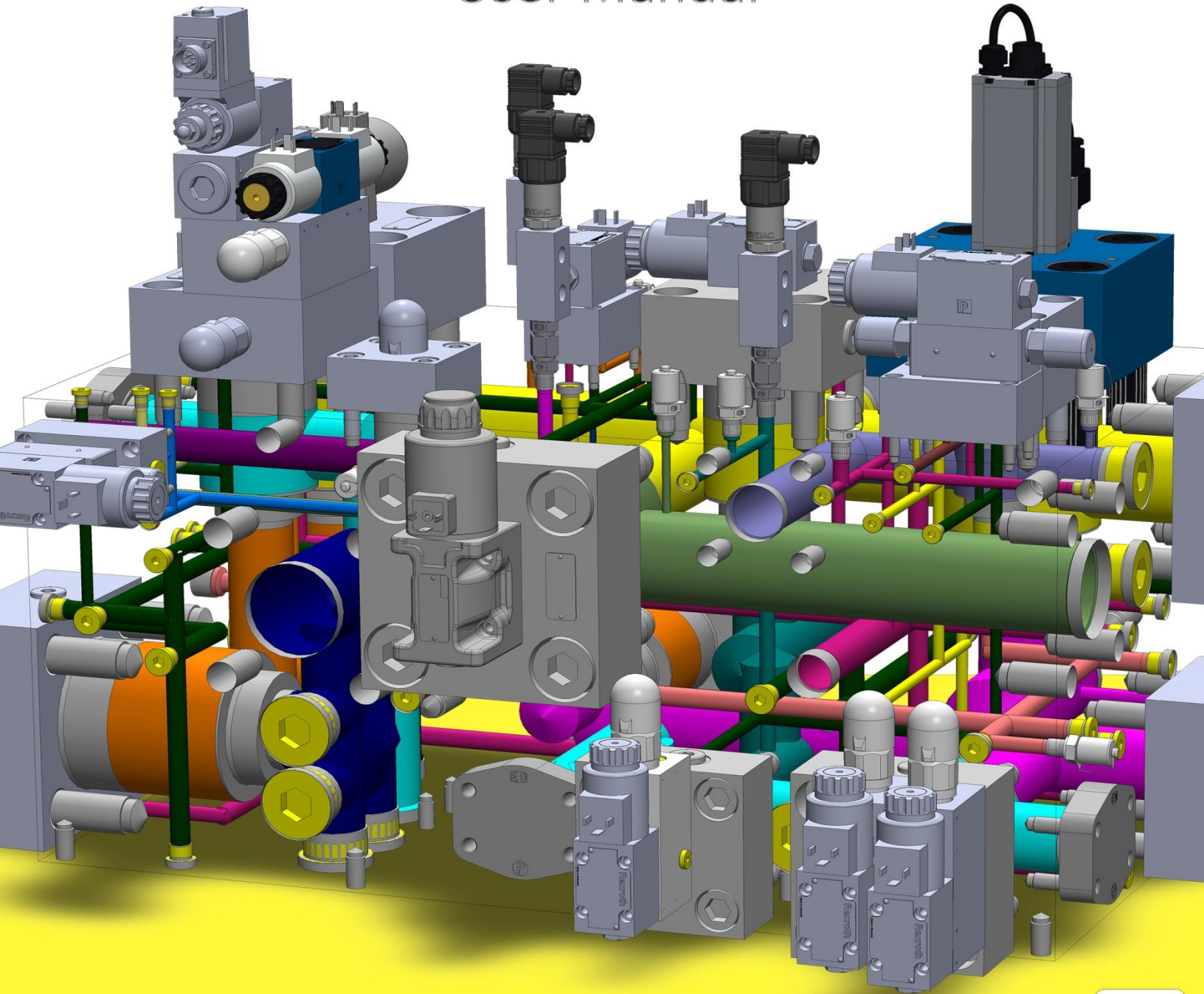


MDTools® 960

User Manual



MDTools[®] 960

manifold design app

Do more...

VEST, Inc.

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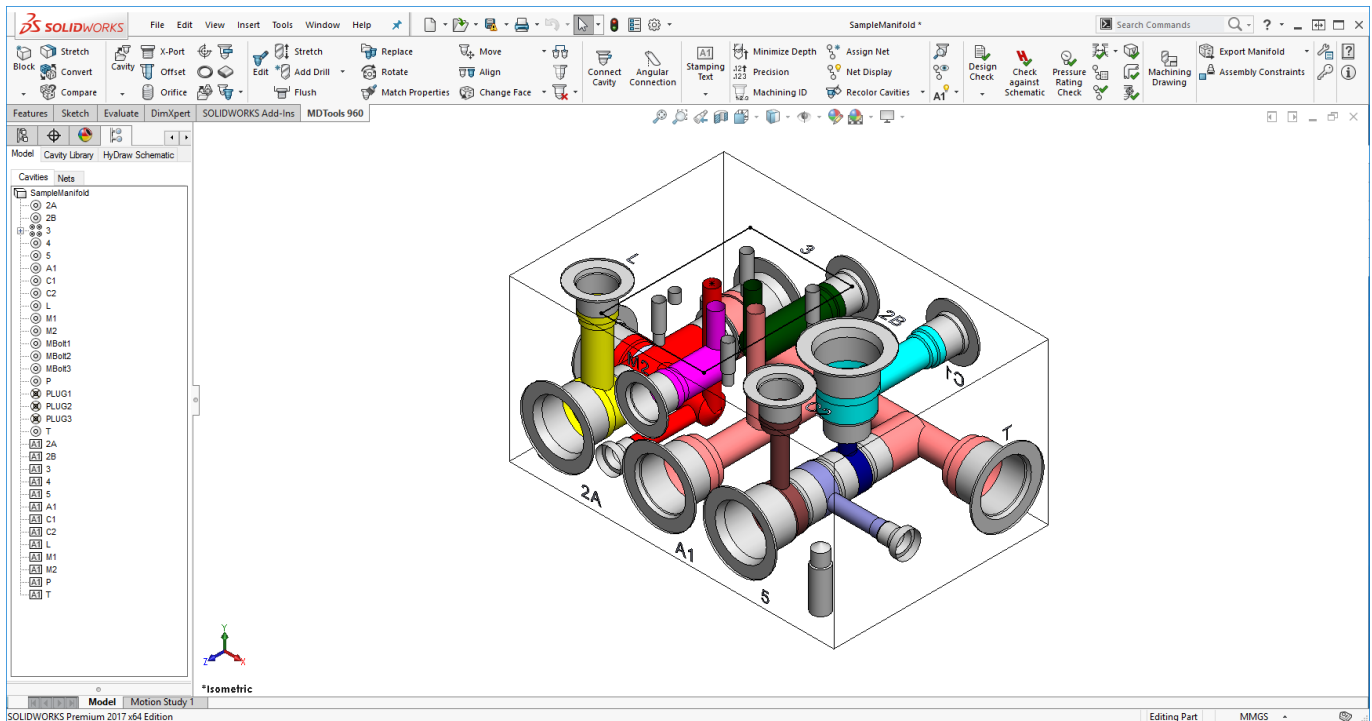
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1. Introduction



VISUALIZES

Color-coded cavities and flow paths

Cavities divided into port areas and dead areas

DESIGNS

Design Fast using Virtual Cavity Design

Simple and compound automated angle holes

Interactive Stretch Block

Color-coded flow paths

Under cuts

Drag and move the cavities using move handle

Embedded design rules

Energy efficient construction ports and connections with smooth bends

CHECKS

Correct connectivity

Manufacturability

Bends: quality of intersections

Wall thickness

Velocity in the block

Connection Offset

Holes cutting outside the port area of cartridge valve cavities

Check against HyDraw® Schematic

Offset recommendation for multiple side ports connection

AUTOMATES

Auto Design Checks

Auto Energy Efficient Connections

MDTools® HyDraw® Interface

Auto Dimensioning

Auto energy efficient construction port sizing

Auto Machining Drawing and Chart

COMPREHENSIVE

Uses both cartridge and interface valves

Cavity libraries with machining details

Includes major OEM libraries

...and more

Welcome to VEST MDTools 960

MDTools[®] 960, the 3D manifold design software from VEST provides you with power tools to automate the manifold design, checking, documentation, and modeling process within the **SOLIDWORKS** environment.

MDTools helps design energy efficient manifold by creating smooth bends and suggesting suitable x-ports to minimize bend losses.

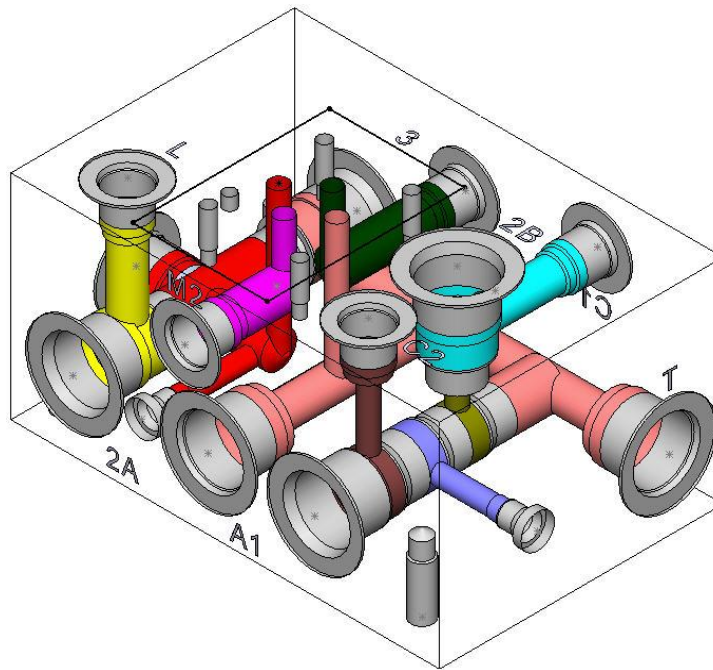
As a designer of hydraulic manifold blocks using both cartridge and interface valves, MDTools 960 is an invaluable tool enabling you to be more productive.

Quickly and easily, design complex and error free manifolds with professional documentation; automated dimensioning, machining chart generation, and more.

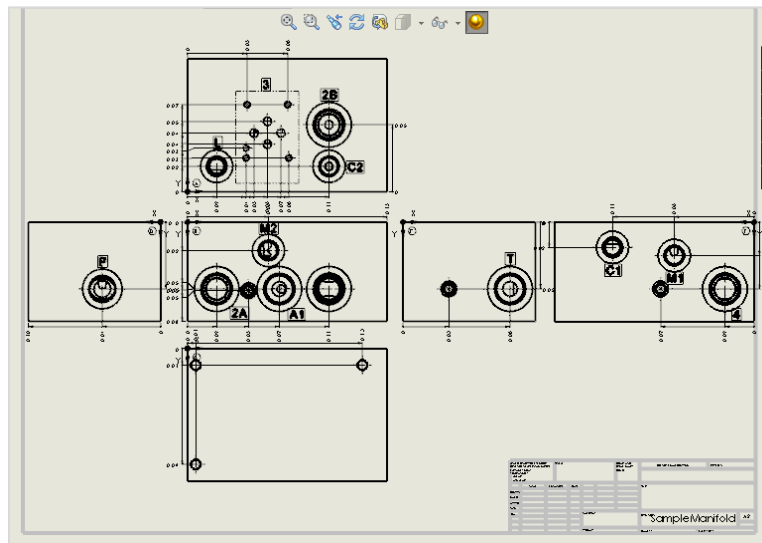
MDTools 960 provides efficient design tools to reduce your design time. Use the powerful Connect to Cavity feature and easily connect two cavities.

Color-coded cavities and flow paths give you effective visualization of the manifold internals and connectivity. Design checks enable you to make timely correction of errors, if any, before release of design and actual machining.

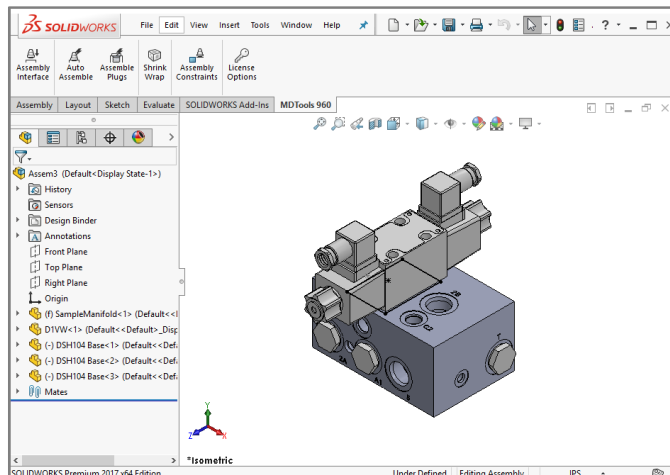
The Machining Chart command enables you to automatically extract the cavity machining data from the block model, create machining chart and insert it into the 2D drawing.



MDTools designed manifold



Automatic Dimensioning



Manifold Assembly

Study Guidelines

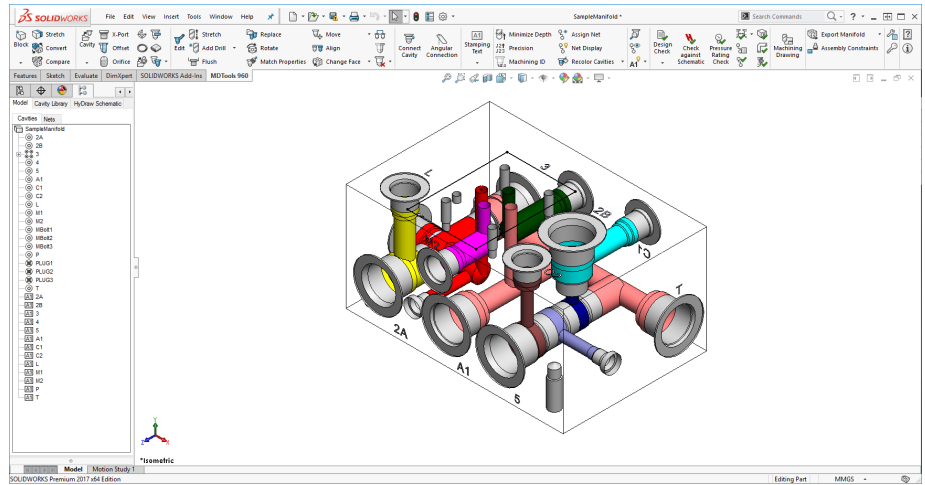
The **MDTools® 960** User Manual provides comprehensive information on the manifold design software.

First time users of MDTools must go through the initial chapters. These chapters cover the basic concepts and help you understand the software environment.

The subsequent chapters give detailed coverage of the commands, their usage, processes, and design methodology.

Use the user manual as a comprehensive reference to the command set and usage of MDTools 960.

The Contents and Index listing guides you to relevant material for study and reference.



MDTools designed manifold

If you have a Question

If you have a question about MDTools 960 email us at support@VESTusa.com.

Please include the following:

- Version number of the software you are using.

To see the version of MDTools on your machine, go to:
> MDTools 960 > **About MDTools**
on the Part MDTools 960 ribbon command tab.
- Configuration of your machine.
- Exact messages, if any, on the screen.
Send a screen capture, if possible.
- Description of the problem and what you were doing when the problem occurred.
- Description of how you tried to solve the problem.

2. Installation

Install MDTools® 960 using the installation program. The installer creates all required directories and installs MDTools 960 on your system.

System Requirements

1. Intel Core i5 2.4 GHz Processor.
2. 8 GB RAM.
3. Microsoft Windows 7*/8/10 (64 Bit) operating system.
4. Microsoft Access Database Engine 2010 (64 Bit)
5. Microsoft .NET Framework 4.
6. SOLIDWORKS 2011 SP5.0 (64 Bit).
7. Other system requirements, per SOLIDWORKS version used.

* Windows Home Operating System not supported

Software Installation

Insert the MDTools 960 CD-ROM in the CD drive of your system.

If Auto run is not set, then:

1. Launch the Setup program.
Windows **Start...** > **Run...** > **Browse...** (Browse to E:\MDToolsStart.exe assuming E is your CD drive).
2. Select MDToolsStart.exe...
3. Click **Open**.
The MDTools 960 setup dialog box displays.

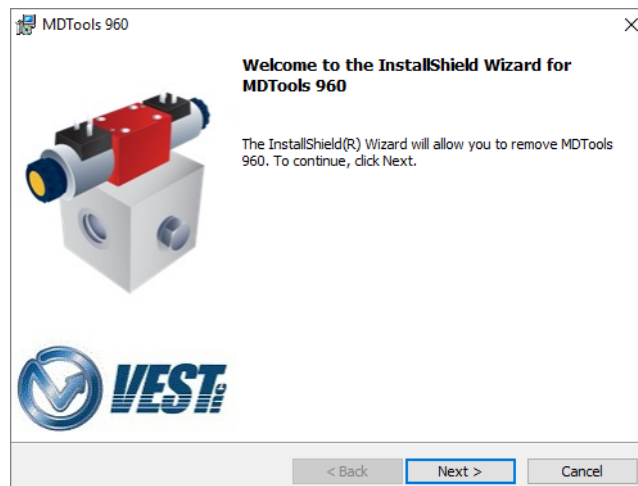


MDTools 960 Setup dialog box

1 Install MDTools 960

1. Click MDTools 960.
The InstallShield wizard for MDTools 960 displays.
2. Respond to all the setup program prompts.
MDTools 960 is installed on your system.

The installation program automatically creates the required directories in your system.



MDTools 960 Installation Wizard

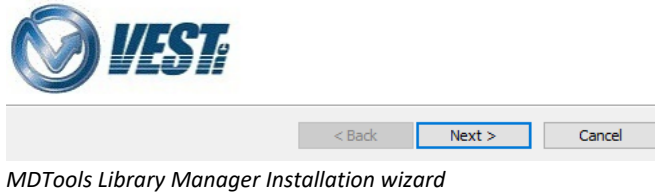
2 Install MDTools Library Manager

1. Click MDTools® Library Manager. *The MDTools Library Manager dialog box displays.*
2. Respond to all the setup program prompts. *The MDTools Library Manager program is installed on your system.*



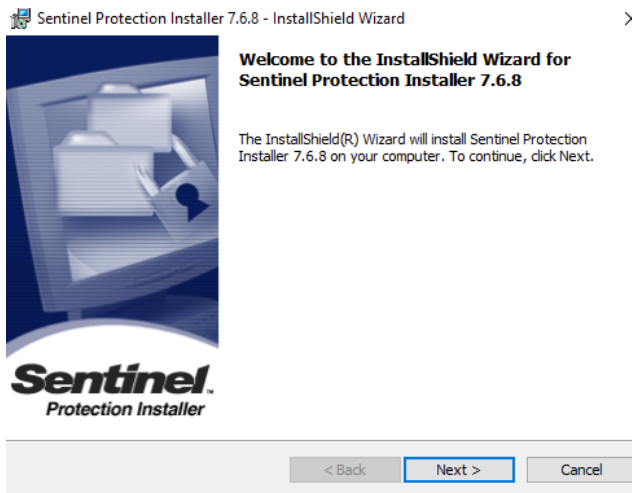
Note:

- Install both MDTools and MDTools Cavity Library to use the MDTools software.
- Install the MDTools Cavity Library on the server to share it with your design team over a network.



3 Install Hardware Lock Manager

1. Install the hardware lock manager on the system you have attached the MDTools hardware lock.
2. Click Sentinel Super Pro Server.
3. Respond to all the setup program prompts. *The Hardware lock driver is installed on your system.*



Note:

If you use the **MDTools Network License**, then install this program only on the system with the hardware lock.

4 Hardware Key Installation

MDTools 960 is protected with the SentinelSuperPro key provided with the software.

Attach the SentinelSuperPro key to the USB/ parallel port of your computer.

Note:

- In case of parallel port, attach the end of the key labeled 'COMPUTER' to the parallel port of your computer.
- The SentinelSuperPro key can also be cascaded with other keys that support cascading.
- Make sure that the SentinelSuperPro key is the last key in the chain ...farthest from the computer.

5 Set License Server Path

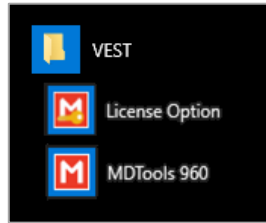
- Start
 - > All Programs
 - > VEST
 - > MDTools 960
 - > **MDTools License Option**

The MDTools® 960 License Option dialog box enables you to set the MDTools hardware lock license file path.

If you have a network license, you can set the IP address or the name of the computer carrying MDTools hardware lock. This enables MDTools to directly pick the license from the remote server location.

Note:

This option is available only in the MDTools 960 Network license version.

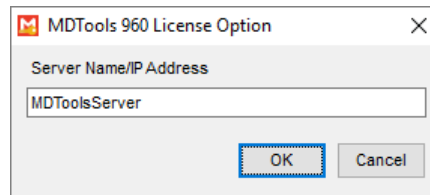


MDTools License Option Menu

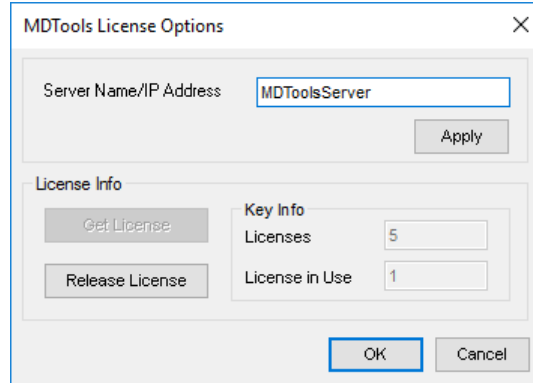
6 Set License Option in SOLIDWORKS Part Model Menu

Set the license path through the Part Model menu.

- MDTools 960 > License Options
The MDTools License Options dialog box displays.
- Enter the server name or the IP address of the system, where the MDTools hardware lock is located.
- Click **Apply**.
MDTools automatically selects a license and displays the license information in the License info form.
If a license is selected successfully, then the Get License button is disabled and the Release License button is enabled.
- To release a license, click the **Release License** button.
This releases your license, the Release License option is disabled and the Get License button is enabled.
- To get a license, click the **Get License** button.
If MDTools successfully gets a license, then the Get License button is disabled and the Release License button enabled.



MDTools 960 License Option dialog box



MDTools License Options dialog box

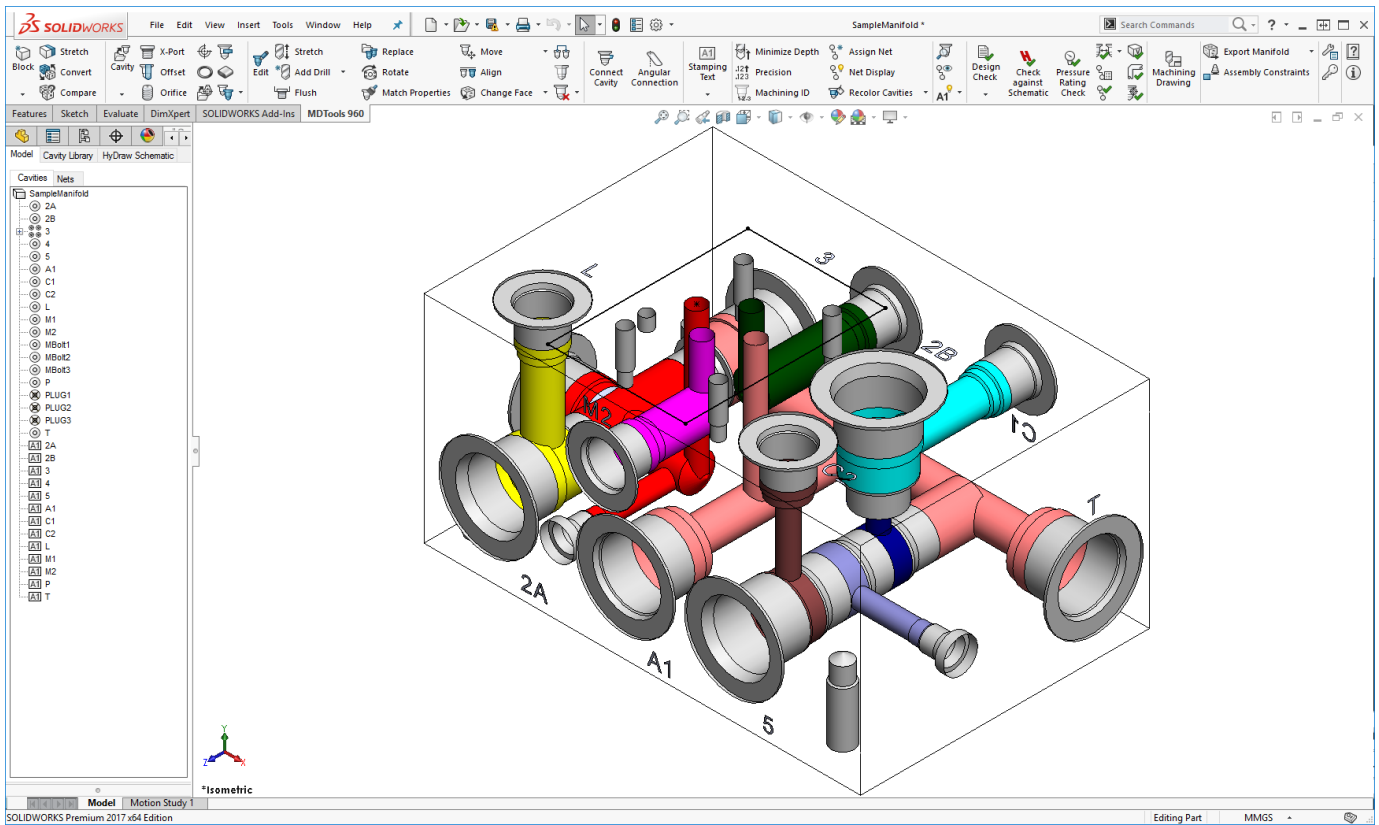
Click **OK** to continue.

Note:

This option is available only in the MDTools 960 Network license version.

BASICS

- 3 MDTools Workspace
- 4 HyDraw Schematic Interface
- 5 MDTools Cavities
- 6 Nets
- 7 Using Angle Holes



3. MDTools Workspace

The MDTools® 960 manifold design app enables you to design, check, draw, and model manifolds within the **SolidWorks** environment.

There are three types of commands available in the MDTools:

1. Block design (Part model) commands
2. 2D Drawing Commands
3. Assembly Commands

Note:

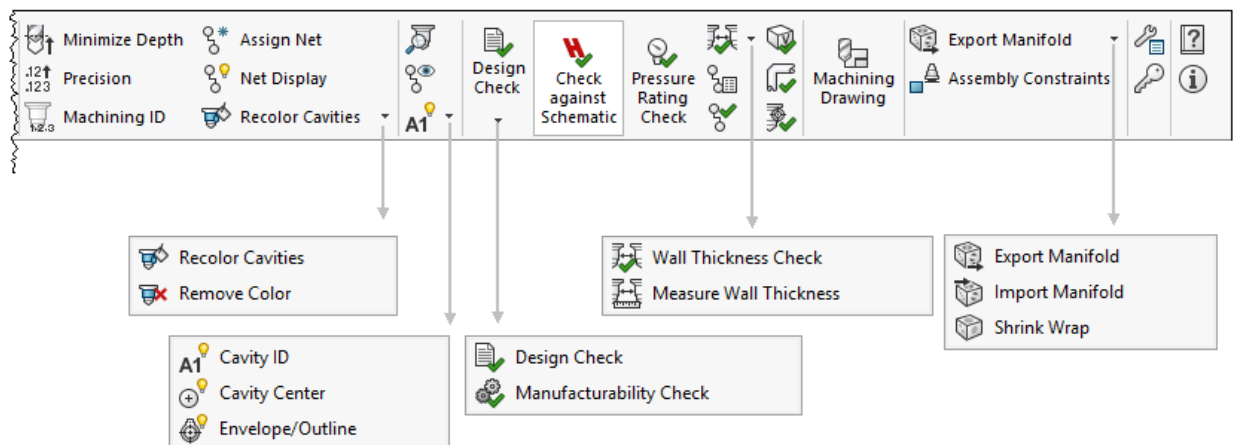
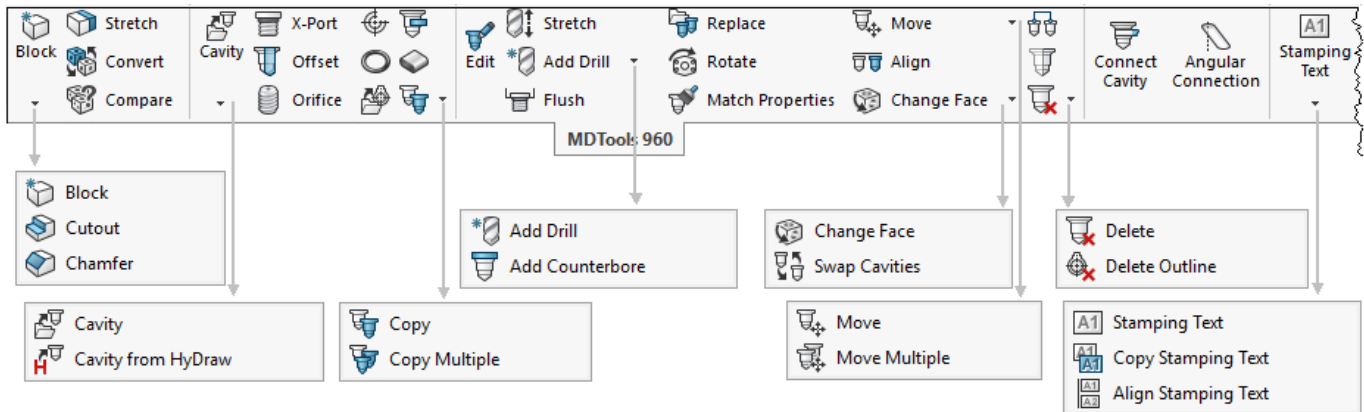
Block Design (Part model) commands are available only in the part model environment (.sldprt).

Block machining drawing commands is available only in the 2D drawing environment (.slddrw).

Assembly commands are available only in the Assembly environment (.sldasm).

3.1 Block design (Part model) commands

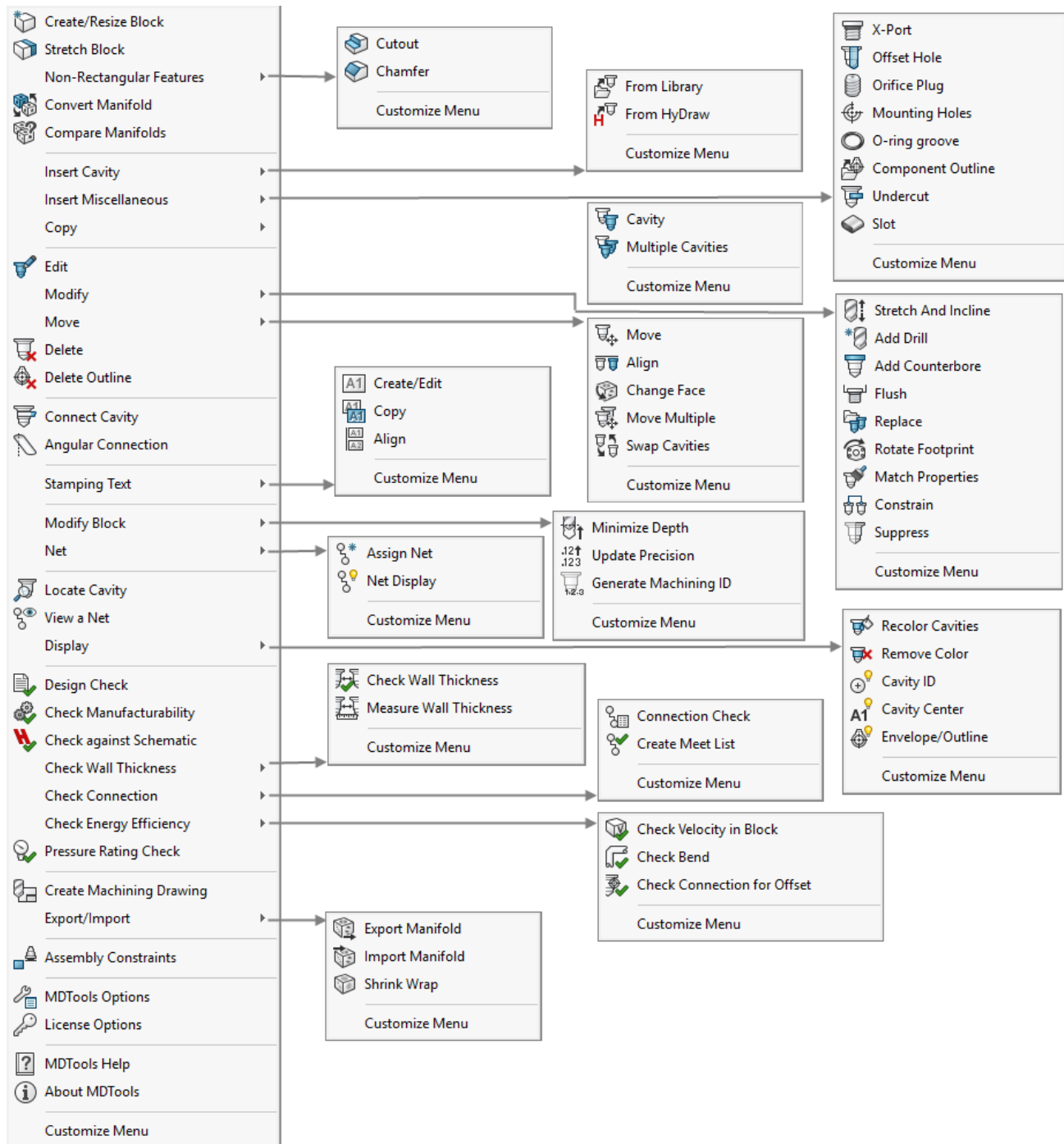
1 MDTools Part Model Ribbon Menu



MDTools Ribbon Menu – Submenus Expanded

2 MDTools Dropdown Menu

Note: Refer Appendix for command details



MDTools Dropdown Menu – Submenus Expanded

3 MDTools Browser

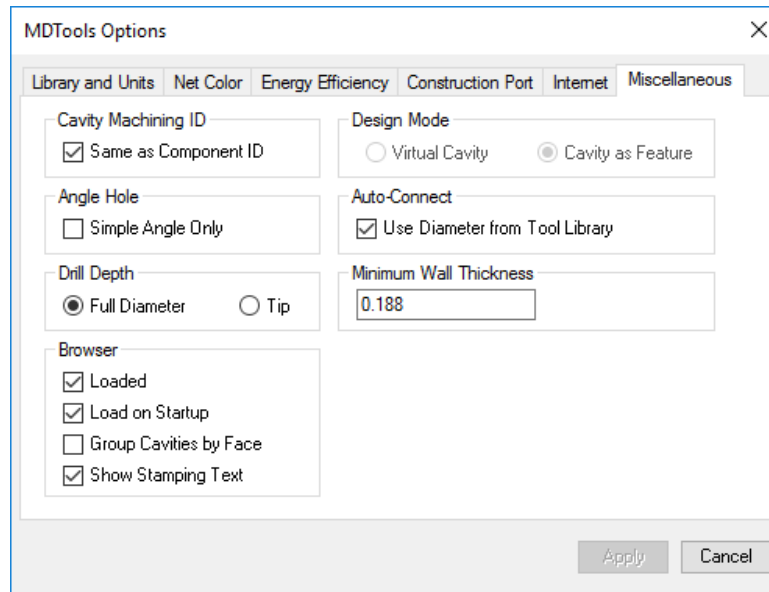
MDTools® adds its own Browser tab to the SOLIDWORKS Features' Manager tabs.

Browser Load Behavior

Switches between loading the browser on startup and loading the browser manually.

Load on Startup

1. MDTools 960
> MDTools Options
The MDTools Settings dialog box displays.
2. Select the **Miscellaneous** tab.
3. Check/Uncheck the **Load on Startup** check box in the Browser Load Behavior section.
4. Click **Apply**.



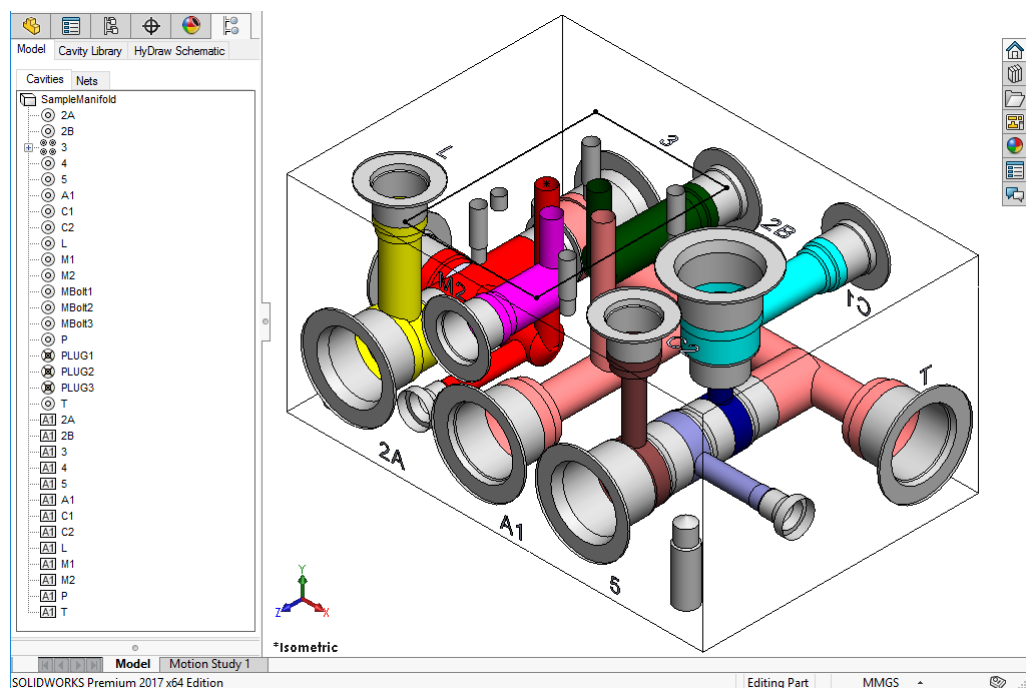
Browser Load Behavior: Load on Startup option

MDTools Cavity Browser

- Displays in the SolidWorks feature Manager tab
- Lists the cavities on respective face nodes.
- Automatically marks construction ports with a different icon
- Lists Stamping text with different icons.
- Lists miscellaneous cavities (i.e. undercuts, slots, O-rings)

Note:

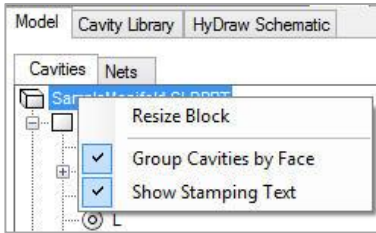
Edit the port information directly in the browser.



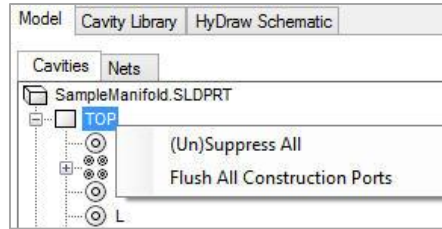
MDTools Cavity Browser

Cavity Browser Context Menu

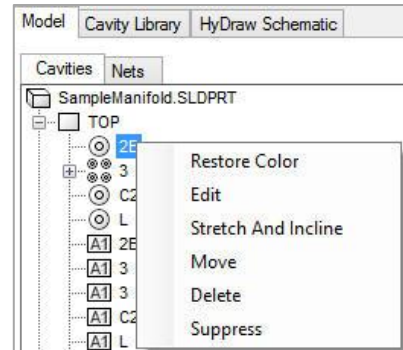
Right click a manifold node, face node or cavity node for the Context menu



Context Menu: Manifold Node



Context Menu: Face Node



Context menu: Cavity Node

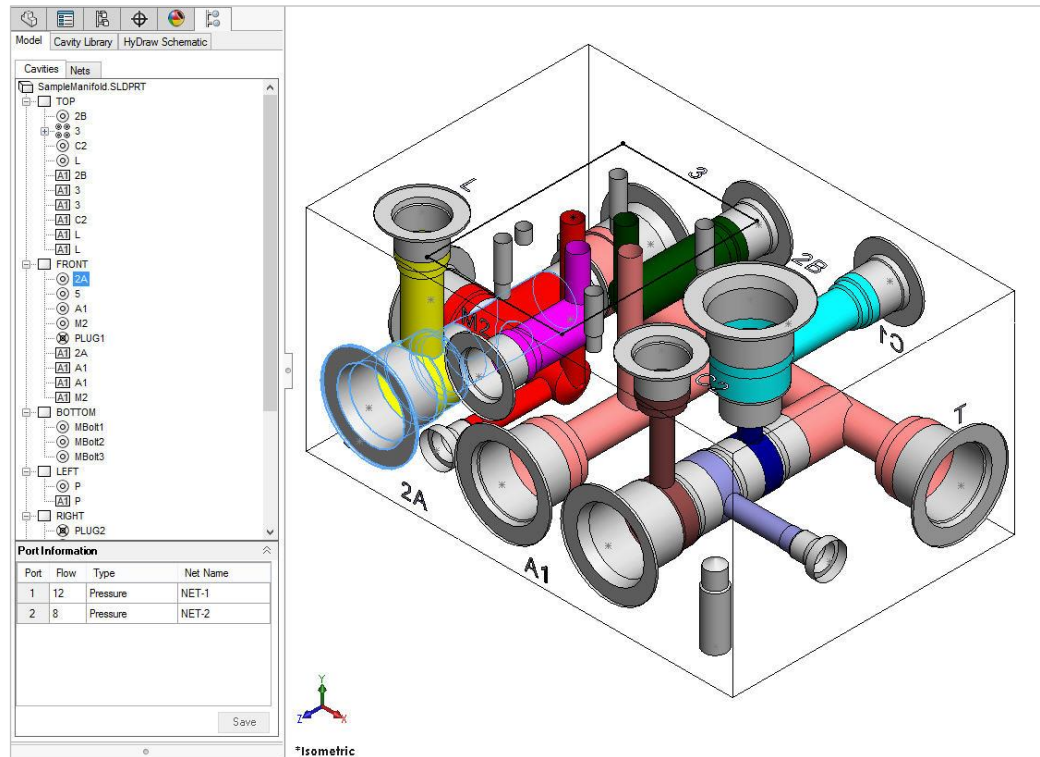
Edit Port Information

View and edit the port information, such as flow, type, and Net name of the selected cavity.

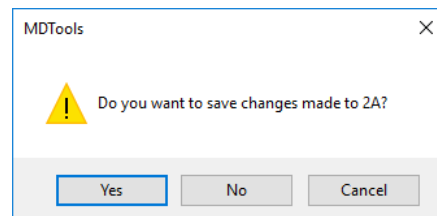
1. Select a cavity/footprint node in the browser. *MDTools displays the port information for the selected cavity/footprint.*
2. Change the flow, type or net name.
3. Click **Save**. *Port information for the selected cavity/footprint is updated.*

If you do not save the modified data and select another cavity or the MDTools Cavities browser tab, MDTools display a warning message.

*Click **Yes** to save the modified data and **No** to skip the modification.*



Edit Port Information dialog box



Modify data save validation message

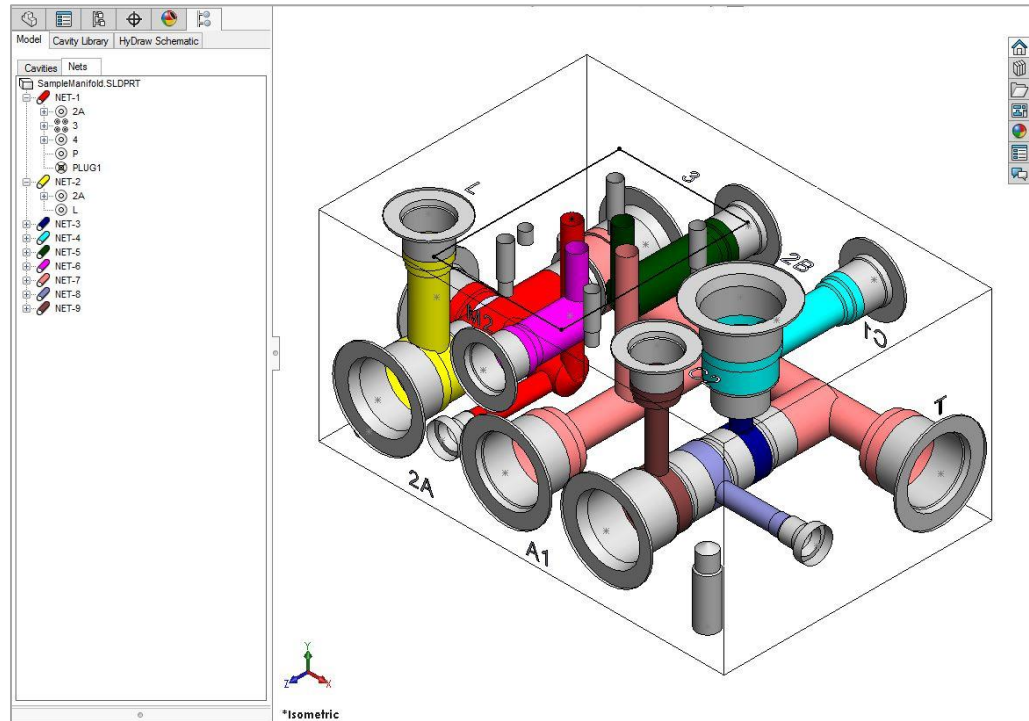
MDTools Nets Browser

The MDTools® Nets Browser in the SolidWorks, Features-Manager tab:

- Displays the Connectivity (Net) list
- Displays all the cavities and ports in each net
- Displays the net node in the same color of a net in the model

Change the flow, type and pressure for the selected net.

Change the visibility and color of nets using the right-click context menu.



MDTools Nets Browser

Nets Browser Context Menu

Show Selected Net

Displays the selected net with the net color and all other nets with the Dead Area color.

Show All Nets

Restores the color settings of all the nets in the manifold.

Hide All Nets

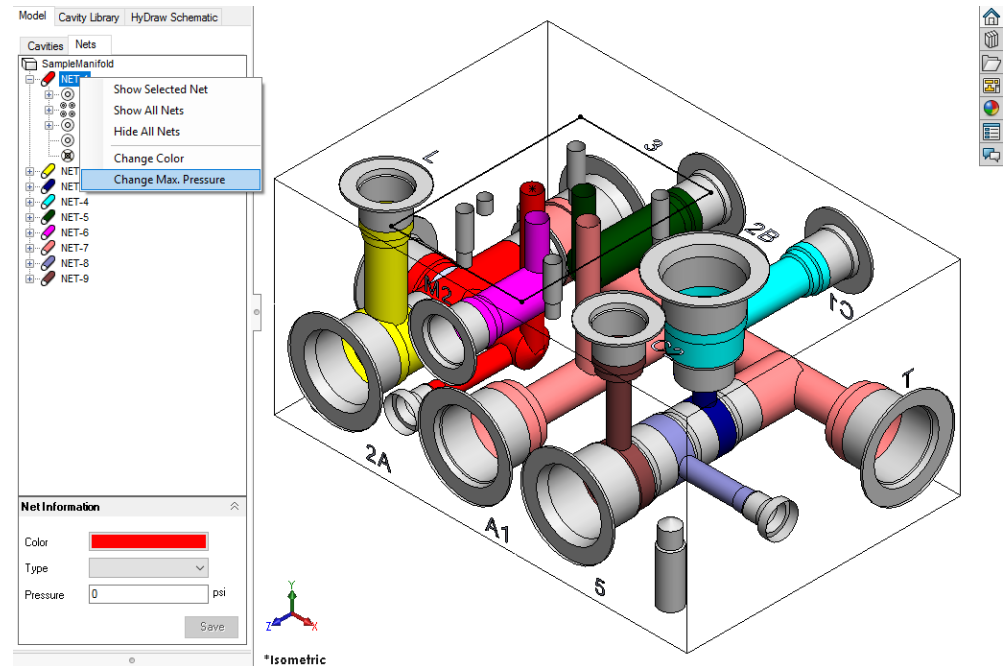
Hides all the nets in the manifold by shading them with the SolidWorks grey color, default.

Change Color

Change the color of the selected net.

Change Max. Pressure

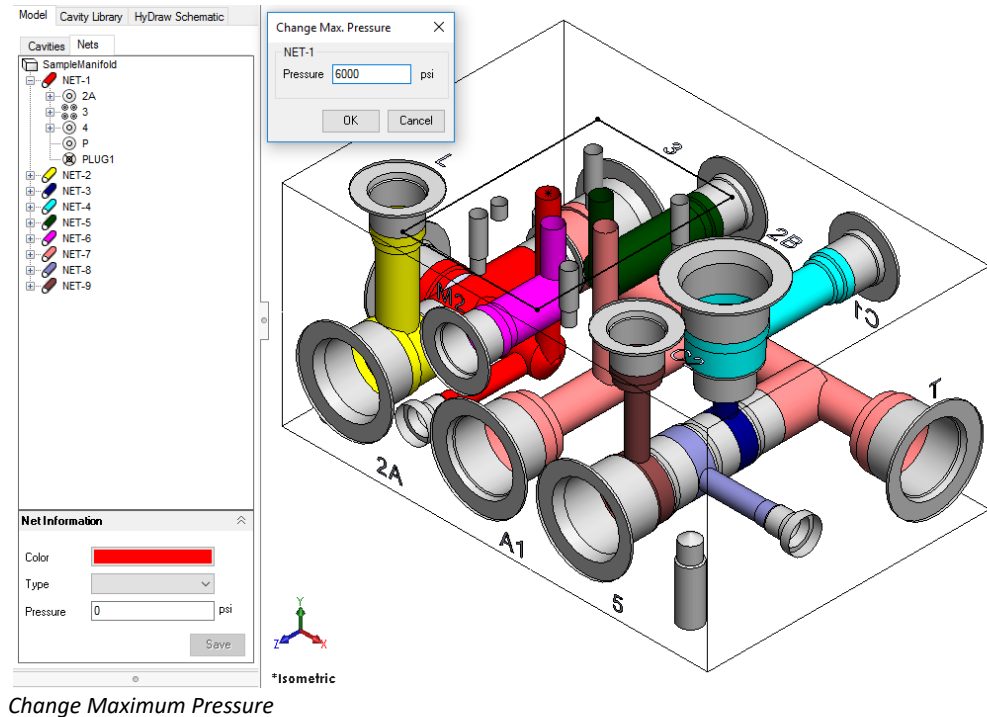
Displays options to edit maximum pressure of the selected net.



