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Introduction

CATIA Version 5 Electrical Harness Design

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

- Define geometric bundles
- Define complete harnesses of a dynamic length
- Define complete harnesses of a static length
- Develop harnesses within the context of a product
- Develop and utilize a harness in multiple products

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Electrical Harness Design

Defining an electrical harness requires two steps. You must first define the required connectors and connection points. Once you have these connections, you are ready to begin defining the geometric bundle that links the various connection points. These geometric bundles will behave as a space reservation for the wiring they will contain. In this section of the course, you will not be defining the actual wires within the geometric bundle, but rather just the overall size and shape of the geometric bundle that will contain the wiring.

There are two workbenches involved in electrical harness design. They are the Electrical Harness Assembly and the Electrical Harness Installation workbenches. The Electrical Harness Assembly workbench will allow you to work with the geometric bundle as a whole. The Electrical Harness Installation workbench will allow you to define the specific bundle segment and route the bundle. The two workbenches are used simultaneously to define the geometric bundle. Although the Electrical Harness Installation workbench is a separate workbench, it is generally only accessed through the Electrical Harness Assembly workbench when defining a specific bundle segment. This is a similar behavior to the Sketcher and Part Design workbenches. You generally do not access the sketcher workbench directly, but instead you access sketcher through the Part Design workbench. In our case, the Electrical Harness Assembly workbench works in the product environment, whereas the Electrical Harness Installation workbench works with a specific branchable part in the product.

In this course, you will not be defining the specific wires within the geometric bundle. Instead, you will be defining the bundle as a whole for space reservation and connectivity information and not to define pin to pin connectivity. To define pin to pin connectivity you will need to study the Electrical Wire Routing workbench. With that said, keep in mind, you can always define a geometric bundle per wire if desired. This will emulate defining specific connectivity, however, you will find that it will require a lot of time and work when dealing with smaller wires.

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Electrical Harness Design

In this section, you will look at developing a simple single branch harness. Keep in mind, you will be using both the electrical harness assembly and electrical harness installation workbenches. These two workbenches work together to define the harness and the bundles.

Defining Geometric Bundles

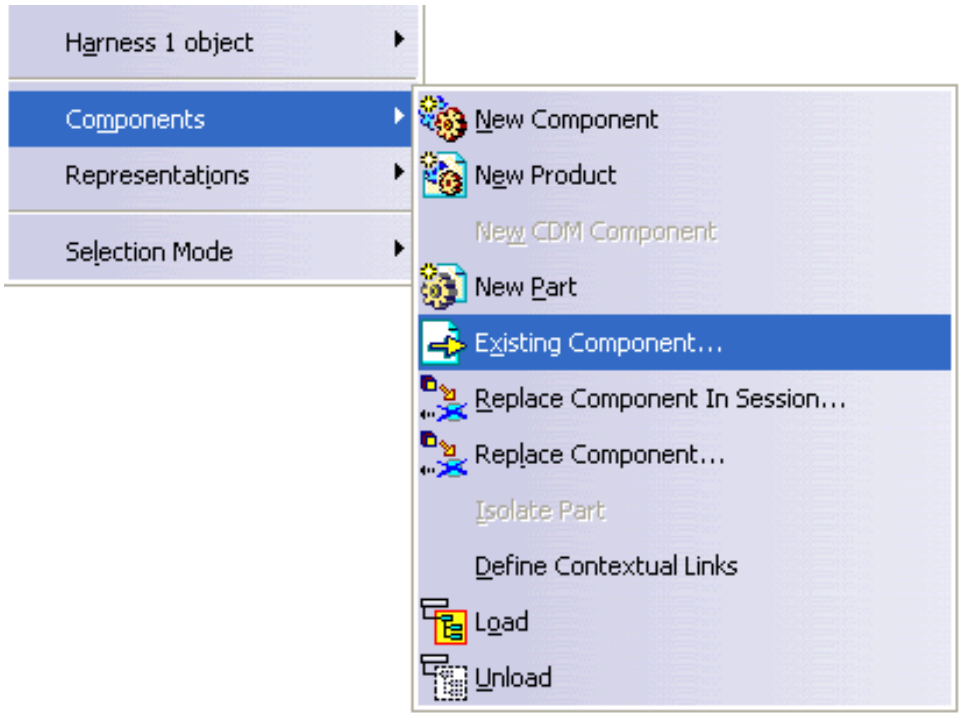
In this first exercise, you are going to look at creating a basic geometric bundle between two connectors. As you continue through this book you will find the harnesses and bundles becoming more and more complex as the options are covered in more detail.

Create a new product. Name the product Harness 1. This new product will serve as your first harness.

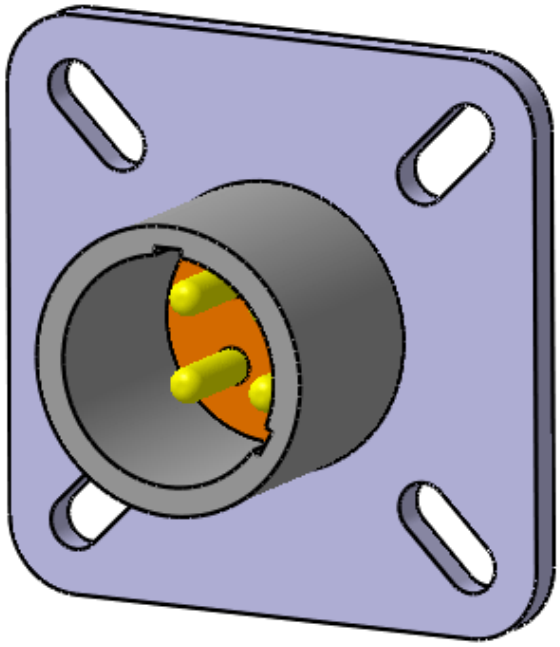
If not already there, switch to the Electrical Harness Assembly workbench. This will allow you to build the electrical harness. It is available under the *Equipment & Systems* solution and the *Electrical Harness Discipline*.

Notice there is not an icon to insert an existing component into the product. This is not an issue since you can use the *Insert* pull down menu or right click on the product.

Right click on *Harness 1* in the specification tree and select *Components, Existing Component*. This will display the *File Selection* window.



Insert the 4 Pin Mount Connector document from the *Electrical Harness I* directory. This will be a simple four pin mounting connector.

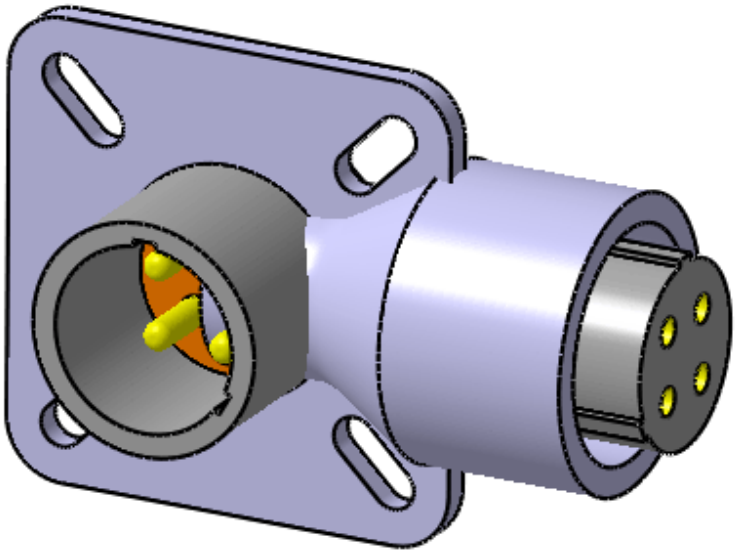


Remember, you can also insert components from the catalog.

Select the Catalog Browser icon from the bottom toolbar. This will display the *Catalog Browser* window.

Open the Electrical Catalog from the *Electrical Catalog* directory. Open the *Connectors* chapter and the *Single Insert Connectors* family. Remember, to open the chapters and families, all you need to do is double select on them.

Find the 4 Pin Connector and double select it, select *OK* to insert it into the product. Close the catalog browser when done. This will insert a connector into the assembly as well.



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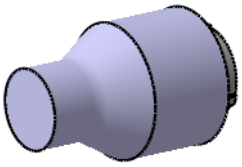
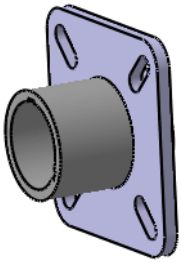
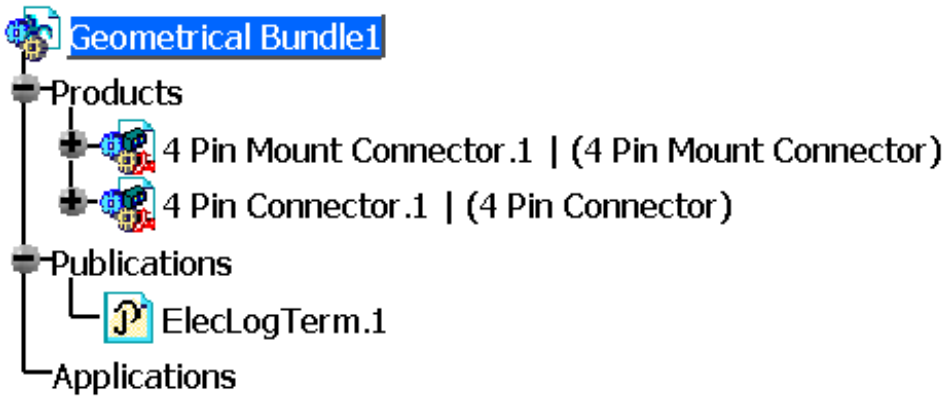
Using the compass or other manipulation tools, manipulate the 4 pin connector to the approximate location shown. The exact position is not required, just separate the two parts.





