



Walt Disney World Swan and Dolphin Resort
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Bridging the Gap from AutoCAD® Electrical to Autodesk Inventor® Professional

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MA35-3 Creating an AutoCAD electrical control diagram for a wire harness is slick using AutoCAD Electrical. But lets not stop there! This course will show you how to reuse that data in your 3D model in Inventor Professional. This will ensure accuracy of schematics, allow you to generate accurate wire harness lengths in your purchase list, and provide full documentation for your wire harness assembly.

About the Speaker:

Nicole has been a software instructor and support tech with KETIV Technologies in California since 1998. Coming from a civil-based multidiscipline background, she has worked with controls for pumping station and water treatment plants. This allows her to relate software practices to real-world examples in her courses. She is an energetic speaker and instructor who can reach a diverse group of users successfully.

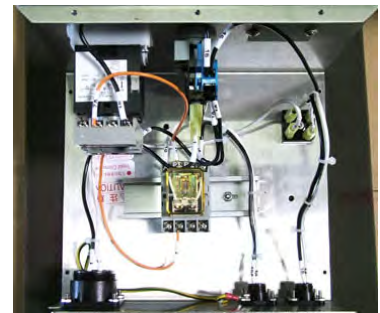
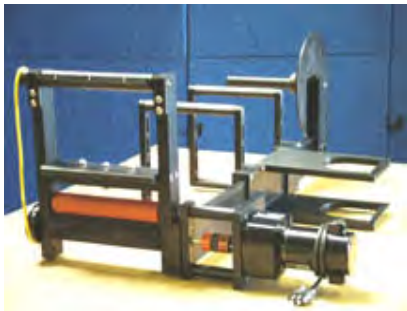
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Introduction

In talking to people who are responsible for installing power to their assemblies, they faced some similar challenges. One challenge was that they wanted to know the amount of each gauge of wire they will need for one assembly, especially if they are producing several or more of a particular design. They will need to know where to route the wire and they need to place wire number labels at each terminal connection points. These challenges can be time consuming and costly.

With Autocad Electrical and Inventor Professional you can design and build a virtual prototype of how the model will look complete with parts lists. These parts lists include component part numbers and their pin numbers, numbers, length, gauge and color of each wire and cable. If your manufacturing design team is already using Inventor for their design, you can add your cable and wire harness into that assembly using Inventor Professional.

The example I will be using is a foil feeding machine built by Charlie Irwin at AFM Engineering, Inc. AFM Engineering, Inc. is a 26 year old Southern California company engaged in the manufacture of hot stamping equipment and other machinery for secondary plastics assembly. They are especially strong in the medical industry as their machines are CE approved and clean room compatible.



In the past, once the main function of the assembly had been completed, AFM would build the assembly according to the Inventor model. Charlie would create the schematic diagram in Autocad Electrical and then give both the actual assembly and the schematic drawing to the installer who would figure out how to wire the assembly from the schematic drawing. The installer would place labels on each wire at each connection point. He explained that it was very time consuming trying to figure the length and routing of wires and which wires should be tied together. He said that it was difficult to know how many wire labels would need to be printed and so he would do them one at a time as he needed them. He would document the amount of material used and the way it was routed after the assembly control was completed and installed on the physical prototype. He would then be able to repeat the same process for the next assembly.

In this course, you can start with an assembly that has not been wired and wire it from the very beginning. You will know what steps must be included in the process so that you can apply this knowledge to your own assemblies.



Note: You may find it easier to work with Inventor Professional and Autodesk Electrical open at the same time. You can open the assembly in Inventor Professional and the schematic diagram in AutoCAD Electrical. Alt-Tab will help you cycle through the programs.

Analyze Inventor Assembly

Start in the Inventor Professional assembly and decide where your power will run. Decide which parts will be discreet wires and which will be cables. Also you should decide which wires will be grouped together.

Understanding the Import File

To understand the information that will need to come from AutoCAD Electrical and be received by Inventor Professional, it is helpful to look at an example of a report and its configuration file. Each wire will come from one of the lines in this file. Since you are importing data from AutoCAD Electrical into Inventor Professional, it helps to know what information you are extracting and how it connects to Inventor Professional. You will be using two files during the import process. One will be the configuration which controls the mapping of the imported report, extension .cfg. The second one will be the report file exported from AutoCAD Electrical, file extension .csv.

