

TABLE OF CONTENTS

| | |
|--|----|
| Introduction | 1 |
| Knowledgeware | 2 |
| Pull Down Menus | 3 |
| Insert - part environment | 3 |
| Insert - product environment | 3 |
| Knowledge Toolbar | 4 |
| Parameters | 5 |
| Intrinsic Parameters | 5 |
| Renaming Parameters | 13 |
| Filtering Parameters | 19 |
| Deactivating/Activating Parameters | 23 |
| Locking/Unlocking Parameters | 25 |
| User Defined Parameters | 27 |
| Settings | 27 |
| Creating Parameters | 31 |
| Single Value | 32 |
| Multiple Value | 34 |
| Geometrical | 35 |
| Editing Parameters | 36 |
| Changing Values | 36 |
| Hiding Parameters | 37 |
| Reordering Parameters | 38 |
| Locking/Unlocking Parameters | 39 |
| Showing Parameters | 40 |
| Properties of Parameters | 41 |
| Additional Options | 43 |
| Importing Parameters | 52 |
| Product Parameters | 55 |
| Creating Parameters | 55 |
| Publishing Parameters | 56 |
| Intrinsic Parameters | 58 |

| | |
|---|-----|
| Formulas | 61 |
| Basic Formulas | 61 |
| Creating Formulas | 61 |
| Editing Formulas | 69 |
| Changing the Formula | 69 |
| Deactivating/Activating Formulas | 71 |
| Hiding/Showing Formulas | 72 |
| Reordering Formulas | 72 |
| Properties | 73 |
| Advanced Formulas | 75 |
| Geometrical Formulas | 75 |
| Measurement Formulas | 80 |
| Product Formulas | 82 |
| Using Product Level Parameters | 82 |
| Using Published Parameters | 87 |
| | |
| Equivalent Dimensions | 92 |
| | |
| Laws | 96 |
| | |
| Knowledge Inspector | 103 |
| What If | 105 |
| How To | 107 |
| | |
| Design Tables | 109 |
| Creating Design Tables Using Existing Parameters | 109 |
| Adding Parameters to an Existing Design Table | 115 |
| Creating Design Tables from an Existing Spreadsheet | 118 |
| | |
| Review - Parameters, Formulas, Design Tables | 120 |

| | |
|--|-----|
| Catalogs | 123 |
| Catalog Environment | 123 |
| Catalog Editor Workbench | 124 |
| Terminology | 124 |
| Catalog Structure | 125 |
| Chapters | 125 |
| Families | 127 |
| Linking to Other Catalogs | 129 |
| Part Families | 130 |
| Keywords | 133 |
| Creating | 133 |
| Modifying | 135 |
| Copying | 137 |
| Reordering | 139 |
| Removing | 140 |
| Catalog Data | 141 |
| Adding a Component | 141 |
| Adding Generative Parts | 144 |
| Filtering | 146 |
| Synchronizing Chapters | 149 |
| Catalog Browser | 151 |
| Instantiating Parts from Catalogs | 153 |
| | |
| Review - Catalog | 159 |
| | |
| Power Copies | 161 |
| Creating a Power Copy from a Feature | 161 |
| Instantiating a Power Copy | 170 |
| From a Catalog | 170 |
| From a Document | 175 |
| From a Selection | 177 |
| Creating a Powercopy from Multiple Features | 178 |
| Instantiating a Power Copy with Multiple Features | 184 |
| Creating a Power Copy from Surfaces | 188 |
| | |
| User Defined Features | 195 |
| Creating a User Defined Feature | 195 |
| Instantiating a User Defined Feature | 203 |
| Instantiation Modes | 207 |
| Creating a User Defined Feature with a Design Table | 210 |
| Instantiating a User Defined Feature with a Design Table | 213 |
| Comparison between a Power Copy and a User Defined Feature | 215 |
| | |
| Review - Power Copies and User Defined Features | 219 |
| Power Copy | 219 |
| User Defined Feature | 223 |

| | |
|---|-----|
| Part Document Templates | 225 |
| Creating a Part Document Template | 225 |
| Instantiating a Part Document Template into an Assembly | 240 |
| Creating a Part Document Template with Meta Inputs | 245 |
| Instantiating a Part Document Template with Meta Inputs | 249 |
| Knowledge Advisor | 255 |
| Introduction | 255 |
| Knowledge Advisor Workbench | 256 |
| Knowledge Advisor | 257 |
| Creating Rule | 257 |
| Single Conditions | 257 |
| Multiple Conditions | 265 |
| Creating Checks | 273 |
| Review - Rules and Checks | 279 |
| Rules | 279 |
| Checks | 280 |
| Reactions | 282 |
| Value Changed | 282 |
| Remove | 287 |
| Insert | 288 |
| Inserted | 290 |
| Review - Reactions | 292 |
| Managing Knowledgeware | 295 |
| Parameter Sets | 295 |
| Relation Sets | 297 |
| Parameters Explorer | 299 |
| Adding Parameters to Geometry | 304 |
| Comments & URLs | 305 |
| Set of Equations | 308 |
| Actions | 312 |
| Lists | 318 |
| Loops | 320 |
| Knowledge Expert | 325 |
| Introduction | 325 |
| Knowledge Expert Workbench | 326 |
| Knowledge Expert | 327 |
| Creating Expert Rules | 327 |
| Language Table | 334 |
| Creating Expert Checks | 335 |
| Generating a Check Report | 344 |
| Inserting Rules and Checks from an Existing Document | 348 |

| | |
|--|-----|
| Practice Problems | 351 |
| Problem 1 | 351 |
| Problem 2 | 353 |
| Problem 3 | 354 |
| Problem 4 | 356 |
| Problem 5 | 358 |
| Problem 6 | 360 |
| | |
| Appendix A | 361 |
| General - Parameters and Measure - Knowledge | 361 |
| General - Parameters and Measure - Knowledge Environment | 362 |
| General - Parameters and Measure - Report Generation | 363 |
| General - Parameters and Measure - Measure Tools | 364 |
| Infrastructure - Part Infrastructure - General | 365 |
| Infrastructure - Part Infrastructure - Display | 366 |

Introduction

CATIA Version 5 Knowledgware

Upon completion of this course, the student should have a full understanding of the following topics:

- Parameters and formulas
- Design Tables
- Working with catalogs
- Powercopies
- User defined features
- Part document templates
- Product document templates
- Using rules, checks, actions and reactions
- Organizing parameters and relations
- Using sets of equations
- Using lists and loops
- Using expert rules and checks

Knowledgeware

Knowledgeware encompasses the tools that allows you to capture engineering knowledge. There are a number of ways that CATIA allows for this to happen. You can create intelligent and automated templates from a model. This can be done simply by using intrinsic or user defined parameters to create a set of parameters that allow for quick creation of a new design from an existing design following the engineering knowledge that was put into it. These parameters can be controlled with relations that allow for relationships to be built between parameters and you can even create a design table that utilizes an Excel spreadsheet or text file to control different configurations of those parameters.

Besides just modifying parameters, features can be built and then reused in other designs. This is accomplished through the use of powercopies and user defined features. These features can contain inputs that allow for the engineering rules of the feature to be followed consistently throughout a company while still being able to be adapted to different situations. These can be inserted into a catalog for easy utilization throughout the company.

In addition, rules and checks can be created to make sure that while entering changes the engineering intent of the design does not get violated. These checks can trigger responses that adapt the design to a new form that follows the knowledge that is embedded in the model. This allows for the capture of knowledge that can be reused by multiple users and suppliers. These are ideal to implement a standard method of creating features.

Of course, with all of these tools, you have to be careful to make sure you are setting up your designs properly and are not over complicating a design where no other users can work with it. The other danger of embedding too much knowledge into a process or a design is that it can hurt innovation. If all future designs are built off the existing rules then there will not be any new and better designs. Therefore it is necessary to decide if the knowledge that is being put into a design is something that needs to be reused over and over again while ensuring enough flexibility in the design to foster innovation.

Formulas

Formulas are used to build relationships between parameters. They are the first type of relation that you will learn about. Parameters are wonderful but where user defined parameters become useful is when you create relations between them and intrinsic parameters which control your design.

Basic Formulas

Formulas can become quite complicated but this section will provide you with the basic understanding of how to put a formula on a parameter using simple mathematical relationships. This will include simply setting a parameter equal to another.

