

Getting Started Creating Cable and Harness Designs

In this chapter, you learn about Autodesk® Inventor® Cable and Harness functionality and the basic workflow to create and document a design.

Objectives

After completing this chapter, you will be able to:

- Describe the process for creating a complete cable and harness design, create a harness assembly in an assembly design, and insert electrical parts.

Lesson: Creating Cable and Harness Designs

This lesson describes the process for creating a complete cable and harness design, how to create a harness assembly, and how and where to insert electrical parts.

When you are designing a machine or consumer product, your design very often includes an electrical system requirement. Creating the cable and harness runs in your designs helps you ensure that all of the electrical components fit into the design. Creating the cable and harness content is also useful for calculating the lengths of wire and cable required to traverse a specific route and for avoiding bends with too small of a radius.

The following illustration is a picture of the inside of a battery charger. To design and manufacture this product, several sheet metal parts need to be designed and documented. Within the sheet metal case, the actual workings of the charger need to be wired to ensure proper clearance and determine the required wire lengths. For this product, the wiring consists of individual wires run from one connector to another. The alternating current is carried into the case through a cable, and the direct current to the battery is carried through another cable.



Objectives

After completing this lesson, you will be able to:

- Describe the functionality and benefits of Cable and Harness.
- Explain the process to create and document a cable and harness design.
- Create a harness assembly in an assembly design.
- Access and configure the Harness Settings.
- Insert electrical parts into your design that may or may not originate from the Content Center.
- Modify the properties of an electrical part occurrence, including its reference designator.

About Cable and Harness

When you create electro-mechanical designs, you benefit from including the electrical wires and cables in the 3D virtual model to ensure everything fits in the design. You also benefit downstream by having cable and harness information included in reports and drawing documentation. To achieve these benefits while creating and visualizing cable and harness paths, you need to first understand the full functionality and benefits of cable and harness design in Autodesk Inventor.

The following images show real wires and cables that are used within different products and machines. Adding this content as 3D design data within your virtual prototypes helps ensure that your design can be manufactured and that it meets its requirements for use.



Definition of Cable and Harness

A cable and harness is typically thought of as a bundle of multiple cables or wires. In an electrical design, the number and type of components are dictated by the design. The types of components can be individual wires, cables consisting of multiple wires shielded in a single component, or a group of wires and cables bundled into a harness. The start location for wires and cables is specified by the pin locations on an electrical connector part.

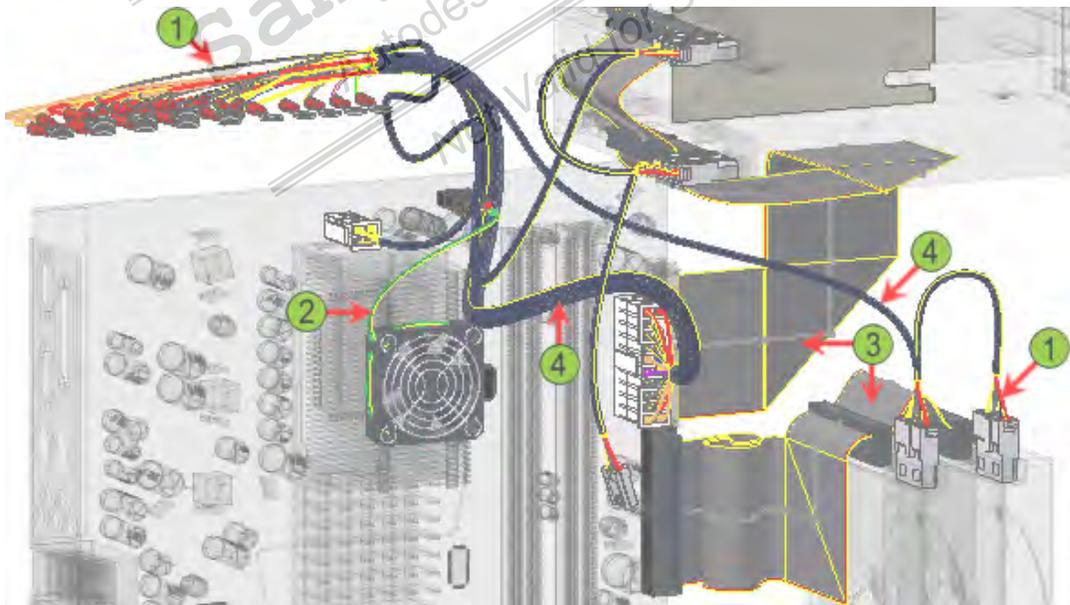
The cable and harness design functionality assists you in designing and documenting the wires, cables, and harnesses that are required in a product or machine. Cable and harness functionality includes being able to:

- Define custom electrical connectors.
- Add wires and cables between connectors in a design.
- Import large wire lists from AutoCAD® Electrical or third-party schematic design applications.
- Manually route critical wires or have Inventor automatically determine the optimal route based on the route segments you have created.
- Create the corresponding documentation for the cables or harnesses in the form of nailboards and other drawing views.
- Generate reports of the cable and harness data.

To control and specify the information and display characteristics of cable and harness geometry, you can set the properties globally for the harness assembly, or you can set the properties individually for each wire, connector pin, and so on. The property settings can include how lengths are calculated, setting minimum bend radiuses, specifying wire ID, setting pin information, displaying as a centerline or as rendered, and setting how the wire information displays in a nailboard drawing.

Example of a Cable and Harness Design

The types and quantity of connectors, wires, cables, and harnesses vary from design to design. The design shown in the following illustration contains wires bundled into harnesses and a wire cable.



- ① Individual wire
- ② Cable
- ③ Ribbon cable
- ④ Wire harness

Creating a Cable and Harness Design

When you create a cable and harness design, you are presented with a new set of tools and options for creating content and controlling its display. The content you create is automatically created and structured in a slightly different way from standard part and assembly modeling. By understanding these unique characteristics and areas in cable and harness design, it becomes easier to create and edit cable and harness designs. By having an overall understanding of the process, it is easier to understand the importance of a specific tool or procedure for creating or editing a cable and harness design.

In the following illustration, a section of the assembly is shown before and after the creation of the required cable and harness design content.



Access Cable and Harness Tools

When you install software, additional tools, panels, and shortcut menu options are available for design creation and editing. On the ribbon > Begin panel, the Cable and Harness tool is included so that you can create new harness assemblies within the overall assembly design. When a harness assembly is active for editing, the Cable & Harness ribbon displays with all the tools required to create and edit the cable and harness assembly. When you are editing a part file, an additional panel is available for selection. You switch to the Harness Part Features panel to create the part as an electrical connector.

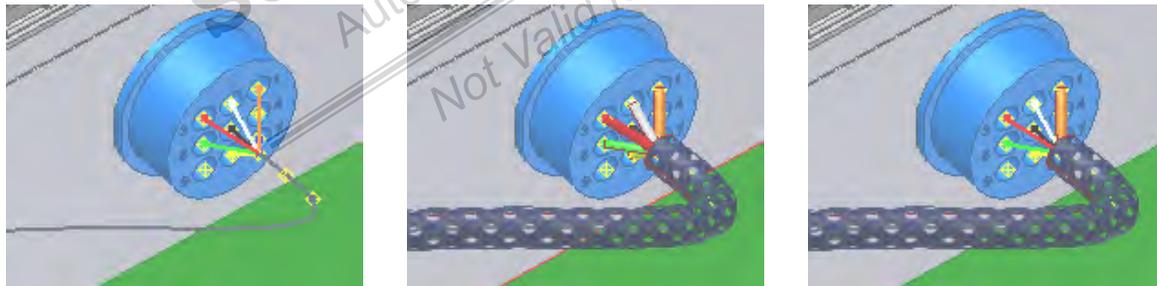
You manually switch between the available panel bars in the active environment to complete other modeling tasks.

In the following illustrations, the Cable & Harness ribbon is shown on the left. This ribbon automatically displays when a harness assembly is active for editing. The Harness panel for part modeling is shown on the right. You manually switch to this panel bar when you are editing a part file and you want to add or edit connector content or properties.