The sample WireListConfiguration.cfg provided with Inventor Professional works well for some point to point where each wire number is unique. For our purposes we modified the configuration file to help sequence multiple connections with the same wire number. Modifications are in bold.

```

cablesandwires
C:\wirelists\log.txt
WI RENO, Wire ID, Cable ID, Library Name, Conductor ID, RefDes1, Pin1, RefDes2, Pin2, Comma
text, text, text, text, text, text, text, text, text
none, none, none, none, none, none, none, none, none, none
    
```

- The first line contains a header **cablesandwires** which defines the type of file you will import.
- The second line is a log file that will show imported cable and wire status.
- The third line describes the order items will be read in a line. We will discuss the source of each item.
- The fourth line describes the type of field for each item on the third line.
- The fifth line describes the default entry for each item on the third line.



Note: There are also a **libwires** and **cablewires** header type .cfg files, these will NOT work for importing wires. They are for exporting and importing Wire Library items and Cable Library items, respectively. See section on **Inventor Professional Cable & Harness Library**.

We will be creating a report from AutoCAD Electrical which will follow the example to the right. This example shows a portion of the report used for this project.

- A single discreet wire between two components
- A discreet wire that connects to multiple components
- A 3-conductor Cable with each of the conductors referenced

```

"1", "10020900", "", "16AWG-BLK", "", "CB1", "1", "P1A", "1",
"1B", "10023003", "", "16AWG-BLK", "", "TD6", "8", "PB18", "1",
"1B", "10023002", "", "16AWG-BLK", "", "TD6", "7", "TD6", "8",
"1B", "10023001", "", "16AWG-BLK", "", "CB1", "2", "TD6", "7",
"1C", "10011900", "CBL1", "2260/3", "1", "P1", "1", "J1A", "1",
"2", "10012900", "CBL1", "2260/3", "2", "J1A", "2", "P1", "2",
"3", "10010900", "CBL1", "2260/3", "3", "P1", "3", "J1A", "3",
    
```



Note: The CABLE ID and CONDUCTOR ID only apply if there are cables.

Bridging the Gap from Autocad Electrical to Autodesk Inventor

To complete the import, you will need to be sure that data in your Inventor Professional assembly matches that of your AutoCAD Electrical schematic. Here is a checklist of all of the items you will need to check. All of these items are discussed in this document in more detail.

THE IMPORT FILE		
CSV ITEM	SOURCE FROM ELECTRICAL	DESTINATION TO INVENTOR PRO
WIRENO	Provided by Wire Numbers	Custom Harness Property to be used on a report
WIRE ID	SEQ1 column configured by Wire Sequencing tool	A unique label given to each wire in the model
CABLE ID	Component Tag for Cable Marker. This will be blank if it is a discreet wire.	Cable will receive a cable ID
NAME	Cable Catalog assignment or Wire Layer for discreet wires	Exact names must match names in the Inventor Professional Cable & Harness Library
CONDUCTOR ID	When using a cable each wire is assigned a Wire ID/Color. This will be blank if it is a discreet wire.	Conductor Numbers must agree with the Cable Library assignment
REFDES1	Tag Name of From Component	Refdes in Cable Harness
PIN1	Pin Number of From Component	Pin Number on Component
REFDES2	Tag Name of To Component	Refdes in Cable Harness
PIN2	Pin Number of To Component	Pin Number on Component
Comma	Electrical .csv report adds an extra comma, this field will not import anything. It is entered so that there are no edits required to the file before import	

