

# Electrical

## *Reference Data Guide*



Process, Power & Marine



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# Preface

This document is a reference data guide for the SmartPlant 3D Electrical task. The purpose of this document is to describe the reference data delivered with the software for this task.

Reference data includes both catalog data and specification data. Catalog data includes the parts that you place in the model, such as piping components and equipment. Specification data includes the rules that govern how those parts are placed and connected.

## SmartPlant 3D Documentation Set

SmartPlant 3D documentation is available as Adobe PDF files. The content is the same as online Help. To access these PDF documents, click **Help > Printable Guides** in the software.

The documentation set is divided into four categories:

- Administrative guides contain information about installing, configuring, customizing, and troubleshooting SmartPlant 3D.
- User's guides provide command reference and how-to information for working in each SmartPlant 3D task.
- Reference data guides define the reference data workbooks. Not all tasks have reference data.
- ISOGEN guides

### Administrative Guides

*SmartPlant 3D Installation Guide* - Provides instructions on installing and configuring the software.

*Project Management User's Guide* - Provides instructions for setting up the databases, creating permission groups, backing up and restoring project data, assigning access permissions to the model, defining and managing locations for Global Workshare, and version migration.

*SmartPlant 3D Global Workshare Guide* - Provides instructions for setting up the software and the databases to work in a workshare environment.

*SmartPlant 3D Interference Checking Guide* - Provides information on installing, configuring, and using the interference detection service.

*SmartPlant 3D Integration Reference Guide* - Provides information about installing, configuring, and using SmartPlant 3D in an integrated environment.

*SmartPlant 3D Interpreting Human Piping Specifications* - Provides information about how to interpret human piping specifications so that you can create the corresponding piping specification in the software.

*SmartPlant 3D Point Cloud Reference* - Provides information for referencing point cloud files provided by point cloud vendors in SmartPlant 3D.

*SmartPlant 3D Troubleshooting Guide* - Provides information on how to resolve errors that you may encounter in the software by documenting troubleshooting tips, error messages, and to do list messages.

*SmartPlant 3D Plant Design System (PDS) Guide* - Provides all information needed to use PDS with SmartPlant 3D. Topics include referencing active PDS projects in SmartPlant 3D, exporting PDS data and importing that data into SmartPlant 3D, and converting PDS reference data to SmartPlant 3D reference data.

*SmartPlant 3D/SmartMarine 3D Programmer's Guide* - Provides information about custom commands, naming rules, and symbol programming.

## **User's Guides**

*Catalog User's Guide* - Provides information about viewing, editing, and creating reference data and select lists (codelists).

*Common User's Guide* - Provides information about defining workspaces, manipulating views, and running reports.

*Electrical User's Guide* - Provides information about routing electrical cable, cableway, cable tray, and conduit.

*Equipment and Furnishings User's Guide* - Provides information about placing equipment.

*Grids User's Guide* - Provides instructions for creating coordinate systems, elevation grid planes, vertical grid planes, radial cylinders, radial planes, grid arcs, and grid lines.

*Hangers and Supports User's Guide* - Provides instructions on placing piping, duct, and cableway supports in the model.

*HVAC User's Guide* - Provides instructions for routing HVAC duct.

*Orthographic Drawings User's Guide* - Provides information about creating and managing orthographic drawings.

*Piping Isometric Drawings User's Guide* - Provides information about creating and managing piping isometric drawings.

*Piping User's Guide* - Provides instructions for routing pipe and placing valves, taps, and pipe joints.

*Reports User's Guide* - Provides information about creating and managing spreadsheet reports.

*Space Management User's Guide* - Provides instructions for placing space objects such as areas, zones, interference volumes, and drawing volumes in the model.

*Structural Analysis User's Guide* - Provides instructions for defining loads, load cases, load combinations, and the importing and exporting of analytical data.

*Structure User's Guide* - Provides instructions for placing structural members such as: beams, columns, slabs, openings, stairs, ladders, equipment foundations, and handrails.

*Systems and Specifications User's Guide* - Provides instructions for creating systems and selecting which specifications are available for each system type.

## Reference Data Guides

*Electrical Reference Data Guide* - Provides information about electrical cable, cableway, cable tray, and conduit reference data.

*Equipment and Furnishings Reference Data Guide* - Provides information about equipment reference data.

*Hangers and Supports Reference Data Guide* - Provides information about hangers and supports reference data.

*HVAC Reference Data Guide* - Provides information about HVAC reference data.

*SmartPlant 3D 2D Symbols User's Guide* - Provides command reference information and procedural instructions for creating 2D symbols used to represent collars, clips, profiles, brackets, and other items.

*SmartPlant 3D 2D Symbols Reference Data Guide* - Provides information about the two-dimensional symbols used in all tasks.

*SmartPlant 3D Symbols Reference Data Guide* - Provides information about the Visual Basic Part Definition Wizard and the three-dimensional symbols used in all tasks.

*SmartPlant 3D Reference Data Guide* - Provides instructions about the Bulkload utility, codelists, and the reference data common to several disciplines.

*Piping Reference Data Guide* - Provides information about piping reference data including piping specifications, piping specification rules, piping parts, and piping symbols.

*Drawings and Reports Reference Data Guide* - Provides information about reports reference data.

*Space Management Reference Data Guide* - Provides information about space management reference data.

*Structure Reference Data Guide* - Provides information about structural reference data.

## ISOGEN Guides

*Symbol Keys Reference Guide* - Provides information about the symbol keys for isometric drawings. This guide is from Alias, the makers of ISOGEN.

## Documentation Comments

We welcome comments or suggestions about this documentation. You can send us an email at: [PPMdoc@intergraph.com](mailto:PPMdoc@intergraph.com).





# What's New in Electrical Reference Data

The following changes have been made to the Electrical reference data.

## *Version 2009.1*

- No changes have been made for this release.

## *Version 2009*

- Routing of duct banks has been added. New workbook includes Ductbank.xls. (P2 CR:17587)
- You can use a delivered Visual Basic Project (VBP) to customize the rules for the cable filling. Topics include the following: (P3 CR:134791)
  - *Customize Cable Fill* (on page 17)
  - *Cable Fill Example* (on page 21)
  - *Cable Fill Calculations* (on page 18)
- Delivered *naming rules* (on page 1) have been added. (P3 CR:114989)



## SECTION 1

# Electrical Reference Data

Before working with electrical reference data, you must be familiar with how the software handles reference data in general. If you have not already done so, read and understand the following important concepts and procedures described in the *SmartPlant 3D Reference Data Guide*:

- Custom attributes
- Symbol creation
- Codelists (also referred to as "select lists")
- Naming rules
- Bulkloading

For example, before you can define parts, you must understand how part data relates to data on the custom interfaces sheet, and how that information relates to parameters defined when the part symbol is created.

### Electrical Workbooks

The electrical reference data is defined in several Microsoft Excel workbooks. The software delivers these workbooks to the *[Product Directory]\CatalogData\Bulkload\DataFiles* folder. The following table lists the delivered workbooks and gives a brief description of their content.

Workbook	Content
CableTray.xls	Defines cable tray classes and parts.
CableWay.xls	Defines cableway specifications and rules.
Cabling.xls	Defines cable classes and parts.
Conduit.xls	Defines conduit classes and parts.
Ductbank.xls	Defines specifications and rules for duct banks.

### See Also

*Cable Parts* (on page 43)

## Naming Rules

The software provides several options for naming the electrical objects that you create. These naming rules are listed in the **GenericNameRules.xls** spreadsheet located in the appropriate install directory folder: ...\\CatalogData\\BulkLoad\\DataFiles. For more information on creating naming rules, see the *SmartPlant 3D Reference Data Guide*.

### DefaultNameRule

Use this option to let the software name the electrical object.

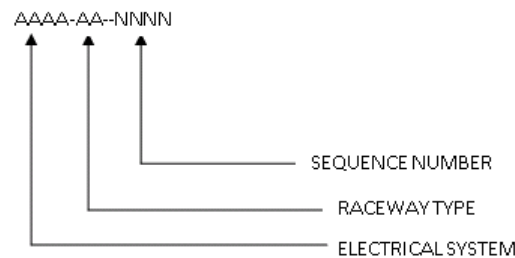
### User Defined

Use this option to define a custom name. You do not need to select this option explicitly. When you enter text in the **Name** box, the value is automatically set in the **Rule** field.

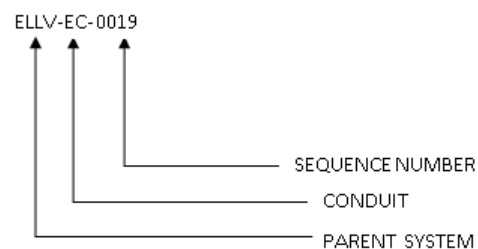
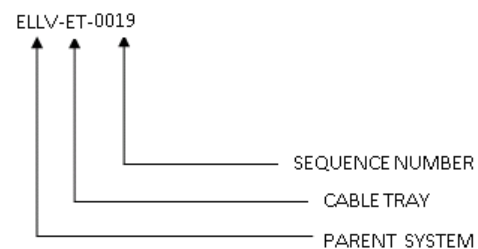
### Cableway and Conduit Runs

The default naming rule for cableways and conduit runs is a combination of the parent system name, the run type, the service level, if applicable, and a sequence number.

The following shows the naming rule format, as delivered:



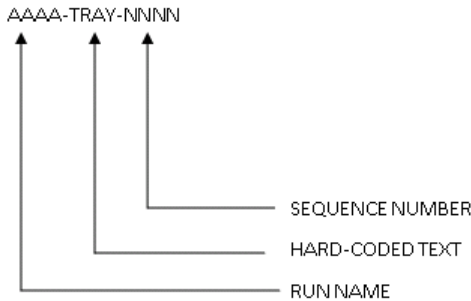
The following samples show the implementation of the naming rule for a cableway and a conduit run.