There are many locations that allow you to access the formula editor. Some of the ways you can access the formula editor are as follows:

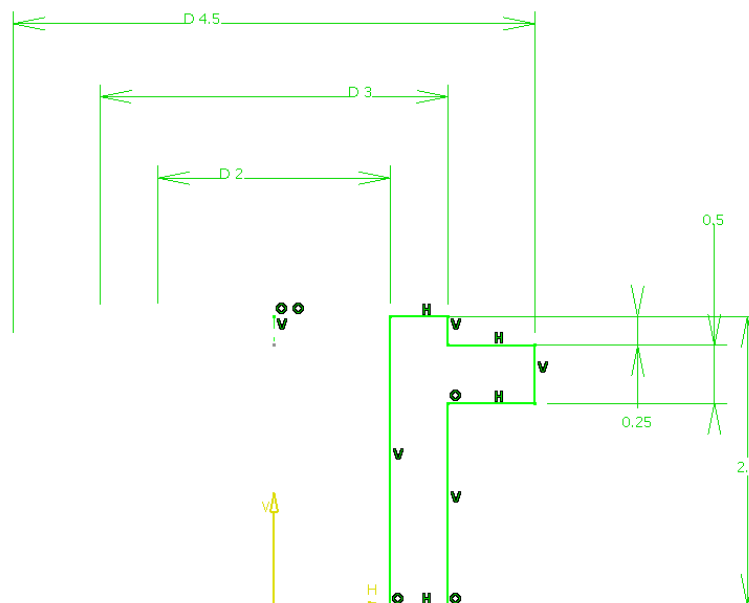
- Pressing the third mouse button while on a parameter and going to the object name and choosing *Edit formula*.
- Pressing the third mouse button while in a field that is expecting a parameter and choosing *Edit formula*.
- Through the formula icon in the Knowledge toolbar.

In this exercise you will access the formula editor through all three of these methods. It does not matter how you access the formula editor, it appears the same in all cases.

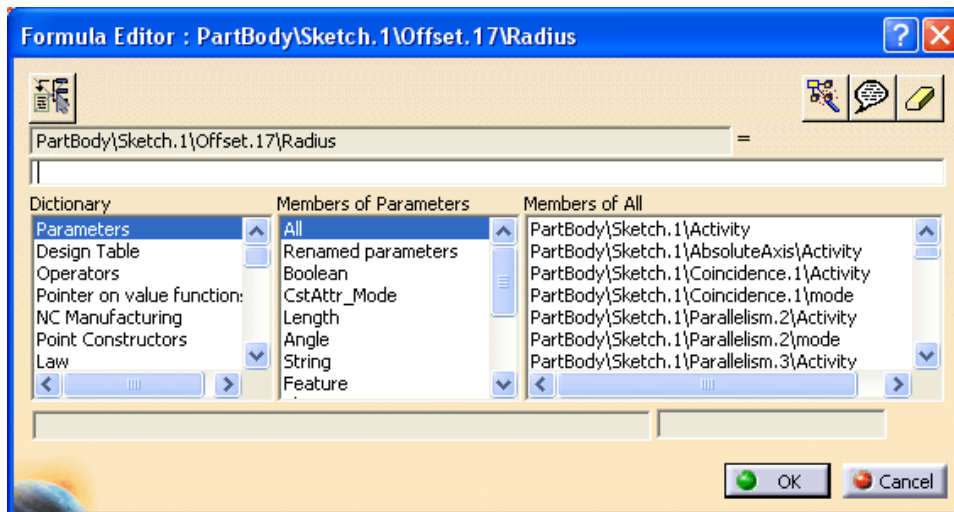
Creating Formulas

Open the Formulas - Basic document. This is a simple model that has some user defined parameters.

Go into *Sketch.1*. The sketch appears with its constraints.



Press the third mouse button while on the 2 inch diameter constraint and select *Offset.17 object* and select *Edit Formula*. The *Formula Editor* appears. Notice that the parameter is really a radius and not a diameter even though it shows as a diameter in the graphical area.



Puts the list into an optimized mode



Shows the language browser



Allows you to add URLs and/or comments



Erases the text field of the formula

Dictionary

Shows the available dictionaries for use in formulas

Members of Dictionary

Shows the options that are available within the selected dictionary

Members of ???

This 3rd column only exists when the dictionary is *Parameters* and it shows the actual parameters that are available based on your 2nd column selection

For all of the following steps you will want to make sure you are in the *Parameters* dictionary.

Select the ***INNER_RADIUS*** parameter from the specification tree. You may have to expand the *Parameters* branch in order to select it. *INNER_RADIUS* appears in the area after the equal sign. You are setting the radius parameter equal to the user defined parameter.

Select **OK**. A formula symbol appears next to the constraint value in the graphical area.

Press the third mouse button while on the 3 inch diameter constraint and select *Offset.20* object and select *Edit Formula*. The *Formula Editor* window appears.

Key in `OUTER_RADIUS` in the area after the equal sign and select *OK*. This is another way you can specify what a parameter is equal to. The formula is created.

Press the third mouse button while on the 4.5 inch diameter constraint and select *Offset.24* object and select *Edit Formula*. The *Formula Editor* window appears.

Select the *Renamed parameters* option in the *Members of Parameters* column. Only renamed parameters appear in the 3rd column.

Double select the `SHELF_RADIUS` parameter from the *Members of Renamed parameters* column. The parameter is filled into the formula. This is another method to specify a parameter in the formula.

Select *OK*.

Double select the 0.25 inch constraint. The *Constraint Definition* window appears.

Type an = in the *Value* area and select the `SHELF_LOCATION` parameter from the specification tree and select *OK*. This sets the parameter to equal the `SHELF_LOCATION`.

Using one of the previous methods set the 2.5 inch constraint equal to the `TOTAL_HEIGHT` parameter.


Exit the sketch.

Go into *Sketch.2* and set the 1 inch constraint equal to the `SLOT_DEPTH` parameter.

Exit the sketch.

Double select on *Hole.1*. The *Hole Definition* window appears.

Press the third mouse button while in the *Diameter* field and select *Edit formula*. The *Formula Editor* appears. This is another method to access the formula editor.

Set the parameter equal to the `HOLE_DIAMETER` parameter and select *OK*. The formula is created. Notice that a  appears next to the *Diameter* field.

Select *OK* in the *Hole Definition* window.

You should notice that a *Relations* branch appears in the specification tree. This contains all of the relations that you have in your model.

Expand the *Relations* branch. All of the formulas that you have created appear.



By setting the intrinsic parameters equal to the user defined parameters you can control the design by changing the user defined parameters.

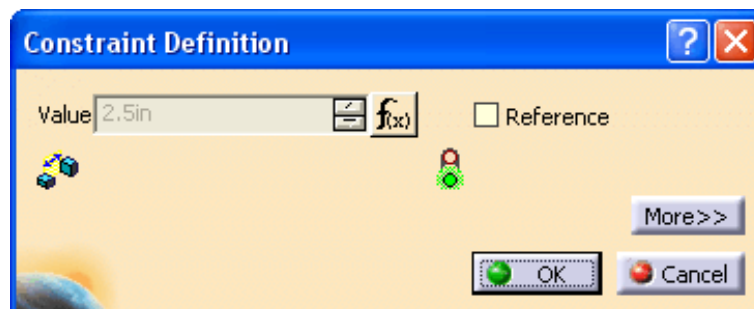
Change the *OUTER_RADIUS* parameter to 1.75 inches. You should notice that the outer cylinder gets larger.

Change the *HOLE_DIAMETER* parameter to 1.0 inch. The hole gets smaller.

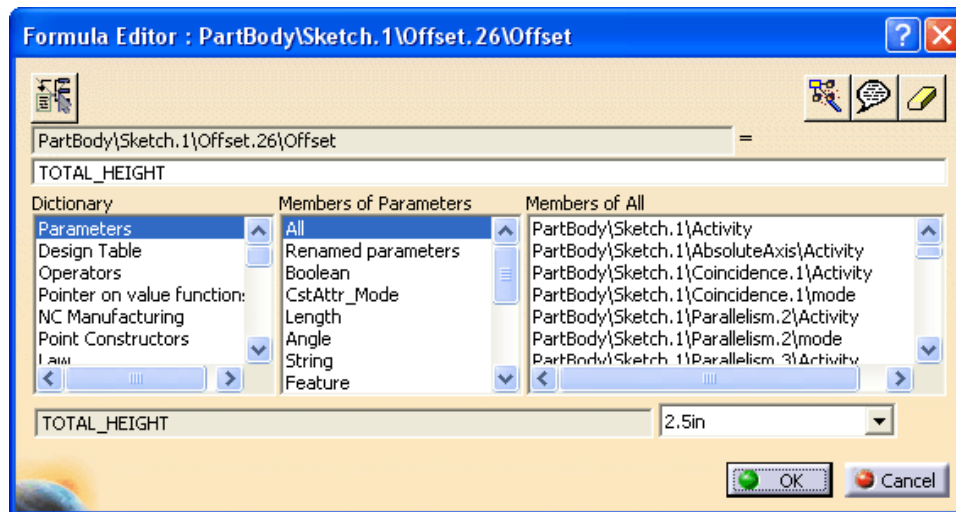
One problem that you can run into is when you have a value controlled by a formula some times you do not know where to go to change it. The formula editor provides one method of finding and changing the driving parameter.

