

CP500007

Getting Started with Model States

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Learning Objectives

- Understand the uses for model states in your Inventor designs.
- Create model states in part and assembly designs.
- Use substitute model states to simplify assembly designs.
- Use model states in drawing and presentation files.

Description

The new Model States functionality introduced in Inventor 2022 software has many uses within your Inventor design files. It was introduced as a replacement for the pre-2022 Level of Detail assembly functionality, and also provides an alternative to the iPart and iAssembly functionality. This class will begin by discussing the uses of Model States, from their role in creating component design configurations to improving retrieval times and performance when working with a large assembly. You will also learn how to create Model States in both part and assembly files, and then how to maximize these files in your drawings and presentation files to document their design.

Speaker(s)

For the past 25 years, Jennifer has been teaching and developing CAD training material for both a synchronous and asynchronous learning environment. She is currently working with the Rand Worldwide company, ASCENT - Center for Technical Knowledge, where she develops and manages the training curriculum used by Autodesk Authorized Training Centers. She also has her Autodesk Certified Instructor (ACI) certification. Jennifer MacMillan holds a mechanical engineering degree from Dalhousie University, Nova Scotia, Canada.



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Introduction to Model States

Model states were introduced in Inventor 2022 and enable you to save configured states of components (parts and assemblies). They can be incorporated into your designs for many uses, including helping to optimize assembly performance, reducing the clutter of large numbers of components, or in the case of part design, creating a model state for manufacturing or FEA analysis.

Model states have multiple uses within part and assembly files. Uses can include creating manufacturing stages, simplifying the display of an assembly for design work, or creating configurations of components in a design to represent various products. Model states can also be valuable when working with a large assembly to improve retrieval times and performance, or they can be used as a starting reference for model simplification. The model states shown in Figure 1 are examples of model states for part (top) and assembly (bottom) files.

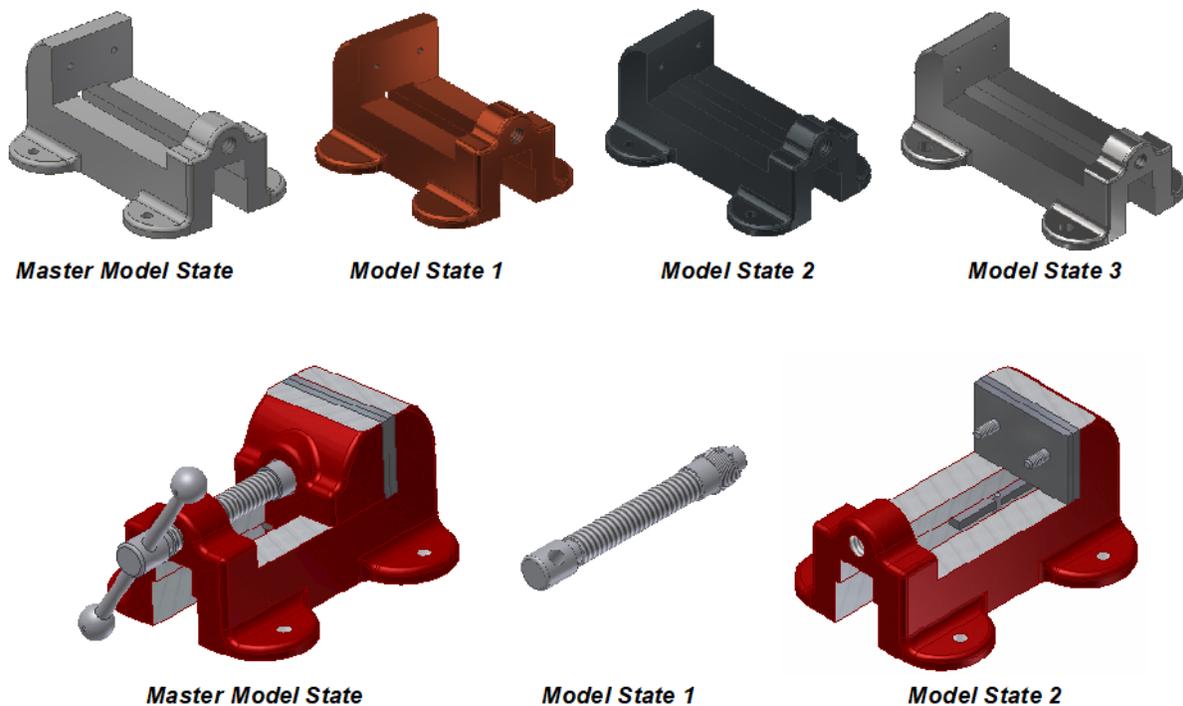


Figure 1

Creating Model States

The process to create model states in parts and assemblies is similar. The following steps describe the process:

How to Create a Model State

1. In the Model browser, right-click on the **Model States** node and select **New**. Alternatively, you can right-click on the model state you want to copy and select **Copy**. The model states, as shown in Figure 2 for a part and assembly, were created as a copy of the active Master model state and are immediately activated once created.