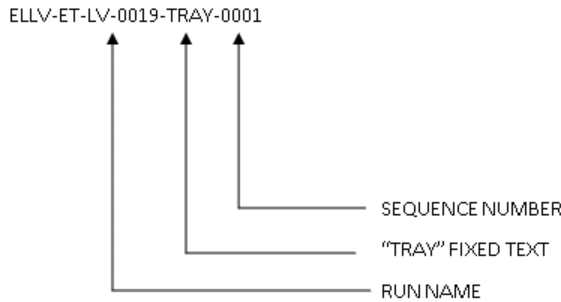
**NOTE** The sequence numbering for electrical runs is contiguous and unique within the system containing the run. Users have no control over the sequence number.

**Cable Tray Parts**

The default naming rule for a cable tray part is RunName-TRAY-SequenceNumber where *RunName* is the name of the parent run and *TRAY* is a hard-coded string.

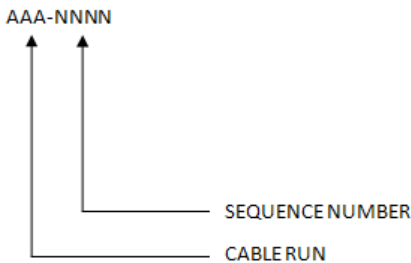


The following sample shows the implementation of the cable tray naming rule.

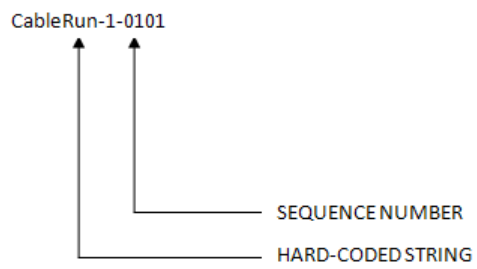


**Cable**

The default naming rule for a cable is CableRun-SequenceNumber where *CableRun* is a hard-coded string.



The following sample shows the implementation of the cable naming rule.



## SECTION 2

# Electrical Reference Data Workflow

The reference data for the Electrical task is divided into the following areas:

- Defining cableway reference data, including specifications and rules.
- Defining duct bank reference data, including specifications and rules.
- Defining cable tray reference data, including specifications and parts.
- Defining conduit reference data, including specifications, rules, and parts.
- Defining cable reference data, including parts.
- Defining electrical symbols for cable tray and conduit. For more information about symbols, see the *SmartPlant 3D Symbols Reference Data Guide* available from the **Help > Printable Guides** command in the software.

### See Also

*Cableway Reference Data Common Tasks* (on page 5)

*Duct Bank Reference Data Common Tasks* (on page 5)

*Cable Tray Reference Data Common Tasks* (on page 6)

*Conduit Reference Data Common Tasks* (on page 7)

## Cableway Reference Data Common Tasks

By following these tasks in order, you can create and customize your own cableway reference data.

### Define Cableway Specifications

Your first step is to define the cableway specifications for your project. For more information, see *Define Cableway Specifications* (on page 9).

### Define Cableway Specification Rules

After defining the cableway specifications, you define the rules associated with the specifications. For more information, see *Define Cableway Nominal Sizes* (on page 10) and *Define Cableway Bend Radius* (on page 11).

### See Also

*Electrical Reference Data Workflow* (on page 5)

## Duct Bank Reference Data Common Tasks

By following these tasks in order, you can create and customize your own duct bank reference data.

### Define Duct Bank Specifications

Your first step is to define the duct bank specifications for your project. For more information, see *Define Cableway Specifications* (on page 9).

### Define Duct Bank Specification Rules

After defining the duct bank specifications, you define the rules associated with the specifications. For more information, see *Define Cableway Nominal Sizes* (on page 10) and *Define Cableway Bend Radius* (on page 11).

### See Also

*Electrical Reference Data Workflow* (on page 5)

## Cable Tray Reference Data Common Tasks

By following these tasks in order, you can create and customize your own cable tray reference data.

### Define Cable Tray Specifications

Your first step is to define the cable tray specifications for your project. For more information, see *Define Cable Tray Specifications* (on page 26).

### Define Cable Tray Symbols

Almost all parts that you will place in the model are represented by a symbol. A symbol is a graphical representation of the part. In addition to the symbols that are delivered with the software, you can create your own custom symbols for placement in the model. For more information, see *Electrical Symbols Common Tasks* (on page 7).

### Define Cable Tray Parts

Parts are placed in the model. In addition to the parts that are delivered with the software, you can add your own parts to the catalog for placement.

### See Also

*Electrical Reference Data Workflow* (on page 5)



## Conduit Reference Data Common Tasks

By following these tasks in order, you can create and customize your own conduit reference data.

### Define Conduit Specifications

Your first step is to define the conduit specifications for your project. For more information, see *Define Conduit Specifications* (on page 31).

### Define Conduit Specification Rules

After defining the conduit specifications, you define the rules associated with the specifications. These rules involve filters, material control data, nominal diameters, and default commodity selection rules. For more information about filters, see *Define Conduit Filters* (on page 33). For more information about nominal diameters, see *Define Conduit Nominal Diameters* (on page 37), and for more information about commodity selection rules, see *Define the Conduit Default Commodity Selection Rule* (on page 37).

### Define Conduit Parts

Parts are placed in the model. In addition to the parts that are delivered with the software, you can add your own parts to the catalog for placement.

### See Also

*Electrical Reference Data Workflow* (on page 5)

## Cable Reference Data Common Tasks

You can create and customize your own cable reference data by adding your own cable parts.

### Define Cable Parts

Parts are placed in the model. In addition to the parts that are delivered with the software, you can add your own parts to the catalog for placement.

### See Also

*Electrical Reference Data Workflow* (on page 5)

## Electrical Symbols Common Tasks

You can create your own cable tray and conduit symbols. For more information on creating symbols and about the symbols that are delivered with the software, refer to the *SmartPlant 3D Symbols Reference Data Guide* available from the **Help > Printable Guides** command in the software.

### **See Also**

*Electrical Reference Data Workflow* (on page 5)

## SECTION 3

# Cableway Reference Data

The cableway reference data contains specifications and rules. Cableway does not include part definitions in the reference data because cableway is a space reservation in the model and does not have physical parts.

### See Also

*Cableway Specifications* (on page 9)

*Cableway Nominal Sizes* (on page 10)

## Cableway Specifications

The **Cableway Spec** sheet in the **CableWay.xls** workbook determines the specification that you access when you route a new run of cableway or create cableway features such as transitions and turns.

**Default Bend Radius** - Type the default for the throat radius width. Example values for bend radii are **12in**, **24in**, and **36in**.

**Description** - Type a phrase that describes the cableway specification. For example, you can explain the purpose of this particular specification.

**Tray Specification Type** - Indicates if the specification applies to cable trays, cableways, or ductbanks. "1" represents Cableway, "2" represents Cable tray, and "3" represents Duct Bank. Valid codes are listed in the **AllCodeLists.xls** workbook on the **TraySpecificationType** sheet in the **Codelist Number** column.

**Manufacturer** - Specify the manufacturer of the material in the reserved cableway space. This property is used to track the manufacturer for reporting. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Manufacturer** sheet in the **Codelist Number** column.

**Material** - Specifies the material that will reside in the reserved cableway space.

**Spec Name** - Type the name to assign to the cableway specification.

**Tray Type** - Leave **Undefined**

### See Also

*Define Cableway Specifications* (on page 9)

## Define Cableway Specifications

1. Open the **CableWay.xls** workbook.
2. Select the **Cableway Spec** sheet.
3. Select a row after the **Start** keyword but before the **End** keyword, and click **Insert > Rows**.
4. In the **Spec Name** column, type a name for the cableway specification.
5. Define the remaining properties for the specification.
6. Type **A** in the first column of the added rows.
7. Save the workbook, and exit.
8. Bulk load the workbook in the Add/Modify/Delete mode.

### NOTES

- For more information about each specification property that you can define, refer to the *Cableway Specifications* (on page 9).
- The **AllCodeLists.xls** workbook contains codelist values that you need to define cableway specifications.

### See Also

*Cableway Specifications* (on page 9)

## Cableway Nominal Sizes

The **Cableway Nominal Sizes** sheet in the **CableWay.xls** workbook controls which cross sections are available in the specifications. The sizes relate to the various types of cross sections, including rectangular, round, and flat oval.

**SpecName** - Identifies the cableway specification (CWS) for the cross section. An example is **Cws-0**.

**SectionName**- Identifies the outfitting cross section (OCS). Examples are **OCS-4X4**, **OCS-6X4**, and **OCS-8X4**. These cross section examples are defined in the OutfittingCrossSections sheet. If you include cross section names using this sheet, the names must be defined on this sheet in AllCommon.xls.

### See Also

*Cableway Reference Data* (on page 9)

## Define Cableway Nominal Sizes

1. Open the **CableWay.xls** workbook.
2. Select the **CableWay Nominal Sizes** sheet.
3. Select a row after the **Start** keyword but before the **End** keyword, and click **Insert > Rows**.
4. In the **Spec Name** column, type a name for the cableway specification.
5. In the **Section Name** column, type the cross section names that you want to define for the specification.
6. Type **A** in the first column of the added rows.
7. Save the workbook, and exit.
8. Bulk load the workbook in the Add/Modify/Delete mode.

**NOTE** The cableway specification must be defined on the **Cableway Spec** sheet.

## Cableway Bend Radius

The **Cableway Bend Radius** sheet in the **CableWay.xls** workbook determines the cableway bend radii that are available for each specification.

**BendRadius** - Assign the measurement that corresponds to the cableway that you are routing. Examples are **100mm**, **200mm**, **300mm**, and so forth.