At this point, you have simply added a few connectors to your product. Now you are going to turn the product into a geometric bundle.

Select the Geometrical Bundle icon, then select *Harness 1* from the specification tree. Notice a few things happen in the specification tree.



With the default options, the product name will automatically change to *Geometrical Bundle1*. You can change the name of the bundle to anything you want.

Change the name of *Geometrical Bundle1* back to <u>Harness 1</u>. This will change the product name back. Remember, to change the name, you will have to go to the properties of the product.

At this point, you are ready to define a bundle between the two connectors.

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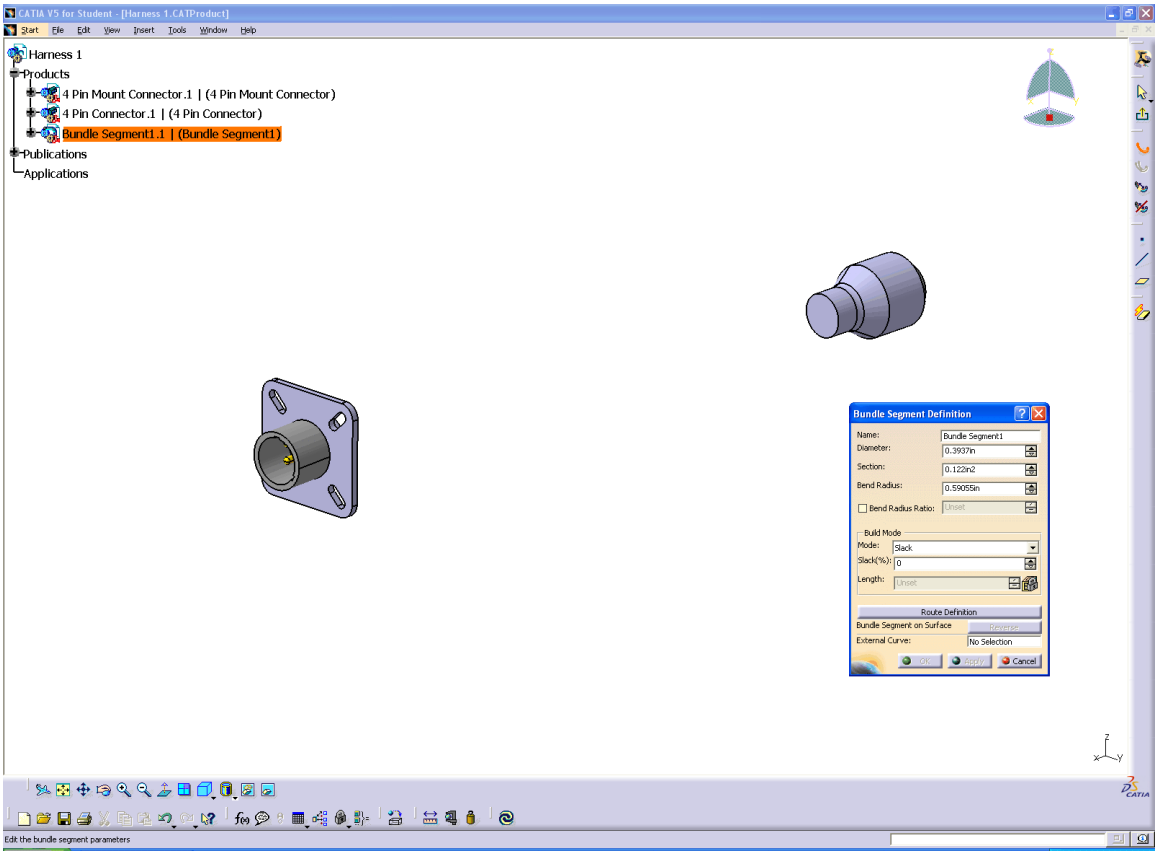
Select the Bundle Segment icon. This icon may be under the multi-branchable document icon. When you select the icon, a few things will happen.

By selecting on the bundle segment icon, you will automatically be switched into the Electrical Harness Installation workbench, as well as have a bundle segment created in the specification tree.



At this point, you are ready to define the bundle segment. Take a moment to examine the *Bundle Segment Definition* window.

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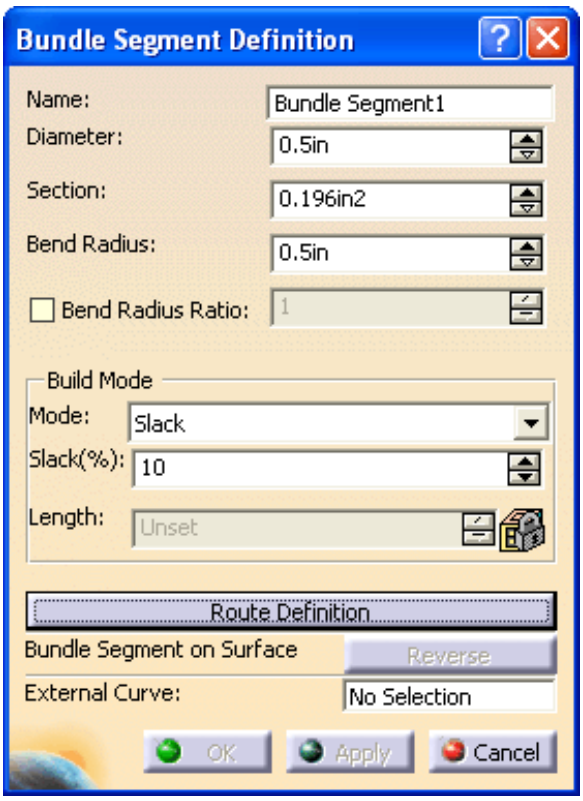


Name Specifies the name of the bundle

Diameter Specifies the outside diameter of the bundle

Section Specifies the cross sectional area of the bundle

Bend Radius Specifies the minimum bend radius allowed for the bundle

Bend Radius Ratio Defines the bend radius based on the diameter of the bundle. A ratio of 1 will set the *Bend Radius* to the same size as the bundle *Diameter*.

Build Mode

Mode

Slack Bundles are computed with a minimum distance, and then a percentage of slack is added to the bundle

Length Bundles are a set length, regardless of the amount of slack

Bend CATIA will compute the minimum length possible while respecting the *Bend Radius*

Slack (%) Defines the percentage of slack between connection points. Although 0% is allowed, there needs to be a slack of at least .1% to avoid update errors with Harness Flattening tools.

Length	Defines the length of the bundle when in *Length* mode. The length must be as long, or longer than the distance between the two connection points.
Route Definition	Defines the bundle route
Bundle Segment...	Allows for the bundle to swap sides of a surface that is attached to the bundle
External Curve	Allows selection of a curve to define the bundle route

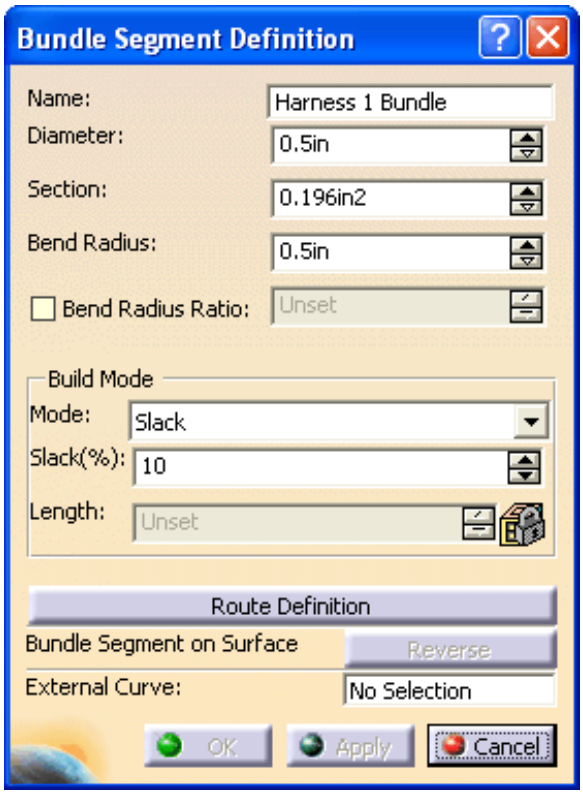
Many of these parameters will be tested further once the route is defined.

Change the *Name* to Harness 1 Bundle. This will define the name for the bundle.

Unless already set, change the *Diameter* to 0.5in. You will notice the Section will automatically change to 0.196in2. This is due to the two fields being computed based on each other.