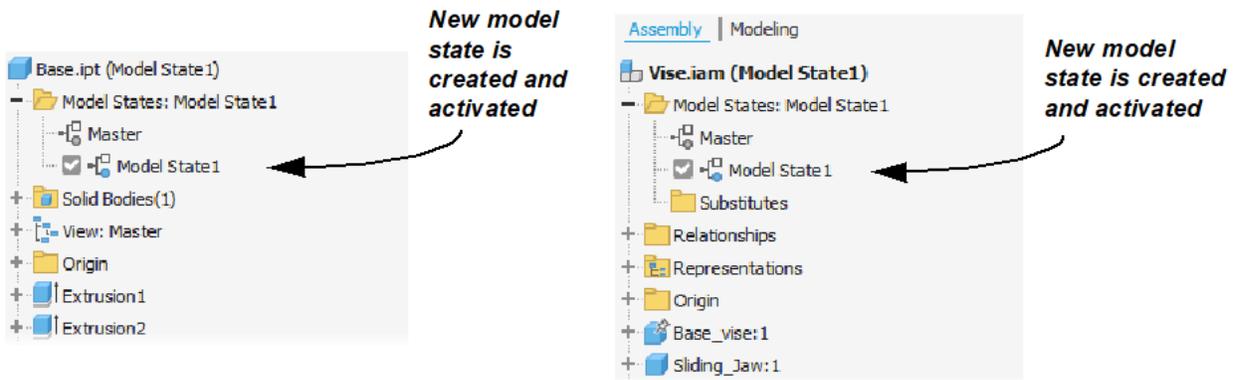


Figure 2

- Verify the edit scope setting is appropriate for the model state customization that you will be doing. This setting determines if the change will affect only the active model state or all model states. By default, the edit scope is set for the current model state only and the  (blue pencil) icon appears adjacent to its name.
 - By enabling the scope  to affect all model states (as shown for an assembly in Figure 3), you can ensure the change is made to all model states. When enabled, the  (blue pencil) icon appears adjacent to all model state names, indicating they will all be edited.
 - Scope editing functions the same in both parts and assemblies.

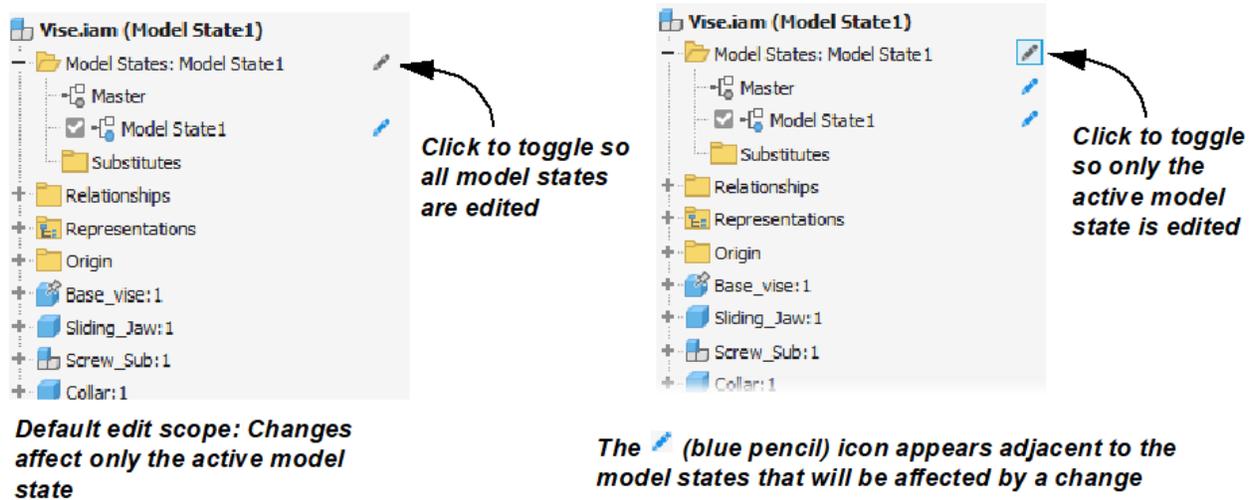


Figure 3

The Delete operation is global and affects all model states regardless of the edit scope setting. To delete a feature or component from a model state, you must activate it and set it as suppressed.

