

IM500015

BOMs Away Managing Bills of Materials in AutoCAD

Mike Thomas
Prairie Machine

Learning Objectives

- Learn how to manage bills of materials within AutoCAD
- Learn how to share the BOM with others
- Learn about the benefits of using AutoCAD Mechanical
- Learn how to utilize Vault Professional for BOM management

Description

Wait, what? You can create a bill of materials (BOM) in AutoCAD software? Lets explore the options for creating a BOM in AutoCAD and the embedded tools within AutoCAD Mechanical. We'll check in the drawing to Vault Professional, and use Vault's tools to manage and manipulate the BOM. Then we'll explore our options for sharing the BOM with other systems.

Speaker

Mike is the Technical Services Manager for Prairie Machine and is responsible for overseeing the company's technical operations and strategic (technical) growth. Primary duties include the ongoing support of critical computer systems and programs, the interactions between departments, providing the engineering department with effective systems and technology, and working with the General Manager on the development and implementation of a cohesive strategic plan for the technical growth of the company.

Bill of Materials

The **bill of materials** (BOM) is a list of things. In manufacturing, it is the recipe ingredients for producing (and repairing) equipment and machinery. It lists the raw material, parts, sub-assemblies, purchased items, and everything else that goes into the product.

The BOM acts as a key communication piece between departments. It contains the items designed by engineering. A BOM provides the list of items to be purchased and the items that must be manufactured. It contains the identifiers (part numbers, stock numbers), the descriptions, quantities, purchasing details, manufacturer information, costs, and other key attributes.

The BOM is the single source of truth between so many systems. From sales (CRM) to engineering (PDM), production (ERP, MRP), and product lifecycle management (PLM).

It is the most important piece of information in manufacturing. I've seen it multiple times where the material is ordered, received, assembled, and shipped to the customer all without the drawing being opened one time.

AutoCAD Bills of Materials

AutoCAD has no tools to manage bills of materials! right? Well... maybe sort of? AutoCAD does not have dedicated BOM tools, but there are enough to fake it.

What tools am I talking about? How about the **Count** feature? Or the **Data Extraction** tools? And **Blocks with attributes** are essentially the same as 3D models with meta-property data.

Blocks and Attributes

AutoCAD **Blocks** group objects into a single entity. As a singular object, it is easier to select, manipulate, and share across drawings. Using blocks leads to consistency and standardization as the same symbol is used across all drawings. Attributes provide the ability for variable text metadata across your blocks. Each instance of a block definition can contain different attribute text content.

Creating blocks is easy. Use the BLOCK command to set the name, select the objects (including attribute definitions), and set the insertion point. By selecting the attribute definitions they automatically become part of the block, ready for use on the first insertion.

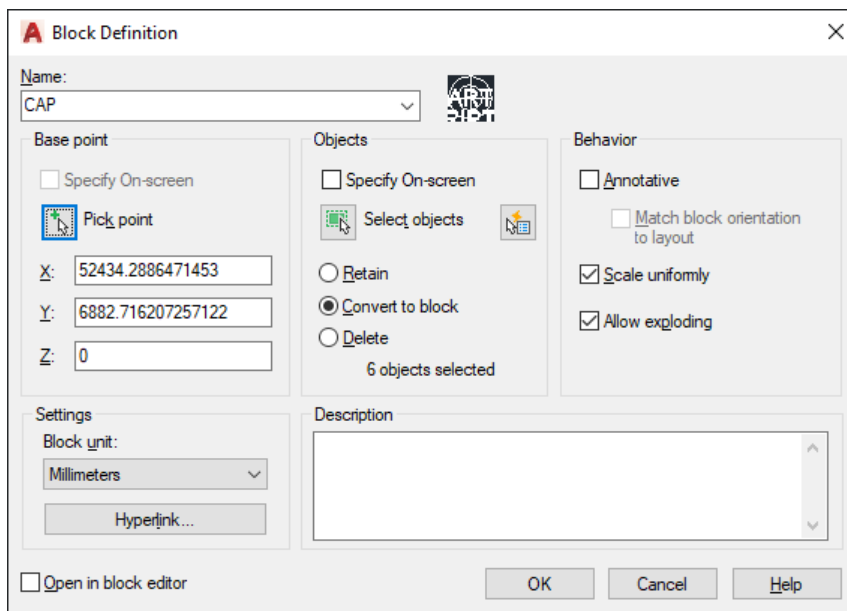


Figure 1: Building a Block

How does this help with bills of materials? It allows you to take unrelated 2D objects, group them into a singular named object, and specify descriptive metadata. So instead of lines, arcs, and circles you now have countable objects representing the items you manufacture and purchase.

Counting Blocks

AutoCAD's [COUNT](#) is sort of a BOM tool, but mostly a tool to quickly extract the count of things. With this feature, AutoCAD quickly counts the instances of any object type within the drawing, including blocks. Insert a field with the count data or a table listing the blocks, both updating with changes to the drawing.

