AutoCAD MEP Schedules

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Learning Objectives

Objective 1: Comprehend the schedule philosophy and hierarchy ........................................... 2
Objective 2: Develop Property Set Definitions ............................................................................. 4
Objective 3: Creating a new Palette .............................................................................................. 11
Objective 4: Define a new Tag ....................................................................................................... 14
Objective 5: Create a Schedule Table from an Excel spreadsheet .............................................. 16
Objective 6: Putting it all together ................................................................................................. 21

Description

AutoCAD MEP schedules are one of the most productive yet underutilized feature sets of the program. By investing a little time up front with schedules, a CAD manager can greatly improve the quality and decrease the time taken to achieve construction documents. CAD managers can take schedules that engineers have developed over the course of years of practice in Excel spreadsheets and recreate them as AutoCAD MEP schedules to automate the process.

This achieves converting a manual, disconnected process from updating drawing separately from Microsoft Excel spreadsheets, to automated tags and tables that keep up to date with the AutoCAD MEP model. The greatest part about this is that the more these feature sets are used, the greater the ROI becomes. Over the course of 12 months, the time it takes to coordinate spreadsheets with drawings is eliminated. Take advantage of this.

Speaker(s)

Jay Ayala is a long-time user of Autodesk products. Starting in 1992 with AutoCAD LT R14 with both mechanical and architectural drawings, he has seen the industry of AEC evolve over the years. Jay practiced design & engineering up until 2006 doing anything from drafting redline drawings to designing HVAC systems. He always looked for the next challenge.

In 2004 Jay evolved his skillset in the engineering practice with 3D models that eventually became called Building Information Modeling. That challenge along with the design process catapulted Jay’s career. He eventually found that he was demonstrating software capabilities internal to the engineering division of the architecture firm he worked for.

This in turn led him to seek employment on the sales side of the Autodesk side of the business where he excelled. His career in helping others understand technology and how to best leverage it to for companies to gain efficiency and quality is where Jay is best.
Objective 1: Comprehend the schedule philosophy and hierarchy

The philosophy behind an AutoCAD MEP schedule is simple. It is a report that provides predefined information of objects in a drawing. The schedule leverages Property Set Definitions (PSD) about objects. Schedules also have properties that allow a CAD manager to optimize its use. Like the ability to read through to an XREF. Or to automatically add objects into the schedule. The way a CAD manager should use these are simple, take an existing table that is done in Excel as a spreadsheet and recreate it within AutoCAD MEP.

The hierarchy of an AutoCAD MEP schedule has certain requirements. Illustrated below, you will see that first the object must exist in the model. Next the object must have PSD’s assigned to it. Finally, you have the report mechanism, either a Tag or a Schedule. If any part of this is missing, then the Tags & Schedules wont report properly.

When the schedules, PSD’s and the objects are working in harmony, then we have a scenario where this is pushed so far in the background that the standard user will not even realize they are using custom content. It will be seamless and unobtrusive. That is the best scenario to facilitate and ensure adoption.
As you can see in this illustration, we have the three-tier hierarchy in full effect here. First, there is the object, then there is the PSD, finally you have the report (Tag or Schedule). The items need to exist together as a cohesive set of related items.

First, the object can be anything, really. It can be a standard AutoCAD block. It can be a Multi-View Block (smarter objects that can be found in AutoCAD Architecture). Or it can be a Multi-View Part (even smarter objects that can be found in AutoCAD MEP). In this example, we have a Multi-View Part.

Second, we have the PSD. In the properties panel you can clearly see the custom properties. Any greyed-out properties are extracted from the PSD as either automatic values, or calculated values. Those cannot be edited directly. However, if you see there are values that are white, those can in fact be directly edited. Additionally, by default, the properties of the PSD’s show up in the Extended Data tab of the Properties Palette alphabetically. However, you can choose the order of the properties when defining the properties.

Third, we have the reporting mechanism. One reporting mechanism is a Tag. A Tag is actually a Multi-View Block that you can define to look like anything. We will have an exercise later that will cover this. One reason that developing your own custom Tags is compelling is because the tag will read information about the object from the Property Set Definitions and will avoid the user from having to manipulate an attributed block. Another reason is the tag displays the same property as what the schedule displays. Eliminating chances of ever transposing alphanumeric characters incorrectly. This aids in the consistency of the documents. And finally, the tag is anchored to the object. Which is to say that if the object is moved, the tag follows. Also, if the object is deleted, then the tag self-deletes along with it.
Objective 2: Develop Property Set Definitions

Property Set Definitions should be thought of as parameters that can be called for a lot of different purposes. Some can be manual; some can be automatic; others can be formulas like string concatenation or algebraic. I once used a derivative of Hazen Williams formula to determine pipe head.

