

# BendWorks™

## HELP DOCUMENT



## INSTALLATION/UNINSTALLATION

The installer that ran when you downloaded this plug-in from Exchange has already installed the plug-in. You may need to restart Revit to activate the plug-in. To uninstall this plug-in, simply rerun the installer by downloading it again from Exchange, and select the 'Uninstall' button, or you can uninstall it from 'Control Panel | Programs | Programs and Features' (Windows 7/8) or 'Add/Remove Programs' (Windows XP), just as you would uninstall any other application from your system.

## SETUP

BendWorks™ installation provides a “**GreenleeStandards.rvt**” project file that contains the information required for using the BendWorks split tool. The default location of this file is

**C:\Users\<current\_user>\Documents\Greenlee\Bendworks**, unless otherwise specified during the installation. The standards contained in this file need to be transferred to a current or new project prior to using the tool.

Open the “**GreenleeStandards.rvt**” file. Open an existing project file or create a new project file using the Electrical Template.

Make the new or existing file the current sheet. Choose the **Manage** tab. Choose the **Transfer Project Standards** icon. The **Select Items to Copy** dialog will appear. Change the “Copy from:” to “GreenleeStandards.rvt”. Choose **Check None**. Select **Conduit Sizes** and **Conduit Types**. Choose **OK**. The **Duplicate Types** dialog appears; choose **Overwrite** to add Greenlee standards to project.

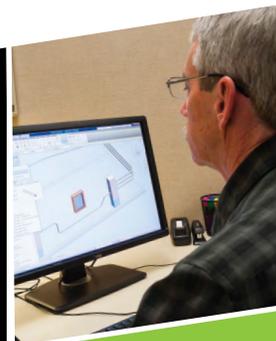
The “GreenleeStandards.rvt” should be kept unaltered for future use.

The BendWorks add-in is now ready to be used in the project.

*Note: If Revit is upgraded to a new version, BendWorks will need to be reinstalled using a compatible version.*



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# INTERFACE RIBBON



**Select Conduit** - Selects and highlights conduit runs by type



**Single Split** - Splits a single run of conduit by selecting from screen



**Multiple Split By Type** - Splits multiple runs of conduit by a chosen type through a dialog box



**Multiple Split By Selection** - Splits multiple runs of conduit by selecting from screen



**Single UnSplit** - Unsplits a single run of conduit by selecting from screen



**Multiple UnSplit** - Unsplits multiple runs of conduit by selecting from screen



**Conduit Check and Export** - Reprocesses an individual conduit section of a split run and resaves the output file



**Settings** - Sets default parameters for splitting a conduit run (can be overridden during split processing)



**About/Help** - Information and help file access

# SETTINGS

## **Default location of output (.csv) files:**

This designates the location where all “.csv” files will be written. The Manual Bender File “.txt” files will also be written to this location when enabled.

## **Default nominal length of straight (ft.):**

This designates the length at which each straight section of conduit is split, in feet.

## **Default nominal length of bends (ft.):**

This designates the length at which each bent section of conduit is split, in feet.

## **Default number of bends for a bend of nonstandard radii:**

This designates the number of bends used in a bend that is larger than the standard radii.

## **Manual Bender File to Be Exported:**

This designates to export a text file for use with manual Greenlee benders.

## Split Conduit Run into Segments

### **Location of output (.csv) files:**

This designates the Default location the “.csv” files will be written for splitting process. Users may change location that overrides default setting.

### **The conduit that has been selected:**

This identifies the Revit assigned identifier of the conduit run.

### **Nominal lengths:**

This designates the lengths the split process will use. Users may change designations that override default settings. Choosing **Both Lengths Equal** sets lengths to the nominal straight length.

### **Split options:**

This designates how a run is processed.

**Start:** Processes split from point selected nearest to termination.

**End:** Processes split from opposite end of selected point.

**Optimize:** Processes split that results in minimum number of cut segments.

### **The prefix for output file:**

This is the input for designating the Custom Mark of the sections of conduit. Designation limited to (7) seven characters. This Custom Mark is attached to the conduit sections and is an added field in the Properties Browser. This Custom Mark may be changed by the user.

### **The number of bends for non standard radii:**

This is the input for overriding the default number of bends used in a bend that has a larger than standard radius.