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3. With the new model state active, modify the configurable attributes for the part and assembly as follows to customize the model state. Once modified, each configurable attribute is assigned a column in the file's internal model state spreadsheet.
 - Suppress/unsuppress part or assembly features in the model state.
 - Suppress/unsuppress components in the model state. Note: The bill of materials will list suppressed assembly components as a QTY 0.
 - Modify the iProperties, as required, for the active model state. In the Model browser, right-click the model state name or the model name and select iProperties.
 - Materials can be assigned to model states at the part level. To incorporate a specific part in the top-level assembly model state, the required part-level model state can be enabled as required.
 - Modify parameters, as required, for the active model state. This can be done in the Parameters dialog box () or by showing dimensions in the graphics window and modifying them.
 - In the Model browser, modify constraint offset values, as required, for the active model state.
4. Rename the model state using a descriptive name by clicking it twice (not double-clicking) in the Model browser and entering the new name.
5. (Optional) Once you have created one model state, you can use standard spreadsheet functionality to create additional model states or add customizable attributes. To open the spreadsheet, right-click on the **Model States** node in the Model browser and select **Edit via Spreadsheet**. Edit as required, save, and close. The model states update to reflect any new model states or edits to existing model states.
6. Save the file to save the new model state.

You can make changes to the model states once created. To do this, ensure the required model state is active, verify the edit scope setting is as required for the change, and manipulate them as needed. Once edits are done, ensure the file is saved.

Model States in Subassemblies

Subassembly model states can be enabled within model states in the top-level assembly. In these situations, the model state must already exist in the subassembly. You cannot create, edit, or delete subassembly model states within the context of a top-level assembly (in place edit). To do this, you must explicitly open the subassembly in its own window to create/edit. For example, the Screw_Sub subassembly shown in Figure 4 is active in the context of the assembly. The right-click model states menu does not allow you to create a new model state.

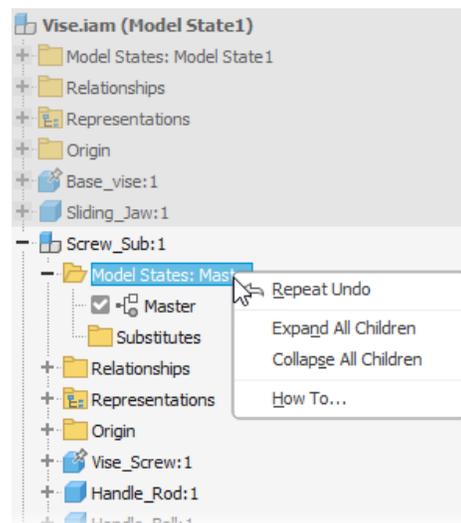


Figure 4

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Model States vs. iParts/iAssemblies

The model state functionality was introduced in Inventor 2022. It is a replacement for the pre-2022 level of detail assembly functionality, and additionally provides an alternative to the iPart and iAssembly functionality (still available in Inventor 2022). With the introduction of model states, the model state functionality and the iPart/iAssembly functionality become mutually exclusive. The model state functionality is enabled by default in all new parts and assemblies. If you are using previously created files, consider the following:

- If the file does not contain pre-existing iParts or iAssemblies, the model state functionality is enabled. Any level of detail representations that existed (assemblies only) are converted to model states in Inventor 2022.
- If the assembly contains pre-existing iParts or iAssemblies, the model state functionality is not enabled. Any level of detail representations that existed (assemblies only) are converted to design view representations in Inventor 2022.

The process of converting an iPart or iAssembly table that exists in a pre-2022 assembly to model states is manual. You can either delete the table and recreate the configurations using model states or you can use spreadsheets, as follows:

1. Open the file, right-click on the **Table** node in the Model browser, and select **Edit via Spreadsheet**.
2. With the spreadsheet open, copy the data or save the file to a temporary location.
3. Delete the iPart/iAssembly table. A Model States node appears in the Model browser, indicating that it is active.
4. Create a new model state in the file.
5. Right-click on the **Model States** node and select **Edit via Spreadsheet**.
6. Copy the data from the iPart/iAssembly table into the model states table to provide a starting point for your model states table.

Note that the syntax is not the same in the two tables. For example, model states tables use Compute and Suppress for feature/component inclusion and iAs-sembly tables use Include and Exclude. Edits will be required for the model states table to be recognized and generate the required configurations.

Consider the following:

- Unlike iParts and iAssemblies, model states are all saved and managed in the one part or assembly file.
- To return to iAssembly functionality, only a Master model state can exist in the file. To switch, on the Manage tab, click  (Create iAssembly) and create an iAssembly member. Once complete, the Model States node is removed from the Model browser and is replaced with an iAssembly table.

Model States and Autodesk Vault

Model states offer capabilities similar to those found in iParts/iAssemblies; however, all configurations are stored in a single file instead of multiple files. Additional Vault integration functionality is available for model states if your Vault Professional implementation includes items. If your Vault implementation does not include items, any file that contains model states will display the master model's properties (e.g., iProperties, parameters, etc.). If you require separate files that can be managed and released, consider using iParts and iAssemblies. For more information, see "Working with Model States and Vault Files" in the Vault Help documentation.