Complete the Schematic Layout in AutoCAD Electrical

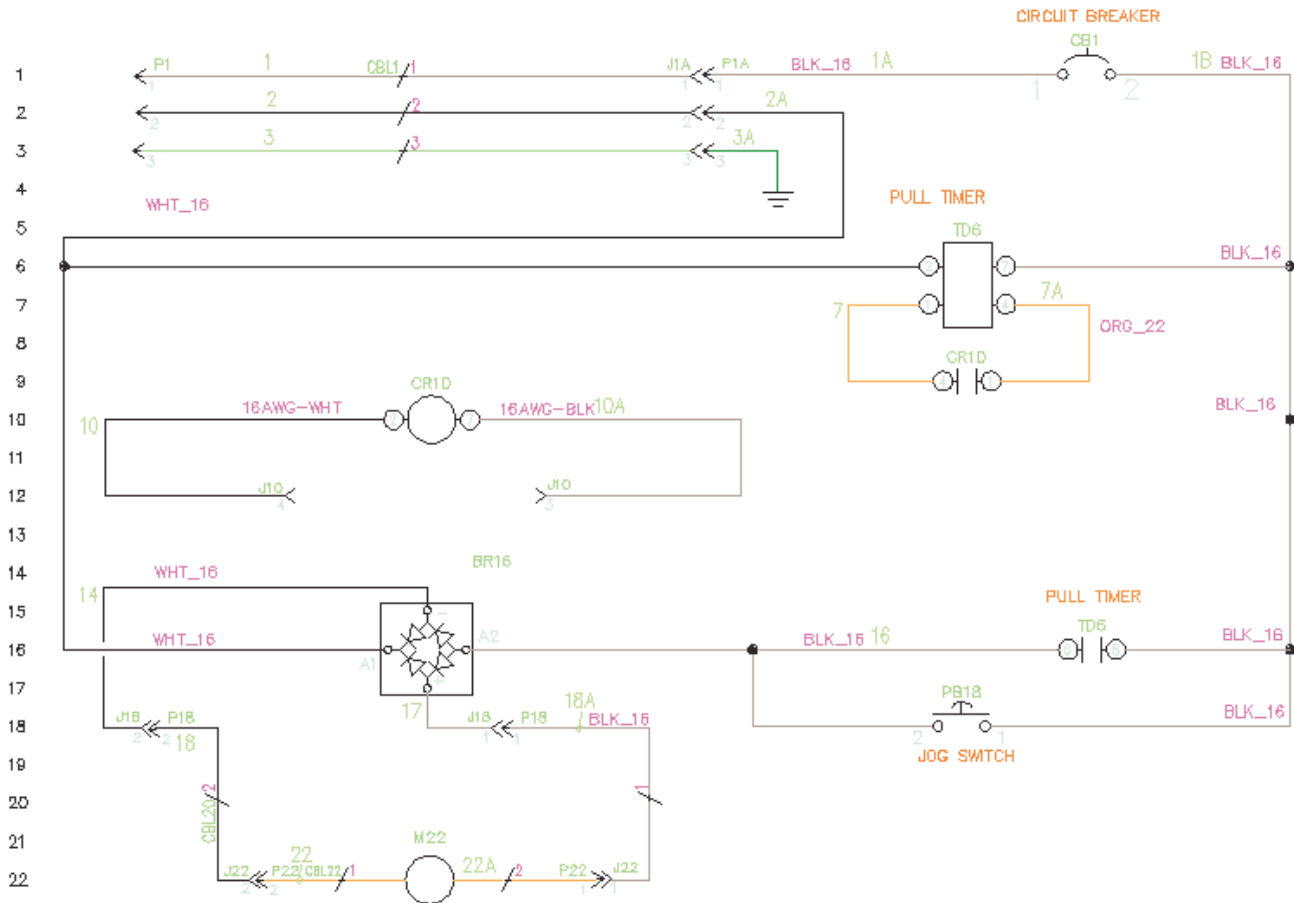
Configure your schematic drawing(s) in AutoCAD Electrical. Decide whether you will use sequential based or reference based Component Tags and Wire Numbers. Lay out connectors and assign pin numbers in AutoCAD Electrical schematic. You can use the components provided by AutoCAD Electrical or create your own custom components using the black box builder. If you always have the same pin assignments on a component set the defaults on the pins in the block or use the Pin List Database found under Components>Cross Referencing>**Pin List Database**.



