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Getting the Most from Autodesk Inventor® Professional's Tube and Pipe Application

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MA34-2   This class is not just an overview of the Tube and Pipe (and Flexible Hose) application in Autodesk Inventor Professional. You'll see good, better, and best practices for creating and editing routes, and tips and tricks for authoring and publishing custom content to your fitting and component libraries. See how the new global BOM, positional representations, and other Autodesk Inventor tools integrate with the Tube and Pipe application.

About the Speaker:

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Overview of Tubing and Piping

Pipe, tube, and flexible hose runs are common subsystems on a variety of machinery. You can use the tube and pipe application to create pipe, tube, and hose routes between assembly components. Pipe, tube, or hose segments and fittings based on a selected style are automatically placed along the route to create a run. You can add fittings and components to your routes from the Tube and Pipe libraries in the Content Center. You can also create custom conduits and fittings, and publish them to the Content Center. As your design changes, the runs automatically update to match changes in the positions of related assembly components.

The tube and pipe application is designed to create pipe, tube, and hose runs for industrial machinery. It is not intended to be a process piping application. Typical uses include the routing fluids and gases through machine assemblies by using rigid tube, pipe, or flexible hose segments.
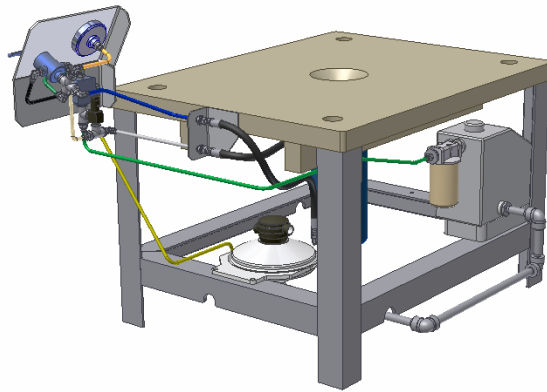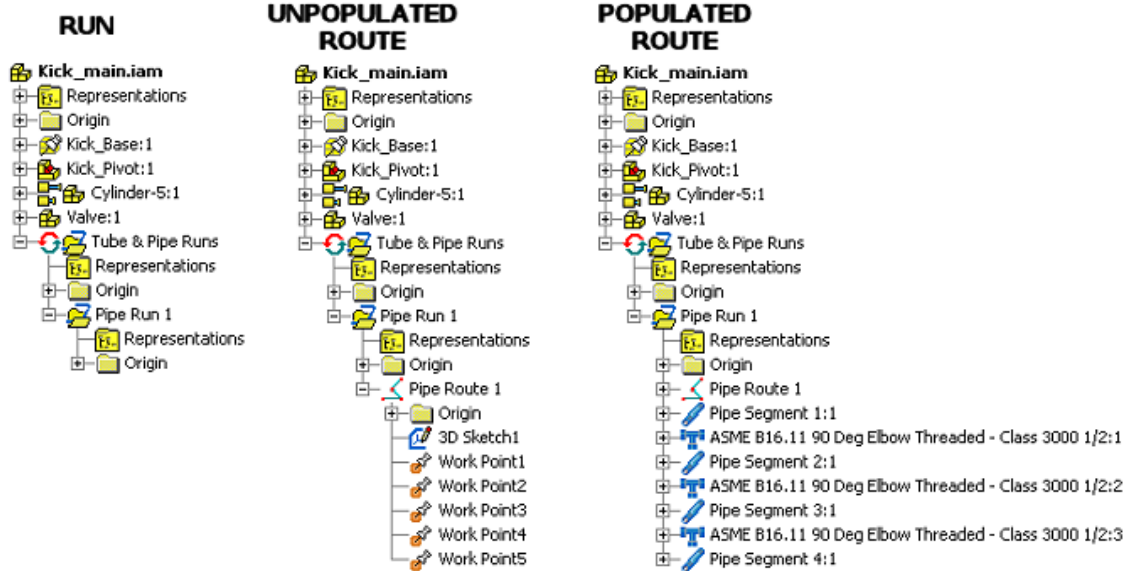

Tube and Pipe Environment

In planning for assemblies that contain pipe, tubing, or flexible hose runs, consider the following:

- All runs are contained in a Tube & Pipe Runs subassembly below the active assembly document. This means that if you want to place runs that are completely contained within, and are considered as a part of a subassembly, you must open the subassembly in a separate window (edit in-place will not work). In addition, prior to any edits of runs in the subassembly you must open the subassembly in its own window.

- Currently, there is no provision to copy or reuse existing runs, either within the same Tube & Pipe Runs subassembly or between different Autodesk Inventor assemblies.

The Tube & Pipe Runs subassembly is a first-level child of the top-level assembly that contains all of the runs between components in the assembly. Each run that you create is a separate subassembly in the Tube & Pipe Runs subassembly. Each run can contain one or more routes.

- Each route is a path in the assembly that is populated with conduit segments and fittings defined in the active pipe style.
- You can assign a different pipe style to each route.
- A single run can include routes with the same pipe segment style but different diameters.
- You can also combine pipe, tube, and flexible hose routes in the same run.
- To modify the route or the fittings in a run, you edit the run in place.

RUN

```
Kick_main.iam
  Representations
  Origin
  Kick_Base:1
  Kick_Pivot:1
  Cylinder-5:1
  Valve:1
  Tube & Pipe Runs
    Representations
    Origin
    Pipe Run 1
      Representations
      Origin
```

UNPOPULATED ROUTE

```
Kick_main.iam
  Representations
  Origin
  Kick_Base:1
  Kick_Pivot:1
  Cylinder-5:1
  Valve:1
  Tube & Pipe Runs
    Representations
    Origin
    Pipe Run 1
      Representations
      Origin
      Pipe Route 1
        Origin
        3D Sketch1
        Work Point1
        Work Point2
        Work Point3
        Work Point4
        Work Point5
```

POPULATED ROUTE

```
Kick_main.iam
  Representations
  Origin
  Kick_Base:1
  Kick_Pivot:1
  Cylinder-5:1
  Valve:1
  Tube & Pipe Runs
    Representations
    Origin
    Pipe Run 1
      Representations
      Origin
      Pipe Route 1
      Pipe Segment 1:1
      ASME B16.11 90 Deg Elbow Threaded - Class 3000 1/2:1
      Pipe Segment 2:1
      ASME B16.11 90 Deg Elbow Threaded - Class 3000 1/2:2
      Pipe Segment 3:1
      ASME B16.11 90 Deg Elbow Threaded - Class 3000 1/2:3
      Pipe Segment 4:1
```
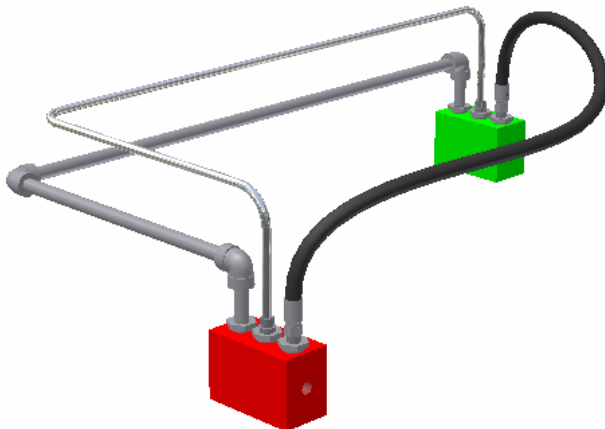
Styles

Styles determine the properties of rigid pipe, tube, and hose paths and components, such as the size and material of the pipe, tube, or hose segments and the specifications for the default fittings.