Change the *Bend Radius* to 0.5in. Typically your bend radius will be equal to or greater than the diameter. If you set the bend radius smaller than the diameter, CATIA will display an error message about the impracticality of this.

Change the *Build Mode* to *Slack*, and set the *Slack* percentage to 10. This will have all the bundle options defined. Now to generate the bundle via the route definition.



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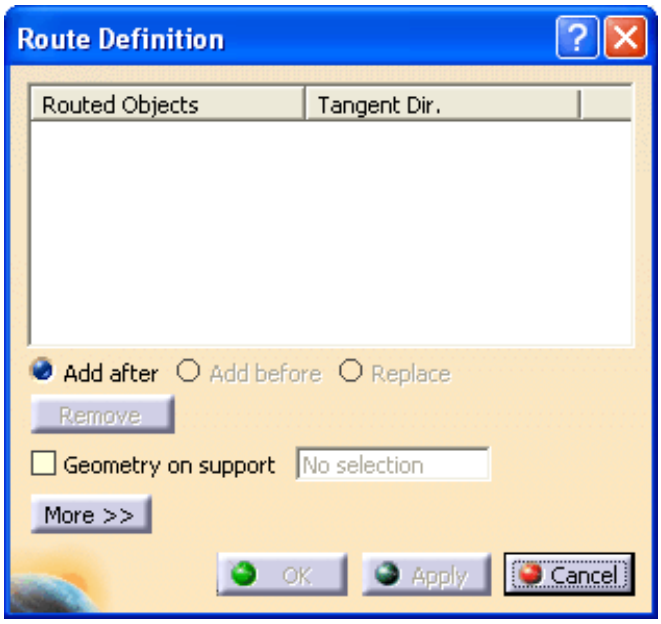
Select *Route Definition*. This will allow you to define the route for the bundle. The *Route Definition* window will display. Take a quick look a the various options in the *Route Definition* window.



Routed Objects / Tangent Dir.	This area displays the objects and points for the route definition
Add after	Adds points and connection points after the selected point
Add before	Adds points and connection points before the selected point
Replace	Replaces the selected point with another selection
Remove	Removes the selected point
Geometry on support	Allows bundles to be placed on surfaces or other support parts

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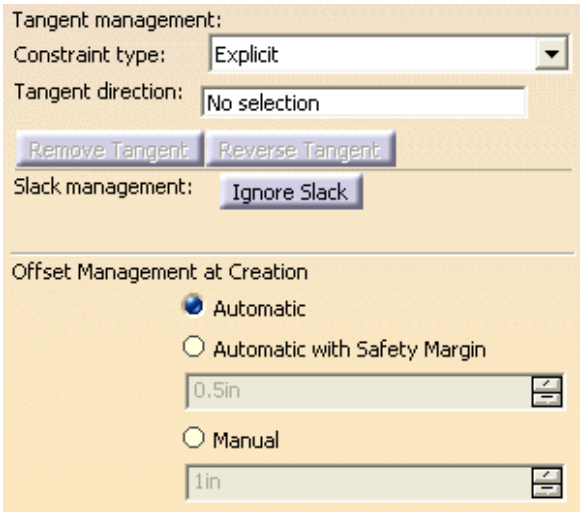
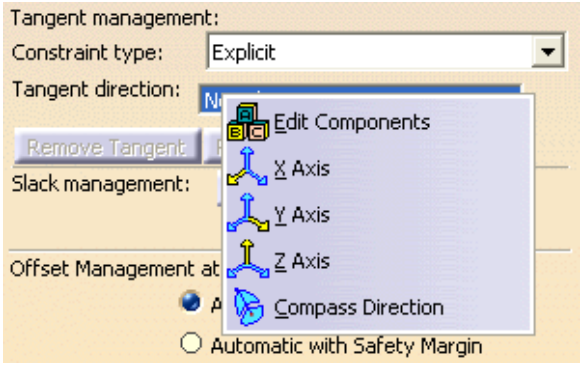
By selecting the *More>>* button, you get a few additional options.



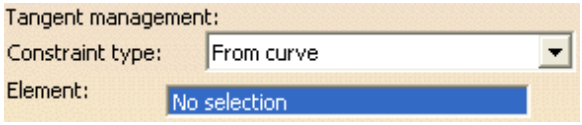
Tangent management

Constraint type Defines the type of tangency to be defined

Explicit Tangency is defined via a manual vector definition. Tangency definition is defined through a right click in the *Tangent Direction* field.



From curve Tangency is defined from a curve or line selection. When *From curve* is selected, the *Tangent direction* changes to *Element*.



Slack management, Ignore Slack Ignores or removes slack between points

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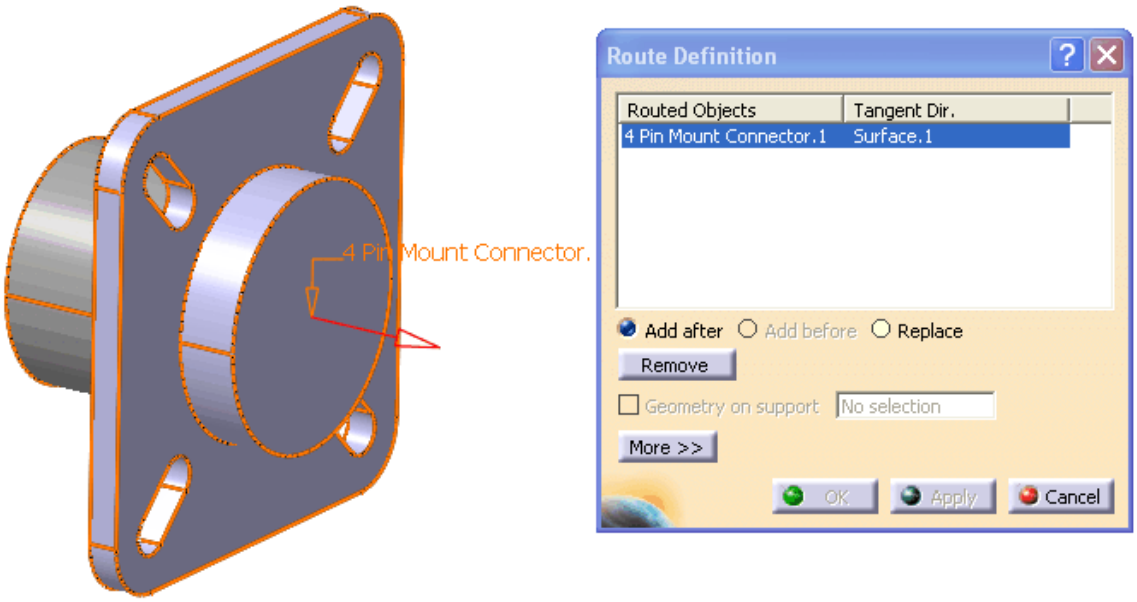
Offset Management at Creation

Automatic	Lays the bundle on the surface
Automatic with Safety Margin	Lays the bundle on the surface with an additional offset of the safety margin distance
Manual	Allows you to specify a specific distance for the bundle to exist off the surface

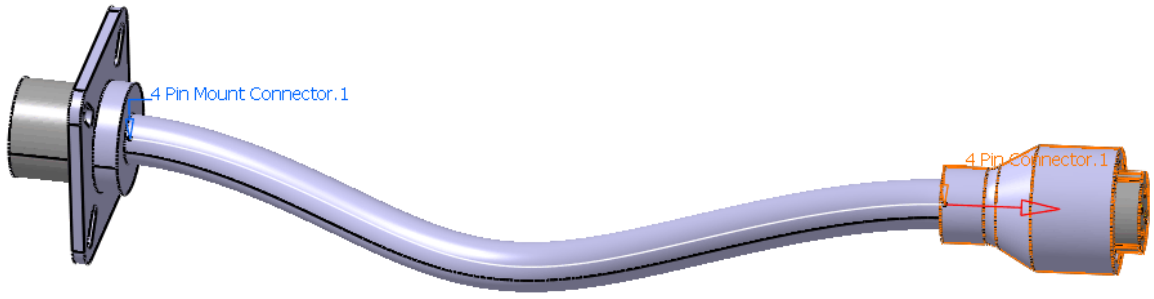
Now you are ready to define the route.

Select the 4 pin mount connector. Notice the connector is automatically added to the *Route Definition* window, as well as the bundle connection point is automatically defined.



Anytime you select an electrical device with a bundle connection point, the connection point will automatically be selected and the tangent direction will automatically be defined in the *Initial Condition* direction defined in the bundle connection point's placement constraints.

Select the 4 pin connector. This connector will also be defined in the routed objects. Notice the bundle is now present.