Wire, Cable, and Segment Display

You can display cables, wires, and segments in two different ways. You can have them display as thin lines at the center of their path or as rendered with the appropriate diameters. Each object and type of object can be set separate from the others. For example, you can have one wire display as rendered while all the other wires display as thin centerlines.



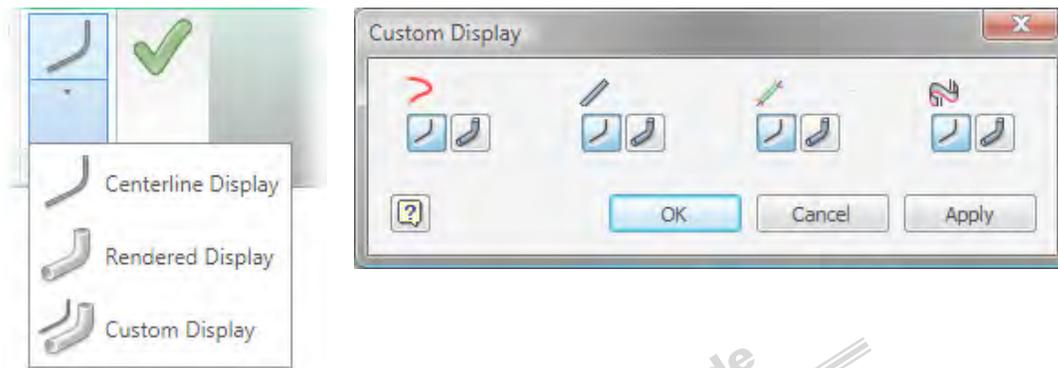
Centerline Display

Rendered Display

Mix of Centerline and Rendered Display

There are three different ways you can change the display between thin centerline and rendered. To change the display of a single object, you can toggle the display using the shortcut menu option or change the setting in the properties dialog box for that object. Using the display option on the Cable and Harness tab > Visibility panel, you can change the display for all the wires, cables, and segments in the active harness assembly. When you select the Custom Display option, the Custom Display dialog box displays. Within the dialog box, you set the display setting for all the objects of that type that are in the active harness assembly.

The following illustration shows the display options being accessed on the ribbon when a harness assembly is active. It also shows the Custom Display dialog box, which displays after selecting Custom Display from the display list.



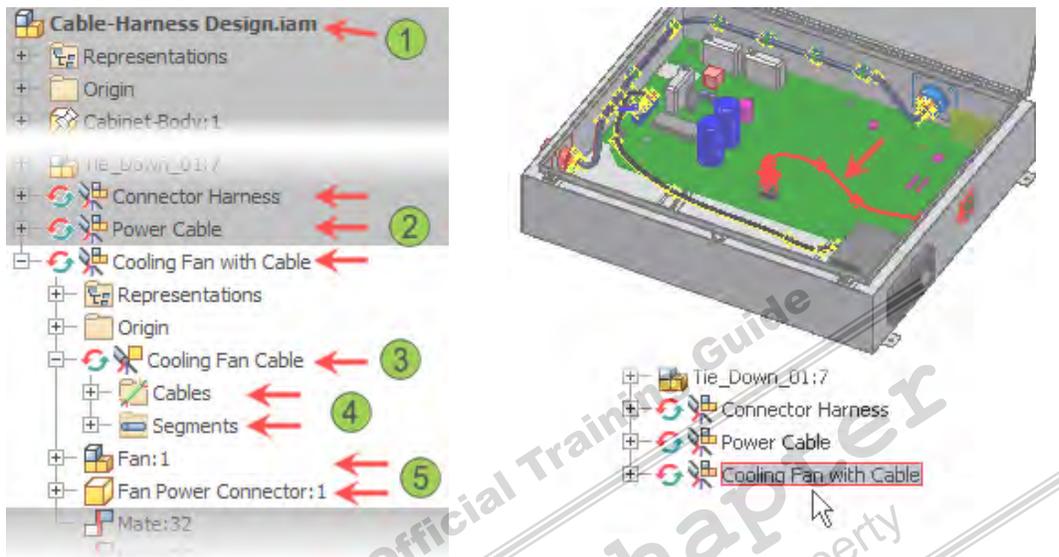
Cable and Harness Design Files

At a minimum a harness design is composed of a harness assembly and a harness part within the harness assembly. The harness part is automatically created when you create the harness assembly. The harness objects like wires, cables, and segments are then added to the harness part or harness assembly.

You create a harness assembly from within a standard Inventor assembly file. You can locate the harness anywhere in the assembly hierarchy except in another harness assembly. A standard Autodesk Inventor assembly can contain as many harness assemblies as required.

An electrical part is a part that has connecting pin information defined within it that enables you to connect wires and cables to it. Depending on your design, you either add electrical parts to the overall assembly, directly to a harness assembly, or a combination of both. You typically add connectors to the harness assembly when the connectors are a part of the harness. One example is a purchased cable with the end connector already attached to the wires.

The following illustration shows a design consisting of multiple harness assemblies. On the right side of the illustration, one of the harness assemblies is highlighted and identified. In this design, some of the connectors are in the overall assembly, some are positioned in subassemblies, and some were added directly to the harness assembly. The listing of folders within the harness part is dependent on the objects created in that harness assembly.

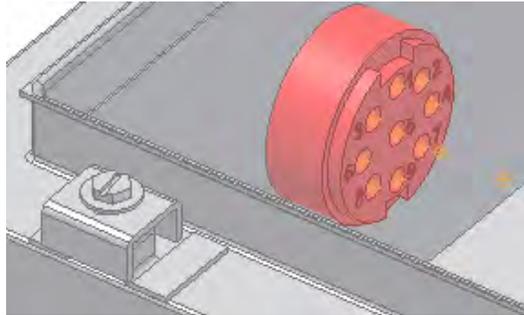


- ① Overall standard Inventor assembly file
- ② Individual harness assemblies
- ③ Harness part within the active harness assembly
- ④ Object folders for the types of objects created in the harness assembly and added to the harness part
- ⑤ Parts added to the harness assembly that are defined with connector information

Process: Creating a Cable and Harness Design

The following steps give an overview of creating a cable and harness design.

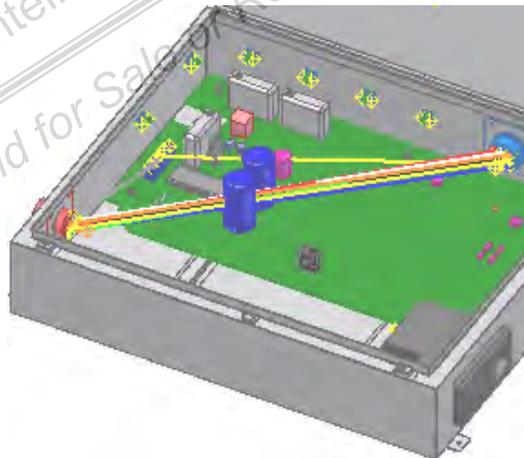
1. Place and constrain electrical parts in the assembly.



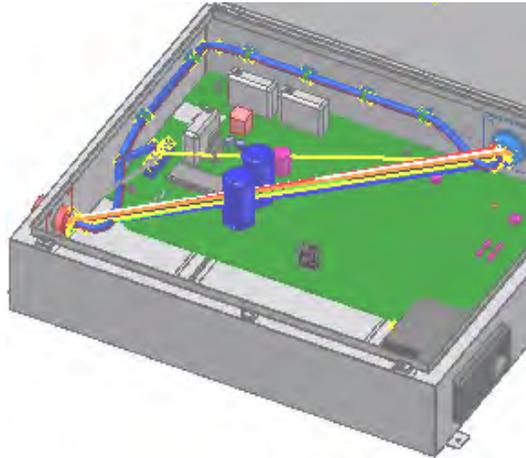
2. Add a harness assembly to the current assembly. If required, place and constrain electrical parts to the harness assembly.