Nets Browser context menu

Change Max. Pressure

1. Select **Change Max. Pressure** from the context menu. *The Change Max. Pressure dialog box displays.*
2. Enter the **Pressure** value.
3. Click **OK**. *MDTools updates the selected net with the specified pressure value.*

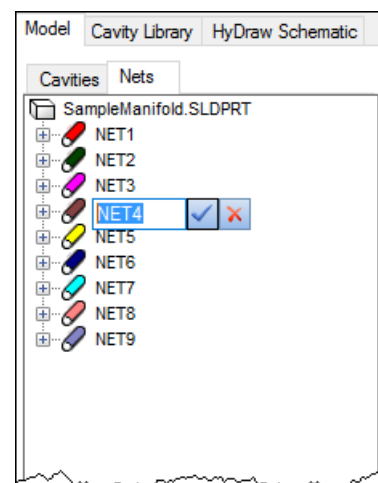
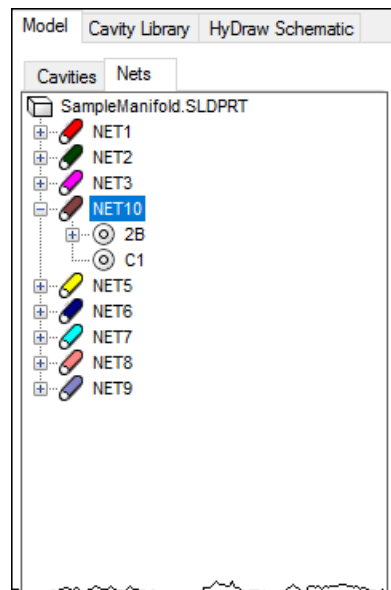


Note:

- If a manifold is designed with a HyDraw circuit, you can override the pressure value of a net that exists in the HyDraw schematic.
- If a manifold is designed without a HyDraw circuit or a net does not exist in the HyDraw circuit, you can manually enter pressure rating for such nets from the Connectivity Browser **Net information** section.

Rename Net Name from Net Browser

1. Double click on the nets in Net Browser to rename the nets.
2. Edit the net name in the textbox that appears.
3. Click to make the changes or Click to discard the changes.

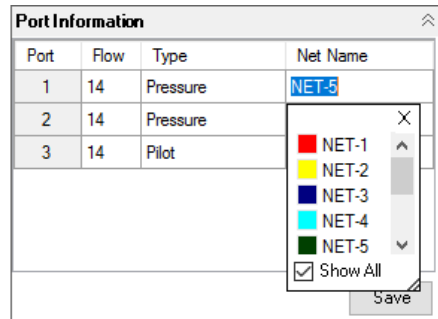


MDTools Net Name Pop-up

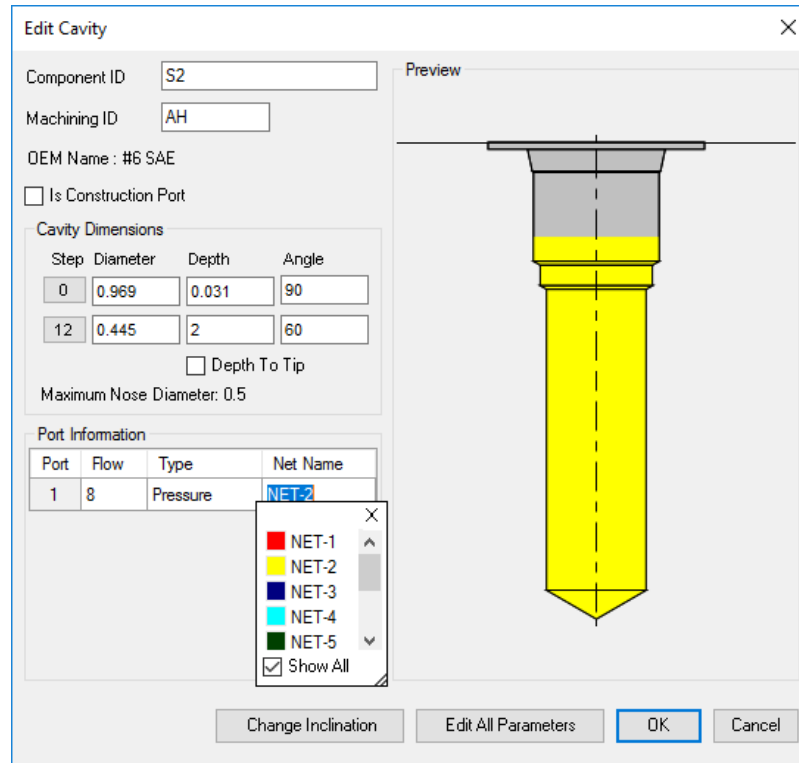
Select a net from the existing nets.

The MDTools Net Name pop-up displays when you click:

- The Net Name column in the Port Information section of the MDTools Browser.
- The Net name column of the Port Information section of Edit Cavity dialog box.
- The Net Name column of the Port Information section of the Edit All Cavity Parameter dialog box.
- The Net Name field of the Insert orifice plug dialog box.
- The Net name field of the Edit slot dialog box.



Net Name Pop-up

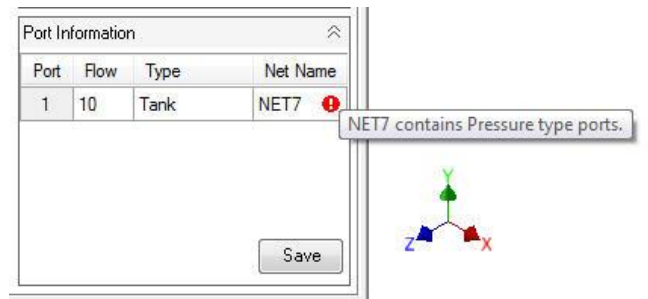


Edit Cavity dialog box

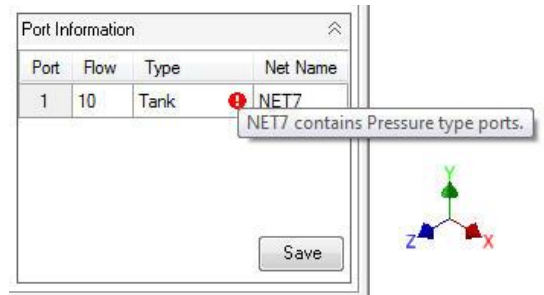
Note

- The **Show All** option shows all the nets from model as well as default nets defined in MDTools Settings. If the 'Show All' option is not selected, then it shows only nets from the model.
- MDTools does not allow different types of port in a single net.
(For example, for Net1 there is pressure type port defined. When you insert a cavity with Net-1 and port type suction, then MDTools warns you and will not allow you to insert the cavity with that port information.)

- MDTools® does not allow following types of port in a single net:
 - A pressure type port and tank type port.
 - A pressure type port and drain type port.
 - A suction type port with any other type of port.
- When conflicting type of ports come in a single net, MDTools displays a red exclamation warning on that field either Port type or Net name.



- Tool Tip of warning shows the actual type of port that the net contains when you move the mouse over the warning.



- You can override the net port type information by changing all the port information existing in that net.
- If you use HyDraw® Schematic, you cannot override the net port type information defined in HyDraw Schematic.

4 MDTools Context Toolbar

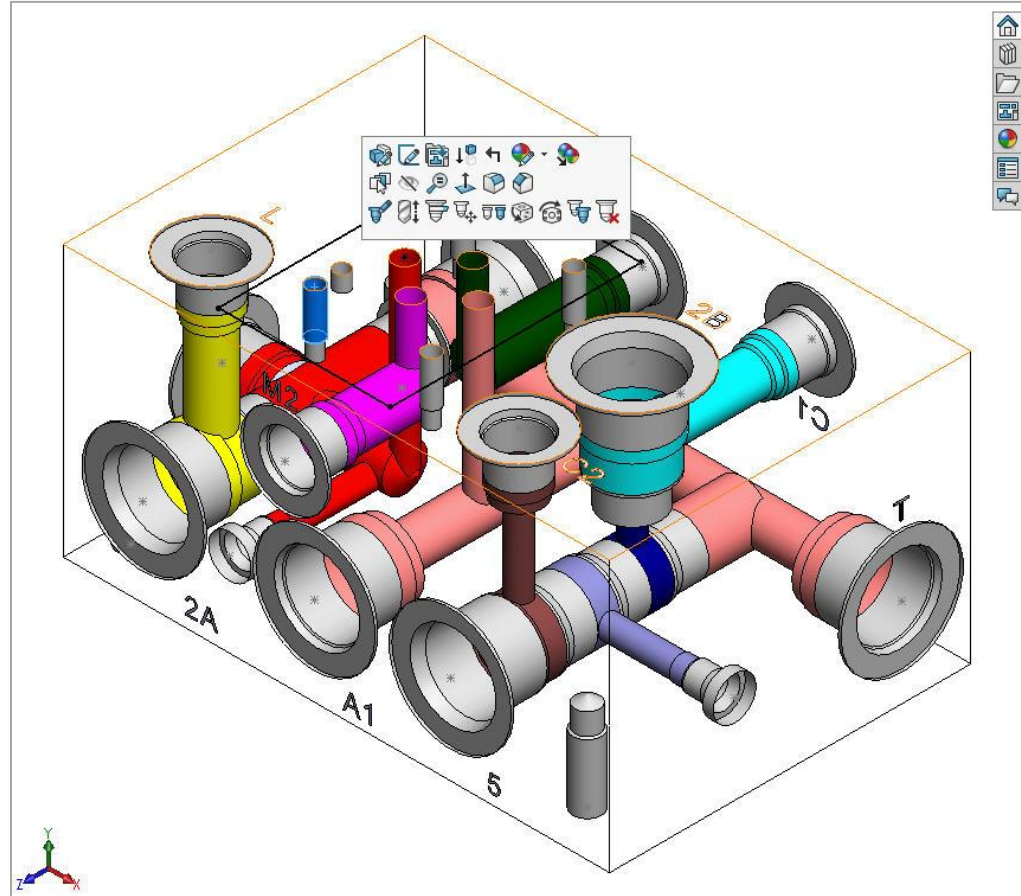
Quickly access commands related to the selected MDTools feature.

Right-click the feature to view the MDTools® context toolbar.

Note:

MDTools add commands to the SolidWorks context toolbar when you select a cavity or manifold block in a model.

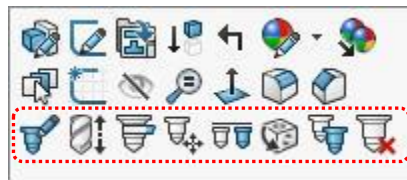
SolidWorks commands also appear along with the MDTools' commands.



MDTools Context Toolbar

Context Toolbar for Cavity

Edit, stretch and incline, connect cavities, move, align, change face, rotate (only for footprints), copy or delete selected cavity.



Context Toolbar for Cavity

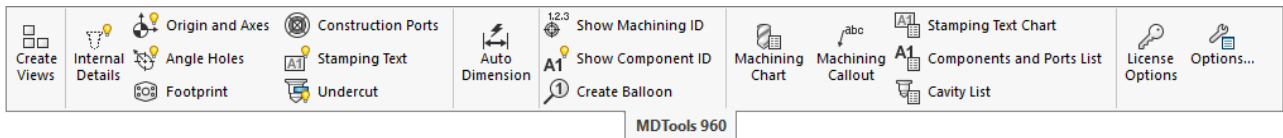
Context Toolbar for Block

Resize or stretch the manifold block.



Context Toolbar for Block

3.2 MDTools Drawing Menu

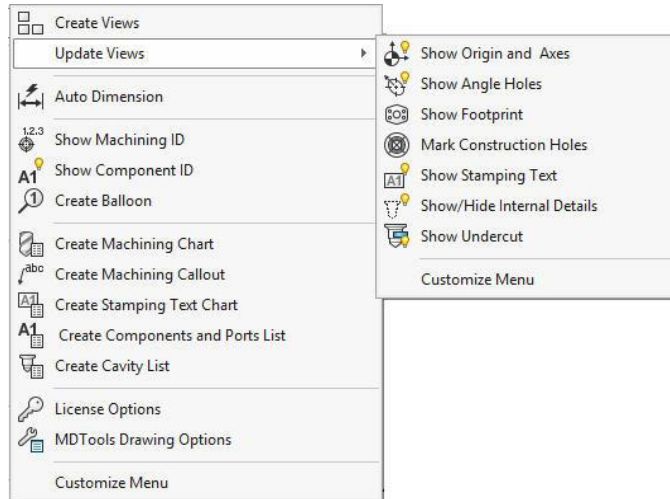


Drawing Ribbon Menu

Commands related to a block machining drawing creation are available only in the 2D drawing environment (.slddrw).

Note:

- MDTools® drawing commands work only in the SolidWorks drawing environment. (.slddrw file)
- MDTools drawing commands work only if the views are created using MDTools.
- MDTools Drawing and Assembly commands can only be undone, if the model is not rebuilt after the command.



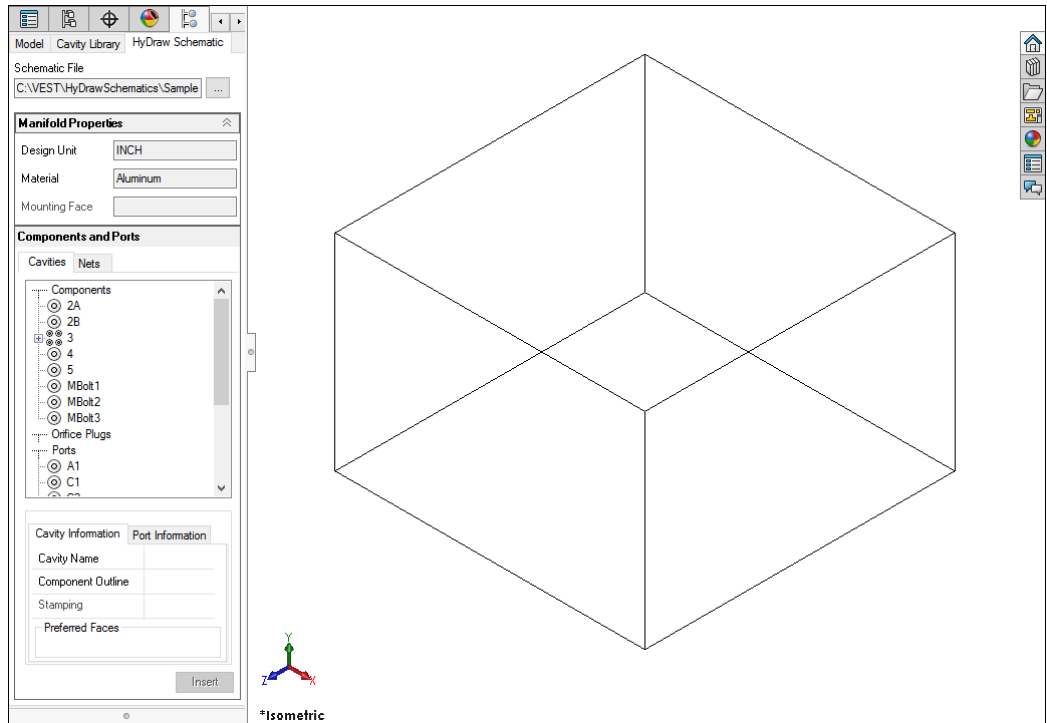
Drawing Dropdown Menu

4. HyDraw Schematic Interface

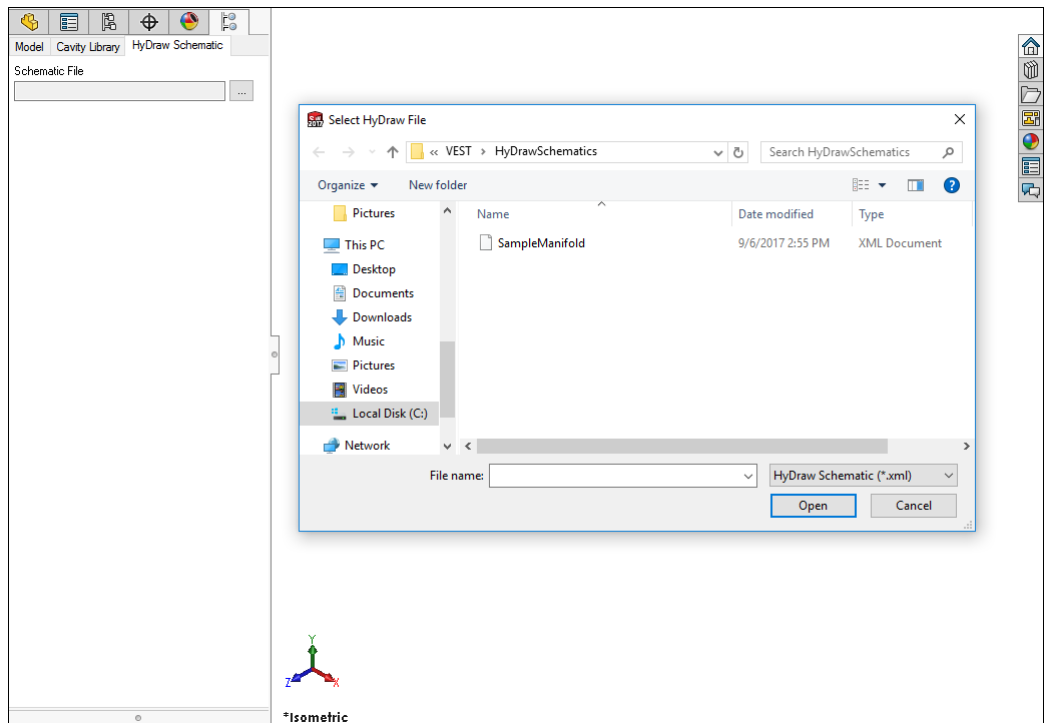
The HyDraw® Schematic Interface enables you to automatically read an XML exported from a HyDraw created schematic drawing and insert all the required cavities with connectivity information into a model.

MDTools® automatically inserts component outline and stamping text (if defined) with the cavity.

1. MDTools 960
> Cavity
> **Cavity From HyDraw**
The MDTools HyDraw Interface dialog box displays.
2. Click **Browse** and select the XML exported from the schematic drawing.
3. Click **Open**.
MDTools automatically populates the Cavity Explorer with all the components from the schematic drawing.



HyDraw Schematic Interface



HyDraw Schematic Interface: Schematic data populated

4.1 Manifold Properties

Manifold section displays properties of the manifold defined in the schematic, such as Design Unit, Material, and Mounting Face.

Manifold Properties

Design Unit: INCH

Material: Aluminum

Mounting Face: Bottom

HyDraw Schematic: Manifold Section

4.2 Components and Ports

This section lists all components and external ports in the schematic.

Select a Component, Orifice plug or Port from the list to view the cavity and port information.

Cavity Information

Cavity Name Name of the cavity in the library

Component Outline Component outline defined for cavity, or

Stamping Stamping text defined for the cavity

Preferred Faces Preferred faces to insert the cavity, defined in schematic

Port Information

Flow, Type, and Net Name defined for each port in the schematic.

Components and Ports

Cavities Nets

Components

- 1
- 3
- 4

Orifice Plugs

- 5

Ports

- CL
- CR
- P

4

Cavity Information Port Information

Cavity Name: T-11A

Component Outline:

Stamping: 4

Preferred Faces: Top, Front, Left, Right, Back

Insert

4

Cavity Information Port Information

Port	Flow	Type	Net Name
1	2	Pressure	NET-2
2	10	Tank	NET-10
3	10	Pilot	NET-11

HyDraw Schematic: Components and Ports Section

4.3 Construction Ports

This section lists construction ports to be used in the design, which are defined when exporting the schematic data from HyDraw.

Select the Flush option to insert a flushed x-port.

Construction Ports

Cavity Name: G 1/2-14

Flush

Insert

HyDraw Schematic: Construction Ports Section

4.4 Mounting Holes

Directly insert mounting holes inside the manifold, which are defined when exporting the schematic data from HyDraw.

Mounting Holes

Cavity Name: M10x1.5-6H

Number of Holes: 4

Through Hole

Insert

HyDraw Schematic: Mounting Holes Section

5. MDTools Cavities

In MDTools®, all types of holes used in a manifold are called **Cavities**.

An MDTools cavity can be a drill hole, a port (SAE ports, BSP ports, NPT ports, etc), a cartridge valve cavity, a bolt hole, locating pin hole, or an under cut.

5.1 Modeling Cavities

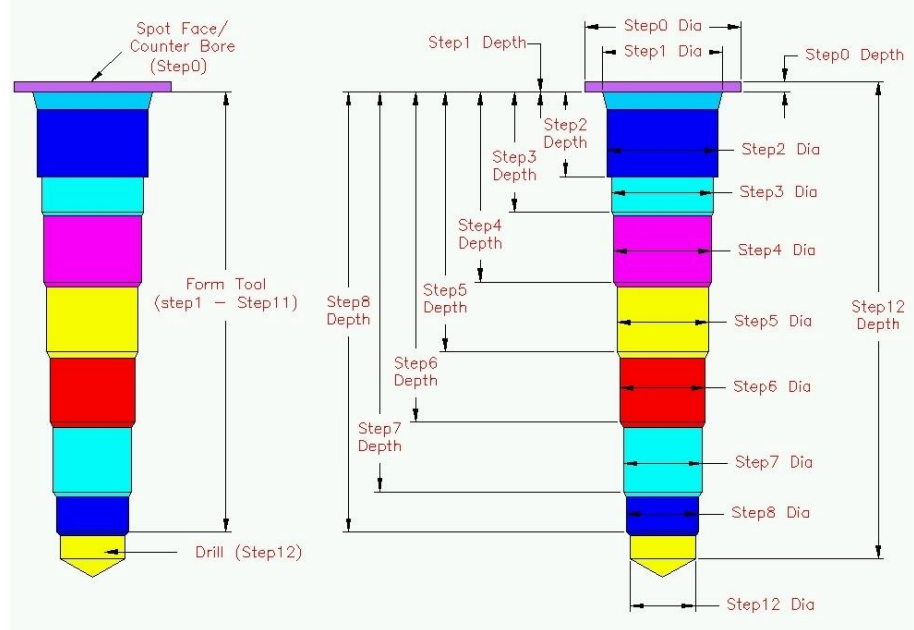
Geometry of a cavity is defined in terms of its dimensions, and its relationship with the step number and step dimensions.

Each step, which consists of cylindrical and or a conical pair, in the cavity profile is denoted by the term 'Step' in MDTools.

Step information is analogous to a drill tool, which has the drill diameter, drill depth, and bottom cone angle of the drill.

Note:

Depth for Step1 through Step11 is measured from Step0.



MDTools Cavity Geometry

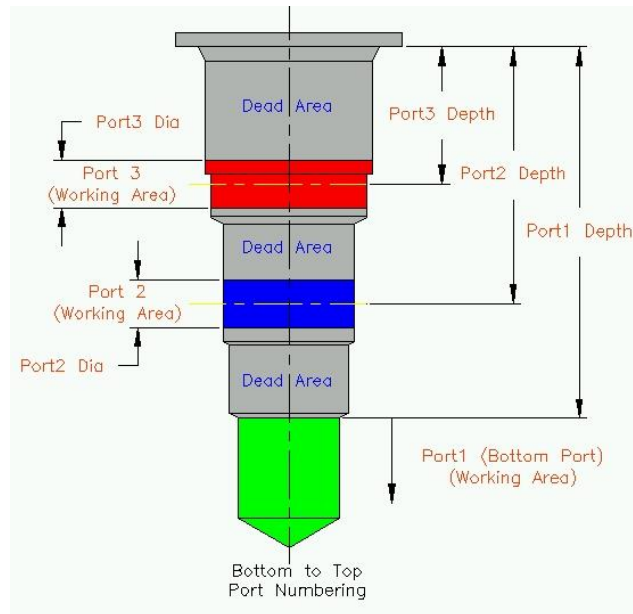
1 Cartridge Valve Cavities

Cartridge valve cavities are divided into working areas (port areas) and dead areas.

All the parts of a cavity other than the port areas are considered as Dead Areas.

Note:

Bottom port depth of a cartridge valve cavity is the starting depth of the bottom port from the spot face.



Typical 3-port Cartridge Valve Cavity

2 Ports

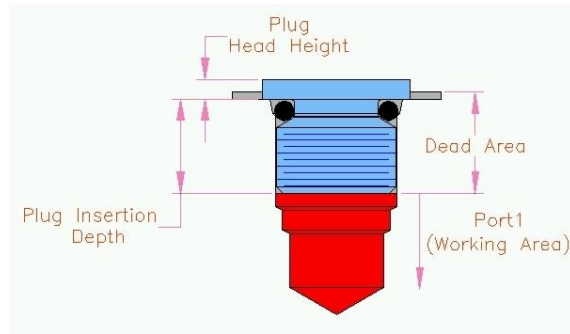
Cavities of ports are divided into working and dead areas.

Area of cavity below the insertion depth of plug/fitting is considered as Working Area.

Area down to the insertion depth is considered as Dead Area.

Note:

- For port cavities, the plug insertion depth must be specified.
- If not specified, the complete cavity will be included in the working area during connectivity and wall thickness checks.

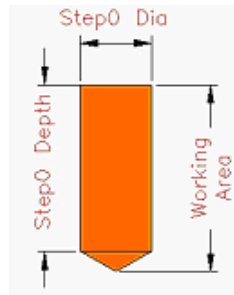


Port Cavities

3 Drill Holes

The complete cavity is treated as Working Area.

Hole dimensions are entered in Step0 of the cavity.



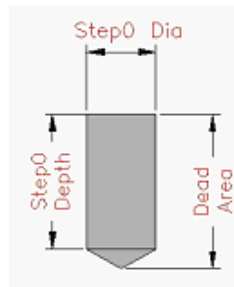
Drill Holes

4 Locating Pin Holes

The complete cavity is treated as Dead Area.

Hole dimensions are entered in Step0 of the cavity.

All the dimensions are fixed.



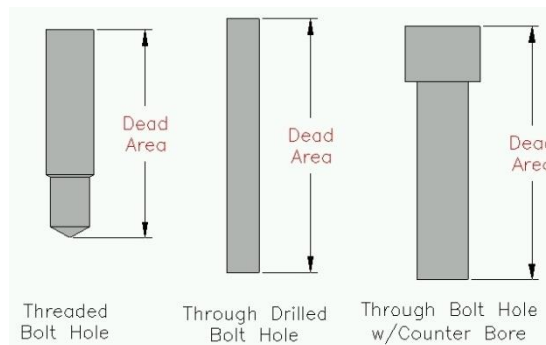
Location Pin Hole

5 Bolt Holes

The complete cavity is treated as Dead Area.

Three variations of bolt holes are used in manifold design.

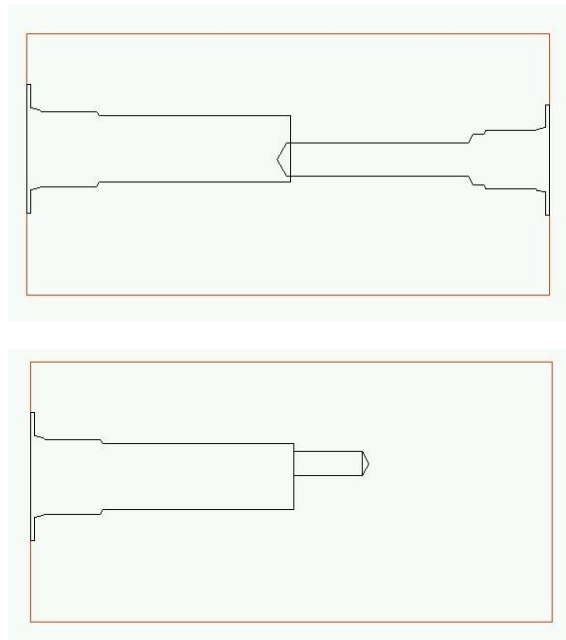
1. Threaded Bolt Hole (for mounting components on manifolds and for mounting manifolds)
2. Through Drilled Bolt Hole
3. Through Bolt Hole with Counter Bore (for mounting manifolds)



Bolt Holes

Note:

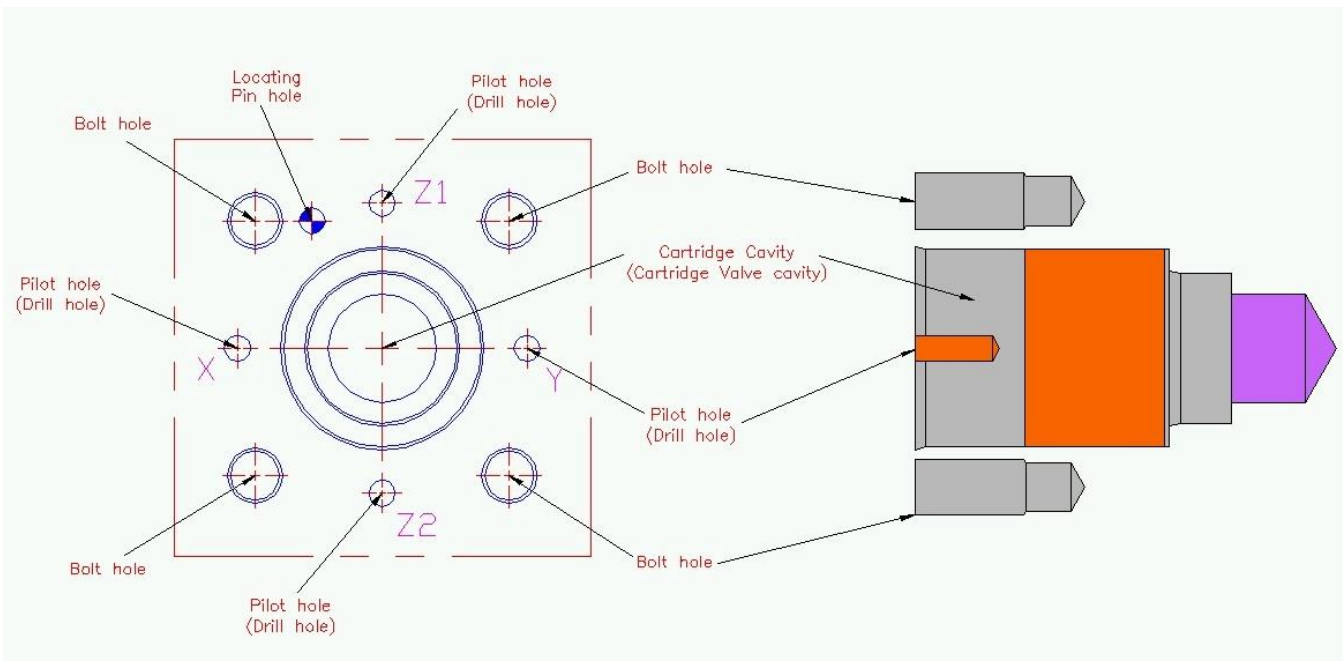
- Cavities meeting at the bottom of a flat bottom cavity (cavity with 0 angle in the last step); and an offset hole passing through the flat bottom cavity, does not appear in the meet list of cavity.
- When you use flat bottom drills inside cavities, instead of making it exactly flat with 0 degree angle, use a small angle, let us say 1 degree, and allow the formation of a very small cone at the bottom to get correct result in design check. (This is a current limitation.)



5.2 Footprints

If a component in a circuit has more than one cavity, such cavities are grouped together to form footprints.

Footprints generally contain different type of cavities; bolt holes for mounting the component, locating pinholes for locating the component in correct orientation, and holes for different ports on the component.



Typical slip-in cartridge valve footprint

6. Nets (Flow paths)

*All the valve ports and external ports that are interconnected are in various flow paths. In MDTools®, all these flow paths are called **Nets**.*

6.1 Net List

The **Net List** information is entered for each cavity in the manifold using the Edit Cavity dialog box.

Each cavity or each port of a cartridge valve identifies its connectivity, per the System Circuit diagram or schematic.

When MDTools design rule checks are performed, **meet lists** are generated.

These meet lists are processed further to generate the connectivity net lists.

1 Design Net List

The **Design Net List** is generated from the net information entered for each of the cavities, per the schematic.

Any cross drills used in the manifold to make connection must also be included in this net list.

2 Connectivity Net List

The **Connectivity Net List** gives the actual connectivity inside the manifold.

If the Design Net List and the Connectivity Net List match, then the manifold connectivity may be assumed to match the connectivity in the circuit diagram.

3 Creating a Net List from a Schematic

MDTools® provide facilities to check a manifold design against the circuit diagram by enabling consistent naming convention, between the circuit diagram and the manifold design.

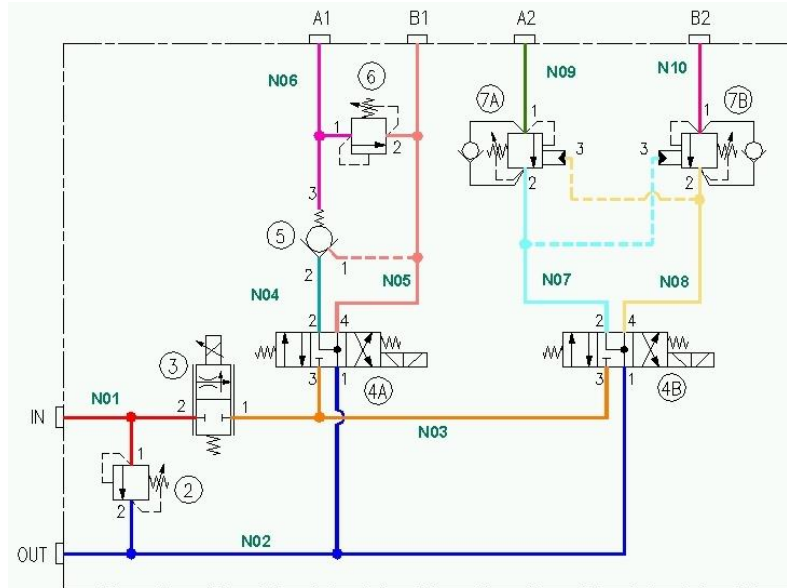
MDTools consistent naming system between schematics and the manifold encompasses:

- Component names in the schematics, with the cavity ID in the manifold.
The component name in the schematic will be used as the component ID for the cavity on the manifold.
- Port numbering/naming in the schematic and in the manifold.
- Net lists (flow paths) in the schematic and in the manifold.

Study the method used to create a net list from a schematic and use it in the manifold design.

Observe the following for the typical schematic diagram shown on right.

1. The circuit has eight components. Components 2, 3 and 6 have two ports each, components 5, 7A, and 7B have three ports each, and components 4A and 4B have four ports each.
2. The manifold has six ports, IN, OUT, A1, A2, B1, and B2.
3. For designing the manifold, consider these ports as components and assign the component names as the port names.



Typical schematic showing nets

Each unique path or passage in the schematic/manifold is termed as a **Net**, and numbered serially N01, N02, N03, ...

Naming all the nets in the schematic enables precise description of the manifold passages in relation to the corresponding schematic diagram.

Observing the schematic, a Net List of connections can be made as follows:

Net Name	Component ID-Port name
N01	2-1, 3-2, IN
N02	2-2, 4A-1, 4B-1, OUT
N03	3-1, 4A-3, 4B-3
N04	4A-2, 5-2
N05	4A-4, 5-1, 6-2, B1
N06	5-3, 6-1, A1
N07	4B-2, 7A-2, 7B-3
N08	4B-4, 7A-3, 7B-2
N09	7A-1, A2
N10	7B-1, B2

The listing is interpreted as follows:
(For example N01 and N02)

N01 (Net 1) consists of passages connecting 2-1 (port1 of component 2), 3-2 (port2 of component 3) and port IN

N02 (Net 2) consists of passages connecting 2-2 (port2 of component 2), 4A-1, (port1 of component 4A), 4B-1, (port1 of component 4B) and port OUT.

Refer the schematic and check the listing for other nets.

7. Using Angle Holes

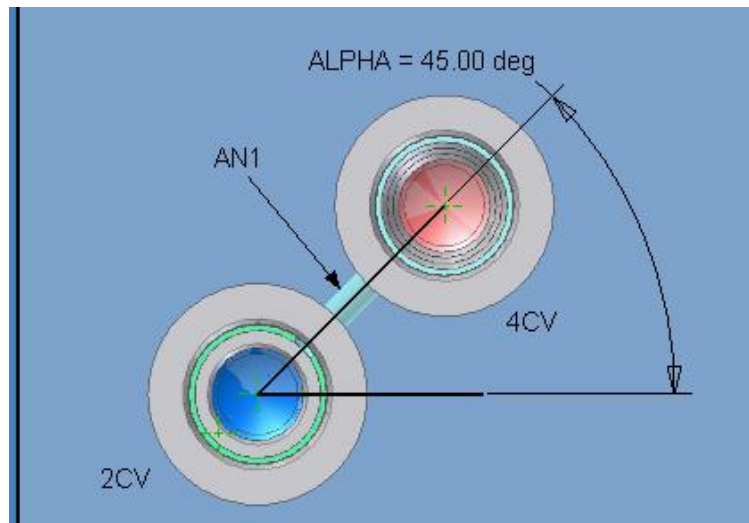
Compact manifolds, using minimum number of cross drills are often possible using angle drill holes. MDTools® is equipped to model, visualize, and design using angle holes.

Let us see how to use the angle drill holes to create connections when designing a manifold with the help of an example.

The figure, 'Alpha' - rotation on the surface, displays two cavities, 2-CV and 4-CV, which are connected using angle drill AN1, inside cavity, 2-CV.

1. Cavity 2-CV is a 2-port cartridge valve cavity. Cavity 4-CV is a 4-port cartridge valve cavity.
2. Port2 of 2-CV is required to be connected to Port2 of the 4-CV valve.

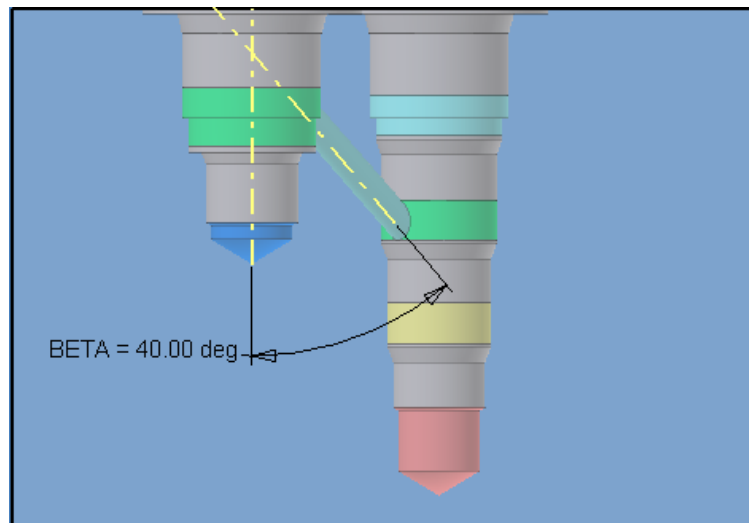
This connection is made using a compound angle drill AN1.



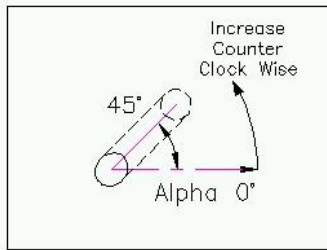
Alpha - rotation on the surface

Note:

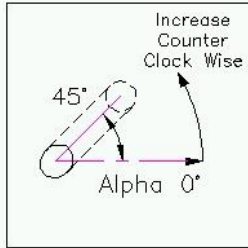
- Alpha angle is the rotation of an angle hole on the surface.
- Angle holes with alpha angle of 0, 90, 180, or 270 are called Simple Angle Holes.
- Angle holes with alpha angle other than 0, 90, 180, or 270 are called Compound Angle Holes.
- Beta angle is the inclination of the angle hole from the surface normal.
- Alpha and Beta values are the values entered in the MDTools Edit Cavity dialog box.



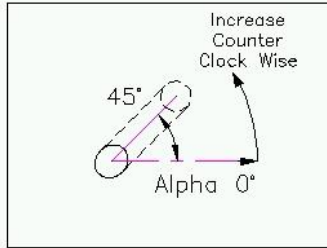
Beta - inclination from surface Normal



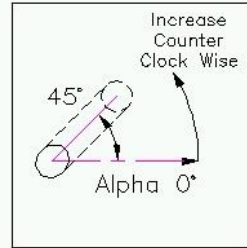
A Top



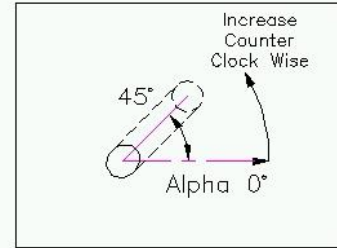
D Left



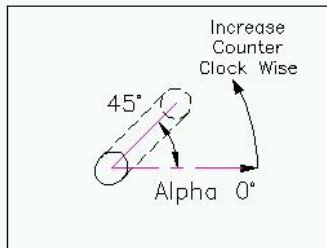
B Front



E Right



F Back



C Bottom

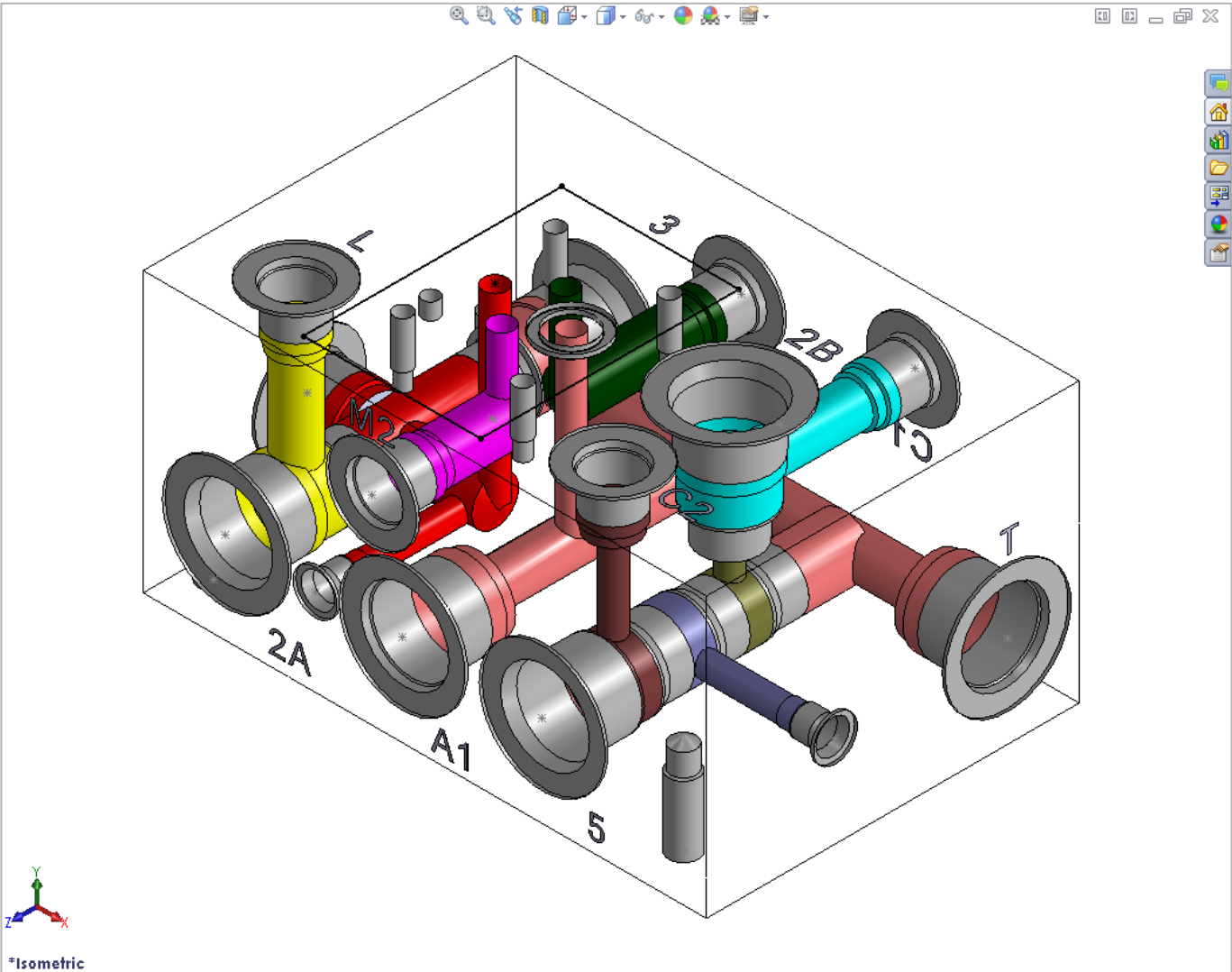
Alpha angle convention used in MDTools

Note:

The depth of an angle hole shown in the Edit Cavity dialog box is the depth along the axis of the angle hole.

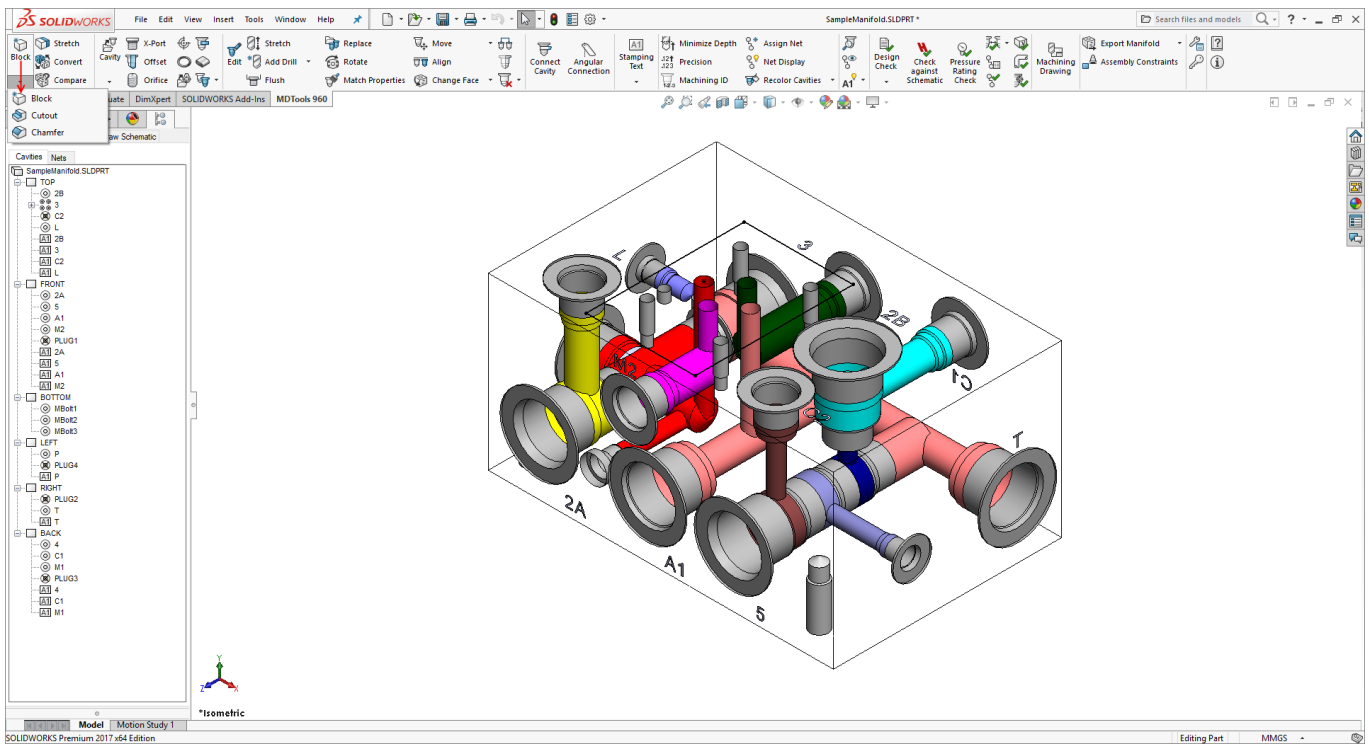
DESIGN and CHECK COMMANDS

8 - 14	Block Commands
15 - 27	Insert
28-33	Edit Cavity
34 - 49	Modify Cavity
50 - 51	Make Connections
52 - 54	Stamping Text
55 - 61	Update Block
62 - 66	Display Options
67 - 77	Design Check
78 - 82	Miscellaneous
83 - 84	MDTools Settings
85 - 86	Help



Block Commands

- 8 Create Block
- 9 Resize Block
- 10 Stretch Block
- 11 Create Cutout
- 12 Create Chamfer
- 13 Convert Manifold
- 14 Compare Manifolds

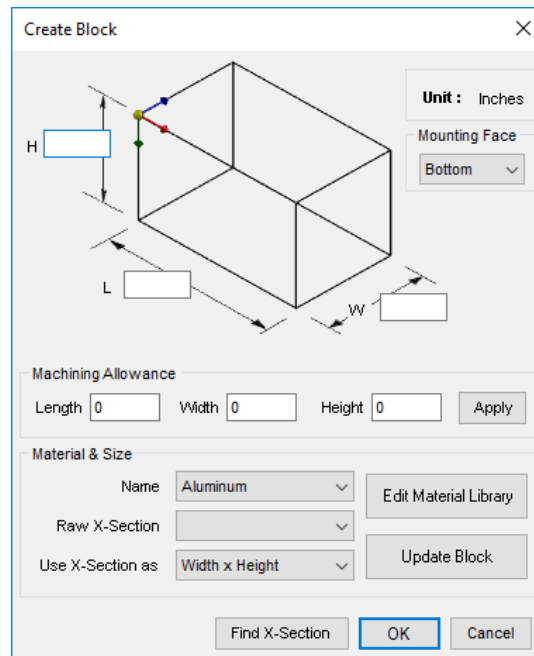


8. Create Block

Automatically draw the manifold block in SolidWorks based on the required manifold length, width, and height entered; or by selection of the required material cross section from an existing material X-section database, and input of the corresponding length. The Machining allowance values on the raw X-section can also be specified.

8.1 Create Block - Dimensions entered manually

1. MDTools 960
> **Block**
The Create Block dialog box displays.
2. Enter the required dimensions manually.
3. Enter the manifold dimensions in the data fields:
 - **H** Manifold Height
 - **L** Manifold Length
 - **W** Manifold Width
4. Enter the machining allowance for each of the dimensions.
5. Click **Apply**.
The machining allowance is subtracted from the respective manifold dimensions when drawing the manifold.