**SpecName** - Type the name assigned to the cableway specification. An example is **Cws- 0**.

### See Also

*Define Cableway Bend Radius* (on page 11)

## Define Cableway Bend Radius

1. Open the **CableWay.xls** workbook.
2. Select the **CableWay Bend Radius** sheet.
3. Select a row after the **Start** keyword but before the **End** keyword, and click **Insert > Rows**.
4. In the **Spec Name** column, type the cableway specification to which to assign bend radii.
5. In the **Bend Radius** column, type the bend radii that you want to associate with the specification.
6. Type **A** in the first column of the added rows.
7. Save the workbook, and exit.
8. Bulk load the workbook in the Add/Modify/Delete mode.

### NOTES

- For more information about each column, see *Cableway Bend Radius* (on page 11).
- The cableway specification must be defined on the **Cableway Spec** sheet.

### See Also

*Cableway Reference Data* (on page 9)



## SECTION 4

# Duct Bank Reference Data

The duct bank reference data contains specifications and rules.

## Duct Bank Specifications

The **Cableway Spec** sheet in the **DuctBank.xls** workbook determines the specification that you access when you route a new run of duct bank or create cableway features such as transitions and turns.

**Default Bend Radius** - Type the default for the throat radius width. Example values for bend radii are **12in**, **24in**, and **36in**.

**Description** - Type a phrase that describes the data bank specification. For example, you can explain the purpose of this particular specification.

**Tray Specification Type** - Indicates if the specification applies to cable trays, cableways, or ductbanks.

**Manufacturer** - Specify the manufacturer of the material in the reserved cableway space. This property is used to track the manufacturer for reporting. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Manufacturer** sheet in the **Codelist Number** column.

**Material** - Specifies the material that will reside in the data bank space.

**Spec Name** - Type the name to assign to the duct bank specification.

### See Also

*Define Duct Bank Specifications* (on page 13)

## Define Duct Bank Specifications

1. Open the **Ductbank.xls** workbook.
2. Select the **Cableway Spec** sheet.
3. Select a row after the **Start** keyword but before the **End** keyword, and click **Insert > Rows**.
4. In the **Spec Name** column, type a name for the duct bank specification.
5. Define the remaining properties for the specification.
6. Type **A** in the first column of the added rows.
7. Save the workbook, and exit.
8. Bulk load the workbook in the Add/Modify/Delete mode.

### NOTES

- For more information about each specification property that you can define, refer to the *Duct Bank Specifications* (on page 13).

- The **AllCodeLists.xls** workbook contains codelist values that you need to define cableway specifications.

**See Also**

*Duct Bank Specifications* (on page 13)

## Cableway Nominal Sizes

The **Cableway Nominal Sizes** sheet in the **Ductbank.xls** workbook controls which cross sections are available in the specifications. The sizes relate to the rectangular cross sections.

**SpecName** - Identifies the duct bank specification for the cross section; that is, **DBS-0**.

**SectionName**- Identifies the outfitting cross section (OCS). Examples are **OCS-4X4**, **OCS-6X4**, and **OCS-6x6**. These cross section examples are defined in the OutfittingCrossSections sheet. If you include cross section names using this sheet, the names must be defined on this sheet in **AllCommon.xls**.

**See Also**

*Define Cableway Nominal Sizes* (on page 14)

## Define Cableway Nominal Sizes

1. Open the **Ductbank.xls** workbook.
2. Select the **CableWayNominalSizes** sheet.
3. Select a row after the **Start** keyword but before the **End** keyword, and click **Insert > Rows**.
4. In the **Spec Name** column, type a name for the cableway specification.
5. In the **Section Name** column, type the cross section names that you want to define for the specification.
6. Type **A** in the first column of the added rows.
7. Save the workbook, and exit.
8. Bulk load the workbook in the Add/Modify/Delete mode.

**NOTE** The cableway specification must be defined on the **Cableway Spec** sheet.

**See Also**

*Define Cableway Nominal Sizes* (on page 10)



## Cableway Bend Radius

The **Bend Radius Cableway Bend Radius** sheet in the **Ductbank.xls** workbook determines the duct bank bend radii that are available for each specification.

**BendRadius** - Assign the measurement that corresponds to the duct bank that you are routing. Examples are **100mm**, **200mm**, **300mm**, and so forth.

**SpecName** - Type the name assigned to the duct bank specification. An example is **DBS- 0**.

### See Also

*Define Cableway Bend Radius* (on page 11)

## Define Cableway Bend Radius

1. Open the **Ductbank.xls** workbook.
2. Select the **CableWayBendRadius** sheet.
3. Select a row after the **Start** keyword but before the **End** keyword, and click **Insert > Rows**.
4. In the **Spec Name** column, type the duct bank specification to which to assign bend radii.
5. In the **Bend Radius** column, type the bend radii that you want to associate with the specification.
6. Type **A** in the first column of the added rows.
7. Save the workbook, and exit.
8. Bulk load the workbook in the Add/Modify/Delete mode.

### NOTES

- For more information about each column, see *Cableway Bend Radius* (on page 14).
- The cableway specification must be defined on the **Cableway Spec** sheet.

### See Also

*Cableway Bend Radius* (on page 14)



## SECTION 5

# Customize Cable Fill

The rules for determining the amount of cable that can be placed in a cable tray or conduit are typically set by the owner; however, it is common in the U.S. to mandate that the fill amounts conform to the guidelines established by the National Fire Protection Association (NFPA) in their National Electric Code (NEC). Therefore, the delivered implementation is driven by NEC rules.

If you want to change these settings, the software delivers a Visual Basic Project (VBP) which can be customized to define your own rules. This project is available under C:\Program Files\[*Reference Data Product Directory*]\CommonRoute\Rules\bin\cblFillCalculations\ of the delivered product. The project contains two files: CableTrayType.bas and clsFillCalc.cls.

### CableTrayType.bas

This file mainly contains data from the NEC Specification tables under article 392. These tables specify the maximum allowed area for different sizes of cable trays. The file also contains a method called GetAllowedArea which returns the maximum allowed area based on size from these tables. This file only needs to be modified when table-based rules, similar to NEC, are included.

### clsFillCalc.cls

This file contains *Implements IJDFillCalculations* whose interface contains two important methods for calculating the fill: Private Sub IJDFillCalculations\_GetConduitFillParams and Private Sub IJDFillCalculations\_GetCwayFillParams. These methods will be overwritten when you customize them. The two method definitions follow:

- Private Sub IJDFillCalculations\_GetConduitFillParams(ByVal pDispConduitFeatObject As Object, ByVal pDispConduitGenPart As Object, INoCables As Long, dWireArea As Double, bTradeSize As String, dTotalTraverseArea As Double, dAllowableTraverseArea As Double, dPercentFull As Double, dAvailableTraverseArea As Double, bStatus As String)
- Private Sub IJDFillCalculations\_GetCwayFillParams(ByVal pDispCableWayFeatObject As Object, ByVal pDispCableWayGenPart As Object, INoCables As Long, dWireArea As Double, bTradeSize As String, dTotalTraverseArea As Double, dAllowableTraverseArea As Double, dPercentFull As Double, dAvailableTraverseArea As Double, bStatus As String)

The most important arguments in these methods are pDispCableWayFeatObject and dPercentFull. In addition, the cableway or conduit object from which we get the remaining properties, pDispCableWayFeatObject, is included as well as dPercentFull—a parameter which returns the calculated fill.

The following arguments are return parameters which are used purely for reporting purposes:

- dTotalTraverseArea

- dAllowableTraverseArea
- dAvailableTraverseArea
- bStatus

### General Workflow

The general workflow is as follows:

- Initialize the NEC tables.
- Get the FillEfficiency for the feature.
- Get the collection of cables in the feature.
- Get the required properties for each cable in the feature.
- Get the cableway part and get properties from that part.
- Call the CalculateMaximumFill method to process the fill as per NEC.
- Set the fill on dPercentFull and exit the function.

## Cable Fill Calculations

This is the preferred means of customizing the rules, as you do not need to deal with the implementation details of the creating a new ActiveX COM component. Modifying any one of the below two methods in clsFillCalc.cls will serve the purpose of customizing the rules. CableTrayType.bas needs to be modified only when you have table-based rules similar to that of NEC.

The following are the methods that need to be overwritten. You can modify either of the following two fill methods in clsFillCalc.cls to customize the fill rules.

- **Fill Calculations for Cableway Features**  
Private Sub IJDFillCalculations\_GetCwayFillParams
- **Fill Calculations for Conduit Features**  
Private Sub IJDFillCalculations\_GetConduitFillParams

### Data for Determining Fill Percentage

Fill percentage is the area occupied by all of the cables divided by the cable tray or conduit area. The following data is required for calculating the fill percentage.

- Properties of the cableway feature such as width, depth, area, and so forth.
- Number of cables passing through the feature.
- Properties of each cable passing through the feature such as radius, area, bend radius, and so forth.

### Modifying the existing project

This is the preferred means of customizing the rules, as you do not need to deal with the implementation details of the creating a new ActiveX COM component. Modifying any one of the below two methods in clsFillCalc.cls will serve the purpose of customizing the rules.

CableTrayType.bas needs to be modified only when you have table based rules similar to that of NEC. The following are the methods that need to be overwritten.

Fill Calculations for Conduit Features

```
Private Sub IJDFillCalculations_GetConduitFillParams
```

Fill Calculations for Cableway Features

```
Private Sub IJDFillCalculations_GetCwayFillParams
```

### Data needed for calculating fill

In simple terms Fill Percentage is nothing but the area occupied by all the cables in a feature to that of the area of the feature. Hence the following data is primarily required for calculating the fill.

- Properties of the cableway feature like width, depth, area, and so forth.
- Number of cables passing through the feature
- Properties of each cable passing through the feature like radius, area, bendradius, and so forth.

The means to get the above data is described below.

### Getting properties of the cableway feature like width, depth, area, and so forth.

The cableway feature is passed in as an input parameter to the method. If you notice the first parameter coming in as input to IJDFillCalculations\_GetCwayFillParams, pDispCableWayFeatObject is a cableway feature type object.