Substitute Model States

A substitute model state enables you to swap out a complex component for a simpler one that represents it. The substitute still contains all of the BOM information that is normally associated with the assembly, as well as the physical information (such as center of gravity and mass). Using substitute parts reduces the amount of components loaded into memory, as well as the number of constraints and adaptive relationships that must be recalculated when changes are made. By simplifying the model, the intention of a substitute model state is to reduce the computing resources and thereby increase performance without sacrificing access to BOM information.

The model on the left in Figure 5 shows the Master model state for an assembly. A substitute model state for the fan and its electronic components is shown on the right. In this example, the substitute part was simplified using a simple cylindrical-shaped part; however, substitutes can also generate a part file with surfaces or merged solid bodies to help make the substitute model state simpler to help improve performance.

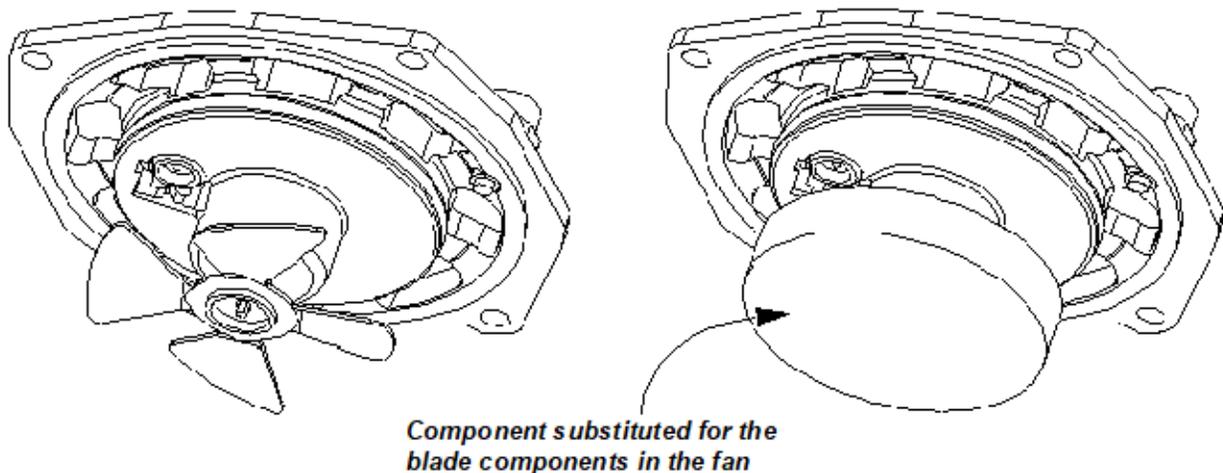


Figure 5

Create a Substitute Model State

1. Open the subassembly that is to be simplified. This assembly is called the Owning Assembly.
2. (Optional) Create a reduced-part model state for the subassembly. In this model state, suppress any subassembly components that can be removed to help further simplify the assembly. This is not a requirement.

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3. In the Model browser, right-click on a model state node and expand **New Substitute**. Select one of the options shown in Figure 6.

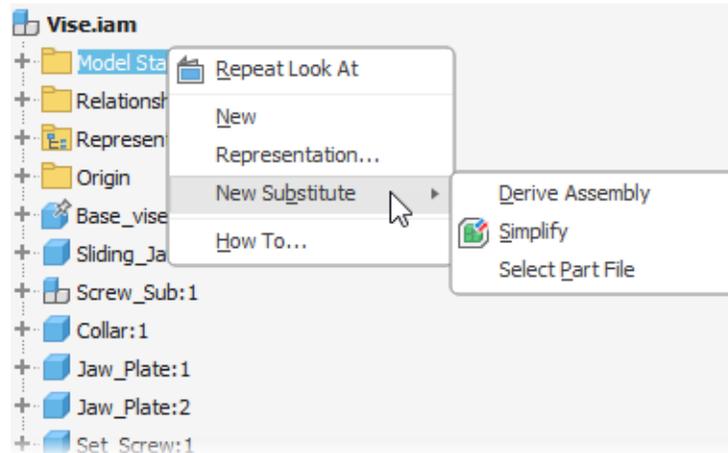


Figure 6

- The **Derive Assembly** option simplifies the assembly using the Derived Component functionality. A new part file is created that is then substituted for the assembly in the model state. The derived part is created in the same way as one that uses the Derive tool. You define its name, template, and location, and then use the Derived Assembly dialog box to control which components are included in the new part file. The new substitute model state is created using the new derived part file.
 - The **Simplify** command creates a simplified substitute part that represents the active assembly and uses that part in a substitute model state. The simplified substitute part is created in the same way as one that uses the Simplify tool. The new simplified substitute part is automatically created, and a substitute model state is created that uses it.
 - The **Select Part File** option substitutes a single part file for the assembly. Selecting **Select Part File** substitutes a selected file for the assembly in the substitute model state. The part file can be a previously simplified assembly, simplified model, or another part file. After you select this option, you are prompted to select a component. The substitute model state is created using the selected part file.
4. In the main assembly, create a new model state and activate the substitute model state in any subassemblies, as required.

