag, so users can’t see a part while you work on it, or so it can be seen when the part is finished.
    - Turn on custom sizing so parts can be created on-the-fly from within ABS part Add commands.
  - Part preview in the Size Parameter dialog 
    - Size Parameters > Edit Values… select any value field, the click on the Part Preview button. You can now change all of the values in the Size Parameters dialog and see the part preview update.
  - Update Model in the Size Parameter dialog 
    - Size Paremeters > Edit Values… set the values to the size you want. If you click the Update Model button, the variable values in the Size Parameter dialog will be pushed back to the DWG model. This can be useful if you need to inspect a part that isn’t doing what you expect it to as it changes size.
- **Methods for making your part more specific**
  - Adding size validation

        - Allows a limit to be imposed so that only parts of a certain size can be added in DWG.
        - In Size Parameters > Edit Configuration… click the New button, choose Size Validation. In Calculations, edit the calculation to create an evaluation statement (variable < or > a value). If a value is selected that does not meet that requirement, the part will not be created. In other words, the sizes must make that evaluation statement true for a valid part to be created.
        - This can sometimes be useful for limiting an angle size, keeping a height below a certain value, or keeping a complex model from going haywire.
        - Keep size validation tests simple. It's better to have three separate tests than to have a complicated equation or AND statements as part of the test.
    - Adding custom parameter
        - In Size Parameters > Edit Configuration… click the New button, choose Custom.
        - Custom parameters can be used to add model number, manufacturer information, or other part details.
    - Changing the Part Size Name calculation to include sizes
        - In Size Parameters > Edit Calculations… double-click the Part Size name field, or chose the field and click the Edit button. Use the calculator to add variables to the part size name so the tool tip over the part in a DWG will display the size.

❖ **Working with Catalogs**

- Every part must have a unique Part Name and a unique Part ID. Both Content Builder and Catalog Editor keep track of this information and you can copy parts using either of these functions.
- DO NOT manually copy a part in Windows Explore and rename it to make a copy. It will have the same Part ID and will not be found during a catalog regenerate.
- After working with new parts, if they do not seem to be in the catalog, try regenerating the catalog.