Important! There are some conditions to consider when laying out your schematic:

- Parent and Child relationships will show as one component, even if they are two components in Inventor Professional like the plug and jack components. The wire going into the parent and coming out of the child will both go to the pin number of the Parent. Use two separate parents in AutoCAD Electrical for this condition.
- The Ground component in AutoCAD Electrical does not have a Tag or a Pin Number. All wires will need to connect to a component with a Tag (Refdes) and a Pin number to import. You will need to modify or create a new ground component in AutoCAD Electrical.
- Wire layer naming must match the wires in Cable & Harness Library in Inventor Professional.
- Cable ID and number of Conductors must match the cables in Cable & Harness Library in Inventor Professional.

Lay out the wires on the desired layers and use the Automatic Wire Numbering tool to number your wires.



Wire Sequencing Tool

Each wire coming into Inventor Professional must have a unique wire number. This is not the case with some point to point and many ladder diagrams. In the above diagram there are several wires that go to several components. For example wire number 2A goes from the Plug to the Timer to the Rectifier. Since you cannot insert several wires with the same Wire ID, use the Wire Sequencing tool to select the order of the sequence.

Go to the pull-down menu Wires>Wire Miscellaneous>select Define Wire Sequence. There is a default sequence in this dialog box. If you select OK, it will decide the order for the wires. For example, the default may have assumed you wanted to go from the Plug to the Rectifier and then to the Timer. But if you select the Pick option and select the pins in the order, starting with the first connection point, you can control the order. Then choose Ok-New.

Go to the pull-down menu Wires>Wire Miscellaneous>select Show Wire Sequence; enter to show a graphics display of the order of the sequence. This is graphical only and will go away as soon as you zoom. When we export the wire list, the SEQ1 column will show an 8-digit number that is unique. This will be the Wire ID we will import.

Adding Cables

While there is a large library of Cables in AutoCAD Electrical, there are only a few in Inventor Professional. However, you can add your own library entries to either program. The next two sections will discuss how to configure cables in Inventor Professional and AutoCAD Electrical so they will relate.

Inventor Professional

Check out the Cable & Harness Library in Inventor Professional. Take note of the way the wires are listed. For example the Generic group of wires are named 22AWG-GRN, 22AWG-RED AND 22AWG-BLU. These are going to be the name of the Wire Layers used in AutoCAD Electrical. If you have preferences for wire naming convention in AutoCAD Electrical, like wire part numbers or just gauge, you can enter these in the Wires portion of the Cable & Harness Library.

In Inventor Professional, each library Cable has a Part Number and assigned conductor wires. On the Wires Tab you will see the conductor ID's. When assigning a Cable in AutoCAD Electrical, you will need to create a new catalog entry and include the conductors in AutoCAD Electrical. While this is not crucial to the import, you will ensure that your schematic and model will agree.



Notes: You can export custom wire and cable types from your library and import them into another computer. Be sure to use the configuration file that has a `libwi res` or `cabl ewi res` header respectively.

Cable Catalog in AutoCAD Electrical

To match the Belden 8441 Cable in Inventor Professional we will need to create a Catalog entry in AutoCAD Electrical. When placing a Cable Marker, choose Catalog Lookup. You can select a similar 2-conductor Cable and then select New. This will make a copy with most information already filled in. For the import file, the information that will be used is the catalog number 8441. Select Ok.

In the Parts Catalog Dialog, select Cable Conductor View/List. Enter the conductors as they appear in the Inventor Professional Cable & Harness Library.

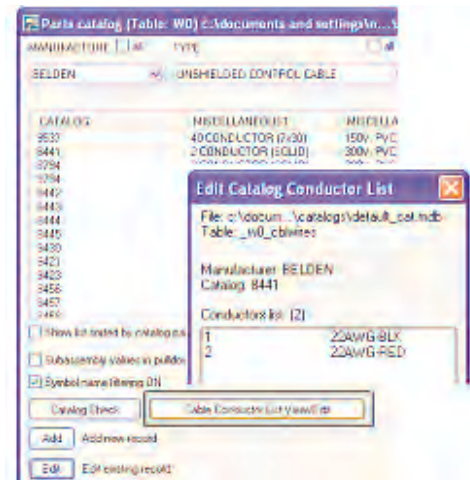
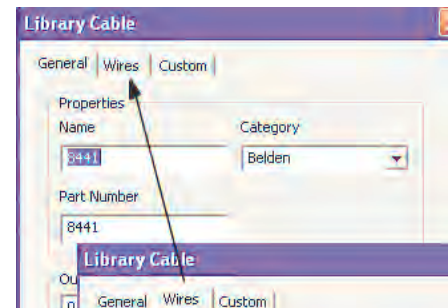


As you place a Cable Marker, assign your catalog number. The first wire you select will automatically enter the Conductor ID's (Wire Color/ID) on each parent and child components as you select them.