### Cableway feature with Parts (Cable trays)

The part that is associated with the feature object contains the width and depth properties. So we need to get the part associated with the above feature in order to get those properties.

You can use the below method to get the part from the passed in pDispCableWayFeatObject.

```
Private Function GetCablewayPartFromFeature(oCablewayfeature As Object) As IJCableTrayPart
    Const METHODNAME = "GetCablewayPartFromFeature"
    On Error GoTo ErrHandler

    Dim oCableWayFeat As IJRtePathFeat
    Dim oParent As IJDesignParent
    Dim oChild As IJDesignChild
    Dim oCableWayPart As IJCableTrayPart
    Dim oCableTrayPartObj As IJPartOcc
    Dim oCableway As IJRteCableway
    Dim oCbleTrayFeat As IJRtePathFeat
    Dim oCblwyPartCol As IJObjectCollection
    Dim oCblwyRun As IJRtePathRun
    Dim oTempPart As IJDPart
    Dim oCblPartObj As Object

    Set oCableWayFeat = oCablewayfeature
    Set oCblwyRun = oCableWayFeat.GetPathRun
    Set oCblwyPartCol = oCblwyRun.GetParts

    For Each oCblPartObj In oCblwyPartCol
        If TypeOf oCblPartObj Is IJPartOcc Then
            Set oCableTrayPartObj = oCblPartObj
            oCableTrayPartObj.GetPart oTempPart
            Set GetCablewayPartFromFeature = oTempPart
            Exit For
        End If
    Next oCblPartObj
    Exit Function

ErrHandler:
    Set m_oServerError = m_oServerErrors.AddFromErr(Err, "Failed GetCablewayPartFromFeature ", METHODNAME, MODULE)
    m_oServerError.Raise
```

End Function

For example, declare the part as:

```
Dim oCableWayPart as IJCableTrayPart
Set oCableWayPart =
GetCablewayPartFromFeature (pDispCableWayFeatObject)
```

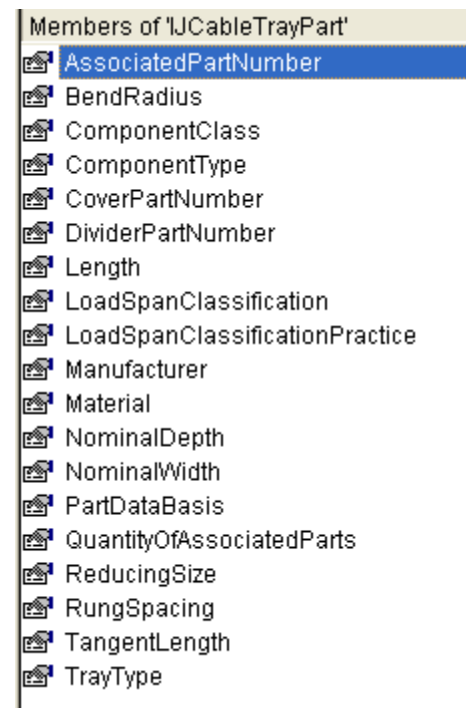
Now you have the part **oCableWayPart**.

### Getting the properties from the part.

Now that you have the part from the cableway feature, accessing the properties from the part is very simple. For example, **m\_intCableTray = oCableWayPart.TrayType**.

```
dTempWidth = oCableWayPart.NominalWidth
dTempDepth = oCableWayPart.NominalDepth
```

The following is the complete of properties that are available on the part



### Getting the collection of cables and their properties from the cableway feature

Get the relationship interface from the cableway feature.

```
Set oIJDAssocRelation = pDispCableWayFeatObject
```

Get the collection of segments in relation with the Cableway feature

```
Set oTargetObjCol = oIJDAssocRelation.CollectionRelations(IID_IJRtePathFeat, "Segment")
m_intCableCount = oTargetObjCol.Count
lNoCables = m_intCableCount
```

Browse through each item and get the Cablerun object from it

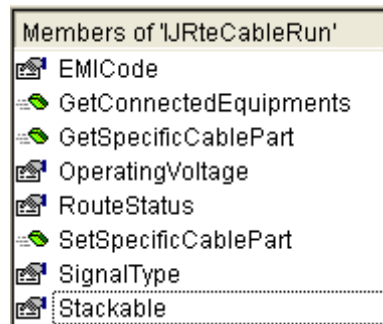
```
For nLoop = 1 To m_intCableCount
    Set oSegmentPathFeat = Nothing
    Set oCableRun = Nothing
    Set OCablePart = Nothing
```

```

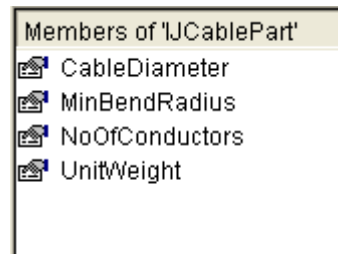
        Set oSegmentPathFeat = oTargetObjCol.Item(nLoop)
Getting the Cablerun
        Set oCableRun = oSegmentPathFeat.GetPathRun
Accessing the properties on the IJRteCableRun interface
        m_intSignalType = oCableRun.SignalType
Some of the properties are available on the cable part.Getting the cable part from the cable run.
        Set OCablePart = oCableRun.GetSpecificCablePart
        End loop
Next nLoop

```

The list of properties that are available on the interface IJRteCableRun:



The list of properties that are available on the interface IJCablePart:



### Creating the new project

Apart from modifying the existing project we can create a new ActiveX dll project and implement the rules, but under the following guidelines.

- Make sure the project has the same progid "cblFillCalculations.clsFillCals".
- Make sure that the vbp contains all the references as in cblFillCalculations.vbp.
- Make sure the class clsFillCals implements the interfaces
  - Implements IJDFillCalculations
  - Implements IJRteCARRealTimeFill

## Cable Fill Example

To modify cableway fill, modify the method **IJDFillCalculations\_GetCwayFillParams**.

### Sample Rule

For all cableways having a nominal width of less than 18 inches, calculate the fill with respect to the cross-sectional width.

### Data Needed

To solve such calculations, you need the following information:

- Nominal width from the cableway feature.
- Cross-sectional width from the cableway feature.
- Collection of cables passing through the feature.
- Diameter of the cables passing through the feature.
- Sum of the diameters of all the cables passing through the feature.
- Fill calculation = sum of diameters of cables / cross-sectional width.
- Returns the fill calculated.

### Modify IJDFillCalculations\_GetCwayFillParams

The code is written as follows:

```
Private Sub IJDFillCalculations_GetCwayFillParams(ByVal pDispCableWayFeatObject As Object,
ByVal pDispCableWayGenPart As Object, lNoCables As Long, dWireArea As Double, bTradeSize As String,
dTotalTraverseArea As Double, dAllowableTraverseArea As Double, dPercentFull As Double,
dAvailableTraverseArea As Double, bStatus As String)

    Const METHODID = "IJDFillCalculations_GetCwayFillParams"

    On Error GoTo ErrorHandler

    Dim oCableWayFeat As IJRteCablewayPathFeat
    Dim oParent As IJDesignParent
    Dim oChild As IJDesignChild
    Dim oCableWayPart As IJCableTrayPart
    Dim oCableTrayPartObj As IJPartOcc

    Dim oIJDAssocRelation As IJDAssocRelation
    Dim oTargetObjCol As IJDTargetObjectCol
    Dim nLoop As Integer
    Dim oSegmentPathFeat As IJRtePathFeat
    Dim oCableRun As IJRteCableRun
    Dim oCablePart As IJCablePart

    Dim oCableway As IJRteCableway
    Dim oCbleTrayFeat As IJRtePathFeat
    Dim oCblwyPartCol As IJDObjectCollection
    Dim oCblwyRun As IJRtePathRun
    Dim oTempPart As IJDPart
    Dim oCblPartObj As Object
    Dim dTempWidth As Double
    Dim dTempDepth As Double
    Dim dblAvailArea As Double
    Dim strFillStatus As String

    'Get the input cableway feature variable pDispCableWayFeatObject.
    'Get IJRtePathFeat interface from the object.
    Set oCbleTrayFeat = pDispCableWayFeatObject
    'Get the cableway run from the IJRtePathFeat.
    Set oCblwyRun = oCbleTrayFeat.GetPathRun
    'Pass the run to the method to get the fillefficiency defined for the run.
    m_dblCableTrayFillEff = GetFillEfficiencyFromFeature(oCblwyRun)
    'Get collection of cables inside the feature.
```



```

    Set oIJDAAssocRelation = pDispCableWayFeatObject
'Get the collection of segments in relation with the Cabletray.
    Set oTargetObjCol = oIJDAAssocRelation.CollectionRelations(IID_IJRtePathFeat, "Segment")
'Get count of cables.
    lNoCables = oTargetObjCol.Count
    Dim dSumofCableDia As Double
    dSumofCableDia = 0#
    For nLoop = 1 To lNoCables
        Set oSegmentPathFeat = Nothing
        Set oCableRun = Nothing          Set OCablePart = Nothing
        Set oSegmentPathFeat = oTargetObjCol.Item(nLoop)
        Set oCableRun = oSegmentPathFeat.GetPathRun
        m_intSignalType = oCableRun.SignalType
        Set OCablePart = oCableRun.GetSpecificCablePart
        If Not OCablePart Is Nothing Then
            dSumofCableDia = OCablePart.CableDiameter
        End If
    Next nLoop

    Set oCableWayPart = GetCablewayPartFromFeature(pDispCableWayFeatObject)
'The method GetCablewayPartFromFeature is declared below.
'Check if we found a part; if not, this must be a cableway with no part.
    If Not oCableWayPart Is Nothing Then
        Dim dNominalWidth As Double
'Get the nominalWidth.
        dNominalWidth = oCableWayPart.NominalDepth
'The default units will be meters, so need to convert the meters to inches as we need to compare the distance in
inches
        dNominalWidth = m_UOM.ConvertDbuToUnit(UNIT_DISTANCE, dNominalWidth, DISTANCE_INCH)
        If dNominalWidth < 18 Then
'Need to get the crosssectional width from the cableway feature
            Dim oRteCrossSectOcc As IJRteCrossSectOccur
            Dim dCWWidth As Double
            Dim dCWDepth As Double
            Dim dCWRad As Double
            Dim eShape As tagCrossSectionShapeTypes
'Get the cross section occurrence
            Set oRteCrossSectOcc = pDispCableWayFeatObject
'Get the cross section parameters of the current run
            oRteCrossSectOcc.GetParameters eShape, dCWWidth, dCWDepth, dCWRad
'The most important thing to remember is to set the fill value to dPercentFull because this is the variable where the
data will be persisted.
            dPercentFull = dSumofCableDia / (dCWWidth * m_dblCableTrayFillEff)
        End If
    End If

    Exit Sub
ErrorHandler:
    Set m_oServerError = m_oServerErrors.AddFromErr(Err, "Error processing ", METHOD, MODULE)
    m_oServerError.Raise
End Sub