The example that we will be using for this seminar is a company standard pump schedule. You will learn what it takes to create a custom schedule and everything along with it. This involves using a few unique tricks I have developed over the years to facilitate this process.

<table>
<thead>
<tr>
<th>MARK NUMBER</th>
<th>LOCATION</th>
<th>SERVERS</th>
<th>TYPE</th>
<th>FLOW GPM</th>
<th>HEAD FT WG</th>
<th>MIN EFF %</th>
<th>MOTOR DATA</th>
<th>SUCTION DIFFUSER</th>
<th>TRIPPLE DUTY VALVE SIZE IN</th>
<th>OPERATING WEIGHT LBS</th>
<th>BASIS OF DESIGN</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>POWR-101</td>
<td>PUMP ROOM BUILDING 16</td>
<td>HORIZ SPLIT CASE</td>
<td>10</td>
<td>4</td>
<td>75</td>
<td>6</td>
<td>1600</td>
<td>240 VFD</td>
<td>NO</td>
<td>N/A</td>
<td>1300</td>
<td>86G HSCP RIS</td>
</tr>
<tr>
<td>POWR-102</td>
<td>PUMP ROOM BUILDING 16</td>
<td>HORIZ SPLIT CASE</td>
<td>10</td>
<td>4</td>
<td>75</td>
<td>6</td>
<td>1600</td>
<td>240 VFD</td>
<td>NO</td>
<td>N/A</td>
<td>1300</td>
<td>86G HSCP RIS</td>
</tr>
<tr>
<td>POWR-103</td>
<td>PUMP ROOM BUILDING 16</td>
<td>HORIZ SPLIT CASE</td>
<td>10</td>
<td>4</td>
<td>75</td>
<td>6</td>
<td>1600</td>
<td>240 VFD</td>
<td>NO</td>
<td>N/A</td>
<td>1300</td>
<td>86G HSCP RIS</td>
</tr>
</tbody>
</table>

When we consider the custom pump schedule illustrated here, we see that there are several columns and their headers. We should think of those headers as individual properties of a PSD. Each PSD would be specific for each equipment type. For example, we would have a PSD for a pump and a different PSD for a chiller, and yet another for a cooling tower, etc.

In the Style Manager illustration, you can see the PSD for the pump fully defined below.
Creating the PSD

Let us begin by defining a new Property Set Definition (PSD) for our pump example. From the AutoCAD MEP Style Manager, find the Property Set Definitions sub-category and select it. It can be found under the Documentation Objects category. Then click on New Style.

Pro Tip:
When creating company standard styles of any types, I highly encourage any CAD manager or person creating the content to add some basic info about the author so if there is every any questions about modifying or changing it, then they can find the person who created the style.
In the “Applies To” tab there are some fundamental settings you need to select for this PSD to work properly. First, we need to ensure that the PSD applies to “Objects”. Next, we need to identify that the PSD applies to are Multi-View Parts. Finally, we must select the proper classification. In this case, its Pump.
Manual Property Definition

Now that we have created a PSD, let us define a manual property. Most of the properties for this seminar will be manual with a couple of special cases that will be setup differently. This is an example of a particular property that will be set up as a manual property that allows a user to enter text into the property panel. Ensure that the Type, Default and Format are properly set per your liking.

Below you will see that I have made a MarkPrefix property that is Type “text” with a Default of “PCWS” and its Format is “Case-Upper” so it is always displayed as UPPERCASE letters. Additionally, I have defined that this property is property number 2 that shows up in my list when I look at it in the properties panel by leveraging the Order.
Auto Incrementing Integer Property Type

Now that we have seen a manual property, we are going to look at a special case of a manual property. This is an example of an Auto Incrementing Integer property type. This special case is where if you were to copy an object with an Auto Incrementing Integer PSD, it would automatically increment the digit. For example, if we copied a boiler that had a value of 204, then the resulting copy would increment the integer and the new boiler would automatically have a value of 205. No need to manipulate the property.

We start the same way by defining a new manual property called MarkNumber.

Now we define the Type as “Auto Incrementing – Integer” and again define the Default, Format and Order as well.
Formula Property Definition

Now that we have seen Manual Property Definitions, next we will look at adding a Formula Property Definition. We will define the formula for a new property called MarkNo.