# USAGE

Select **Greenlee tab** to open BendWorks interface ribbon.

## Select Conduit tool:

Allows user to locate Greenlee conduits and elbows of a particular type and size from a dialog box. Selection highlights on screen.

## Single Split tool:

Allows user to choose a single conduit run to be split. Runs should be selected at one of the ends for best practice; otherwise run must be processed by **Optimize** option. Select icon, select run on screen to be processed. After choosing run user is allowed to change parameters of split through the **Split Conduit Run Into Segments** dialog.

*Note: BendWorks adds an underscore followed by a 4-digit extension to the designated prefix.*

Choosing **OK** starts the process. The **Conduit Check and Export** dialog appears. This shows how run is split, marks lengths and errors. User has option to pick a section and highlight it on the screen. Choose **OK** to finish processing. Split is finished and output files are written.

*Note: If UNDO command is executed after splitting a run, the run will un-split, but the output files **will remain in the folder**.*

*Note: The **Split Run Into Segments** window will display in the bottom left corner the value of the **Total Angle of Bends**. It is intended to be used in the splitting process for reference only.*

## Multiple Split By Type tool:

Allows user to choose multiple runs to be split by designated size and type. After selecting icon, a dialog box appears that lists all runs by type and size. User makes selection, chooses **OK** to continue, selection highlights. User is allowed to change parameters of split through the **Split Conduit Run Into Segments** dialog.

*Note: When splitting multiple runs, only split run **Optimize** is available.*

Choosing **OK** starts the process. Prefix Settings for **Selected Conduit Runs** dialog appears. This shows the mark prefixes, number of straights, number of bends, type and size of conduits in runs. User has option to pick a run and highlight it on the screen.

*Note: BendWorks adds a 2-digit extension to the designated prefix, and an underscore followed by a 4-digit extension for each piece of conduit.*

Choosing **OK** continues the process. **Conduit Check and Export** dialog appears. This shows how runs are split, marks lengths and errors. User has option to pick a section and highlight it on the screen. Choose **OK** to finish processing. Split is finished and output files are written.

*Note: If UNDO command is executed after splitting a run, the run will un-split, but the output files will remain in the folder.*

*Note: The **Split Run Into Segments** window will display in the bottom left corner the value of the **Total Angle of Bends**. This variable refers to the first run of conduit selected. It is intended to be used for reference in the splitting process.*



### **Multiple Split By Selection tool:**

Allows user to choose multiple runs to be split, regardless of type and size. After selecting icon, user makes selections from screen, chooses **Finish** to continue. User is allowed to change parameters of split through the **Split Conduit Run Into Segments** dialog.

*Note: When splitting multiple runs, only split setting Optimize is available.*

Choosing **OK** starts the process. Prefix Settings for **Selected Conduit Runs** dialog appears. This shows the mark prefixes, number of straights, number of bends, type and size of conduits in runs. User has option to pick a run and highlight it on the screen.

*Note: BendWorks adds a 2-digit extension to the designated prefix, and an underscore followed by a 4-digit extension for each piece of conduit.*

Choosing **OK** continues the process. **Conduit Check and Export** dialog appears. This shows how runs are split, marks lengths and displays errors. User has option pick a section and highlight it on the screen. Choose **OK** to finish processing. Split is finished and output files are written.

*Note: If **UNDO** command is executed after splitting a run, the run will un-split, but the output files will remain in the folder.*

*Note: The **Split Run Into Segments** window will display in the bottom left corner the value of the **Total Angle of Bends**. This variable refers to the first run of conduit selected. It is intended to be used for reference in the splitting process.*

### **Single UnSplit tool:**

Allows user to choose a single conduit run to unsplit by selection from screen. After selecting icon, user selects any section of Greenlee conduit on the screen. A dialog appears, warning that the output files for that run will be deleted. Choosing **Continue** completes the process.

### **Multiple UnSplit tool:**

Allows user to choose multiple runs of conduit to un-split by selections from screen. After selecting icon, user selects runs on the screen. Choose **Finish** to continue. A dialog appears, warning that the output files for the runs will be deleted. Choosing **Continue** completes the process.

### **Conduit Check and Export:**

Allows user to check sections of a split run and reprocess if needed. After selecting icon, user selects segment(s) to be updated and chooses **Finish**. The **Conduit Check and Export** dialog appears. This shows marks, lengths, and any errors. User has option pick a section and highlight it on the screen. User must check the **Update/Generate CSV's** box to update files. Choose **OK** to finish update.