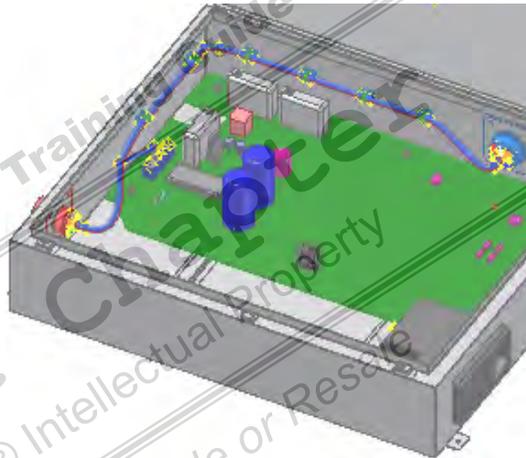
3. Add wires and cables to the active harness subassembly between pins on the electrical parts. Add cable and harness properties to the wires as needed.



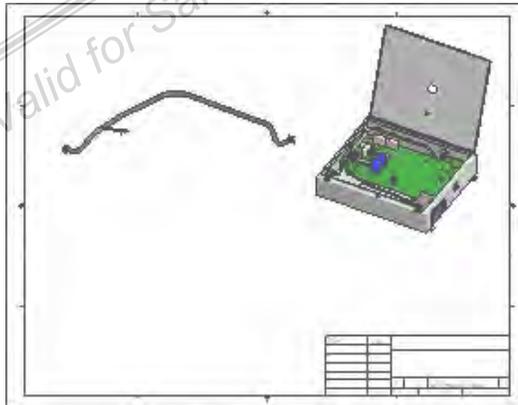
4. Create segments that define the possible wire paths through the assembly. Add cable and harness properties to the segments as needed.



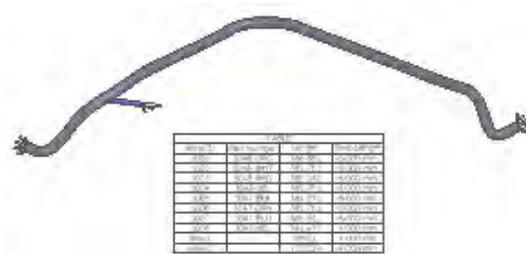
5. Route wires through the segments.



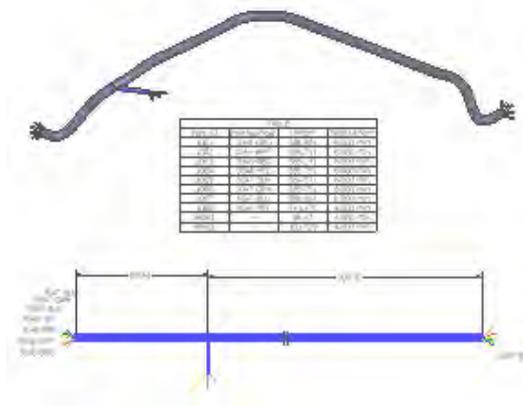
6. Document the harness assembly by creating drawing views of the assembly just as you would any other assembly.



7. Use the Cable and Harness report generator to create reports on part count, wire lists, wire lengths, and other required electrical information.



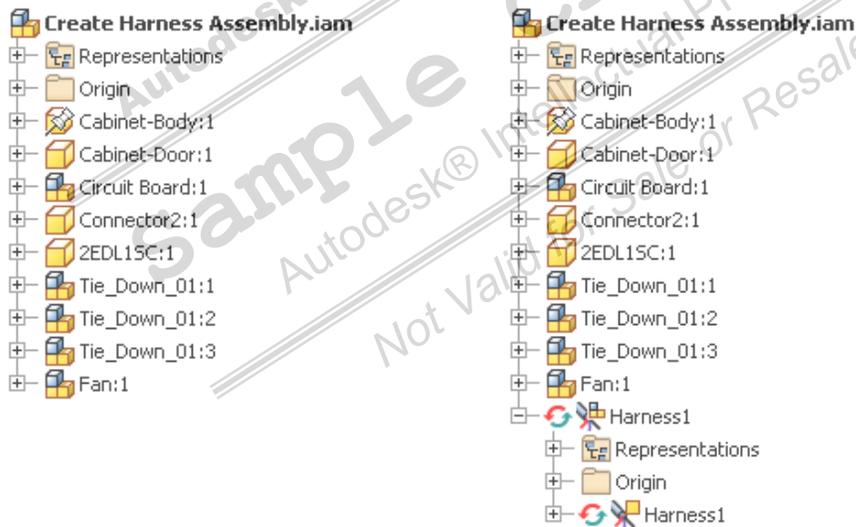
8. Create a nailboard drawing showing a 2D layout of the 3D harness assembly.



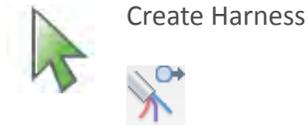
Creating a Harness Assembly

To add cable and harness content to your assembly designs, you must first create a harness assembly. To create a harness assembly in your design, you need to know where and how to create it.

In the following illustration, the browser for an assembly is shown before and after the creation of a harness assembly.

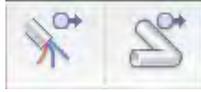


Access



Create Harness

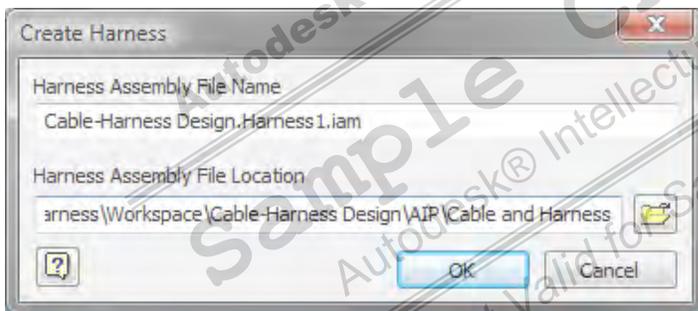
Ribbon: Assemble tab > Begin panel



File Creation Options

You begin creating a cable and harness design by first creating a harness assembly in your assembly model. You create the harness assembly using the Create Harness tool. After you start the tool, the Create Harness dialog box displays enabling you to enter a unique name and location for the harness subassembly.

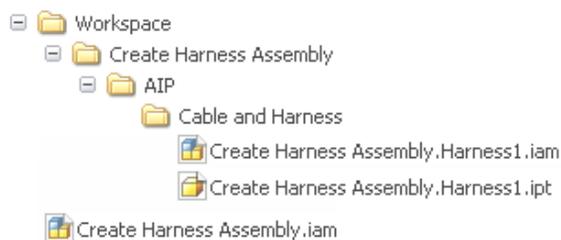
By default, the file is named <assembly name>Harness#.iam, where <assembly name> is the name of the overall assembly file and where # is the next incremental number. The harness assembly file is saved to the location of the open assembly file in a folder of the same name as the assembly file. Along with the harness assembly file, a corresponding harness part is also created and saved. You can provide a different name and location.



Create Harness Assembly.iam



Browser with new default



Folder and file relationship for new harness assembly

Procedure: Creating a Harness Assembly

The following steps give an overview of creating a new harness assembly.

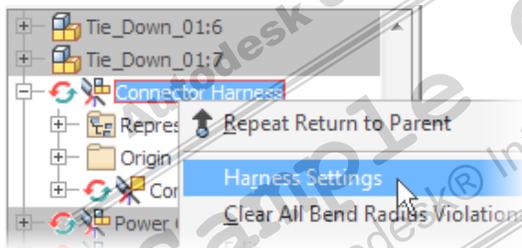
1. Open the assembly in which you want to create a harness assembly. Or, activate the overall assembly for editing.
2. Start the Cable and Harness tool.
3. In the Create Harness dialog box, set the harness assembly name and location. Accept the default name or enter a unique name.

Configuring Harness Settings

Each harness assembly that you create can have its own unique set of master settings. To change the default values for a harness assembly, you need to know where and how to access the settings.