- Tube styles include a default coupling.
- Rigid pipe styles include a coupling and elbows.
- Hose styles specify start and end fittings.

The style defines a set of segment length rules that are maintained during route creation and editing. Minimum and maximum segment lengths ensure that the run can be constructed with available materials, and an increment length enables engagement between segments and fittings while maintaining measurable segment lengths. Autodesk Inventor Professional software includes default styles for common ANSI, ISO, DIN, and JIS tube and pipe standards, and flexible hose styles based on standard Parker hoses and fittings.
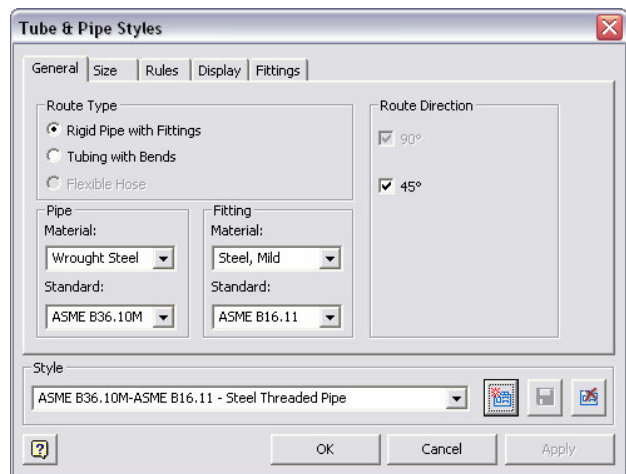
If the included styles do include the conduits or fittings used in your company, you will need to create iPart factories for the conduit (pipe, tube, or hose) and any fittings not available from the Content Center. After creating the iPart factory, you publish the factory to a custom Content Center library.

These published components will form the basis for all your runs, so take your time.

> **Note**: You must create a new style for each nominal diameter of a conduit part. Create one version of the style, and then create new styles based on the first, and edit the diameter. The styles conduit and fittings will automatically adjust for the newly selected nominal diameter.

Authoring and Publishing Tips:

- You can edit many of the parameters and properties of the components included in the Content Center libraries by first copying the family (the specific fitting or conduit) to a custom user library. The models used to publish to the Content Center libraries are not accessible. If the fitting is dimensionally correct, you can change part numbers, materials, and add custom columns for BOM extraction.

- Before you create and publish new fittings or conduit iParts, review your BOM requirements. Try to add all required property fields before publishing the iPart factory to the Content Center.

- If you are not familiar with creating iParts, learn everything you can before creating your custom content. A number of good tutorials are available at www.sdotson.com. Plenty of discussion and tips can be found on the Autodesk Inventor news group http://discussion.autodesk.com/index2.jspa?categoryID=21

- Creating and publishing conduit and fittings, and creating new styles using custom content is described in three Skill Builder tutorials on the Autodesk web site.

    www.autodesk.com/us/inventorprofessional/pdf/skill_builder-tp_publish_iParts_R10_part1.pdf

    www.autodesk.com/us/inventorprofessional/pdf/skill_builder-tp_publish_iParts_R10_part2.pdf

    www.autodesk.com/us/inventorprofessional/pdf/skill_builder-tp_publish_iParts_R10_part3.pdf

- Note the following in the above tutorials:

  o In Part1, the key column is referred to as Nominal Size (NS). The AIP help files use Nominal Diameter (ND). The name of the column is not critical, but be consistent to avoid confusion (I'd recommend using ND).

  o The SN iPart column name is for Schedule Number. This column is required for all conduit parts but requires different treatment for different conduit types (pipe or tube, or hose)

    - For rigid pipe and tube, the nominal size reflects the OD of the conduit. The SN affects the ID of the pipe. For custom wall thicknesses you can replace a SN with the ID of the conduit using ID=(custom value)

- Flexible hose does not use a schedule number. The nominal diameter of a hose is the ID. Although the one supplied hose (Parker) has the ID mapped to the SN column, mapping the OD column will enable consistent display of both ID and OD when selecting nominal hose sizes.


o **Part1, Step 8**: This step seems to indicate that you need to add a second column named Material. This is not the case. When you add the Material property in the step outlined in the first bullet point, a new column is added. The value in the column is set to the active material in the document. You must right-click the column header and select Material Column from the context menu to identify the column as the material source for each iPart version.
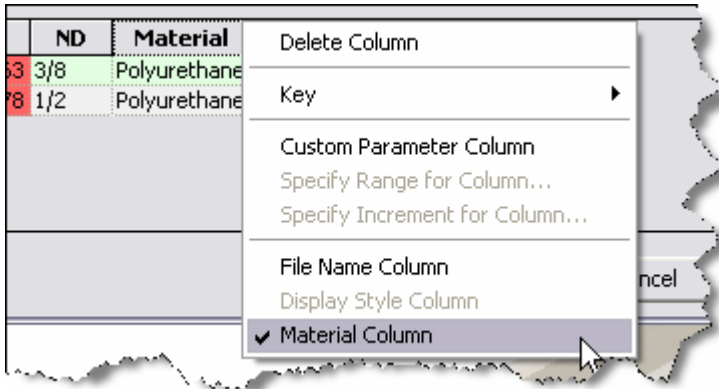

o The nominal diameter (ND) and schedule number (SN) are the only keys actually required in rigid pipe and tubing iPart factory tables. For a hose, ND is the only required key since hoses are not described by a schedule number. The length column (PL) is not a key value. However, all conduit parts in the Content Center libraries include these three columns as keys in the iPart table. Copy this strategy in your custom conduit iPart factories.