*Note: This function does not execute an error message if a section of a split run is changed to be outside of the specified length parameters, and will update .csv and .txt files to reflect any dimensions of the conduit section.*

*Note: The command will not display an error message when checking conduit that is not Greenlee conduit. It will execute and yield a blank field.*





**Settings:**

Allows user to set defaults for BendWorks. After selecting icon, user inputs parameters to be used for the splitting process.

*Note: The settings may be overridden during the splitting process.*

**Help/About**

Provides access to BendWorks version and **Help** files. After selecting icon, a dialog appears that shows the BendWorks version and **Help** files.



# NOTES

Once a run of conduit has been split, changes to the individual sections will not be reflected in the .csv or .txt files unless **Conduit Check and Export** command is executed on the modified sections. For best results, unsplit the conduit run before making any modifications. This will insure the entirety of the run is reanalyzed for optimum conduit use.

Conduit bends are not intended to be greater than 90 degrees. Revit inserts a very short straight section in the middle of a bend greater than 90 degrees. This will produce an error, because the straight section does not create adequate distance between individual bends of conduit to be bent by Greenlee benders.

For exceptionally long runs as well as processing many runs, the program may need up to a minute or more to process and output all of the data.

Naming convention for files is hexadecimal, where instead of numbers being represented from 0-9; they are represented 0-F. The order is 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F. This may cause output files to be displayed out of order when viewed in Windows Explorer, where the files with alphanumeric (letters and numbers) are ordered before numerically named files because numbers are prioritized after letters. The following table compares the order in which the files will be displayed.

BendWorks	Microsoft
2b_0000	2b_0000
2b_0001	2b_000A
2b_0002	2b_000B
2b_0003	2b_000C
2b_0004	2b_000D
2b_0005	2b_000E
2b_0006	2b_000F
2b_0007	2b_0001
2b_0007	2b_0002
2b_0009	2b_0003
2b_000A	2b_0004
2b_000B	2b_0005
2b_000C	2b_0006
2b_000D	2b_0007
2b_000E	2b_0007
2b_000F	2b_0009
2b_0010	2b_0010
2b_0011	2b_0011

# CONDUIT CREATION

After installation and setup of BendWorks, conduit runs may be created using Greenlee-specified conduits and benders. Runs created using Greenlee specified conduit contain information associated with specific benders, such as bend radii and minimum distances from bend that are needed for processing of the individual sections.

BendWorks adds Families of conduits and elbows to a Revit project so that conduit runs can be created and then split using the add-in. The information added to the project can be viewed in the **Project Browser** in the **Families** area under the **Conduit Fittings** and the **Conduits without Fittings** sections.

Settings (ID, OD, and Min. Bend Radius) for the Greenlee conduits can be viewed through the **MEP Settings**.

**Warning: Do not change these settings as this will result in inaccurate BendWorks processing.**

Creating a conduit run using Greenlee conduit is the same as creating a standard run in Revit. The user sets the view to work in, selects the **System** tab and chooses the **Conduit** icon. In the properties pane, the users can scroll through the choices and pick the Greenlee conduit they require. The families are set up by type of conduit and bender model. Once the selection is made, the run can be developed by using the native Revit tools. Only the diameters applicable to the bender chosen are available for use in the bar across the top of the screen. Any of the standard tools in Revit can be applied to create runs. The **Split** tools can then be used to process the runs into section and bend information for fabrication purposes.

When aborting the splitting process at any time, it is best practice to select **Cancel** rather than the “x” in the upper right corner of the window. Failure to follow best practice may cause temporary errors in viewing.



# OUTPUT FILES

BendWorks creates files from the splitting process and outputs them into a folder of the user's choice.

## There are two types of output files:

1. **.CSV files:** These can be viewed using Microsoft Excel. The .CSV files are always output when splitting, and they are the only file type containing information formatted to load into Greenlee programmable benders, such as the 1055 AutoBend 3D and the 855GX IntelliBender.
2. **.TXT files:** These can be viewed using any text file reader. The .TXT files may be output after splitting only if selected to do so in the Settings control box. These output files are used as a guide for bending when using Greenlee non-programmable benders, such as the 555C, 854DX, 881, etc.