Start by selecting the objects to count. This initiates the count environment, with the Count toolbar along the top of the drawing area. Use this toolbar for a quick reference to the number of objects, to navigate between the objects in the count, to insert the count field, and to end the counting process. When selecting a single object, all objects of that type and configuration are automatically selected. When selecting multiple objects, AutoCAD looks for identical instances of the same object combination.

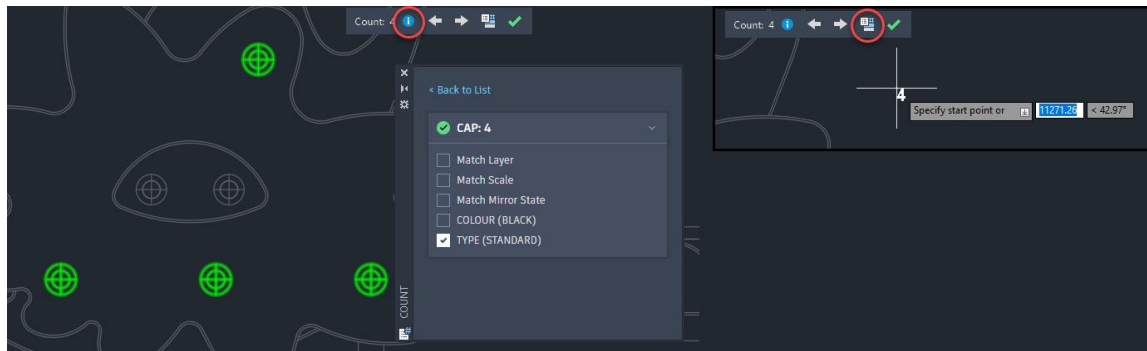


Figure 2: Using the Count Toolbar

Use the List **All Blocks** option for the **Count palette** – a list of blocks. This includes the number of instances contained with the drawing. Select a block within the palette to drill into the selection. It's in the *right-click menu* where you'll find the option of inserting a **Count Field**. Use the palette option to insert a **table**.

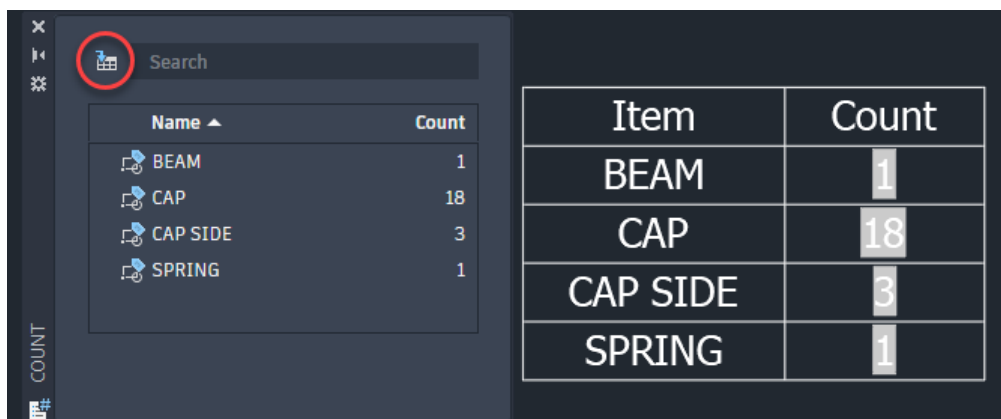


Figure 3: Insert a Count Table

What about blocks with varying attribute information? Within the Count palette, expand the block by property or attribute value. This allows you to see instances group by common properties.

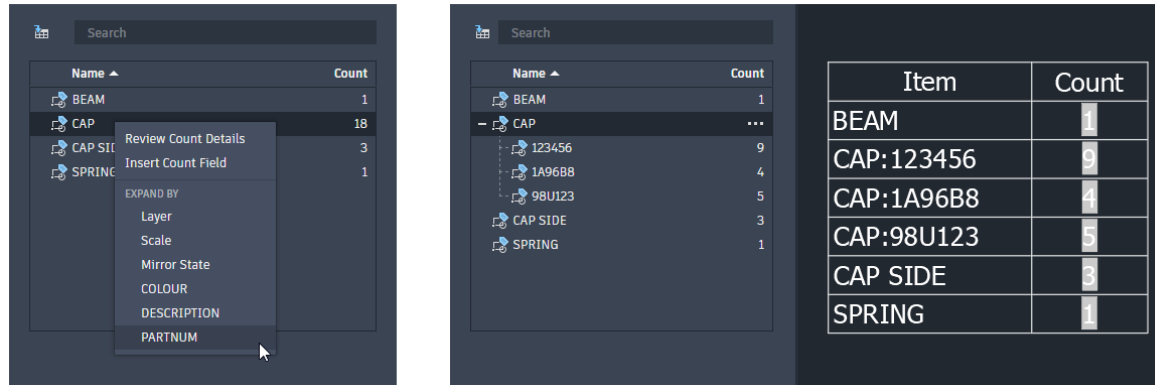


Figure 4: Expanding the Block Count

The Verdict? Count is sort of a bill of materials tool.