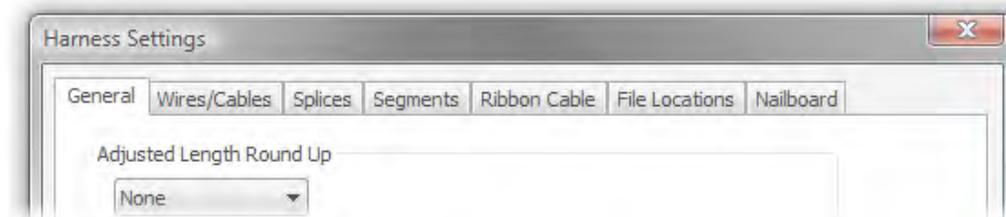
Harness Settings Access

You change the master settings for a harness assembly in the Harness Settings dialog box. You display this dialog box by clicking the Harness Settings option on the shortcut menu. You access the Harness Settings shortcut menu option by right-clicking the browser name of the active harness assembly.



Harness Settings

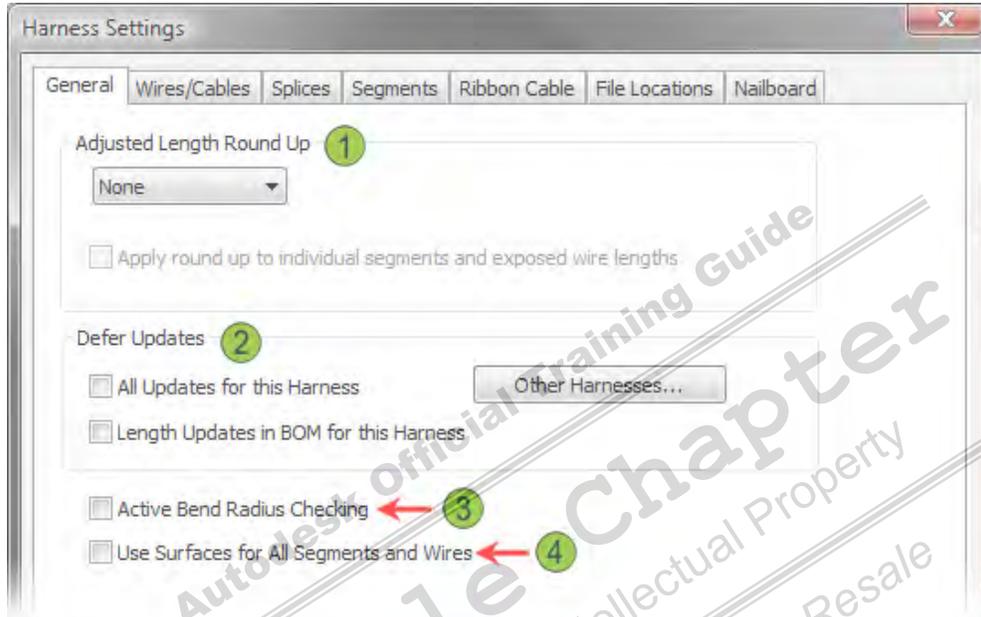
The values you set in the Harness Settings dialog box control the creation and configuration of newly created wires, cables, splices, segments, and nailboard drawings for that specific harness assembly. The options and settings are split between multiple tabs based on what they control. The settings that are pertinent to all harness objects are located on the General tab and the File Locations tab. When you change the settings in the Harness Settings dialog box, those settings and values apply to newly created objects and information. The properties for existing objects do not update.





After creating a new harness assembly and prior to creating the harness objects, review the harness settings for the harness assembly to ensure that the default settings match your requirements for newly created harness objects.

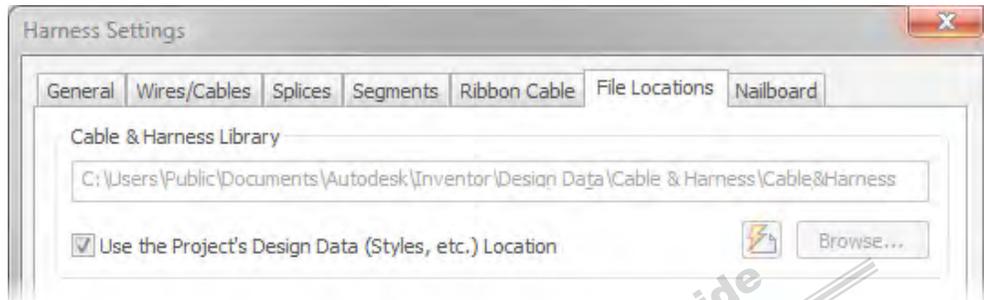
Harness Settings: General Tab



- 1 Use to set if and how much of a round up value should be applied to the adjusted wire, cable, ribbon cable, and segment lengths.
- 2 Set if and how updates to the harness assembly should be deferred or not. Select to defer updates to improve performance when a large number of objects are being created and edited within the harness assembly.
- 3 Select to have all segments, wires, and cables automatically checked to see if they violate the minimum bend radius value for the style of that object.
- 4 Select to have wires and segments created as surfaces. Clear to have them created as solids. Set as surfaces for faster processing times. Set as solids for enhanced visual representation.

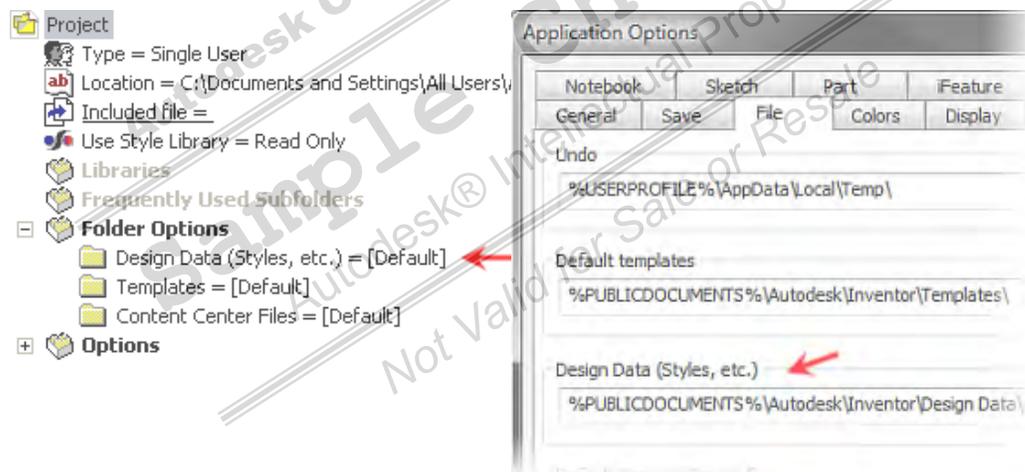
Harness Settings: File Locations Tab

The cable and harness library file that is used by the harness assembly is determined based on the setting on the File Locations tab. You can either select to use a specific library file, or you can use the library file that resides in the folder specified for the active project's design data location.



When the option is selected to use the project's design data location, the library that is used is based on what is located in the folder specified in the project file or the Application Options dialog box. When the project file is set to use [Default] for Design Data (Styles, etc.), then the path defined in the Application Options is utilized.

In the following illustration, the design data configuration location in the project file is shown on the left and in the Application Options dialog box on the right.



Procedure: Configuring Harness Settings

The following steps give an overview of configuring the harness settings for a harness assembly.

1. Activate the harness assembly for in-place editing.
2. In the browser, right-click the harness assembly name. Click Harness Settings.
3. In the Harness Settings dialog box, set the default creation properties to match your requirements.

Inserting Electrical Parts

You place and constrain electrical parts in an assembly just as you would place and constrain standard Autodesk Inventor parts. To add the electrical parts you require in the proper location, you need to understand your options for inserting electrical parts and how to insert parts that may or may not originate from the Content Center.