*Tip #1: You can also create a simplified substitute model (with a substitute model state) by clicking **Simplify** in the Assemble tab> Simplification panel and setting the **Substitute** type in the Properties panel.*

Tip #2: Individual parts cannot be simplified. To create a simplified part of a specific subassembly inside the top-level assembly, you must first open the subassembly explicitly (it cannot be edited and created in place) and create a substitute model state in that assembly. After saving and returning to the master subassembly, the lower-level model state is available for selection in the higher level's Model States folder.

Using Model States in Drawings and Presentations

Drawing Views

Any model state can be selected for use while creating base drawing views. When modifying the parent view, you can also change the model state that is active by editing the view. When creating a base view, select the required model state name from the drop-down list, as shown in Figure 7. To change the model state that is used in a base view, right-click on the view, select Edit View, and select a new model state name. All views that reference it will also update. Hint: If you want an isometric drawing view to have a different model state than a 2D base view, create the isometric view as a new base view and orient it as needed.

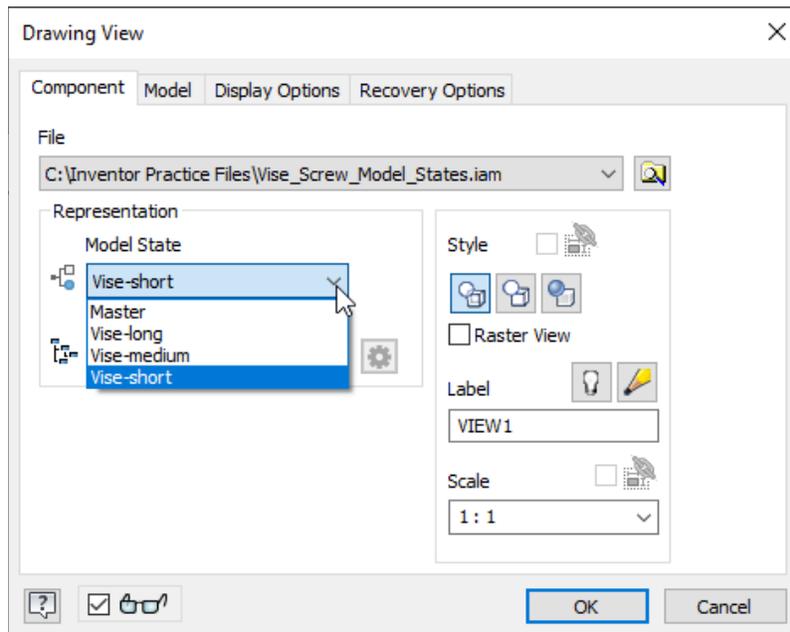


Figure 7

Assembly Parts Lists

Drawing parts list tables must be associated with a view when created. If the view has been set to represent a model state, the parts list will reflect this. If components are suppressed in the model state, their QTY value will report appropriately. If a component does not exist in a model state, it will still show the component as an item and will have QTY 0.

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Figure 8 shows a drawing sheet with two different model states documented. The 2D views show the parts list with one Vise assembly. The isometric view's parts list shows all 4 vise components are included.