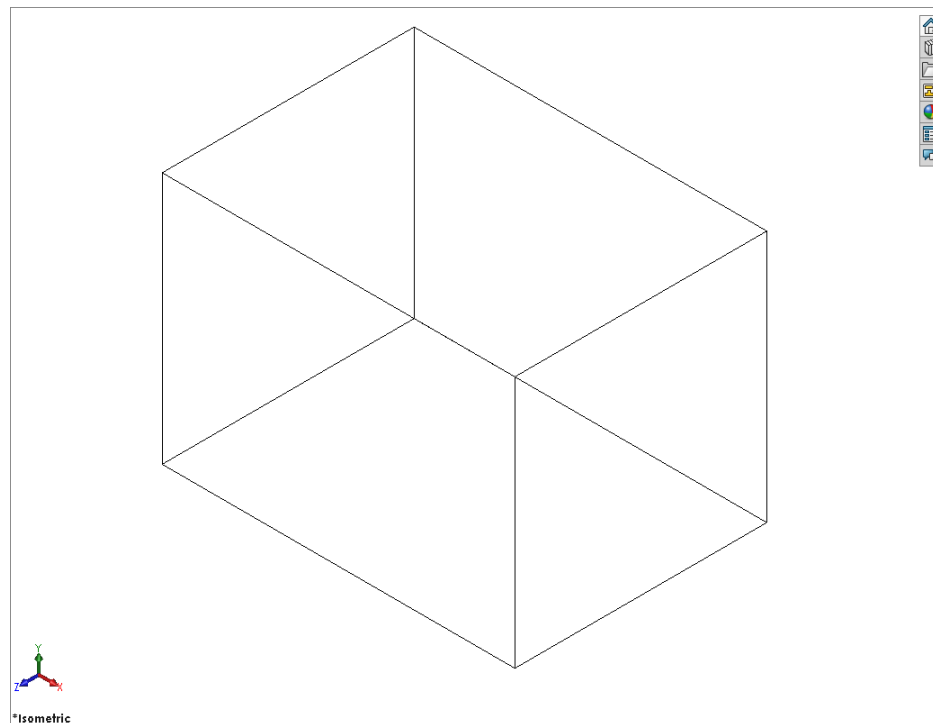


Create Block dialog box

6. Click **OK** after the required data is entered.
MDTools[®] automatically creates the block in the SolidWorks model workspace.

Note:

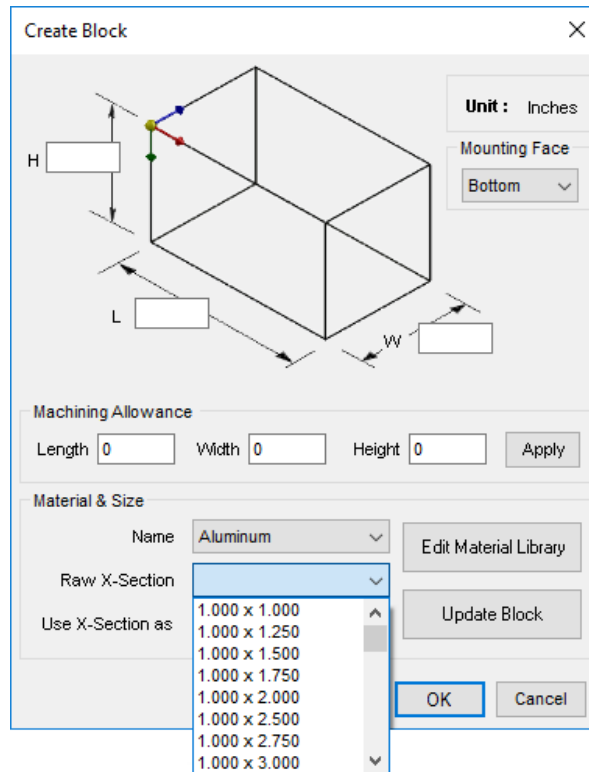
- MDTools uses the following model parameters to define the block dimensions: Block Length, Block Height, and Block Width.
- Do not change these parameter names, if you change any of these parameter names, the MDTools' Modify Block command will give unexpected result.



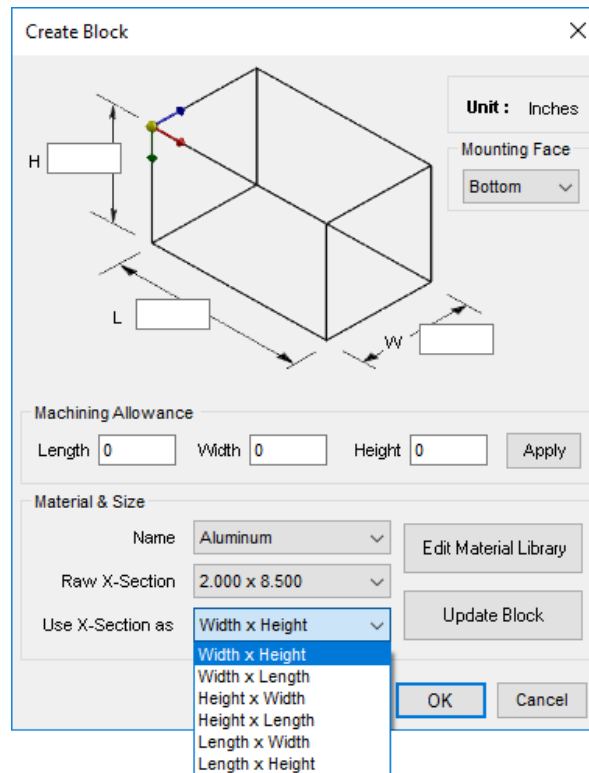
Block created in SolidWorks

8.2 Create Block - using Material X-Section Libraries

- MDTools 960
> **Block**
The Create Block dialog box displays.
- Select the material from the **Name** drop-down menu in the Material & Size section.
The default material is Aluminum. You can change the material, if required.
- Select the raw X-section from the **Raw X-Section** list of the selected material.
- Select the required option from the **Use X-Section as** list.
You can use the X-section in any of the possible combination of length, width, and height.
- Click Update Block Dimensions.
MDTools® updates the block dimensions with the selected X-section, per the selection made in the Use X-Section as option.
- Enter the third dimension for the block.
For example, if X-section is used for block width and height, then enter the block length.
- Enter the machining allowance for each of these dimensions.
- Click **Apply**.
The machining allowance is subtracted from the respective manifold dimension when drawing the manifold.
- Click **OK** after the required data is entered.
MDTools automatically creates the block in the SolidWorks model workspace.



Create Block dialog box showing the material X-section dimensions



Create Block dialog box: Use X-Section as

8.3 Create Material X-Section Library

MDTools® enable new X-sections and material data to be added into the Material X-section library. The existing X-sections or materials in the library can also be edited.

1. MDTools 960
> **Block**
The Create Block dialog box displays.
2. Click Edit Material Library.
The Edit Material Library dialog box displays.

Add New Material

3. Enter the material name in the Material text box.
4. Click **Add**.
MDTools adds the new material into the library.

Change Material Name

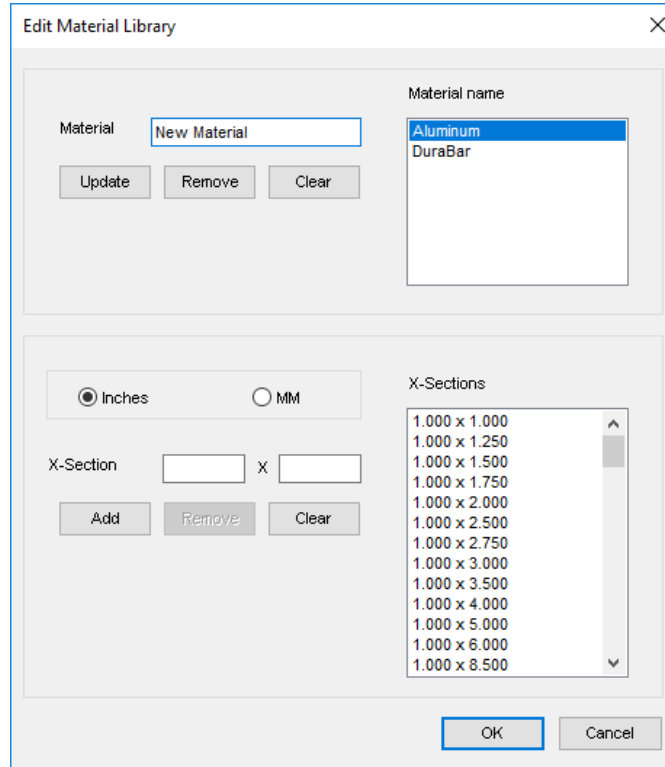
5. Select the name of the material you want to change from the material list.
The selected material name is displayed in the Material text box.
6. Enter the new material name in the Material text box.
7. Click **Update**.
MDTools updates the material name with the new name entered.

Delete Material

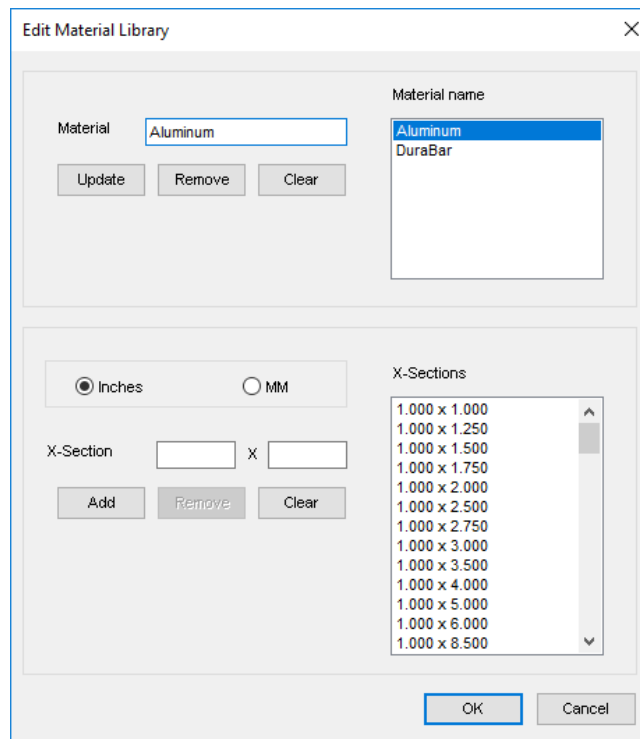
8. Select the material you want to remove from the material library.
The selected material name is displayed in the Material text box.
9. Click **Remove**.
A message displays 'Do you want to delete selected material name?'
10. Click **Yes**.
MDTools deletes the material from the Material library.

Note:

Click **Clear** to clear the material selection or an entry in the Material box.



Add new material



Update material name

Add new X-section

1. Select a material name from the library
A list of X-section displays in the X-Sections list.
2. Select the unit, **Inches** or **MM**.
3. Enter the X-section dimensions in the text boxes.
4. Click **Add**.
MDTools® adds the new X-section to the library.

Change X-section dimension

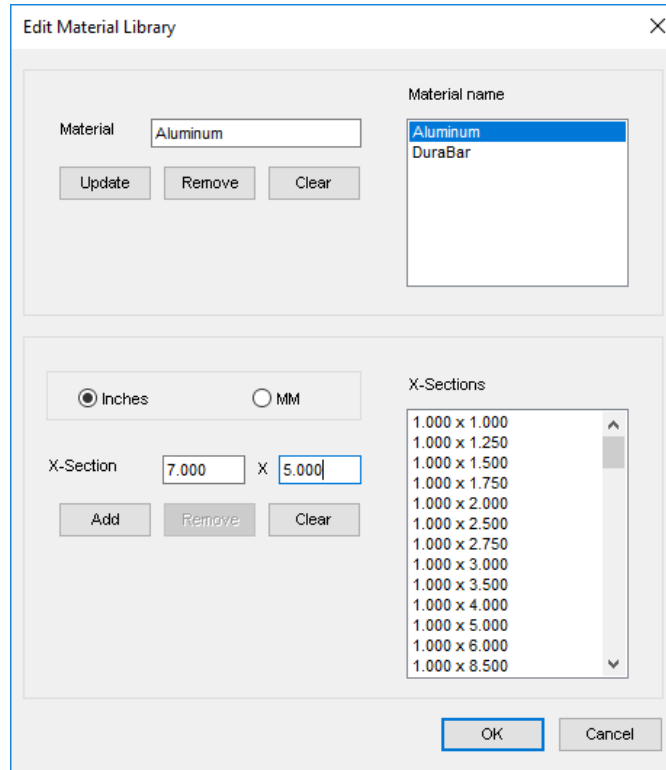
5. Select the X-section you want to change from the X-Sections list.
X-section dimensions are displayed in the text boxes for X-Section.
6. Select the X-section you want to change.
7. Change the dimension in the **X-Section** textboxes, as required.
8. Click **Update** to save the change.

Delete X-Section

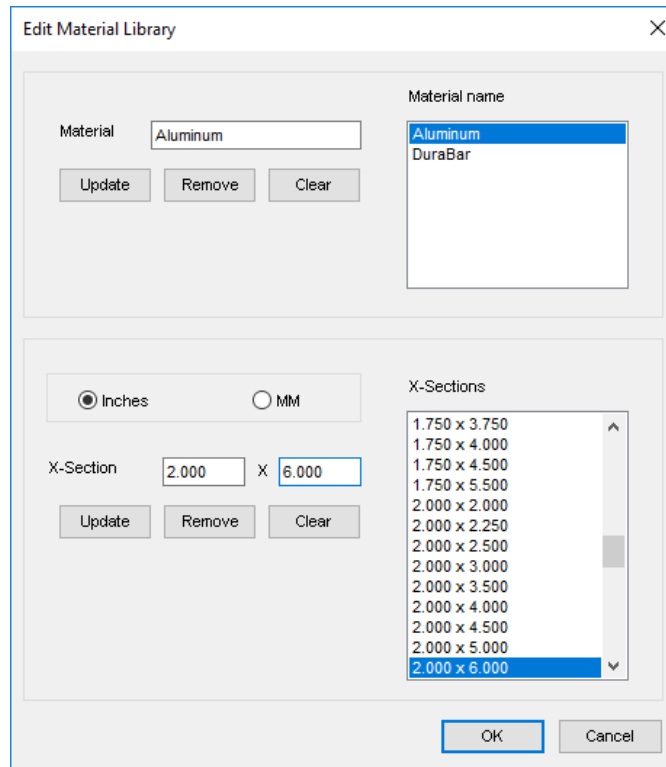
9. Select the X-section you want to remove from the library.
X-section dimensions are displayed in the text boxes for X-Sections.
10. Click **Remove**.
A message displays, 'Do you want to delete selected X-section?'
11. Click **Yes**.
MDTools deletes the selected X-section from the Material library.

Note:

Click **Clear** to remove the entries in the X-Section text boxes or to clear the X-Section selection.



Add new X-section



Change X-section dimensions

8.4 Find X-Section

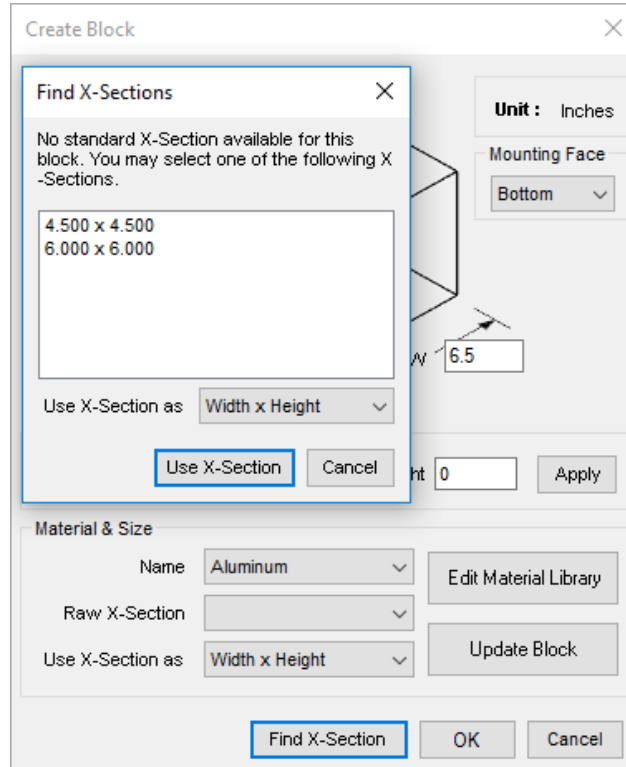
Check the availability of X-sections when you enter the block dimensions manually, i.e., without selecting a standard X-section from the Material library.

1. Select the desired material from the Material **Name** list from the Create Block dialog box.
2. Click Find X-Section.

MDTools® checks the availability of X-sections for the block dimensions in the selected material X-section list.

If a standard X-section is available, then MDTools displays the X-section dimensions in a message box.

If a standard X-section is not available, then MDTools lists the nearest X-sections available and displays in the Find X-Sections dialog box.



Find X-Sections dialog box

Updating Block Dimensions

Use one of the X-sections listed in the Find X-Sections dialog box and update the block dimensions with the standard X-section.

3. Select the X-section you want to use for the block.
4. Select the required **X-section** from the **Use X-Section as** drop down.
5. Click Use X-Section.

MDTools updates the block dimensions with the selected X-section dimensions.

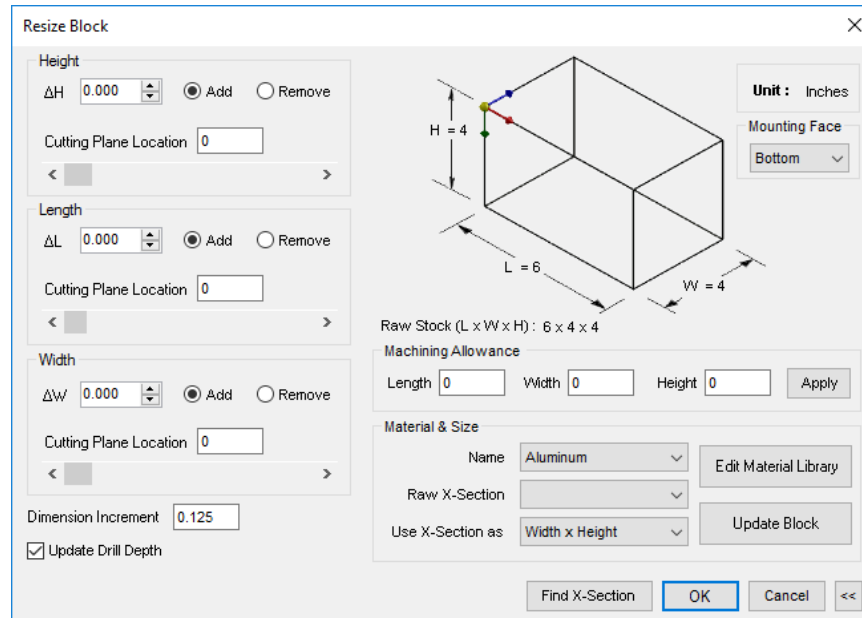
Note:

The Create Block command cannot be undone in the SolidWorks interface.

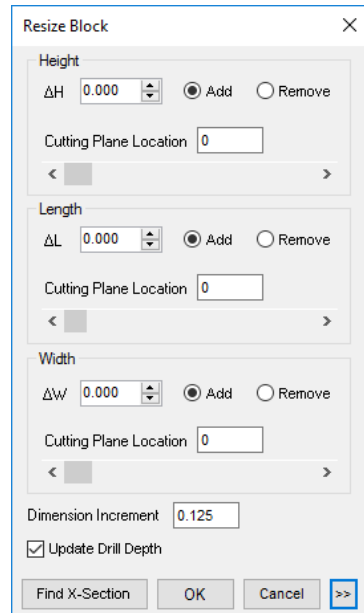
9. Resize Block

Modify the manifold block size during the manifold design process based on the required change in manifold size. The length, width, and height can be changed by entering the values in the space provided; or by selection of required material cross section from an existing material X-Section library.

1. MDTools 960
> **Block**
The *Resize Block dialog box* displays.
2. Enter the change in the dimension.
3. Select **Add** or **Remove** to add or remove material.
4. Specify location, where you want to add/remove the material, either by entering value in the Cutting Plane Location text box or by using the scroll bar.
5. Select **Update Drill Depth** to update the drill depth of the cavities according to the change in block dimensions.
6. Click **OK**.
The manifold block will be modified, per specified values. The location and the drill depth of the affected cavities will also be modified.



Modify Block dialog (Expanded)



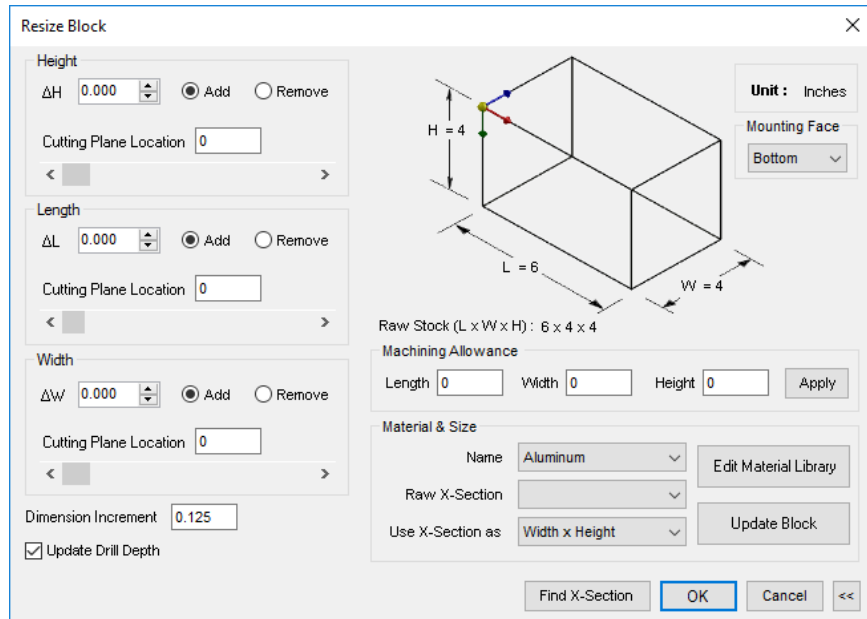
Modify Block dialog (Collapsed)

9.1 Using X-Sections to Modify Block Dimensions

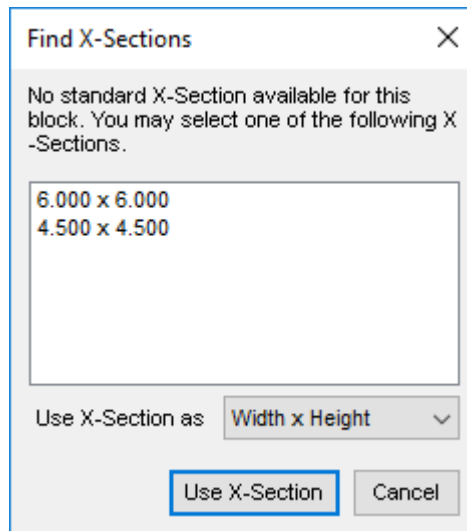
1. Select a material from the **Material Name** list.
2. Select an available raw X-section from the list.
3. Select a combination of dimensions from the Use X-Section as list.
4. Click the Update Block Dimensions button.
Or, if no X-section is used by any combination of block dimensions then Click the Find X-Section button.

The Find X-Sections dialog displays.

5. Select any suggested **X-Section** from the list.
6. Select a combination from the **Use X-Section as** dropdown.
7. Click the **Use X-Section** button.
The values in the delta textboxes are updated, per the selected option.
8. Specify the cutting plane location.
9. Click **OK** to update the manifold block.



Resize Block dialog box



Find X-Sections dialog box

Note:

- When you enter the block dimensions manually, use the Find X-Section button to check the availability of an X-section.
- If a standard X-section is available, then MDTools® displays the X-section dimensions on a message box.
- If a standard X-section is not available, then MDTools lists the nearest X-sections available in the Find X-Sections dialog box.

10. Stretch Block

*Stretch and change the block size by dragging a manifold face in the model.
Snap to X-Section option enables to use material x-sections available in library.*

1. MDTools 960
 > Block
 >**Stretch Block**

MDTools prompts to select a manifold face.

2. Select a face
Stretch Block dialog box displays.

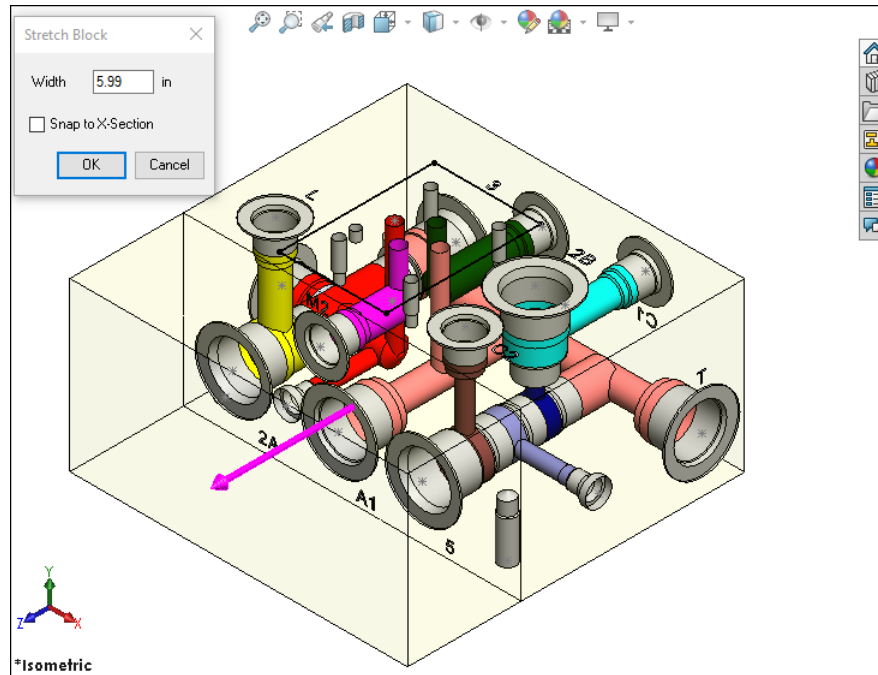
The Select arrow appears on the selected face.

3. Select **Snap to X-Section** to snap the selected dimension to the available x-sections in the library.

4. Drag the select arrow in the desired direction to change the block dimension.

5. Change the value in textbox, if required.

6. Click **OK** to apply the changes.
Location and drill depth of the cavities will be updated, if required.



Stretch Block

Note:

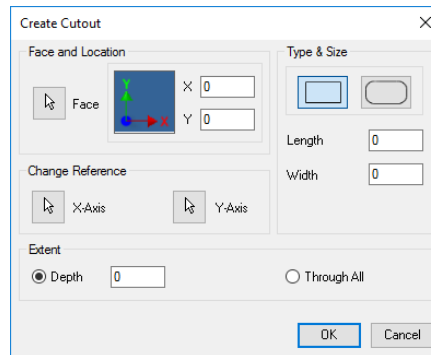
You can also edit the selected dimension directly by editing the value in the textbox.

11. Create Cutout

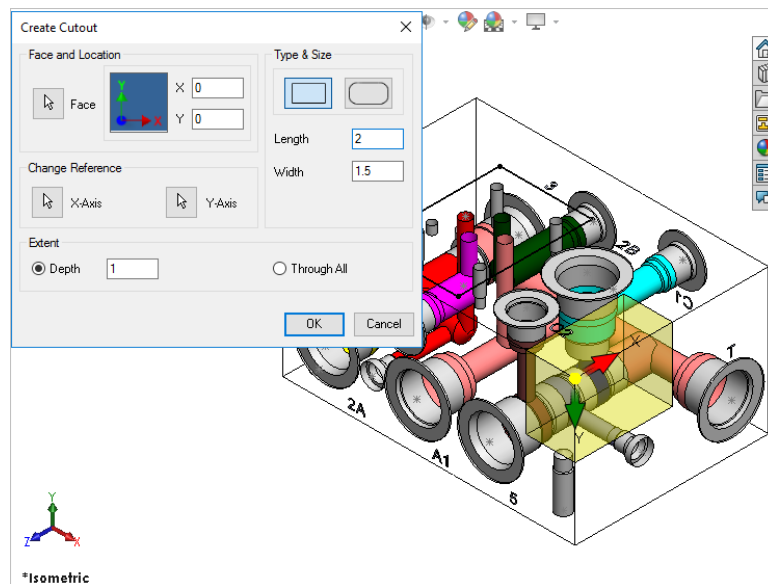
Design non-rectangular manifolds: Create cutouts on a selected face with the specified values.

Create Cutout

1. MDTools 960
> Block
> **Cutout**
The Create Cutout dialog box displays.
2. Select a face to insert the cutout.
The default X and Y axis displays.
3. Change reference, if required.
4. Enter the X and Y location as the start point of the profile (rectangle or rounded rectangle).
5. Specify a type for the cutout i.e. rectangle or rounded rectangle.
6. Enter the **length** and **width** (and corner radius, if the rounded rectangle option is selected).
The preview of the cutout displays.
7. Select the **Extent** type, Depth and/or Through All.
8. Click **OK** to create the cutout.
The Cutout is created, per the specified dimensions/parameters.



Create Cutout dialog box



Create Cutout preview

Delete Cutout

1. Select the SolidWorks Features Manager Design tree.
2. Right-click the **Cut Extrude** option of the Cutout feature and select **Delete**.

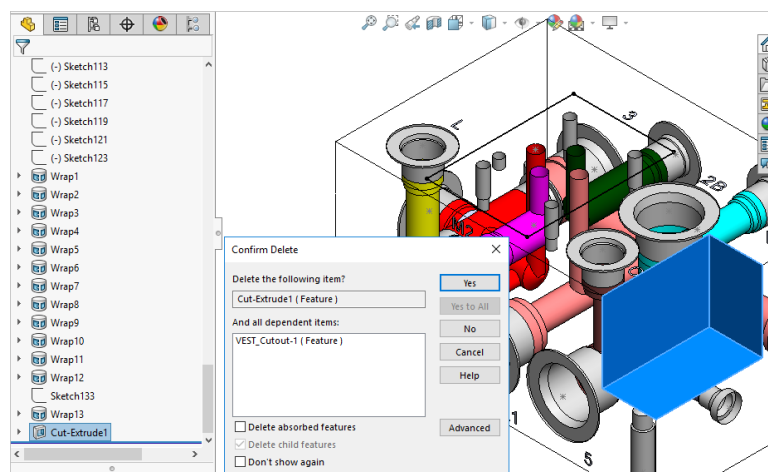
The Confirm Delete dialog box displays.
3. Select the **Delete absorbed features** option and click **Yes**.

Note:

You can edit the cutout from the SolidWorks Feature Manager Design Tree also.

Limitation:

In a Non-rectangular manifold (with cutout), you may not get expected result with the following commands, Insert Bolt Holes, Connect to Cavity, Angular Connection, Export Manifold, Import Manifold, Shrink Wrap, and Show/Hide Internal Details.



SolidWorks Feature Manager Design Tree - Cutout

12. Create Chamfer

Create the chamfer feature inside the SolidWorks part model. It helps you design a non-rectangular manifold using MDTools®.

1 Create Chamfer

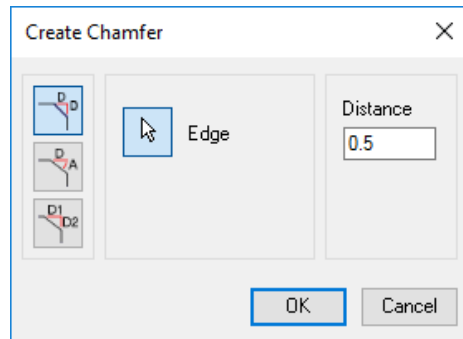
MDTools 960

> Block

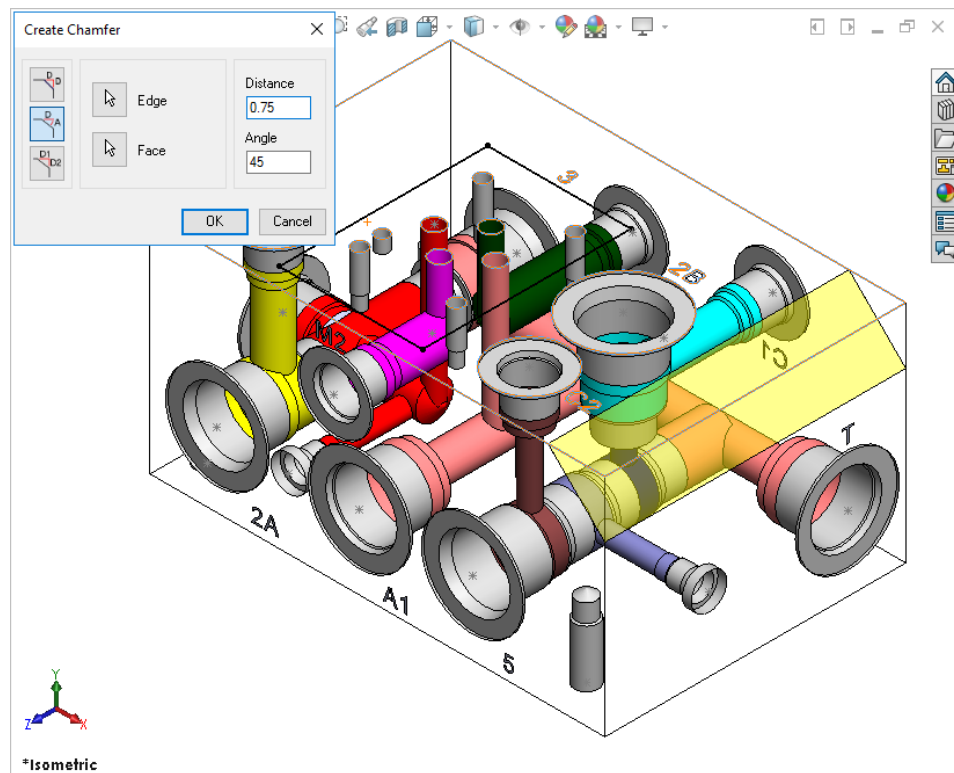
> Chamfer

The Create Chamfer dialog box displays.

1. Specify a chamfer creation method by selecting the required icon, Equal Distance, Distance-Angle, or Distance-Distance.
2. Select an **Edge** to create a chamfer.
3. If required, select a face adjacent to the selected edge to change the reference direction, if the Distance-Angle or Distance-Distance option is selected.
4. Enter the required values.
The preview for the chamfer displays.
5. Click **OK** to create the chamfer.
MDTools adds a chamfer to the selected edge, per specified parameters.



Create Chamfer dialog box



Create Chamfer preview

2 Delete Chamfer

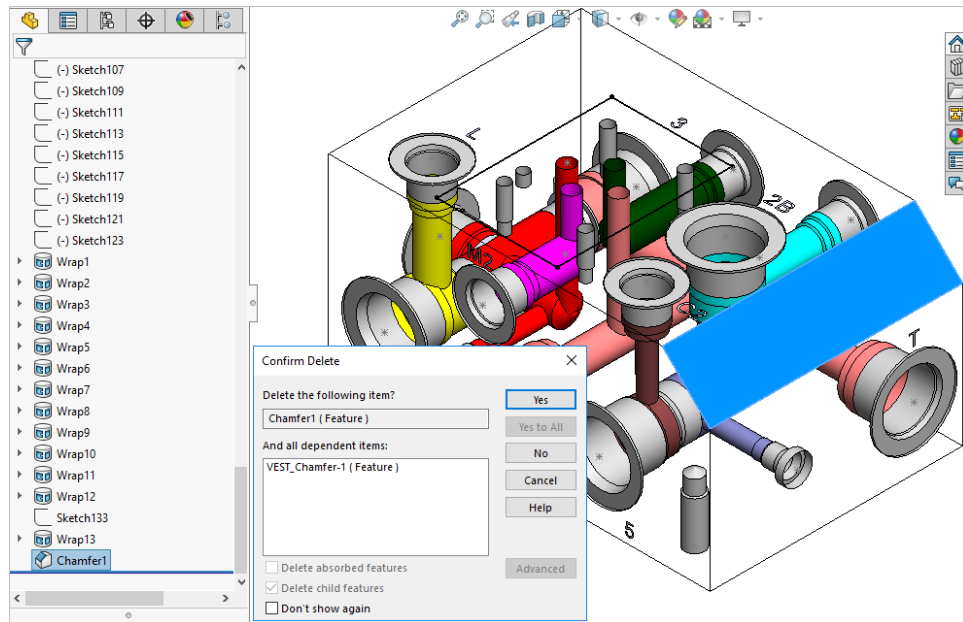
1. Select the SolidWorks Feature Manager Design tree.
2. Right click the **Chamfer** feature and select **Delete**.
The Confirm Delete dialog box displays.
3. Click **Yes**.

Note:

- You can edit the chamfer from the SolidWorks Feature Manager Design Tree.

Limitation:

- In a Non-rectangular manifold having angled surfaces (Chamfered surfaces not parallel to the six manifold faces), you may not get expected result with the following commands, Insert Bolt Holes, Connect to Cavity, Angular Connection, Export Manifold, Import Manifold, Shrink Wrap, and Show/Hide Internal Details.



SOLIDWORKS Feature Manager Design Tree – Delete Chamfer

13. Convert Manifold

Convert a virtual cavity design into a feature-based block design and vice versa.

MDTools 960

> Block

> Convert

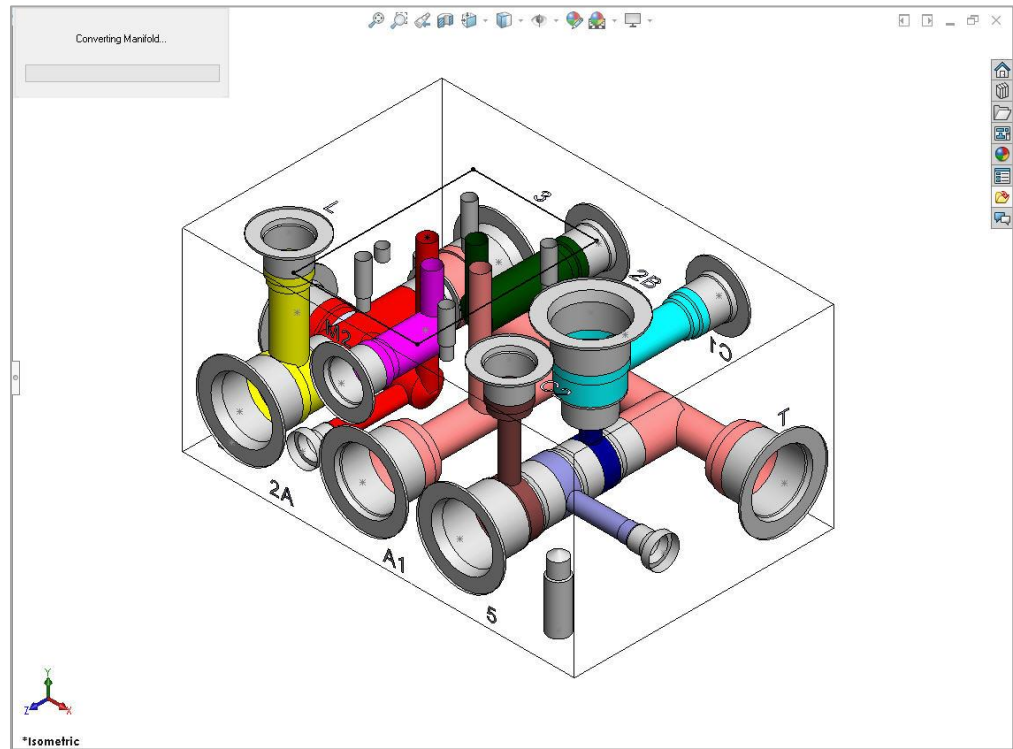
The *Converting Manifold...* message displays.

MDTools® automatically converts:

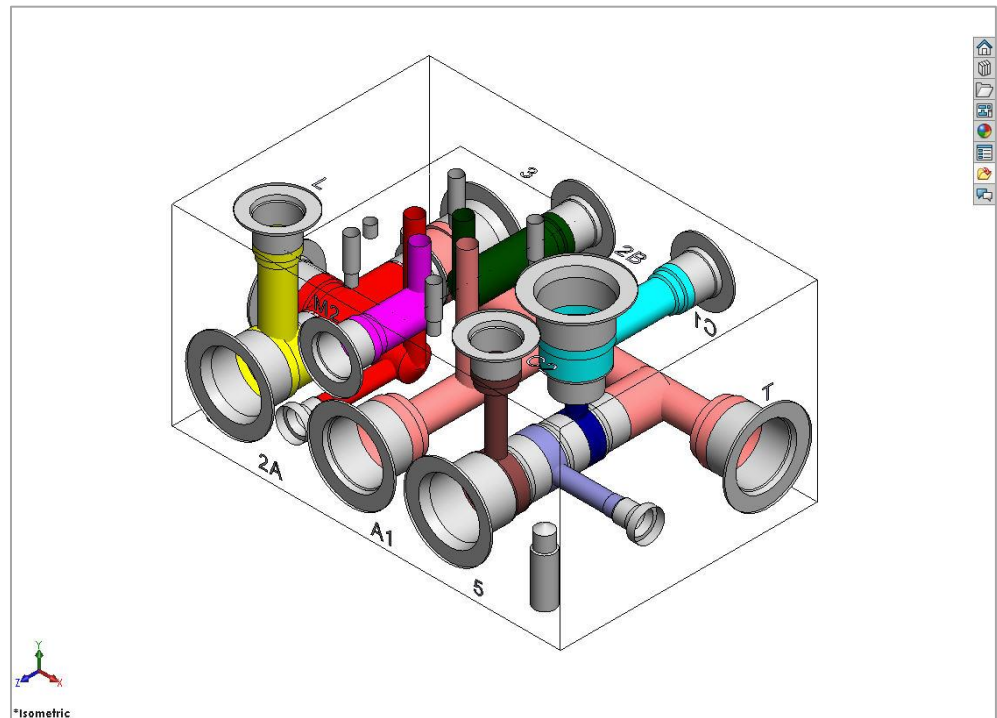
- A virtual cavity design into a feature-based design.
- A feature-based design into a virtual cavity design.

Note:

- Constrained cavities will be unconstrained when converting the manifold.
- Attached stamping texts will be detached from the parent cavity after converting.
- An O-ring groove inserted in the Virtual design mode is also converted to a feature.



Converting manifold




Converted manifold

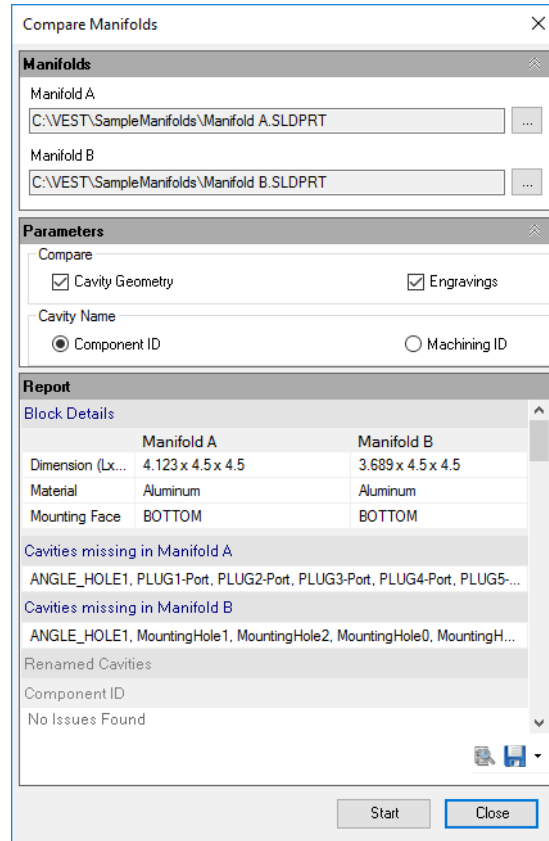
14. Compare Manifolds

Compare two selected manifolds.

MDTools® checks the all relevant manifold properties such as, dimensions, material and components like cavities, footprints, engravings etc. and lists the changes

1. MDTools 960
 - > Block panel
 - > **Compare Manifolds**

The Compare manifolds dialog box displays.
2. Select two manifolds to compare.
Manifold A: By default, the current manifold displays. Select a different manifold, if required.
3. Parameters:
These are optional parameters.
These sections can be included in the report along with the fixed sections.
 - **Cavity Geometry**
Compares all the cavity steps including Step0 and Step12 dimensions and port dimensions.
If unselected, then MDTools will not include Cavity geometry in the report.
 - **Engravings**
Compares engravings also.
The section included in the report will be
 1. Engravings missing in Manifold A
 2. Engravings missing in Manifold B
 3. Renamed engravings
 4. Modified engravings
 5. Moved engravings
 - **Component ID**
Shows all the cavities name as the Component ID.
 - **Machining ID**
Shows all the cavities name as the Machining ID.
4. Click **Start**.
Report is displayed in the Report section.
5. Click , to save the list.
The Save As dialog box displays.
6. Enter an appropriate file name and click **Save**.



Compare Manifolds dialog box

Report contains the following sections:

- **Block Details:**
 - Dimensions
 - Material
 - Mounting Face

- **Cavities Missing in Manifold A:**

Lists all cavities/ports deleted from Manifold A that exists in Manifold B.

- **Cavities Missing in Manifold B:**

Lists all cavities/ports deleted from Manifold B that exists in Manifold A.

- **Renamed Cavities:**
 - Component ID:**

Lists all cavities/ports where component IDs are different in Manifold A and Manifold B.

 - Machining ID:**

List all cavities/ports where machining IDs are different in Manifold A and Manifold B.

- **Modified Cavities:**
 - Cavities Replaced:**

Lists all cavities/ports of Manifold A, which are replaced by other cavities/ports in Manifold B.

 - Spot Face Diameter Changed:**

Lists all cavities/ports of Manifold A, where spot face diameter is changed in Manifold B.

 - Spot Face Depth Changed:**

Lists all cavities/ports of Manifold A, where spot face depth is changed in Manifold B.

 - Drill Diameter Changed:**

Lists all cavities/ports of Manifold A, where drill diameter is changed in Manifold B.

 - Drill Depth Changed:**

Lists all cavities/ports of Manifold A, where drill depth is changed in Manifold B.

- **Engravings:**
 - Engravings Missing in Manifold A:**

Lists all engravings deleted from Manifold A that exists in Manifold B.

 - Engravings Missing in Manifold B:**

Lists all engravings deleted from Manifold B that exists in Manifold A.

 - Modified Engravings:**

Lists the modified engravings in this section. It contains the modified parameters with the new and old values.

 - Engravings Moved:**

Lists the engravings moved on same face or moved to another face.

Drill Added:

Lists all cavities/ports of original manifold in which a new drill has been added in Manifold B.

Counterbore Added:

Lists all cavities/ports of original manifold in which a counterbore has been added in Manifold B.

Step Dimension Changed:

If the Cavity Geometry option is selected, MDTools compares all steps and port dimensions and lists the changes.

Note: This is an optional section in the report.

Machining Information Modified:

Lists all cavities/ports of Manifold A, where machining information has been changed in Manifold B.

Inclination Changed:

Lists all cavities/ports of original manifold, where inclination has been changed in Manifold B.

Cavities Moved:

Lists all cavities/ports, where location has been changed to other face or moved to the other location on the same face in Manifold B.

Footprints Rotated:

Lists all footprints which have different rotation in original and Manifold B.

The difference of rotation in original and Manifold B is listed in the Rotated by Angle field.

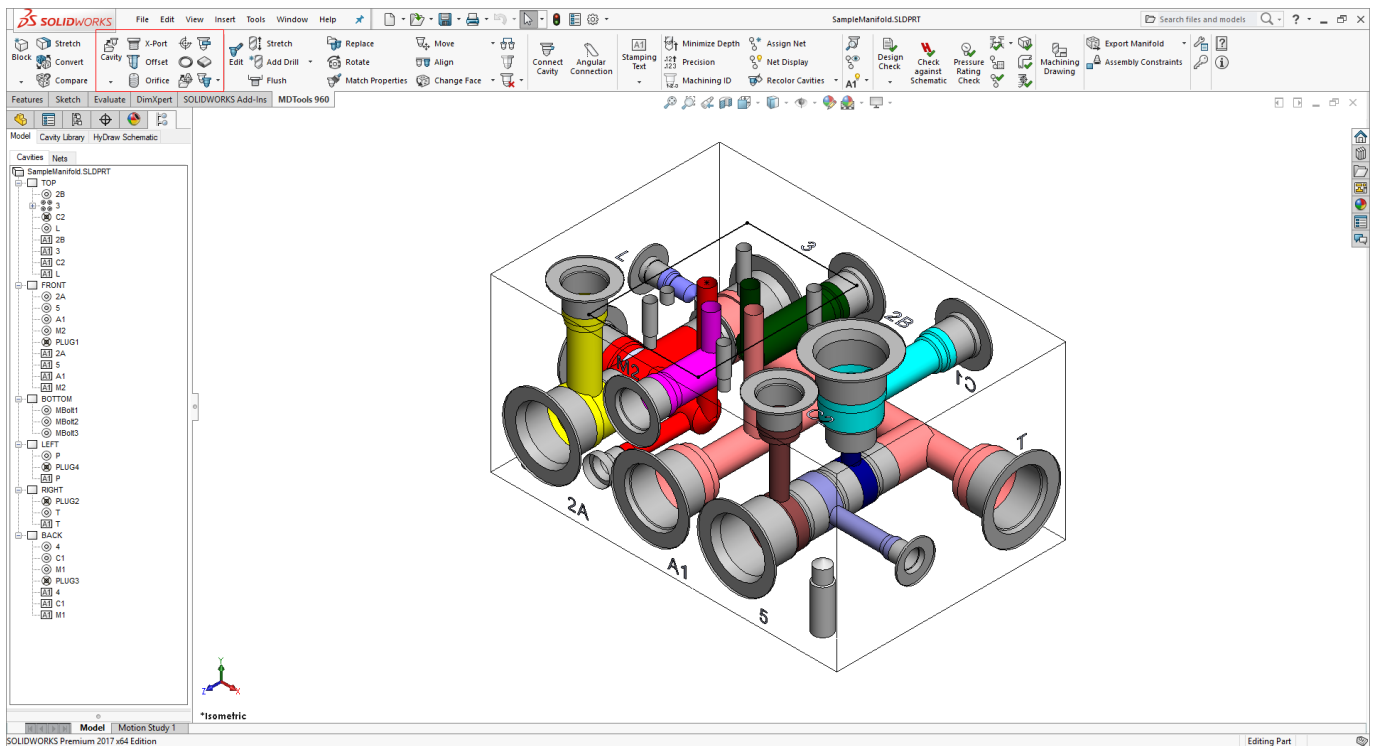
Note:

Engravings section is optional.

You can include this section in the report using the Engravings option in the Parameters section.

Insert Cavity

- 15 Insert Cavity (...from Library)
- 16 Insert Cavity (...from HyDraw)
- 17 Insert Construction Port (X-Port)
- 18 Insert Offset Hole
- 19 Insert Orifice Plug
- 20 Insert Mounting Holes
- 21 Insert O-ring Groove
- 22 Insert Component Outline
- 23 Insert Undercut
- 24 Insert Slot
- 25 Copy Cavity
- 26 Copy Slot
- 27 Copy Multiple Cavities



15. Insert Cavity (...from Library)

Easily select and insert cavities/footprints on the manifold from a standard cavity/footprint library. Easily search a cavity/footprint by name. Precisely position the cavity with reference to either an edge of the block, an existing cavity, or to either one or two existing cavities on the block. Position the cavity maintaining a minimum wall thickness with an existing cavity.