Go into *Sketch.1*. The constraints appear.

Double select on the 2.5 inch constraint. The *Constraint Definition* window appears.



Select the **Formula** icon within the window.  The *Formula Editor* window appears.



Notice at the bottom of the window is the driving parameter and its value appears. You can change the value at that location. Since this is a multiple value constraint you can choose a value from the list of available values.

Change the value of *TOTAL_HEIGHT* to 3.0 inches within the window using the drop down arrow and select *OK*.

Select *OK* in the *Constraint Definition* window.

Exit the sketch. The part is taller.


Double select on *Hole.1*. The *Hole Definition* window appears.

Select the **Formula** icon within the window.  The *Formula Editor* window appears.

At the bottom of the window change the value to 1.50. Since this is a single value parameter you can key in the value.

Select *OK* in both windows. The hole is larger.

You can also access the formula editor using the formula icon in the Knowledge toolbar.

Select the Formula icon in the Knowledge toolbar.  The *Formulas* window appears. You should be fairly familiar with this window. Notice that there are two buttons on the right hand side that allow you to add a formula or delete a formula.

Select *Sketch.1*. Only the sketch parameters appear in the list.

Double select on the *PartBody\Sketch.1\Offset.30\Offset* parameter. The *Formula Editor* window appears. By double selecting on a parameter you can add a formula or edit an existing formula.

Select *Cancel*.

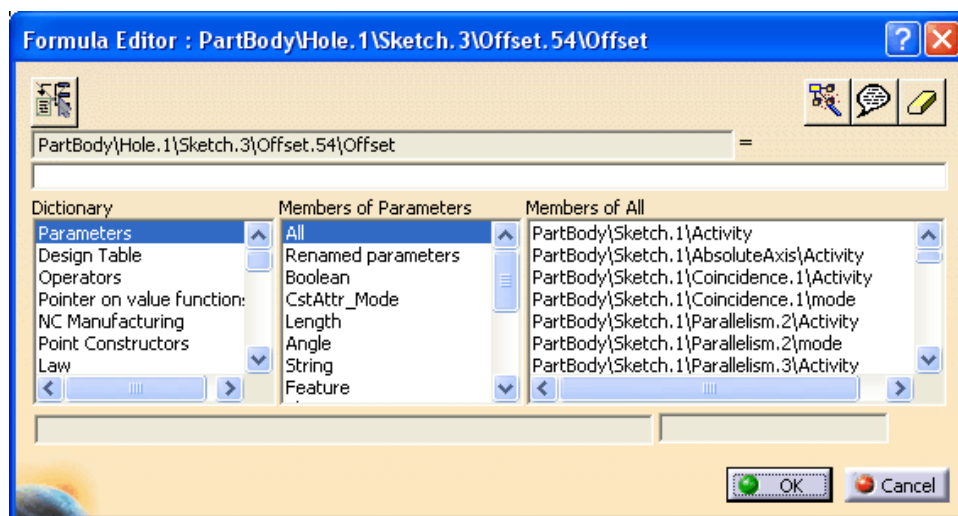
With the parameter selected, select the *Add Formula* button. The *Formula Editor* window appears. Notice that this is adding a new formula to the parameter as well. This option will not edit an existing formula.

Set the parameter to equal the *SHELF_THICKNESS* parameter and select *OK*. You can also delete a formula using the *Delete Formula* button. You will not do this at this time.

Select *OK* in the *Formulas* window.

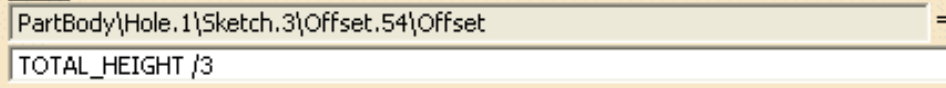
All of your formulas have involved just setting one parameter equal to another parameter. You can also perform basic mathematical operations without using any of the available dictionaries.

In *Sketch.3*, get to the *Formula Editor* for the constraint. *Sketch.3* is the sketch for the hole. You can use any of the above methods to get to the *Formula Editor*. This constraint sets the location of the hole from the bottom of the part.



You are going to want the location of the hole to be 1/3 the total height from the bottom of the part.

Select the **TOTAL_HEIGHT** parameter and key in **/3**. Since this is a ratio the value keyed in does not require units. This is true for multiplication and division but not addition and subtraction.



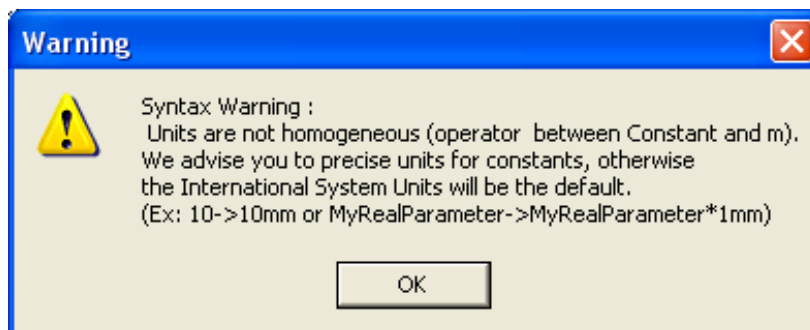
Select **OK**. The location of the hole will always be up from the bottom 1/3 the total height of the part.

For **Plane.1**, get to the **Formula Editor for the offset**. You can use any method you wish. The **Formula Editor** window should be open.

Select the **OUTER_RADIUS** parameter and key in **+0.375in**. When adding or subtracting values you must specify the units.

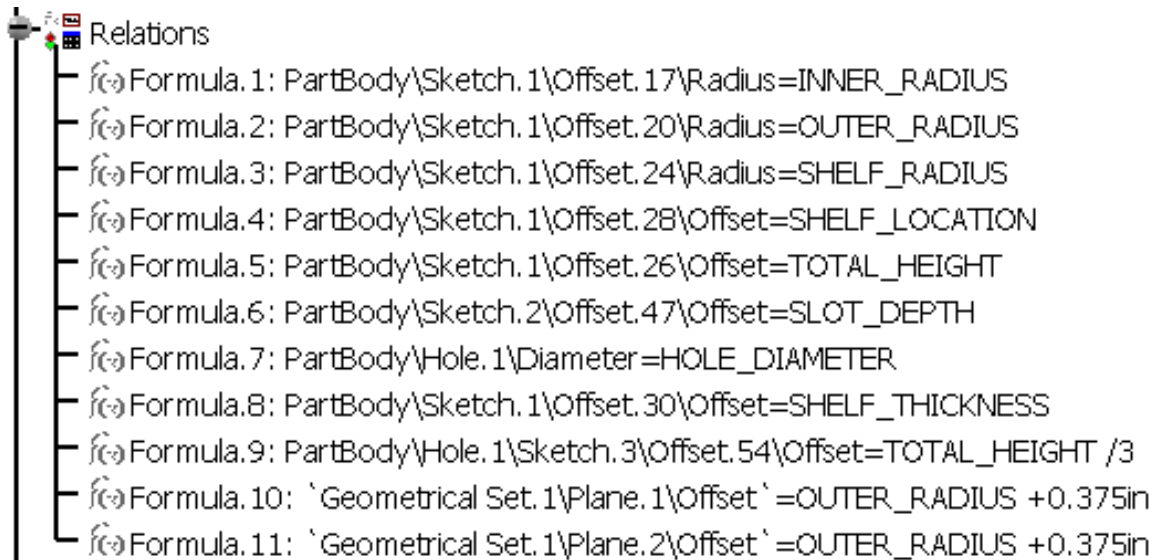


If you do not specify the units then you will get an warning message similar to the one shown below.



In the **Formula Editor** window select **OK**. You will now repeat the process for the other plane.

Put the same formula that you just created on the offset of *Plane.2*. Your *Relations* branch should look like the following.



For *Sketch.2*, get to the *Formula Editor* for the **0.75** constraint. The *Formula Editor* window should be open.

Select the *OUTER_RADIUS* parameter, key in **-**, and select the *INNER_RADIUS*. You are setting the width of the slot to equal the difference between the outer radius and the inner radius.



Select **OK**. Since you did not specify a value yourself you do not have to specify units.

Exit the sketch if you are still in it.

Power Copies

A power copy is basically a copy of a group of features that can have various inputs defined to modify the copy. It allows for an item to be reused in multiple situations yet keeping the same standard methodology of creation. Once it is instantiated the user has access to all of the features that comprise the power copy as if they were built manually. Power copies can be instantiated from an existing document or a catalog and can be used in parts or products.