- You can create iPart versions that show components in different states. For example, valves in open or closed states. Although iParts factories can suppress and unsuppress features between rows, a more robust method is to build the changeable features with respect to a work plane controlled by an angular value.
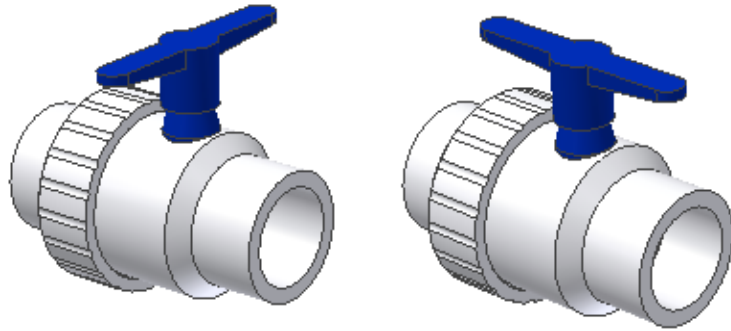
- After publishing your content, you can add additional columns. Create a custom display column (or build one in your iPart table), and map it to the *Member.DisplayName* property. This value will be displayed in the browser.
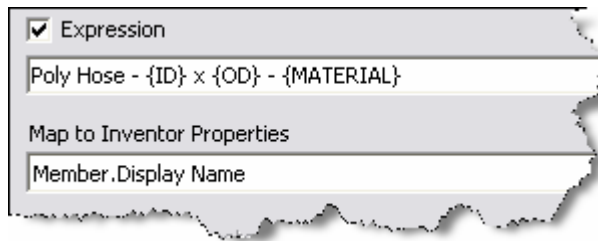
- You can also Author and Publish (or just Publish parts without adding connection information) standard parts to the Content Center. Custom, single size components such as tanks, driers, and even supports and hangers can be published to a common library. Publishing common support components to the Content Center can reduce the time to complete the complete assembly.

  Optionally, you can use the Tube & Pipe Authoring tool to add connection information to a standard Autodesk Inventor part. If you do not publish the part to a Content Center library, you can still place the part in the active run using the Place Fitting tool.

Routes and Runs

The active style defines the characteristics of both the route and run. A route is a defined path in the assembly that, at a minimum, connects the start point and endpoint. You can add intermediate nodes as a combination of user-defined and automatically generated nodes. You can also branch a route.

A run is a subassembly that contains one or more routes, including the segments and fittings placed along the routes. Each route in a run can be associated with a different style. Although it is common for all routes in a run to be the same type (pipe, tube, or hose), you can include routes with any mix of styles. For example, you can define an inlet run that includes a rigid pipe route to a distribution node and flexible hose routes from the distribution node to a number of devices.

Creating a Tube or Pipe Run

- Click the Create Pipe Run tool on the Assembly panel bar. The Tube & Pipe Runs subassembly is generated.

> *Tip*: Don't try to rename the generated subassemblies. You don't have that much hair!

- Before you create the first route, place relevant components such as pumps, tanks, cylinders, manifolds, and control valves in the main assembly, in the Tube & Pipe Runs subassembly, or in the first Pipe Run subassembly.

- Assemble fittings to component connection points. These components can be first-level children of the assembly or they can be located in subassemblies at any level of the assembly hierarchy.

> *Tip*: You can drag and drop standard components into run subassemblies after you create the run. Fittings placed from the Content Center or authored fittings saved as parts outside the Content Center cannot be restructured in the assembly.

- Use the Connect Fittings tool to connect multiple fittings, or fittings to other components prior to starting a route.

- Select a style for the route. Choose a rigid pipe, tubing, or flexible hose style (or create a new style), and specify settings such as pipe diameter and allowable segment length.

- Create a pipe route by manually placing route node points with the 3D Orthogonal Route tool or by allowing automatic routing to place the nodes. For rigid pipe or tube runs you can derive the route from an existing 3D sketch.

> *Note*: You cannot derive routes for flexible hose routes.

> *Tip*: You can derive any 3D sketch, including those created in Autodesk Inventor Series software. If you have a mix of AIS and AIP licenses, an AIS user can detail the tube or pipe route. An AIP user can then derive in the 3D sketch into a route.

> *BIG TIP*: Leave routes unpopulated as long a possible to improve assembly performance. You can place fittings in unpopulated routes to create route branches, and edit route segments and nodes.

- Once you create the route, you can move, add, or delete nodes and segments. You can place fittings such as tees from the Content Center in an unpopulated route to create branch points for additional routes.

> **Note**: Tube and pipe runs consist of standard Autodesk Inventor components that have additional attributes and relationships that are specific to the tube and pipe environment. To preserve the integrity of the run and underlying route, use only piping specific tools to edit the route and run. Using standard Autodesk Inventor tools to edit the components can corrupt these relationships and attributes, resulting in a failed route or run.

Route Types

The active style specifies a route type that can be rigid pipe segments connected by elbows and couplings, rigid tube segments that have bends in place of elbows, or flexible tubing with or without fittings. Pipe and tubing routes are rigid routes. You can define the path for a rigid route by one of the following methods:

- **Select start point and endpoint**. One or more route solutions are generated automatically. You can cycle through a preview of each route and select a solution. Intermediate nodes are automatically placed, based on the rules in the active style. You can edit the route segments and nodes to provide a precise route through the assembly.

- **Use the 3D Orthogonal Route tool**. From a selected start point, you use the 3D Orthogonal Route tool to define nodes along the route until you reach the endpoint. Allowable route direction changes are controlled by the active style.

- **Derive the route from an existing 3D sketch**. You can use any 3D sketch that is not contained in a route. The 3D sketch can reside in the top-level assembly, in another subassembly outside the Tube & Pipe Runs subassembly, or in the Tube & Pipe Runs subassembly but outside of a route. You can derive the route from all or a portion of a 3D sketch, and changes to the 3D sketch update the route.

- **A combination of the above techniques**.

For flexible hose routes:

- If the active style includes end fittings, you specify the start and end nodes, usually connection points on pre-placed fittings. The fitting defined in the style is attached to the cursor and aligns to the direction arrow as you move over valid start points. For hose styles without fittings, selecting a start point is identical to selecting a start point for a rigid route.
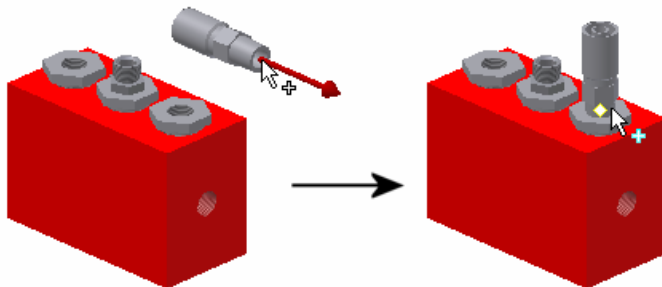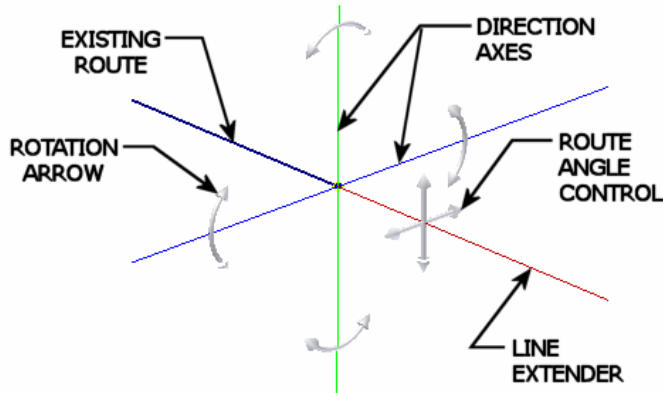
Using the 3D Orthogonal Route Tool

The 3D Orthogonal Route tool assists you in placing node points in a rigid pipe or tube route. The tool has different tools for pipe and tube styles.