```

## Private method to get the cableway part from the cableway feature:

```

Private Function GetCablewayPartFromFeature(oCablewayfeature As Object) As IJCableTrayPart
    Const METHODNAME = "GetCablewayPartFromFeature"
    On Error GoTo ErrHandler

    Dim oCableWayFeat As IJRtePathFeat
    Dim oParent As IJDesignParent
    Dim oChild As IJDesignChild
    Dim oCableWayPart As IJCableTrayPart
    Dim oCableTrayPartObj As IJPartOcc
    Dim oCableway As IJRteCableway
    Dim oCbleTrayFeat As IJRtePathFeat
    Dim oCblwyPartCol As IJDOBJECTCollection
    Dim oCblwyRun As IJRtePathRun
    Dim oTempPart As IJDPart
    Dim oCblPartObj As Object

    Set oCableWayFeat = oCablewayfeature
    Set oCblwyRun = oCableWayFeat.GetPathRun
    Set oCblwyPartCol = oCblwyRun.GetParts

    For Each oCblPartObj In oCblwyPartCol
        If TypeOf oCblPartObj Is IJPartOcc Then
            Set oCableTrayPartObj = oCblPartObj
            oCableTrayPartObj.GetPart oTempPart
            Set GetCablewayPartFromFeature = oTempPart
            Exit For
        End If
    Next oCblPartObj
    Exit Function
ErrHandler:
    Set m_oServerError = m_oServerErrors.AddFromErr(Err, "Failed GetCablewayPartFromFeature ", METHODNAME, MODULE)
    m_oServerError.Raise
End Function

```

**NOTES**

- Do not to modify or remove any of the variable declarations in the project. Additional data types can be added as per your requirement.
- If you are looking for any specific property, try searching for it in the Object Browser (F2) to find out on which interface it is available. Try searching for that interface in the existing implementation to see how it can be obtained.
- Always remember to set the calculated Fill value to the variable dPercentFull.
- If you are generating a report for the Fill Calculations then remember to return the values for dTotalTraverseArea, dAllowableTraverseArea, dAvailableTraverseArea, and bStatus. Go through the existing implementation on how we can calculate them.

## SECTION 6

# Cable Tray Reference Data

Cable tray reference data contains specifications and cable tray parts.

### See Also

*Cable Tray Specifications* (on page 25)

## Cable Tray Specifications

The **Cable Tray Spec** sheet in the **CableTray.xls** workbook determines the specification that you access when you route a new run of cable tray, select an existing run of cable tray, or create cable tray features and parts. The four cable tray specifications which determine the specification that you access include **Manufacturer**, **Material**, **TrayType** and **LoadSpanClassification**.

**Default Bend Radius** - Type the default throat radius width. Example values for bend radii are **12in**, **24in**, and **36in**.

**Description** - Type a phrase that describes the cable tray specification. For example, you can explain the purpose of this particular specification.

**Fitting to Fitting Connection Part #X Component Type** - Select the component type for the fitting to fitting connection part.

**Fitting to Fitting Connection Part #X Quantity** - Enter the number of parts required.

**Tray Specification Type** - Indicates if the specification applies to cable trays, cableways, or duct banks. "1" represents Cableway, "2" represents Cable Tray, and "3" represents Duct Bank. Valid codes are listed in the **AllCodeLists.xls** workbook on the **TraySpecificationType** sheet in the **Codelist Number** column.

**Load Span Classification** - Specify the load span classification. This load span is based on requirements in Section 3.2 of the NEMA Standard VE 1-1991. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Load Span Classification** sheet in the **Codelist Number** column.

**Manufacturer** - Specify the manufacturer of the cable tray component. This property is used to track the manufacturer for reporting. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Manufacturer** sheet in the **Codelist Number** column.

**Material** - Specify the material of the cable tray component. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Cable Tray Materials** sheet in the **Codelist Number** column.

**Preferred Connection Gap** - Enter the preferred gap between the straight cable trays after they have been split.

**Rung Spacing** - Type the measurement for the distance of spacing between rungs. Examples are **6in**, **9in**, **12in**, and **18in**.

**Spec Name** - Type the name to assign to the cable tray specification.

**Tray to Fitting Connection Part #X Component Type** - Select the component type for the tray to fitting connection part.

**Tray to Fitting Connection Part #X Quantity** - Enter the number of parts required.

**Tray to Tray Connection Part #X Component Type** - Select the component type for the tray to tray connection part.

**Tray to Tray Connection Part #X Quantity** - Enter the number of parts required.

**Tray Length** - Enter the tray length. This tray length is used when splitting cable trays.

**Tray Type** - Specify the type of cable tray, such as ladder. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Cable Tray Type** sheet in the **Codelist Number** column.

**NOTE** Use the following attributes as inputs when querying the electrical parts catalog: component type, nominal sizes, manufacturer, material, tray type, load span classification and optionally default bend radius.

### **See Also**

*Cable Tray Reference Data* (on page 25)

## **Define Cable Tray Specifications**

1. Open the **CableTray.xls** workbook.
2. Select the **Cable Tray Spec** sheet.
3. Select a row after the **Start** keyword but before the **End** keyword, and click **Insert > Rows**.
4. In the **Spec Name** column, type a name for the cableway specification.
5. Define the remaining properties for the specification.
6. Type **A** in the first column of the added rows.
7. Save the workbook, and exit.
8. Bulk load the workbook in the Add/Modify/Delete mode.

### **NOTES**

- For more information about each specification property that you can define, refer to the *Cable Tray Specifications* (on page 25).
- The **AllCodeLists.xls** workbook contains codelist values that you need to define cable tray specifications.

## Cable Tray Parts

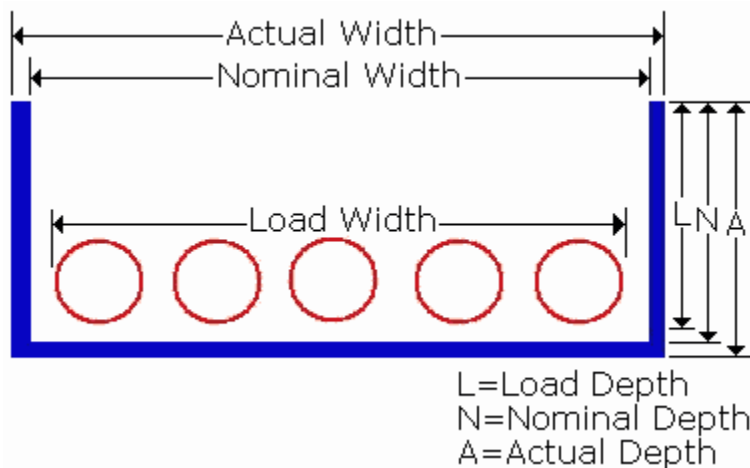
The **CableTray.xls** workbook defines all of the cable tray parts that are available in the catalog.

Almost all cable tray parts are represented by symbols. You can find which symbol is used for a particular delivered part by looking in the **Symbol Definition** column (usually cell C4) of the part sheet. For example, if you look at the **CT90HBend** sheet, you will see that SP3D90HCableTray.C90HCableTray is the symbol definition. Symbols are named after the text that precedes the period. In this example, the part uses symbol SP3D90HCableTray. For more information about symbols, see the *SmartPlant 3D Symbols Reference Data Guide* available from the **Help > Printable Guides** command in the software.

Cable tray symbols can be defined in terms of different dimensions. In some cases, a manufacturer specifies the geometry based on face-to-face dimensions, while in other cases, a manufacturer specifies the geometry based on face-to-center dimensions.

When defining cable tray parts, remember that there are three sets of dimensions: nominal, actual, and load.

- Cable tray parts are commonly called, or referred to, by their nominal width and nominal depth dimensions.
- The actual width and actual depth dimensions are the real world dimensions of the cable tray part—if you used a measuring tape to measure the part.
- The load width and load depth dimensions are the "inside" dimensions available in the cable tray part for the placement of cables. The software uses the load width and load depth dimensions when calculating allowable fill area. In the delivered parts, the load width and load depth are set equal to the nominal width and nominal depth. However, you can edit the load width and load depth dimensions if needed.



Below is a complete listing of all the properties, both common and unique, that you will see on a part sheet.

## Common Properties

These properties appear for all part classes. The properties are listed here in the order that they appear, from left to right, on the part sheet.

**Part Number** - Type the unique identification for the part as found in the catalog data.

**Part Description** - Type a description for the part.

**Manufacturer** - Enter the code that represents the manufacturer of the part. This property is used to track the manufacturer for reporting. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Manufacturer** sheet in the **Codelist Number** column.

**Material** - Specify the material of the part. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Cable Tray Materials** sheet in the **Codelist Number** column.

**Tray Type** - Specify the type of cable tray, such as ladder. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Cable Tray Type** sheet in the **Codelist Number** column.

**Component Type** - Specify the type of component. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Cable Tray Component Type** sheet in the **Codelist Number** column.