Untick the box for “Use formula for description”. In this example we want to concatenate the MarkPrefix and the MarkNumber that we have previously defined.
Leveraging the formula as follows gives us a dash between the MarkPrefix and the MarkNumber.

\[
\text{RESULT} = \text{[MarkPrefix]}-\text{[MarkNumber]}
\]

In the Enter Sample Value: box, you will notice that we have Values placed and the Sample Result gives us a preview of what the formula does.

This MarkNo calculated value is going to be the 1st property in the Order of appearance in the Properties Palette. Following that will be the MarkPrefix, as #2, and MarkNumber as #3.

Pro Tip: If you see that the MarkNumber has odd decimal points that you do not care for, you will need to adjust the format which is controlled by the Property Set Formats.
Add the remaining Property Definitions

Continue adding additional Property Definitions until all the headers or sub-headers from the original Microsoft Excel spreadsheet has been completed. Ensure that the Formats are set up properly while you are at it.

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<th>HEAD FT WG</th>
<th>MIN EFF %</th>
<th>HP RPM</th>
<th>V/P</th>
<th>CONTROL TYPE</th>
<th>SUCTION DIFFUSER</th>
<th>TRIPPLE DUTY VALVE SIZE IN</th>
<th>OPERATING WEIGHT LBS</th>
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<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCWR-101</td>
<td>PUMP ROOM</td>
<td>BUILDING 16</td>
<td>HORIZ SPLIT CASE</td>
<td>10</td>
<td>4</td>
<td>75</td>
<td>6</td>
<td>1600</td>
<td>240</td>
<td>VFD</td>
<td>NO</td>
<td>N/A</td>
<td>1300</td>
<td>B&amp;G HSCP RX6</td>
</tr>
<tr>
<td>PCWR-103</td>
<td>PUMP ROOM</td>
<td>BUILDING 16</td>
<td>HORIZ SPLIT CASE</td>
<td>10</td>
<td>4</td>
<td>75</td>
<td>6</td>
<td>1600</td>
<td>240</td>
<td>VFD</td>
<td>NO</td>
<td>N/A</td>
<td>1300</td>
<td>B&amp;G HSCP RX6</td>
</tr>
</tbody>
</table>

Objective 3: Creating a new Palette

Choosing the right workspace

Consider that we are creating a new palette for mechanical equipment, in our case a pump. That being the case, we will want to leverage the right Workspace to do that. In this example, we will create a new palette under the Piping workspace. The Workspace tool is found in the status bar at the bottom of the screen.

Creating the Palette

Creating a new palette can be very useful. Especially when a CAD manager shares the palette with the team. Once the Workspace is defined, we can create a new palette as illustrated below.
Right-click on the palette grouping to access the New Palette feature. Give it an appropriate name. I named mine “Company Standard Palette”.
If you decide to change the order of the palettes, you will need to activate the Customize Palettes feature by right-clicking on the name of the palette grouping.

There you can move the palette up and down by clicking and dragging it where you desire.
This results in the palette being located as illustrated below.

Once a pump has been added, we can save the file and add the pump to the custom palette we created earlier. Simply click-and-drag the pump from the graphics screen onto the palette.

**Objective 4: Define a new Tag**

This objective will help you understand how to create a tag that is appropriately scaled. Let’s start by grasping the fundamentals of scaling and how tag react to the scales.

**Fundamentals of scaled views and standard text height.**

Let us consider having a standard text height in Paper Space and how a scale gets applied to have the resulting text sized appropriately in the scaled viewport. Let’s say that our standard text height in Paper Space is 1/8". Let’s say that our scale for our view is 1/4" = 1'-0". To determine what the text height must be in Model Space, we must first determine the increment factor of 1/4" in 1'-0". The answer is that there is a total of 48 increments of 1/4" in each 1'-0" length. We know that the text height in Paper Space is supposed to be 1/8". Multiply 1/8" × 48 to get the Model Space text height. This means that the text height in Model Space must be 6".

Now, if we have a Tag that needs to scale up and down according to the view, then we must define it so that the Multiview Block definition that we create the Tag from must have the text set to a height of 1". This way, the Multiview Block first gets scaled down by the standard Text Height of 1/8", then it gets scaled up by the increment factor of the view scale, in our case it would be 48, resulting in the Multiview Block that the tag consists of being scaled to 6”.

Always define your Tags with a text height of 1".
Define the Tag using simple objects like text, lines, arc, and circles.

Start by either using MTEXT or DTEXT. Use lines arcs and/or circles to create the remainder of the graphics of the tags.

Pro Tip: Consider defining text with the right justification. In our example below, I have defined the text to have a justification of Middle Center. It will also become the insertion point of the Tag.