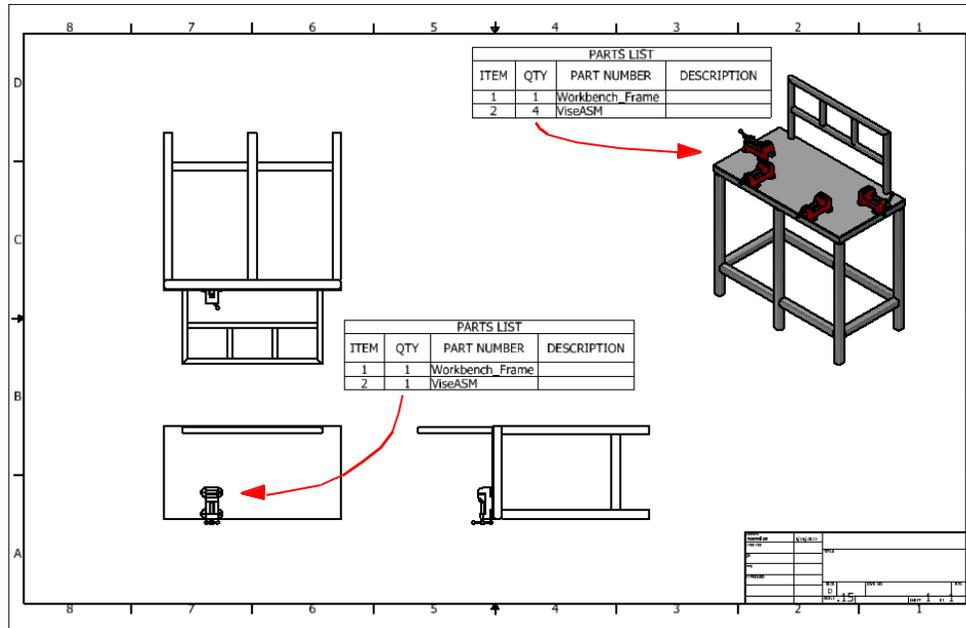


Figure 8

General Tables

A general table can be used to show all of the model state details for a drawing model's configurations. To create this table, complete the following steps:

1. Click  (General Table) on the Annotate tab to open the Table dialog box.
2. Select the drawing view that will be the source for the table. The view can be the master or a model state configuration of the assembly.
3. In the Columns and Rows area, select  (Column Chooser).
4. In the Table Column Chooser dialog box, select the columns that you would like to include in the table from the Available Columns list and move them to the Selected Columns list using the **Add** option. The list will include all of the configurable items that were modified in the model states (e.g., dimensions, parameters, components, etc.).
5. Click **OK** twice to create the table and add it to the drawing.
6. (Optional) To customize the column names, double-click on the table to edit it, right-click on the column name, and select **Format Column**. In the Format Column dialog box, you can disable the **Name From Data Source** option and enter a custom name for the column.

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Figure 9 shows the columns that were added to the general table for a part and the resulting drawing table that was created. In the table, the column headers were customized to have descriptive names using the procedure described in Step 6 above.

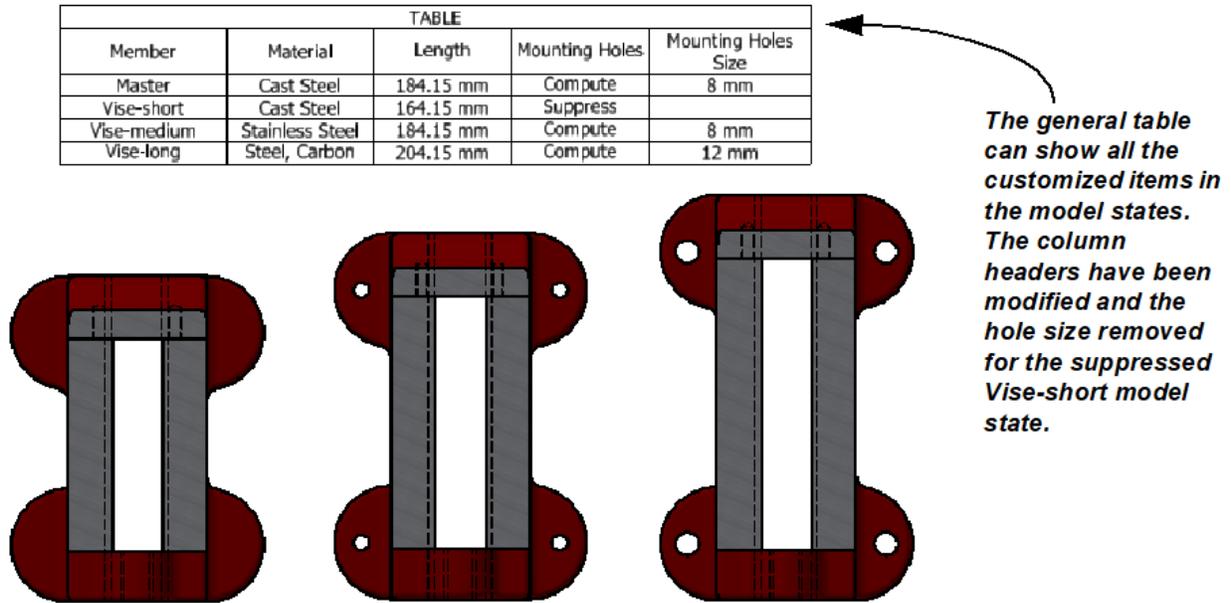


Figure 9

Consider the following when working in a drawing with model states:

- If a design change is made to a model state that is used in a drawing view, it will update to reflect the change when next opened. Any associated parts lists or general tables will also update.
- The model state assigned to a view can be switched by editing the view and selecting an alternate in the Model State drop-down list.
- A view can be modified to replace its reference model (and its model state) using the  (Replace Model Reference) option on the *Manage* tab. In the Replace Model Reference dialog box, select the file that is being replaced, select , select a new file, and click **Options**. In the File Open Options dialog box, select the required model state. Once the file is replaced, the view and associated parts lists will update.
- If a substitute component is used in the model state to represent an assembly, it is still identified as a single item to provide an accurate BOM and parts list.