Keep in mind that AutoCAD Electrical will not change the wire layer to match the conductor ID, you will want to do that manually. The number on the conductors in the report will trigger the appropriate wires from the library on import.

After assigning the Cables you are now ready to export the file.
Quick Check List Before Exporting

- Wire Numbers
- Cable Marker with Tags (if cables exist)
- Cable Catalog Assignment or Wire Layer
- Conductor ID's (if cables exist)
- Component Tags
- Pin Numbers
- Locations (not required in the report but, you will be prompted for location To and From)



Export Report from AutoCAD Electrical

In Schematic Reports there is a format already setup for you to export to Inventor Professional. Go to the Schematic Report Tool and Select Autodesk Professional Wire List. Include all involved drawings. Select All locations From and To. The first time you do this report be sure to add the additional columns as discussed in the table on page 4. Choose the Save to File Option and choose **CSV comma delimited ASCII output**. When prompted to run a script file you can Cancel.

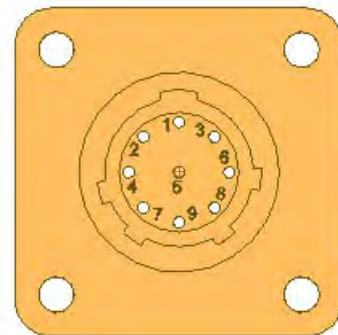
Report Generator								
Drawing AIP Cable and Harness From/To Data Extract (22 records)								
WIRE ID	SEQ1	CABLE ID	WIRE NAME	CONDUCTOR ID	REFDES1	PIN1	REFDES2	PIN2
1	10020900		16AWG-BLK		CB1	1	P1A	1
1B	10023003		16AWG-BLK		TD6	8	PB18	1
1B	10023002		16AWG-BLK		TD6	7	TD6	8
1B	10023001		16AWG-BLK		CB1	2	TD6	7
1C	10011900	CBL1	2260/3	1	P1	1	J1A	1
2	10012900	CBL1	2260/3	2	J1A	2	P1	2
2A	10007001		16AWG-RED		P1A	2	TD6	2
2A	10007002		16AWG-RED		TD6	2	BR16	A1
3	10010900	CBL1	2260/3	3	P1	3	J1A	3

Setting up the Connectors in Inventor Professional

Each connector must have a name, pins and pin numbers that match the AutoCAD Electrical schematic diagram.

Create Pins and Assign Pin Numbers

To create a Pin, you can open the part or edit the component in the context of the assembly. Change the Part Features panel bar menu to Harness Part Features.



Note: If Harness Part Features are not available be sure you are in Inventor Professional and be sure that the Cable and Harness is installed properly.

Pins act like work points. They can be placed on the following objects.

- Center of a 2d circular edge
- Work Point
- Part Corner
- Random Point on the face of part (Not recommended)



Assign the same pin numbers that are used on the same components in AutoCAD Electrical Schematics. On components that always use the same pin numbers, you can put these pin numbers in the connectors and keep them in your library.



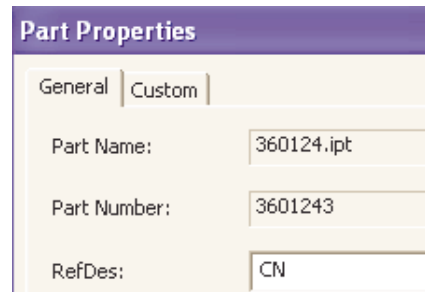
Tip: Mark the component with pin number text using the Emboss tool to make it look like the real component!