BendWorks also creates a “\_Cuts.csv” file. This file designates the sections of conduit that are not the nominal length designated in the split process.

## “X\_xxx.csv” file Definitions:

GREENLEE BENDER	855GX			Bender Designation
vers	2013			Version of Output Data
units	ENG			Units
bendtype	SEQUENT			Type of Bend
pipetype	IMC			Type of Pipe
pipesize	100			Size of Pipe (ex: 100 = 1", 112 = 1-1/2")
height	0			
length	0			
angle	0			
straight	0			
h1	0			
h2	0			
vangle	0			
pipe_num	FFF_0004	FFF_0005	FFF_0006	Pipe Markings (before, current, after)
seq_bends	1			Sequence of bends
l1_a1, r1	4.468	90	0	Pipe bend location and angle
l2_a2, r2	0	0	0	
l3_a3, r3	0	0	0	
l4_a4, r4	0	0	0	
l5_a5, r5	0	0	0	
conc_bends	0			Number of bends
conc_angle	0			Angle of bends - These are used for Bends that have non-standard Radii
conc_start	0			Bend locations
conc_radi	0			Bend radii
PL_batch	10			Conduit Length (feet)



### “X\_Cuts” file Definitions:

The following cut pieces were generated based off of default settings of 10 for straights and 10 for bends.

Mark	Type	Size(ft.)	Length(ft.)	Default Length(ft.)
Z_0000	EMT	0.166667	9.578066	10
Z_000D	EMT	0.166667	7.693485	10

### “X\_xxx.txt” file Definitions:

Greenlee Bender: 854DX ----Bender Designation  
Conduit Type: IMC ----Type of Pipe  
Conduit Size (INCHES): 1 ----Size of Pipe

Pipe Identification: FFF\_0005 ----Segment name  
Segment Before: FFF\_0004 ----Name of previous segment  
Segment After: FFF\_0006 ----Name of next segment

# of Seq. Bends: 1 ----Number of Sequential bends  
Bend Mark (INCHES): 6.00 ----Distance to mark on Pipe from end  
Bend Rotation (DEGREES): 0 ----Rotation of Pipe for 3D bends  
Bend Angle: (DEGREES): 90 ----Angle of Bend  
Note: NEGATIVE rotation values represent rotating the conduit CLOCKWISE.  
Bend rotation values are all relative to the first bend.

# of Conc. Bends: 0 ----Number of Concentric Bends  
Bend Mark Start (INCHES): 0 ----Distance to mark on Pipe from end  
Bend Angle per Conc. Bend: 0 ----Angle of Bends  
Bend Radius for Conc. Bend: 20 ----Final Bend radius

Cut Mark (INCHES): 0 ----Mark for cutting to length

*Note: for bends of non-standard radii, the user must calculate the distances between bends as well as the angle of each sub-bend that makes up the larger bend.*

# ERRORS

**Error: The conduit with (type.....) is not supported.**

**Reason:** Conduit run is not Greenlee specified Conduit.

**Solution:** Change run to a Greenlee designated conduit.

1>Highlight run

2>Modify/Multi-Select-Change type

3>Choose Greenlee specific conduit

Or recreate run using Greenlee specific conduit.

**Error: Bend angle cannot be smaller than 5°.**

**Note:** Run will be processed.

**Reason:** Benders do not bend conduit to an angle less than 5°. Error may also occur at a bend angle 90-95°. The bend is broken at 90° and a small straight section is added to separate the 90° bend from the rest of the bend.

**Solution:** Recreate run with bend at 5° or larger.

Or change bend to 5° or larger.

Or remove bend.

**Error: Multiple benders not supported.**

**Reason:** Conduit run was created using two or more different Greenlee benders.

**Solution:** Recreate or change run to a single Greenlee specified bender, type, and size of conduit.

**Error: The selected is not the START conduit!**

**Reason:** While processing individual runs from the start or end, it is required that the user select one of the ends, designating the start for reference.

**Solution:** Pick a straight portion near the termination point of the run the user wants to designate as the start.

**Error: The selected is not the END conduit!**

**Reason:** While processing individual runs from the start or end, it is required that the user select one of the ends, designating the start for reference.