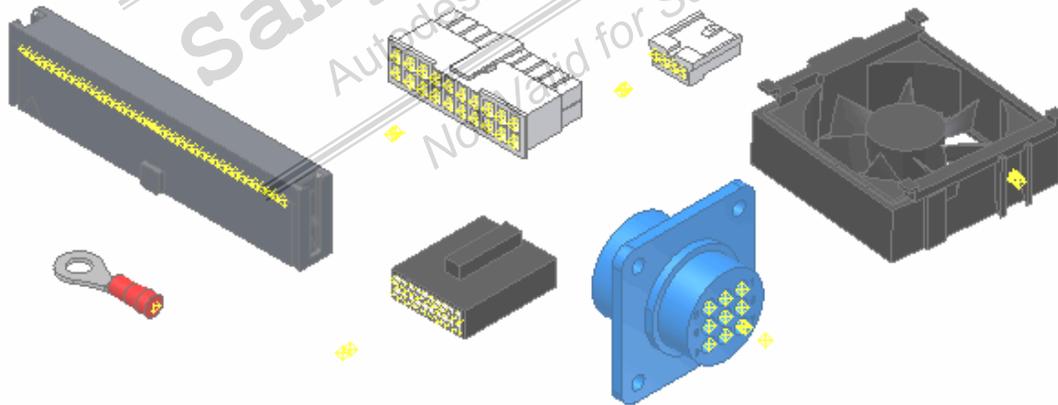
The following illustration shows the default categories in the Content Center for cable and harness content and images of the initially available content in those categories.



Characteristics of an Electrical Part

Electrical parts are standard Autodesk Inventor parts or iParts that have extended properties and one or more defined connection points, known as pins. Electrical parts include any parts to which you connect wires, such as connectors, terminal strips, PLC input/output terminal blocks, power supplies, switches, and indicator lamps.

The following illustration shows just a few of the many possible electrical parts that would have cable and harness connection data associated with them.



To create a wire or cable route, you must select the pins in an electrical part that is already added to the assembly or to the harness assembly. Because the creation of wires and cables requires the pin information in electrical parts, you add the electrical parts to your design prior to creating the wires and cables.

Inserting Electrical Parts

You add an electrical part to an assembly or harness assembly using the Place Component tool or the Place Component from Content Center tool. If you have a harness assembly active for in-place editing, to add an electrical part to the harness assembly, you must manually switch the panel bar from Cable & Harness to the Assembly Panel.

Insert Location for Electrical Parts

You place electrical parts either inside or outside of the harness assembly, depending on how you prefer to document the harness assembly. As a general rule, put the electrical connectors in the harness assembly if they are purchased that way, or if the connectors are assembled to the wires or cables prior to assembling it in the overall assembly design.

In the following illustration, a portion of a design is shown where electrical connectors have been inserted inside and outside of a harness assembly.



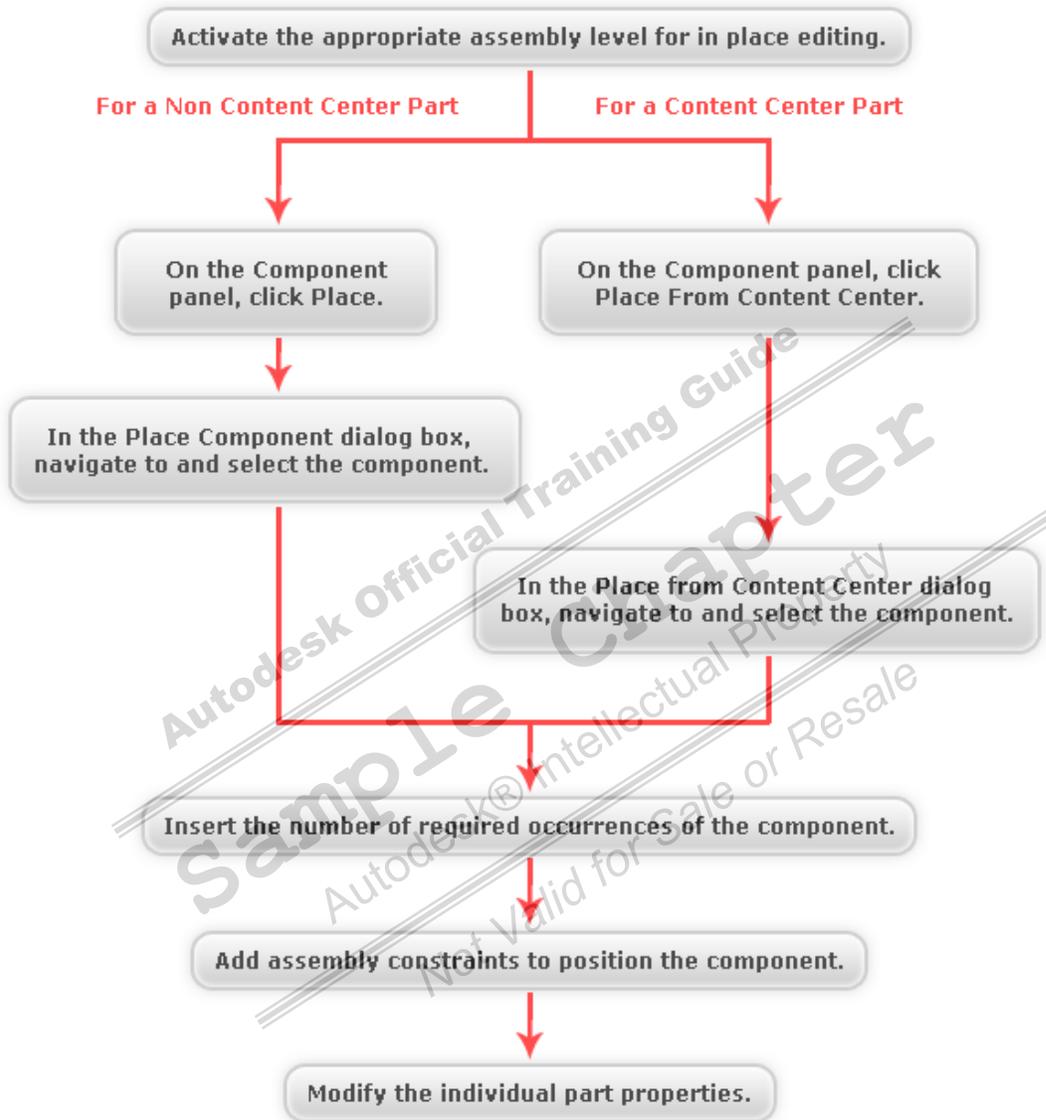
To assemble electrical parts in a harness assembly to parts in the overall design, you must activate the overall assembly prior to adding the assembly constraints. Individual parts within the harness assembly constrain to the proper location because the harness assembly is set as adaptive.



When a harness assembly is active for in-place editing, the selection priority defaults to the selection of sketch features. To move an electrical part in the harness assembly, change the selection priority to Part Priority so that you can click and drag the part to a new location.

Process: Inserting Electrical Parts

The following diagram illustrates an overview of the steps for inserting electrical parts.



Setting Unique Part Properties for Electrical Parts

To create a complete electrical design, specific properties and values should be added to electrical parts. These additional properties and values communicate the complete information about the design when you generate reports for the design. For you to complete your electrical designs with the information you require, you must know how to modify the properties of an electrical part occurrence, including its reference designator.

In the following illustration, the Part Properties dialog box has been accessed for an occurrence of the Fan Power Connector part to enter a unique RefDes (reference designator) value.



Part Properties

When you insert an electrical part into a design, that part contains properties that are specific to that part file, and it contains properties that can be set unique for each occurrence. The part name and part number are set automatically based on the part file name and the Autodesk Inventor part number. The reference designator (RefDes) and custom properties are unique for each occurrence.

The reference designator is a unique identifier that maps the part to the schematic design. A typical electrical part has a placeholder identifier, such as U?, already set for its RefDes value. You then add a specific designator value for each occurrence of the part in the context of the assembly. For example, if you place three occurrences of a certain RS232 connector in an assembly, each occurrence must have a unique identifier, such as U1, U2, and U3.

You can add custom properties to the part to provide specific information to downstream processes, such as reporting. Most custom properties are not used by Autodesk Inventor. They are used to add data to the part so the information is available when you create a report of the design. Custom properties specific for electrical parts can include properties for current, resistance, temperature, voltage, and embedded length. The values for these custom properties often come from the data book for the component.

Part Property Access

To edit the properties of an electrical part, you must first activate the harness assembly. When the harness assembly is active, you select the part in the browser or graphics window and then click **Harness Properties** on the shortcut menu. When the harness assembly is active, you can select any electrical part and access the **Harness Properties** menu option, regardless of where the electrical part is located in the model. After you click **Harness Properties**, the **Part Properties** dialog box displays, enabling you to change the RefDes value and add or edit custom properties.