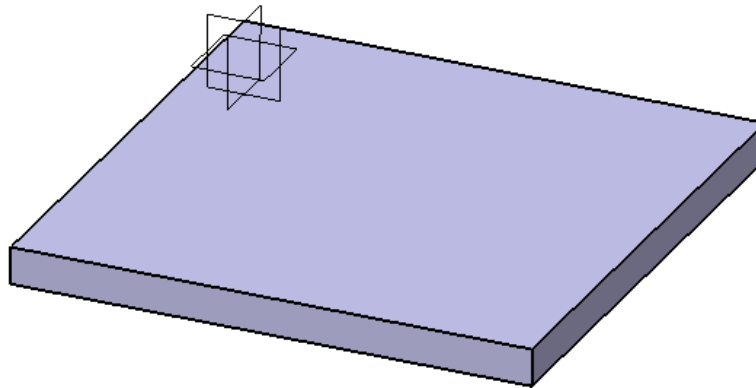
Creating a Power Copy from a Feature


You are going to create a power copy of a single feature representing the a cutout for an instrument panel. This will allow you to explore some of the various option involved with a power copy.


Create a new part called Instrument Panel Cutout. You are going to create some supporting geometry to use when defining your cutout.

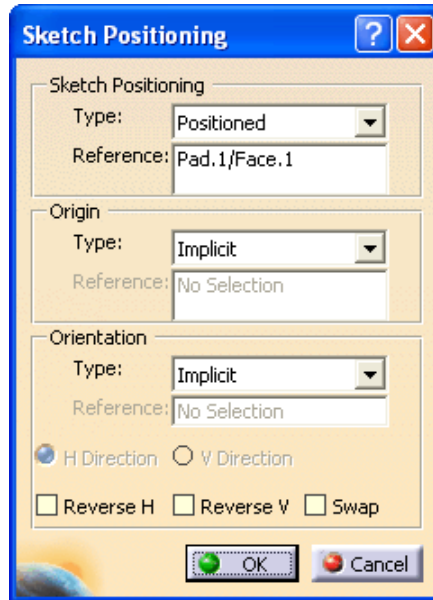
Create a sketch on the xy plane of a square 3.50 inches by 3.50 inches with the corner at the origin.

Create a pad using the sketch that is 0.25 inches thick. It should appear similar to the one shown below.



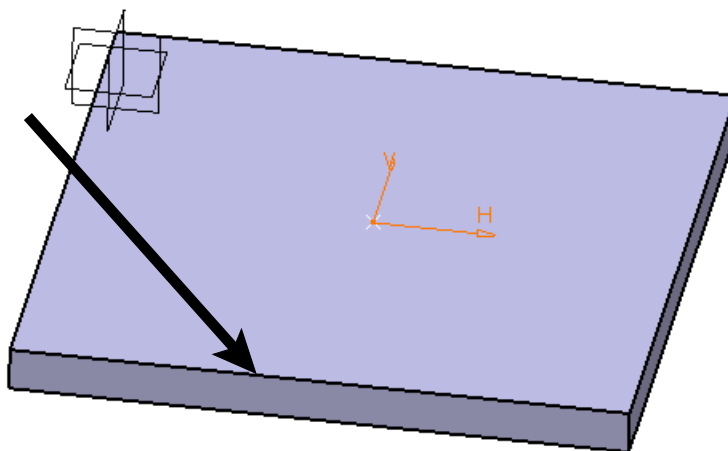
Using the Point icon, create a point at 1.75, 1.75, 0.25.  This will be used to locate the sketch origin of the cutout. This will allow you to have this point as an input when the power copy is instantiated.

Select the **Positioned Sketch** icon and select the top face of the pad.  The *Sketch Positioning* window appears. If you are going to create features that are going to be used in a power copy it is a good idea to use positioned sketches. This will allow you to use constraints to the sketch axis while ensuring that when the feature is used in another document it will still be oriented correctly.



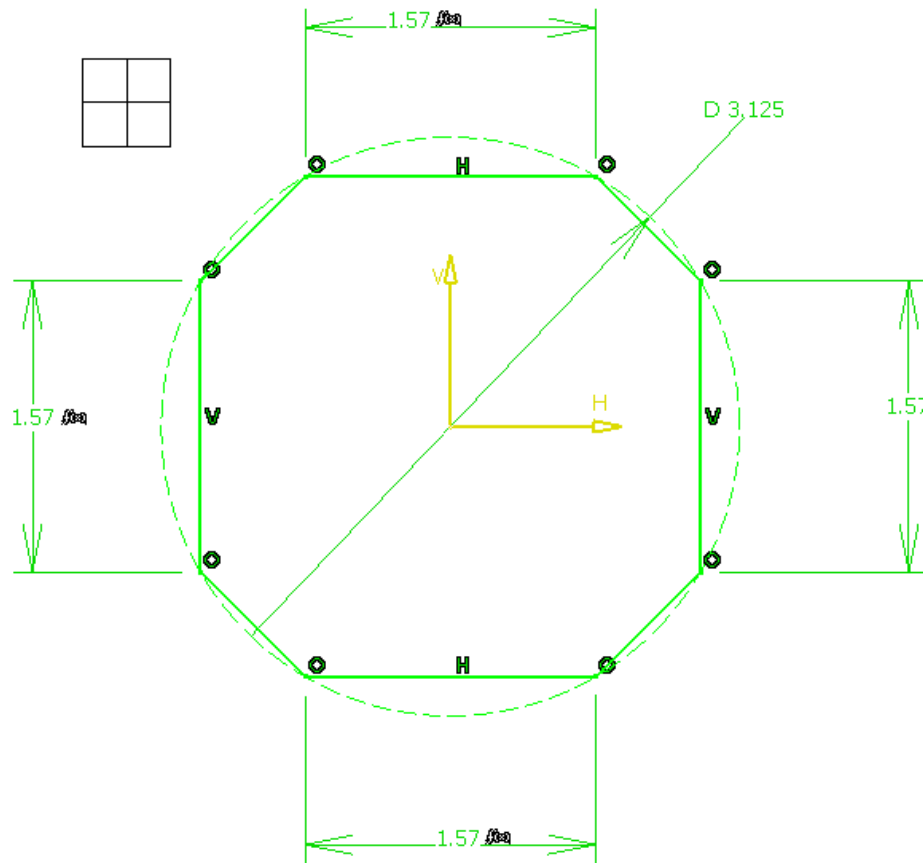
Under the *Origin* area, change the *Type* to *Projection point* and select the point that you just created. This locates the origin of the positioned sketch at the point.

Under the *Orientation* area, change the *Type* to *Parallel to line* and select the top edge of the pad as shown below. This orients the horizontal axis to be parallel to this edge. This will allow you to have an input that controls the orientation of the cutout.

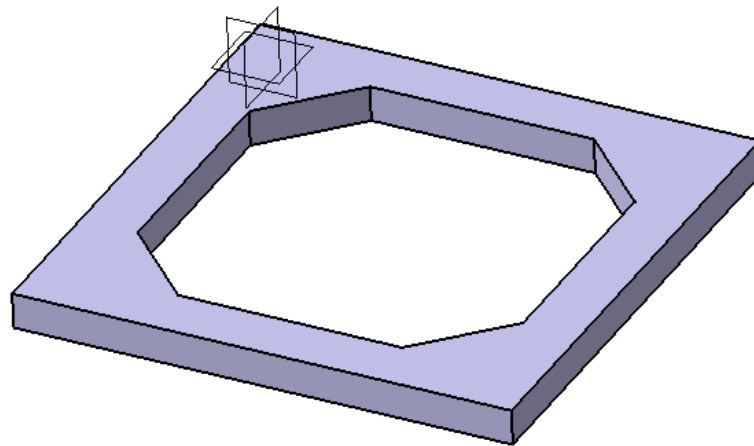


Select **OK**. You are in the sketch.


Create the following sketch. It is shown without the pad. The four sides should be tied together using formulas.