Although it provides the block name, count, and one subsequent property, you need to provide the descriptions and other details. Do not dismiss this tool though, it provides a quick and easy method to get quantities - say to figure out purchasing details.

Data Extraction

For AutoCAD bills of materials, the creme-la-creme is [Data Extraction](#). This wizard extracts information from objects, including block attributes and drawing properties. Send the information to an external document or insert it as a table into the drawing.

The process:

1. Create new or select an existing Data Extraction
2. Specify the data source(s)
3. Select the objects
4. Select the properties
5. Refine the properties
6. Choose the output

The data extraction (.dxe) is the saved configuration. It only needs to be created once as you can use this as a template as opposed to re-establishing the settings each time.

The data source is a portion of a drawing, the active drawing, or a selection of drawings. You choose to include blocks and/or to include objects from xrefs.

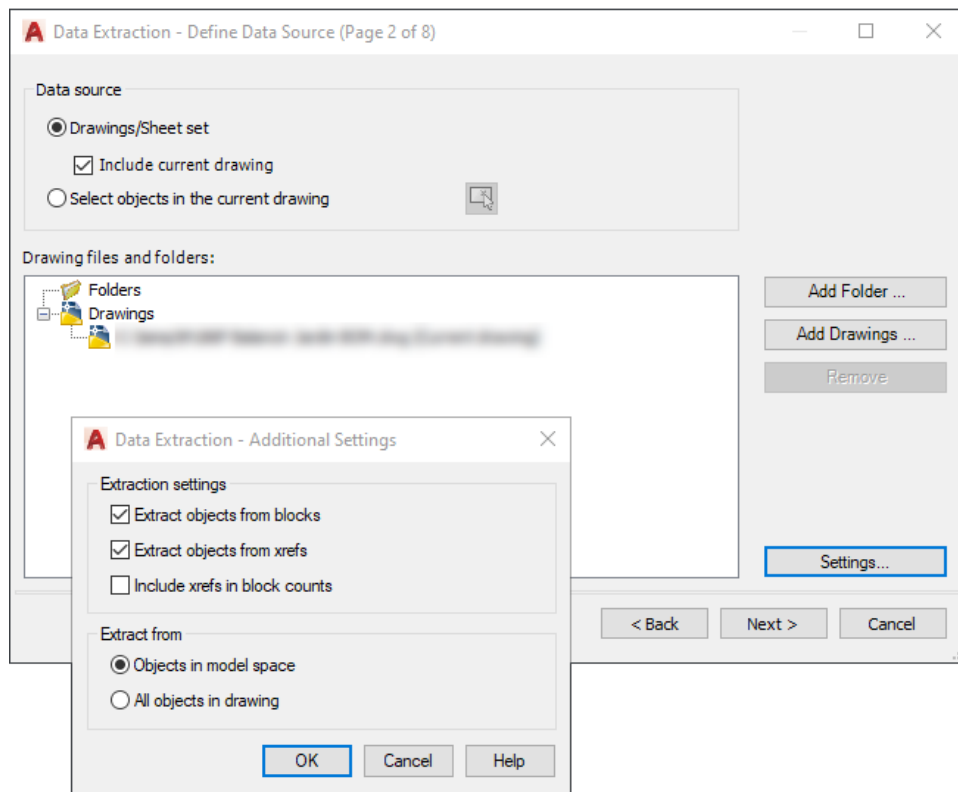


Figure 5: Define the Data Source

When selecting objects, use the filtering options to quickly select only the blocks with attributes. A key feature is the option of adjusting display names, allowing for the merging of like objects (with different names). For example, blocks representing different views of an item (front, top, side, etc).

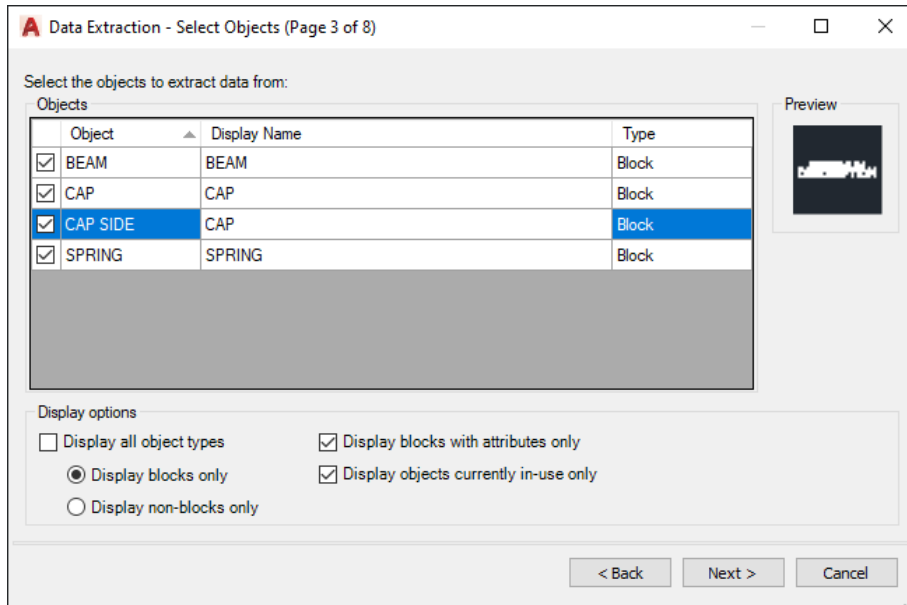


Figure 6: Select Objects

For a bill of materials hide the name column (unless the name represents an important property) and enable Combine identical rows.