Pipe Style Routes

When a the active style has rigid pipe segments, the 3D Orthogonal Route tool consists of a line extender, direction axes, rotation arrows, and a 45-degree angle control if the style includes 45-degree elbows.


Tube Style Routes

When the active style is a rigid tube style, the 3D Orthogonal Route tool replaces the 45-degree angle control with Angle Handles. The Angle Handles control the angle at each tube bend. The bend angle snaps in increments based on the 3D Angle Snap setting of the current document. A set of Radius Handles are also added to the tubing 3D Orthogonal Route tool. Click the Radius Handles to override the default bend radius for the current bend.
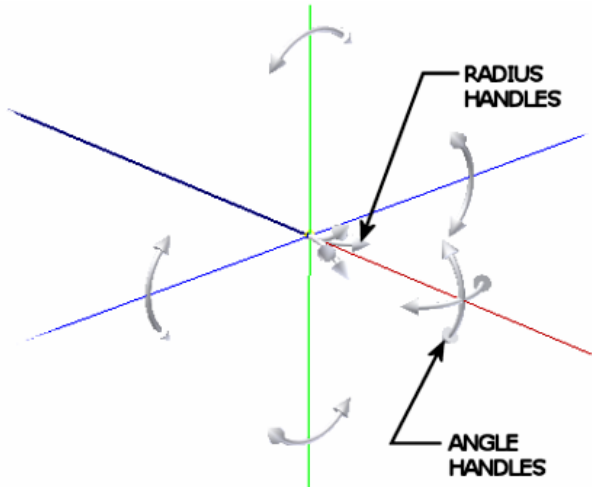
To place nodes using the 3D Orthogonal Route tool, move the cursor over one of the axis, and either click to place a node, or type in a precise distance. The cursor provides feedback as to the validity of the node to be placed.
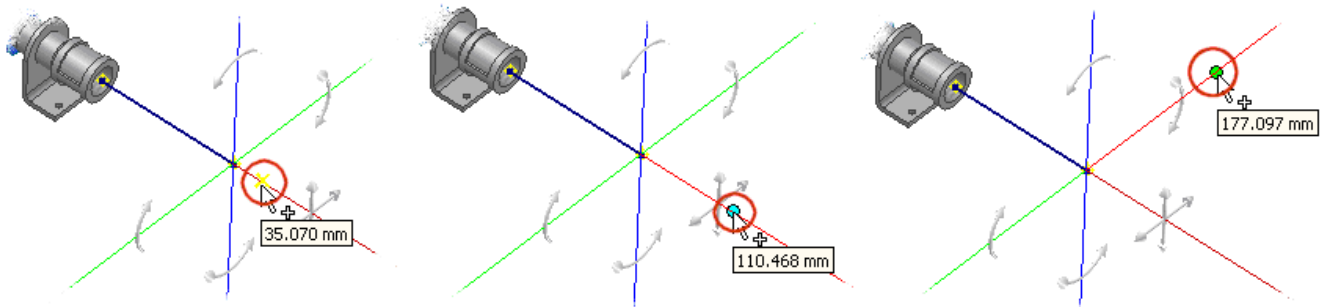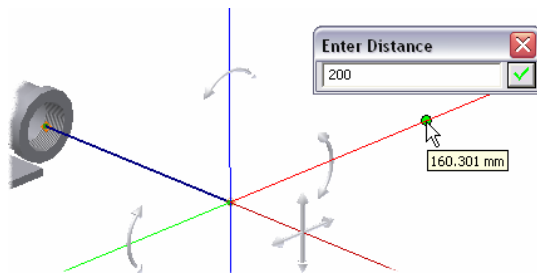
- Yellow X – node violates minimum length rule
- Blue Dot – node valid for coupling at previous node, invalid for elbow
- Green Dot – valid node for coupling or elbow

Tip: Use the + and - keys to enlarge or reduce the size of the 3D Orthogonal Route tool.

Optionally, move the cursor over an axis and type in a precise distance.

Note: In the Enter Distance dialog box, you enter the distance between route node points. For a rigid pipe route, the resulting pipe segment length is less than the node-to-node distance to allow for fittings. Therefore, the minimum acceptable distance between route nodes is greater than the minimum segment length in the current style.

Point Snap

With the Point Snap option on, you can precisely locate points along the tool axes relative to existing geometry. As you move the cursor over a planar part face or work plane, the intersection of the plane and one of the tool axes is previewed as the next route node. Use Point Snap for accurate routing around components in an assembly.

You can also specify a precise offset value along the axis from the intersection point. Both negative and positive offsets are allowed. A positive offset places the node farther along the axis from the previous node. A negative offset places the node closer to the previous node.
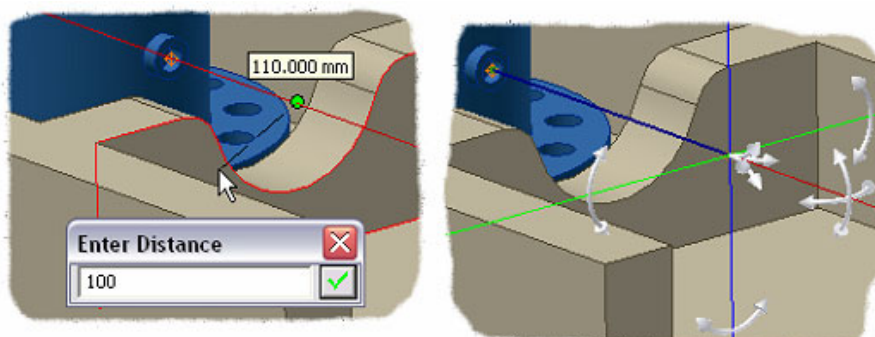
Rotation Snap

You can specify a rotation angle by snapping to existing geometry. When Rotation Snap is on and you dynamically rotate the axes, you can position the cursor over edges, axes, vertices, or work points to align the attached tool axis to a projection of that geometry.
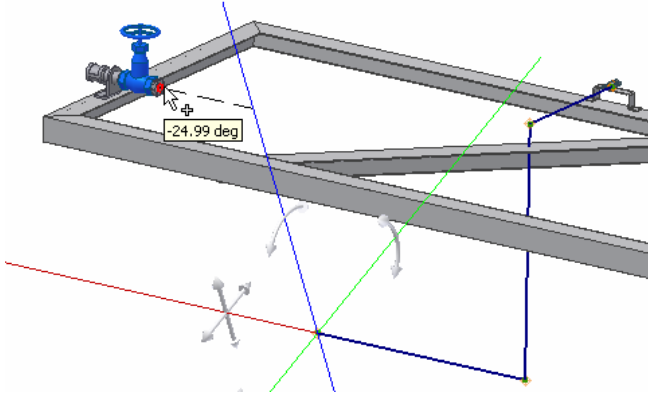
3D Orthogonal Route Tool Tips

- Practice with the point and rotation snap options on. For complex assembly routes, the auto-route solutions are often impractical. With a good understanding of how to work with point and rotation snap you can create precise routes relative to assembly components.