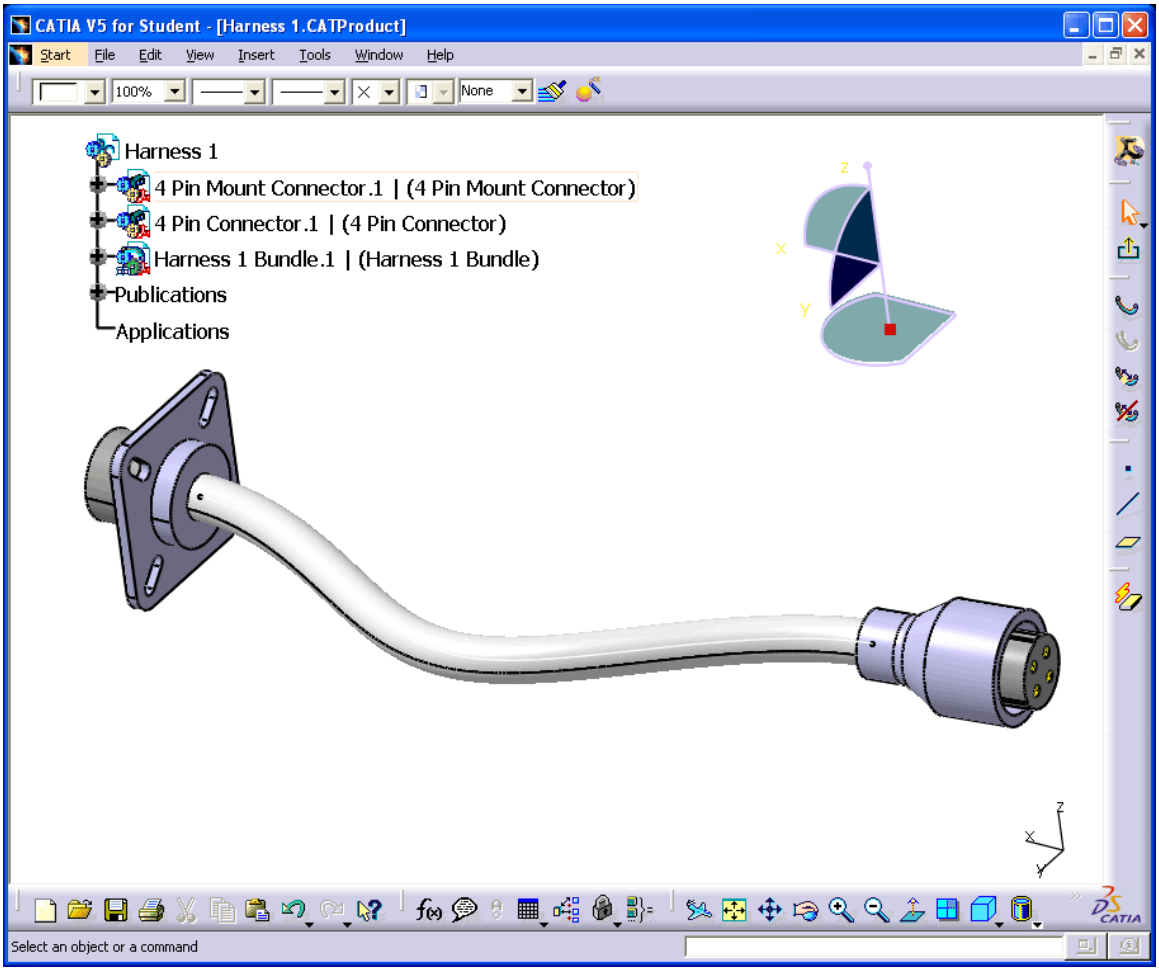


Note: The physical shape of the bundle may vary based on the position of the two connectors.

Select *OK* to the *Route Definition* window. This will take you back to the *Bundle Segment Definition*.

Select *OK* to the *Bundle Segment Definition* window. This will have the bundle defined.

Notice that you are still in the Electrical Harness Installation workbench.



Select the Exit icon. This will take you back to the Electrical Harness Assembly workbench.

Save your harness. When you save, you will be prompted to save the Harness 1 Bundle as well. Be sure you save the bundle into the same directory. Save Management would be a good option to use when saving your bundles. Leave your harness open, it will be used in the next section.

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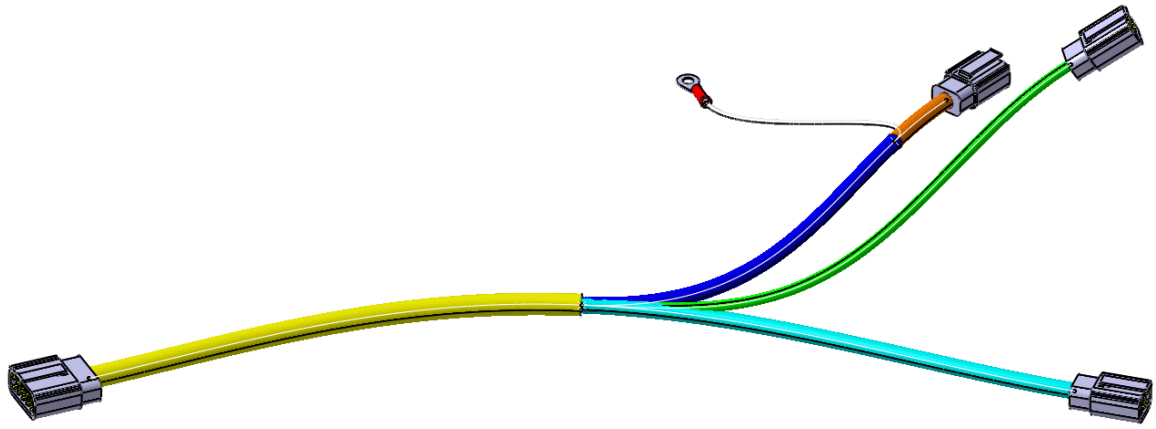
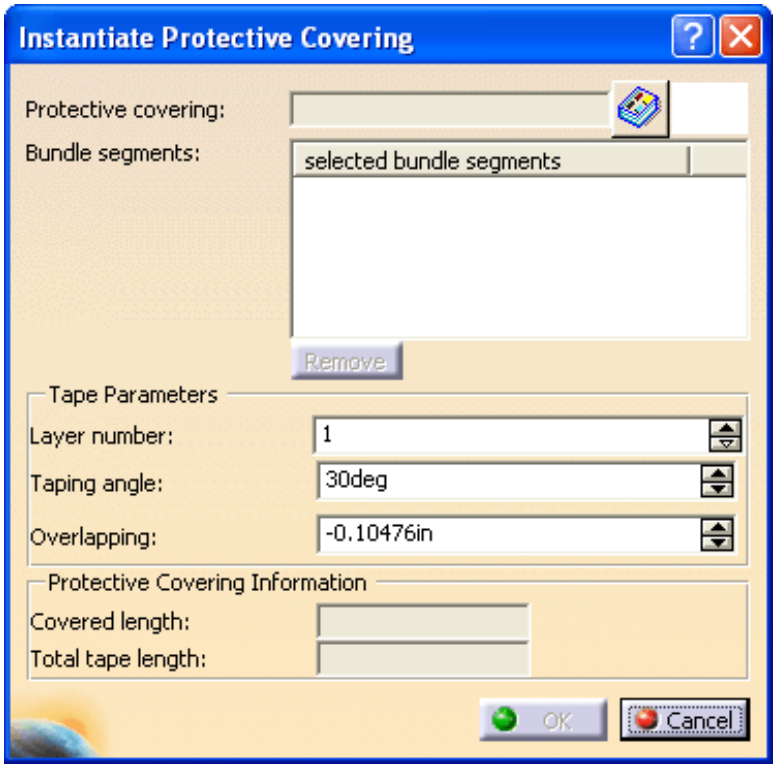
Protective Coverings

There may be many times when you want to add protective coverings to your bundles. You have the ability to add protective tape or a protective corrugated tube to your harness. Protective coverings are instantiated from an electrical catalog. By default, the protective covering will cover the entire bundle segment, however, it can be adjusted to cover just particular segments.

Open the Protective Covering document from the *Protective Covering* directory.
This is a simple harness that has several bundle segments of various sizes.



In the Electrical Harness Assembly workbench, select the Protective Covering icon.
This will display the *Instantiate Protective Covering* window. Take a moment to look at the various options in this window.



Protective covering	Defines the protective covering being applied. This protective covering must be selected from a catalog.
Catalog selection	Display the catalog browser for protective covering selection
Bundle segments	Specifies the bundle segments that will have protective covering applied

Tape Parameters

Layer Number	Defines how many layers of tape to that are to be applied
Taping angle	Defines the angle to which the tape is applied. A taping angle of 0deg indicates the tape is applied normal to the bundle. A taping angle of 90deg would indicate that the tape is run straight along the length of the bundle. You must define an angle between 0 and 90.
Overlapping	Defines the amount of overlap for each strip of tape

Note: Taping angle and Overlapping are computed based on each other. Changing one will automatically recompute the other parameter. When a corrugated tube is selected, the taping parameters go away.

Protective Covering Information

Covered length	Defines the length of the protective covering in millimeters
Total tape length	Defines the overall length of the tape used in millimeters

Select the catalog selection icon from the *Instantiate Protective Covering* window. This will display the *Catalog Browser* window.

Select the Browse Another Catalog icon, then select the Electrical Catalog found in the *Electrical Catalog* directory. This will open the class electrical catalog.

Double select the *Protective Covering* family. This will display all the protective coverings in the catalog.