Insert Cavity/Footprint.

- MDTools 960
> **Cavity**
The Library tab in the browser gets activated.

- Enter few letters of the cavity name in the **Cavities/Footprint** search text box to automatically search cavity/footprint in the library.

or,

Select the required library from the dropdown.

All cavities/footprints in the selected library are listed in the Cavity/Footprint Name list box.

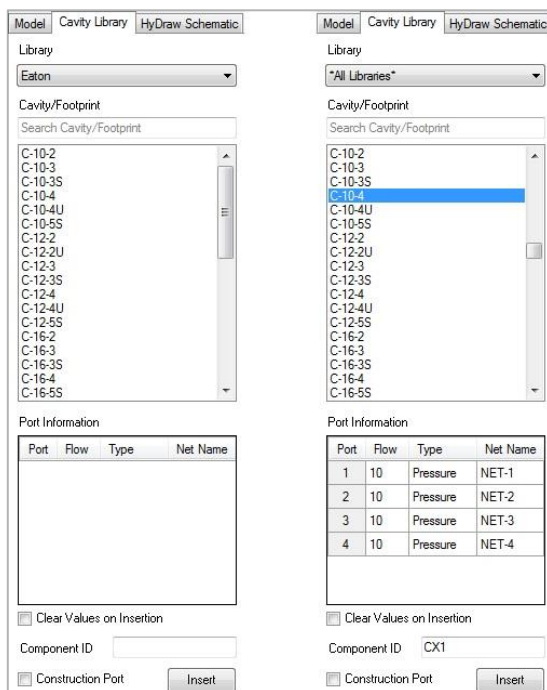
- Select the required cavity/footprint. Enter the component ID.
When you insert a cavity/footprint for a component in a schematic, use the ID of the component in the schematic as the component ID for the cavity/footprint. If you insert a cavity for a construction hole, then select the Construction Port option to automatically assign the component ID.

- Enter the port information for the cavity.
- Click **Insert**.

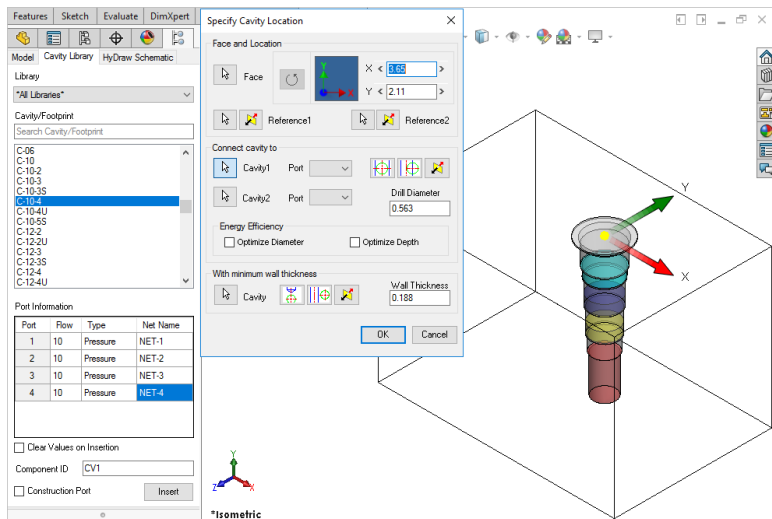
The Specify Cavity Location dialog box displays.

- Select the point on the manifold face, where you want to insert the cavity.
MDTools® displays a preview with center point and x and y axis arrows indicator of the selected cavity at the selected point on the manifold.

- Enter the X and Y distance from the block origin or Drag the center point to move cavity any axis or Drag the X and Y axis arrow to move cavity along a single direction.
- Click **OK** to insert the cavity at the specified location.



Library Tab



Specify Cavity Location dialog box

Note:

- The last selected library will be selected by default when you open the dialog box.
- Colored areas on a cartridge valve cavity represent the port areas.
- The Mandatory undercut is automatically inserted along with the cavity from the MDTools Cavity library and becomes integral profile of the cavity.

15.1 Position the cavity with reference to an edge or a cavity

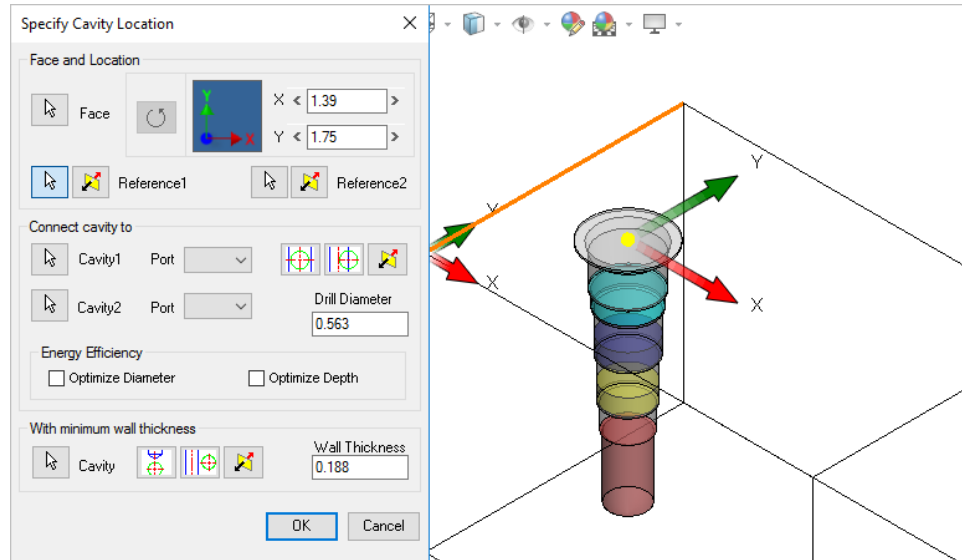
1. Click the selection button for Reference1.
2. Select an edge or an existing cavity.
MDTools automatically relocates the origin symbol and X and Y axis Arrow indicator to the selected reference and updates the X and Y values, per the new origin.*

Note:

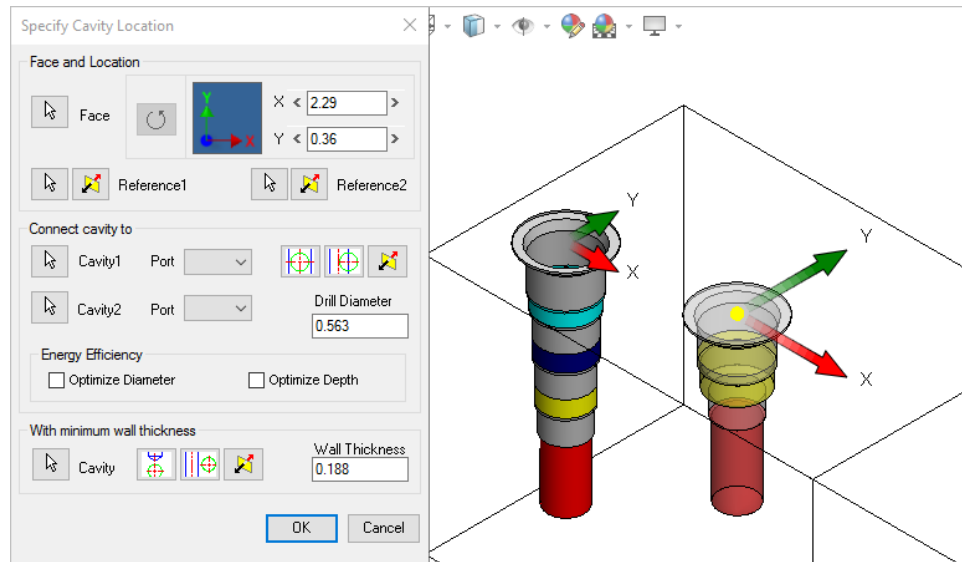
- Select Reference2 to change the reference of both the X and Y axis.
- Click the Flip button to change the direction of axis.
This flips the cavity location when a cavity is used as a reference.

3. Change the X and Y values to precisely position the new cavity or
Drag the center point to move cavity on any axis.
or
Drag the X and Y axis arrow to move cavity along a single direction.
MDTools automatically updates the preview of cavity/footprint on changing the X and Y values.

4. Click **OK** to create the cavity at the specified location.



Position the new cavity with reference to an edge



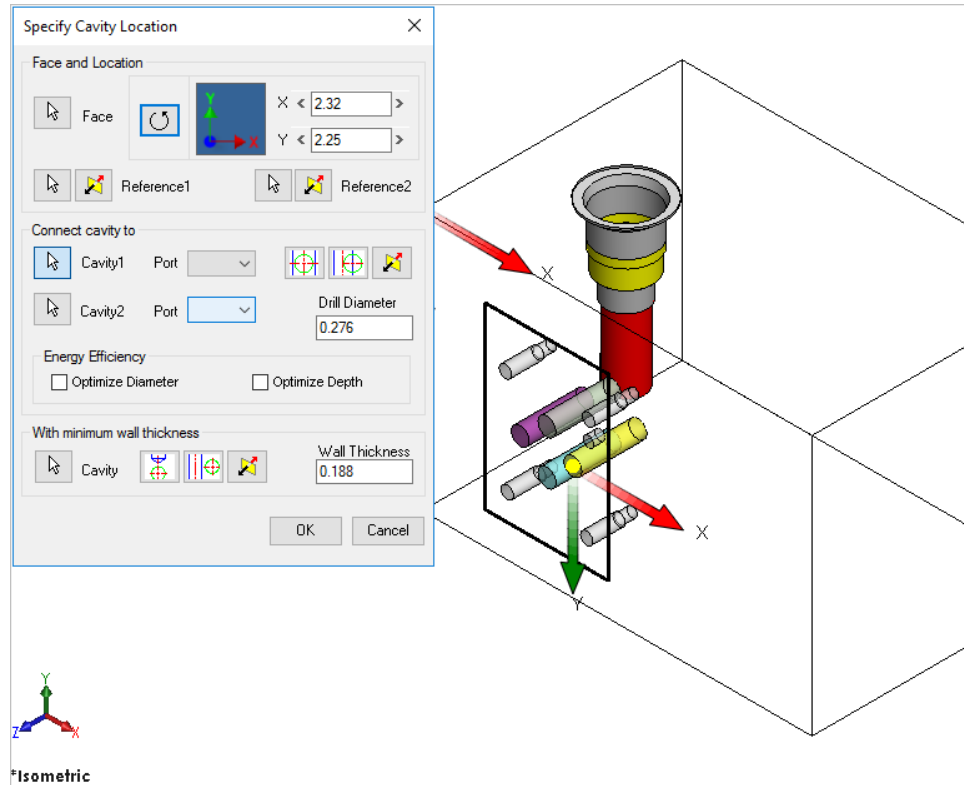
Position the new cavity with reference to an existing cavity

15.2 Rotate Footprint

The Rotate Footprint option in the Specify Cavity Location dialog box enables you to specify the rotation of a new footprint.

- Click the **Rotate Footprint** button
 - Once to rotate the footprint by 90 degrees
 - Twice to rotate the footprint by 180 degrees
 - Three times to rotate the footprint by 270 degrees

MDTools® rotates the footprint in the counter clockwise direction.



Rotate Footprint

15.3 Connecting existing cavities

Connect the new cavity to either one or two existing cavities on the manifold.

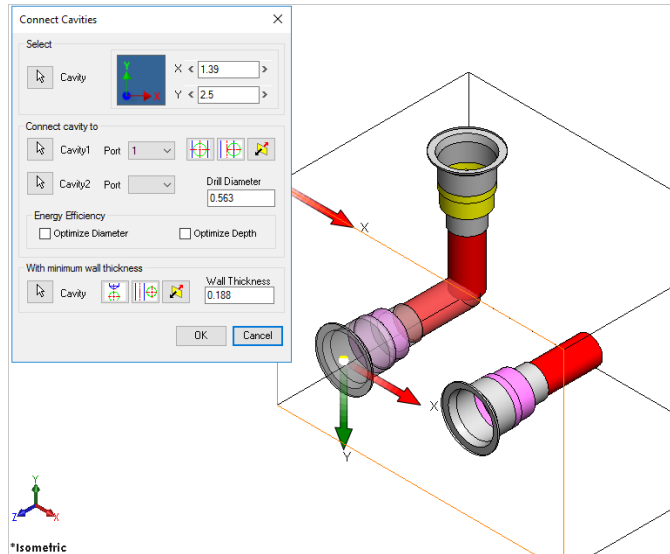
1. Click the selection button for cavity1.
2. Select the connecting cavity1.
3. Select the connecting port on the first cavity. *MDTools* automatically relocates the cavity to the port center and displays the drill diameter.*

Or

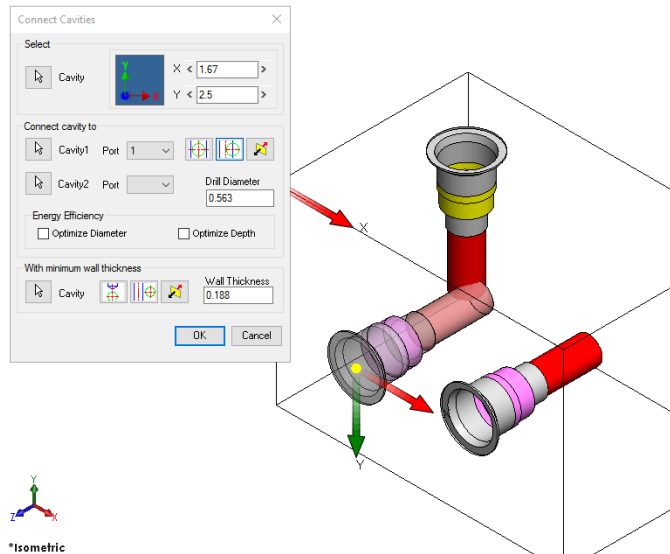
4. Click the selection button for cavity2.
5. Select the connecting cavity2.
6. Select the connecting port on the second cavity. *MDTools automatically relocates the cavity to the overlapping center of the two cavity ports.*
7. Click **OK**. *MDTools creates the new cavity at the specified location and connects the cavity to the selected connecting cavities.*

Note:

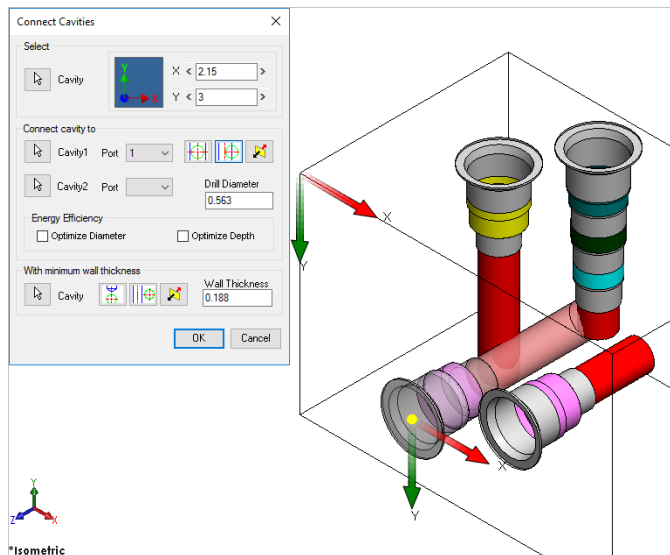
- Click the Relocate to side button to relocate the cavity to a side.
- Click the Flip side button to flip the sides.
- MDTools automatically selects the best drill diameter from the tooling database based on the port diameter.



Connecting existing cavities



Positioning the cavity on the sides

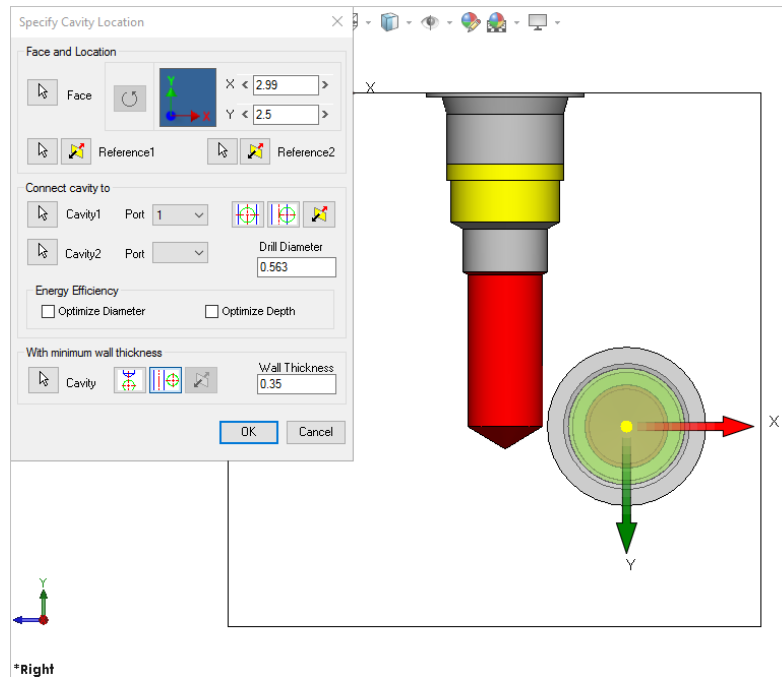


Connecting two existing cavities

15.4 Position with minimum wall thickness

Position the new cavity while assuring minimum wall thickness with an existing cavity on the manifold.

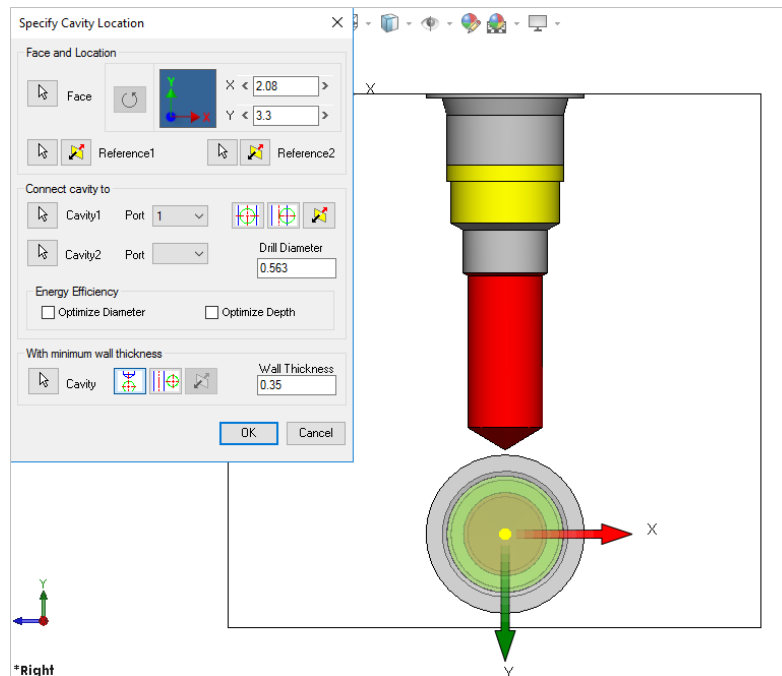
1. Click the selection button for cavity.
2. Select an existing cavity on the manifold.
3. Click **Move to side** to position the new cavity away from the selected cavity axis.
4. Click the Flip side button to change the side, if required.
5. Repeat the above steps to position the cavity with minimum wall thickness from a second cavity on the manifold.



Positioning the new cavity using the Move to side option

Note:

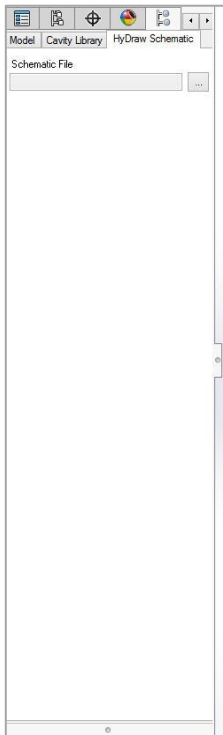
Select the Locate below cavity tip option to locate the new cavity with minimum wall thickness from the tip of an existing cavity.



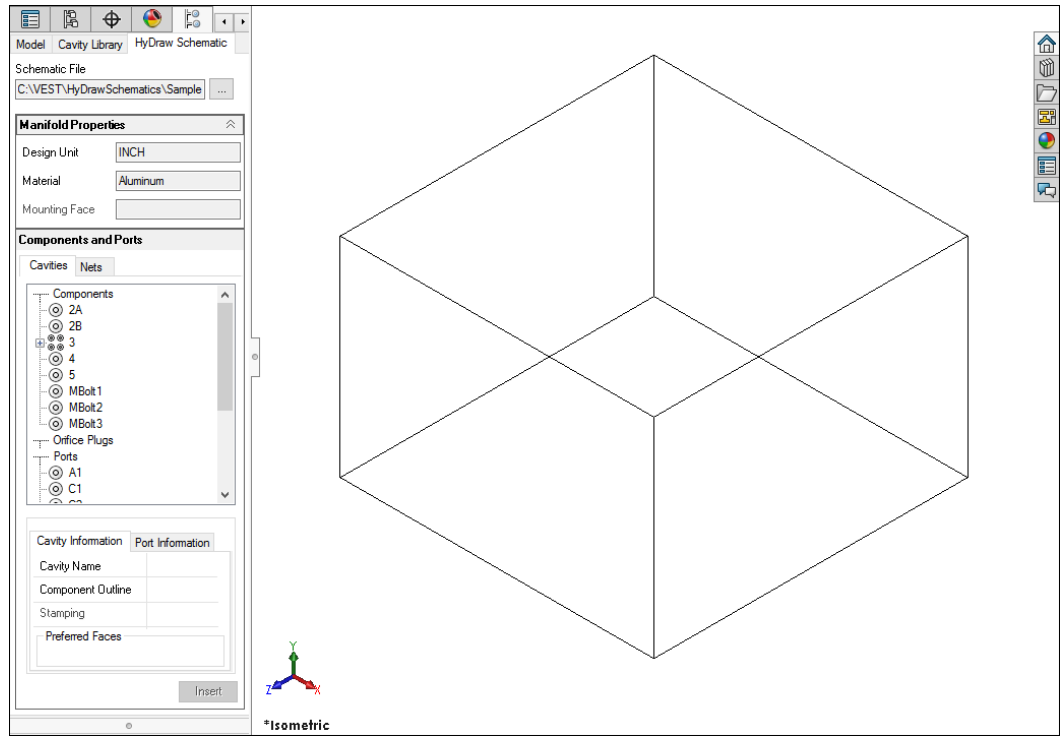
Positioning the new cavity below the cavity tip

16. Insert Cavity (...from HyDraw)

The HyDraw Schematic Interface enables you to automatically read an XML exported from a HyDraw® created schematic drawing and insert all the required cavities with the connectivity information into MDTools®.



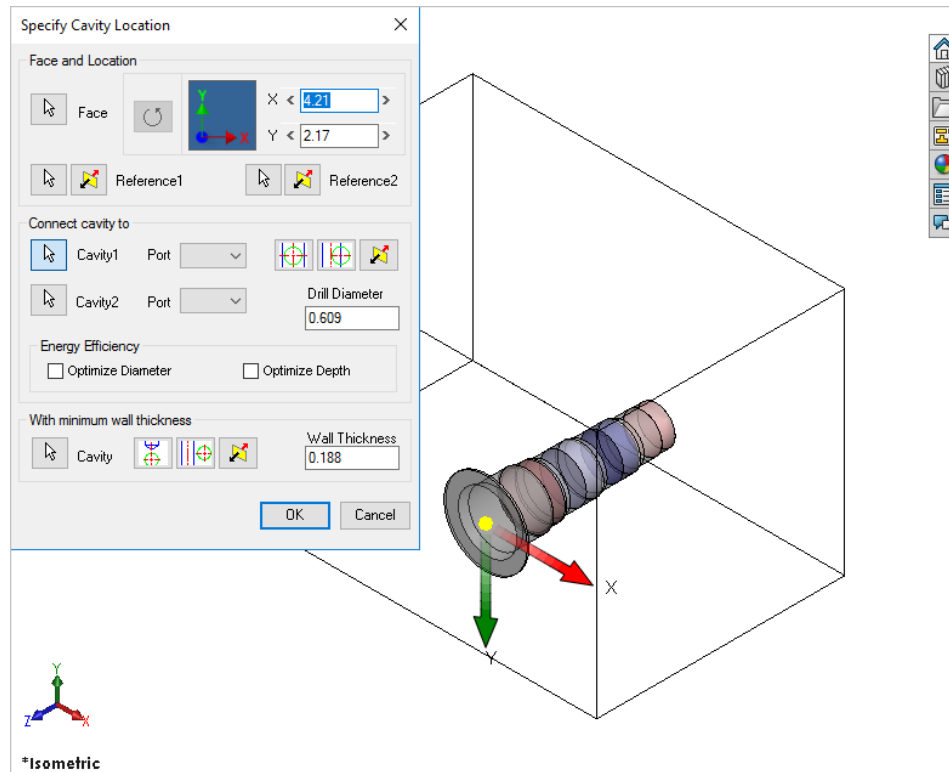
HyDraw Schematic Interface



MDTools HyDraw Interface: Component data populated

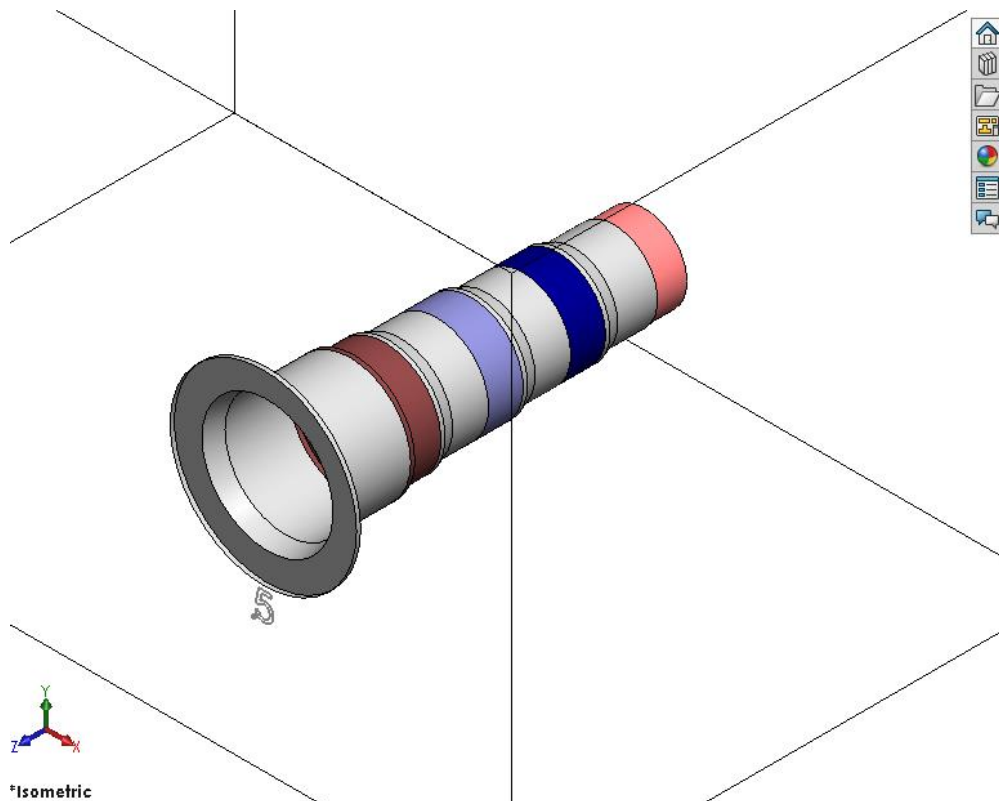
The Insert Cavity option on the HyDraw® Schematic Interface dialog box enables you to insert the cavity for a selected component with the connectivity and flow information.

1. Select a component or external port from the list.
2. Click Insert Cavity. *The Specify Cavity Location dialog box displays.*
3. Select the point on the manifold face, where you want to insert the cavity. *MDTools® displays a preview with center point and X and Y axis arrow indicator of the selected cavity at the selected point on the manifold.*



Specify Cavity Location dialog box

4. Click **OK**. *The cavity is inserted at the specified location. MDTools inserts component outline and stamping text (if defined) with the cavity automatically.*



Cavity inserted with connectivity information

Note:

Once a cavity is inserted on the manifold it is displayed in black against a shaded background in Cavities Browser and Nets Browser.

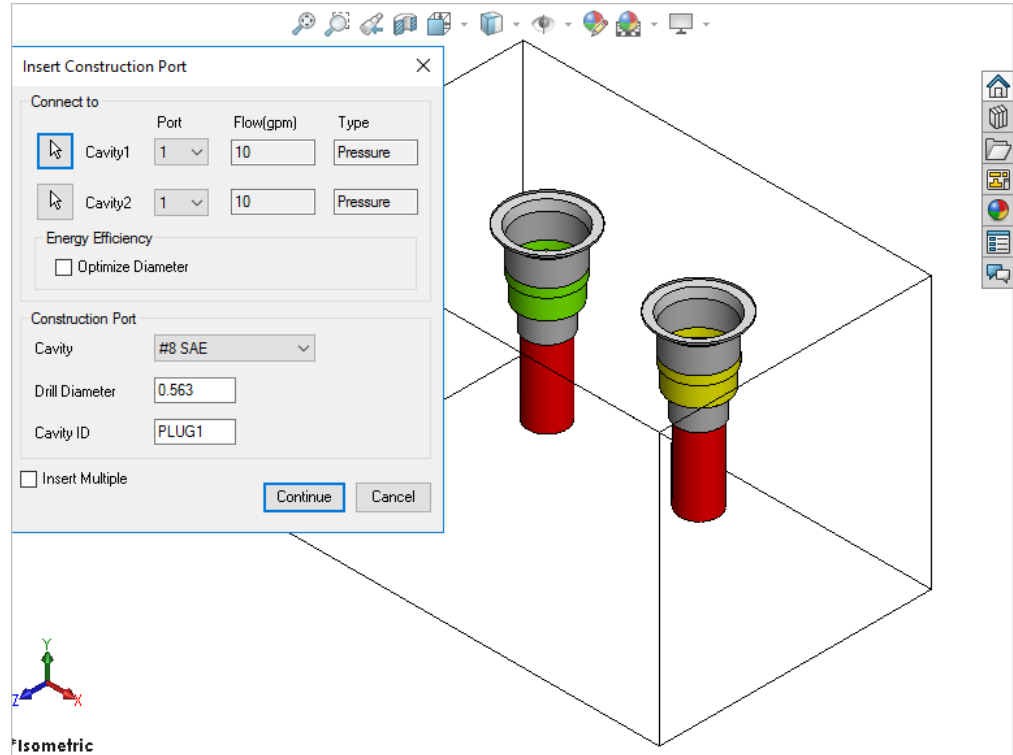
Refer Chapter 4 for more description.
(MDTools HyDraw Interface)

17. Insert Construction Port (X-Port)

Select and insert the best suitable X-Port as per the specified connecting cavity.

If Energy Efficient Connection is selected, then MDTools® calculates the X-port diameter to minimize the bend losses per the information in MDTools Options: Construction Port Sizing section, and selects a suitable construction port from the available list of cavities (i.e. Preferred Cavities in MDTools Options: X-Port section).

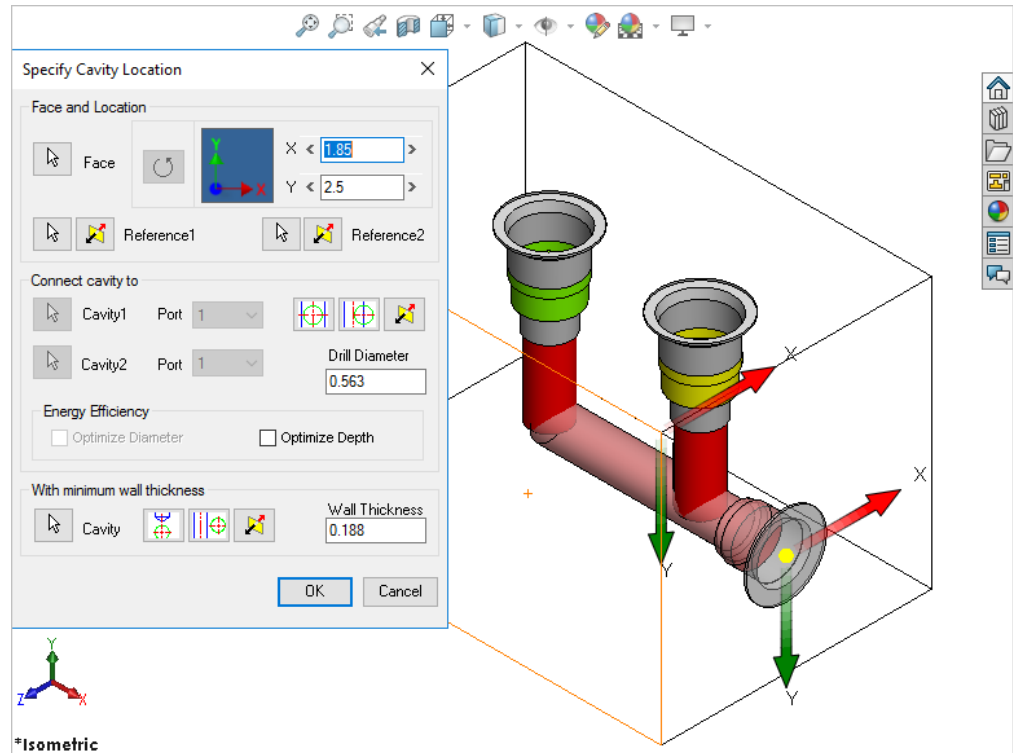
- MDTools 960
> **X-Port**
The Insert Construction Port dialog box displays.
- Select Cavity1 and port to connect the construction port.
- Select Cavity2 and port, if required.
MDTools automatically suggests a construction port to make the connection.
- Change Cavity, Drill Diameter and Cavity ID, if required.
- Click Continue.
Specify Cavity Location dialog box displays.
- Specify face and location of the construction port.
MDTools displays the preview of the cavity.
- Click **OK** to insert the construction port.



Insert Construction Port dialog box

Note:

- If you select a port area of a cavity, then MDTools automatically selects the port to connect in the dialog box.
- If **Check Rating at Connection** is selected in MDTools Settings, then MDTools validates the Construction port Rated Pressure with the connected cavity1 Net Operating Pressure.
- If connected cavity1 port Net Operating Pressure is not defined, then MDTools validates the connected cavity2 Net Operating Pressure.

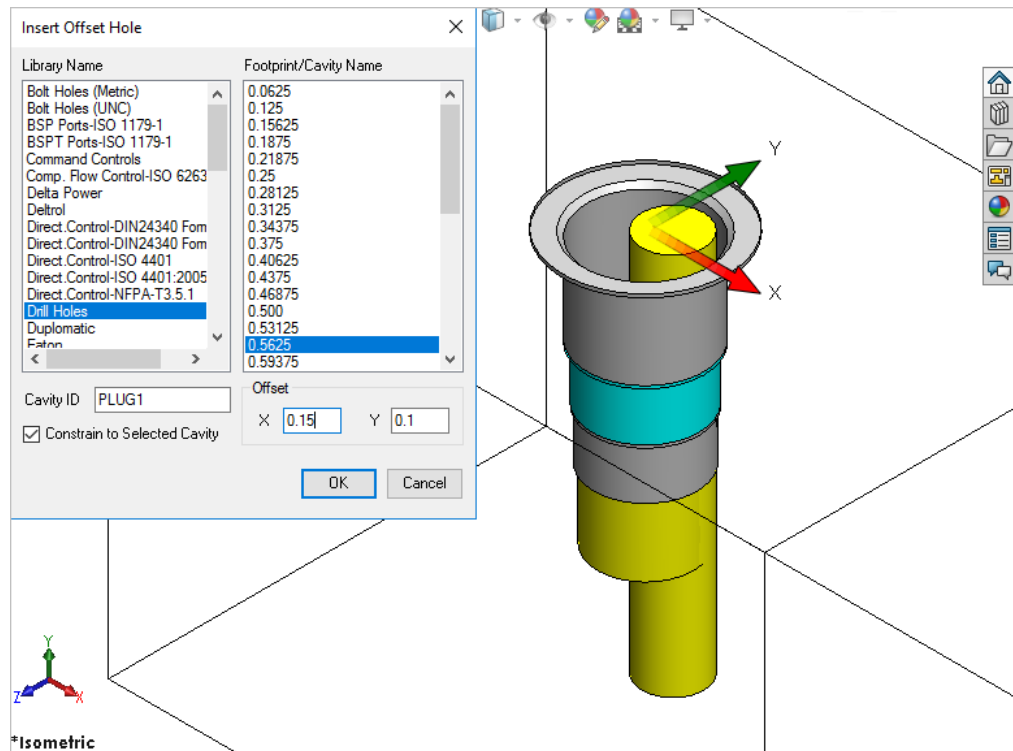


Preview of Construction Port in the model

18. Insert Offset Hole

Insert an offset drill hole into an existing cavity on the manifold. Precisely locate the offset hole by entering the X and Y distance from the main cavity center.

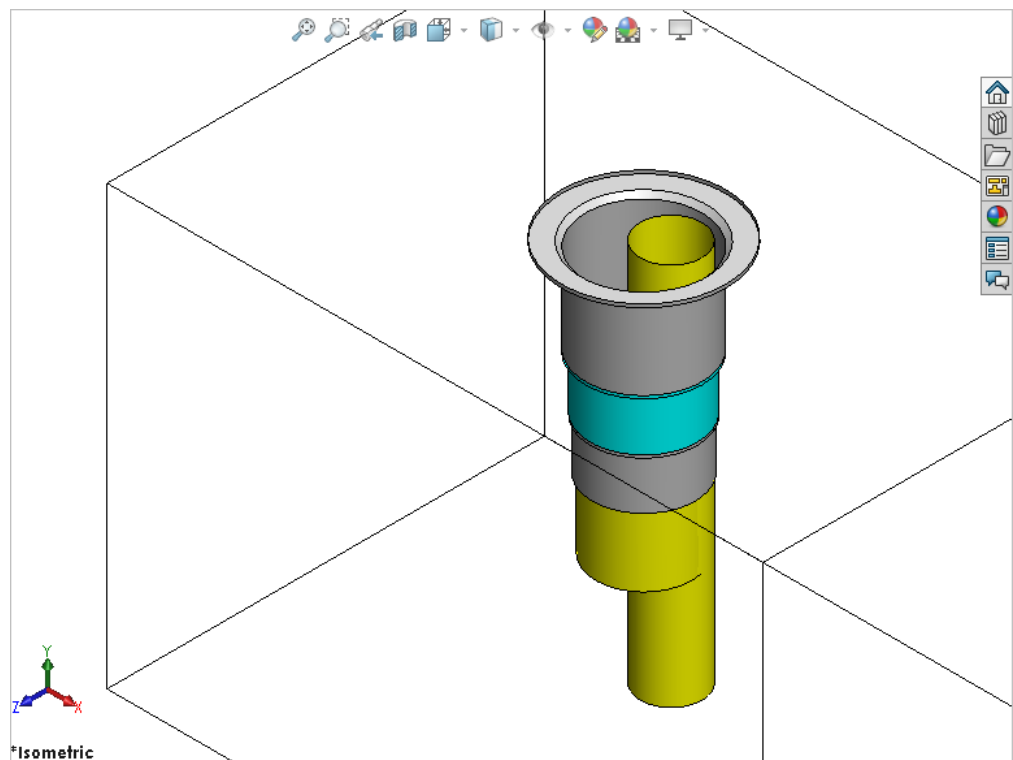
1. MDTools 960
> **Offset**
The MDTools Select Cavity dialog box displays.
2. Select a cavity to insert the offset hole.
The Insert Offset Hole dialog box displays.
3. Select the offset hole from the library.
MDTools® displays a preview of the drill hole at the specified location(s).
4. Enter X and Y distances from the parent cavity center.
MDTools® displays a preview of the drill hole at the specified location(s).
5. Click **OK**.
MDTools® inserts the offset hole into the selected cavity with the specified X and Y offset distances.



Insert Offset Hole dialog box

Note:

- The depth of the offset hole is equal to the depth of the main cavity plus the standard depth of the offset cavity in the MDTools library.
- The offset hole is constrained to the parent cavity by default.
- To unconstrain the offset hole with the parent cavity, deselect the Constrained to Selected Cavity option.
- Use $X = 0$ and $Y = 0$ to create a concentric hole.
- The offset hole can only be placed within the drill boundary of the main cavity.



Offset hole inserted into the cavity

19. Insert Orifice Plug

Insert the cavity for orifice plug at the center of a cavity on the manifold. MDTools® automatically updates the spot face depth of the orifice cavity so that the cavity starts from the bottom of the main cavity.

An option for merging the orifice plug cavity with the parent cavity is also available.

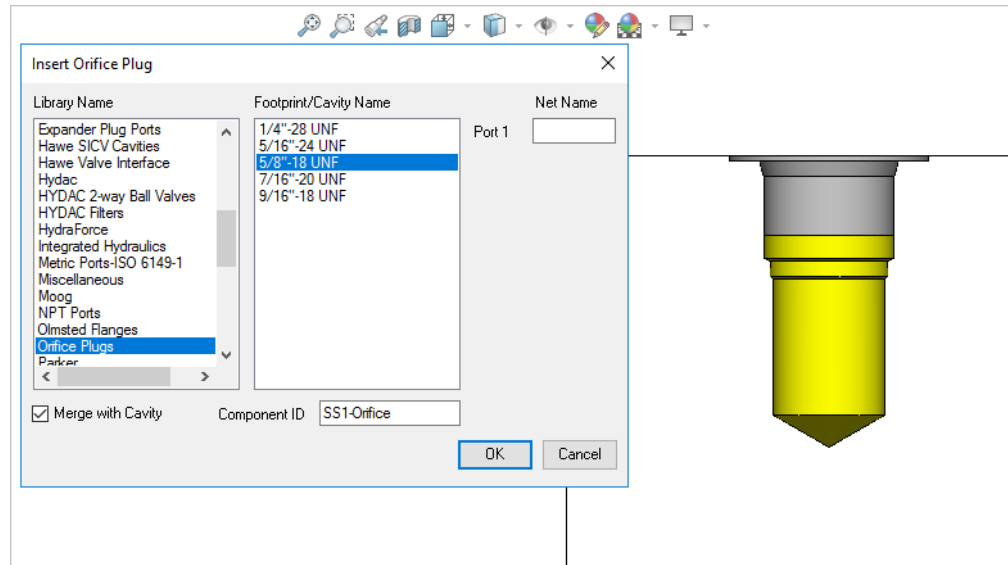
1. MDTools 960
> **Orifice**
The MDTools Select Cavity dialog box displays.
2. Select a cavity to insert into the port plug.
The orifice plug cavity is inserted into the center of the cavity.

The Insert Orifice Plug dialog box displays.
3. Select the cavity for orifice plug from the library.
4. Enter the component ID for the orifice plug cavity.
5. Enter port net name for orifice plug. Or Click net name field to select a net from existing nets.
6. Click **OK**.

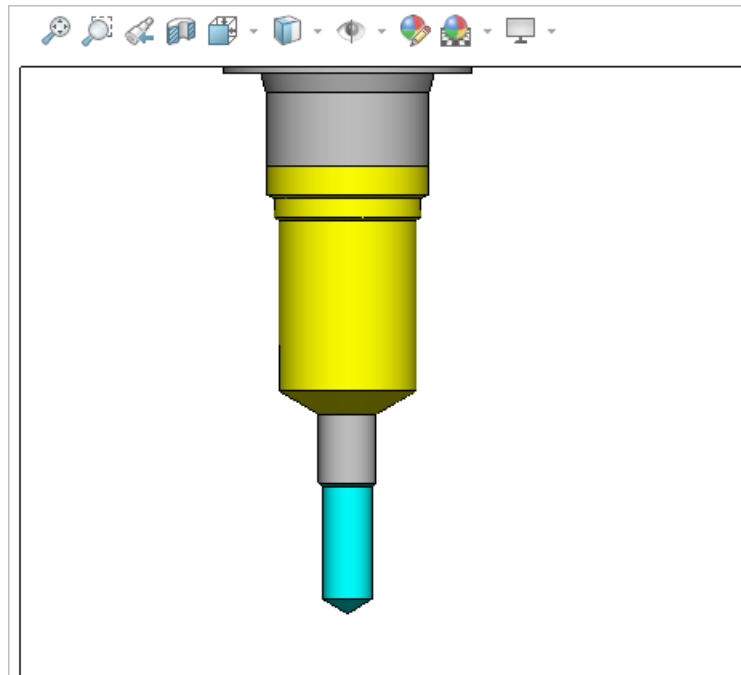
MDTools inserts the orifice cavity into the center of the selected cavity and automatically updates the spot face depth of the orifice cavity.

Note:

- The spot face depth of an orifice cavity is equal to the depth of the main cavity plus the standard spot face depth of the orifice cavity in the MDTools library.
- Both the orifice cavity and the main cavity will be two separate cavities and considered as two different cavities in MDTools.
- The orifice cavity automatically constrains to the main cavity.
- The orifice cavity automatically relocates when the main cavity is relocated.



Insert Orifice Plug dialog box



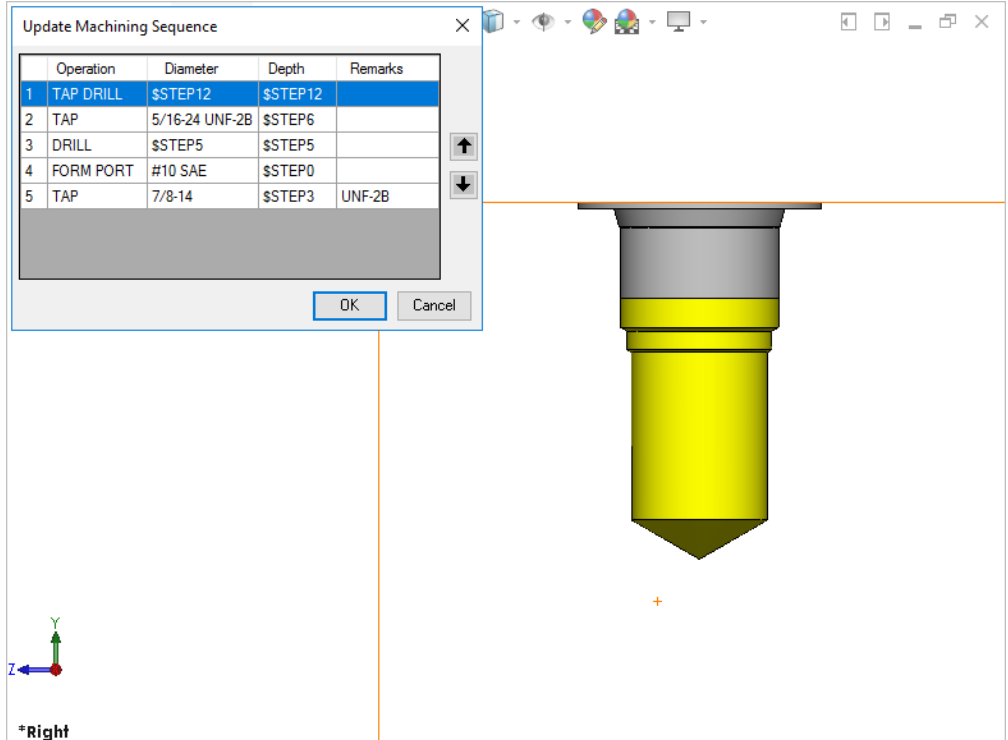
5/16"-24 UNF orifice plug inside #10 SAE port

Merge with Cavity Option

Merge the orifice plug with the existing cavity.

The Merge with Cavity option deletes the original cavity and creates a merged cavity at the same location.

- MDTools 960
> **Orifice**
The MDTools Select Cavity dialog box displays.
- Select a cavity to insert into the orifice plug.
The orifice plug cavity is inserted into the center of this cavity. The Insert Orifice Plug dialog box displays.
- Select the cavity for orifice plug from the library.
- Select the **Merge with Cavity** option.
- Enter **Component ID** for the orifice plug cavity.
The default Component ID is <Parent Cavity Component ID> - Orifice.
- Click **OK**.
MDTools® evaluates the possibility of merging and displays the Update Machining Sequence dialog box.



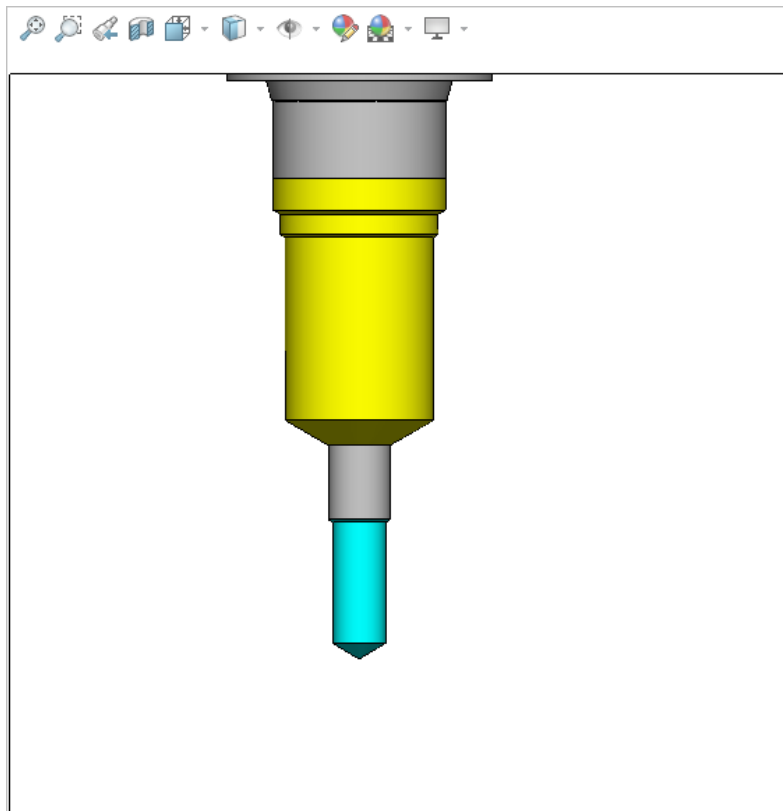
Update Machining Sequence option

Note:

- The Update Machining Sequence dialog box shows the machining sequence extracted from both the cavities.
 - You can reorder the processes, per requirement.
- Click **OK**.

Note:


- The Merge with Cavity option converts all the cavity types to Cartridge Valve (CV) cavity types.
- The area from the bottom port plug to the drill end is considered as Working Area. Thus, the merged cavity has a side port in this area.
- The machining parameters for both the cavities are also automatically merged.