- Routing to the final point in a rigid route can be difficult. A good practice to complete the route is by routing from both ends.

    1. Stop the route two nodes back from the end node.
    2. Continue the route from the end node. Create a segment normal to the end fitting.
    3. Use rotation snap with two (2) tool rotations to align the line extender axis (red) with the other route end point.

- Using Point Snap or Rotation Snap to create route nodes does not create a relationship between the selected geometry and the node. All user-defined nodes created along axes of the 3D Orthogonal Route tool are fixed nodes and are not associative to any geometry in the assembly.

- With Point Snap on, there may be multiple solutions for a route segment when you hover over a face or circular edge (intersection with two axes). To cycle between valid node solutions, right-click and click *Select Other Snap*. You can then use the *Select Other* tool to cycle between node placements.
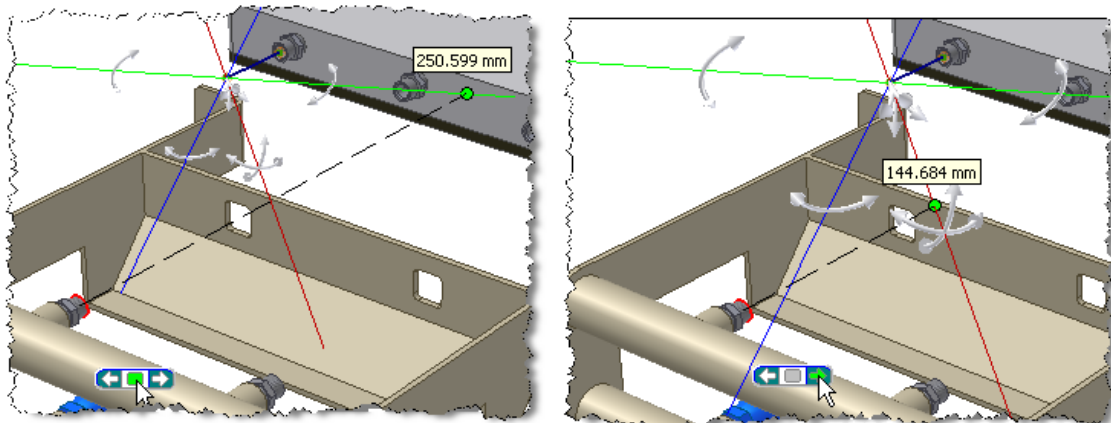
Derived Routes (Rigid Pipe and Tube Routes only)

You can derive rigid pipe and tube routes from all or part of an existing 3D sketch in the assembly. You can use this workflow to create routes and runs in previously created assemblies where 3D sketches outlined conduit paths outside of the Tube & Pipe application. The route is associative to the 3D sketch, and any changes to the sketch geometry are reflected in the derived route. You can create routes that are highly associative to assembly geometry by creating adaptive work features in the 3D sketch relative to faces, edges, and vertices of parts in the assembly.

All 3D sketches used in derived routes have the following general requirements:

- The 3D sketch cannot be contained within an existing route. The sketch can be contained in a part in the top-level assembly or in any of the subassemblies below the top-level assembly. You can also include the 3D sketch in the Tube & Pipe Runs subassembly, but it must be located outside of any routes defined in the runs. You can create the sketch with Autodesk Inventor Series or Autodesk Inventor Professional software.

- The 3D sketch must approach end fittings or points perpendicular to the openings. Derived routes do not recognize connection points or the requirement that the adjacent segment be collinear with the connection axis.

- The 3D sketch does not need to be continuous. A single 3D sketch can describe the route for multiple conduit segments.

- There are no restrictions on how you create the 3D sketch. You can use any combination of associative work points, grounded work points, and freehand sketch points.

- If the start point and endpoint of each chain in the 3D sketch are associated to circular edges of fittings, you do not need to position the points to engage the fittings. You can use the Trim or Extend Pipe tool to define the engagement at each fitting after you create the route.
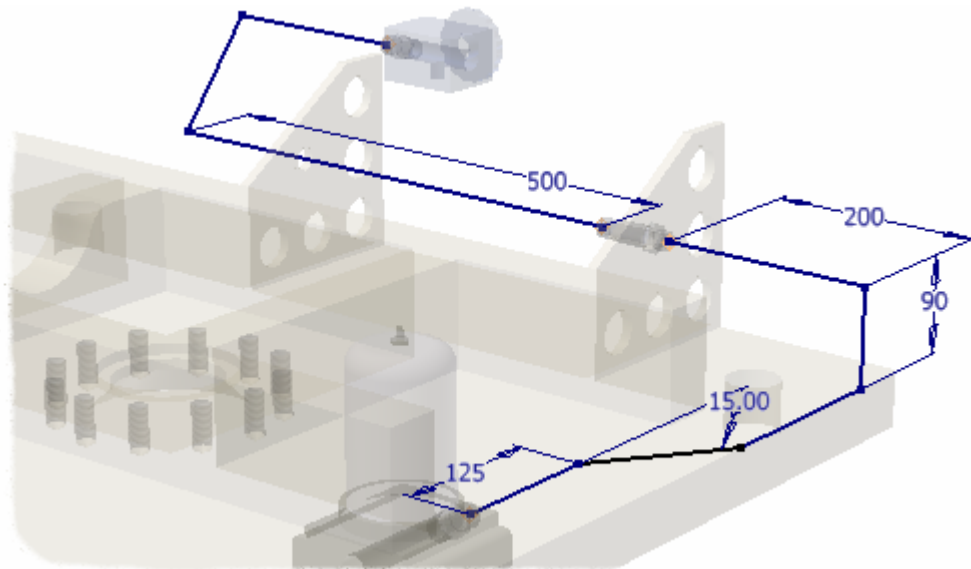
Tips for 3D Sketches for Rigid Pipe Routes

▪ Turn off automatic bend placement when you create a 3D sketch for a rigid pipe route.

▪ Orient the part containing the 3D sketch so that its origin geometry is aligned to one of the 3D sketch lines. Add a parallel sketch constraint between the line and the appropriate origin axis, and then apply constraints and dimensions to control the position and orientation of the other sketch lines.

Tips for 3D Sketches for Tubing Routes

▪ If two adjacent lines are not connected with a bend in the 3D sketch, a default bend radius is added when the 3D sketch is derived into the route.