In the following illustration, the **Harness Properties** option is shown being accessed for electrical parts that are inside and outside of the active harness assembly.



To change the properties of an electrical part by selecting the part in the graphics window, after you activate a harness assembly for in-place editing, change the selection priority to **Part Priority**.

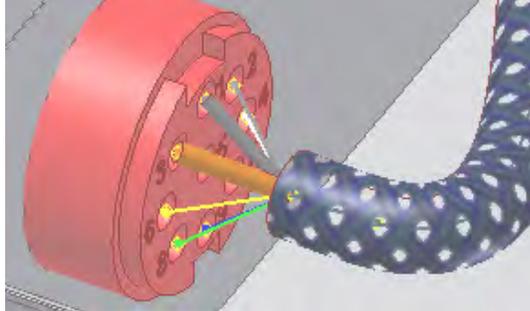
Procedure: Setting Unique Part Properties for Electrical Parts

The following steps give an overview of setting unique part properties for different occurrences of electrical parts.

1. Activate a harness assembly for in-place editing.
2. In the browser or graphics window, right-click the occurrence of the electrical part. Click **Harness Properties**.
3. In the **Part Properties** dialog box, enter a unique RefDes value or specify a custom property value.

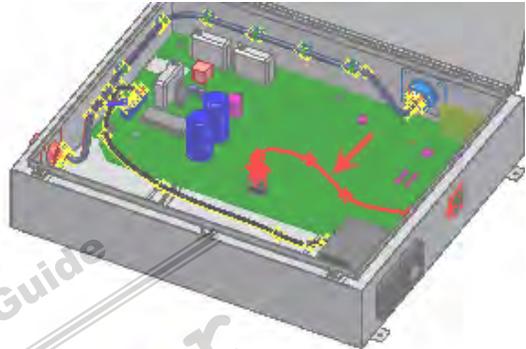
Exercise: Review and Navigate a Design

In this exercise, you identify and review the different aspects and properties of a cable and harness design.



The completed exercise

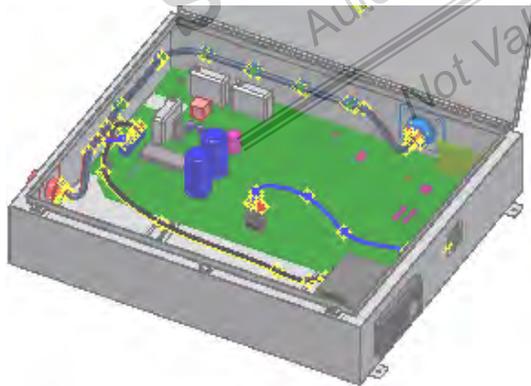
- In the browser, click each harness assembly and review what highlights in the graphics window.



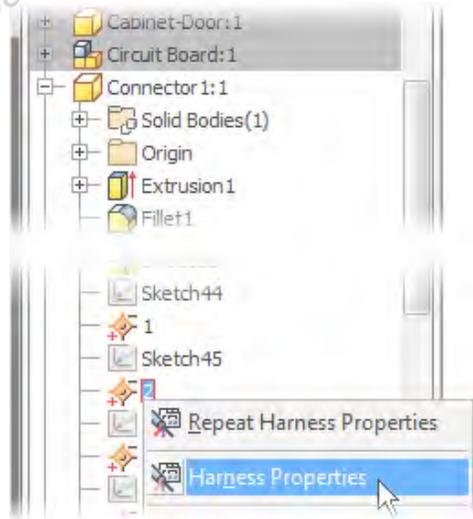
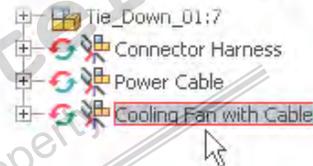


Completing the Exercise
To complete the exercise, follow the steps in this book or in the onscreen exercise. In the onscreen list of chapters and exercises, click Chapter 1: Getting Started Creating Cable and Harness Designs. Click Exercise: Review and Navigate a Design.

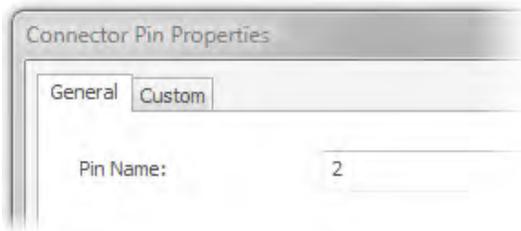
- Open Cable-Harness Design.iam



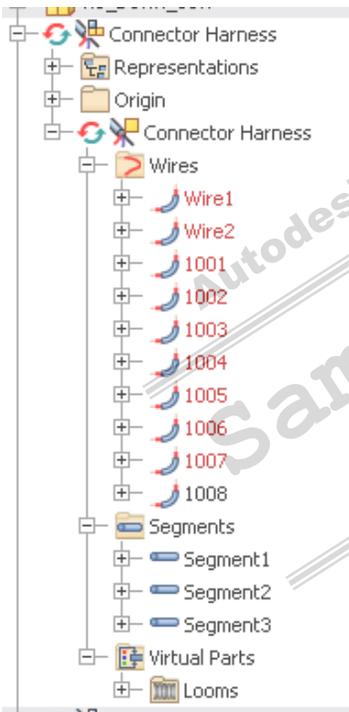
- To begin reviewing the harness properties for an electrical connector, in the browser, double-click Connector1 to activate it for in-place editing.
- In the browser, right-click the second connector pin work point. Click Harness Properties.



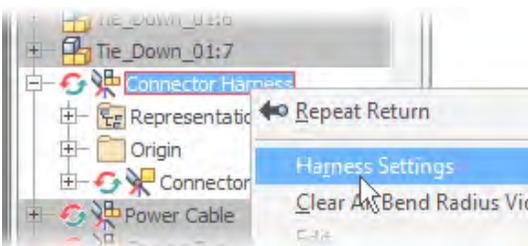
5. In the Connector Pin Properties dialog box:
 - Review the current name for this pin.
 - Click Cancel.



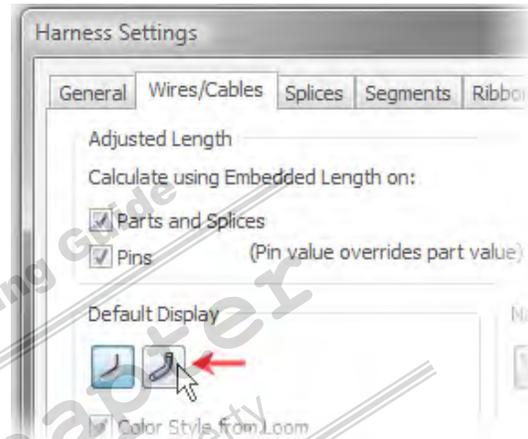
6. Click Return.
7. In the browser, double-click Connector Harness to activate it for in-place editing.
8. In the browser, expand the categories below the harness part to review the wires, segments, and virtual parts that compose the harness part.



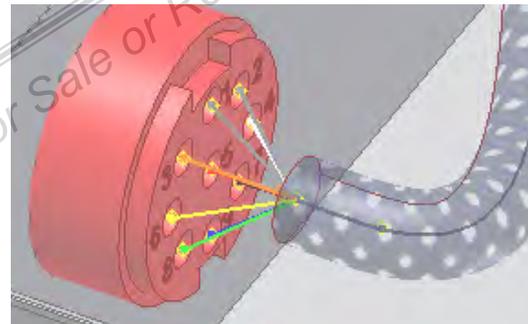
9. To begin reviewing the properties for the harness assembly, in the browser, right-click Connector Harness. Click Harness Settings.



10. In the Harness Settings dialog box:
 - Click the different tabs and review the available settings and options.
 - To change the display for wires from centerline to rendered:
 - On the Wires/Cables tab, in the Default Display area, click Rendered Display.
 - Click OK.