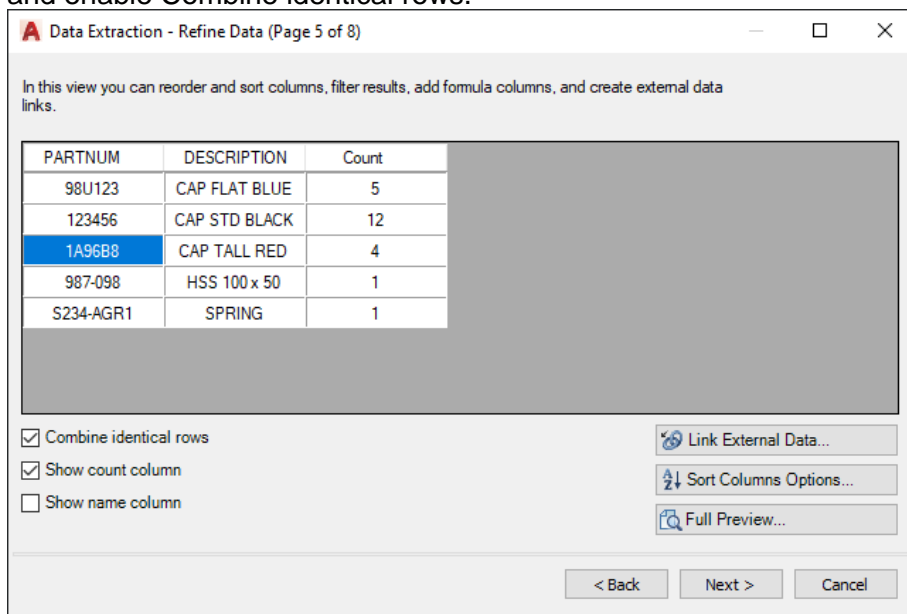


Figure 7: Refine the Data

Note, externally exported data extractions do not auto-update with changes to the drawing. You will need to re-export the details.

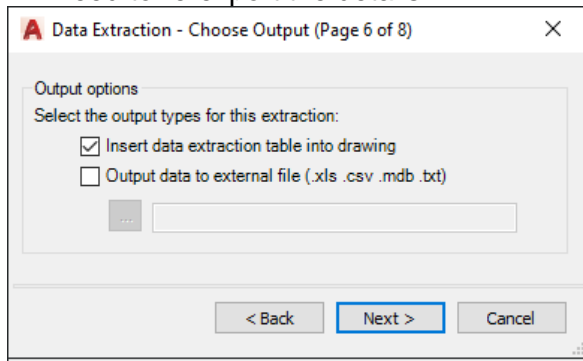


Figure 8: Choose the Output

With changes to the drawing use Update All Data Links, to update the data extraction and associated tables.

BOM		
PARTNUM	DESCRIPTION	Count
98U123	CAP FLAT BLUE	5
123456	CAP STD BLACK	12
1A96B8	CAP TALL RED	4
987-098	HSS 100 x 50	1
S234-AGR1	SPRING	

BOM		
PARTNUM	DESCRIPTION	Count
98U123	CAP FLAT BLUE	5
123456	CAP STD BLACK	11
1A96B8	CAP TALL GREEN	1
1A96B8	CAP TALL RED	3
987-098	HSS 100 x 50	1
S234-AGR1	SPRING	1

Sharing the Data with Others

To share the BOM information with others the best method is via a table. Why?

1. Anyone who can view the drawing can view the BOM table
2. Tables can be exported (via the right-click menu) to be shared via a spreadsheet
3. Data Extraction allows for the direct export to a spreadsheet

Managing Bills of Materials in AutoCAD... the Verdict

As you can see, AutoCAD provides basic bill-of-material-like-tools for the presentation of components represented in your drawings. **Count** provides a quick and convenient method to extract the number of instances, useful for ordering. **Data extraction** creates a more traditional bill of materials, listing the component's description, part number, and other key attributes.

With the lack of true BOM tools within AutoCAD, there are limitations. There is no eloquent method of ballooning tying the balloon item number to the parts list, there is only a single view of the BOM, and AutoCAD provides no BOM integration with Vault or PLM. The setup of blocks is time-consuming as you need to ensure each block definition uses the same set of attributes. Without this, there is no way to extract the bill of materials.