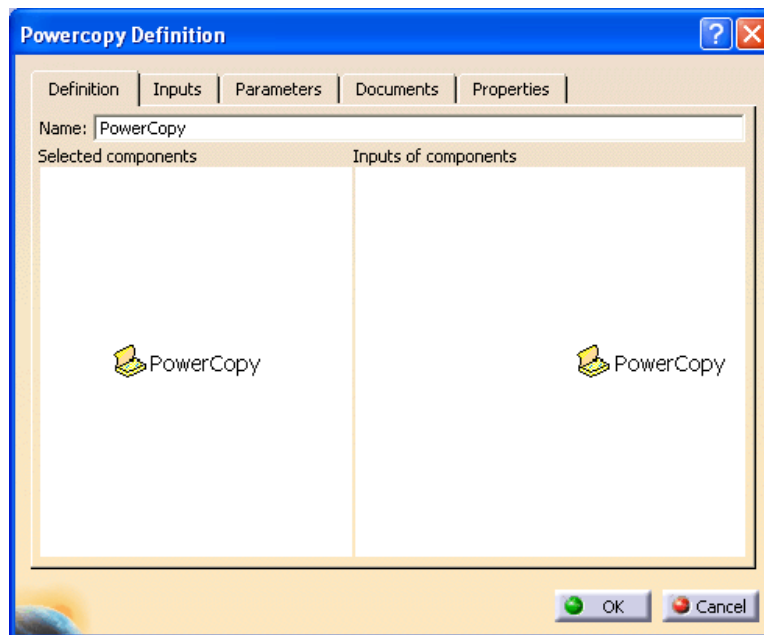


Exit the sketch and create a pocket, using *Up to last*. It should appear as shown below.



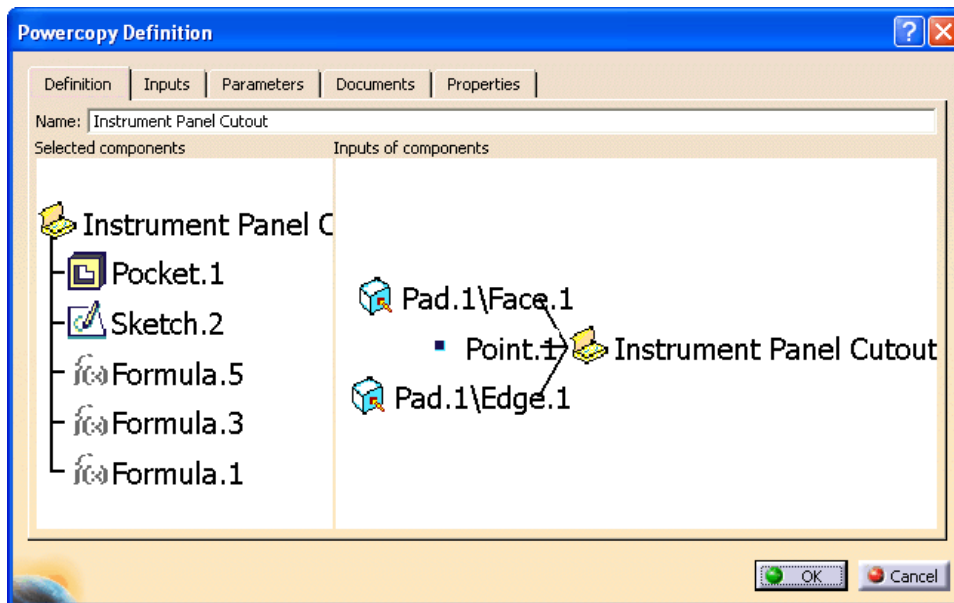
You are now ready to build your power copy of this feature.

Select the **Create a Power Copy** icon in the bottom toolbar.  The *Powercopy Definition* window appears.



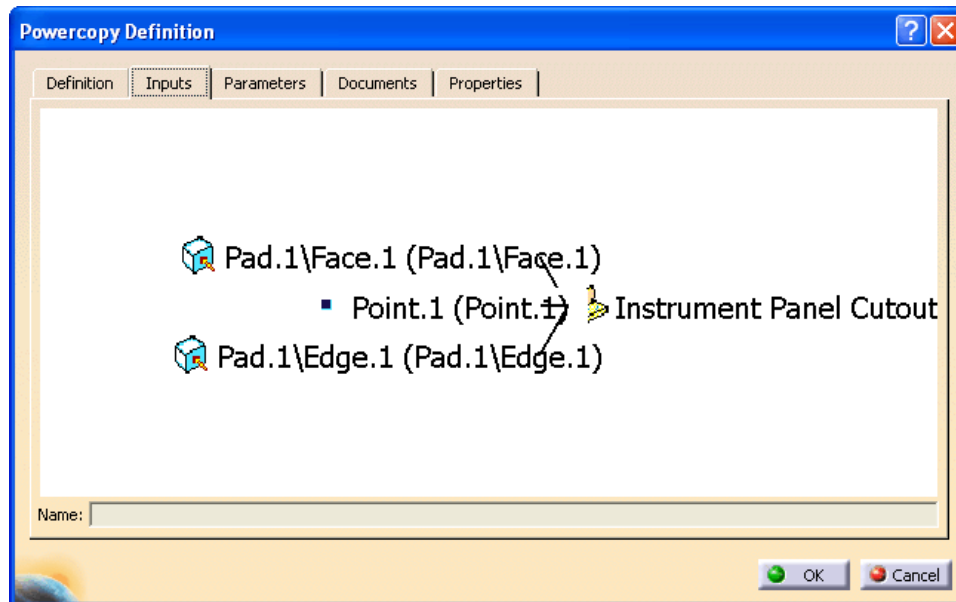
Change the *Name* to be **Instrument Panel Cutout**. Now you need to define what will be used to create the power copy.

Select the **pocket and its sketch from the specification tree**. This specifies that the pocket will be used to define the power copy. The window should appear as shown.

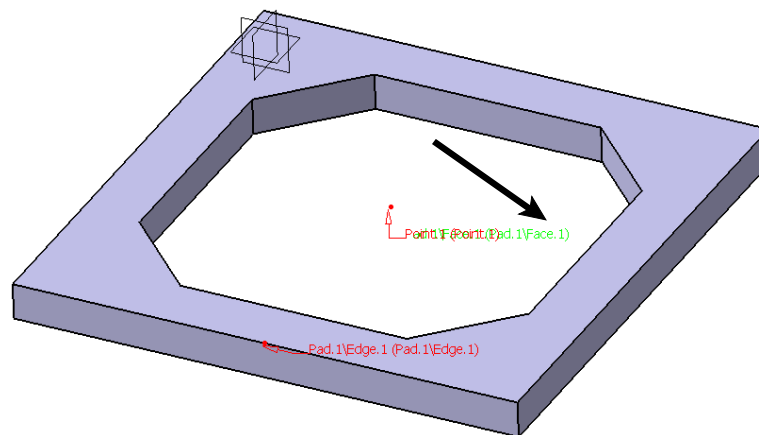


This window displays all of the inputs that were used to create the pocket. It is a good idea to give the inputs proper labels so that another user will have an idea of what they are defining upon instantiation.

Select the **Inputs** tab. The window should appear as shown. This allows you to give the inputs appropriate names.



Select the **first input in the window (This should be the face)**. You should notice this is the input specifying the sketch support for the pocket. It should highlight green in the display as shown below.



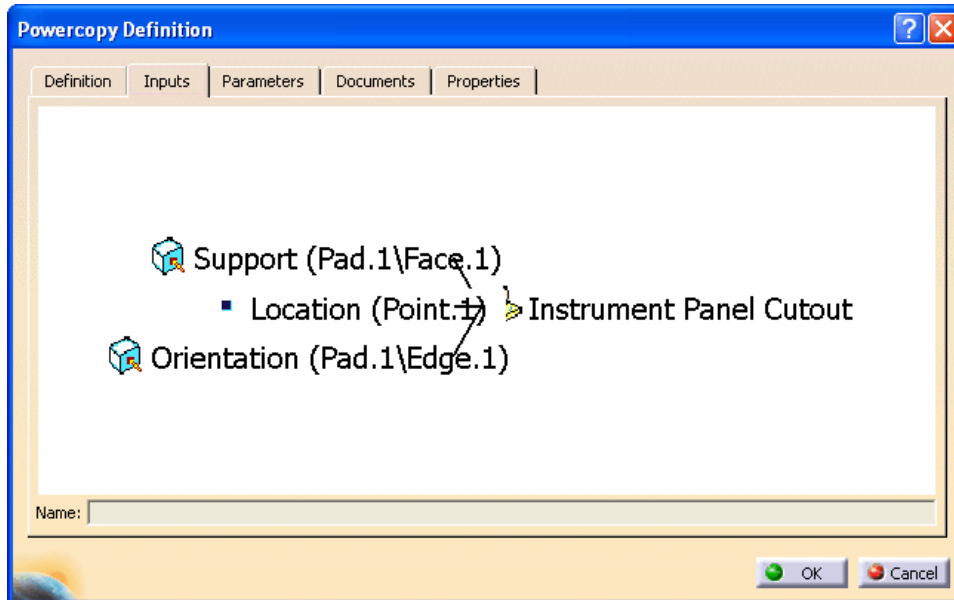
Change the **Name** of the input to be **Support**. This is a more meaningful name.

Select the **next input (This should be the point)**. This should be the input for the location of the sketch origin of the pocket. Check the display to make sure the correct input highlights green.