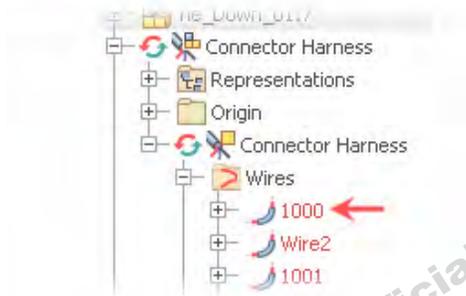
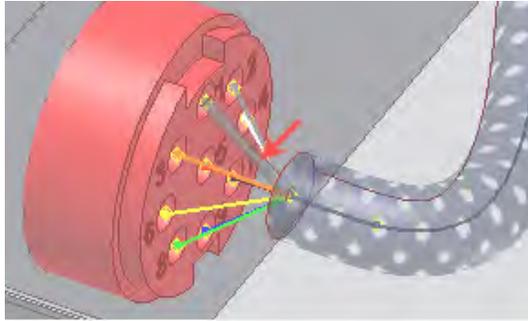


11. Zoom in to view the wires at Connector1. Notice the wires are still displaying as thin lines at the center of the wire. The previous setting impacts only newly created wires.

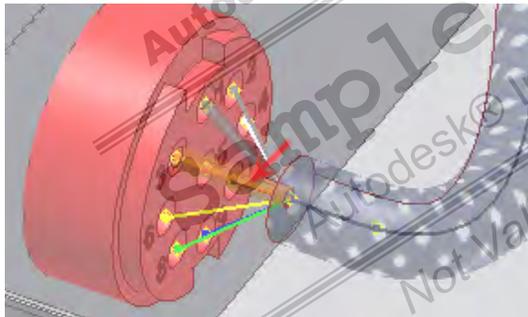


12. To begin changing harness properties for a single wire, in the browser, right-click Wire1. Click Harness Properties.
13. In the Wire Properties dialog box:
 - On the Occurrence tab, for Wire ID, enter 1000.
 - On the Display tab, Default Display area, click Rendered Display.
 - Click OK.

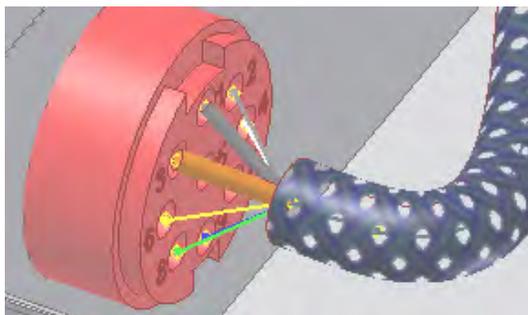
14. In the browser and graphics window, review the changes to the wire name and its display.



15. To toggle the display of a wire, in the browser or graphics window, right-click wire 1001. Click Display As Rendered.



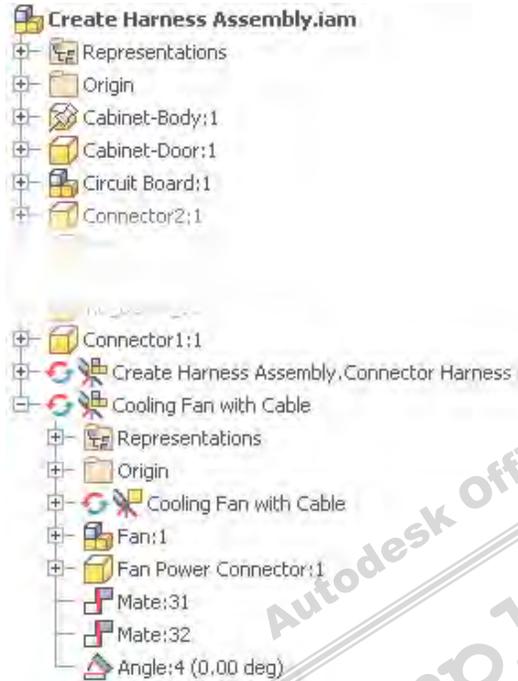
16. Click Finish Cable and Harness.



17. Close all files without saving changes.

Exercise: Create a Harness Assembly

In this exercise, you create harness assemblies, add electrical parts, and set the properties of the electrical harness and one of the electrical parts.



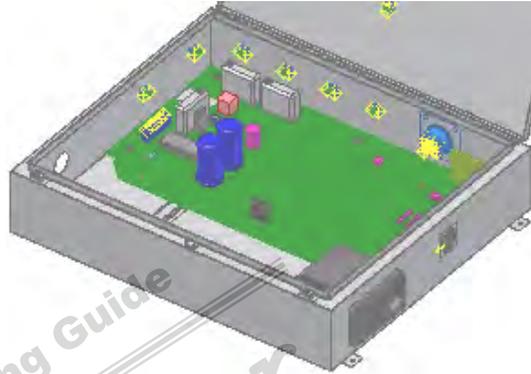
The completed exercise



Completing the Exercise

To complete the exercise, follow the steps in this book or in the onscreen exercise. In the onscreen list of chapters and exercises, click Chapter 1: Getting Started Creating Cable and Harness Designs. Click Exercise: Create a Harness Assembly.

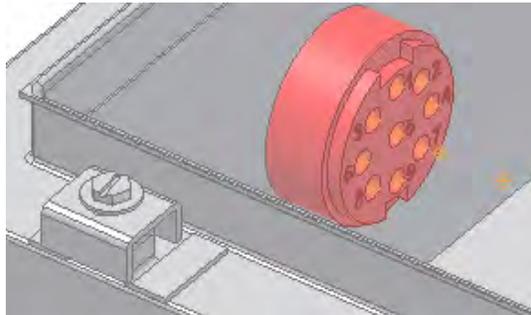
1. Open Create Harness Assembly.iam.



2. To add an electrical part to the assembly:
 - On the ribbon, click the Assemble tab > Component panel > Place.
 - In the Place Component dialog box, select Connector1.ipt.
 - Add a single occurrence as shown.

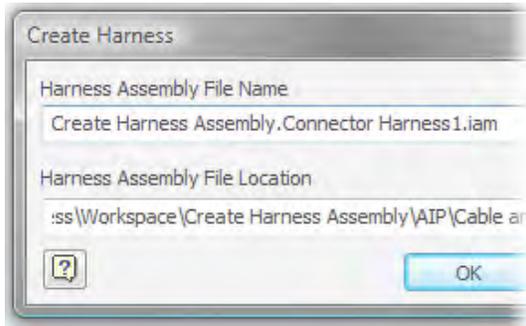


3. Add an insert and an angle assembly constraint to assemble the part as shown.

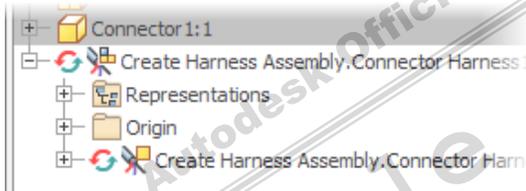


4. To begin creating a new harness assembly with its name having the assembly name as a prefix, on the ribbon, click the Assemble tab > Begin panel > Cable and Harness.

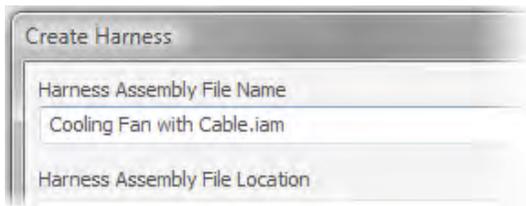
5. In the Create Harness dialog box:
 - In the Harness Assembly File Name field, change the name from Create Harness Assembly.Harness1.iam to Create Harness Assembly.Connector Harness.iam.
 - In the Harness Assembly File Location field, review the default folder location where the assembly will be created.
 - Click OK.



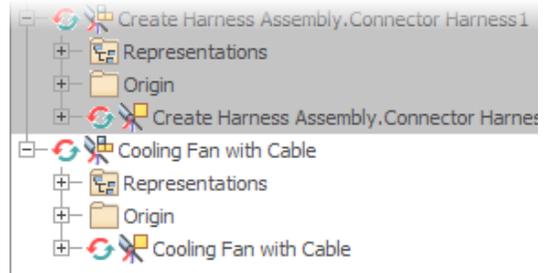
6. In the browser, review what was created and the corresponding folder and file names.