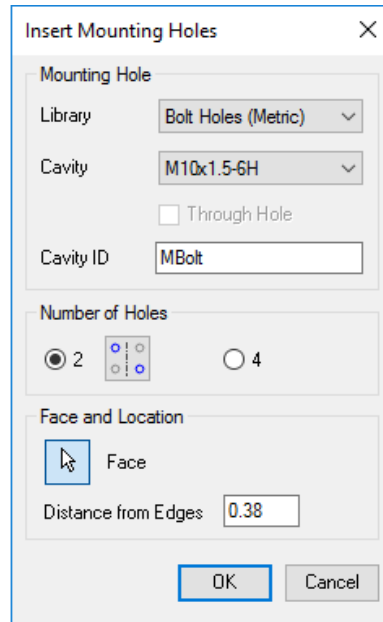


Orifice Plug: Merge to Cavity option

20. Insert Mounting Holes

Insert mounting holes on a selected manifold face. MDTools® inserts mounting holes on the selected manifold face at a specified distance from the edges.

1. MDTools 960
> **Mounting Holes**
The *Insert Mounting Hole dialog box* displays.
2. Select the bolt hole, if you want to use for mounting the manifold.
3. Select **Through Hole**, if you want to insert through mounting holes.
4. Select number of holes, **2** or **4**.
5. Press , the Flip Hole Positions button, to change the location of mounting holes on the selected face, which is applicable for Number of Holes of 2 Holes only.
6. Edit **Distance from Edges**, if required.
This is the distance between the center of the bolt hole and the manifold edge.

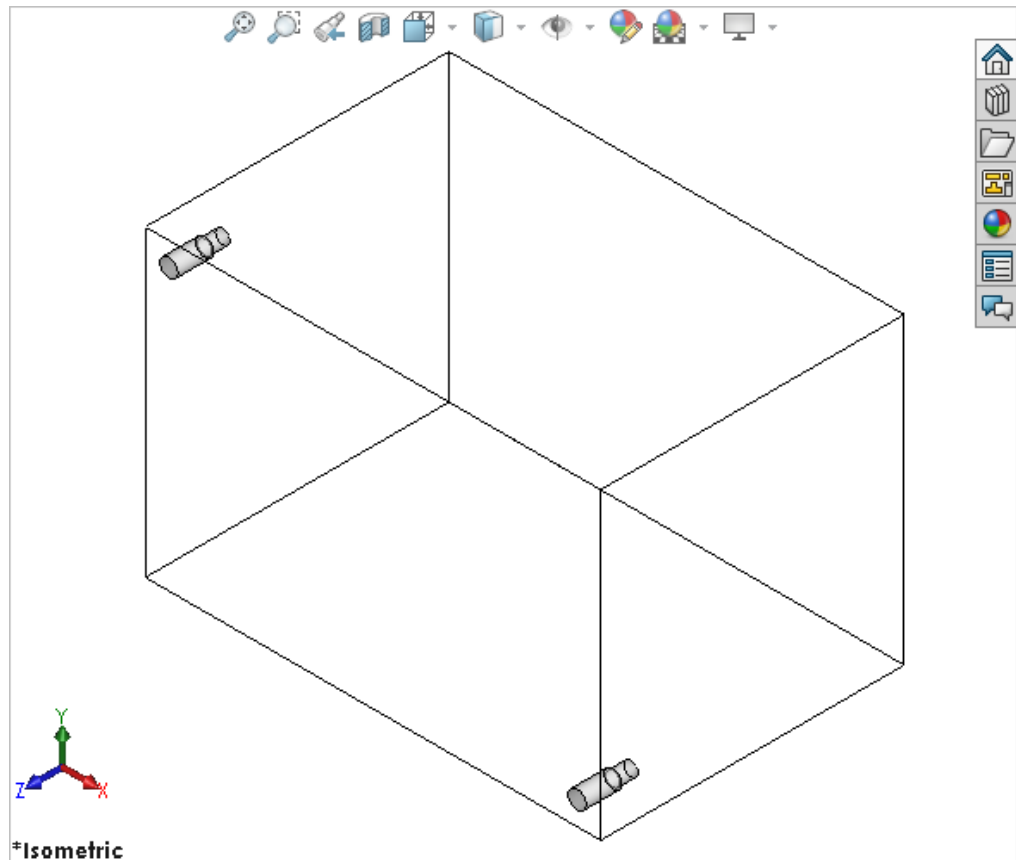


Insert Mounting Holes dialog box

7. Enter the **Cavity ID**.
MBolt is the default cavity ID.
8. Click **OK**.
MDTools automatically inserts 2 or 4 bolt holes on the selected face.

Note:

- MDTools automatically calculates distance from the edge, considering the minimum wall thickness defined in MDTools Options and the selected cavity.
- When inserting the bolt holes, MDTools adds suffix 1, 2, 3, and 4 to the component ID entered for the mounting holes to make the ID unique.



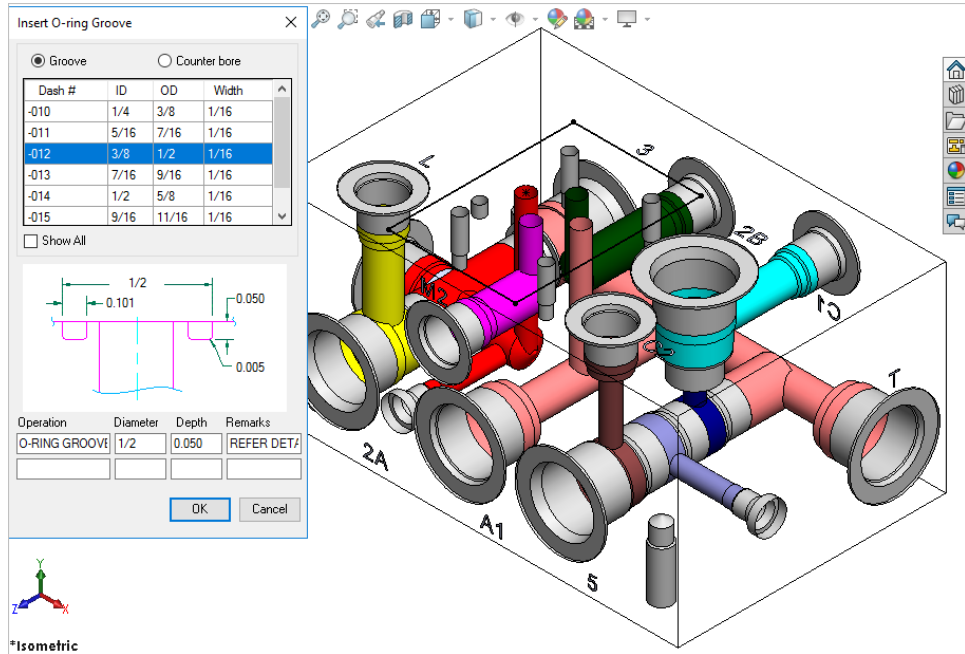
MDTools automatically inserts mounting holes

21. Insert O-ring Groove

O-ring grooves are created around the blind holes of footprints on the manifold surface to fit O-ring seals to make these holes leak proof. This section shows how such cavities are modeled using MDTools' 960.

Insert O-ring grooves on a selected cavity, according to the specification provided in the Insert O-ring Groove dialog box.

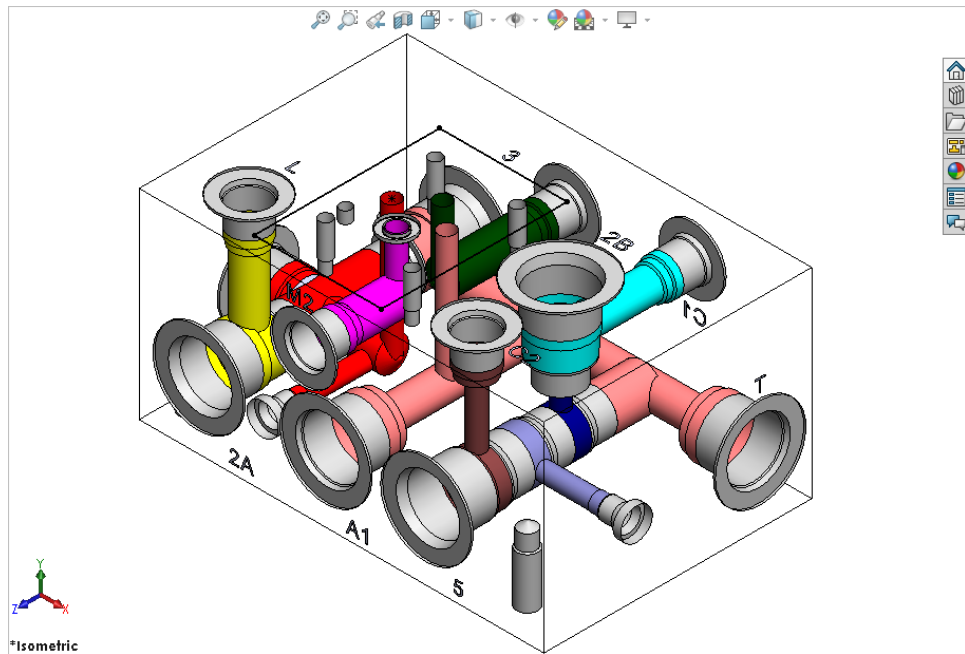
1. MDTools 960
> **O-ring Groove**
The MDTools Select Cavity dialog box displays.
2. Select the cavity in which you want to insert the O-ring groove.
The Insert O-ring Groove dialog box displays.
3. Select the O-ring size to automatically specify the groove dimensions.
4. Click **OK**.
MDTools automatically creates a groove to the specification.



Insert O-ring Groove dialog box

Note:

- You can add machining details, such as operation, tool name, diameter, and depth with O-ring.
- The O-ring machining information is displayed in the drawing sheet via the machining chart.
- You can use \$Step for diameter and depth fields. Actual value of these will be displayed in machining Chart.
- \$Step in diameter field will display the outer diameter of o-ring groove in Machining Chart.

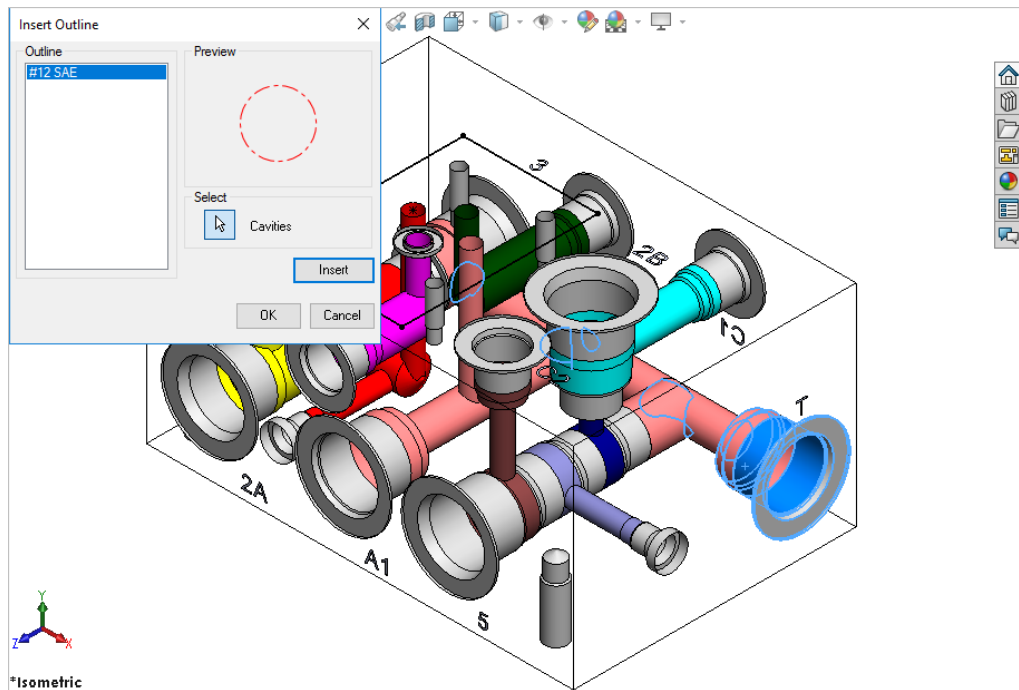


MDTools automatically inserts O-ring groove

22. Insert Component Outline

Create the outline of a valve assembly around the selected cavities/footprints.

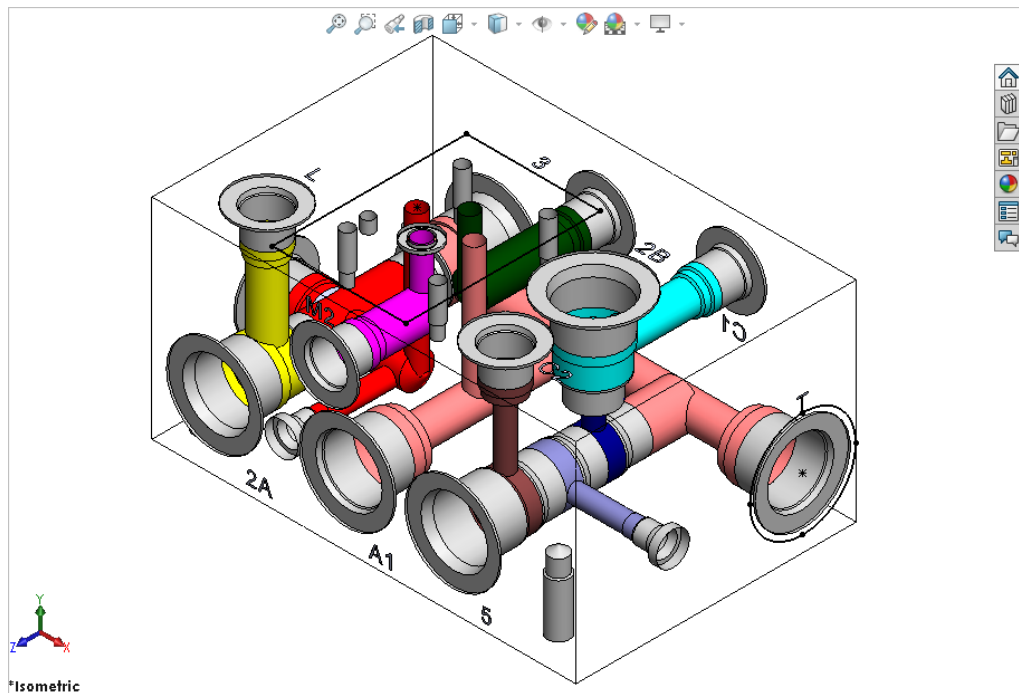
1. MDTools 960
> **Outline**
The *Insert Outline* dialog box displays.
2. Select the outline from the list.
MDTools® displays a preview of the selected component outline.
3. Select the **Cavities** option.
When you move the cursor over a cavity, it gets highlighted. This indicates the selected cavity.
4. Click **Insert**.
MDTools automatically creates a component outline around the selected cavities.
5. Click **OK**.



Insert component Outline dialog box

Note:

Use the MDTools Library Manager 2016 program to create the Component Outline library.



Component outline created on the selected cavities

23. Insert Undercut

Undercut is a special machining operation that is required in cavities to ensure increased flow requirements through ports of the same size. Undercut increases the port area to handle the increased flow.

This section shows how to model undercuts using MDTTools' 960.

Insert an optional undercut in a selected cavity on a manifold.

MDTools inserts an undercut in a cavity at the specified depth from the cavity's face and at a specified angle from the center of the selected cavity.

1. MDTTools 960
> **Undercut**
The Insert Undercut dialog box displays.

2. Select the cavity in which you want to insert the undercut.
3. Select any optional undercut from the list, if defined for the cavity.

Or

4. Select the **port area** of the cavity.
Default values for the undercut per the selected port/optional undercut are displayed.

5. Select/Deselect **Concentric**, if required.

This option is available for undercuts at zero offset distance.

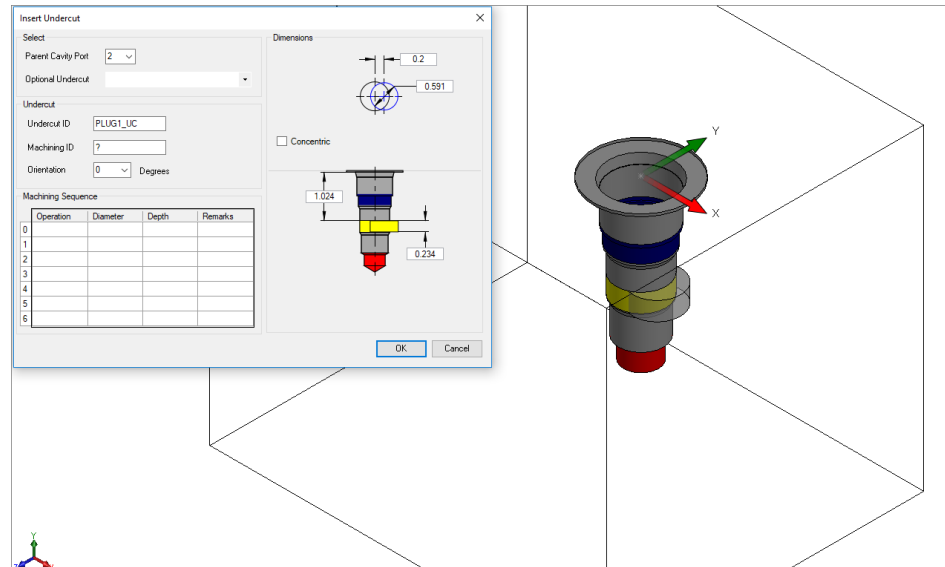
Diameter should be larger than the selected port starting step diameter for concentric undercut.

6. Enter Undercut ID.
<Selected Cavity ID>_UC is the default component ID. For example, if the ID of the selected cavity is 23, then by default the component ID for the undercut will be 23_UC.

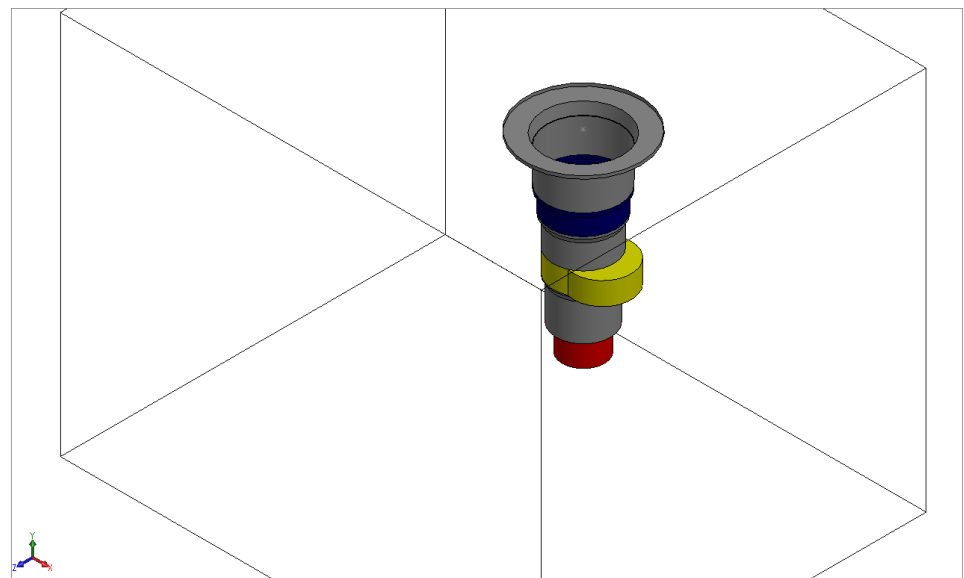
7. Modify the **Offset distance**, as required.
Modify the desired distance between the center of the undercut and the selected cavity.

8. Modify the **Undercut diameter**, as required.
Undercut diameter should be larger than the selected port diameter.

9. Modify the undercut depth.
Modify the desired depth of the undercut from the spot face of the cavity.



Insert Undercut dialog box



MDTools inserts undercut in the selected cavity

10. Modify the **undercut height**, as required.
Default value is the diameter of the selected port.
11. Select the **Orientation** from the drop-down list or enter the orientation angle.
Enter the orientation angle between 0 to 360 degrees.
12. Enter the machining ID.
13. Click **OK**
MDTools automatically creates an undercut in the selected cavity.

Refer the image, Insert Undercut dialog box, to enter various values.

Note:

- You can use \$DIA, \$DEPTH, \$OFFSET & \$HEIGHT for the machining sequence of any field for easy maintenance of the Machining chart information.
- \$DEPTH is measured from the surface of the manifold in the Machining chart.
- Optional undercuts linked to the cavity inside the Library Manager are displayed in the *Optional Undercuts* drop-down list.
- Mandatory undercuts can be defined inside the Library Manager for a cavity. and this undercut is created automatically when the cavity is inserted.
- You can insert an undercut in the dead area of a cavity when the Concentric option is selected.

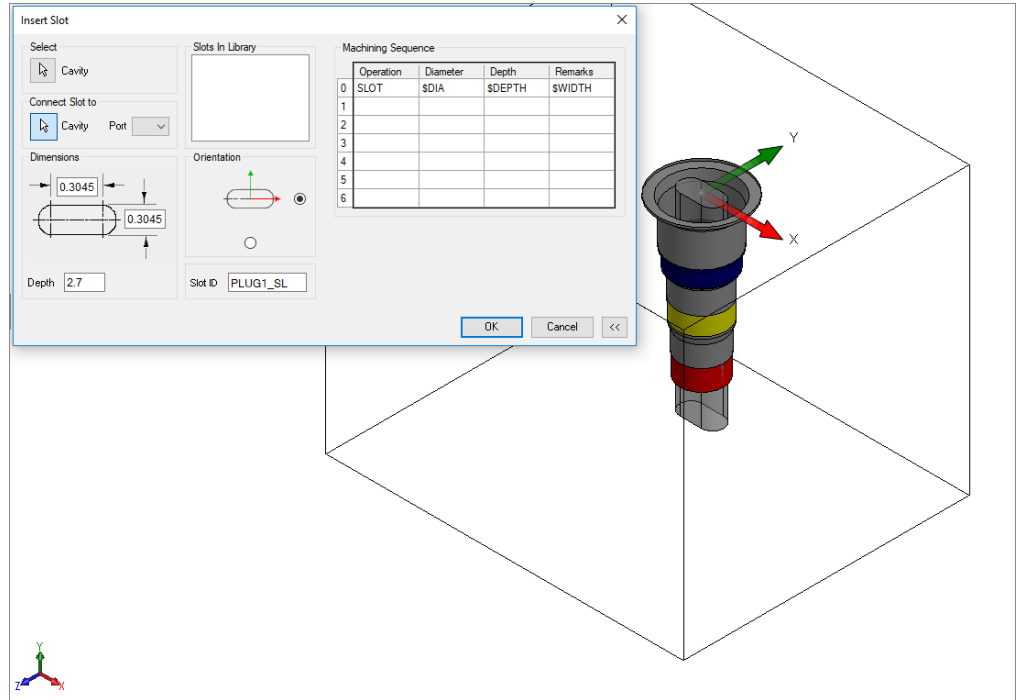
You can insert an undercut overlapping with dead area and working area.

24. Insert Slot

Increased flow requirements often require the use of slots within the cavities. This section shows how such cavities are modeled using MDTools® 960.

Insert a slot in a selected cavity: MDTools inserts a slot into a cavity at the specified depth from the manifold surface.

1. MDTools 960
> **Slot**
The *Insert Slot dialog box* displays.
2. Select the cavity in which you want to insert the slot.
3. Select an available slot in the MDTools library from the **Slots** list.
4. Enter the **Slot ID** and the **Machining ID**.
<Selected cavity ID>_SLOT is the default component ID.
For example, if the ID of the selected cavity is 23, then by default the component ID for the slot will be 23_SL.

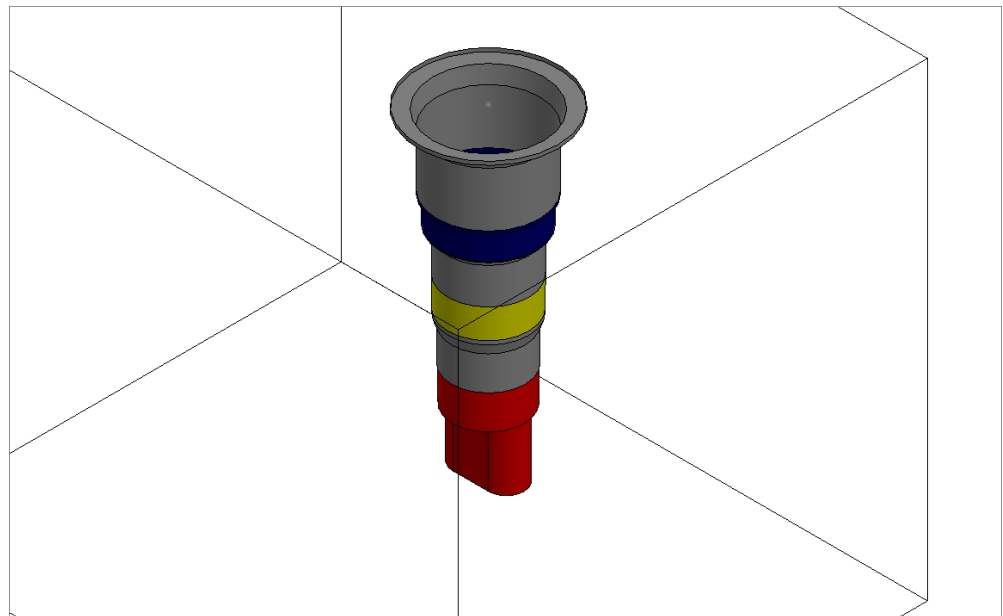


Insert Slot dialog box

5. Modify the slot **dimensions**.
The default value of the slot diameter and the slot width is the maximum drill diameter of the Parent cavity by half.

The slot diameter plus the slot width should not be larger than the parent cavity maximum drill diameter.

6. Enter the **depth** of the slot.
Default value is the parent cavity depth + 0.5 inches/12mm.
7. Select the **Orientation**.
8. Select the orientation of the slot from the axis or center of the selected cavity.
9. Modify the Machining sequence.
Default values is SLOT, \$DIA, \$DEPTH & \$WIDTH.



MDTools automatically creates a slot in the selected cavity

10. Click **OK**.
MDTools automatically creates a slot in the selected cavity.

Refer the image, Insert Slot dialog box to enter various values.

Note:

- You can use the \$DIA, \$DEPTH & \$WIDTH for Diameter, Depth and Remarks field for easy maintenance of the machining chart information.
- \$Depth is the END depth of undercut from manifold surface. Parameters(\$Depth/\$STEP) used in depth field of machining sequence are considered as END depth of operation from manifold surface.
- You can use \$STEPO & \$STEP0 for Diameter and Depth field for easy maintenance of the machining chart information.
- You can use \$WIDTH for the Diameter and Remarks field for easy maintenance of the machining chart information.
- You can use \$DIA X \$WIDTH (e.g. 0.275 X 0.25) for the Diameter field for easy maintenance of the machining chart information.
- Slot is always constrained to the parent cavity.

Connect Slot to existing cavity

Connect a new slot to an existing cavity in the manifold.

1. Click the selection button for Cavity.
2. Select the connecting cavity.
3. Select the connecting port on the cavity.
MDTools® automatically relocates the slot with the cavity to the port center and displays the slot diameter, width and depth.

4. Modify slot **dimensions**.
5. Modify the **depth** of the slot.

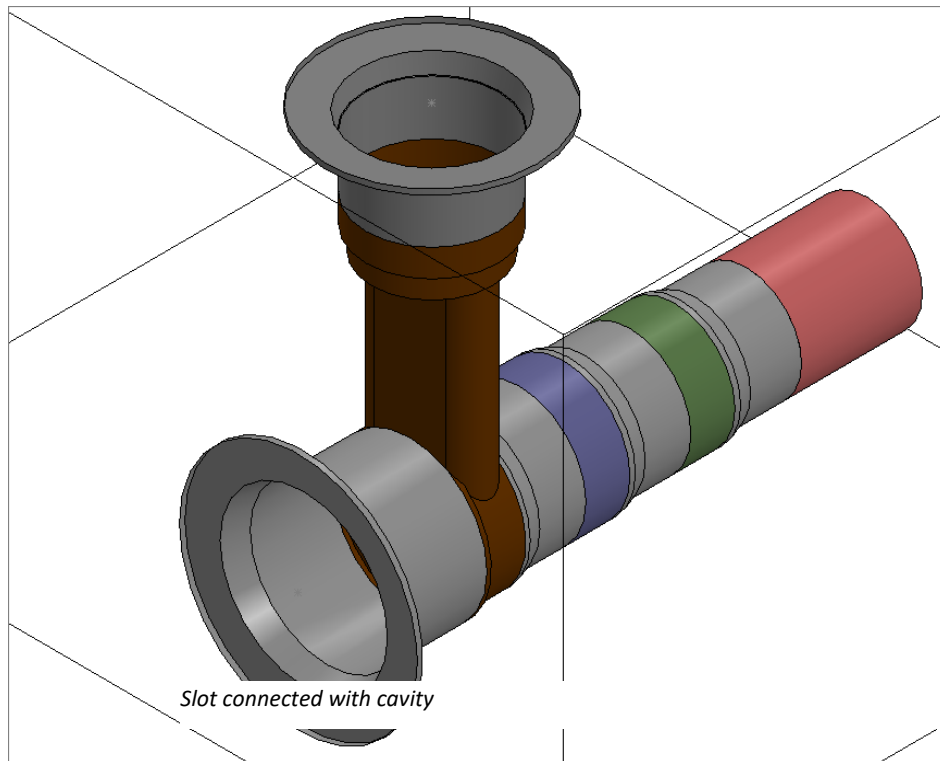
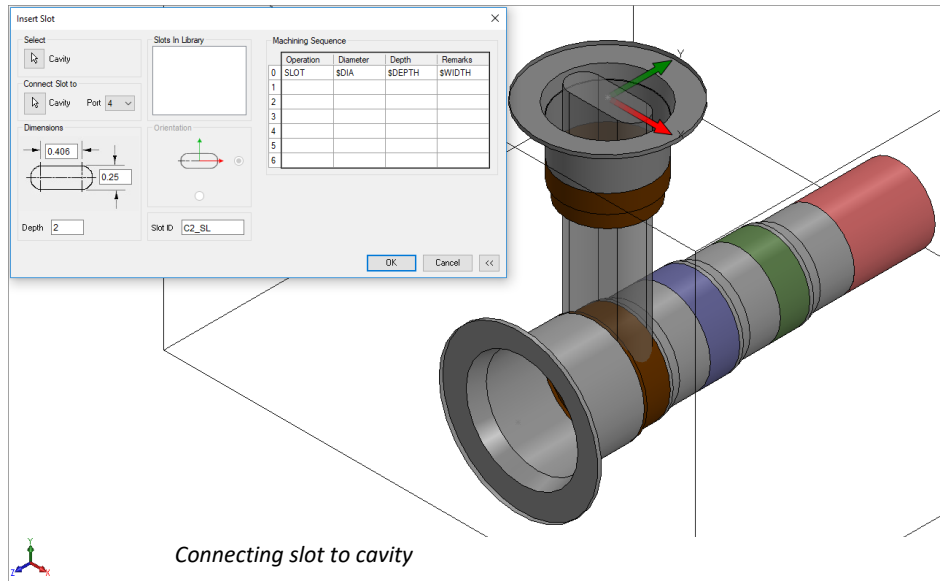
Default value of the slot depth is the center distance between the parent cavity and the connecting cavity.

Slot depth should not be less than the center distance between the parent cavity and the connecting cavity.

6. Click **OK**.
MDTools inserts the slot with the cavity at the specified location and connects the slot to the selected connecting cavity.

Note:

- Connect slot to cavity, only works for cartridge valves.
- Orientation of the slot depends upon the connecting cavity axis.



25. Copy Cavity

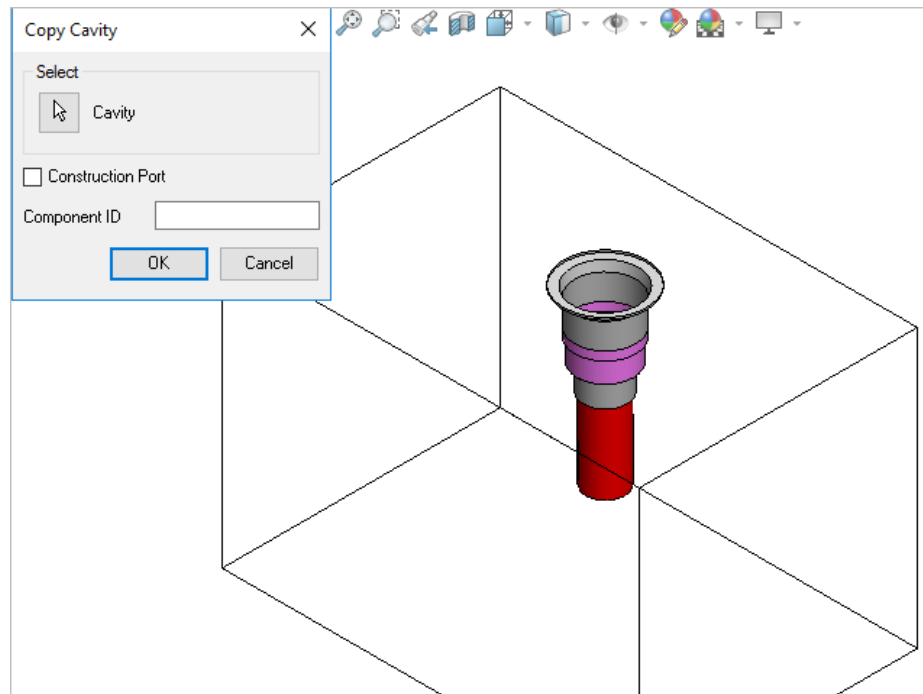
Create a copy of an existing cavity/footprint on the manifold.

All the parameters including the connectivity information are copied to the new cavity.

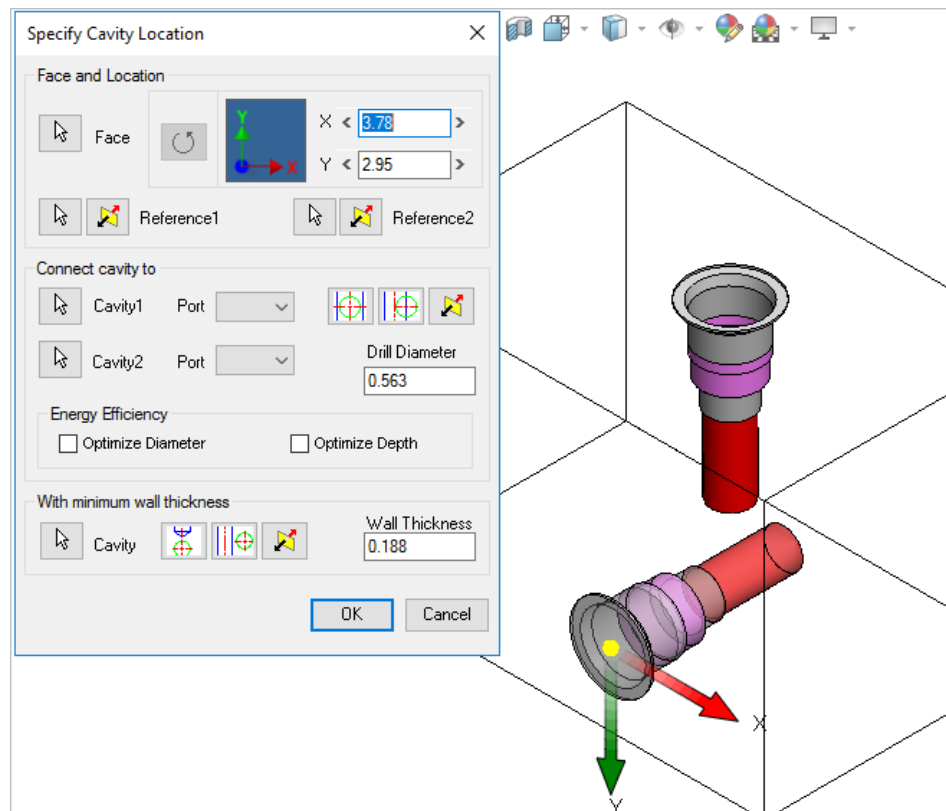
1. MDTTools 960
> **Copy**
The *Copy Cavity* dialog box displays.
2. Click the **Select** button and then select the cavity you want to copy.
3. Enter the **component ID** for the new cavity/footprint.
4. Select the **Construction Port** option when you use the new cavity as a construction hole.
If this option is selected, then MDTTools® automatically assigns the component ID.
5. Click **OK**.
The *Specify Cavity Location* dialog box displays.
6. Select the point on the manifold face where you want to insert the cavity and pick connecting cavities.
MDTools displays a preview of the selected cavity at a selected point on the manifold.
7. Click **OK**.
MDTools creates a copy of the selected cavity at the specified location.

Note:

- When you select a cavity on a footprint, then the complete footprint will be copied.
- When you copy a footprint, the main cavity on the footprint will be created at the selected location.



Copy Cavity dialog box

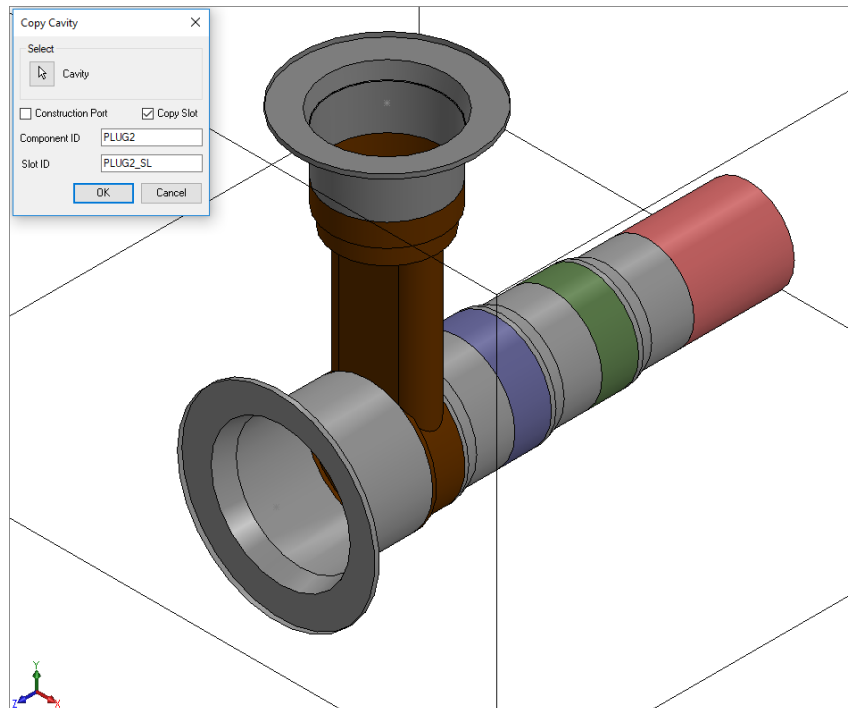


Specify Cavity Location dialog box

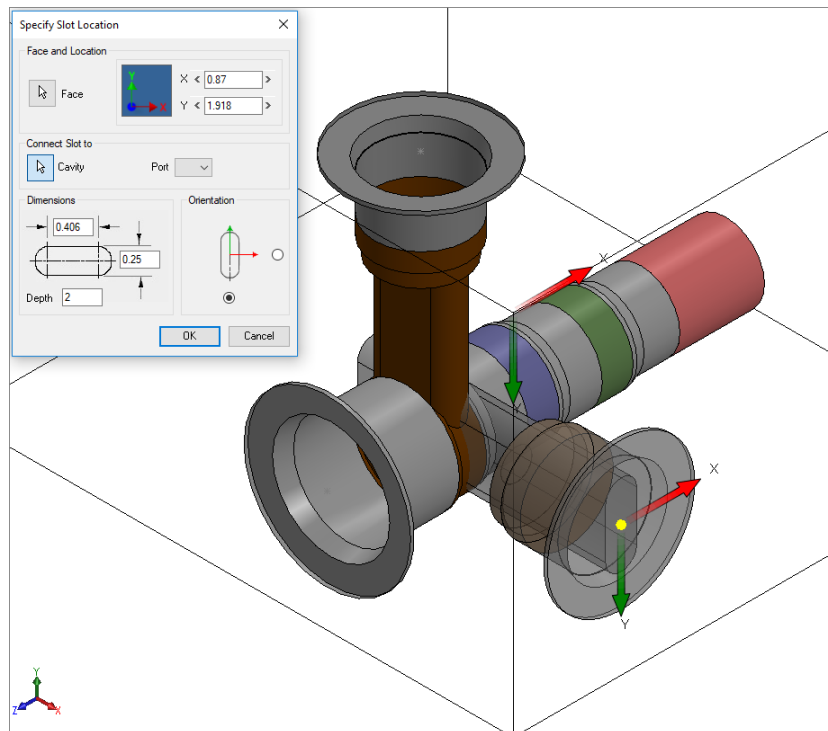
26. Copy Slot

1. MDTools 960
> **Copy**
The MDTools Select Cavity dialog box displays.
2. Select the slot you want to copy.
Copy Slot option selected by default.
3. Enter the **component ID** for the new cavity/footprint.
4. Enter the slot ID for the new slot.
5. Select the **Construction Port** option when you use the new cavity as a construction port.
If this option selected, then MDTools® automatically assigns the component ID.
6. Click **OK**.
The Specify Slot Location dialog box displays.
7. Select the point on the manifold face where you want to insert the cavity and select connecting cavities.
MDTools® displays a preview of the selected cavity at a selected point on the manifold.
8. Enter the X and Y distance from the block origin.
9. Modify slot **dimensions**.
Default value of slot diameter and slot width is the maximum drill diameter of parent cavity/2.

Slot diameter plus slot width should not be larger than the parent cavity maximum drill diameter.
10. Modify the **depth** of the slot.
Default value is the parent cavity depth + 0.5 inches/12 mm.
11. Select Orientation.
Select the orientation of the slot from the axis or center of the selected cavity.
12. Click **OK**.
MDTools creates a copy of the selected slot with the parent cavity at the specified location.



Copy Slot dialog box



Specify Slot Location dialog box

Note:

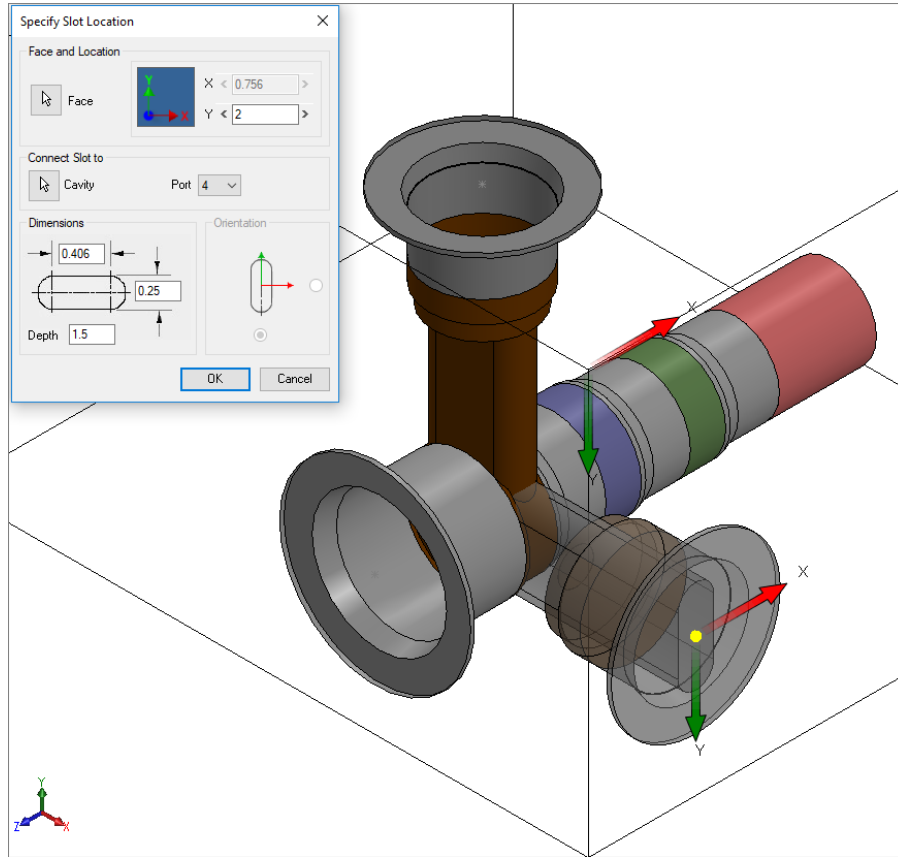
- If a slot on the origin of a footprint is selected, then the slot is copied with the footprint.
- If a slot on a child cavity of a footprint is selected, then the Copy Slot command will be terminated.

Connect Slot to existing Cavity

Connect a new slot to an existing cavity in the manifold.

Click the selection button for a Cavity.

1. Select the connecting cavity.
2. Select the connecting port on the cavity.
MDTools[®] automatically relocates the slot with cavity to the port center and displays the slot diameter, width and depth.



3. Modify slot **dimensions**.
Default value of the slot diameter is the connecting cavity port diameter.

Slot diameter plus slot width should not be larger than the parent cavity maximum drill diameter.

4. Modify the **depth** of the slot.
Default value of the slot depth is the center distance between the parent cavity and the connecting cavity.

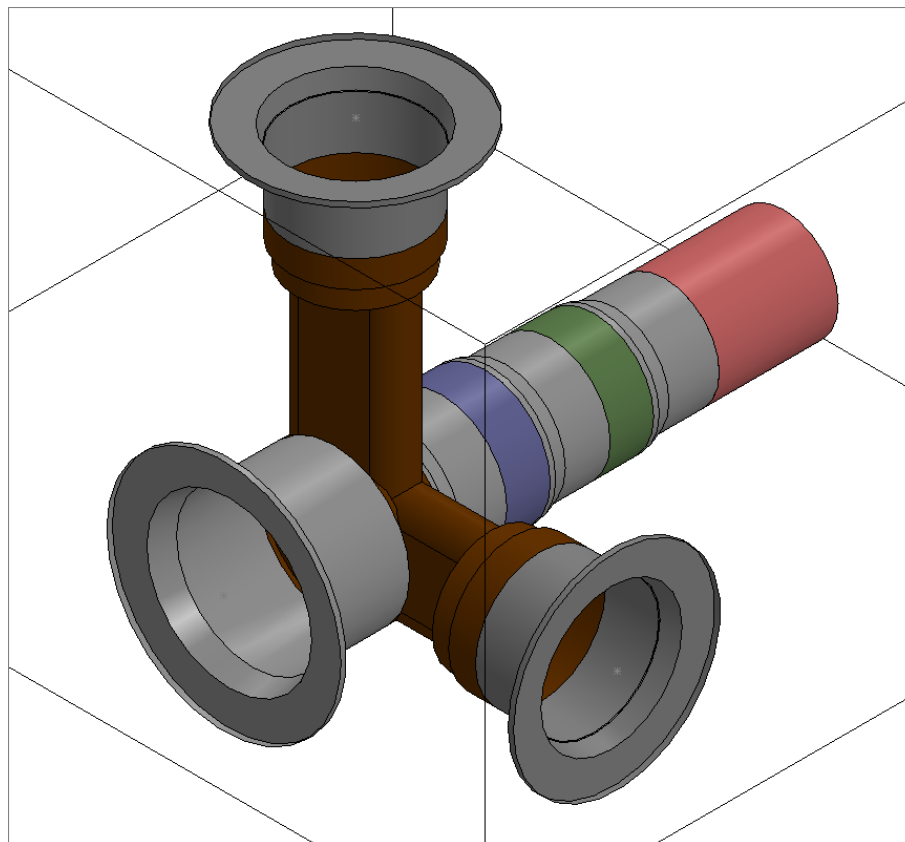
Slot depth should not be less than the center distance between the parent cavity and the connecting cavity.

5. Click **OK**.
MDTools creates a new slot with the cavity at the specified location and connects the slot to the selected connecting cavity.

Note:

- The *connect slot to cavity* option only works with cartridge valves.
- Orientation of the slot depends upon the connecting cavity axis.

Connecting slot to cavity



Slot connected with cavity

27. Copy Multiple Cavities

Copy multiple cavities/footprints simultaneously by specifying the displacement along their common axes.

1. MDTools 960

> Copy

> **Copy Multiple**

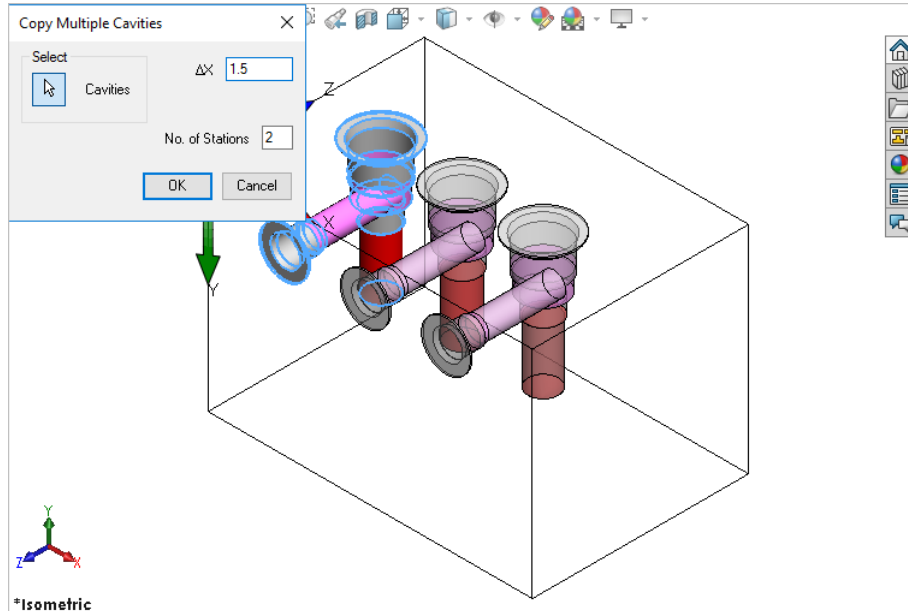
The *Copy Multiple Cavities* dialog box displays.

MDTools[®] displays the coordinate symbol, indicating the direction of coordinates at the manifold origin.