## Unique Properties

Unique properties appear only for certain classes. The properties are listed here in alphabetical order.

**Actual Depth[port number]** - Enter the actual depth of the cable tray at the port. Include the units, such as **in** for inches or **mm** for millimeters. A part can have multiple ports, and you can enter an actual depth for each port.

**Actual Width[port number]** - Enter the actual width of the cable tray at the port. Include the units, such as **in** for inches or **mm** for millimeters. A part can have multiple ports, and you can enter an actual width for each port.

**Bend Angle** - Enter the bend angle for the part. Include the units, such as **Deg** for degrees.

**Bend Radius** - Enter the bend radius for the part. Include the units, such as **in** for inches or **mm** for millimeters.

**Dry CogX** - Type the center-of-gravity location for the part along the x-axis when the part is empty.

**Dry CogY** - Type the center-of-gravity location for the part along the y-axis when the part is empty.

**Dry CogZ** - Type the center-of-gravity location for the part along the z-axis when the part is empty.

**Dry Weight** - Type the total dry weight for the part.

**Face to Tangent** - Enter the face to tangent dimension of the part. Include the units, such as **in** for inches or **mm** for millimeters.

**Insertion Depth** - Enter the insertion depth. This value is the distance between the end of the cable tray part and the location of the cable port. Only positive values are allowed. Include the units, such as **in** for inches or **mm** for millimeters.

**Length** - Specify the length of the part. Include the units, such as **in** for inches or **mm** for millimeters.

**Load Depth[port number]** - Enter the load depth of the cable tray part at the port. This is the depth available for cables in the tray. Usually this is the same as the Nominal Depth value, but can be smaller if required. Include the units, such as **in** for inches or **mm** for millimeters. A part can have multiple ports, and you can enter a nominal depth for each port.

**Load Width[port number]** - Enter the load width of the cable tray part at the port. This is the width available for cables in the tray. Usually this is the same as the Nominal Width value, but can be smaller if required. Include the units, such as **in** for inches or **mm** for millimeters. A part can have multiple ports, and you can enter a nominal width for each port.

**Load Span Classification** - Enter the code that represents the classification of load span based on National Electrical Manufacturers Association (NEMA) standards. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Load Span Classification** sheet in the **Codelist Number** column.

**Mirror Behavior Option** - Specify the mirror behavior for the part. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Mirror Behavior Option** sheet in the **Codelist Number** column.

**Nominal Depth** - Enter the nominal depth of the part. Include the units, such as **in** for inches or **mm** for millimeters.

**Nominal Depth[port number]** - Enter the nominal depth of the cable tray part at the port. Include the units, such as **in** for inches or **mm** for millimeters. A part can have multiple ports, and you can enter a nominal depth for each port.

**Nominal Width** - Enter the nominal width of the part. Include the units, such as **in** for inches or **mm** for millimeters.

**Nominal Width[port number]** - Enter the nominal width of the cable tray part at the port. Include the units, such as **in** for inches or **mm** for millimeters. A part can have multiple ports, and you can enter a nominal width for each port.

**Reducing Size** - Enter the reducing size dimension of the part. Include the units, such as **in** for inches or **mm** for millimeters.

**Replacement Part Number** - Type the part number for replacements of the part.

**Rung Spacing** - Specify the rung spacing for the part. Include the units, such as **in** for inches or **mm** for millimeters.

**Symbol Definition** - Type the symbol definition for the part. For more information about symbols, see the *SmartPlant 3D Symbols Reference Data Guide*.

**Tangent Length** - Enter the tangent length for the part. Include the units, such as **in** for inches or **mm** for millimeters.

### **See Also**

*Cable Tray Reference Data* (on page 25)





## SECTION 7

# Conduit Reference Data

Conduit reference data contains specifications, rules, and conduit parts.

### **See Also**

*Conduit Specifications* (on page 31)

*Conduit Filter* (on page 31)

## Conduit Specifications

The **Conduit > Specifications Conduit Spec** sheet in the **Conduit.xls** workbook determines the specification that you access when you route a new run of conduit or select an existing run of conduit.

**Material** - Specifies the material that composes the conduit. For example, you can type **Steel**.

**Service** - Specifies the service type of the conduit. For example, you can type **Conduit Spec CS0 Service**.

**Spec Name** - Type the name to assign to the conduit specification.

### **See Also**

*Define Conduit Specifications* (on page 31)

## Define Conduit Specifications

1. Open the **Conduit.xls** workbook.
2. Select the **Conduit Spec** sheet.
3. Select a row after the **Start** keyword but before the **End** keyword, and click **Insert > Rows**.
4. In the **Spec Name** column, type a name for the conduit specification.
5. Define the remaining properties for the specification.
6. Type **A** in the first column of the added rows.
7. Save the workbook, and exit.
8. Bulk load the workbook in the Add/Modify/Delete mode.

**NOTE** For more information about each specification property that you can define, refer to the *Conduit Specifications* (on page 31).

## Conduit Filter

The **Conduit Filter** sheet in the **Conduit.xls** workbook defines the data required to select the conduit commodity when routing.

**Bend Radius** - Allows you to assign the turn radius to use while routing. The throat radius can determine the proper cables to use within the conduit. The software considers rules for the default throat radius for routing.

**Bend Radius Multiplier** - Specifies a factor used in determining the absolute bend radius value, which is the product of the nominal diameter times the bend radius multiplier.

**Comments** - Type an optional brief description of the conduit commodity.

**Commodity Option** - Type an option code. Valid entries are listed in the **AllCodeLists.xls** workbook on the **Commodity Option** sheet in the **Codelist Number** column. The option code gives the software a way of recognizing the default component when more than one component will work.

**Contractor Commodity Code** - Enter the contractor commodity code, which is the commodity code that is used during the design phase.

**First Size From** - Defines the lower bound of the largest nominal diameter for which this conduit commodity applies within the conduit materials class.

**First Size To** - Defines the upper bound of the largest nominal diameters for which this conduit commodity applies within the conduit materials class.

**First Size Units** - Specifies the units for the **First Size From** and **First Size To** columns. For example, you could enter **in** for inches or **mm** for millimeters.

**Short Code** - Type a short code for this row. A short code is used as a grouping or designation for each component so you can select the component. The software uses the short code to automatically insert components. An example for conduit is **Conduit Bend**.

**Second Size From** - Defines the lower bound of the next largest nominal diameter for which this conduit commodity applies within the conduit materials class.

**Second Size To** - Defines the upper bound of the next largest nominal diameters for which this conduit commodity applies within the conduit materials class.

**Second Size Units** - Specifies the units for the **Second Size From** and **Second Size To** columns. For example, you could enter **in** for inches or **mm** for millimeters.

**Selection Basis** - Defines values that indicate if the conduit is available for the designer to select manually or only for selection as a result of a rule. Valid entries are listed in the **AllCodeLists.xls** workbook on the **Conduit Selection Basis** sheet in the **Codelist Number** column.

**Spec Name** - Specify the conduit specification (materials class) for which the conduit commodity is intended. You must define the conduit specification on the **ConduitSpec** sheet before you can use it. For more information, see *Conduit Specifications* (on page 31).

### See Also

*Define Conduit Filters* (on page 33)

## Define Conduit Filters

1. Open the Conduit.xls **workbook**.
2. Select the **Conduit Filter** sheet.
3. Select a row after the **Start** keyword but before the **End** keyword, and click **Insert > Rows**.
4. In the **Spec Name** column, type a name for the conduit specification for which you want to specify filters.
5. Define the filter by providing appropriate values in the different columns.
6. Type **A** in the first column of the added rows.
7. Save the workbook, and exit.
8. Bulk load the workbook in the Add/Modify/Delete mode.

### NOTES

- The conduit specification must be defined on the **Conduit Spec** sheet.
- For more information about each column on the **Conduit Filter** sheet, refer to *Conduit Filter* (on page 31).

### See Also

*Conduit Filter* (on page 31)

## Conduit Commodity Material Control Data

The **Conduit Commodity Matl Control Data** sheet in the **Conduit.xls** workbook defines the material control data for the conduit specification. This information does not vary per conduit specification.

**Bolting Requirements** - Select the bolting requirements for the conduit commodity. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Bolting Requirements** sheet in the **Codelist Number** column.

**Cap Screw Engagement Gap** (Conditionally Required) - Specify the total gap between the cap screw ends inserted into each threaded hole end. The engagement gap is used in the bolt length calculations for cap screws in threaded holes. Use this field when an engagement gap that is unique to a component is needed.

This engagement gap value is used for all cap screw diameters regardless of the cap screw diameter or the nominal diameter for the fitting requiring the cap screws. If you do not specify a value here, then the default value for the conduit specification is used.

**Clamp Requirement** (Conditionally Required) - Select whether or not the commodity requires a clamp if one or more mechanical ends apply. This option overrides the clamp query in the clamp selection filter when the value of the Termination Subclass is set to "Mechanical joint with clamp" or "Mechanical joint with clamp and hub or ferrule".

**Client Commodity Code** - Enter the client commodity code, which is the commodity code that is used during the operations and maintenance phase.

**NOTE** The **Contractor Commodity Code** and the **Client Commodity Code** properties both must be size-independent or size-dependent. One cannot be size-dependent and the other one be size-independent. In addition, both must include a schedule or neither must include a schedule.

**Contractor Commodity Code** - Enter the contractor commodity code, which is the commodity code that is used during the design phase.

**NOTE** The **Contractor Commodity Code** and the **Client Commodity Code** properties both must be size-independent or size-dependent. One cannot be size-dependent and the other one be size-independent. In addition, both must include a schedule or neither must include a schedule.

**Fabrication Type** - Select the fabrication type. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Fabrication Type** sheet in the **Codelist Number** column.

**First Size From** - Defines the lower bound of the largest nominal diameter for which this conduit commodity applies within the conduit materials class.

**First Size To** - Defines the upper bound of the largest nominal diameters for which this conduit commodity applies within the conduit materials class.