Find and double select the 0.5" Corrugated Tube in the catalog.

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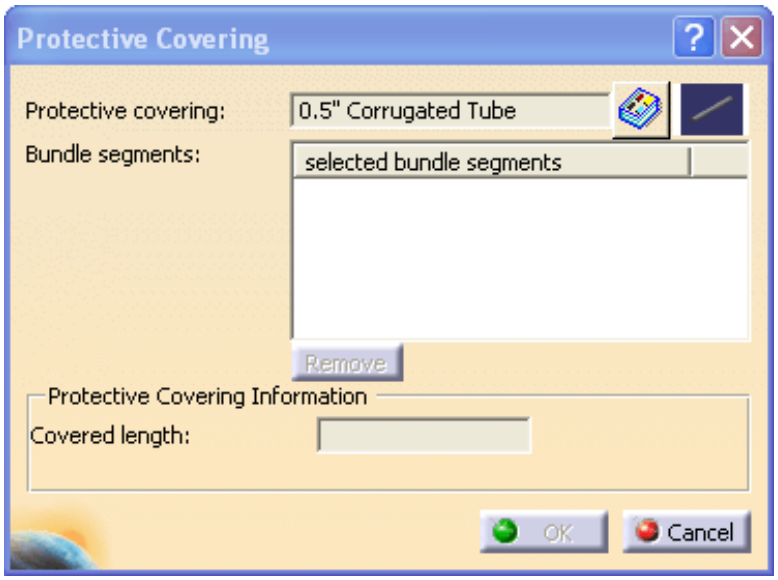
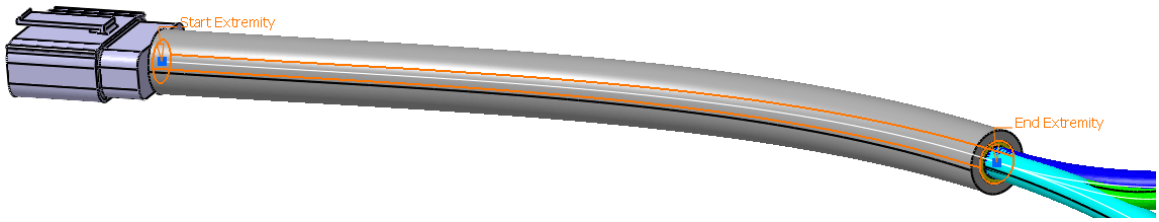
This will change the *Protective Covering* window for the corrugated tube.



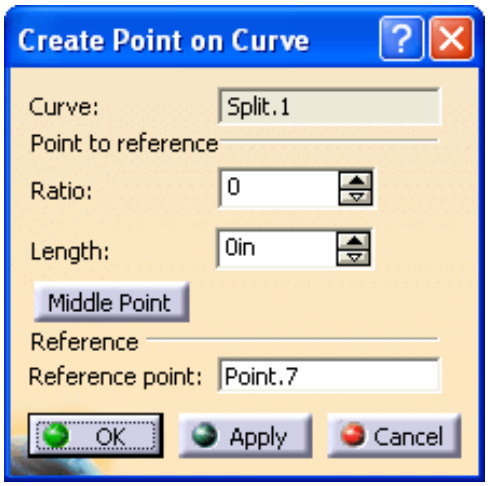
Notice all the tape parameters are now gone.

Select the yellow bundle segment. This will cover the yellow bundle with the corrugated tube.



You will also notice the *Start* and *End Extremity* text on the ends of the tube. These extremities allow you to adjust the endpoints of the tube.

Double select the *End Extremity*. This will display the *Create Point on Curve* window.



Curve Defines the curve that the tube or tape runs along

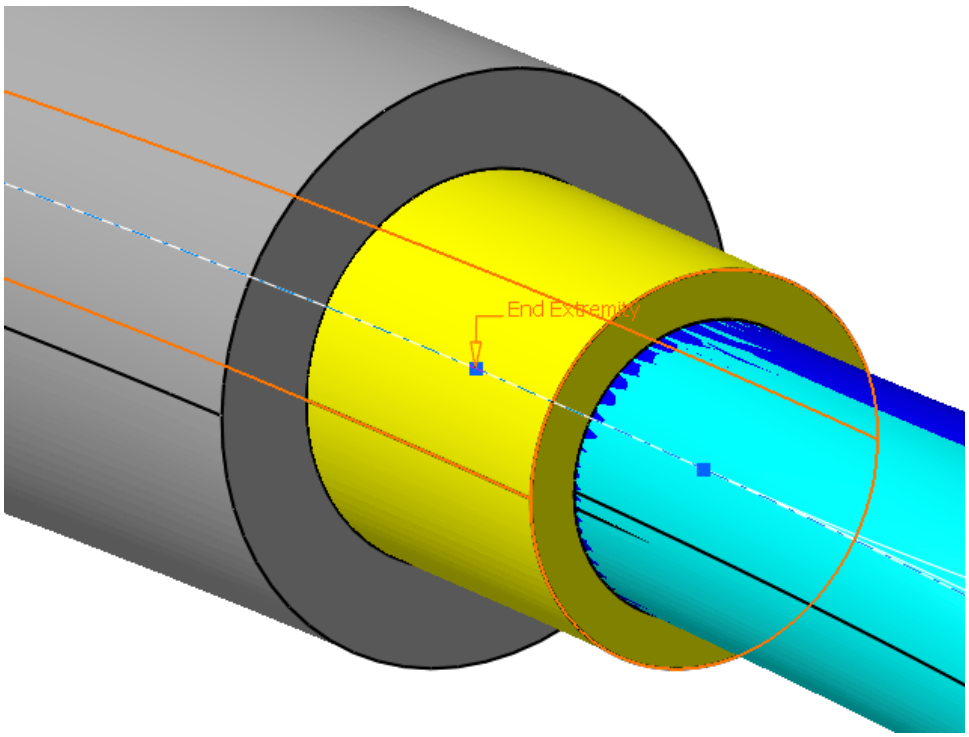
Point to reference

Ratio	Defines the ratio or percentage of the curve length the extremity stops
Length	Specifies the geodesic distances from the end of the curve to the end of the tube or tape
Middle Point	Sets the ratio to 0.5

Reference

Reference point	Defines the point in which the length or ratio is based

Change the *Length* to 0.5in and then select *Apply*. Notice the corrugated tube shortens by a half inch.



You will also notice that while the *Create Point on Curve* window is open, you can dynamically choose your endpoint by sliding your mouse along the centerline of the bundle segment.

Select the *Middle Point* button, then select *OK*. This will put the tube along half of the bundle segment.

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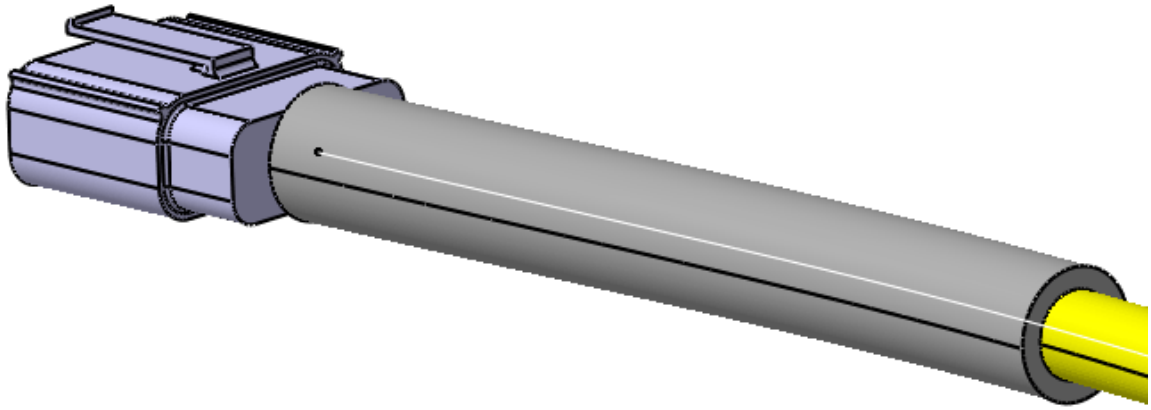
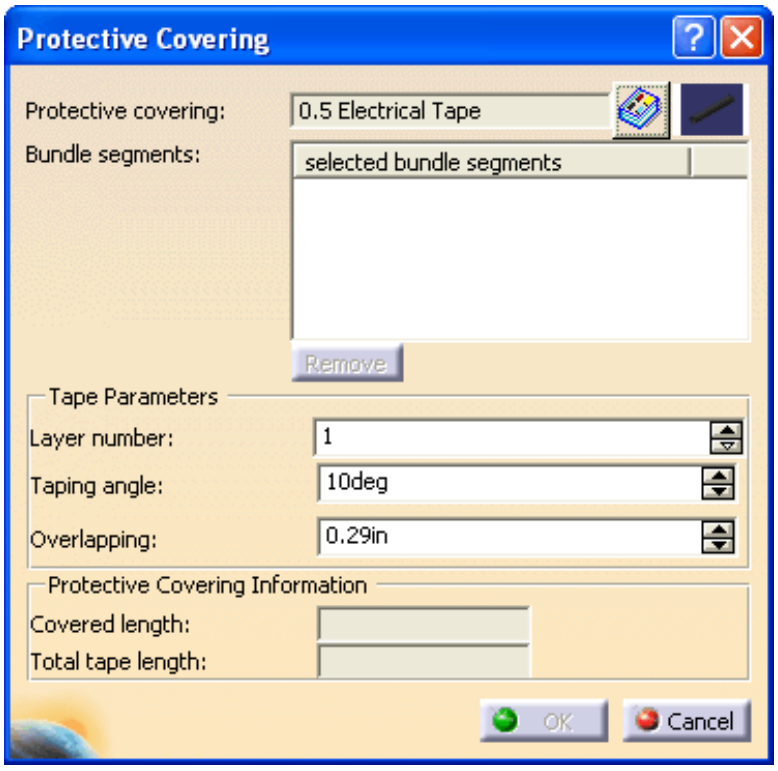
Select *OK* to the *Protective Covering* window. This will establish the protective covering.