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Using Model States in Presentations

A model state can be selected for use while creating scenes in a presentation file using either of the following methods:

- With the model state active in the assembly, right-click on the assembly name in the Model browser and select **Create Presentation**, as shown in Figure 10. In the Presentation Template dialog box, select the required presentation template file and click **OK**. A presentation scene of the selected model state is immediately created.

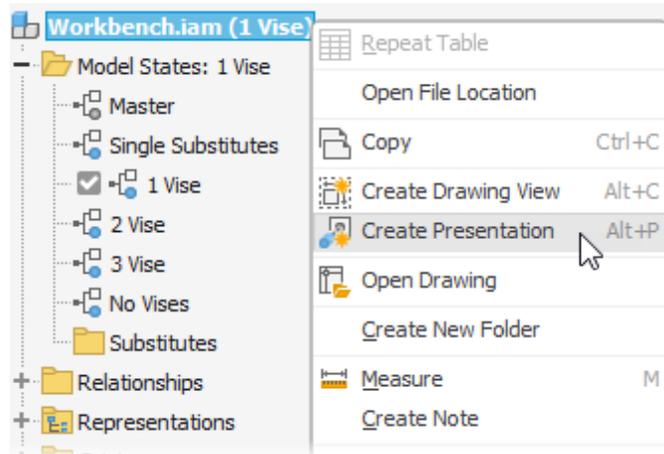


Figure 10

- Using the **New** option to create a presentation file, you can select the template and when prompted to select the assembly, select the assembly name and click **Options** at the bottom of the Insert dialog box. In the File Open Options dialog box, select the required model state for use in the presentation scene, as shown in Figure 11.

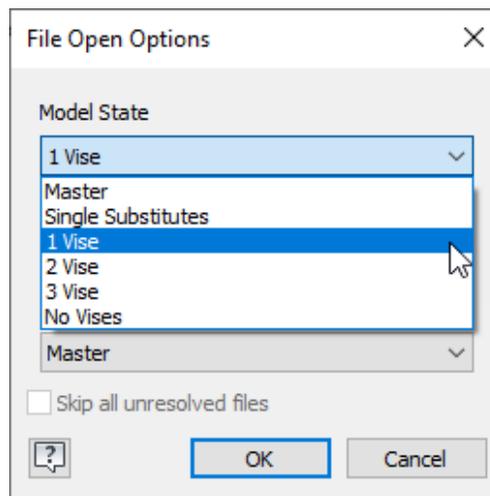


Figure 11

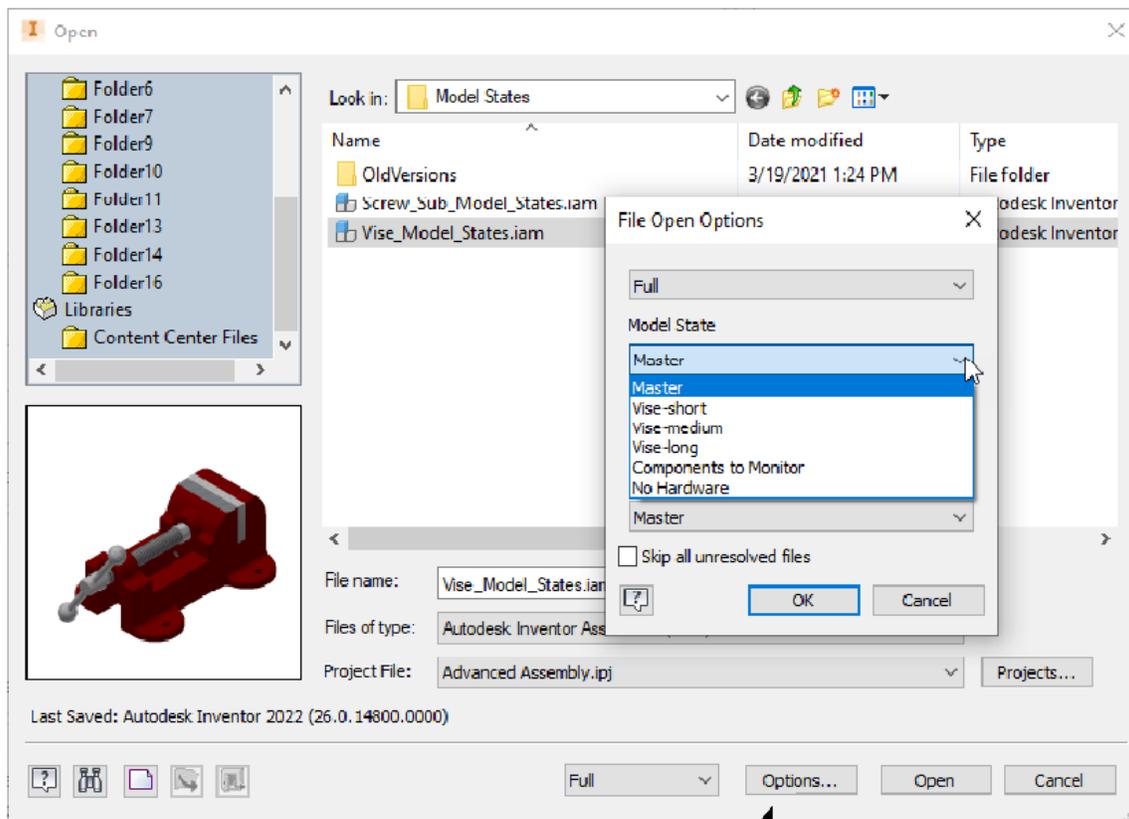
- When creating new scenes in a presentation, use **Options** at the bottom of the Insert dialog box to access the File Open Options dialog box to select a different model state.