AutoCAD Mechanical Bills of Materials

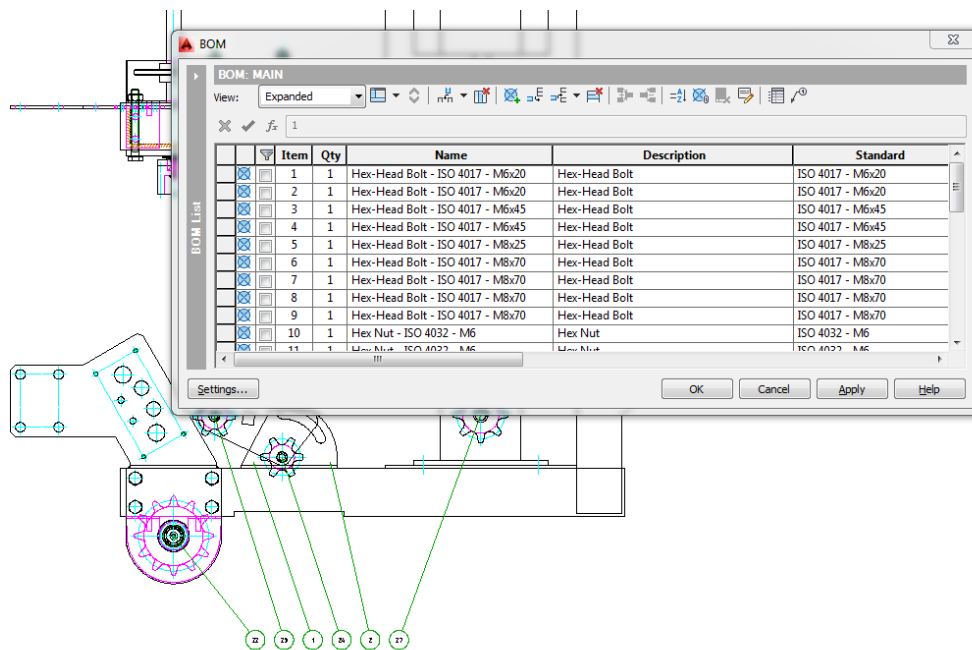
Autodesk initially released AutoCAD Mechanical (ACM) as an addition for AutoCAD 2014. In the initial release it simply added a toolbar of extra *mechanical* focused functionality. Autodesk then acquired German based Genius and the fun began. AutoCAD Mechanical is a member of the AutoCAD One toolset as well various Autodesk suites and collections.

AutoCAD Mechanical is AutoCAD! It is based on AutoCAD, meaning everything you can do in AutoCAD, you can do in AutoCAD Mechanical.

Bill of Materials, Parts Lists, and Balloons

The **Bill of Materials (BOM)** is a collection of **Part References** and their metadata. The BOM is *live* - as the drawing changes, the BOM automatically updates. The metadata represents any and all data you want to track on your components, including descriptions, material, and vendor.

Create **Balloons** manually or automatically from any **Part Reference**. The format managed by the active standard, the item numbers managed by the BOM.



Parts Lists are the *BOM representations* inserted into the drawing. They do not need to contain all of the information contained within the BOM and they can be filtered to only show the desired content.

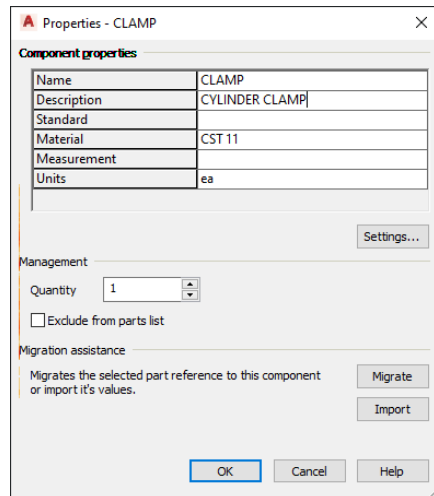
What's great about these features is that any drawing, whether it contains AutoCAD Mechanical content or not can have Part References inserted to define your components. Any drawing with Part References will have a Bill of Material and any Part Reference can be ballooned. This means that even a drawing of lines, arcs, and circles can contain intelligent information that is organized, ballooned, and displayed in the fashion you want on the drawing.

Part References

Use **Part References** to tag geometry as parts and assemblies.

Place **Part References** into the drawing to create components with no geometry. Select an object to associate the **Part Reference**. As the geometry moves, so does the reference.

Associate a **Part Reference** with a block to count all instances of the block in the quantity. **Part References** nested within blocks behave as assemblies.



As you add references, AutoCAD Mechanical prompts for the component information. The available fields are managed via the AutoCAD Mechanical Options.