Temporary Reference Designators

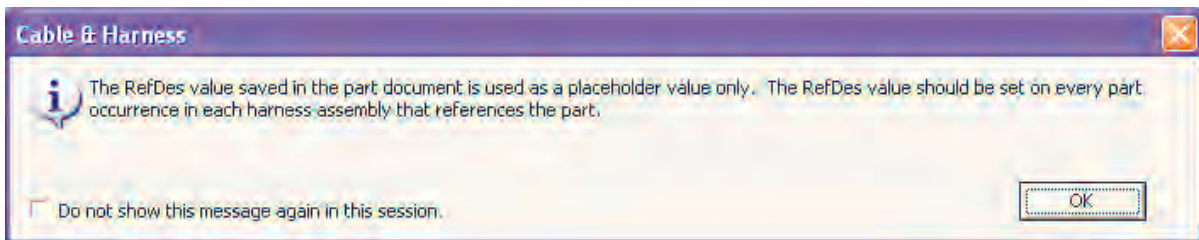
Each connector has a reference designator that will match the Component Tag name of the device on the AutoCAD Electrical Schematic.

If you create multiple wire harnesses, these components can have different reference designators assigned in that Harness. This is the reason for not being able to assign the RefDes in the part.

However, if you include FAMILY name in your component assignments in AutoCAD Electrical either with sequential or with reference numbering, you can include that FAMILY name in the part file as a temporary reference designator. In the Harness Part Features Panel Bar, choose Harness Properties, enter the AutoCAD Electrical FAMILY name in the RefDes field. When entering this temporary Family name in the RefDes field, you will get a message telling you that while you are active in a part, this value can only be a place holder.



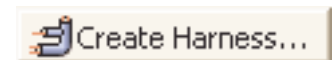
Part Properties	
General	Custom
Part Name:	360124.ipt
Part Number:	3601243
RefDes:	CN



If you have not already inserted your connectors into your assembly you can insert them now. You can double check the pin number by expanding the connectors in the Assembly browser. This will show the pins and their numbers.

Create Harness

Create a new harness. Enter a name and select a location in your project. While active in a Harness, you have two choices.



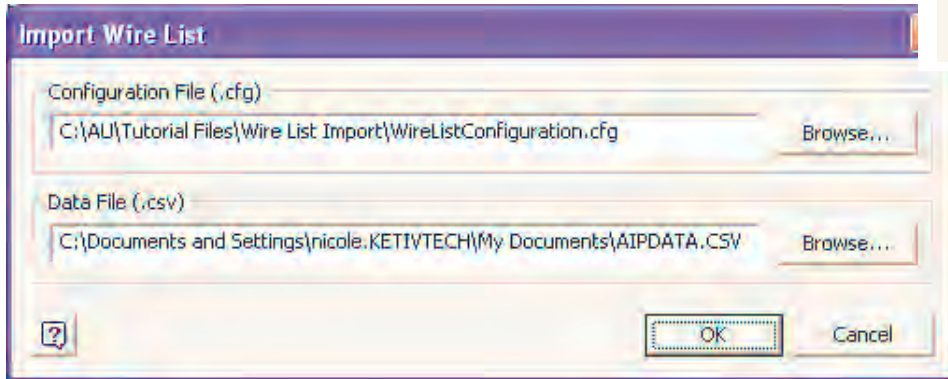
- Option1: You can select the components and drag and drop them into the Harness. This method works if you want the connectors will be used in only one Harness.
- Option 2: (Preferred) You can leave them in the main assembly and access them where they are. This allow us to use them in multiple wire harnesses.

Assign Reference Designators

In the Report Generator, open the file you exported from AutoCAD Electrical and refer to it as you assign the final reference designators. Right click on each connector in the browser that you will be wiring and choose Harness Properties. You can now add the number of the device from the AutoCAD Electrical schematic drawing.

Import Wires and Cables into Inventor Professional

In the import dialog box, select the configuration file (.cfg extension) and AutoCAD Electrical report file (.csv extension). Wires and cables should come in attached to the devices in the most direct route possible.



Troubleshooting Tips

For troubleshooting, you can open both the imported report and the configuration file and make quick edits to resolve problems. However, be sure to go back to the electrical report and make any adjustments needed. When you re-import the report, it is best to delete all wires and cables before re-importing the file. Otherwise, if a wire is routed to a different component or pin, it will not update. Here are some examples of errors you might receive and some areas to consider for adjustments.