Opening Files Using Model States (Bonus Objective)

Opening Files

Part and assembly files can be opened with a specific model state is active. You can control the model state that is placed in an assembly. In all cases, when the Open or Place Component dialog box appears, you should use **Options** to ensure the required model state is selected.

1. In the Open or Place Component dialog box, select the file name and click **Options**. The File Open Options dialog box opens.
2. Select the required model state from the Model State drop-down list, as shown for an assembly in Figure 12.



In the Open dialog box, click Options to access the drop-down list to open a specific model state

Figure 12

3. Click **OK** in the File Open Options dialog box.
4. Click **Open** in the Open or Place Component dialog box. The file opens with the selected model state active or it is placed in the top-level assembly.

This process can also be used when placing parts or subassemblies that have model states into a top-level assembly.

Setting the Default Model State for Opening

By default, parts and assemblies are set to open the model state that was active when the file was last saved. Maintaining this setting helps reduce the chance that you might open the master model state in error. You control this setting in the Application Options.

1. In the Application Options dialog box, select the *File* tab and click **File Open**.
2. Select the required option in the Model State drop-down list.
 - Maintain the default **Last Active** option to always open files based on the model state that was active the last time they were saved.
 - Select **Master** to always open the Master model state of the file.

When using model states to improve large assembly performance, retrieval times are improved by directly opening model states. When opened, none of the suppressed components are retrieved and loaded into memory. In the case of large assemblies, this can significantly improve retrieval times. If components are unsuppressed or another model state is activated, any required components are loaded at that time.

Linking Model States (Bonus Objective)

The Link Model States option () automatically activates any subassembly model states that have the same name as the one selected in the Link Model States dialog box. This tool makes activating model states at multiple levels in an assembly much faster, since you do not need to manually activate model states at multiple levels. The command is shown in Figure 13.

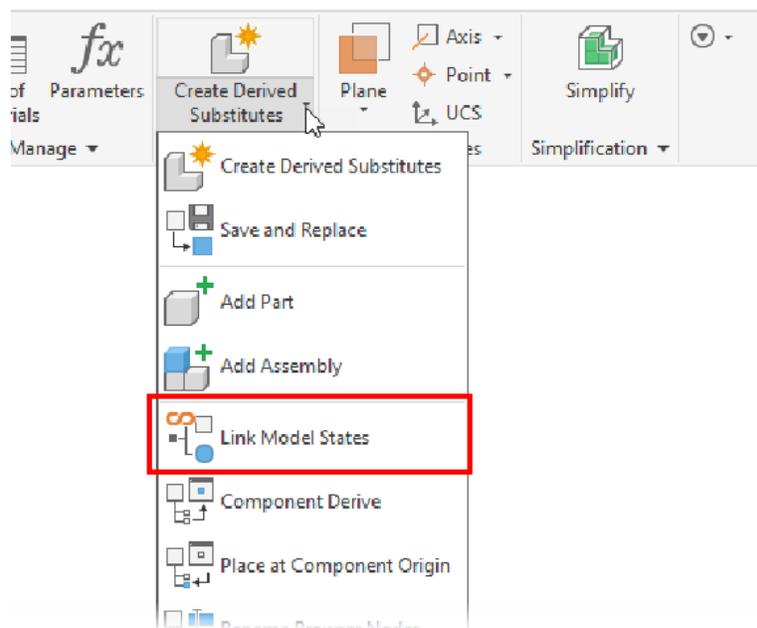


Figure 13

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If the **Create Derived Substitutes** option was used to create a substitute model state in the top-level assembly (and subassemblies), you do not need to explicitly link the model states. This is done automatically in the Create Derived Substitutes command.

You should consider adding model states to your assembly templates to capture any company-specific model states that are consistently used in your designs. Using model states in the template can help reduce the time spent creating them and ensure consistent naming conventions for use with the Link Model States command.