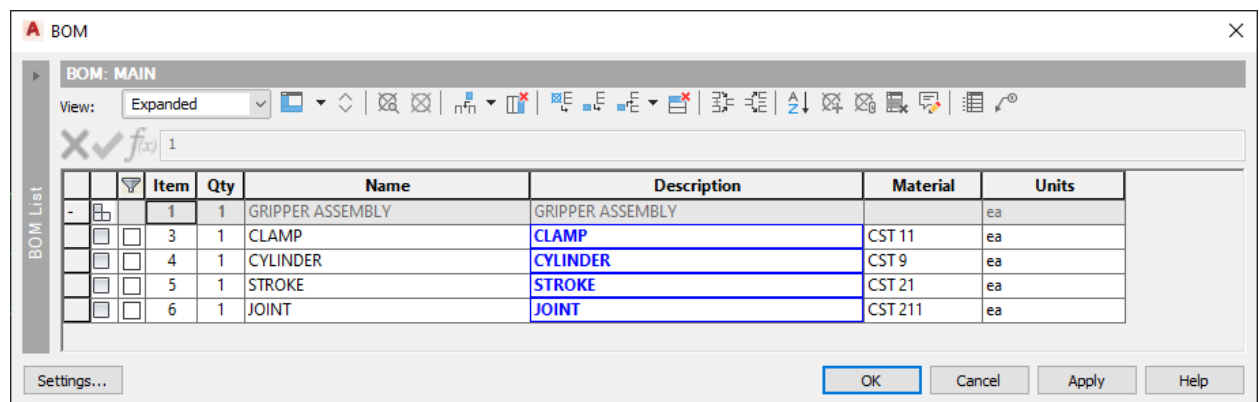
Copying a Part Reference increments the quantity of the component within the BOM. Changing one reference automatically updates all instances to match. To create a new reference, utilizing an existing reference, use the Part Reference Copy option.

The typical workflow is creating the part reference first, thus building the BOM. However, you can generate Part References from BOM rows.

Figure 9: Populating the Part Reference

Bill of Materials (AMBOM)

The Bill of Materials (BOM) contains the information about the parts in the drawing. From the BOM you generate Parts Lists and Balloons. Because parts lists and balloons are derived from the BOM, the BOM must exist before you can use those features.



When a BOM is created, all Part References are included. As you create more references or edit existing, the BOM updates automatically.

The BOM dialog provides tools for working with the bill of materials. This includes adjusting the component data, editing multiple cells, and copying-and-pasting information. Additionally sort the entire BOM or selected rows (with up to three sort criteria), increment the Item value, add (or remove) BOM-only items, add columns (properties), and export the BOM.

Balloons

With the ACM toolset create single or multiple balloons at a time. With multiple balloon placement you decide the alignment: horizontally, vertically, at an angle, or distributed around a rectangular area. When ballooning, the leaders automatically snap to the center of the part references.

Use the Collect feature to merge several balloons under one leader.

AM:Standards

Like all things in AutoCAD Mechanical, the format of the Component Properties, BOM, Parts List, and Balloons are controlled by the active Standard, but can be overridden after insertion (on the fly).