▪ You can use equations in sketch dimensions to create parametric bends. For example, you can create a 180º degree bend in a 3D sketch that maintains the bend angle when the bend radius is changed.
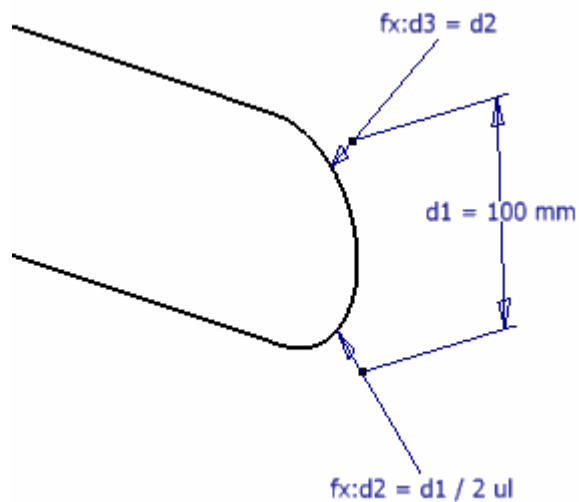

▪ Only 3D line and arc segments can be derived into a route. You can use the include geometry tool to create 3D sketch entities from part edges, but included segments that are splines are ignored when the 3D sketch is derived into a route

Flexible Hose Routes

When the active flexible hose style has both a start and an end fitting, you do not use the 3D Orthogonal Route tool to place intermediate nodes. You are prompted to select the start point and the endpoint of the route. After you specify these two nodes, a preview of the spline path is displayed.

- You can specify one or more intermediate nodes to refine the shape of the spline.

- If the route requires more than one intermediate node, place them in order starting with the node closest to the start node.

- You place intermediate nodes by moving the cursor over part faces or work planes. You see a preview of the node offset from the surface at the cursor position. You can edit the offset value from the shortcut menu and continue to place nodes using the new offset value.
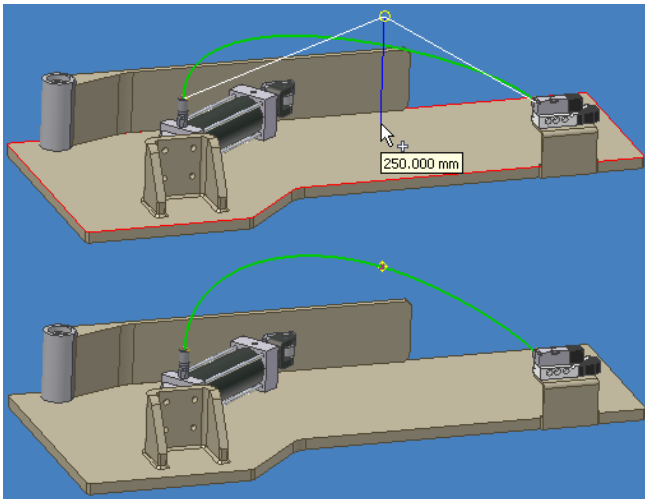
> **Note:** *You can also select a circular or arc edge to define an intermediate node. An arrow indicates the side of the containing plane from which the spline approaches. To change the direction of the approach arrow, press the SPACEBAR. You can also specify an offset distance along the axis through the edge. To do this, select the edge and enter a value to offset the node in the direction indicated by the arrow.*
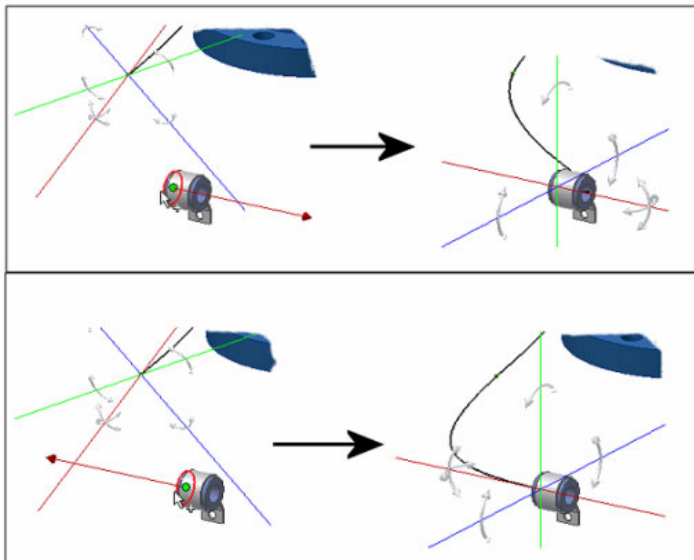
Editing Routes and Runs

As you develop your design, you may need to reposition conduit segments around or through assembly components. You can reposition nodes and segments by dynamically dragging segments or by specifying distances and locations with the 3D Orthogonal Route tool. You can also add new nodes or segments at the middle or end of an existing route, delete nodes or segments, and change the style of a node so that it either remains fixed or automatically repositions itself

> **Note:** *You cannot edit a rigid route derived from a 3D sketch with the 3D Orthogonal Route tool or by dragging segments and nodes. You edit the 3D sketch to add or remove segments, reposition nodes, and then update the route. If you first break the link between the 3D sketch and the route, you can edit the route nodes and segments by using the edit tools for the route type.*

Common ways to edit a rigid route include the following:

- Move segments or nodes to meet design changes.
- Delete and replace route segments to reroute around revised assembly designs.
- Change route diameter (you apply a different style to the route).
- Place fittings to create route branches.
- Edit connections to add or change fittings.

In flexible hose routes, you often need to redefine intermediate route nodes and adjust hose length to match standard hose assembly lengths.

Route Updates

Nodes may move when you edit the positions of components in the assembly because the route is automatically recalculated and the size and position of all conduit parts and fittings can change. When you reposition a coupling node along a conduit segment, you must edit the node position and the length of the two adjacent segments. If you move a conduit segment that changes the position of a branch node where two or more routes are connected, nodes and segments in downstream routes can be affected. The number of components involved can affect update performance. To increase performance when you edit a route, you can defer updates at a number of levels in the Tube & Pipe Runs subassembly.

You have the following options to defer updates in the Tube & Pipe Runs subassembly:

Defer All Tube & Pipe Updates:

You can disable updates to all routes and runs with the Tube & Pipe Settings dialog box. Consider disabling all updates when you need to edit the position of assembly components that affect the position of associated route nodes. To defer all updates:

1. Activate the top-level assembly or the Tube & Pipe Runs subassembly.
2. In the browser, right-click *Tube & Pipe Runs*. Click Tube & Pipe Settings.
3. Select Defer all Tube & Pipe Updates.

All routes and runs are hidden and you cannot edit routes or add new routes or runs in the assembly. Clear the check box to update all routes and runs.

Update Routes Only

When you make any change that affects the position of one or more route nodes, the size and position of affected conduit parts and fittings is automatically recalculated. The performance of the update depends on the number of affected nodes and can take considerable time. To increase performance, you can limit automatic updates to the route elements only. You can control update settings at each level of Tube & Pipe Runs subassembly.

The following steps outline how to edit one or more routes with automatic updates limited to the route elements.

1. In the browser, right-click the Tube & Pipe Runs subassembly, a run subassembly, or a route. Click Display/Update Settings > Route Objects Only. Conduit parts and default fittings along the route are hidden and do not update during route edits.

2. Edit one or more routes. The route elements update so that you can evaluate the changes to the route.

3. In the browser, right-click the run or route that you selected earlier. Click Display/Update Settings > All Tube & Pipe Components. All deferred updates to conduit parts and fittings are processed.