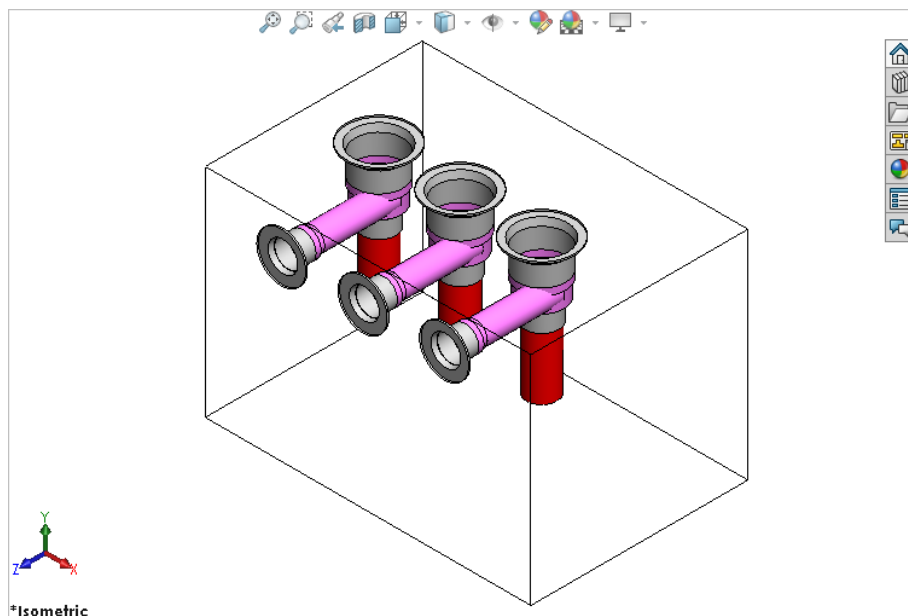
- Click the **Select** button and then select the cavities you want to copy.
A data field to enter the displacement along the common axes displays on the dialog box.
- Enter the required **displacement** along each axis.
If you select cavities on perpendicular faces, MDTools displays only one field to enter displacement. This happens because cavities have only one common axis.
- Enter the number of multiple copies required in the **No. of Stations** option.
- Click **OK**.
MDTools creates copies of selected cavities/footprints.

Note:

- Cavity ID of original cavity _Copy is used as the cavity ID for all the copies of the cavity. For example, if you copy a cavity with ID '2A', then the ID of the copy will be '2A_Copy'.
- Names of the construction ports will be assigned automatically as per the default construction port ID in MDTools Options.
- Displacement can be specified only along the common axis of the cavities.
- Cavities on three mutually perpendicular faces cannot be copied using this command. For example, top, left, and front.



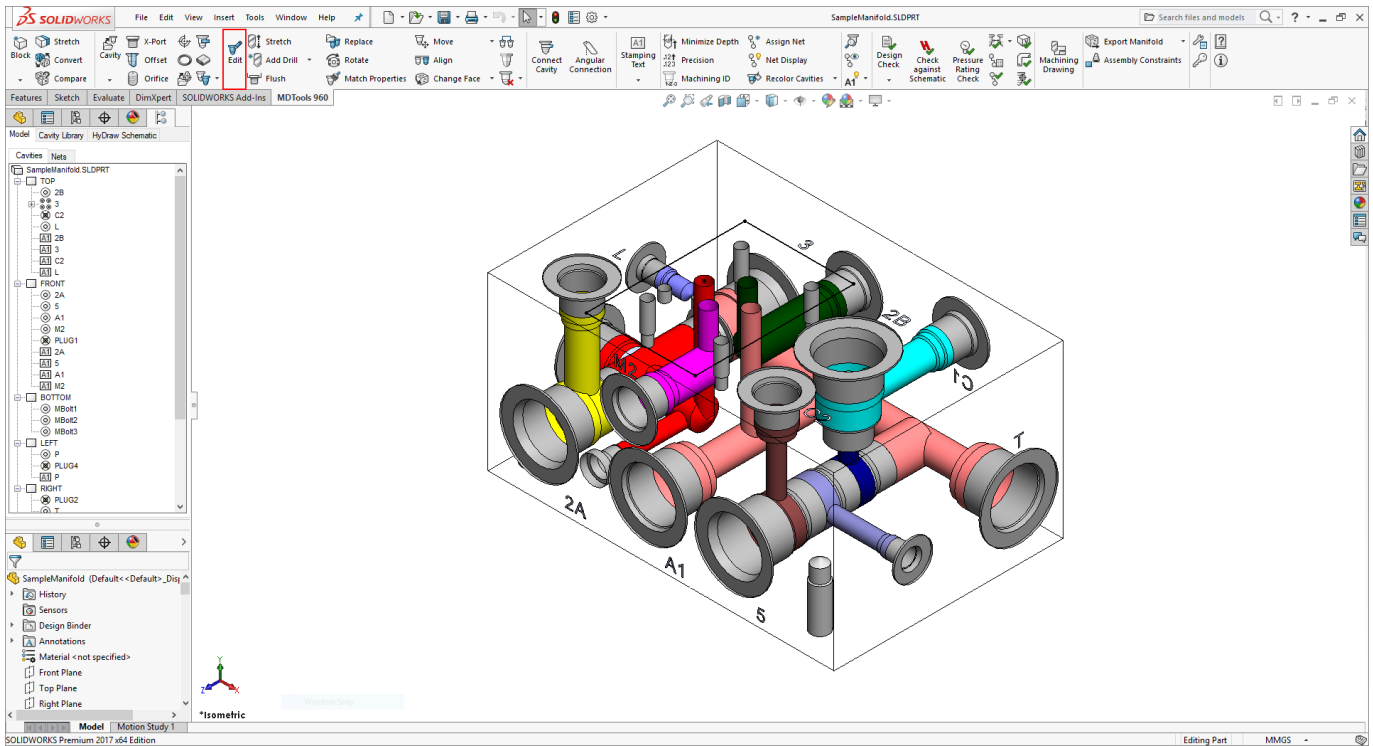
Copy Multiple Cavities: Enter displacement and No. of Stations



Copies of selected cavities created

Edit Cavity

- 28 Edit (Cavity)
- 29 Edit All Cavity Parameters
- 30 Sink Orifice Plug
- 31 Edit (Undercut)
- 32 Edit (Slot)
- 33 Edit (O-ring Groove)



28. Edit Cavity

Change the design specific cavity dimensions inside SolidWorks.

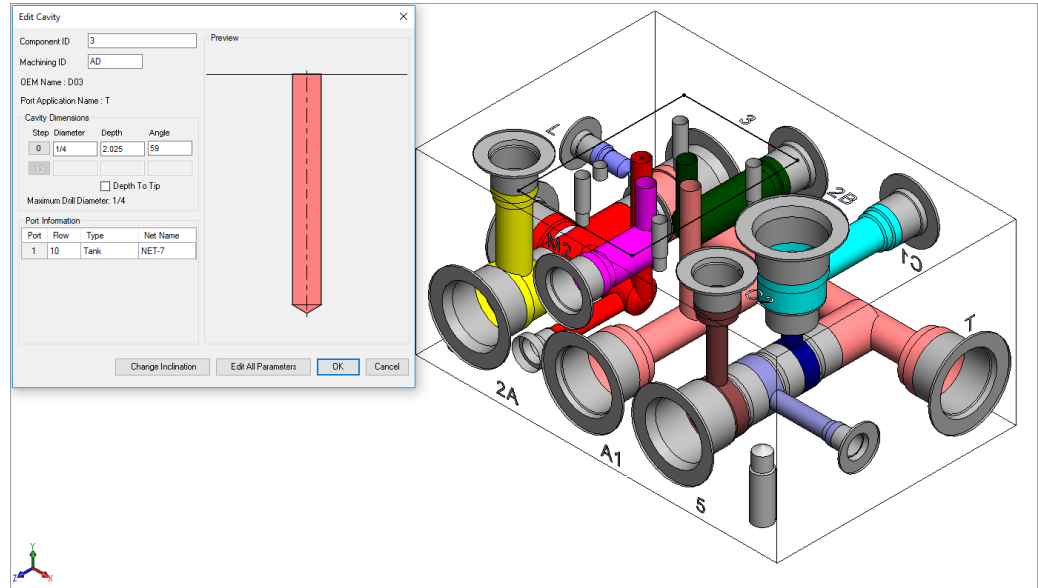
It also enables you to select a tool (Drill or Spot Face tool) from a tooling knowledge base. This helps avoid the use of non-standard drills and spot faces.

1. MDTools 960
> **Edit**
The MDTools Select Cavity dialog box displays.

2. Select and click the highlighted cavity on the manifold.
When you move the cursor over the cavity, it gets highlighted.

The Edit Cavity dialog box displays.

MDTools® displays the cavity preview with the design-specific cavity dimensions.

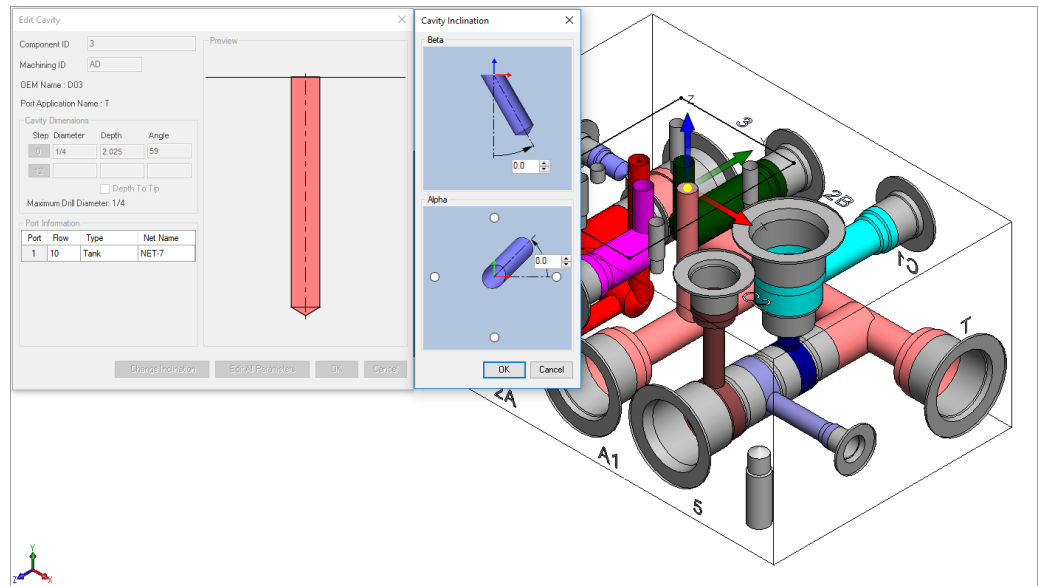


Edit Cavity dialog box

3. Click Edit All Parameters.
4. View or change all the cavity parameters.

Note:

- Click Change Cavity Inclination to change the inclination of a cavity.
- Select the Depth to Tip option to get the drill depth up to the tip.
- The Depth to Tip option is selected, if the Drill Depth Tip option is selected in MDTools Settings.
- You can override the Depth to Tip option locally.
- Port Application Name displays the Footprint type cavity.



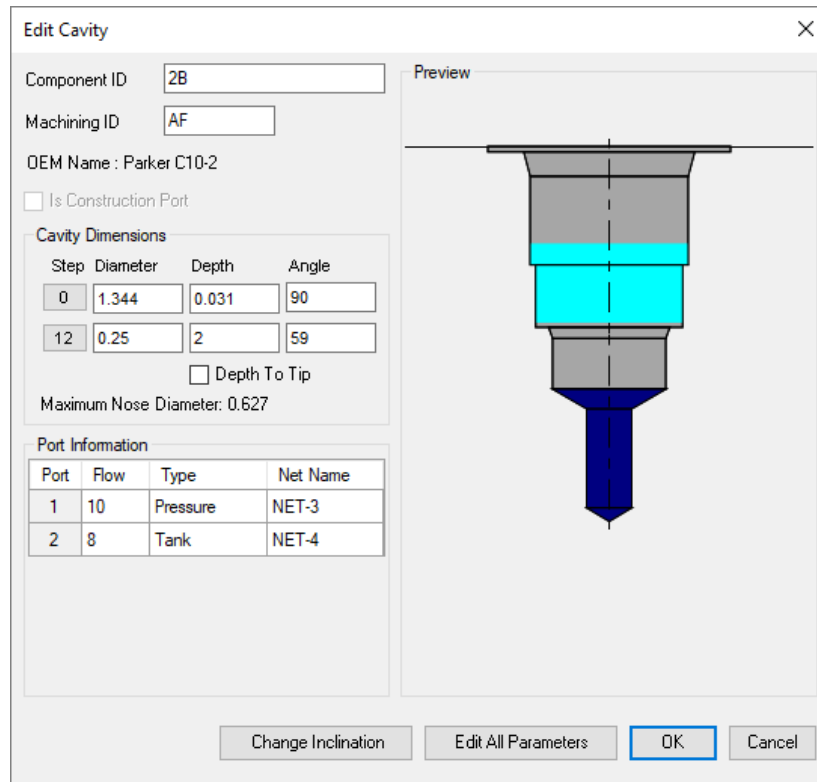
Angle Dimension

The **Edit Cavity** dialog box displays:

- Component ID
- The component ID for the cavity.
- Machining ID
- The default ID is '?'.

This ID is used to identify the hole in the block machining drawing and the machining chart.

- Spot face and drill dimensions
- Cavity Insertion angles (Alpha and Beta)
- Inclination angle is only applicable to drill holes, ports, or cartridge valve cavities.
- Maximum Nose (Drill) Diameter
- This is a reference parameter, therefore not editable during design.
- Port Information
- Enter flow, type, and net name for the cavity.
- When the net name is edited, the color of the cavity is updated according to the color assigned to the net.
- When you click at Net Name Column Net Name pop up occur to select a net from existing nets.



Edit Cavity: Cartridge valve cavity

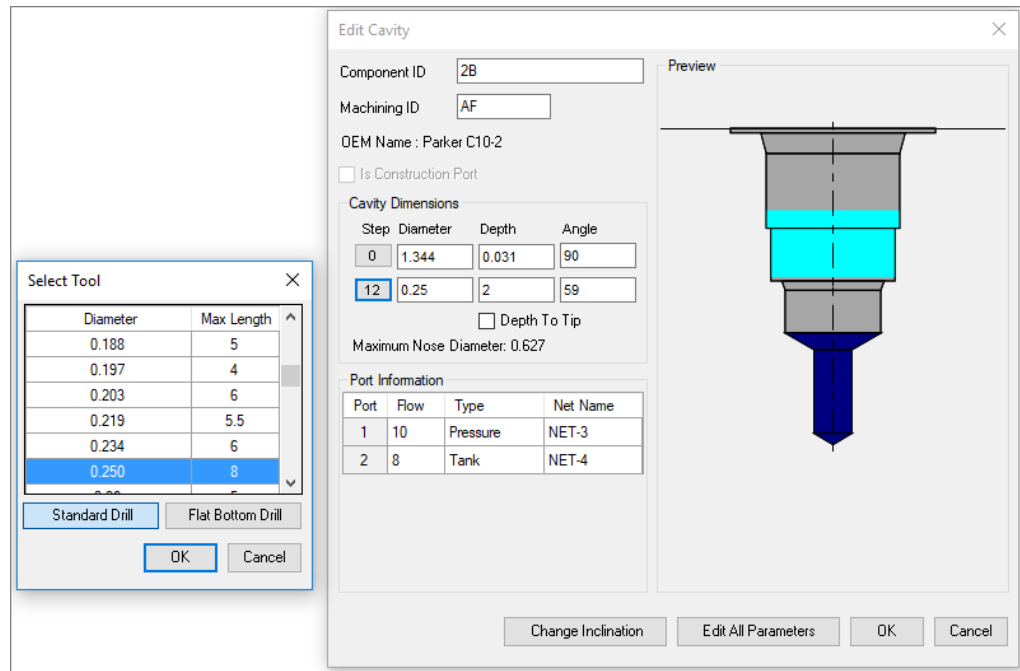
28.1 Selecting Drill Diameter from Drill List

Select and use a drill from a standard drill list.

1. Click the Step button before drill dimensions. *The Select Tool dialog box displays.*
2. Select a drill from the list.
3. Click **OK**. *MDTools updates the drill diameter of the cavity with the selected diameter.*

Note:

- Click Flat Bottom Drill to view and select a flat bottom drill.
- Only drills with diameter less than or equal to the maximum allowable drill diameter of the cavity are listed.

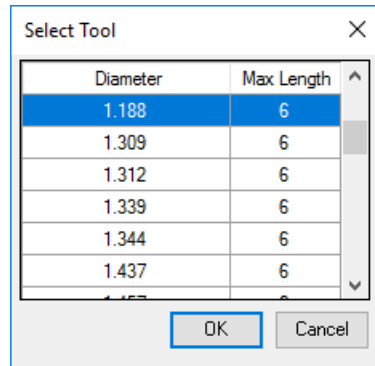


Edit Cavity and Select Tool dialog box

28.2 Selecting Spot Face Diameter from the Spot Face Tool list

Select and use a spot face from a standard spot face tool list.

1. Click Step button before spot face dimensions. *The Select Tool dialog box displays with a spot face tool list.*
2. Select a spot face tool from the list.
3. Click **OK**. *MDTools updates the spot face diameter of the cavity with the selected spot face tool diameter.*



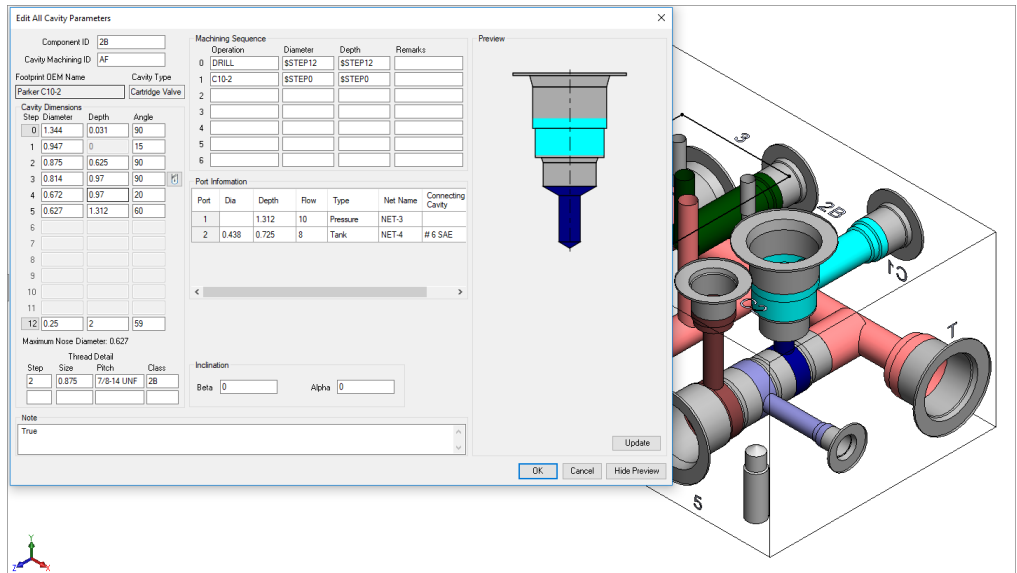
Spot face tool list

29. Edit All Cavity Parameters

View and change all the cavity dimensions and other parameters within SolidWorks.
 You can also select a tool (Drill or Spot Face tool) from a tooling knowledge base.

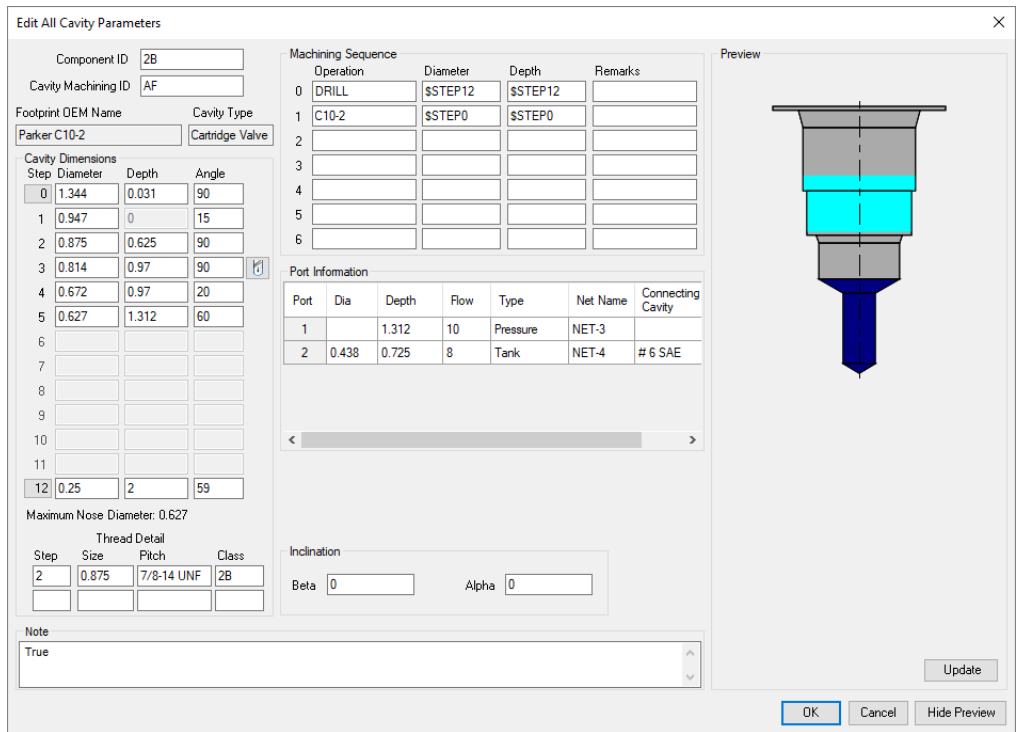
- MDTools 960
 > **Edit**
 The Edit Cavity dialog box displays
- Click Edit All Parameters.
 The Edit All Cavity Parameters dialog box displays showing all the parameters of the cavity.
- View the associated parameters and change the values, if required.

The Edit All Cavity Parameters dialog box shows:



Edit All Cavity Parameters dialog box

- Component ID
 The default cavity ID is the same as the component ID.
- Cavity Machining ID
 The default ID is '?'.
- Cavity Dimensions
 Step0 through Step12 dimensions are editable.
- Maximum Nose (Drill) Diameter
- Machining Sequence
- Cavity Inclusion Angle (Alpha and Beta)
- Thread Detail
 Only available for Cartridge valve cavities
- Port Information
 Only available for Port type cavities
- Plug Detail
 Only available for Port type cavities




Edit All Cavity Parameters dialog box

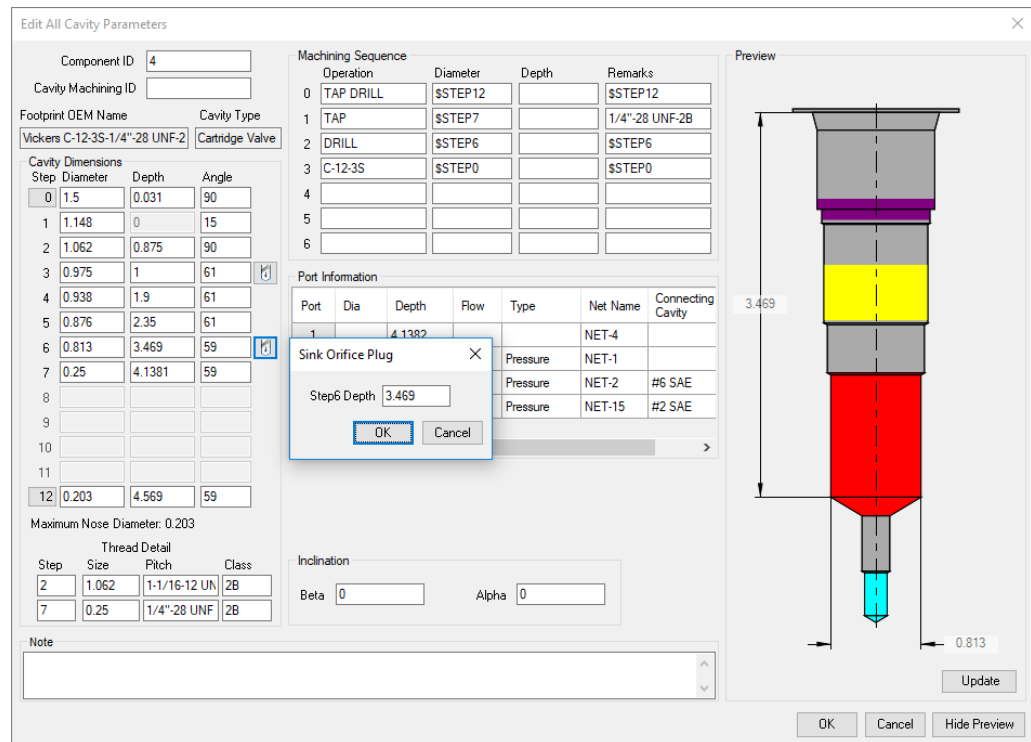
Note:

- You cannot add or remove a step in the cavity inside SolidWorks.
- To add a step in a cavity, use the Add Drill command.
 For example, to add another drill above the drill in Step12.

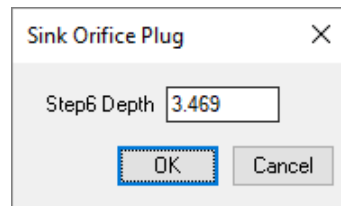
30. Sink Orifice Plug

Move a merged orifice plug up and down without manually editing the data of all affected steps and ports.

- MDTools 960
> **Edit**
The *Edit Cavity dialog box* displays.
- Click the Edit All Cavity Parameters button.
The *Edit All Cavity Parameters dialog box* displays.
- Click , the Sink Orifice Plug icon displayed next to the cavity dimensions' step.
The *Sink Orifice Plug dialog box* displays.
- Enter the new **step depth** in the Sink Orifice Plug dialog box and click **OK**.
MDTools[®] updates the data for all the affected steps and ports automatically in the *Edit All Cavity Parameters dialog box*.
- Click **OK** in Edit All Cavity Parameters to save the changes.



Edit All Cavity Parameters dialog box



Sink Orifice Plug dialog box

Note:

- The Sink Orifice Plug icon will be available only if there is a merged orifice plug in a cavity.
- The Stretch Cavity Step icon (Similar feature for cartridge valve insertion) will be available for 2 and 3 port cartridge valve cavity for steps in which the top port of the cavity ends.
- This functionality will not be available for the merged orifice plugs created using the previous versions of MDTools.

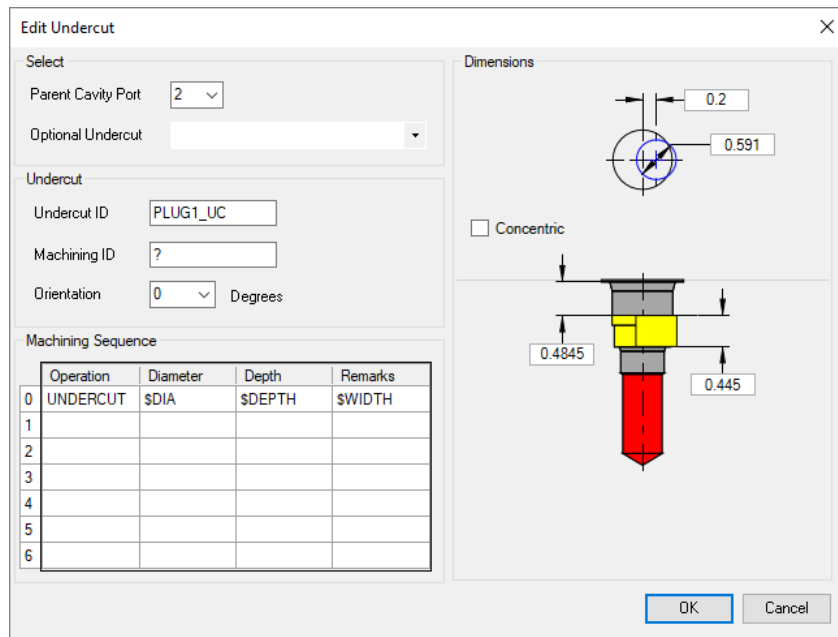
31. Edit Undercut

Change all the values used when creating the undercut. MDTools® modifies the existing undercut according to the new specifications.

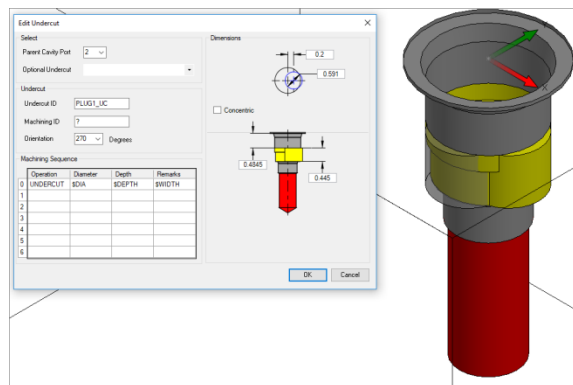
1. MDTools 960
> **Edit**
The MDTools Select Cavity dialog box displays.
 2. Select the undercut you want to edit.
The Edit Undercut dialog box displays.
 3. Select any optional undercut from the list, if defined for the cavity.
- Or
- Modify the **port** of the cavity.
Default values for the undercut as per the selected port/optional undercut are displayed.
4. Select/Deselect **Concentric**, if required.
For undercut at zero offset distance, diameter should be larger than the selected port starting step diameter for the concentric undercut.
 5. Modify the **Undercut ID**, if required.
 6. Modify the **offset distance**, as required.
Modify the desired distance between the center of undercut and selected cavity.
 7. Modify the **undercut diameter**, if required.
Undercut diameter should be larger than the selected port diameter.
 8. Modify the **undercut depth** from the spot face of the cavity, as required.
 9. Modify the **undercut height**, as required.
 10. Modify the **orientation** from the drop down or enter the orientation angle.
Enter the orientation angle between 0 to 360 degrees.
 11. Modify the **machining ID**.
 12. Click **OK**.
MDTools automatically updates the selected undercut according to the changed dimensions.

Note

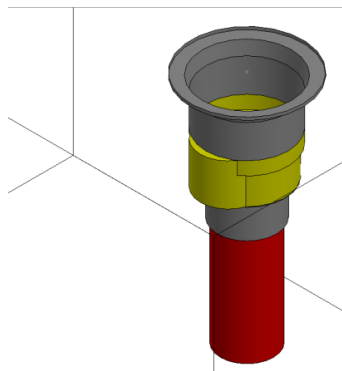
- You can move the undercut into dead area of a cavity, when the **Concentric** option is selected.
- You can move the undercut overlapping with the dead area and the working area.



Edit Undercut dialog box



Modifying Offset Undercut to Concentric Undercut



Offset Undercut changed to Concentric Undercut

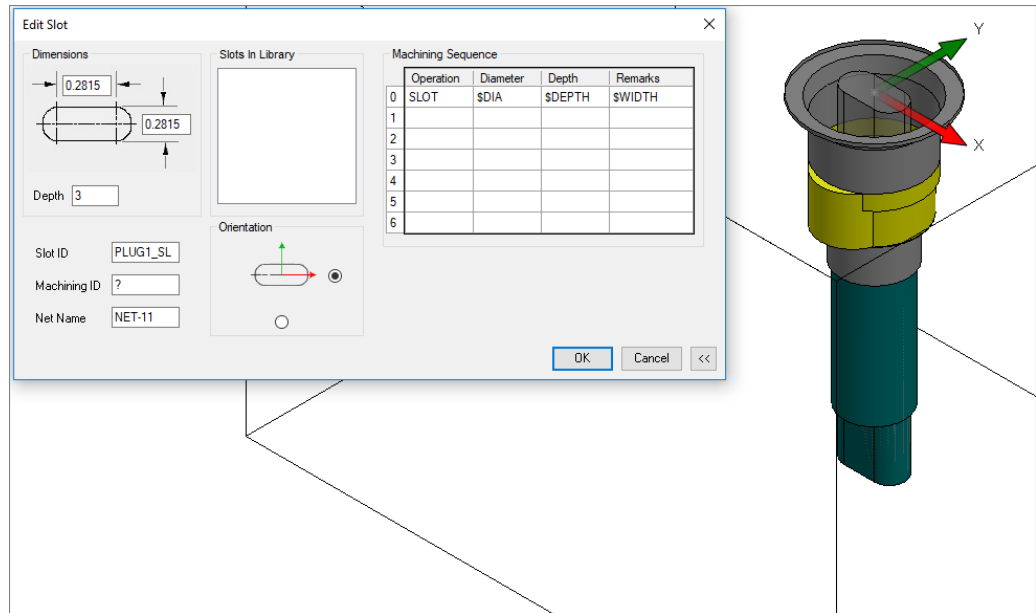
32. Edit Slot

Edit or modify all the values entered when creating the slot. MDTools® modifies the existing slot according to the new specifications.

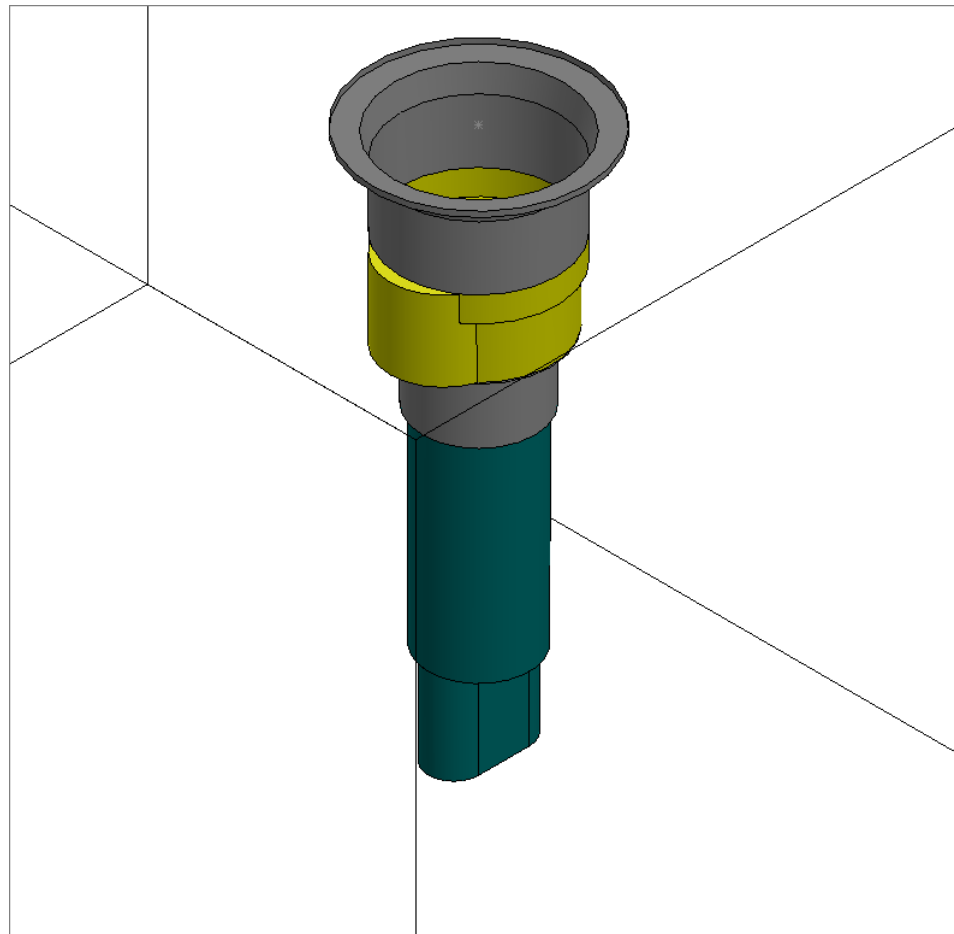
- MDTools 960
> **Edit**
The MDTools Select Cavity dialog box displays.
- Select the slot you want to edit.
The Edit Slot dialog box displays.
- Select any pre-defined slot that exists for the cavity, if required.
- Change Slot ID, Net Name, and Machining ID, if required.
- Change the slot **dimensions**, if required.
Slot diameter plus slot width should not be larger than the parent cavity maximum drill diameter.
- Modify the slot **depth**, if required.
Slot depth should not be less than the parent cavity minimum drill depth.
- Modify the orientation, if required.

Caution!
Changing connected slot orientation, intersects with the dead area of the connected cavity.

- Modify the machining sequence, if required.
- Click **OK**.
MDTools® automatically updates the selected slot according to the changed values.



Edit Slot dialog box



Slot: Orientation changed

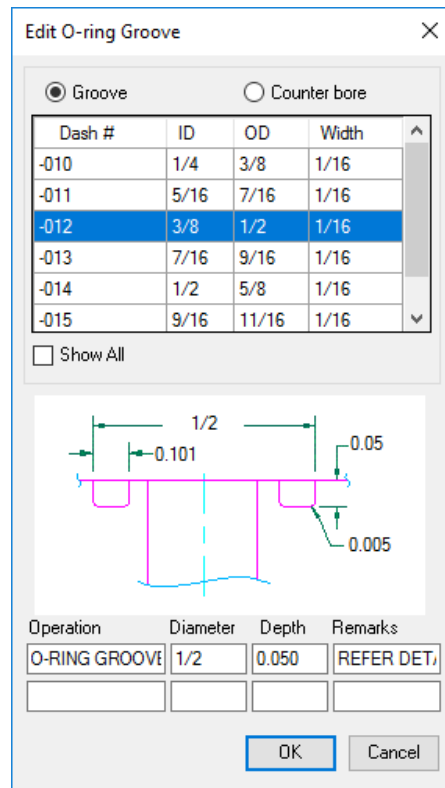
33. Edit O-ring Groove

MDTools® recreates/modifies the existing O-ring groove according to the new specifications.

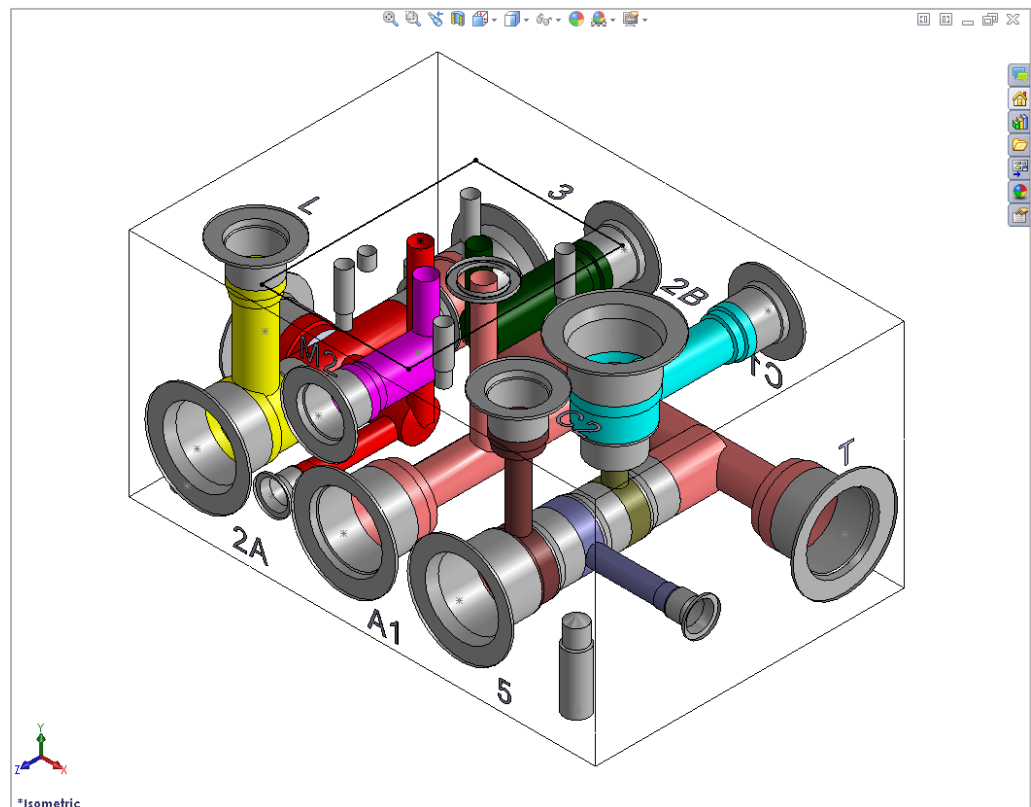
1. MDTools 960
> **Edit**
The MDTools Select Cavity dialog box displays.
2. Select the O-ring groove you want to edit.
The Edit O-ring Groove dialog box displays.
3. Change the O-ring groove dimensions either by selecting an O-ring or by manually modifying the dimensions.
4. Click **OK**.
MDTools automatically modifies/creates a groove with the changed specification.

Note:

- You can edit machining details, such as operation, tool name, diameter, and depth with O-ring.
- The O-ring machining information is displayed in the drawing sheet via the machining chart.
- You can use **\$Step** for diameter and depth fields. Actual value of these fields will be displayed in the Machining chart.
- \$Step in diameter field will display the outer diameter of an O-ring groove in the Machining chart.



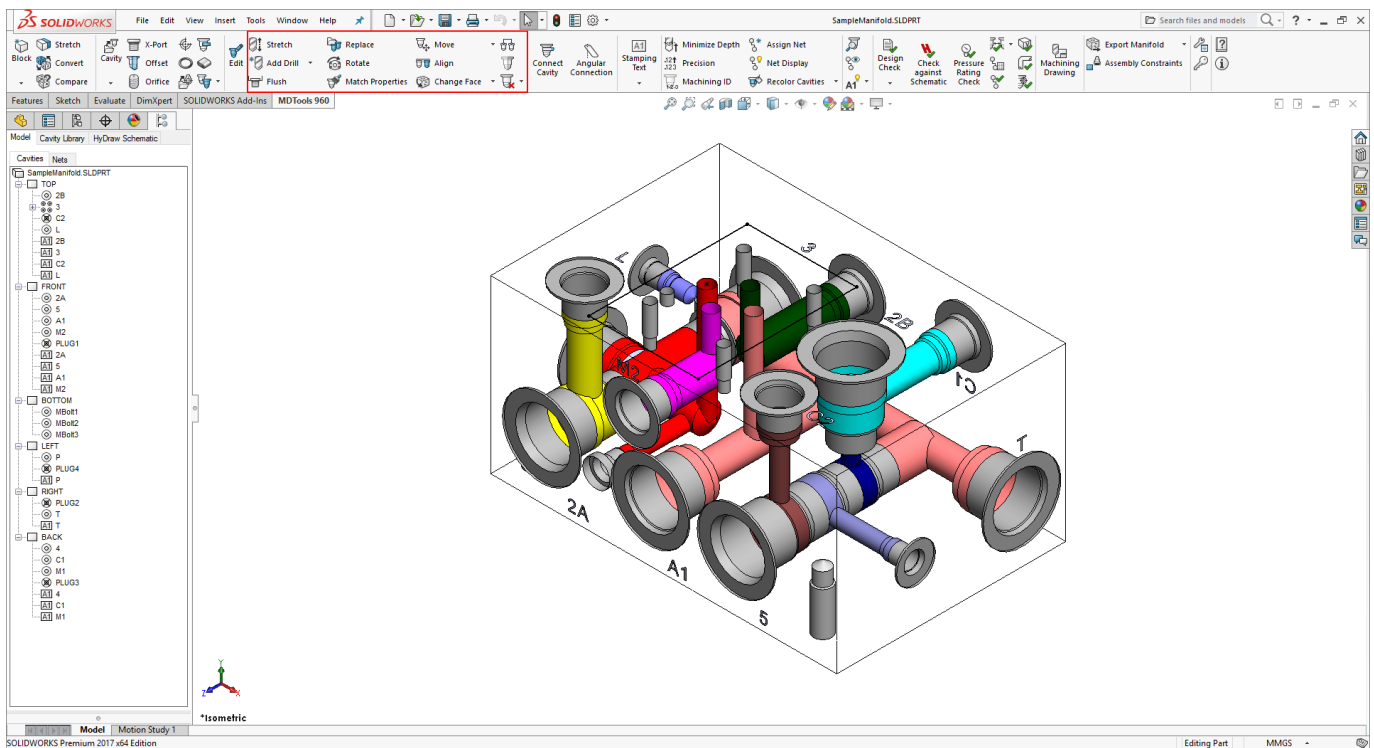
Edit O-ring Groove dialog box



MDTools® automatically recreates the O-ring groove

Modify Cavity

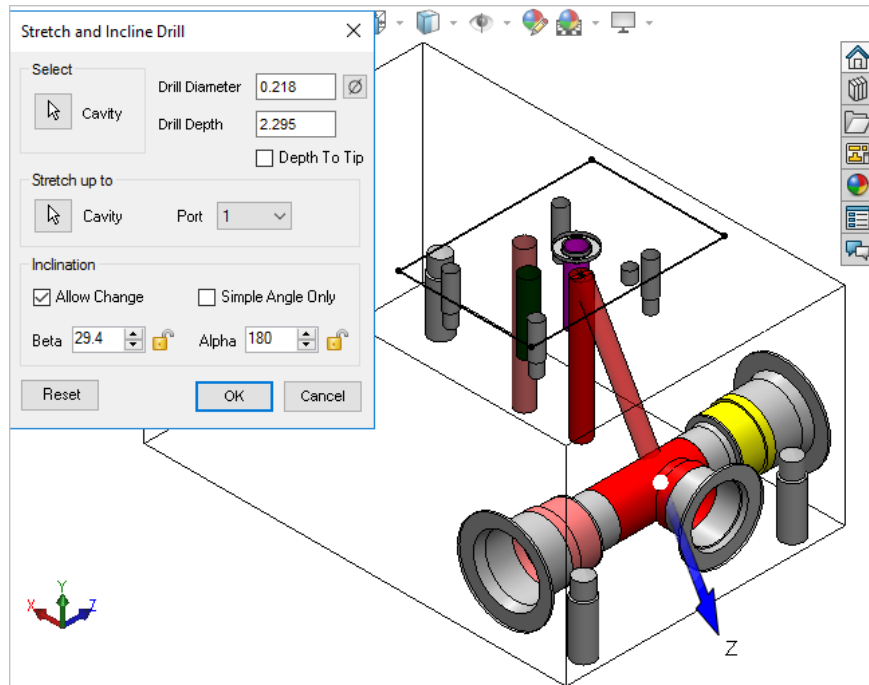
- 34 Stretch and Incline Drill
- 35 Add Drill
- 36 Add Counter Bore
- 37 Flush Construction Ports
- 38 Replace Cavity
- 39 Rotate Footprint/Cavity
- 40 Match Properties
- 41 Move Cavity
- 42 Move Multiple
- 43 Align Cavities
- 44 Change Face
- 45 Swap Cavities
- 46 Constrain Cavities
- 47 Suppress Cavity
- 48 Delete
- 49 Delete Component Outline



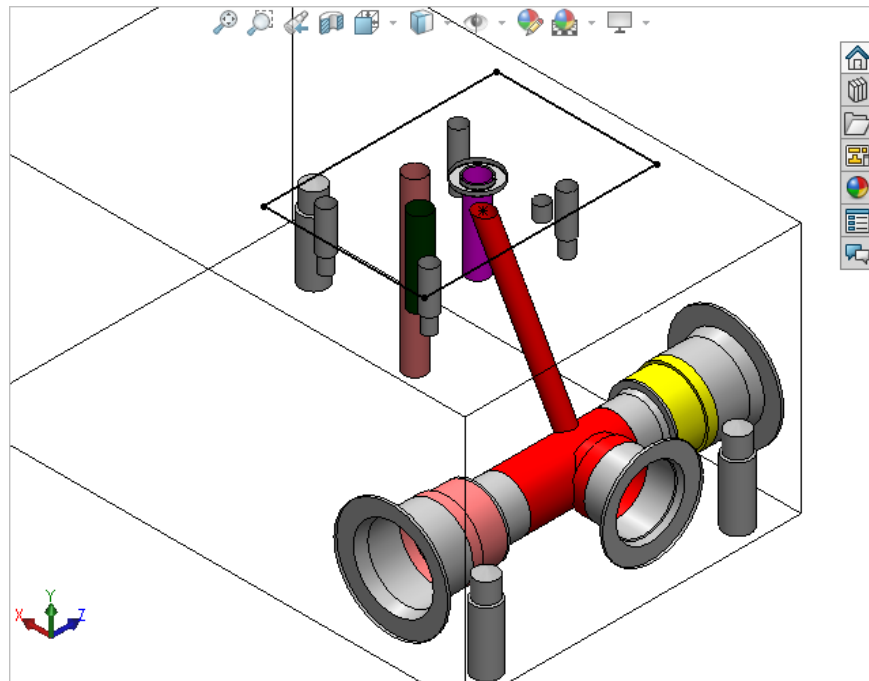
34. Stretch and Incline Drill

Stretch the drill and change its inclination and depth by selecting and dragging the cavity in the model.

1. MDTools 960
 > **Stretch**
 The *Stretch and Incline Drill* dialog box displays.
2. Select a cavity to stretch.
 MDTools[®] displays the preview of the drill in the selected cavity.
 The current drill depth, diameter and inclination are displayed in the dialog box.
3. Select and drag the arrow at the bottom of the cavity to the required depth. Or, Select and drag drill tip point to move the drill in the required direction.
 MDTools automatically updates the preview showing the new depth.
4. Release the mouse button on reaching the required direction and depth.
 MDTools displays the new depth and inclination in the dialog box.
 Change the drill depth, if required.
5. Click **OK**.
 MDTools updates the drill depth, diameter and inclination of the selected cavity.



Stretch and Incline Drill dialog box



Change the drill depth by dragging

Stretch up to a Cavity

Automatically stretch the selected cavity up to a port of a cavity.

6. Select a cavity to stretch.
7. Select a cavity and port to connect.
8. MDTools automatically calculates the inclination and depth and then populates the values in the dialog box.
9. Click **OK** to update the cavity.

Note:

- Select Allow Change to change the inclination by dragging.
- Select the drill tip point to change both the inclination and depth.
- Select and drag the arrow to change the drill depth only.
- The drill depth cannot be increased beyond the manifold block
- You can lock either Beta or Alpha angle while dragging the cavity using the option provided in the dialog box.
- To restrict the drill tip in a plane switch to a view plane parallel to that plane.

35. Add Drill

Automatically add drill operation to an existing cavity.

MDTools® automatically adds the machining operation in a user-specified row in the machining sequence.

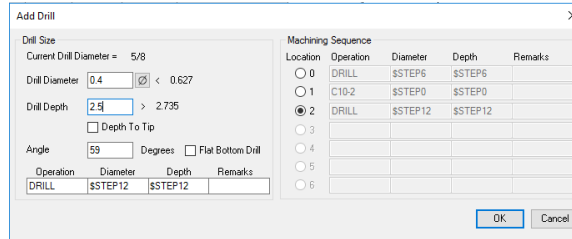
1. MDTools 960

> **Add Drill**

The *Select a Cavity* prompt displays.

2. Select the cavity in which you want to add the drill.

The *Add Drill* dialog box displays.