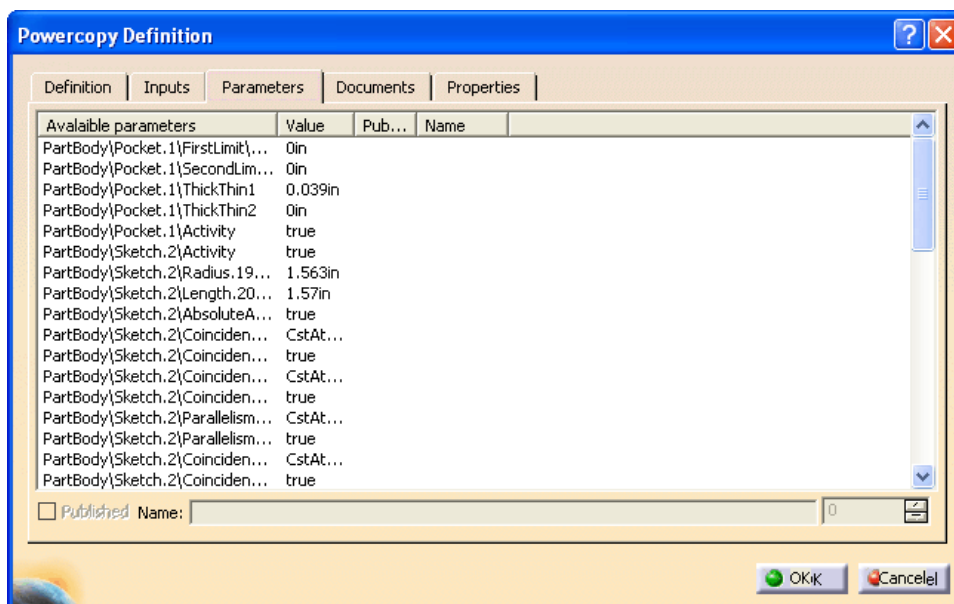
Change the **Name** to be **Location**.

Select the last input (This should be the edge). This should be the input for the orientation of the horizontal axis of the sketch of the pocket. Check the display to make sure the correct input highlights green.

Change the Name to be Orientation. The window should appear as shown.



Select the Parameters tab. The window should appear similar to the one shown below. This shows all of the parameters involved with this power copy. You have the option of publishing any of these parameters if you want the user to have the option of changing them upon instantiation. You are going to publish the radius of the construction circle and the length of a side.

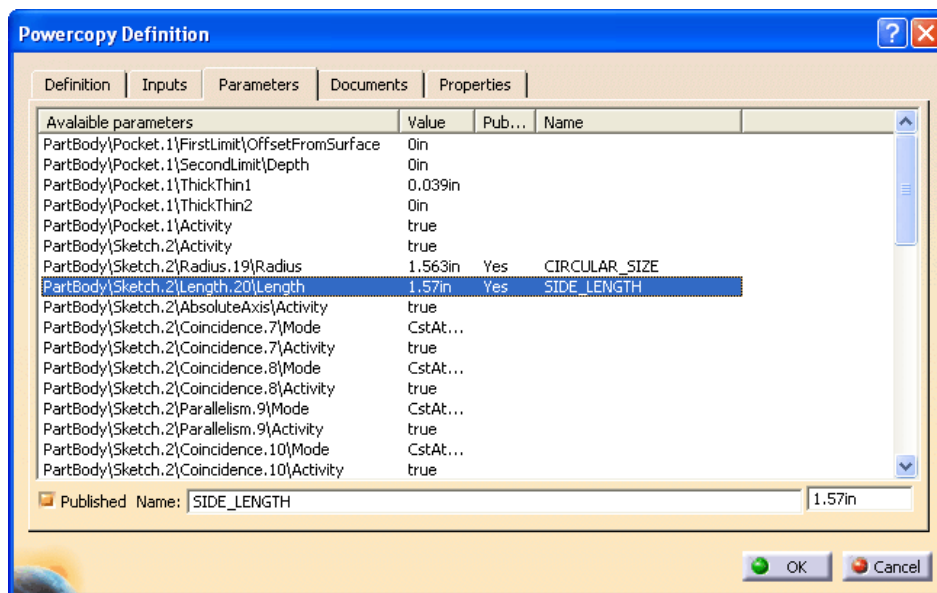


Double select on the *Radius* parameter with a Value of 1.563in. This parameter is for the radius of the circle used to constrain the sketch of the pocket. By double selecting on the parameter, you are activating it so it will be available for use when you instantiate the power copy later on. You can change the name of the published parameter at the bottom of the window.

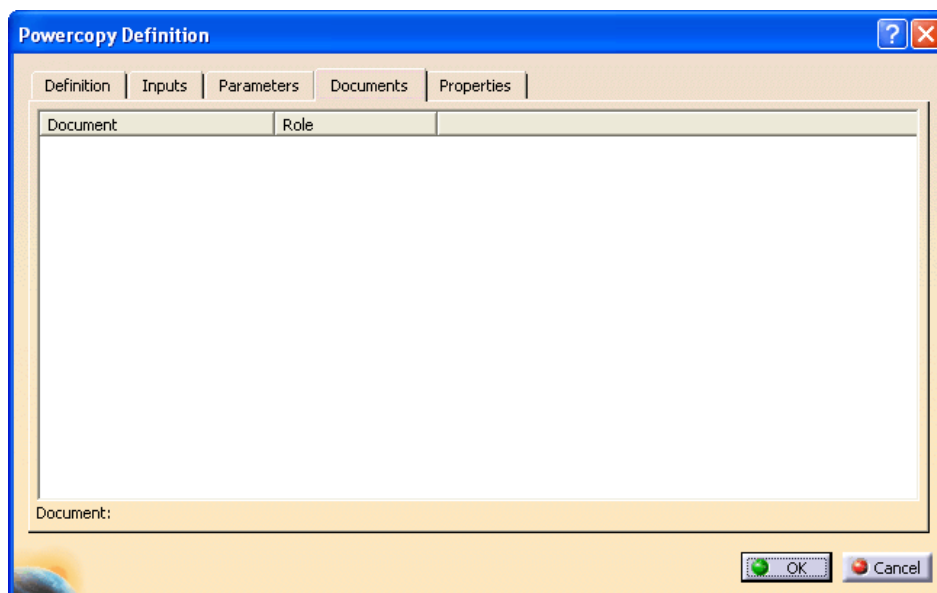
Change the *Name* to be CIRCULAR_SIZE.

Double select on the *Length* parameter with a Value of 1.57in. This parameter is for the length of the sides of the cutout.

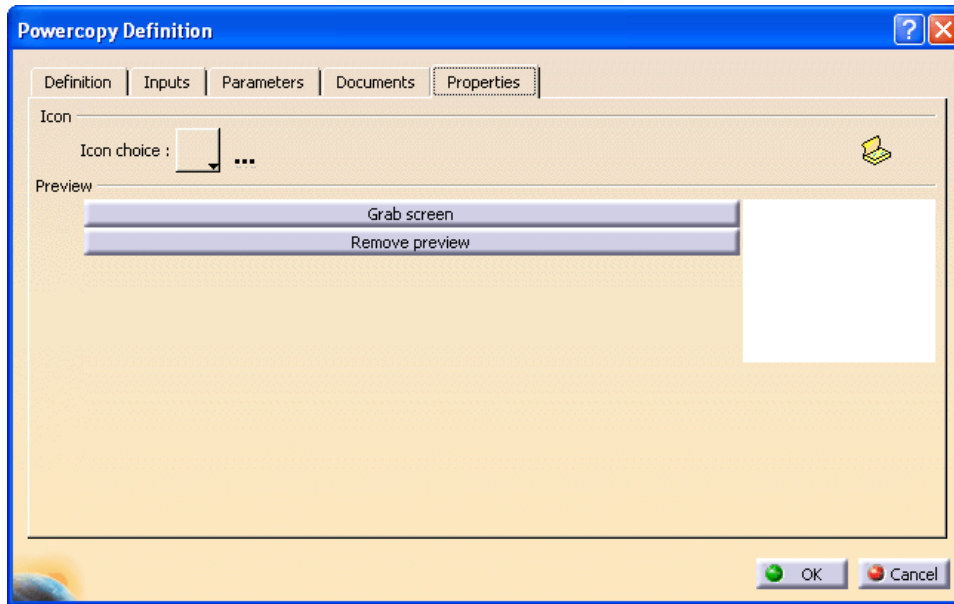
Change the *Name* to be SIDE_LENGTH. The window should appear similar to the one shown below.




Select the *Documents* tab. The window appears similar to the one shown below. If the model was connected to a design table, the design table would show up under this tab.