**First Size Units** - Specifies the units for the **First Size From** and **First Size To** columns. For example, you could enter **in** for inches or **mm** for millimeters.

**Gasket Requirements** - Specify the commodity gasket requirements. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Gasket Requirements** sheet in the **Codelist Number** column.

**Geometric Industry Standard** - Specify the source used in the preparation of the catalog data applicable to the conduit commodity. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Geometric Industry Standard** sheet in the **Codelist Number** column.

**Hyperlink To Electronic Vendor** - Type the URL address to the electronic vendor catalog.

**Industry Commodity Code** - Enter the industry commodity code, which is the commodity code that is used to access the catalog.

**Legacy Commodity Code (Optional)** - Type the commodity code required by a legacy material control system, if different from the contractor commodity code. For some legacy material control systems, the commodity codes are inadequate for SmartPlant 3D. For example, the material control system uses the same commodity code for a globe valve from Manufacturer A and Manufacturer B, even when the face-to-face dimension of the two valves are different. You are required to use different commodity codes for these parts in SmartPlant 3D. However, you may also have a requirement to track the globe valve based on its legacy commodity code. Use this column to solve the problem.

The legacy commodity code can be size-independent or size-dependent. However, the contractor commodity code and the legacy commodity code both must be size-independent, or both must be size-dependent commodity codes. Likewise, both the contractor commodity code and the legacy commodity code must include schedule, or neither must include schedule.

**Localized Short Material Description** - Type a description for the material. The software uses this description in the bill-of-materials part of isometric drawings when construction personnel require a different language than what was used in the **Short Material Description** box.

**Long Material Description** - Type a description for the material to use when requisitioning.

**Loose Material Requirements** - Specify the loose material requirements for the conduit commodity. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Loose Material Requirements** sheet in the **Codelist Number** column.

**Manufacturer** - Select the manufacturer of the conduit commodity. This property is used to track the manufacturer for reporting. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Manufacturer** sheet in the **Codelist Number** column.

**MultiSize Option** - Type a string to represent an optional conduit commodity selection for multi-sized fittings when the first size and second size are inadequate.

For example, if two additional sizes (2" and 1") are required in addition to a first size of 6" and a second size of 4", the string that would represent the sizes would be 6x4x2x1. The software interprets the string to determine the second size and the number of sizes in addition to the first size and second size. Do not include a unit of measure in the string. The unit of measure for the first size, defined in the **First Size Units** column is used.

**Quantity of Reportable Parts** - Type the number of items to be reported per instance of the conduit commodity. This value must be an integer.

**Reportable Commodity Code** - Type the commodity code of the commodity that you want created with the primary commodity code object. For example, you may want safety covers or housings reported for material control but not represented graphically in the model. You would enter the commodity code of the safety cover here.

**Reporting Type** - Select the reporting requirements for the conduit commodity. You can specify that the commodity is reported or not reported. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Reporting Type** sheet in the **Codelist Number** column.

**Second Size From** - Defines the lower bound of the next largest nominal diameter for which this conduit commodity applies within the conduit materials class.

**Second Size To** - Defines the upper bound of the next largest nominal diameters for which this conduit commodity applies within the conduit materials class.

**Second Size Units** - Specifies the units for the **Second Size From** and **Second Size To** columns. For example, you could enter **in** for inches or **mm** for millimeters.

**Short Material Description** - Type a description for the material. The software uses this description in the bill-of-materials part of isometric drawings, for reporting, and for visual feedback to the designer for design, construction, and fabrication.

**Substitute Cap Screws Quantity** - Type the number of machine bolts or studs that are being replaced by cap screws at each bolted end of the conduit commodity.

For non-through bolted fittings, the number of cap screws to substitute for machine bolts or studs required by the drilling template is the same as the number of machine bolts or studs being replaced.

For through bolted fittings with threaded holes, the number of cap screws required is twice the number of machine bolts or studs being replaced.

This value is not required when all bolts defined by the drilling template are replaced by cap screws.

**Substitute Cap Screw Contractor Commodity Code** - Type the contractor commodity code for the replacement cap screws.

**Substitute Cap Screw Diameter** - Type the diameter of the cap screw including the units. For example, type **0.5in** or **1in**.

**Supply Responsibility** - Specify the person responsible for supplying the commodity. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Supply Responsibility** sheet in the **Codelist Number** column.

**Tapped Hole Depth** - Type the depth of the tapped hole in the valve or fitting that requires substitution cap screws, including the units. This value is not required for substitution cap screws at threaded holes.

**Tapped Hole Depth 2** (Conditionally Required) - Type the depth of the tapped hole at port two of an asymmetrical fitting that requires substitution cap screws (or substitution tap end stud bolts), if applicable.

**Valve Operator Type** - Specify the specific type of valve operator, actuator, or appurtenance. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Valve Operator Type** sheet in the **Codelist Number** column.

**Valve Operator Geometric Industry Standard** - Specify the source used in the preparation of the catalog data applicable to the valve operator. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Geometric Industry Standard** sheet in the **Codelist Number** column.

**Valve Operator Catalog Part Number** - Type the commodity code for the valve operator as found in the catalog data and the material control data.

**Vendor** - Specify the vendor that is supplying the conduit commodity. This property is optional, but can be used to track the vendor for reporting. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Vendor** sheet in the **Codelist Number** column.

### **See Also**

*Conduit Reference Data* (on page 31)

## **Permissible Nominal Conduit Diameters Rule**

The **Conduit Nominal Diameters** sheet in the **Conduit.xls** workbook defines what nominal conduit diameters (NCD) are valid for the different conduit materials classes. These NCDs appear on the **New Conduit** dialog box in the **Nominal Conduit Diameter** box.

**NPD** - Type the nominal conduit diameter that you want available for the conduit materials class.

**NPD Unit Type** - Specify the units for the nominal conduit diameter value that you entered in the **NPD** column. For example, type **mm** or **in**.

**Spec Name** - Type the name of the conduit specification (materials class) for which you are defining valid nominal diameters. The specification that you enter must be defined on the *Conduit Specifications* (on page 31).

### **See Also**

*Conduit Reference Data* (on page 31)

## Define Conduit Nominal Diameters

1. Open the **Conduit.xls** workbook.
2. Select the **Conduit Nominal Diameters** sheet.
3. Select a row after the **Start** keyword but before the **End** keyword, and click **Insert > Rows**.
4. In the **Spec Name** column, type the name of your conduit materials class.
5. In the **NPD** column, type the nominal diameters that you want to define in your conduit materials class.
6. In the **NPD Unit Type** column, type the units for your nominal diameter. For example, type **mm** or **in**.
7. Type **A** in the first column of the added rows.
8. Save the workbook, and exit.
9. Bulk load the workbook in the Add/Modify/Delete mode.

**NOTE** The conduit materials class must be defined on the **Conduit Spec** sheet.

### See Also

*Permissible Nominal Conduit Diameters Rule* (on page 36)

## Default Conduit Commodity Selection Rule

The **Conduit Default Commodity Selection Rule** sheet in the **Conduit.xls** workbook defines which short code should be used during the automatic placement of fittings.

**Feature Type** - Enter the feature type. Feature types are defined in the **AllCodeLists.xls** workbook on the **Feature Type** sheet in the **Feature Type Short Description** column.

**Generic Short Code** - Enter the short code to use for the defined feature type.

### See Also

*Define the Conduit Default Commodity Selection Rule* (on page 37)

## Define the Conduit Default Commodity Selection Rule

1. Open the **Conduit.xls** workbook.
2. Select the **Conduit Default Commodity Selection Rule** sheet.
3. Select a row after the **Start** keyword but before the **End** keyword, and click **Insert > Rows**.
4. In the **Feature Type** column, enter the feature type.
5. In the **Generic Short Code** column, enter the short code to use for the defined feature type.
6. Type **A** in the first column of the added rows.
7. Save the workbook, and exit.
8. Bulk load the workbook in the Add/Modify/Delete mode.

**NOTE** Feature types are defined in the **AllCodeLists.xls** workbook on the **Feature Type** sheet in the **Feature Type Short Description** column.

## Conduit Parts

The **Conduit.xls** workbook defines all of the conduit parts that are available in the catalog.

Almost all conduit parts are represented by symbols. You can find which symbol is used for a particular delivered part by looking in the **Symbol Definition** column (usually cell C4) of the part sheet. For example, if you look at the **ConduitCPL** sheet, you will see that SP3DConduitCoupling.CCoupling is the symbol definition. Symbols are named after the text that comes before the period. In this example, the part uses symbol SP3DConduitCoupling. For more information about symbols, see the *SmartPlant 3D Symbols Reference Data Guide* available from the **Help > Printable Guides** command in the software.

Below is a complete listing of all the properties, both common and unique, that you will see on a part sheet.

### Common Properties

These properties appear for all part classes. The properties are listed here in the order that they appear, from left to right, on the part sheet.

**Bend Angle** - Specify the bend angle, if any, for the part.

**Bend Radius** - Type the allowable bend radius as an absolute value. If you define a value in this column, do not define a value in the **Bend Radius Multiplier** column.

**Bend Radius Multiplier** - Type the NCD multiplier that you want to use to define the bend radius. This value is required only for bends. If you define a value in this column, do not define a value in the **Bend Radius** column.

**Commodity Type** - Type the conduit commodity type short description or the corresponding codelist value. Valid codes and short descriptions are listed in the **AllCodeLists.xls** workbook on the **Piping Commodity Type** sheet in the **Codelist Number** column.

**Dry COG X** - Type the center-of-gravity location for the part along the x-axis when the part is empty.

**Dry COG Y** - Type the center-of-gravity location for the part along the y-axis when the part is empty.

**Dry COG Z** - Type the center-of-gravity location for the part along the z-axis when the part is empty.

**Dry Weight** - Enter the empty weight of the part. Be sure to specify the units when entering this value.

**End Preparation**[*port number*] - Specify the end preparation for the part port. Valid codes are listed in the **AllCodeLists.xls** workbook on the **End Preparation** sheet in the **Codelist Number** column.