Add Drill dialog box

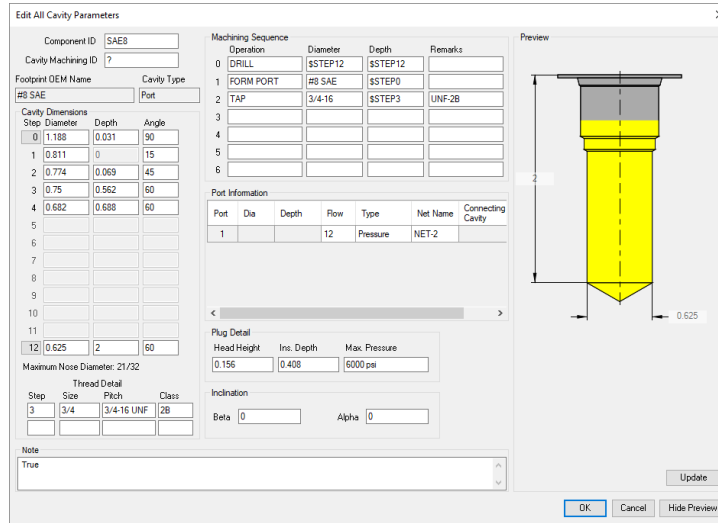
3. Enter the drill diameter and the drill depth.

MDTools displays a preview of the drill of the selected cavity.

Changing drill dimensions, MDTools automatically updates the drill preview.

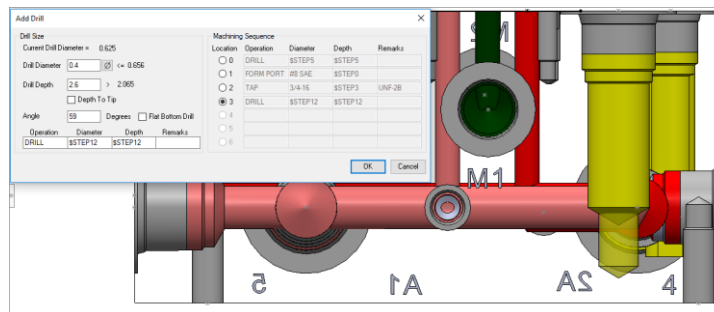
4. Select the **Depth to Tip** option to enter the drill depth value from the depth to the tip.

5. Select the location of a new machining operation in the cavity Machining sequence. The default location is the first empty row in the machining sequence.



Cavity data before adding the drill

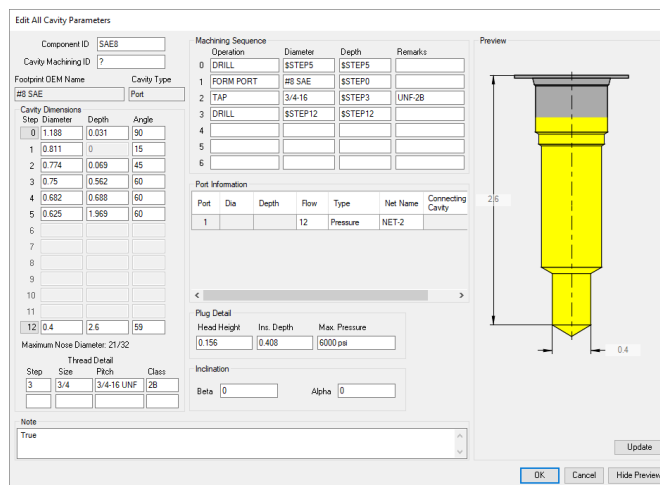
6. Change the machining detail, if required.
7. Select **Flat Bottom Drill**, if the drill needs to be flat bottomed.
8. Click **OK** to add the drill to the selected cavity.



Preview While adding Drill

Note:

- You can add only a drill in a cavity, if there is at least one empty circle (circle with no data) in the cavity.
- If there is no empty circle in the cavity, then the message, “cannot add drill as all circles have data”, is displayed.
- Drill is added in circle 12, if it is empty, else the drill is added to the first empty circle from top in the cavity.

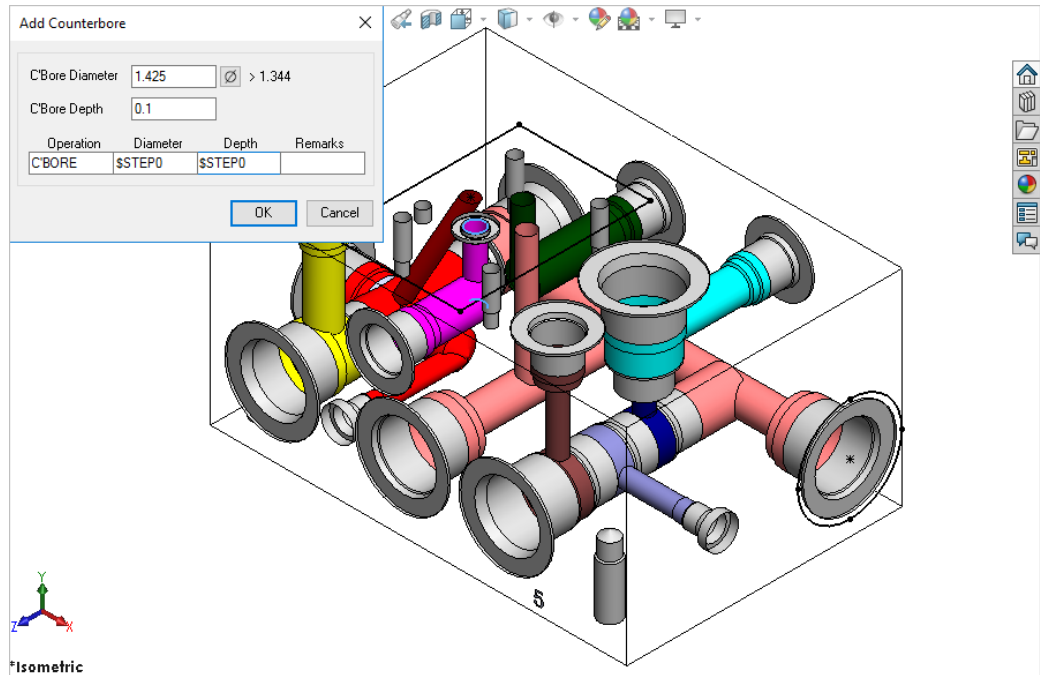


Cavity data after adding the drill

36. Add Counter Bore

Automatically add counter bore operation to an existing cavity.

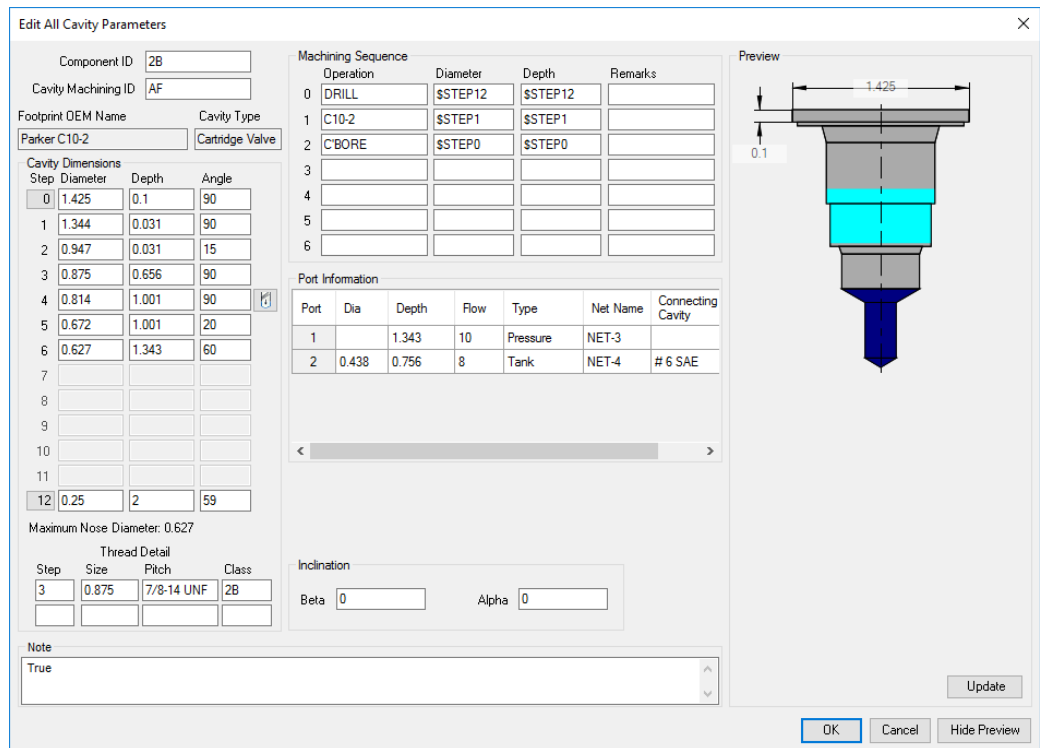
- MDTools 960
 > Add Drill
 > **Add Counter Bore**
 The *Select Cavity dialog box* displays.
- Select the cavity in which you want to add the counter bore.
 The *Add Counterbore dialog box* displays.
- Enter the counterbore **diameter** and **depth**.
- Change the machining details, if required.
- Click **OK** to add the counterbore to the selected cavity.



Add Counterbore dialog box

Note:

- The Add Counter Bore command modifies the cavity geometric data and the machining data.
- If a counterbore is added to a cartridge valve cavity, appropriate changes are also made to the port depth of the cavity.
- To add a counterbore, at least one circle data should be available as a blank, else this command will not be able to add a counterbore.



Cavity data after adding the counterbore

37. Flush Construction Ports

Automatically flush the construction ports below manifold surface by increasing the spot face depth of the cavity. You can flush either the selected cavities or all the cavities on a selected face.

MDTools 960

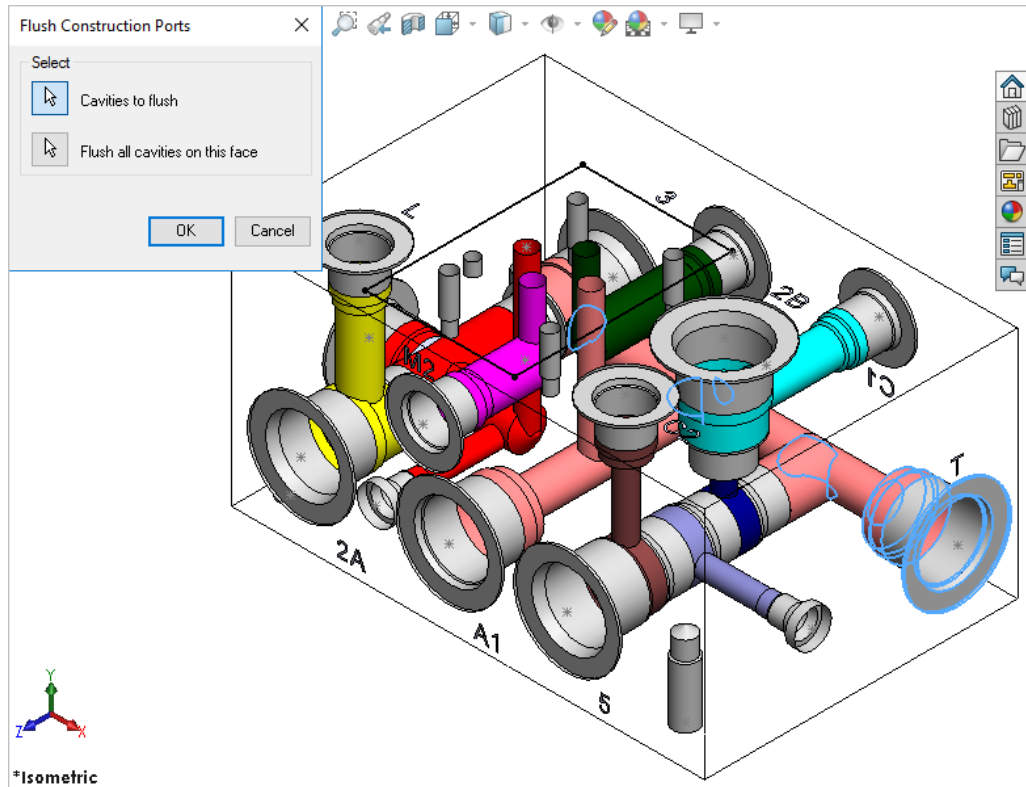
> **Flush**

The Flush Construction Ports dialog box displays.

Flush selected Construction Ports

1. Select the cavities to flush.
The default selection is, Cavities to flush.
2. Click **OK**.
MDTools[®] automatically flushes the selected cavities by increasing their spot face depths.

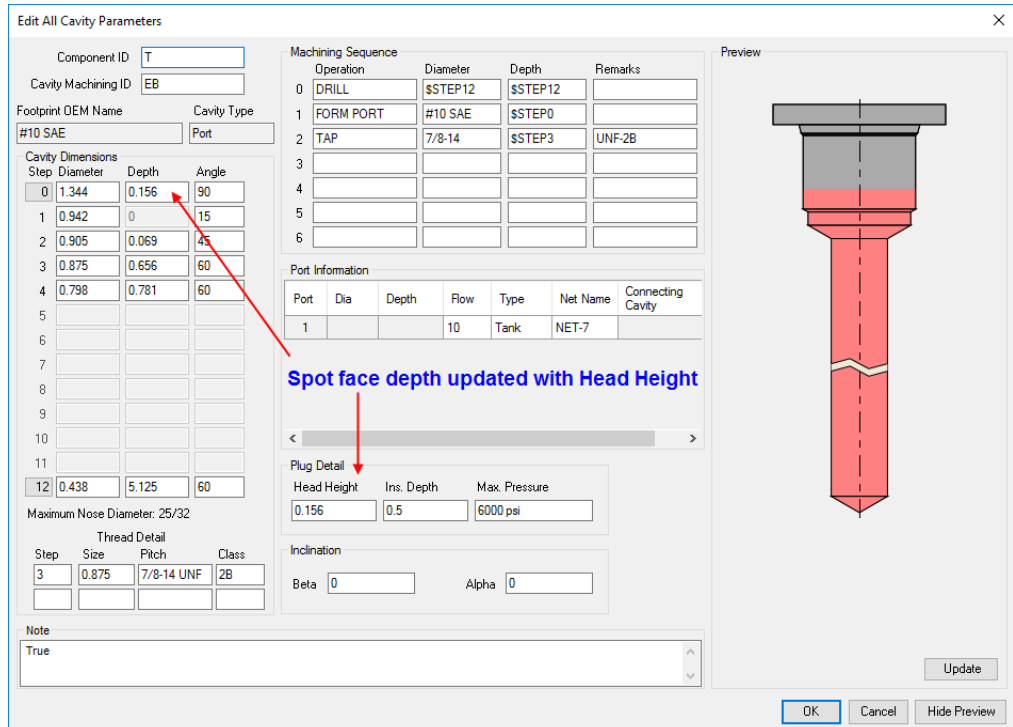
When flushing each cavity, MDTools updates the spot face depth with the plug head height entered in the cavity.



Flush Construction Ports dialog box

Flush all Construction Ports on a selected face

1. Click Flush all cavities on this face.
2. Select the face.
3. Click **OK**.
MDTools flushes all the construction ports on the selected face.

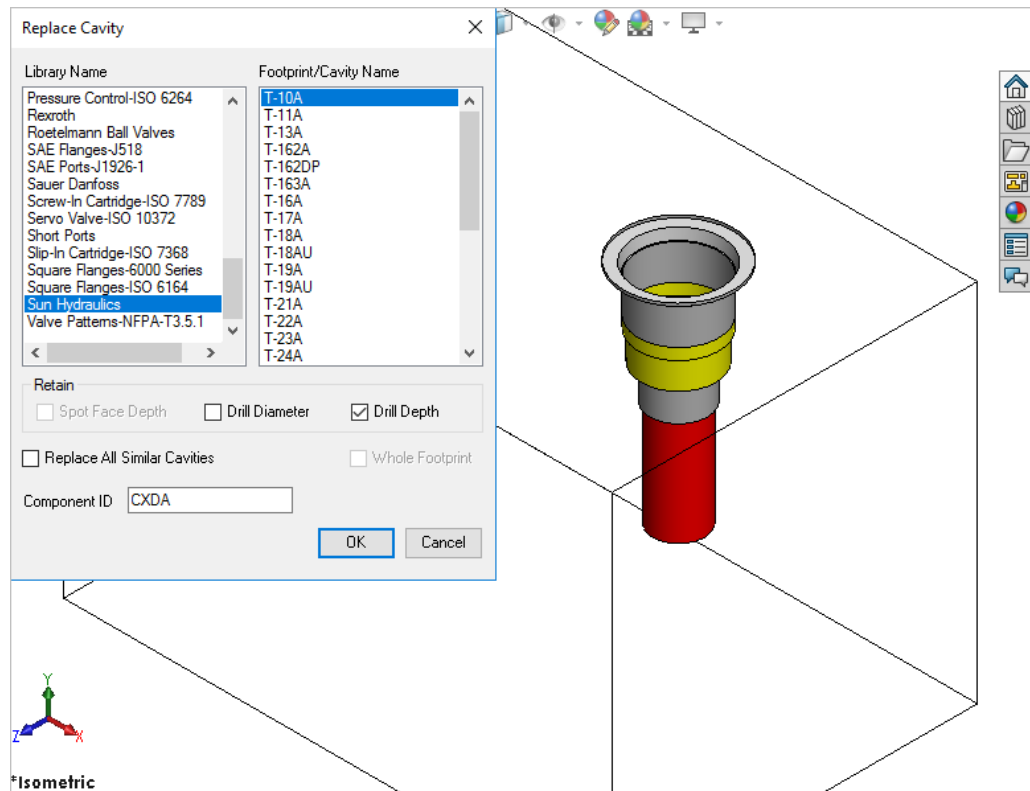


Edit Cavity dialog box : Updated spot face depth

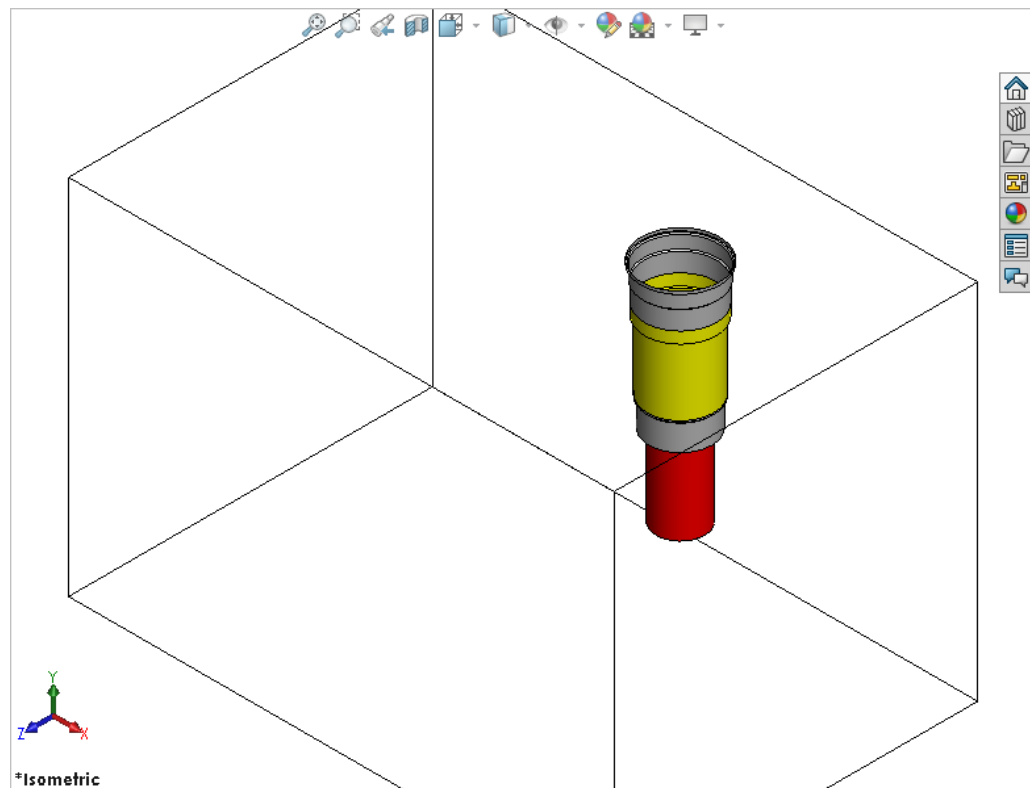
38. Replace Cavity

Replace a cavity located on a manifold with any cavity in the MDTools® library. The new cavity will replace the original at the same position on the manifold.

1. MDTools 960
> **Replace**
The MDTools Select Cavity dialog box displays.
2. Select the cavity to replace.
The Replace Cavity dialog box displays the MDTools library.
3. Select the cavity from the library to replace the existing cavity.
The new cavity automatically takes the cavity ID from the existing cavity.
4. Select **Replace All Similar Cavities** checkbox to replace all the original cavities at the same position on the manifold.
The new cavity automatically takes the cavity ID from the existing cavity.
5. Click **OK**.
MDTools replaces the selected cavity on the manifold with the new cavity from the library.



MDTools Replace Cavity dialog box



Cavity is replaced with the new cavity

39. Rotate Footprint/Cavity

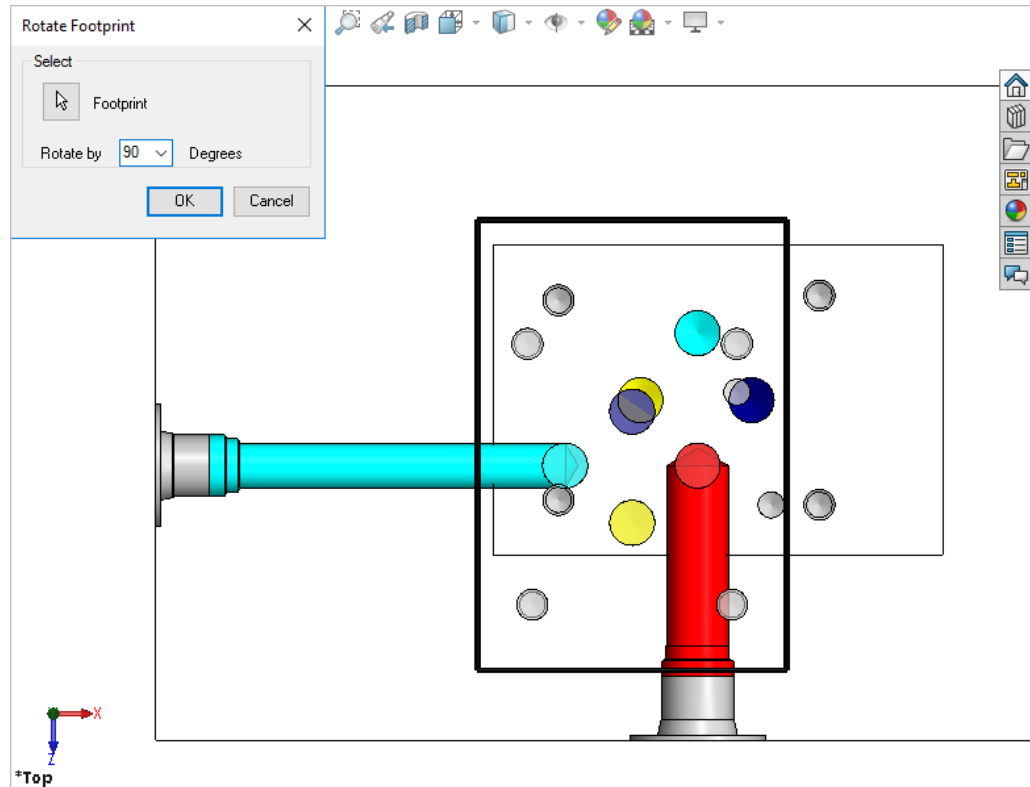
Rotate a footprint/cavity on the manifold surface.

The footprint/cavity is rotated by the specified angle, about the center of the parent cavity of the footprint.

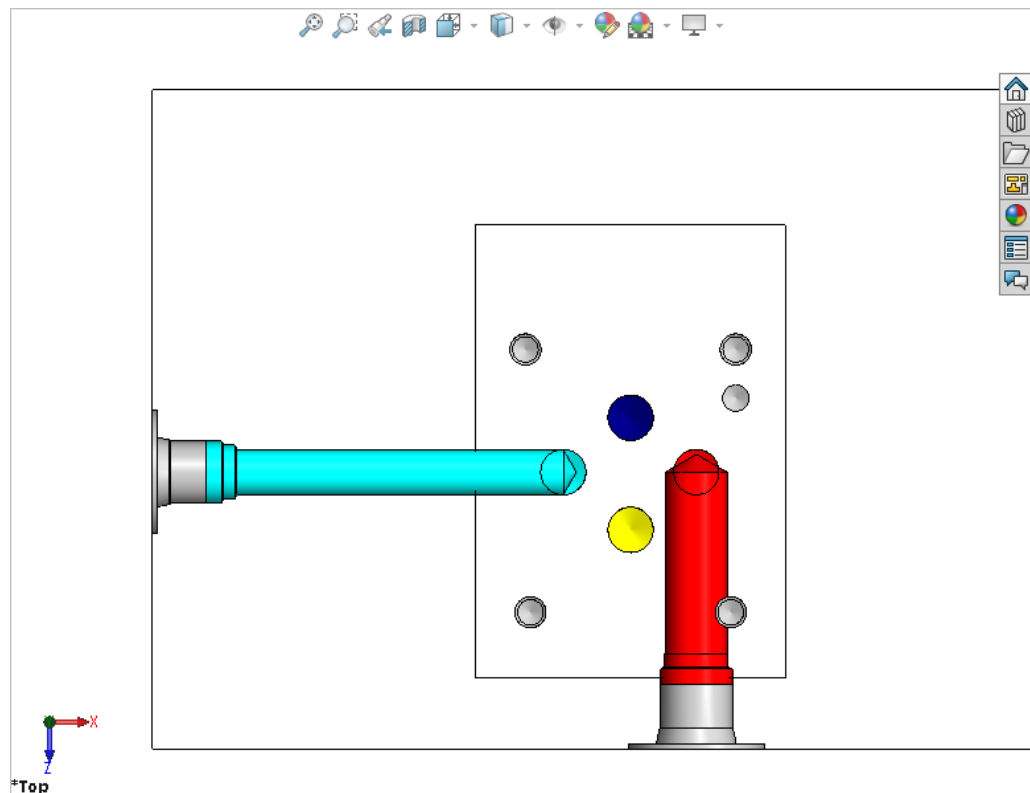
1. MDTools 960
> **Rotate**
The Rotate Footprint dialog box displays.
2. Select a cavity on the footprint.
When you move the cursor over a cavity, it will be highlighted. This indicates the selected cavity.
3. Enter the **Rotation Angle** in degrees.
4. Click **OK**.
MDTools® rotates the footprint by the rotation angle entered, about the center of parent cavity of the footprint in a counter-clockwise direction.

Note:

- The parent cavity is the cavity created at the insertion point of a footprint.
- MDTools displays the center point only on the parent cavity.
- Display of the parent cavity center point enables you to identify the parent cavity in a footprint inside SolidWorks.



Rotate Footprint dialog box

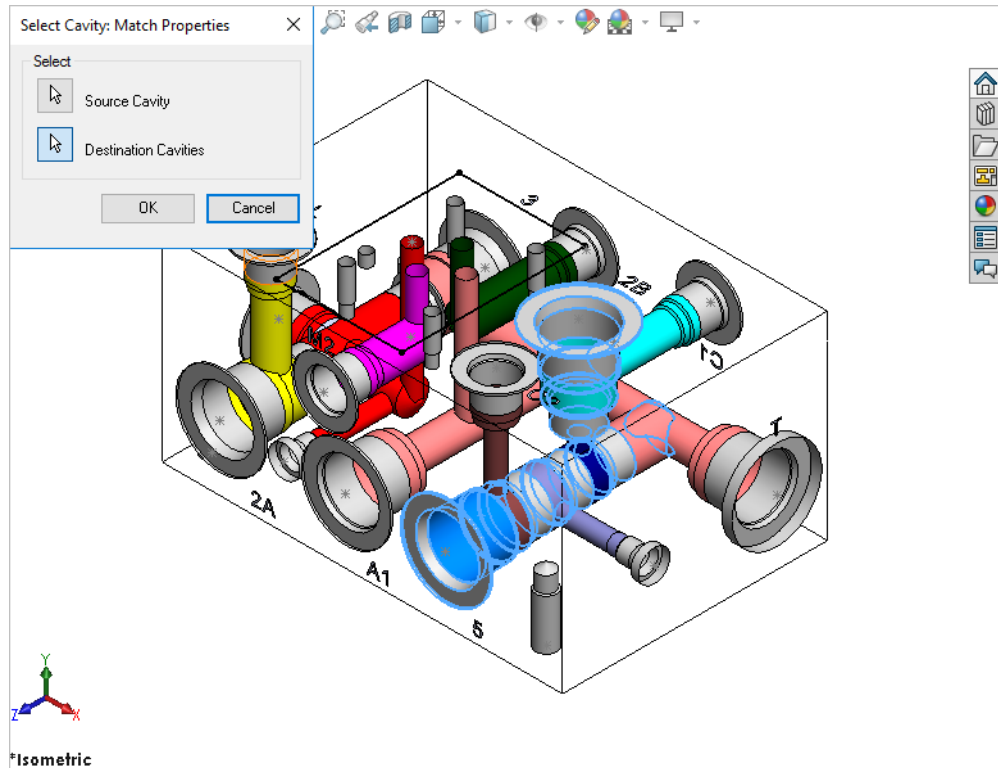


Footprint rotated by 90 degrees

40. Match Properties


Match the properties of two or more cavities. You can match drill diameter, drill depth, drill tip angle, spot face/LS depth, cavity inclination (Alpha and Beta), net name, and cavity machining information.

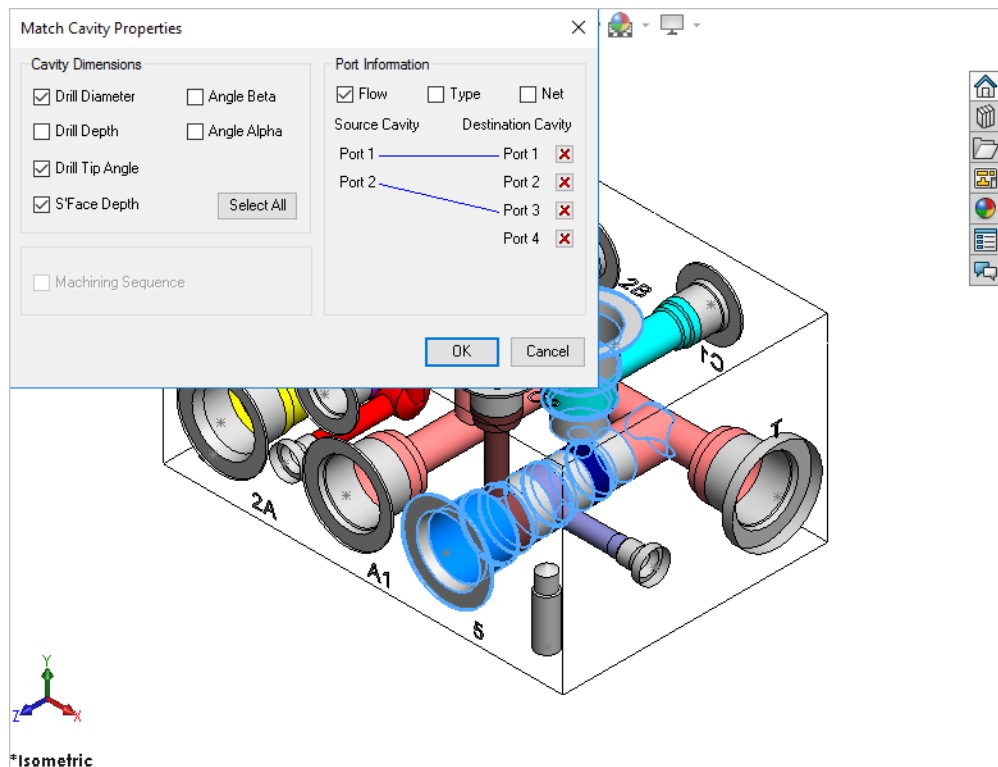
1. MDTools 960
> **Match Properties**
The *Select Cavity Match Properties dialog box* displays.
2. Select the source cavity.
3. Select the destination cavities.
4. Click **OK**.
The *Select Cavity: Match Properties dialog box* displays.
5. Select properties you want to match.
6. Click **OK**.
MDTools® updates the selected properties of destination cavities with that of source cavities.



Select Cavity Match Properties dialog box

Match Net Name

7. Click the source cavity port.
For example, Port1 Net
8. Click the destination cavity port.
For example, Port2 Net
MDTools displays a line connecting the ports selected to match the net name.
9. Click  to delete the selection.



Match Cavity Properties dialog box

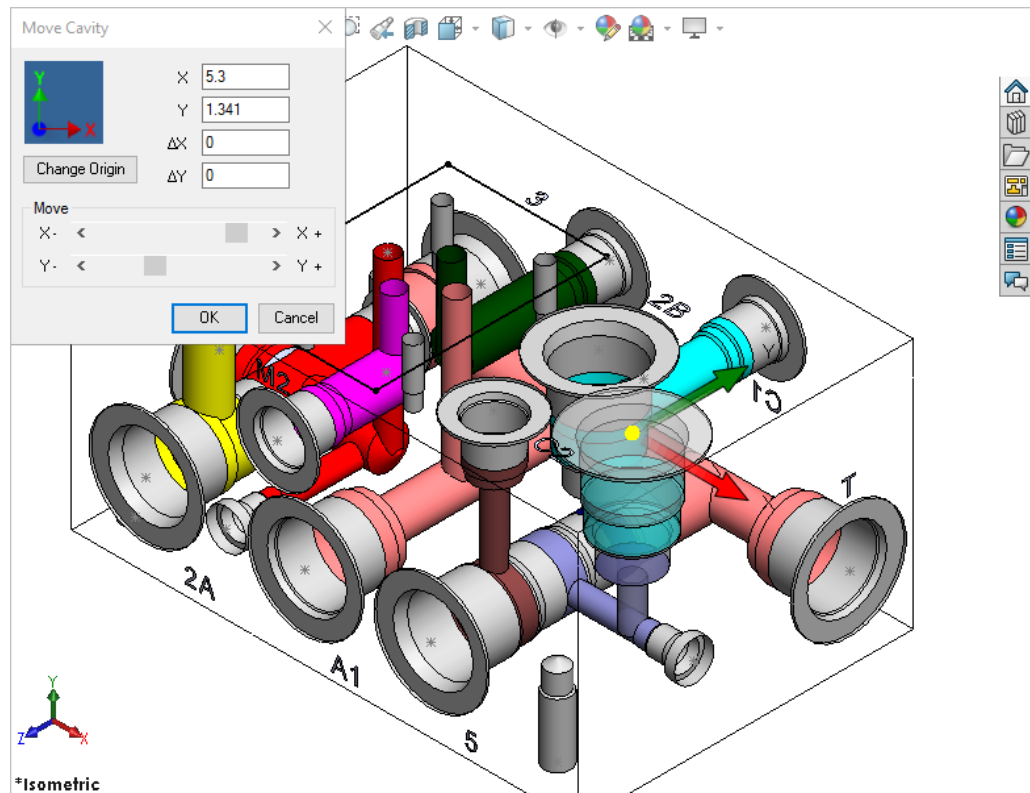
41. Move Cavity

Precisely relocate a cavity by specifying the X and Y values from the face origin. You can also move the cavity by entering displacement values (delta X and delta Y).

1. MDTools 960
> **Move**
2. The MDTools Select Cavity dialog box displays.
3. Select a cavity on the manifold.
The Move Cavity dialog box displays.

MDTools® displays the origin indicator on the manifold face.

Current X and Y values of the cavity location from the face origin are displayed in the dialog box.



Move Cavity dialog box

Moving by Entering X and Y

Relocate the cavity by entering X and Y

4. Enter X, Y, or both, as required.
5. Click **OK**.
MDTools relocates the cavity to the new location.

Moving by Entering ΔX and ΔY

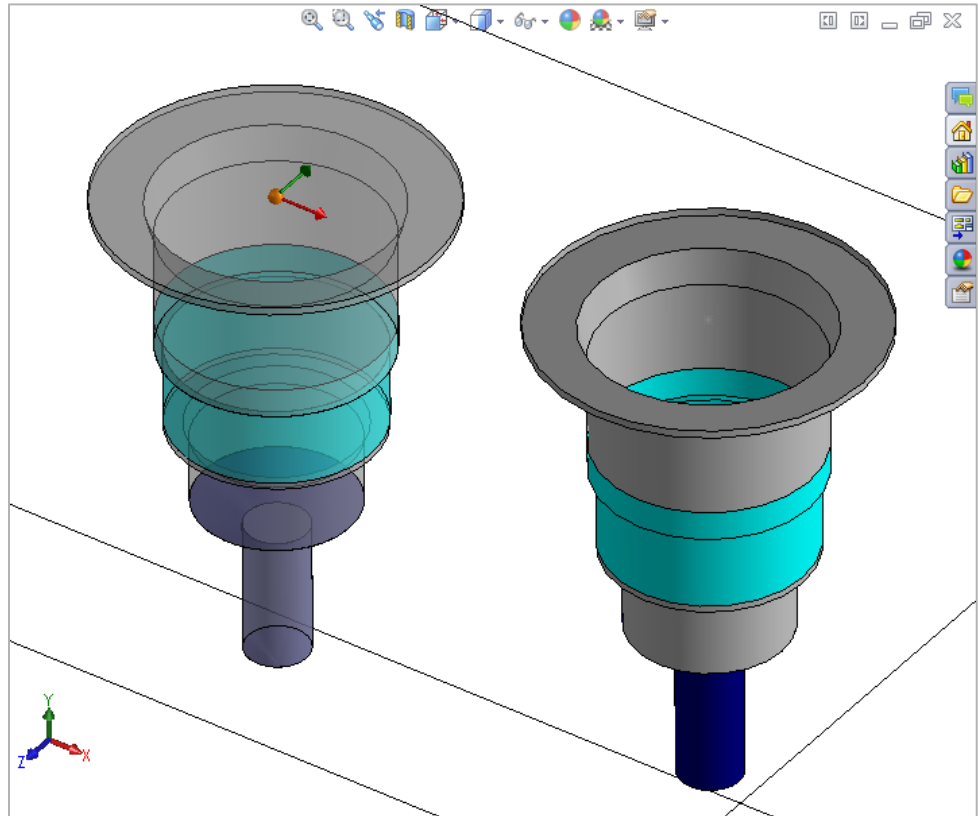
Relocate the cavity by entering displacement.

6. Enter ΔX, ΔY, or both, as required.
7. Click **OK**.
MDTools moves the cavity by the ΔX and ΔY values entered.

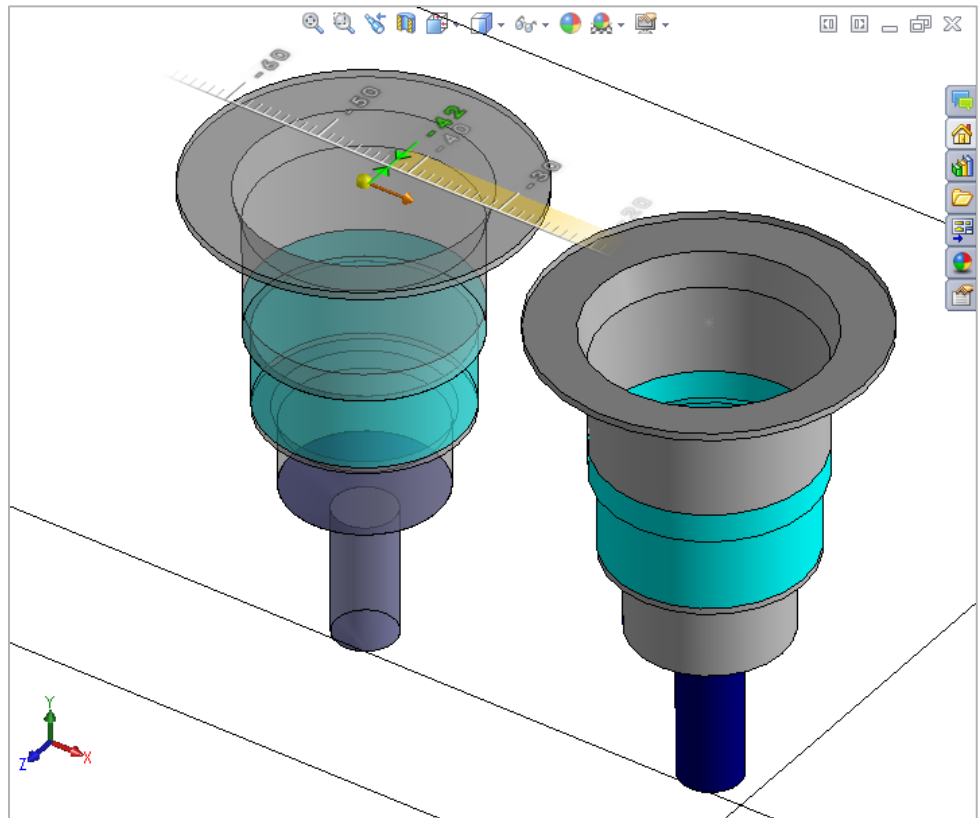
41.1 Moving by Dragging Cavity in Model

Move a cavity by dragging the cavity in the model.

1. Select cavity center displayed as a yellow dot in the model.
Or,
Select one of the directional arrows to move the cavity in the desired direction only.
2. Drag the cavity to the desired location.



Moving Cavity by dragging the cavity center point.



Moving Cavity by dragging the directional arrow.

41.2 Moving by Increment

Move a cavity by an incremental distance (0.05" /1.00 mm)

Click the scroll bar button.

For one click, MDTools moves the cavity by 0.05" /1 mm.

- Click the right scroll bar button to move the cavity in the +ve X/Y direction.

- Click the left scroll bar button to move the cavity in the -ve X/Y direction.

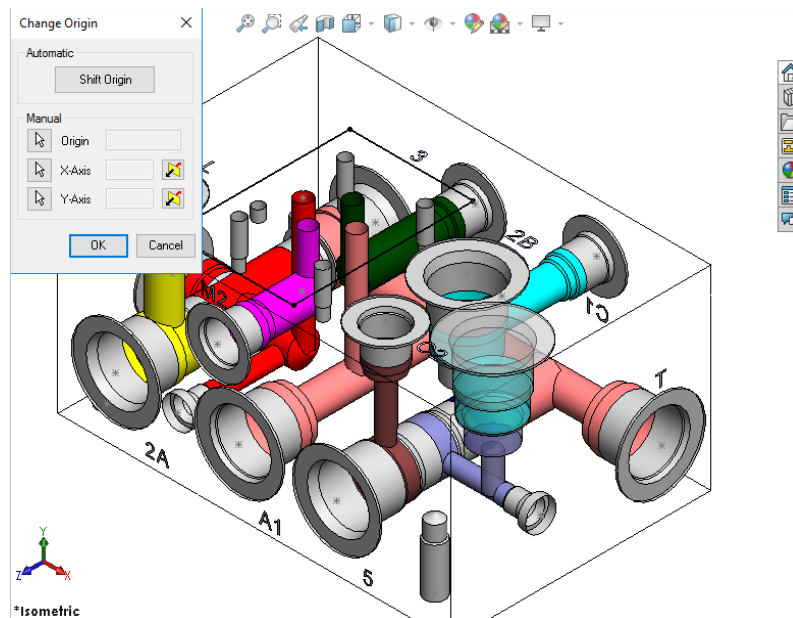
Note:

- In case of a non-rectangular manifold, the command automatically calculates a point nearest to the origin on the face on which the selected cavity is placed.
- This is taken as the origin and X and Y vectors are also calculated accordingly. The procedure to change the coordinate system is described in the next section.

41.3 Moving the origin

Change the origin of a manifold face to move the selected cavity.

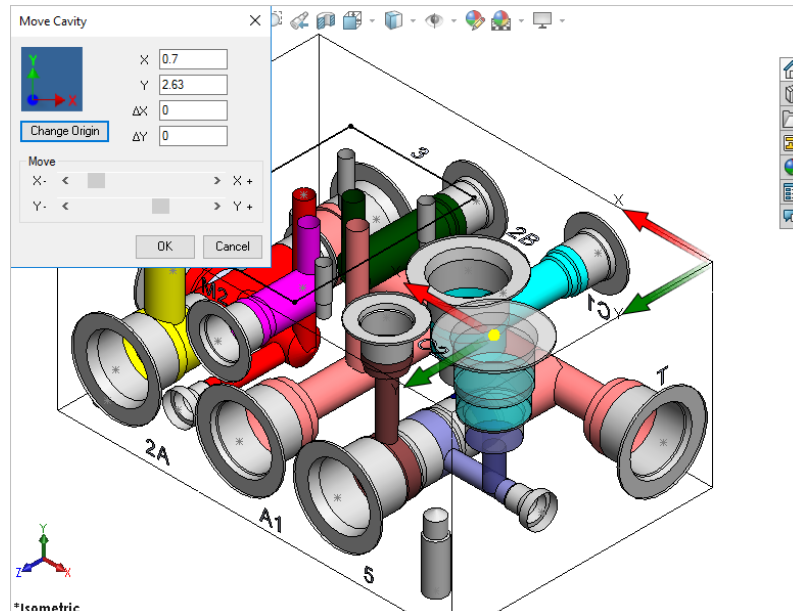
1. Click Change Origin.
The *Change Origin dialog box* displays.
2. Select a point to make it the origin.
3. Click a cavity/face of a cavity to move the origin to the projection of cavity center point on the face.
4. Select the edges to make X and Y-axis.
5. Flip the axis direction by clicking the corresponding flip axis button.



Change Origin dialog box

Note:

In case of a rectangular manifold, the Shift Origin command can be used to automatically pick the next vertex as the origin.



Origin changed and X and Y values updated

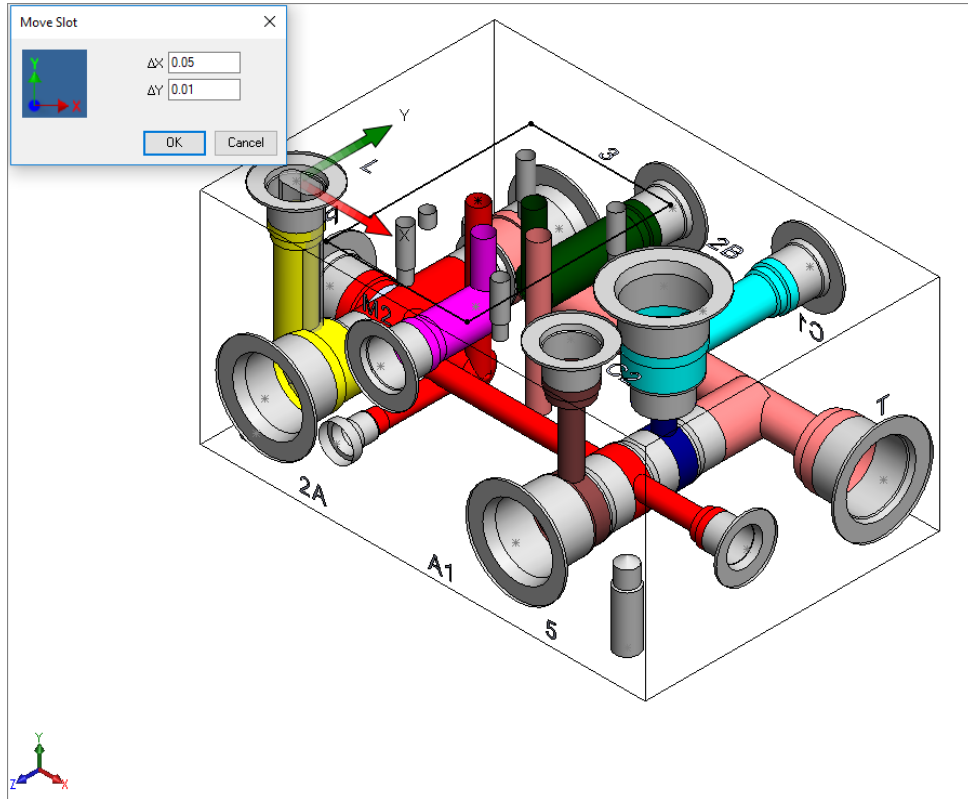
41.4 Move a Slot inside the cavity

Relocate the slot inside the parent cavity by entering a displacement.

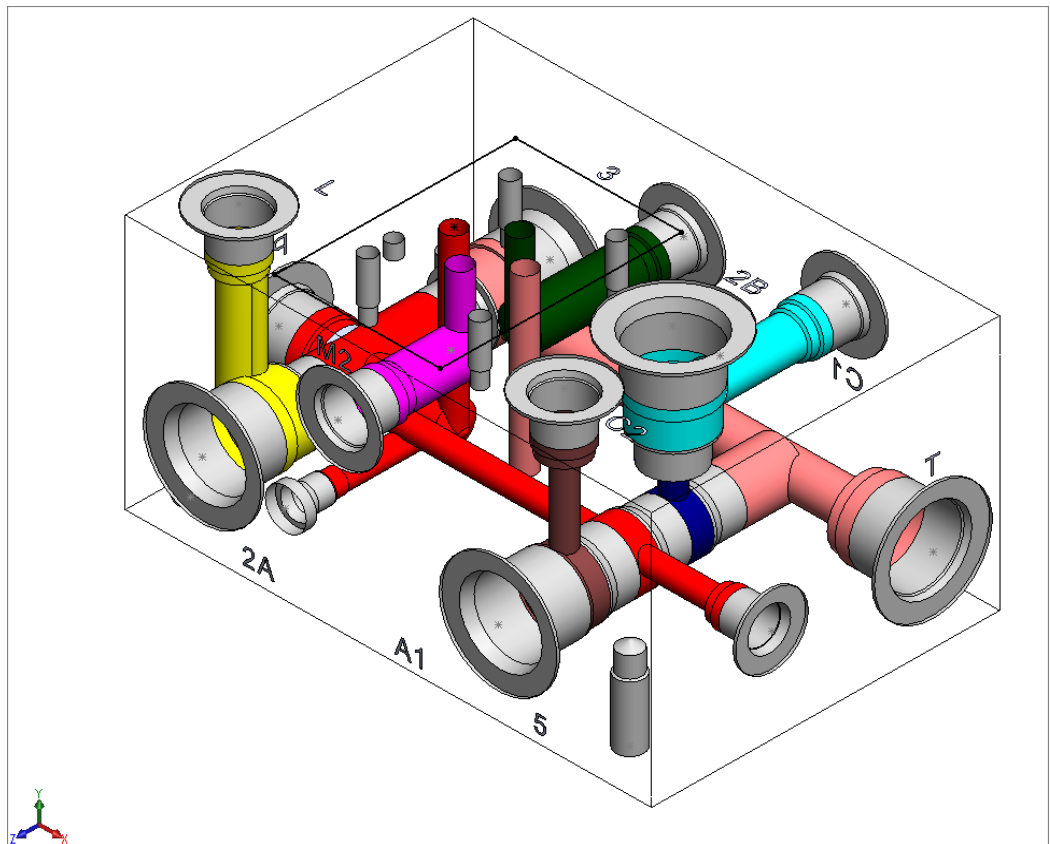
1. MDTools 960
> **Move**
The MDTools® Select Cavity dialog box displays.
2. Select a slot on the manifold.
The slot preview shows the center point and X and Y axis arrow indicator.
3. Enter ΔX , ΔY , or both, as required.
4. Click **OK**.
MDTools relocates the slot inside the parent cavity.