ERROR: The number of values (9) on line 1 of the data file does not match the number of properties (10) defined in the header. The line was skipped. Be sure that there are no extra characters or unnecessary marks in your report. Check that the number of fields match in both the report and the configuration file.

ERROR: The Reference designator "XX1" specified for wire "0001" (line 1) cannot be found. The wire was not added. NOTE: A RefDes value must be applied to each splice occurrence and part occurrence in the active harness assembly, even if a value exists in the part IPT file. Be sure the Tags and Pins in your report match the RefDes and Pins of the components in your model.

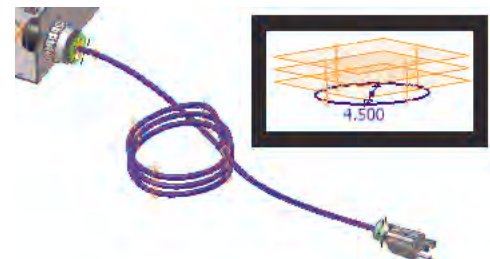
Wire ID is not unique within the Harness Assembly. Please enter a unique Wire ID. Check the 8-digit sequential code, be sure that each Wire ID is unique.

ERROR: The library cable "22AWG-BLK" specified for cable wire "1" of cable "844x" (line 16) does not exist in the Cable & Harness Library. The line was skipped. Be sure the wires and cables match those in the library.

Tips on Routing within Your Model

For basic instructions on how to route your wires, including Splice, Manual and Auto-route, please refer to the Tutorials provided with Inventor Professional. I recommend the Autodesk Official Training Courseware (AOTC) as well. These additional tips can help once you understand the way the tools work.

- Use Work points or centers of circular edges within the parts to help to create your segments.
- Right click on a segment or a discreet wire and choose Add Points. Then right click on the points choose 3d Move/Rotate tool to help you route the wires.
- Create segment ties in your assembly. You can use the centers of a tie to help you route quickly.

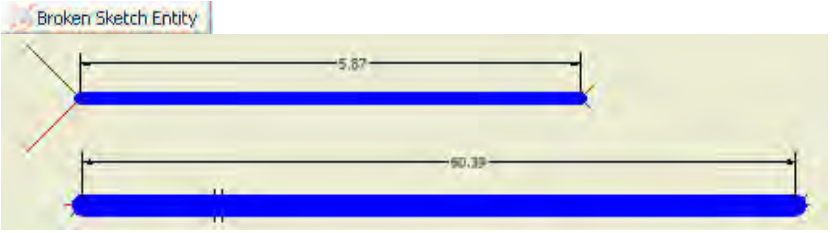



- Create reference parts to help you route your geometry. You can create a collection of sketches and work features in a part, and then bring it into your assembly a reference component. To make a part a reference in Inventor 10, right click the part and select BOM Structure>Reference. This part will not show up in your parts list.

Tips on Documentation

The need for documentation may vary for each project. For this project, AFM needed only a wire list, connector list, a wire number list for the labels and a model view showing the routing. You can also quickly create a Nailboard from your assembly. For full instructions on Harness documentation please see Help and the AOTC courseware.

Once you have learned the basics of how to document your Nailboard the following tips may prove useful.

- Broken Sketch Entity - For our example model, one of the cables is 60 inches long and does not fit well on the page. Use the Broken Sketch Entity tool. This will allow you to select two places and edit the distance that will be removed.
- Display Properties - Select pins before going to the Display Properties Dialog. Then you can hold control to select multiple items to label.
- Show Model View - Using your template, create a model view. In the browser, expand the view, expand the assembly, find the harness. Right click the harness and turn on the centerlines.
- Customizing Reports – To create a report of your own, write down a list of the data you would like to see in the report. Then use report generator to edit the configuration files. Note how the data was retrieved for each of the items you wish to report. Find the configuration file that is closest to your needs and revise it. Be sure to save it with a unique name so you can leave the sample unchanged.

Summary

AutoCAD Electrical and Inventor Professional can help you to design and build a virtual prototype, giving you more precise documentation of the Cable and Wire Harness Assemblies. Once you know which areas need special attention, the process can help you to be more productive and accurate in your process.

I hope you have enjoyed this course and look forward to hearing from you. Please contact me to share your progress and ideas for this tool.

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