A Display/Update Settings list is displayed on the Standard toolbar when either the Tube & Pipe Runs subassembly or a run subassembly is active. You can set the update behavior for the active subassembly from this list. The list is not available when a route is the active edit object. You must change the update settings for individual routes from the browser.
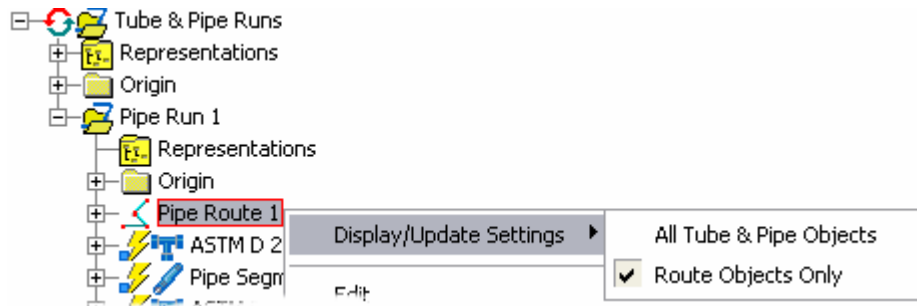

Auto-Route Nodes and Route Updates

Next to performance issues with route updates, unexpected changes to auto-routed portions of a route can generate a lot of extra work. Auto-routed nodes are those nodes placed by the tube & pipe application when you place a user-defined node that is not along one of the 3D Orthogonal Route tool axes. When you move a route segments, nodes in adjacent auto-routed sections of the route are automatically repositioned as required to meet the new segment location.

To reduce the chances of unwanted route changes, consider the following:

▪ Create user-defined nodes whenever possible. Limit the generation of auto-routed nodes to simple routes or where route changes are unlikely to occur.

▪ Change one or more auto-route nodes to fixed nodes (user defined nodes) prior to editing.

In the image to the right, the end node on the left is repositioned along the pipe axis with the 3D Orthogonal Route tool with the Point Snap option on. All nodes between the coupling and the end node are auto-route placed, unfixed nodes. Because the intermediate nodes were placed automatically, they are free to move when edits occur elsewhere on the route. In this example, intermediate nodes and segments were automatically removed by the tube and pipe application.
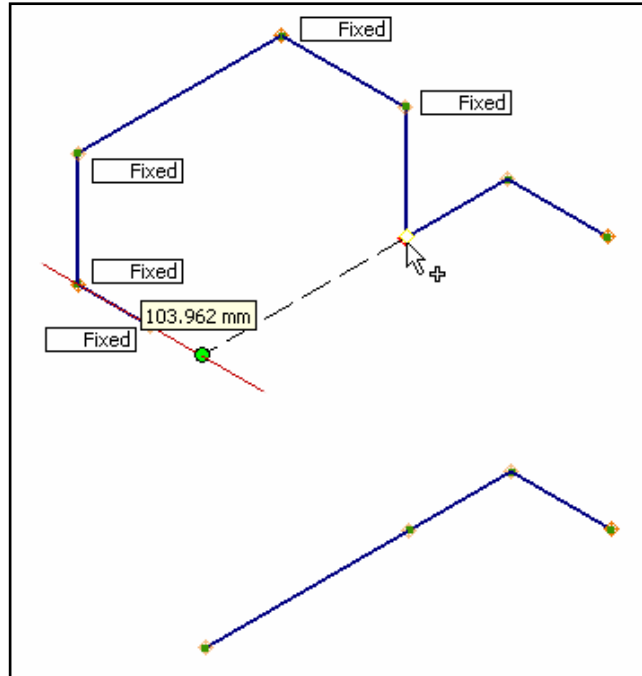

You can fix intermediate nodes to prevent them from moving during route edits. In the image to the right, the node upstream from the end node is changed to a fixed node. When the end node is repositioned, the fixed node prevents the unfixed nodes from updating their position.
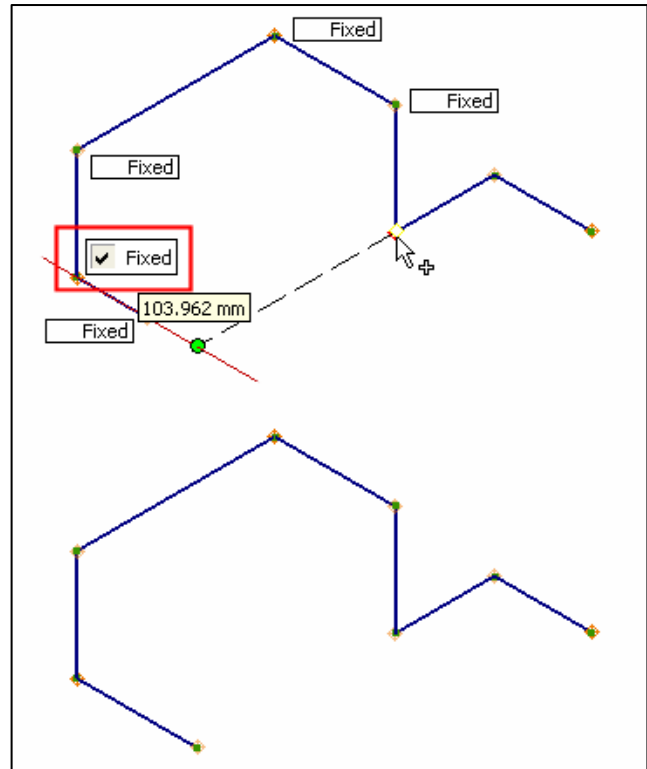
Placing and Editing Fittings

- You can place a library or authored fitting anywhere in a rigid route as long its placement does not violate any of the current style rules, such as minimum segment length.

- You can place fittings that do not match the nominal diameter of the route. For example, you might want a larger or smaller diameter branch route. Additional fittings would need to be placed and connected to restore a valid route.
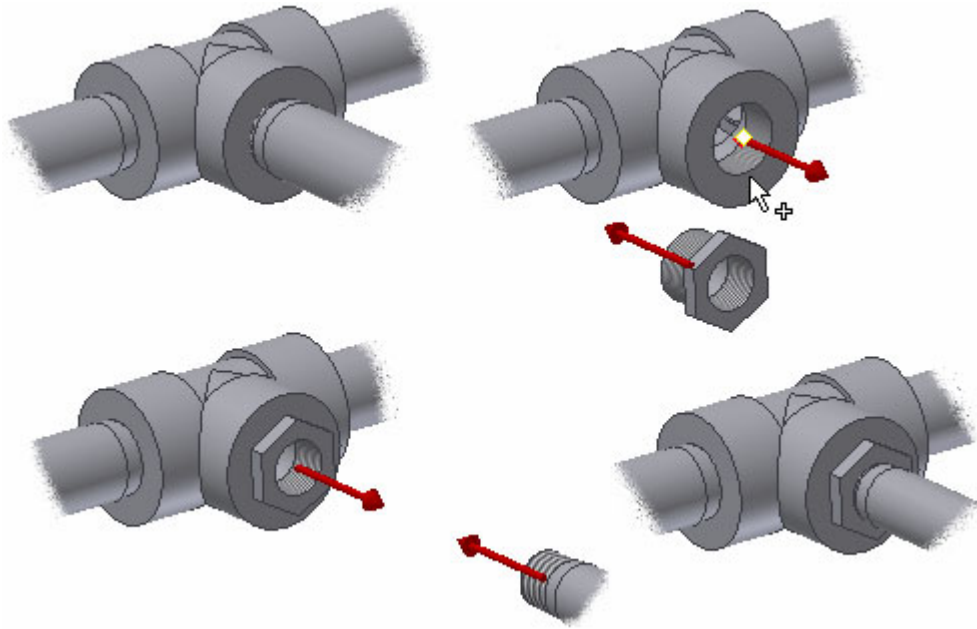
- You can quickly change the diameter of a placed library fitting from the context menu.