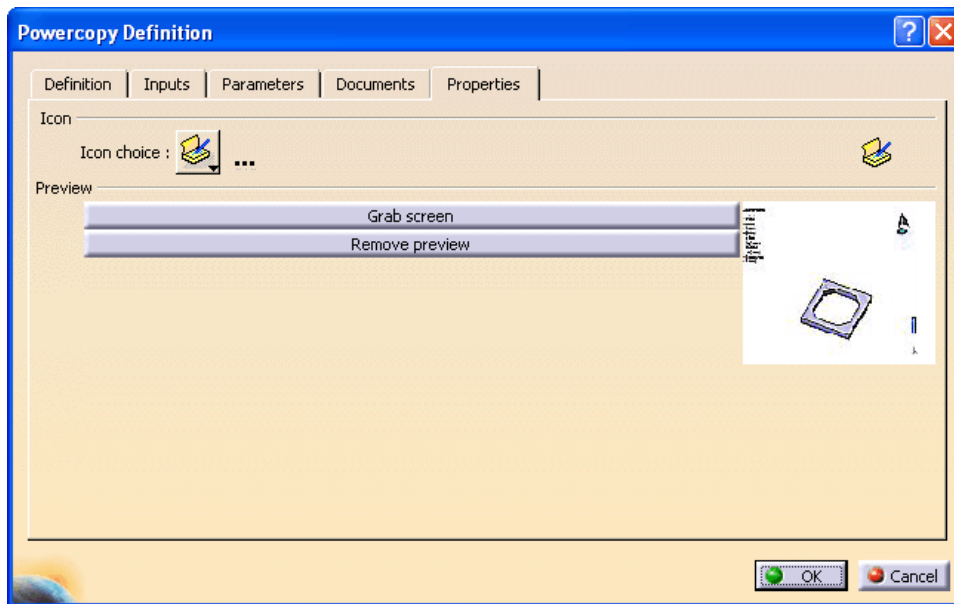


Select the *Properties* tab. The window should appear similar to the one shown below. This window will allow you to choose an icon to represent the power copy as well as attach a preview via a screen shot.

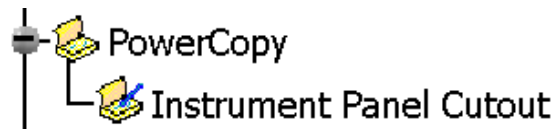


Change the *Icon choice* to this icon.  The power copy will utilize this icon in the specification tree. If you were to select the ... then you could choose an icon from any of the ones available throughout CATIA V5.

Select the *Grab screen* button. A preview should appear in the window.




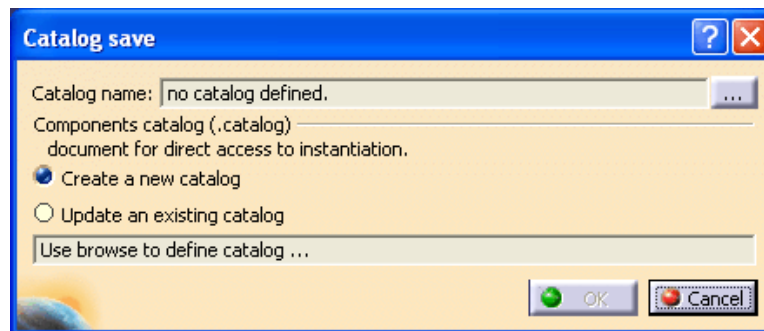
Select OK. The power copy is created and appears in your specification tree.



You can just have the power copy stored in a document but you also have the option of storing a power copy into a catalog.

Save the document. You need to save the document in order to save the knowledge template into a catalog.

Select the Save in Catalog icon located in the bottom toolbar.  The *Catalog save* window appears. It is located under the create a power copy icon.



Select the ... button in order to define a new catalog and its location. This brings up the *Save As* window.

Go to your area and name the catalog as Knowledge Templates and select Save. This will create a new catalog. You have the option of updating an existing catalog with the new templates.

Select OK. The power copy is stored in the catalog.

Save the document as Instrument Panel Cutout and close it.

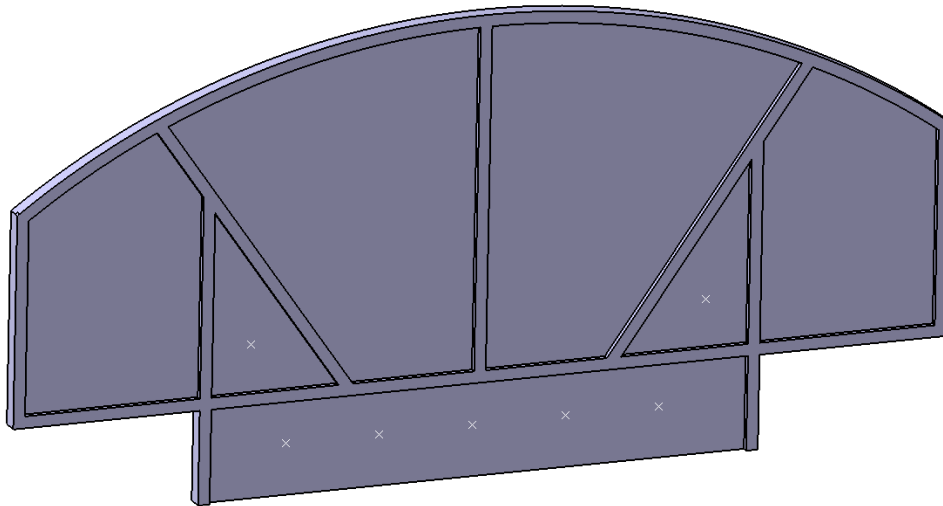
Instantiating a Power Copy


There are basically three methods to instantiating a power copy. You can instantiate it from a catalog, from a document or by selection. You will try all three methods in order to see how each works.

From a Catalog

This is probably the most common method used since it allows for a standards group to create power copies and then store them into catalogs that are easily used by other users.

Open the Power Copy - Instantiation document. The model should appear as shown.

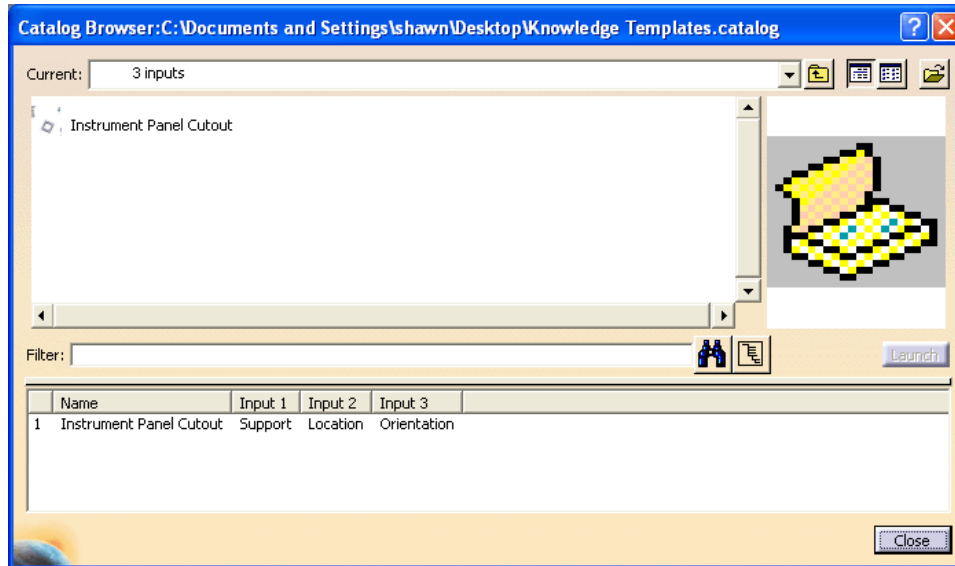


Select the Catalog Browser icon in the bottom toolbar.  The *Catalog Browser* window appears.

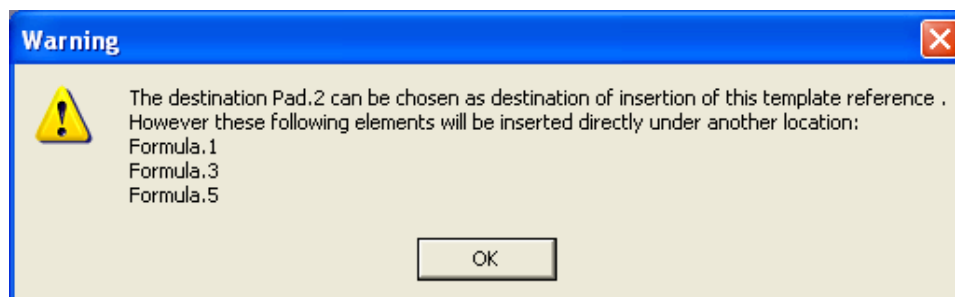
Open your Knowledge Templates catalog that you just created. You will see that you have an item labeled *PowerCopy*. If for some reason you had trouble creating the catalog earlier you can open the one located in the models area (*Power Copy - Knowledge Templates*).