Create Tag tool.
Once you have the text defined with the right justification and at a height of 1", then you can create the tag. The tool will be found in the Home ribbon, under the Annotation slide out as illustrated here.

AutoCAD MEP will prompt you to select the objects that consist of the tag. Select all lines, arcs, and circles along with the text. Then ensure that the resulting dialogue box has a tag name, and the appropriate properties as illustrated here.

1. Name
2. Type
3. Property Set
4. Property Definition
Finally, we will define the tag’s insertion point. AutoCAD will prompt you to specify the insertion point. Use an Insert snap to select the middle center of the text that was justified earlier as illustrated here.

Once the tag has been completed, we can save the file and add the tag to the custom palette we created earlier. Simply click-and-drag the tag from the graphics screen onto the palette.

**Objective 5: Create a Schedule Table**

In one of the earlier objectives, you saw how we can add all the Property Definitions which are each of the headers or sub-headers. Next, we will go through the process of creating a new Schedule Table Style.
Schedule Table Styles
Let us create a new Schedule Table Style for Pump Schedule.

Start creating a Schedule Table Style by accessing the Style Manager in the Manage ribbon.

Select the Schedule Table node. Then click on the New Style button as illustrated here.
Give the new style a name, then use the Applies To tab to ensure that the Schedule applies only to the right classification of objects as illustrated here.

In the Columns tab, use the Add Column button to add each Property Definition. Start by adding all the Properties in the appropriate order.
Next, we will create a header to emulate what the Microsoft Excel spreadsheet looks like. Start by selecting the columns that represent the sub-headers. Then, click on the Add Header button. Then give the Heading a proper value.

Columns can also be changed so that they have fixed widths. This allows you to have a column with the text wrapping into multiple lines. To achieve this, simply select the desired column and click on Modify. In the Modify Column dialog box, click on Override Cell Format and enter a value for the Fixed Width.
Next, we will move onto the Sorting/Grouping tab. We need to ensure that the table gets sorted by the MarkNo in ascending order.

![Sorting/Grouping tab](image)

Use the Layout tab to override the different sections so they have the right text style and height. Set up the different format of each section as desired. Try to match the Microsoft Excel spreadsheet as closely as you can.

![Layout tab](image)

Next, we will skip the Classifications tab and move onto the Display Properties where you will Edit Display Properties of the General Display Representation. Select all the Display components and change the color to ByLayer.

Next, we can insert the schedule table by using the ScheduleAdd command. Once the schedule table has been added, we can save the file and add the schedule table to the custom palette we created earlier. Simply click-and-drag the schedule table from the graphics screen onto the palette.
Objective 6: Putting it all together

Now that you have created all the documentation objects, let's try it all out.

Insert the pump.
Let us start by adding one single pump. It can be found on the custom palette we made earlier in Objective 3. Simply click on the pump tool to add it directly to the graphics screen.

Insert the tag.
Adding the tag is just as simple. It can also be found on the custom palette we made earlier in Objective 3. Simply click on the pump tag tool to add it directly to the graphics screen. Follow the AutoCAD prompts asking you to Select The Object to Tag, then place the tag wherever seems best.
Insert the schedule table.
Finally let us add the schedule table. Again, it can also be found on the custom palette we made earlier in Objective 3. Simply click on the pump schedule table tool to add it directly to the graphics screen. Follow the AutoCAD prompts asking you to Select objects or Enter to schedule external drawing, then place the schedule table wherever seems best.

Once the schedule table has been added, its time to change a few properties of the table. Select the table and change the following properties in the Design tab of the Properties Palette.

1. Update Automatically: YES
2. Add new objects automatically: YES

Renumbering Tool.
Now we will begin to work with the pumps, tags and schedules. By leveraging the Renumber Property Set tool, which can be found in the Annotation Ribbon under the Scheduling slide out, we can redefine the autoincrementing MarkNumber. Supposing the Pump was located on the 3rd floor, then pump number would naturally start with 300.
Here you can see how we have defined the Property Set called Pump, and have targeted the Property called Mark Number which starts at a value of 301 and increments by 1 whole number for the subsequent object. Simply renumber the single instance of the pump accordingly.

Copy Additional pumps.

We have setup all the necessary documentation objects properly to maximize AutoCAD MEP’s productivity. Simply start copying around the single instance of the pump along with its tag and watch how the pump tags and the schedule table automatically update.

Finally, if you need to change any of the properties in the schedule, you can simply select the pump and edit property values in the Extended Data tab of the Properties palette.

Now, go and create all the remaining equipment schedules using these principals and you can start utilizing some of the most productive features of AutoCAD MEP.