- You can drag and drop a new, valid fitting over an existing fitting to replace it.

- You can restore an elbow or coupling that you previously replaced with another fitting. To do this, right-click the replacement fitting. Click Restore Fitting.

Documenting Tube and Pipe Assemblies

When your design is complete, you can document your design using drawings, parts lists, and Inventor Studio.

Tube and Pipe BOM Structure

Because the Tube & Pipe Runs subassembly is a virtual container for all the runs created in the assembly, it should not appear in a BOM or parts list. The Tube & Pipe application assigns a Phantom BOM structure to the Tube & Pipe Runs subassembly. A phantom component is not shown in the BOM, and all children of the phantom component are promoted to the level of the phantom component. Pipe run subassemblies and any components placed as first-level children in the Tube & Pipe Runs subassembly are promoted in the BOM.

The following list describes the BOM structure for route and run components.

- **Tube & Pipe Runs Subasse**mbly: Phantom BOM structure. All runs and any first-level components are promoted one level in the BOM.

- **Pipe Run Subassembly**: Normal BOM structure. All runs are promoted to the level of the Tube & Pipe Runs subassembly in the BOM.

- **Pipe Route**: Phantom BOM structure. Because a route has no child components, it does not appear in the BOM or in a parts list.

- **Rigid Pipe, Tube, or Hose Segment**: Normal BOM structure.

- **Fitting**: Purchased BOM structure. Always appears as a single line in the BOM. Authored fittings placed with the Place Fitting tool also have a Purchased BOM structure.

> **Note:** You can specify that a flexible hose style place the hose and end fittings in a subassembly in the active run. The default BOM structure of this subassembly is Phantom. The hose and end fittings are promoted to be first-level children of the run. To show the flexible hose subassembly in the BOM, you must edit the BOM structure assigned to the subassembly to Inseparable.

Design View Representations

Piping assemblies can range from a single-run tube with start and end fittings to a complex design with multiple branching runs and a many fittings and other components from the Tube and Pipe library. Pipe documentation typically includes one or more dimensioned assembly views to describe the positioning of pipes and fittings in the parent assembly. A complex tube or pipe assembly with multiple runs may require a separate drawing or drawing views for each run or group of related runs.

- You can use design view representations to isolate related runs and the assembly components that are important to those runs. You create the required design views in the assembly and apply one of the design views to a drawing view to control which components are displayed.

- Make use of design views during modeling. When you open an assembly, apply a design view to hide components not applicable to your routes and runs.

Positional Representations

Positional representations capture positional states of an assembly. When you activate a positional representation other than the master positional representation, the tube and pipe runs can *theoretically* react to the change in the position of assembly components.

In practice, the result can be unpredictable. Flexible hose routes can respond to positional representations when the relative position of the route endpoints is affected. You can examine and adjust the hose length in any positional representation. You can use this functionality to examine the range of motion in an assembly and determine the appropriate hose length for the affected route. The success or failure of a positional representation depends on your modeling practice. I've had better success if the end fittings (that the hose fittings attach to) are placed outside the tube & pipe runs.

The functionality of tube & pipe assemblies with positional representations will no doubt improve in future releases.
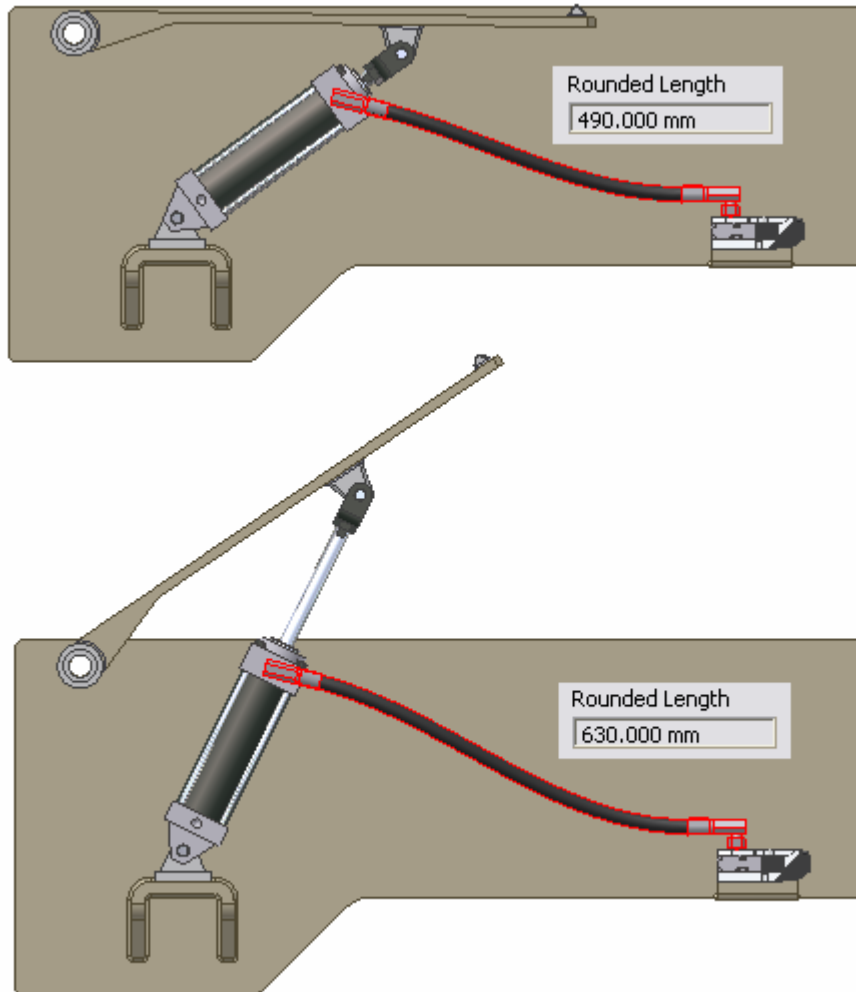
Summary

The tube & pipe application in Autodesk Inventor Professional 10 provides a solid set of tools to create and document rigid pipe, tubing, and flexible hose runs for your machinery designs. It is not a process piping application, but assemblies with tens of runs can be accomplished. Use the defer update tools, 3D sketches, and other larger assembly design techniques to improve the performance of your tube & pipe assemblies.

Thanks for attending.