Double select on *PowerCopy* in the window. You should see an item labeled *3 inputs*. CATIA automatically sorts your power copies by the number of inputs.

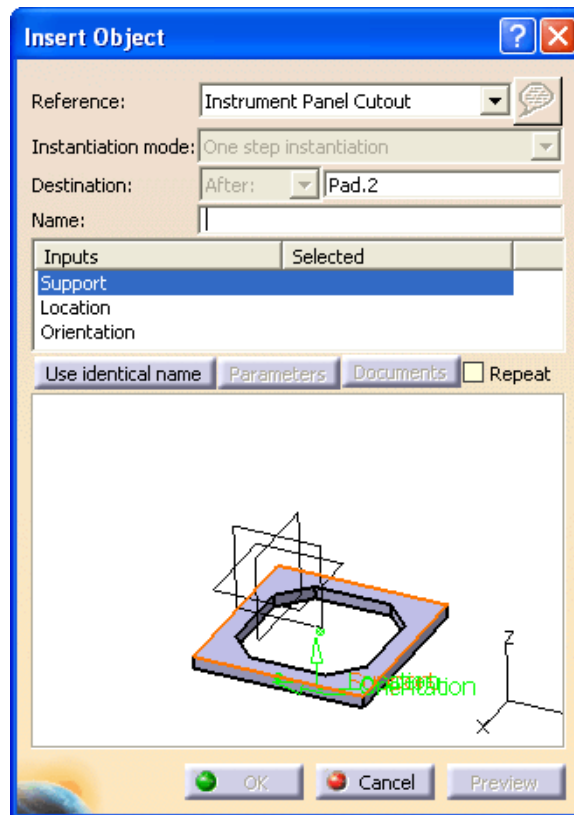
Double select on 3 inputs in the window. You should see your *Instrument Panel Cutout* as shown below.



Double select on the *Instrument Panel Cutout* in the window. A *Warning* window appears. This lets you know that the formulas associated with the power copy will be inserted into your current document in a different location than the current location specified which is after *Pad.2*.

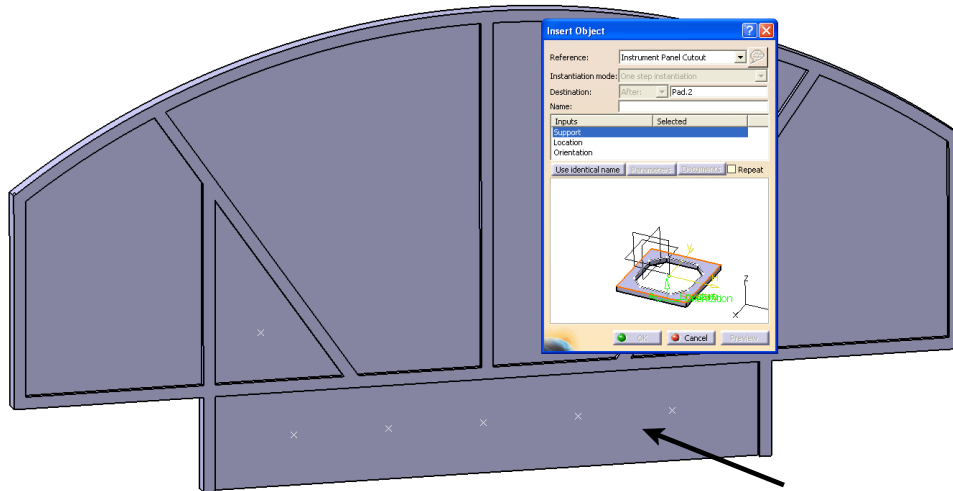


Select **OK** to the **Warning** window. An **Insert Object** window appears.



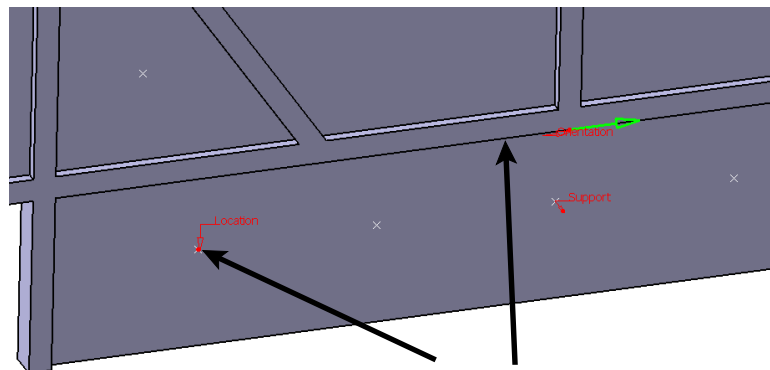
| | |
|---------------------------|--|
| <i>Reference</i> | Specifies which knowledge template to insert. This only applies if there are multiple choices. |
| <i>Instantiation mode</i> | Sets how the item will be instantiated |
| <i>Destination</i> | Specifies where the item will be inserted in the document |
| <i>Name</i> | Gives the inserted feature a name if the template only creates a single feature |
| <i>Inputs</i> | Shows which input is being defined |
| <i>Use identical name</i> | If you have items that are named the same as the inputs they will be automatically used when you select this option |
| <i>Parameters</i> | Allows you to change the parameters that were published with the power copy |
| <i>Documents</i> | Gives you access to any documents associated with the power copy |
| <i>Repeat</i> | Repeats the instantiation using the same inputs, this allows you to just replace the inputs to continue instantiating them |

With **Support** selected, select the face of the part as shown below. It should automatically move to the *Location* input.

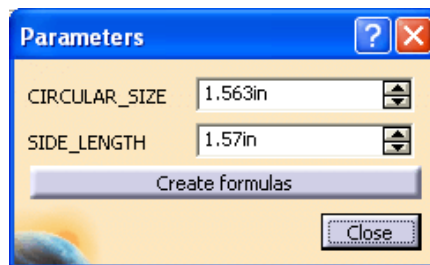


With **Location** selected, select the point on bottom left as shown below. It should automatically move to the *Orientation* input.

With **Orientation** selected, select the horizontal line as shown below. All of the inputs have been defined.

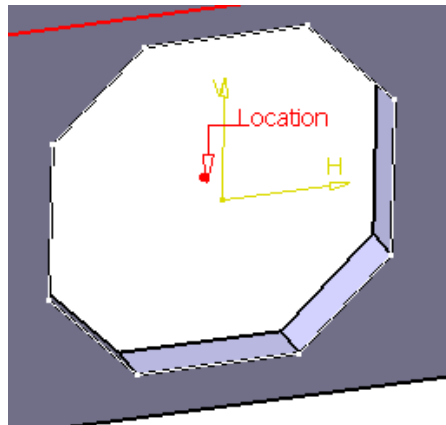


Select the **Parameters** button. A *Parameters* window appears. This allows you to enter new values for the published parameters.

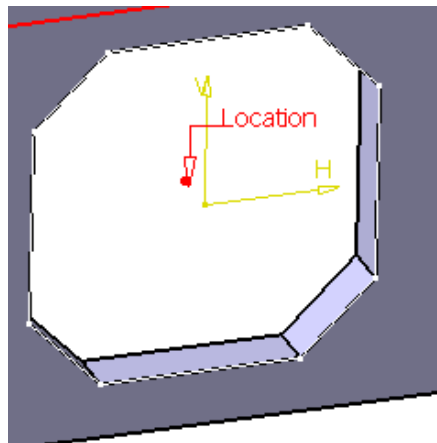


Change the **CIRCULAR_SIZE** to be **1.75** and the **SIDE_LENGTH** to be **1.5** and select **Close**.

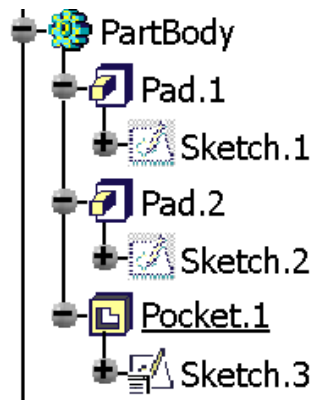
Select **Preview**. The cutout appears.



Select the **Parameters** button again and change the **SIDE_LENGTH** to be **1.75** and select **Close** and then select **Preview** again. The cutout changes shape according to the specified parameters.



Select **OK**. The power copy is instantiated and you are returned to the *Catalog Brower* window. You should notice that a pocket appears in your specification tree. This is the feature that was power copied.



Select **Close**. You are finished with the catalog.