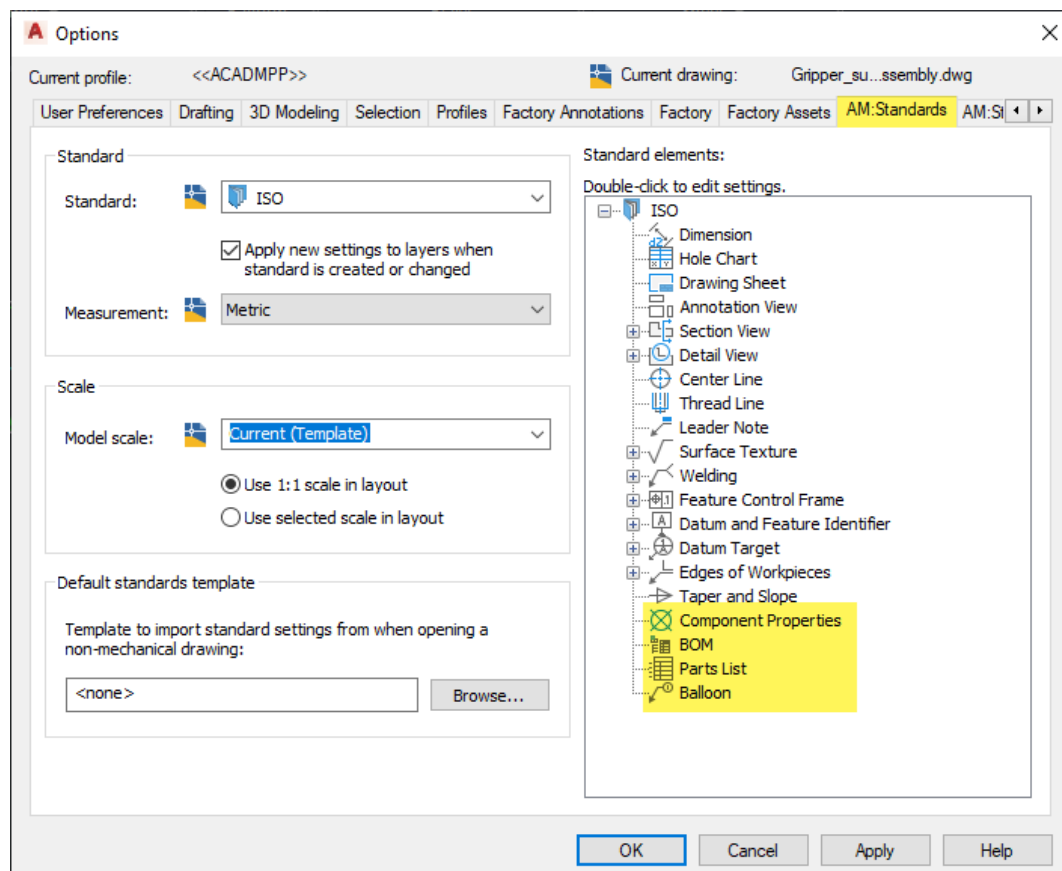
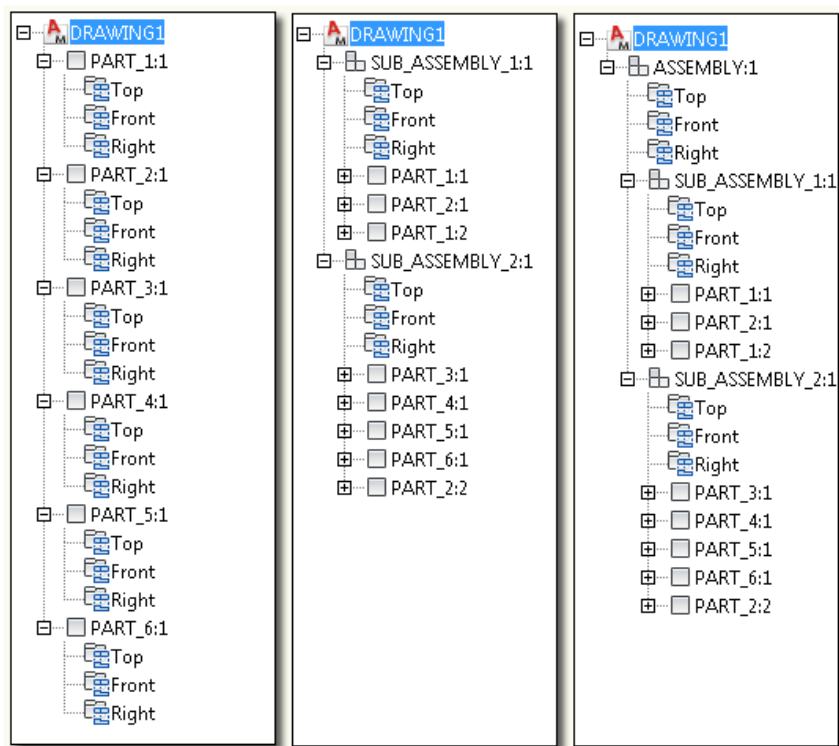


Figure 10: AM:Standards Dialog

AutoCAD Mechanical Structure

Structure could really be a class on its own, just because of the features and functionality and the workflows possible. ACM Structure is like blocks on steroids, a combination of blocks and groups, to define components. Although just 2D geometry the components defined by ACM are both parts and assemblies defining the structure of the assembly you are building. The BOM is automatically built as the structure is defined.

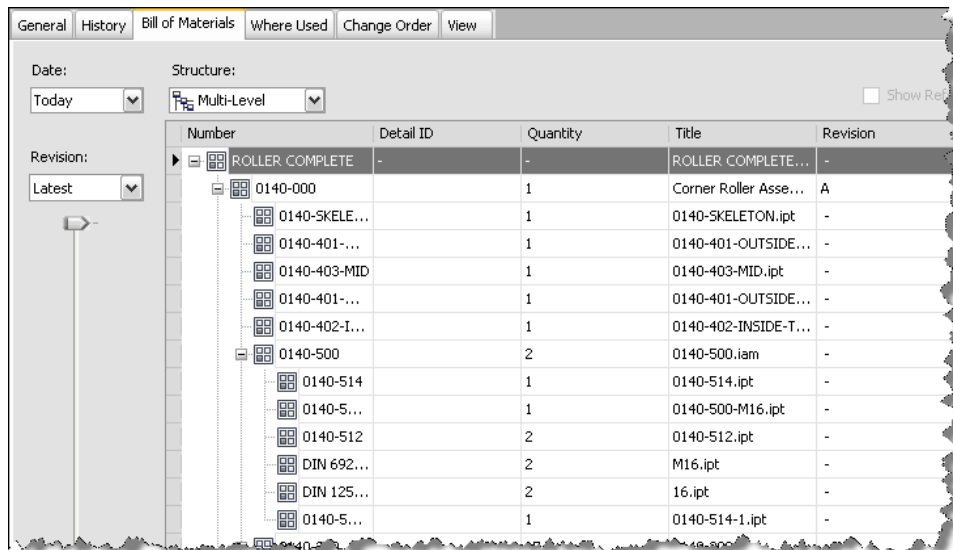
From the ACM help... *“Mechanical Structure offers all the advantages of both Blocks and Layer Groups and more. Since mechanical structure is designed for the explicit purpose of organizing a drawing. The features go beyond visibility enhancements (offered by layer groups), reuse of geometry, and automatic BOM updates (offered by blocks).”*



AutoCAD Mechanical, Vault Professional, and Beyond

Vault Items

Autodesk Vault Professional provides the Item Master. Items representing the parts and assemblies you manage, manufacture, assemble, purchase, and sell. An item will contain the bill of material *recipe* to produce that item.