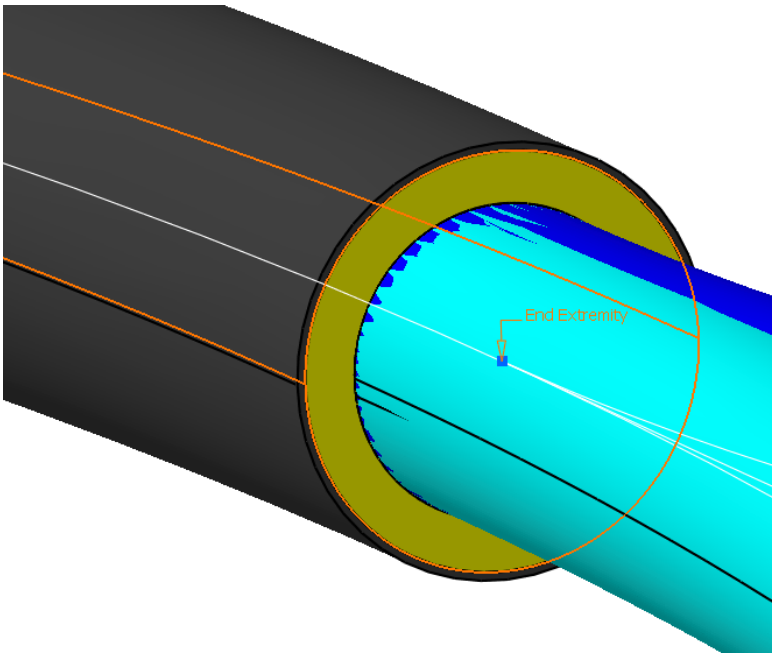
Select the Protective Covering icon again, then select the 0.5 Electrical Tape protective covering from the same catalog as before. You will have to go to the catalog as before.

Notice the tape parameters are still available.

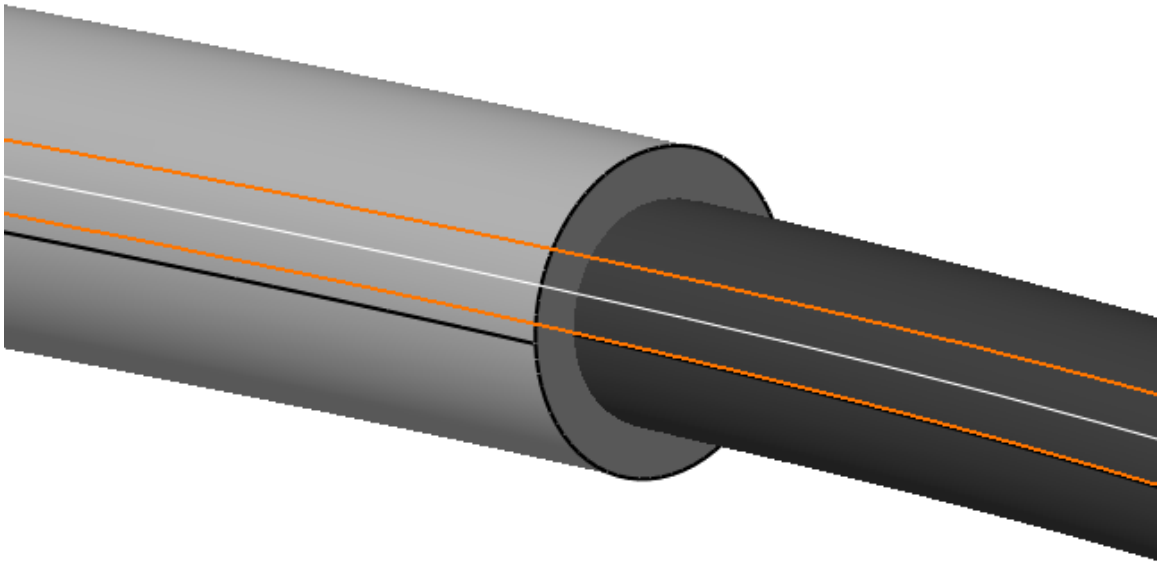


Set the *Taping angle* to 20deg. Notice the overlapping is automatically computed.

Select the yellow bundle again. This will wrap the bundle with the electrical tape.



Notice the tape runs under the corrugated tube.



This is the default behavior of the electrical tape. You can place electrical tape on top of the corrugated tube, you just have to adjust it afterwards. This will be done later.

Select *OK*. This will leave the electrical tape wrapped around the bundle.

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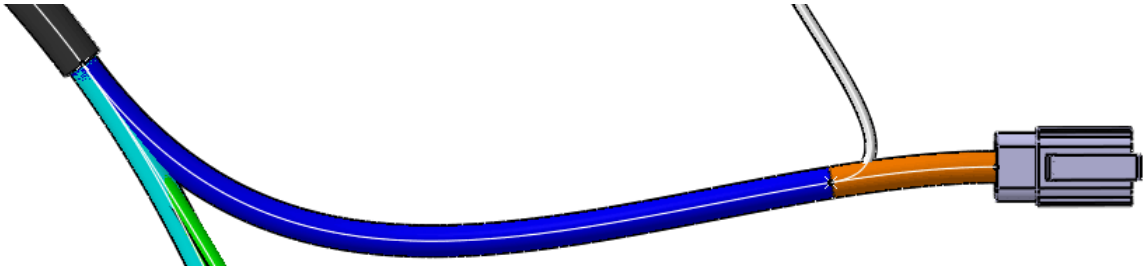
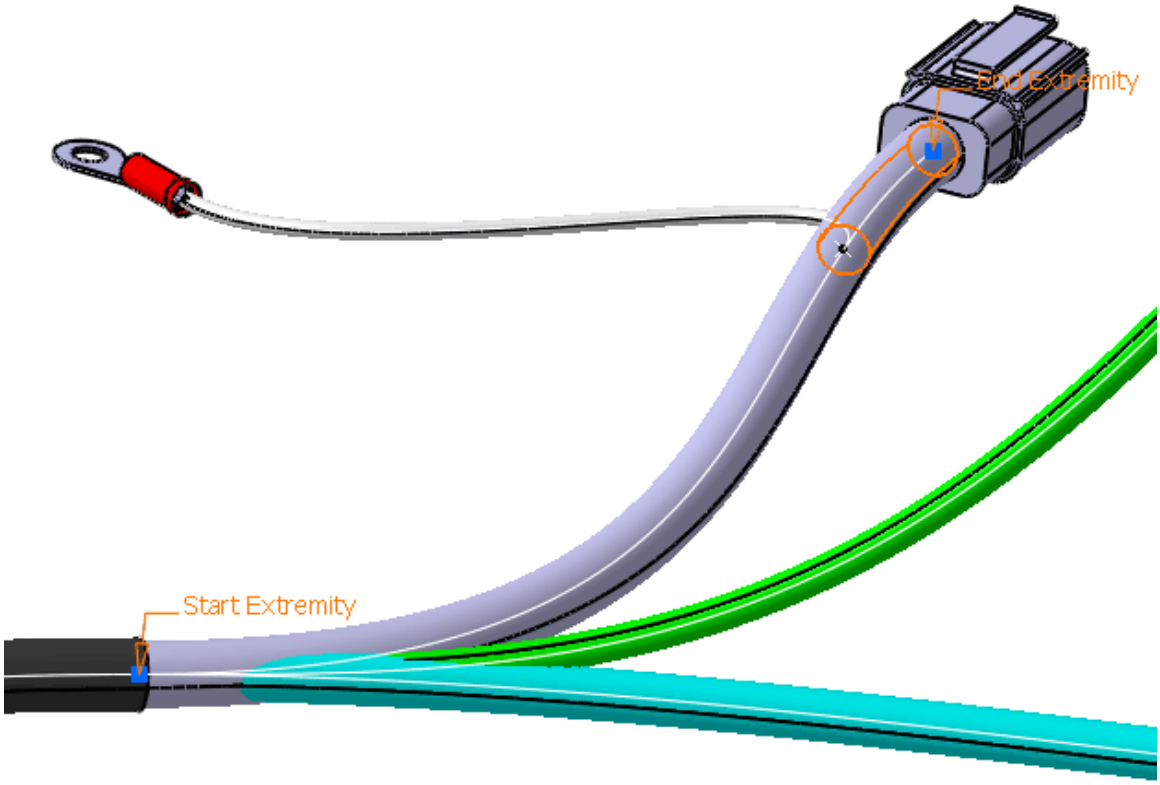
Select the Protective Covering icon again, then select the .375 Corrugated Tube from the catalog. Notice that you have two bundle segments running to one connector.