**End Standard**[*port number*] - Specify the end standard for the part port. Valid codes are listed in the **AllCodeLists.xls** workbook on the **End Standard** sheet in the **Codelist Number** column.

**First Size Schedule** - Specify the schedule (or thickness) for the first size end of this conduit commodity. This data is only required when the commodity code does not include schedule.



Valid codes and short descriptions are listed in the **AllCodeLists.xls** workbook on the **Schedule Thickness** sheet in the **Codelist Number** and **Schedule Thickness Short Description** columns.

**NOTE** If the code for the schedule represents a thickness value, the units of measure for the wall thickness may differ from the units of measure for the nominal diameter.

**Graphical Representation Or Not** - Specify whether or not the part should appear in the model.

**ID**[*port number*] - Type a unique identifying name for the port.

**Industry Commodity Code** - Specify the industry commodity code for the part. All industry commodity codes must be unique across the entire catalog.

**Lining Material** - Specify the lining material, if any, for the part. Examples of lining material include epoxy, rubber, plastic, and so forth. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Lining Material** sheet in the **Codelist Number** column.

**Material Grade** - Specify the material grade for the part. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Material Grade** sheet in the **Codelist Number** column.

**NPD**[*port number*] - Type the nominal diameter for the part port. Unless you specify otherwise, the software defines port 1 as the primary port.

**NPD Unit Type**[*port number*] - Specify the units for the **NPD** column. For example, type **mm** or **in**.

**Piping Point Basis**[*port number*] - Specify the piping point basis that identifies the function of the port. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Piping Point Basis** sheet in the **Codelist Number** column.

**Schedule Thickness**[*port number*] - Specify the schedule thickness short description or code for the part port. Valid codes and short descriptions are listed in the **AllCodeLists.xls** workbook on the **Schedule Thickness** sheet in the **Codelist Number** and **Schedule Thickness Short Description** columns.

**Second Size Schedule** - Specify the schedule (or thickness) for the second size end of this conduit commodity. This data is only required when the commodity code does not include schedule. Valid codes and short descriptions are listed in the **AllCodeLists.xls** workbook on the **Schedule Thickness** sheet in the **Codelist Number** and **Schedule Thickness Short Description** columns.

**Symbol Definition** - Type the symbol definition for the part.

**Surface Area** - Enter the surface area of the part. This value is required for determining the quantity of paint and insulation and the weight of the insulation. Be sure to specify the units when entering this value.

**Volumetric Capacity** - Specify the amount of fluid that the part can hold. This value is required for the analysis of heat tracing requirements. Be sure to specify the units when entering this value.

**Water Weight** - Enter the water weight of the part. Be sure to specify the units when entering this value.

**Water COG X** - Type the center-of-gravity location for the part along the x-axis when the part is filled with water.

**Water COG Y** - Type the center-of-gravity location for the part along the y-axis when the part is filled with water.

**Water COG Z** - Type the center-of-gravity location for the part along the z-axis when the part is filled with water.

### Unique Properties

Unique properties appear only for certain classes. The properties are listed here in alphabetical order.

**Face 1 to Center** - Type the length from the port 1 face to center.

**Face 2 to Center** - Type the length from the port 2 face to center.

**Face to Center** - Type the distance from the face of the port to the center of the part.

**Face to End** - Type the distance from the face of the port to the end of the cap.

**Face to Face** - Type the distance from the port 1 face to the port 2 face.

**NOTE** The following three properties are custom attributes and are used in the Pull box part class.

**IJUAElectricalEquipment::ElecEquipmentLength** - Type the length of the electrical equipment.

**IJUAElectricalEquipment::ElecEquipmentHeight** - Type the height of the electrical equipment.

**IJUAElectricalEquipment::ElecEquipmentWidth** - Type the width of the electrical equipment.

**Union Diameter** - Specify the diameter of the union.

## Conduit Stock

The **Conduit Stock** sheet in the **Conduit.xls** workbook defines the conduit parts that you want in your catalog.

**Commodity Type** - Type the conduit commodity type short description or the corresponding codelist value. Valid codes and short descriptions are listed in the **AllCodeLists.xls** workbook on the **Piping Commodity Type** sheet in the **Codelist Number** column.

**Density** - Specify the material density including the units, for example: 490lbm/ft<sup>3</sup> or 7856kg/m<sup>3</sup>.

**End Preparation**[*port number*] - Enter the end preparation code for the part port. Valid codes are listed in the **AllCodeLists.xls** workbook on the **End Preparation** sheet in the **Codelist Number** column.

**End Standard**[*port number*] - Enter the end standard code for the part port. Valid codes are listed in the **AllCodeLists.xls** workbook on the **End Standard** sheet in the **Codelist Number** column.

**First Size Schedule** - Specify the schedule (or thickness) for the first size end of this conduit commodity. This data is only required when the commodity code does not include schedule. Valid codes and short descriptions are listed in the **AllCodeLists.xls** workbook on the **Schedule Thickness** sheet in the **Codelist Number** and **Schedule Thickness Short Description** columns.

**NOTE** If the code for the schedule represents a thickness value, the units of measure for the wall thickness may differ from the units of measure for the nominal diameter.

**Graphical Representation Or Not** - Specify whether or not the part should appear in the model.

**Industry Commodity Code** - Type a commodity code for the conduit part. The software uses this commodity code to find the conduit in the parts catalog. This code must be unique across the catalog.

**Lining Material** - Specify the lining material, if any, for the part. Examples of lining material include epoxy, rubber, plastic, and so forth. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Lining Material** sheet in the **Codelist Number** column.

**Material Grade** - Specify the material grade for the part. Valid codes are listed in the **AllCodeLists.xls** workbook on the **Material Grade** sheet in the **Codelist Number** column.

**NPD[port number]** - Type the nominal diameter for the end. If both ends have the same NPD, you still must enter the same NPD value in both the **NPD[1]** and **NPD[2]** columns.

**NPD Unit Type[port number]** - Specify the units for the **NPD** column. For example, type **mm** or **in**.

**Purchase Length** - Specify the length in which the conduit can be purchased including the units, for example 6m or 20ft. If you do not specify a purchase length, the software uses the **Maximum Pipe Length** value for the purchase length.

**Schedule Thickness[port number]** - Type the schedule thickness short description or code for the part port. Valid codes and short descriptions are listed in the **AllCodeLists.xls** workbook on the **Schedule Thickness** sheet in the **Codelist Number** and **Schedule Thickness Short Description** columns.

### **See Also**

*Conduit Reference Data* (on page 31)



## SECTION 8

# Cable Reference Data

Cable reference data contains cable parts.

### **See Also**

*Cable Parts* (on page 43)

## Cable Parts

The **Cabling.xls** workbook defines all of the cable parts that are available in the catalog. Below is a complete listing of all the properties, both common and unique, that you will see on a cable part sheet.

### **Common Properties**

These properties appear for all part classes. The properties are listed here in the order that they appear, from left to right, on the part sheet.

**Part Number** - Specify the part number for the cable part.

**IMPORTANT** All part numbers must be unique across the entire catalog.

**Part Description** - Type a description for the cable.

**Unit Weight** - Type the unit weight of the cable.

**Minimum Bend Radius** - Specify the radius below which the cable should not be bent.

**Cable Diameter** - Type the diameter of the cable.

**Number of Conductors** - Type the number of conductors in the cable.

### **Unique Properties**

Unique properties appear only for certain classes. The properties are listed here in alphabetical order.

**Armor Type** - Type the armor type for the cable.

**Back Shell Part Number** - Specify the part number for the backshell.

**Back Shell Part Description** - Type a description for the backshell.

**Cable Category** - Type the category for the cable, such as Power.

**Cable Covering** - Type the covering for the cable.

**Cable Sheath Material** - Type the sheath material for the cable.

**Cable Type** - Specify the type of cable.

**Commercial Type** - Type the commercial type for the cable.

**Conductor Arrangement** - Type the arrangement for the cable, such as 3 Core Cable.

**Connector Part Number** - Specify the part number for the electrical connector.

**Connector Part Description** - Type a description for the electrical connector.

**Family** - Type the family of the cable.

**Formation** - Specify the formation of the cable. For example, type 3 x 95 mm<sup>2</sup>.

**Impedance** - Type the impedance value for the cable.

**Insulation** - Enter the type of insulation for the cable.

**Insulation Material** - Type the insulation material for the cable.

**Insulation Type** - Enter the type of insulation for the cable.

**Insulation Voltage** - Enter the voltage value for the cable.

**Load Rating** - Enter the load rating for the cable.

**Mode** - Type the mode for the cable.

**Nominal Loss Characteristics** - Type the nominal loss for the cable.

**Number of Fibers** - Type the number of fibers for the cable.

**Outer Insulation Material** - Type the material that covers the outside of the cable, such as PVC.

**Power Capacity** - Type the power capacity of the cable.

**Receptacle** - Specify the part number for the electrical receptacle.

**Resistivity** - Type the resistivity value for the cable, such as 0.190 Ohm/1000m.

**Shielding** - Define the shielding for the cable.

**Size of Conductors** - Type the cable size in wire gauge units.

**NOTE** Wire gauge expressed in AWG is convertible to kcmil. However, because AWG only goes to 4/0, anything above that cannot be converted from kcmil to AWG. If you have a situation where the wire gauge is larger than 212 kcmil (4/0 AWG), and specify that the value is converted from kcmil to AWG, the software will display <Undefined> for the size.

**Specification** - Type the specification for the cable.

**Stranding** - Type the stranding for the cable.

**Temp Rating** - Type the temperature rating for the cable.

**Voltage Rating** - Type the voltage rating for the cable.

**Wire Gauge** - Type the wire gauge for the cable.

### **See Also**

*Cable Reference Data* (on page 43)

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