**Solution:** Pick a straight portion near the termination point of the run the user wants to designate as the end.

**Error: Mark Prefix Exists:**

**Reason:** Mark prefix currently exists in the specified output folder.

**Solution:** Choose Rename to change prefix designation.

Choose Continue to use same prefix designation. Beware, continuing through the selection may incur errors in relation to the conduit with the same name. The second run of conduit with the same name will begin the numbering at which the original run left off. This may lead to confusion when reviewing output files. They will appear to refer to the same run of conduit, but in fact are referencing two (2) separate conduit sections. The contents of the output files are not affected. Prefix will be used and will add to files currently in folder.

Choose Cancel to cancel process.

Re-run split and specify a different folder.



**Warning: Elements have duplicate 'Mark' values:**

**Reason:** Portions of conduit before and after a bend have the same mark designation because they are part of the same bent section of conduit.

**Solution:** This warning can be ignored.

**Error: The conduit length between two bends cannot be too small.**

**Note:** Run will be processed.

**Reason:** The distance between bends is not large enough for the bender to make the bends. Bend may have been developed over 90°.

**Solution:** Increase distance between the two bends.  
Check that a bend is not over 90°.

**Error: The distance from the start end of the run to the start end of the first bend cannot be shorter than D+X.**

**Note:** Run will be processed.

**Reason:** The straight portion of a section of conduit adjacent to the bend is too short for the designated bender to use.

**Solution:** Increase distance of straight section adjacent to bend.

**Error: The conduit has been modified to be in the opposite direction or insufficient space to create the required fittings.**

**Note:** Run may be processed, with critical errors. My occur in conjunction with previous error "The distance from the start end of the run to the start end of the first bend cannot be shorter than D+X" due to the reason behind the error. The fitting at an end connection may be located some distance away from the conduit as a result of splitting the configuration.

**Reason:** The straight portion of a section of conduit adjacent to the bend is too short for the designated bender to use.

**Solution:** Increase distance of straight sections adjacent to bends. Decrease number of bends occurring on section of conduit.

**Error: Bend Radius –Edit**

**Reason:** The value entered for the bend radius for the conduit is too small for the conduit/bender type.

**Solution:** Choose: Use the minimum bend radius, to reset bend to the default value.

Or Choose: Enter a larger value, to increase to a radius that the conduit/bender type will accept.

**Error: Bend radius cannot be too big.**

**Note:** Run will be processed.

**Reason:** The value entered for the bend radius for the conduit is too large for the conduit/bender type.

**Solution:** Recreate conduit run using standard bend radius.

Or change bend to a smaller radius.

Or remove bend.

**Error: Total bend angles exceed 360 degrees.**

**Note:** Run will be processed.

**Reason:** The total of the bend angles in a conduit run cannot be over 360 degrees.

**Solution:** Recreate run with less bends.

Or make run two or more runs using junction box or coupling.

**Error: The conduit run is in a loop.**

**Reason:** The run was created as a closed loop with no end points.

**Solution:** Recreate run with open ends.

Or break run by adding junction boxes or additional branches.

Or remove a bend.

**Error: No CSV files are found for the prefix(es) from the following locations:**

**Reason:** The CSV files for the run that is being un-split have been moved or deleted from original directory.

**Solution:** None- Run will be un-split.

**Error: Revit could not complete the external command.**

**Reason:** Items were not selected when running the Conduit Check and Export command.

**Solution:** Items are required to be selected after the Conduit Check and Export command is initiated.

**Error: The value you entered for the bend radius for conduit is too small.**

**Reason:** Value entered for bend radius is smaller than the minimum required for processing.

**Solution:** Choose either Use minimum bend radius

Or choose Enter a larger value and then input a larger value.

**Error: CSV output folder does not exist!**

**Reason:** The designated location for the CSV files is invalid, or blank.

**Solution:** Choose a file location that is available.

**Error: The default nominal segment length of straights is wrong!**

**Reason:** The default nominal length of straights (ft) cannot be 0.

**Solution:** Input a value greater than 0.

**Error: The default nominal segment length of bends is wrong!**

**Reason:** The default nominal length of bends (ft) cannot be 0.

**Solution:** Input a value greater than 0.

**Error: The default number of bends in a concentric bend is wrong!**

**Reason:** The number of bends for a non-standard radius cannot be 0.

**Solution:** Input a value greater than 0.