Select the dark blue and the orange bundle segment. In this case you will notice that the corrugated tube runs the full length of both bundle segments.

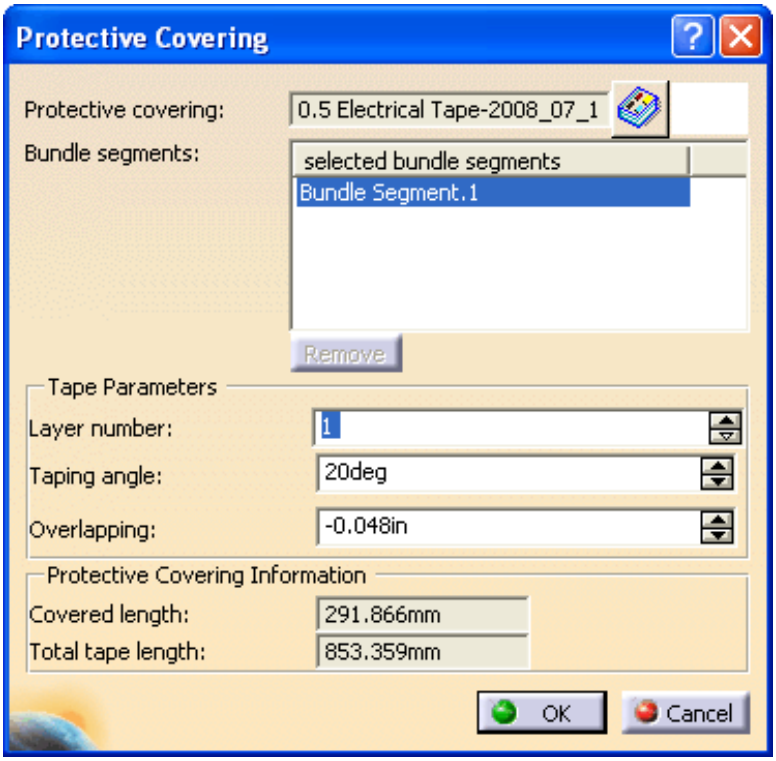


As long as the bundle segments are all part of the same branchable, then you can apply protective covering to them. When you have multiple branches, you cannot apply the protective covering to them at the same time. You must apply the covering independently.

Select *OK* when done.

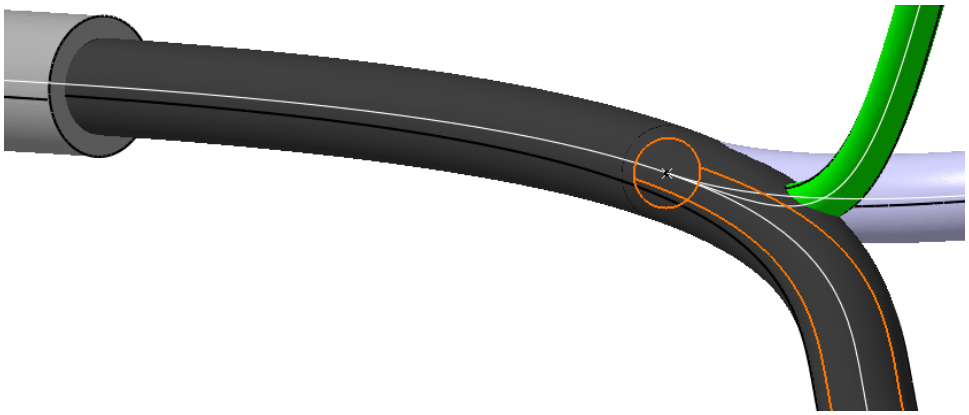
Modifying Protective Covering

Select *0.5 Electrical Tape* from the specification tree, then select the Protective Covering icon. This will display the *Instantiate Protective Covering* window for the electrical tape.



Select the aqua bundle segment. Since this is also on the same branchable, then you can add it to the tape definition.

Notice the tape does not change size for the other bundle segment.



Double select the *End Extremity*. This will display the *Create Point on Curve* window.

Change the *Length* to 8.0in, then select *OK*. Now you can clearly see that the tape stays a constant size as it crosses from one sized bundle segment to the next.

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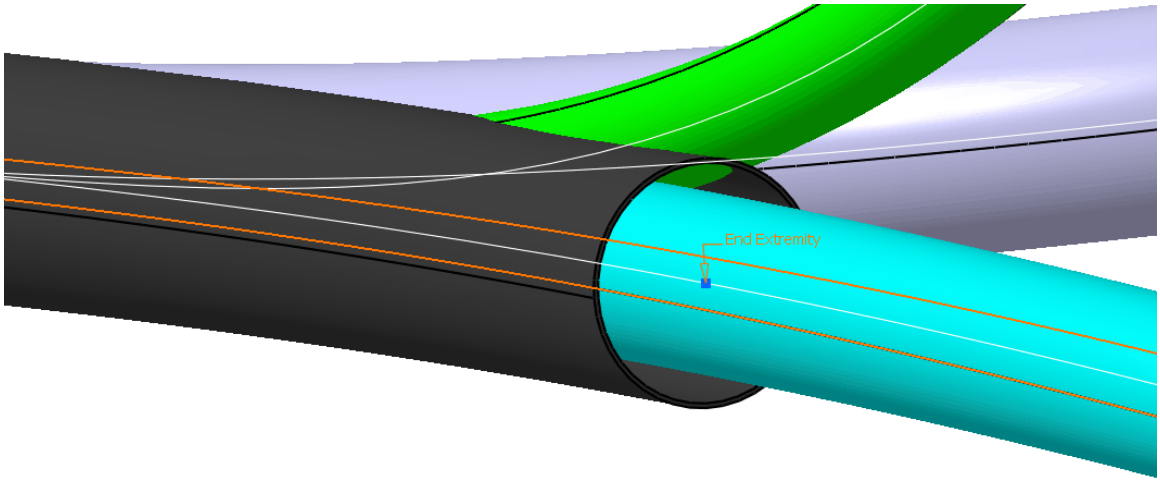


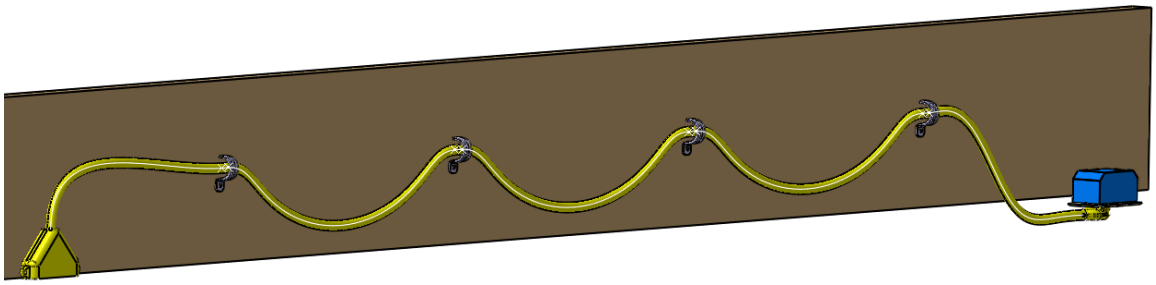
Select *OK* to the *Instantiate Protective Covering* window when done. This will complete this exercise. Next, you will look at combining protective covering and supports.

Save and close your document.

Protective Covering with Supports

There may be many times when you want to apply protective covering around your bundle just at the support locations. This keeps the bundle protected in just the areas susceptible to cutting and damage by the support.

Open the Protective Covering document from the *Protective Covering with Supports* directory. This is a simple bundle that has been ran through a series of supports.



In this case, you want to place protective covering over the geometric bundle, but only near the supports. This is possible by modifying the start and end extremities.

Select the Protective Covering icon, then select the bundle segment. This will define what bundle will have protective covering added.

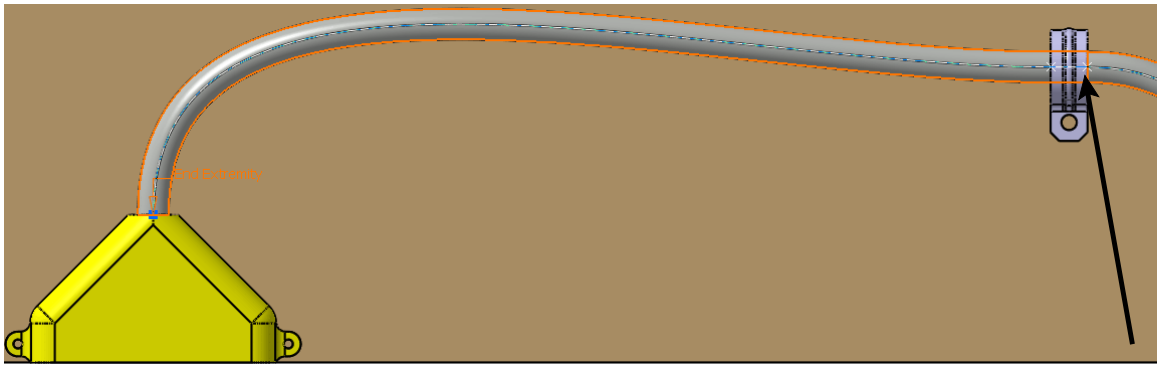
Select the Catalog Selection icon, then find and double select on the Duct Tape protective covering. You can also select the Duct Tape, then select *OK* when done.