Number	Detail ID	Quantity	Title	Revision
ROLLER COMPLETE	-	-	ROLLER COMPLETE...	-
0140-000	-	1	Corner Roller Asse...	A
0140-SKELE...	-	1	0140-SKELETON.ipt	-
0140-401-...	-	1	0140-401-OUTSIDE...	-
0140-403-MID	-	1	0140-403-MID.ipt	-
0140-401-...	-	1	0140-401-OUTSIDE...	-
0140-402-I...	-	1	0140-402-INSIDE-T...	-
0140-500	-	2	0140-500.iam	-
0140-514	-	1	0140-514.ipt	-
0140-5...	-	1	0140-500-M16.ipt	-
0140-512	-	2	0140-512.ipt	-
DIN 692...	-	2	M16.ipt	-
DIN 125...	-	2	16.ipt	-
0140-5...	-	1	0140-514-1.ipt	-

Figure 11: Item BOM

Although AutoCAD drawings can be linked to an item, it cannot generate a BOM. However, an AutoCAD Mechanical drawing containing Part References or Structure Components will generate an Item BOM.

An important step is mapping your Vault properties to the corresponding AutoCAD Mechanical component properties. This way as you assign items, Vault extracts the metadata from the ACM BOM, populating the items.

As Vault Items participate in lifecycle, not only can you revision manage your drawings but also the items and their associated BOMs. The lifecycle state of an item tracks the state of the item through the manufacturing process. This shows the state from the item creation (inception) to when the item is no longer required (retirement)

The Vault Item Master provides the medium for sharing BOM information with other people, departments, and other systems including ERP and PLM.

Item BOM Management

Not all components listed in the BOM have to originate in the attached file. Use the **Add New Row** button to add an existing item to the BOM.

The proper quantities of the items are generated automatically using the same units and quantities from the CAD file. There are times where it may be desired to override this at the item level. For example you may want to increase the amount of bolts or fasteners shown on the BOM to compensate for loss when the unit is shipped.

Each revision of an item has an unique BOM as changes to the attached file can impact the BOM structure, the components contained within the assembly and the quantities. Vault provides a comparison tool to compare one revision of the BOM against the other, highlighting any differences.

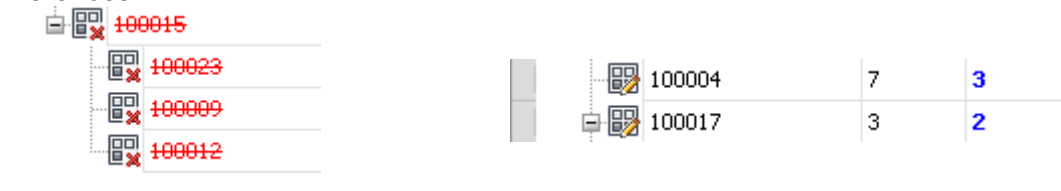


Figure 12: Differences are highlighted

Out-of-the-box you can export an item or a selection of items to various formats (typically Microsoft Excel) which can then be shared with others or other applications. The BOM can be exported in one of two ways: (a) a tree hierarchal view showing each sub-assembly and their components and (b) a flat layout with re-used items rolled up into a single row showing the total quantity (i.e. cut list).

Number	Detail ID	Quantity	Title	Revision	Lifecycle State
Final Mold Assy	-	-	Final Mold Assy.iam	B	Work In Progress
100004	7	3	Grip handle.ipt	-	Released
100017	3	2	Bottomplate2 assy1.iam	-	Released
100019	1	1	topplate2 Assy.iam	-	Released
100013	4	1	bottomplate.ipt	-	Released
100014	5	1	topplate Assy.iam	-	Released
100005	6	2	Sideplate.ipt	-	Released
100007	8	4	Heavy Hex Bolt - UNC (Regular Thread - Inch) 5/8-11 UNC - 2.5	-	Released
100011		1	bottomplate2.ipt	-	Released
100010		1	Cavity.ipt	-	Released
100008		4	Bush bottomplate2.ipt	-	Released
100020		1	topplate2.ipt	-	Released
100022		1	topplate.ipt	-	Released
100021		1	top plate washer.ipt	-	Released
100016		1	plunger.ipt	-	Released
100018		2	Pin1-P1.ipt	-	Released

Figure 13: Export shown in Microsoft Excel

To expand on this functionality you can look to partner products:

- We use a product called CADLink (from QBuild) which pushes Vault Items into our ERP, creating or updating the ERP parts, and populating the BOM in ERP. Our planners then utilize the BOM to create the method of manufacturing, adding the required operations.
- Another example is using CoolOrange's powerPLM to link the Vault Item Master to Fusion Manage, providing an associative link with PLM.