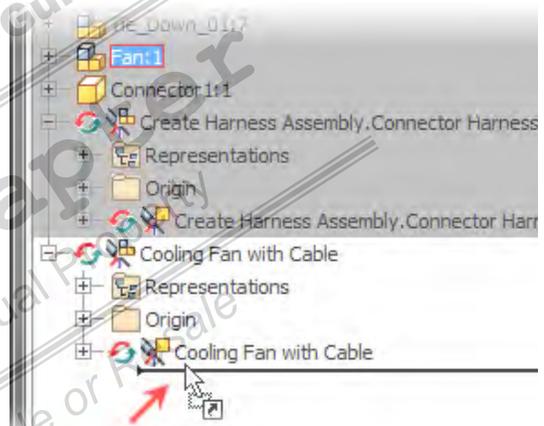
7. Click Finish Cable and Harness.
8. To create a harness assembly with a name that does not include the overall assembly name:
 - On the Assemble tab, click Begin panel > Cable and Harness.
 - In the Create Harness dialog box, Harness Assembly File Name field, enter Cooling Fan with Cable.iam.
 - Click OK.



9. In the browser, review what was created and the corresponding folder and file names.



10. To restructure the fan so that it is in this new harness assembly instead of the overall assembly, in the browser, drag and drop the Fan assembly below the Cooling Fan with Cable part as shown.



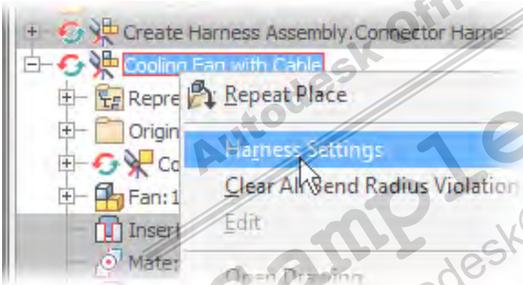
11. The assembly structure appears as shown.



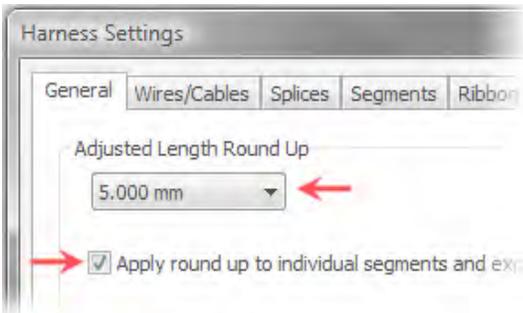
12. To add a connector directly to the harness assembly:
 - On the Assemble tab, click Components panel > Place.
 - In the Place Component dialog box, select Fan Power Connector.ipt.
 - Add a single occurrence as shown.



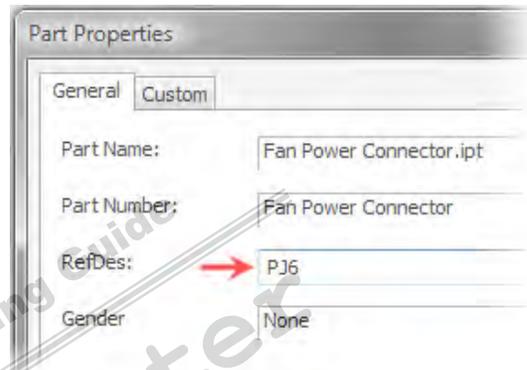
13. To begin configuring global settings for the harness prior to creating wires and cables:
 - In the browser, right-click the Cooling Fan with Cable harness assembly.
 - Click Harness Settings.



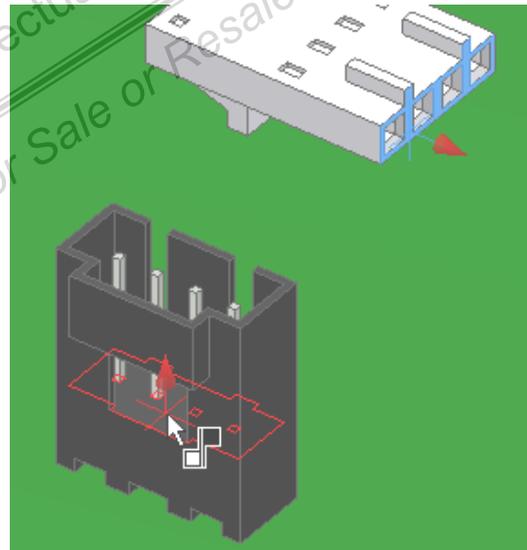
14. In the Harness Settings dialog box, General tab:
 - In the Adjusted Length Round Up list, select 5.000 mm.
 - Click the Apply Round Up to Individual Segments and Exposed Wire Lengths check box.
 - Click OK.



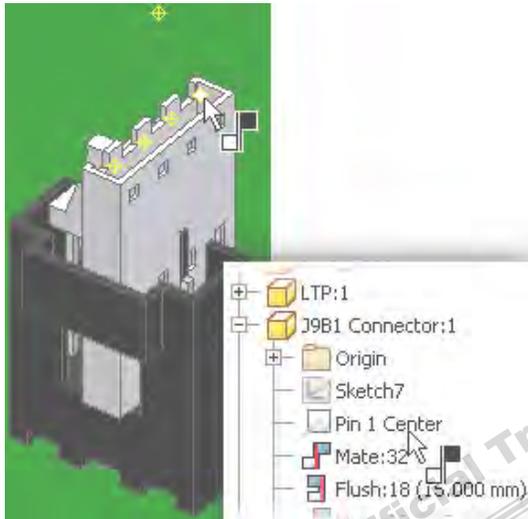
15. To begin setting the properties for the Fan Power Connector part:
 - In the browser, right-click Fan Power Connector.
 - Click Harness Properties.
16. In the Part Properties dialog box, General tab:
 - In the RefDes field, enter PJ6.
 - Click OK.



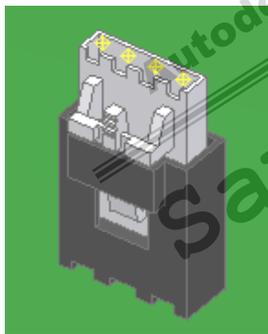
17. To begin assembling this connector to the connector on the circuit board, on the Standard toolbar, click Finish Cable and Harness.
18. Add a mate assembly constraint between the selected faces as shown.



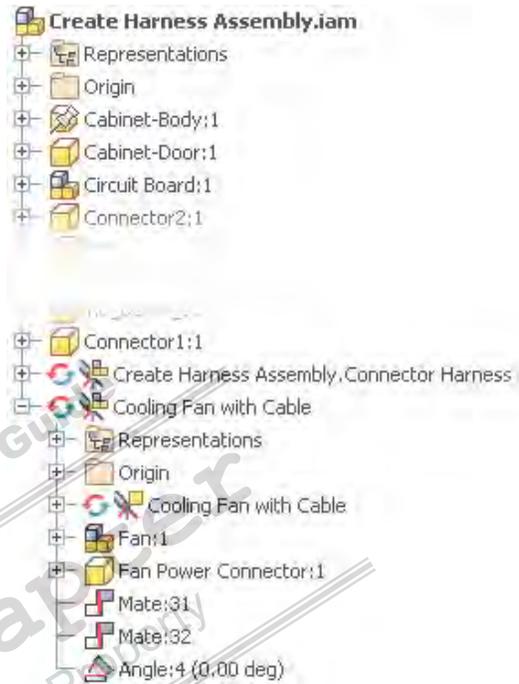
19. To add a mate assembly constraint to align the pins:
 - Select the work point as shown.
 - In the browser, under Circuit Board and under J9B1 Connector, click Pin 1 Center.
 - Click Apply.



20. Add an angle constraint to align the part as shown.



21. In the browser, review what you just added and created in the overall assembly and what you added to the harness assembly.



22. Close all files without saving changes.

Chapter Summary

In this chapter, you learned about Autodesk Inventor Cable and Harness functionality and the basic workflow to create and document a design.

Having completed this chapter, you can:

- Describe the process for creating a complete cable and harness design, create a harness assembly in an assembly design, and insert electrical parts.