At this point, the entire bundle segment will be wrapped in duct tape. This needs to be edited to accommodate the need for tape just around the supports.

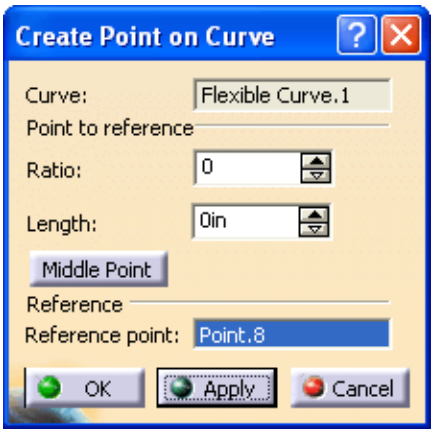
Double select the *Start Extremity*. This will display the *Create Point on Curve* window.

Select the *Reference point* field. In this case, rather than adjusting the length or the ratio of the protective covering, you will adjust the reference points to keep the protective covering just in the area needed.

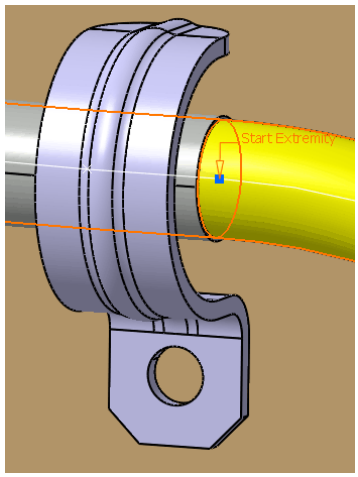
On the last support, the one closest to the 3-way plug, select the point on the right side of the support. This point is shown here.



This will change the *Reference point* to *Point.8*.



Select *Apply*. Notice the covering now starts at the support.



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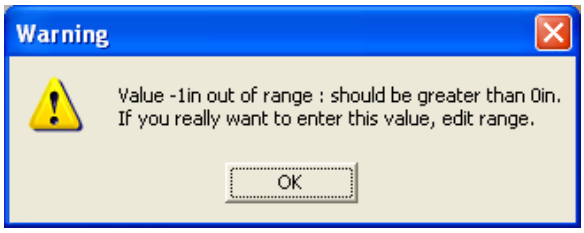
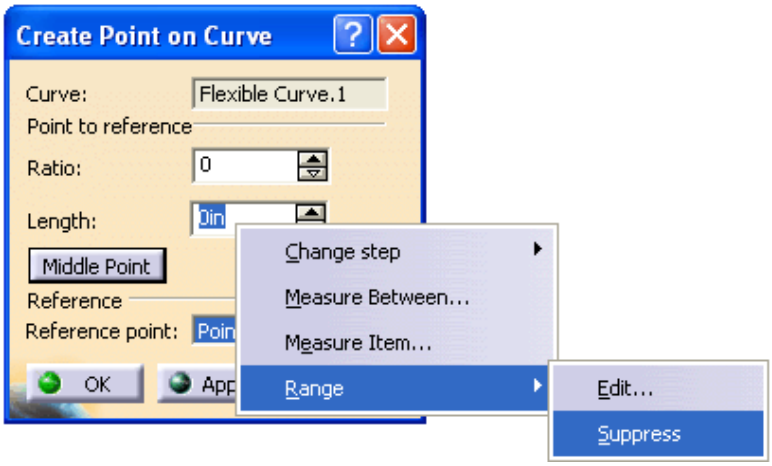
Now to adjust the starting point back a little.

Change the *Length* to -1.0in. Notice a *Warning* window is displayed.

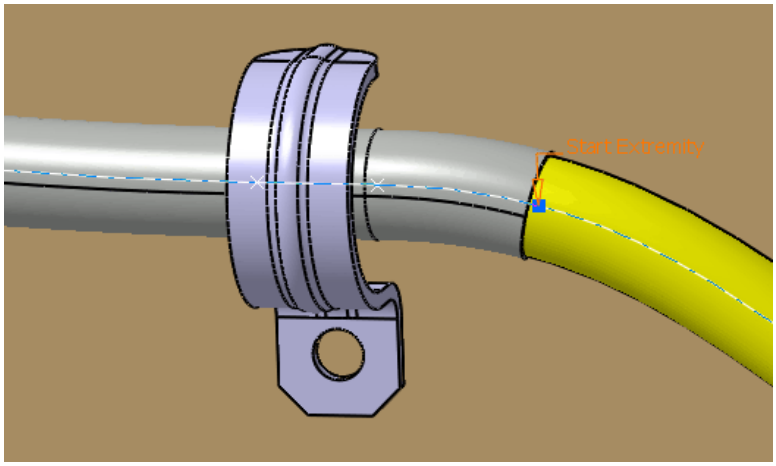


Since the start and end extremities are generally at the end of the curve, you cannot define a negative value. Since you have moved the start extremity towards the center of the curve, you can now define a negative number, however, CATIA is still limiting your range. You will suppress the range so that you can define a negative value.

Select *OK* to the warning. Right click in the *Length* field, then select *Range* and then *Suppress*. This will remove the range limits.



Key -1in for the *Length*. Select *Apply* when done. Notice now the protective covering starts an inch before the support.



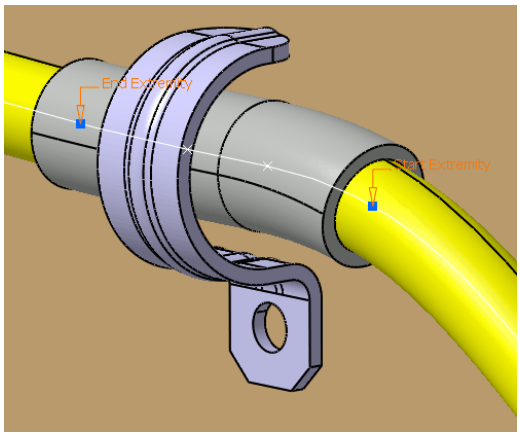
Select *OK* then double select the *End Extremity*. You will be doing the same thing for the end extremity.

Select the *Reference point*, then select the point on the opposite side of the support. This will stop the bundle just after the support.

Suppress the range of the *Length*, then change the *Length* to -1.0in. Select *OK* when done. This will have the start and end of the protective covering defined.

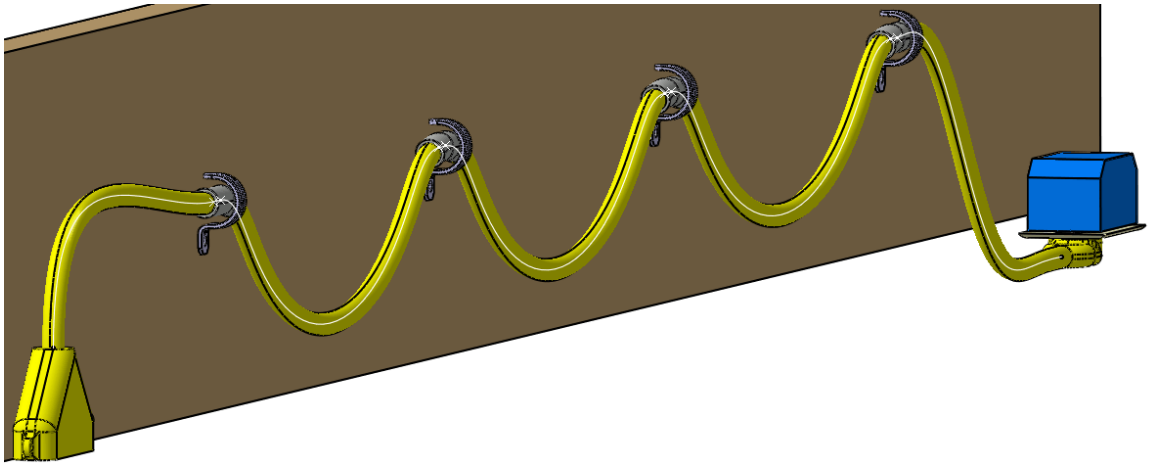
Change the *Taping angle* to 1.0deg. This will wrap the tape nearly straight on the bundle.

Change the *Layer number* to 5.0. This will indicate that five layers of tape will be applied to the bundle. Notice the thickness of the tape is increased as layers are added.



Select *OK* when done. This will establish the protective covering needed around the bundle segment near the support.

Using the same steps, define protective covering around other supports.



You could optionally arrange the bundle segment within the support and the protective covering will move with it.

Save and close the document when done.

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