Note:

Slot should not move outside the parent cavity maximum drill diameter.



Move Slot dialog box



Slot moved at specified location

42. Move Multiple

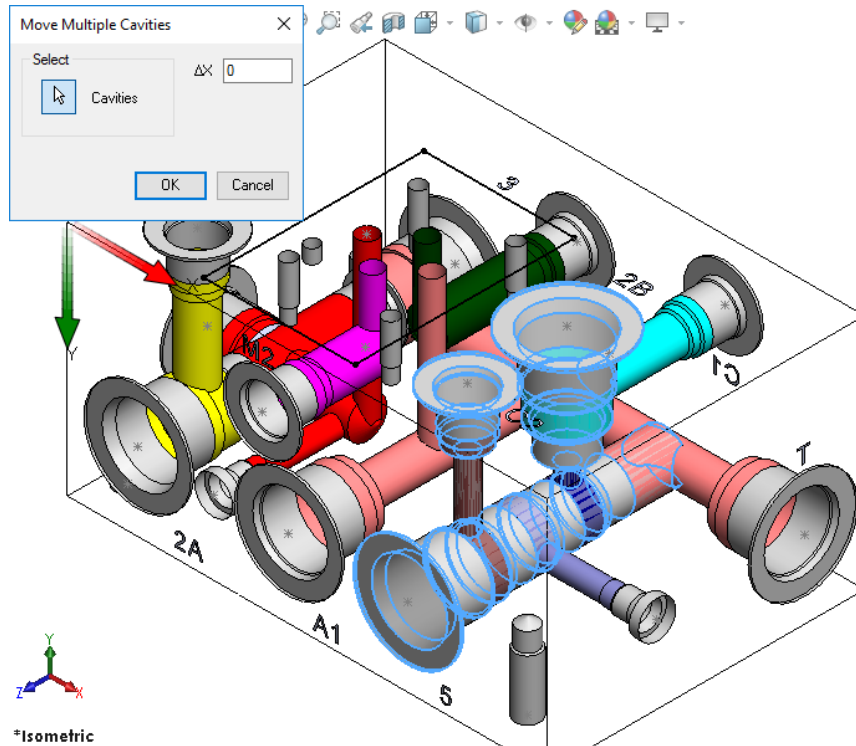
Move multiple cavities on a manifold simultaneously by entering the displacement along the common coordinate. Cavities on the same or opposite faces can be moved along two coordinates and the cavities on perpendicular faces can be moved along one coordinate.

1. MDTools 960
> Move
> **Move Multiple**
The Move Multiple Cavities dialog box displays.

MDTools® displays the coordinate symbol, indicating the direction of axes on the manifold origin.

2. Click the Select button for **Cavities**.
3. Select the cavities you want to move.
Text field to enter the change in the location displays on the dialog box.

4. Enter the displacement along each available coordinate.
If you select cavities on perpendicular faces, MDTools displays only one field to enter displacement, as the cavities have only one common coordinate.

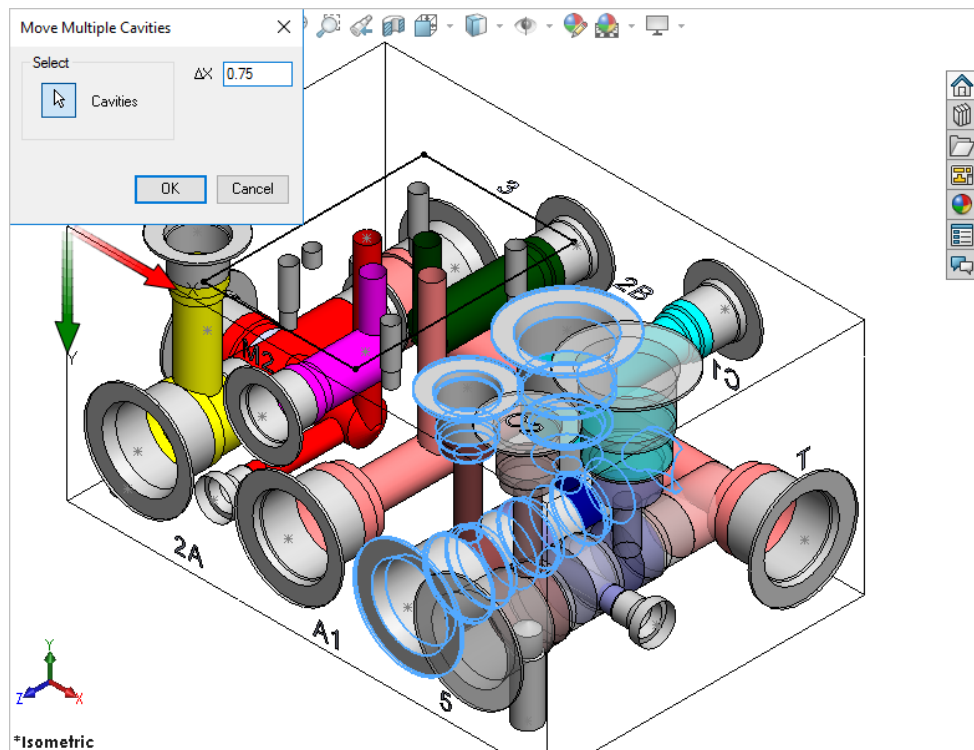


*Isometric
Move Multiple Cavities dialog box

5. Click **OK**.
MDTools relocates the cavities by the specified distance and the coordinate symbol disappears.

Note:

- Cavities can only be moved along their common coordinates.
- Cavities on three mutually perpendicular faces cannot be moved. For example, top, left, and front.
- The coordinate symbol is created on the default center point of the part drawing.
- If a block is created using the Draw Block command, then the coordinate symbol displays on the top left corner of the block.



*Isometric
Move Multiple Cavities: Data field to enter displacement

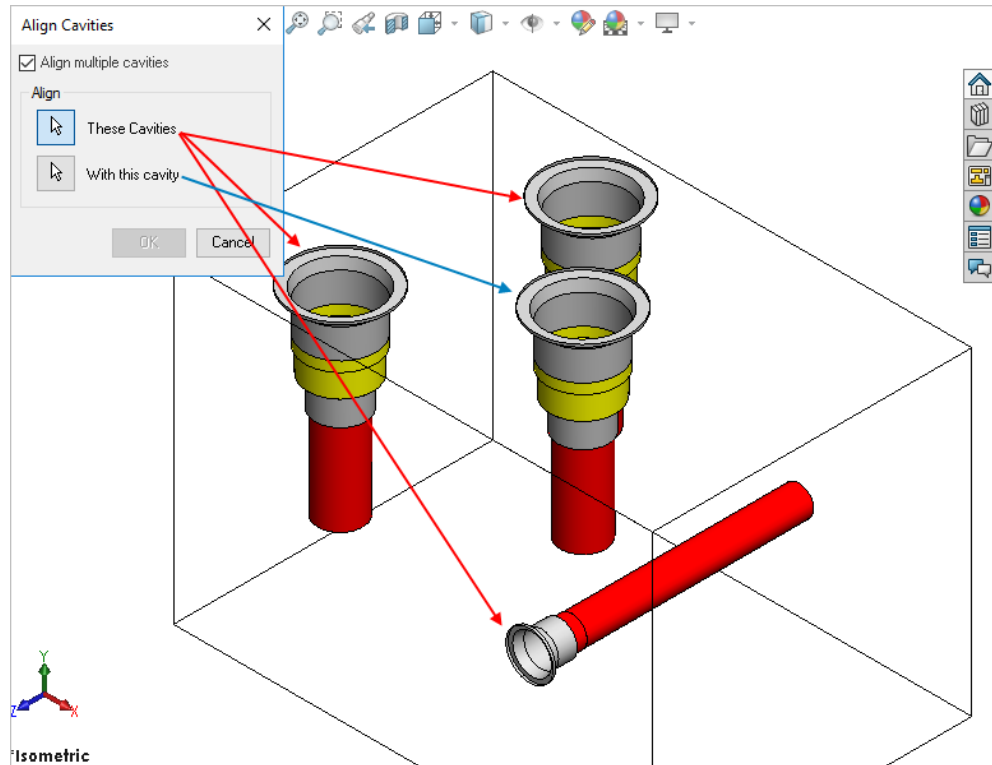
43. Align Cavities

Align two or multiple cavities on the manifold.

When you align two cavities on the same face, the cavities are aligned to the coordinate with the shortest distance.

When you align cavities on two perpendicular faces, the cavities are aligned with reference to the common coordinate.

1. MDTools 960
> **Align**
The *Align Cavity dialog box* displays.
2. Select the **Align multiple cavities** option, if you want to align multiple cavities.
3. Click **These Cavities** to move and align with another cavity.
4. Click **With this cavity** to align the previously selected cavity(s). *MDTools[®] shows a preview of the cavity to be aligned in the new aligned location.*
5. Click **OK**. *MDTools automatically relocates the first selected cavities to align with the Selected cavity.*



Align Cavity dialog box

Changing selection

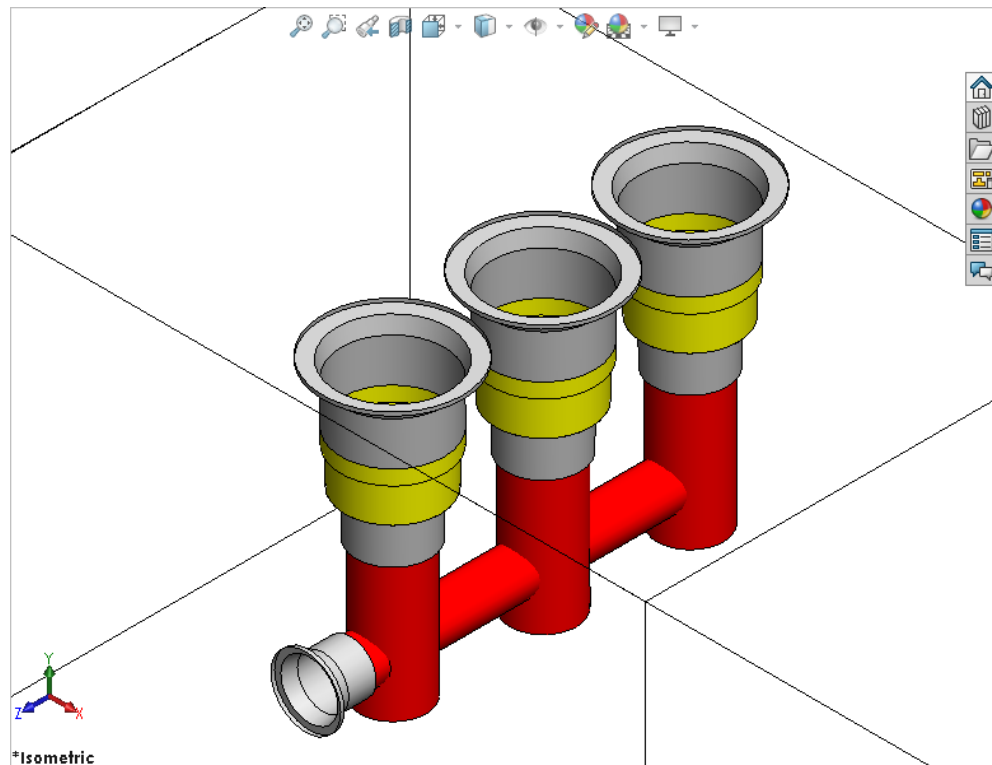
You can easily change the selection made for aligning cavities.

To change the first cavity:

- Click the Align **These cavities** button to change the first selected cavities.



- Click the Align **With this cavity** button to change align with this cavity.

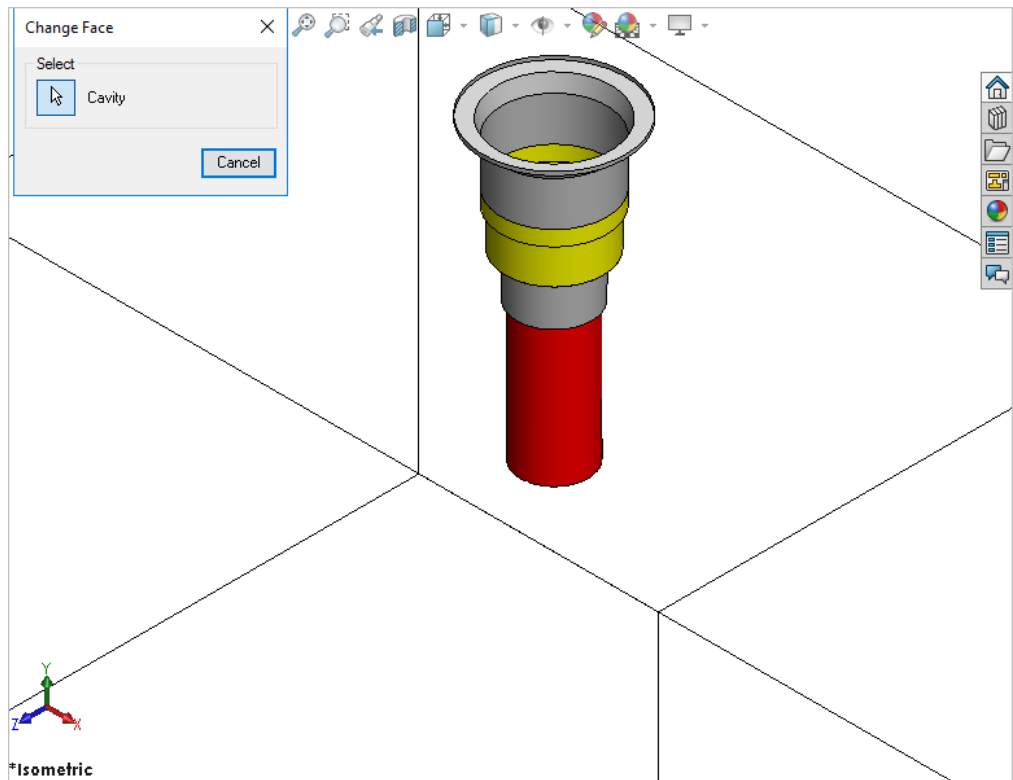


Cavities aligned

44. Change Face

Relocate a cavity/footprint from one face of a manifold to another manifold face.

1. MDTools 960
> **Change Face**
The *Change Face dialog box* displays.



Change Face dialog box

2. Select the cavity/footprint you want to relocate.
The *Specify Cavity Location dialog box* displays.

Note:

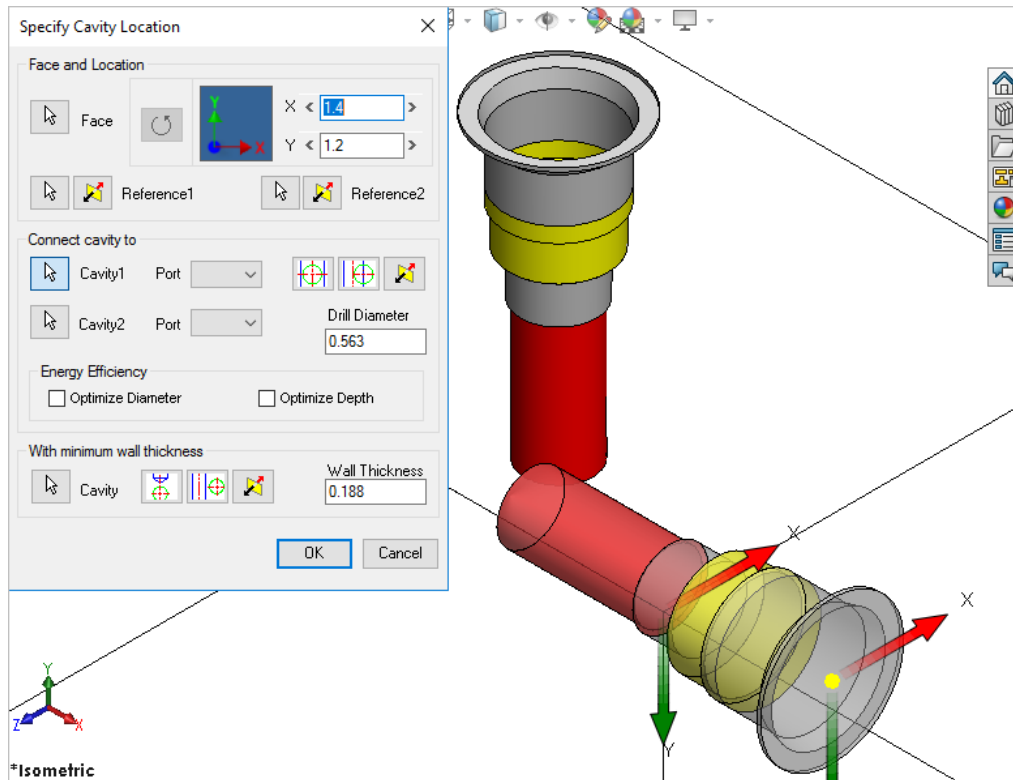
- If you select a cavity in a footprint, then the complete footprint is relocated.
- Select the point on the manifold face, where you want to relocate the cavity and pick connecting cavities.

MDTools® displays a preview of the selected cavity at the selected point on the manifold.

3. Click **OK**.
MDTools relocates the cavity/footprint to the selected location on the manifold.

Note:

When you relocate a footprint using the Change Face command, the main cavity on the footprint is created at the selected location.



Specify Cavity Location dialog box

44.1 Change Slot Face with Parent Cavity

1. MDTools 960
 > **Change Face**
The Change Cavity/Footprint dialog box displays.
2. Select the slot or a slot with inserted cavity you want to relocate.
The Specify Slot Location dialog box displays.

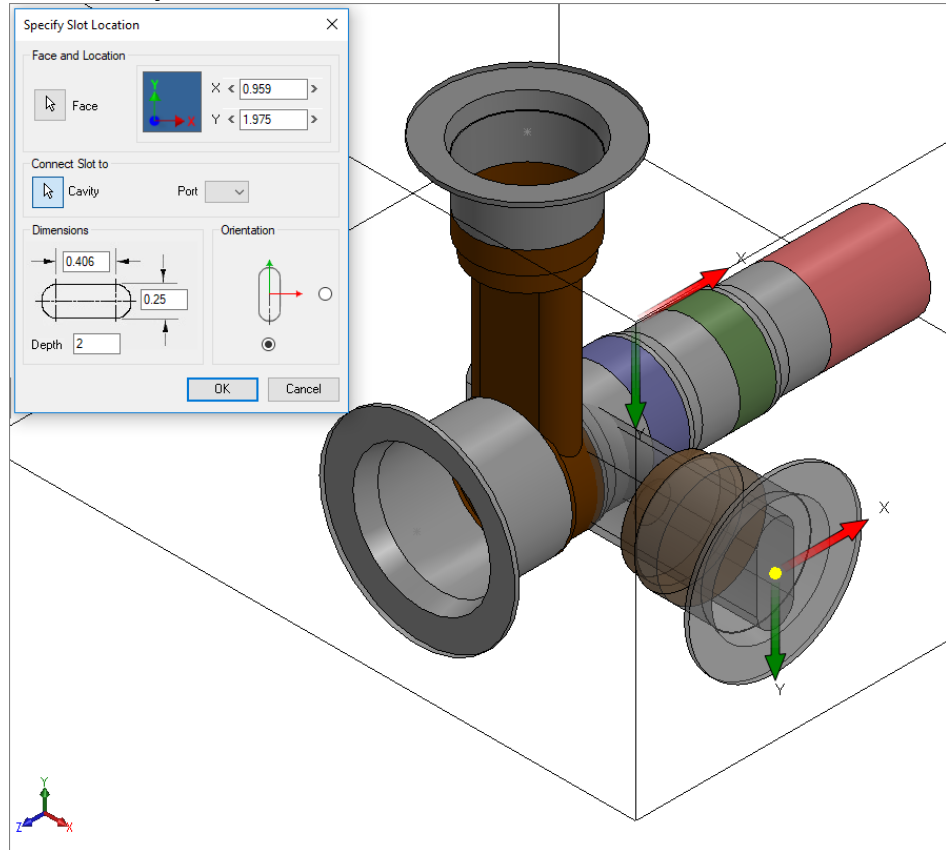
Note:

When you select a slot in a footprint, then the complete footprint is relocated.

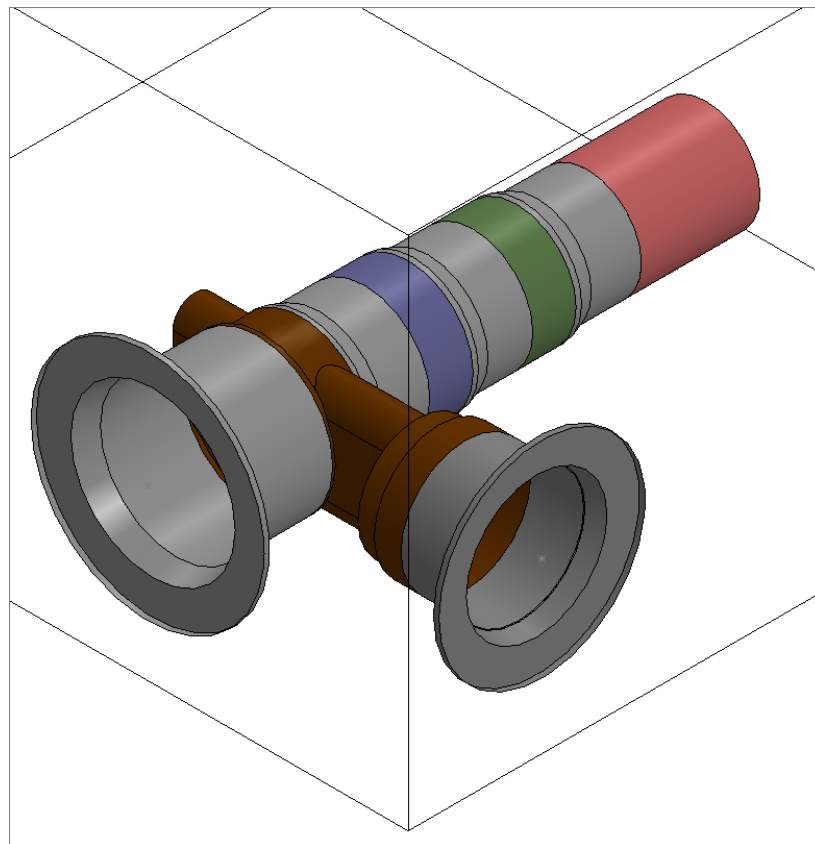
3. Select the point on the manifold face where you want to insert the slot with the cavity.
MDTools® displays a preview of the selected slot with the parent cavity at the selected point on the manifold.
4. Enter the X and Y distance from the block origin.
5. Modify the slot **dimensions**.
Default value of slot diameter and slot width is the maximum drill diameter of parent cavity/2.
Slot diameter plus slot width should not be larger than the parent cavity maximum drill diameter.
6. Modify the depth of the slot.
Default value is the parent cavity depth + 0.5 inches/12 mm.
7. Select the orientation of the slot from the axis or center of the selected cavity.
8. Click **OK**.
MDTools relocates the cavity/footprint to the selected location on the manifold.

Note:

- If a slot on an origin of footprint is selected, then the slot is relocated with the footprint.
- If a slot on a child cavity of footprint is selected, then the slot is deleted from the model on relocation.



Specify Slot Location dialog box

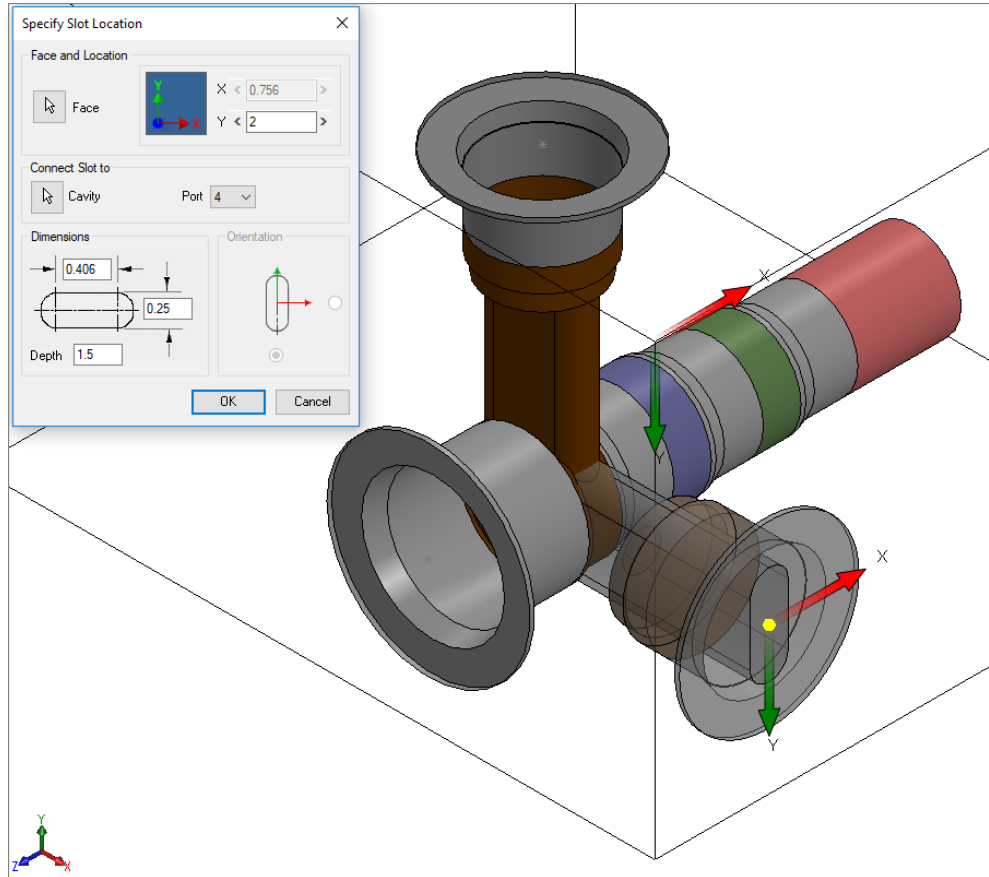


Slot and Parent cavity face changed at specified location

44.2 Connect Slot to Existing Cavity

Connect the new slot to an existing cavity in the manifold.

1. Click the selection button for cavity in the manifold.
2. Select the connecting cavity.
3. Select the connecting port on the cavity.
MDTools[®] automatically relocates the slot with cavity to port center and displays the slot diameter, width and depth.



4. Modify slot **dimensions**.
Default value of the slot diameter is the connecting cavity port diameter.

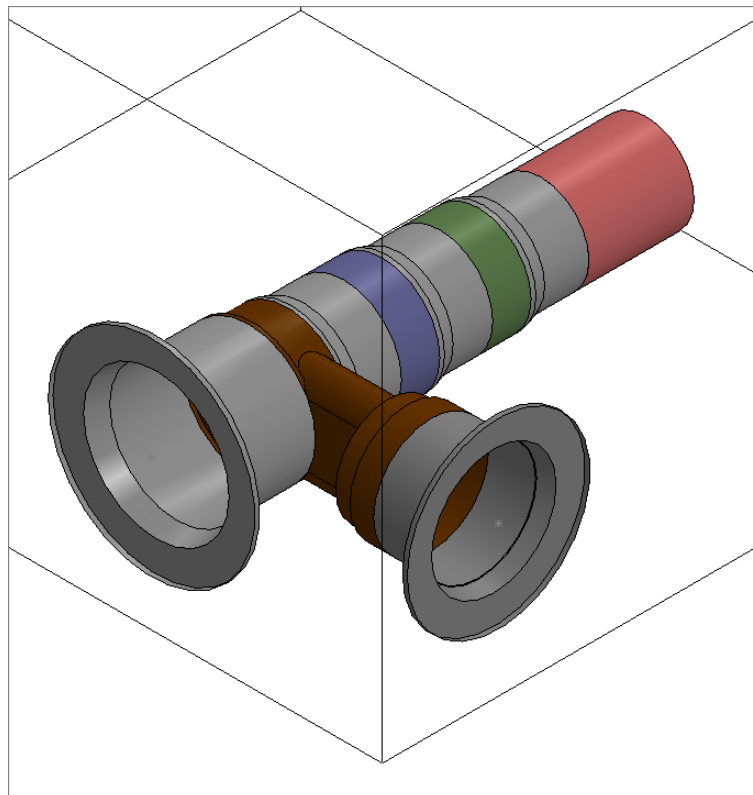
Slot diameter plus slot width should not be larger than the parent cavity maximum drill diameter.

5. Modify the **depth** of the slot.
Default value of the slot depth is the center distance between the parent cavity and the connecting cavity.

Slot depth should not be less than the center distance between the parent cavity and the connecting cavity.

6. Click **OK**.
MDTools relocates the slot with cavity at the specified location and connects the slot to the selected connecting cavity.

Positioning the Slot on the connecting cavity center



Slot face changed and connected with cavity

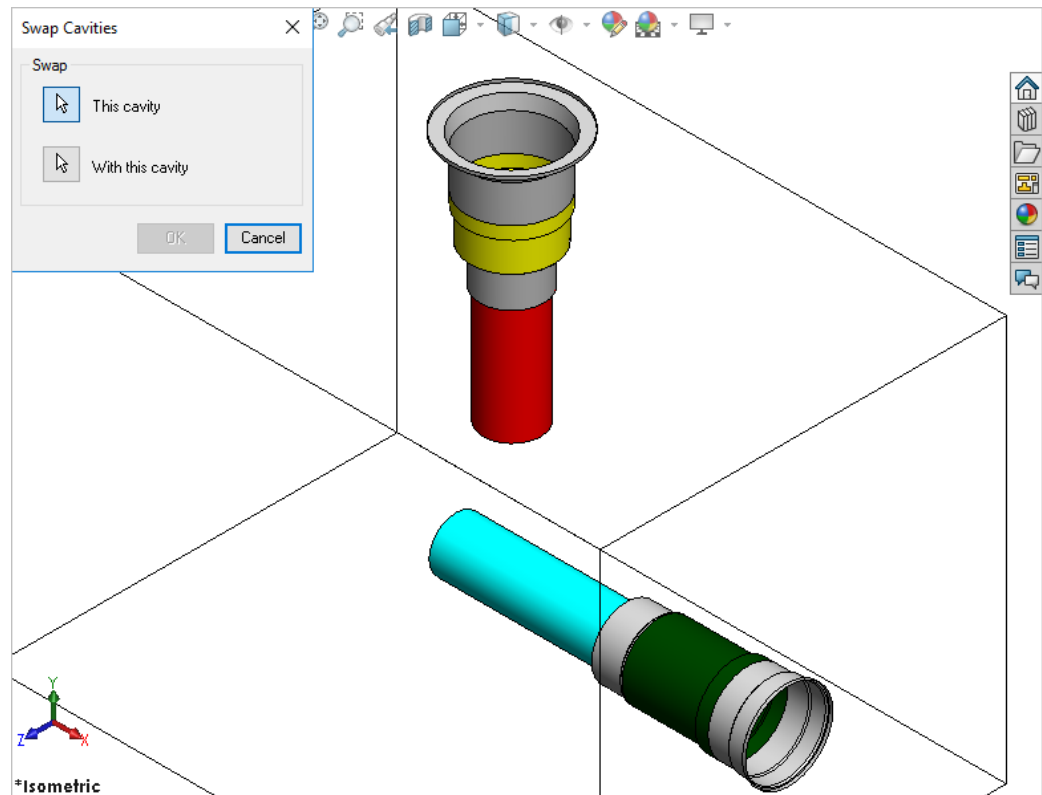
Note:

- The Connect slot to cavity option only works for cartridge valves.
- Orientation of a slot depends upon the connecting cavity axis.

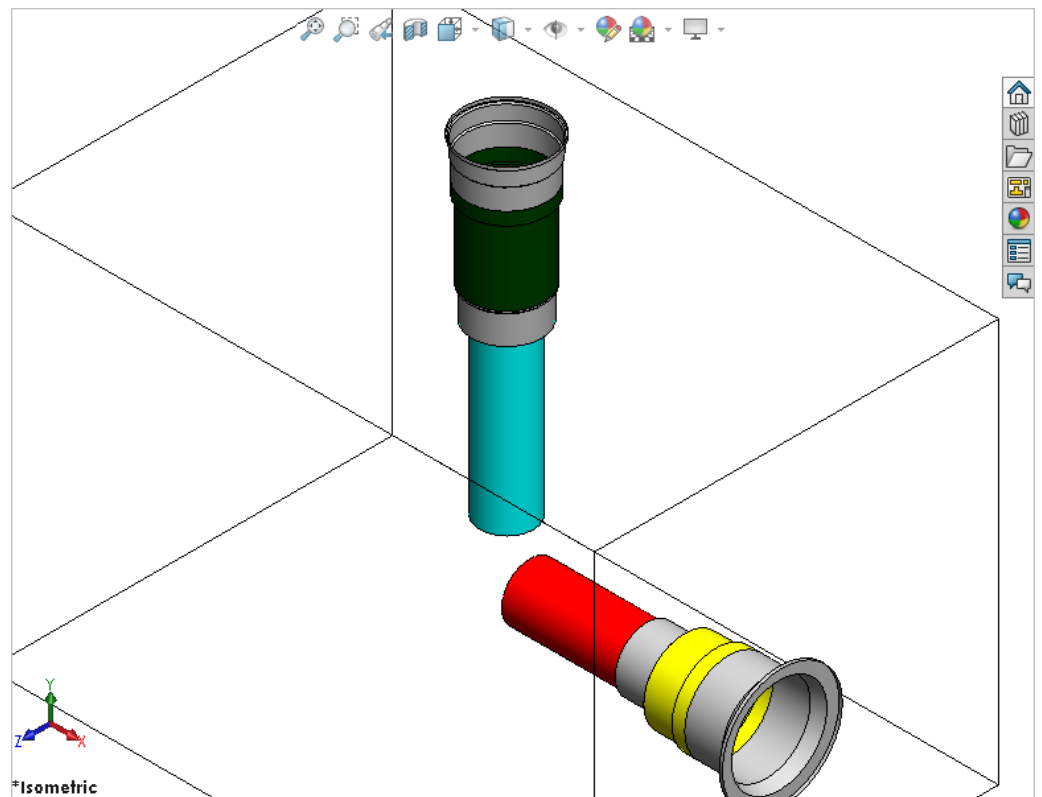
45. Swap Cavities

Interchange the location of two cavities on a manifold.

1. MDTools 960
> Change Face
> **Swap Cavities**
The Swap Cavities dialog box displays.
2. Select the cavity you want to swap.
3. Select the cavity with which you want to swap the last selected cavity.
4. Click **OK**.
Location of two cavities is interchanged on the manifold.



Swap Cavities dialog box



Cavities swapped using the Swap Cavity command

46. Constrain Cavities

Constrain a cavity to another cavity on the manifold or constrain a cavity to a selected manifold edge.

Automatically updates the location of connecting holes when you relocate the main cavity.

The UnConstrain feature enables you to unconstrain the cavity and relocate the cavity independently.

MDTools 960

> Constrain

The Constrain Cavities dialog box displays. The Cavities selection is the default option.

Constrain Cavities

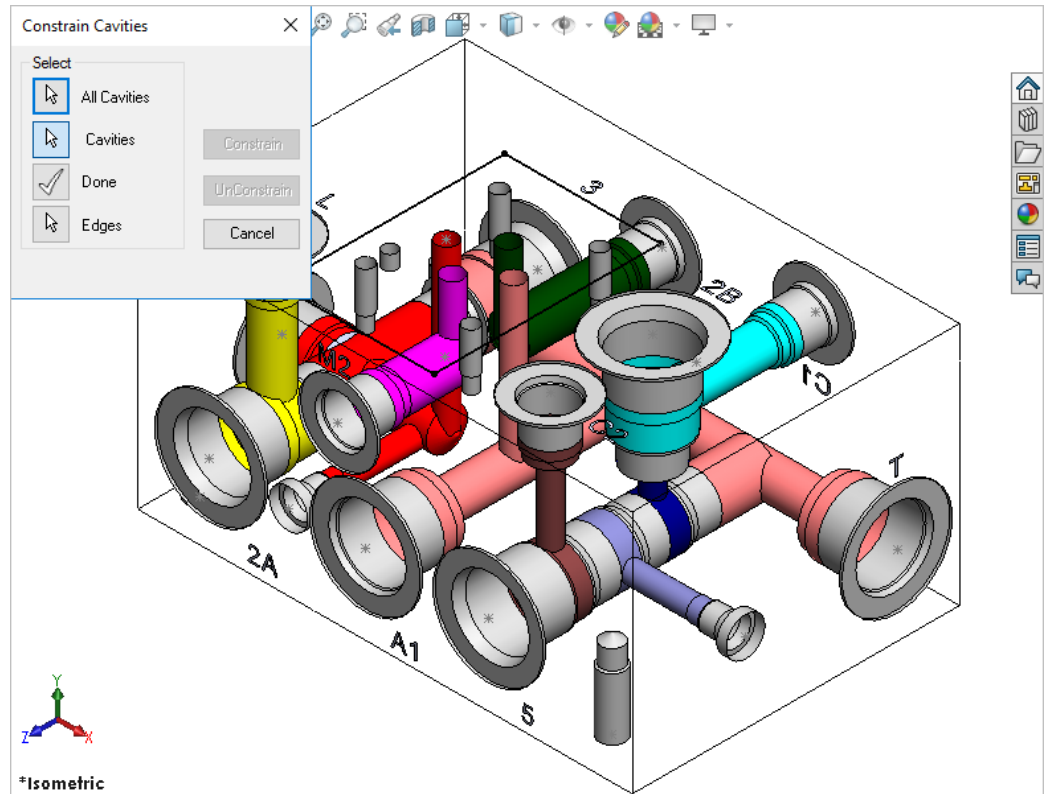
1. Select the cavities you want to constrain.

Note:

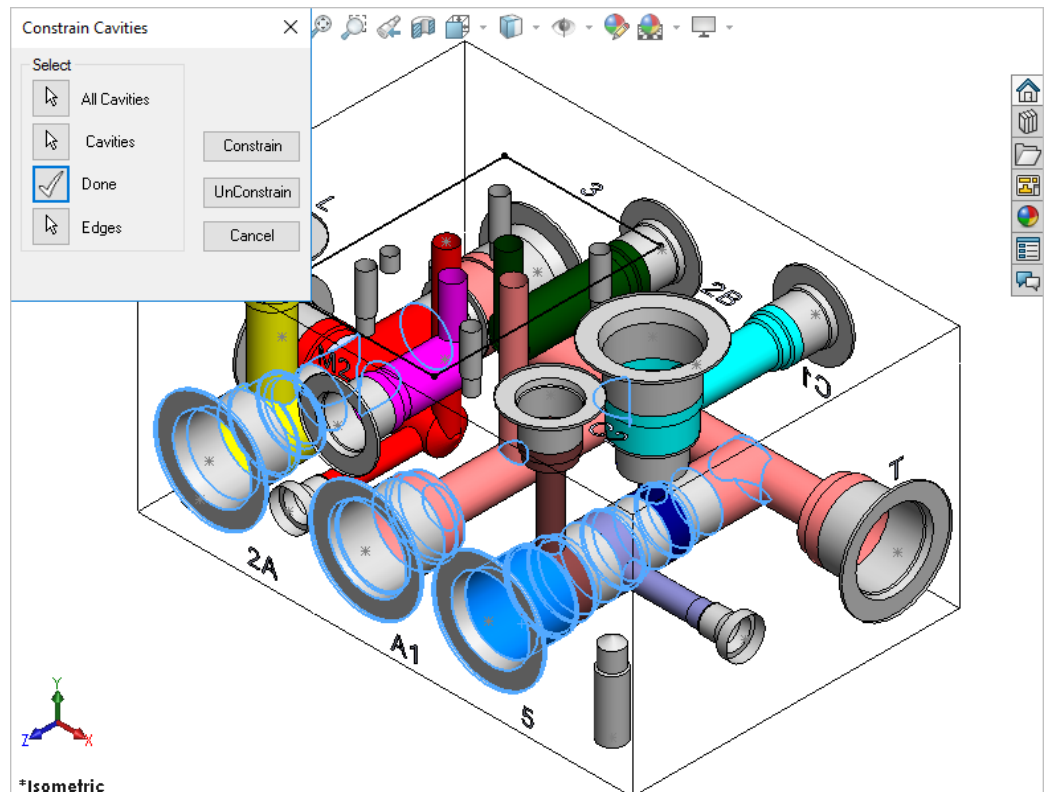
To constrain cavities to another cavity, first select the cavity to which you want to constrain.

2. Click **Done** to finish the cavity selection. The **Constrain** and **UnConstrain** buttons are enabled.

3. Click **Constrain**. All the cavities are selected after the first cavity is constrained to the first cavity.



Constrain Cavities dialog box



Constrain and UnConstrain buttons enabled automatically

Constraining Cavities to a Manifold edge

1. Click the **Edges** selection.
2. Select the edges to which you want to constrain the selected cavities.
3. Click Constrain.
All the selected cavities are constrained to the selected edges.

Constraining All Cavities

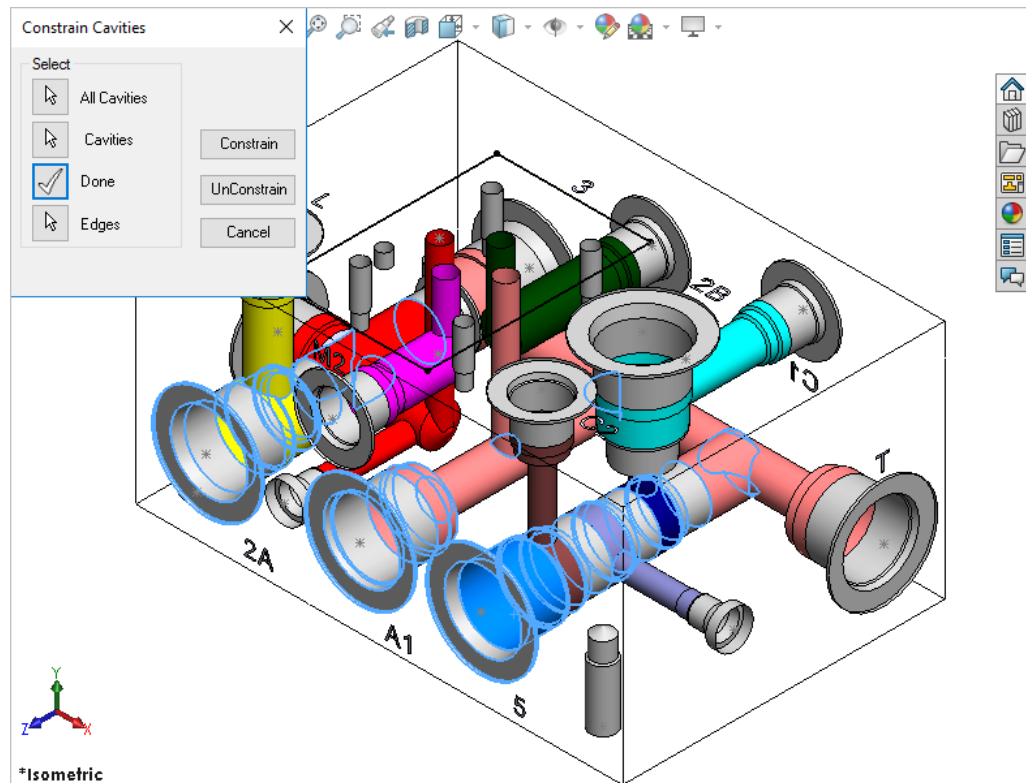
1. Click the **All cavities** selection.
2. Click Constrain.
All the cavities are constrained to the first cavity inserted on the manifold.

Note:

The center point of the cavities becomes invisible on constraining the cavities to another cavity or an edge.

UnConstraining Cavities

1. Select the cavities you want the constraints to be removed.
2. Click **Done** to finish the selection.
3. Click UnConstrain.
MDTools[®] unconstrains the selected cavities.



Unconstraining the constrained cavities on the manifold

UnConstraining All Cavities

1. Click the **All cavities** selection.
2. Click UnConstrain.
MDTools unconstrains all the constrained cavities on the manifold.

47. Suppress Cavity

Suppress an unsuppressed cavity/footprint and vice versa.

When you suppress the cavity, MDTools® automatically suppresses all the features used to create the cavity.

MDTools 960

> Suppress

The Suppress Cavity dialog box displays.

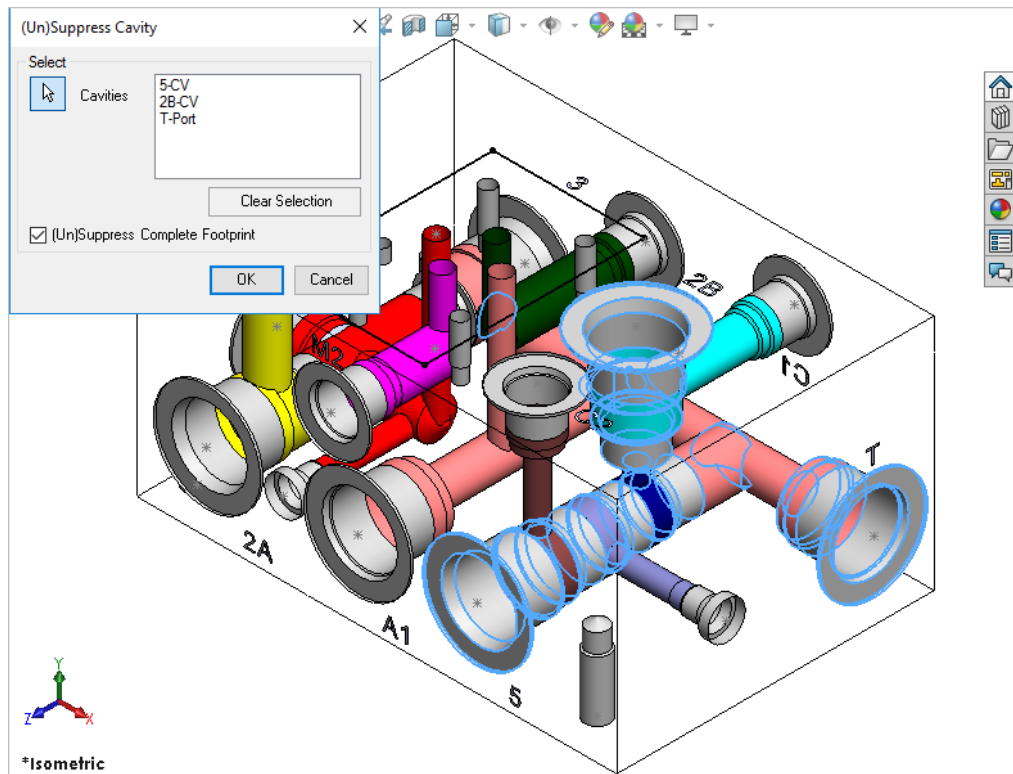
The Select Cavity option is selected by default.

Suppressing cavities

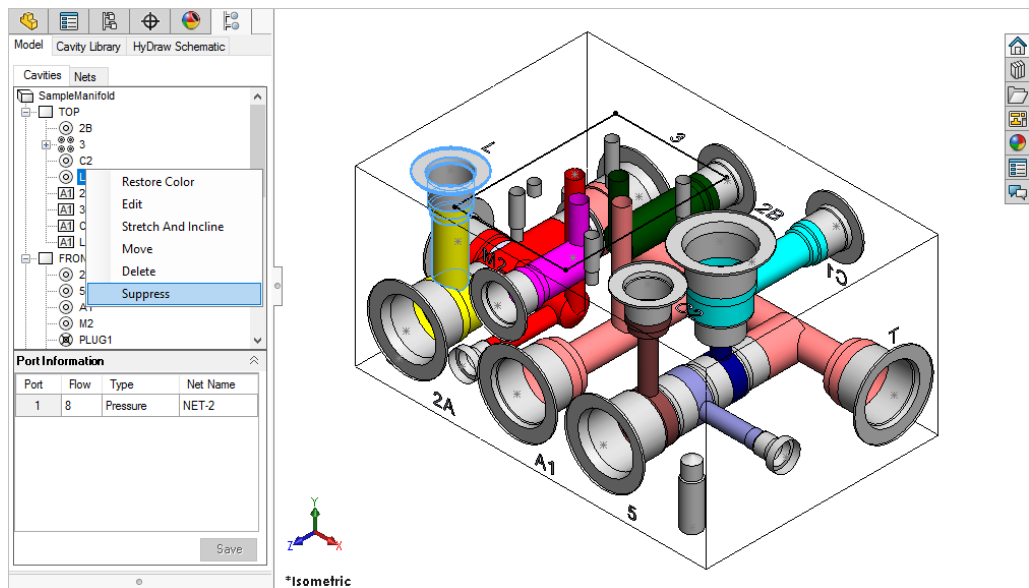
1. Select the cavity/footprint you want to suppress.
2. Click **OK**.
MDTools suppresses the selected cavities.

Un-suppressing Cavities

1. Select the cavity/footprint you want to un-suppress.
2. Select the cavity from the browser.
3. Click **OK**.
MDTools un-suppresses all the selected cavities; if the cavity belongs to a footprint, then the complete footprint will be un-suppressed.



Suppress Cavity dialog box



Selecting cavities from the browser

Note:

- Use the Select Footprint option to suppress or un-suppress the whole footprint.
- If the Select Whole Footprint option is not checked, then the command suppresses/un-suppresses only the selected cavity of the footprint.
- You can suppress/un-suppress multiple cavities by using this command.
- You can reselect a cavity to remove the cavity from the selection list.

48. Delete

Automatically delete the selected Cavities/Footprints/Undercuts/Slots/O-ring grooves.
MDTools' cavity consists of multiple SolidWorks features.
All the features used to create the cavity/footprint are automatically deleted.

1. MDTools 960
> **Delete**
The Delete Cavity dialog box displays.

2. Select Cavities/Footprints/Undercuts/Slots/O-ring grooves, you want to delete.
When you move the cursor over a cavity, it is highlighted. This indicates the selected cavity.

You can select multiple cavities at a time and delete all the selected cavities in one operation.

You can reselect a cavity to remove it from the selection list.

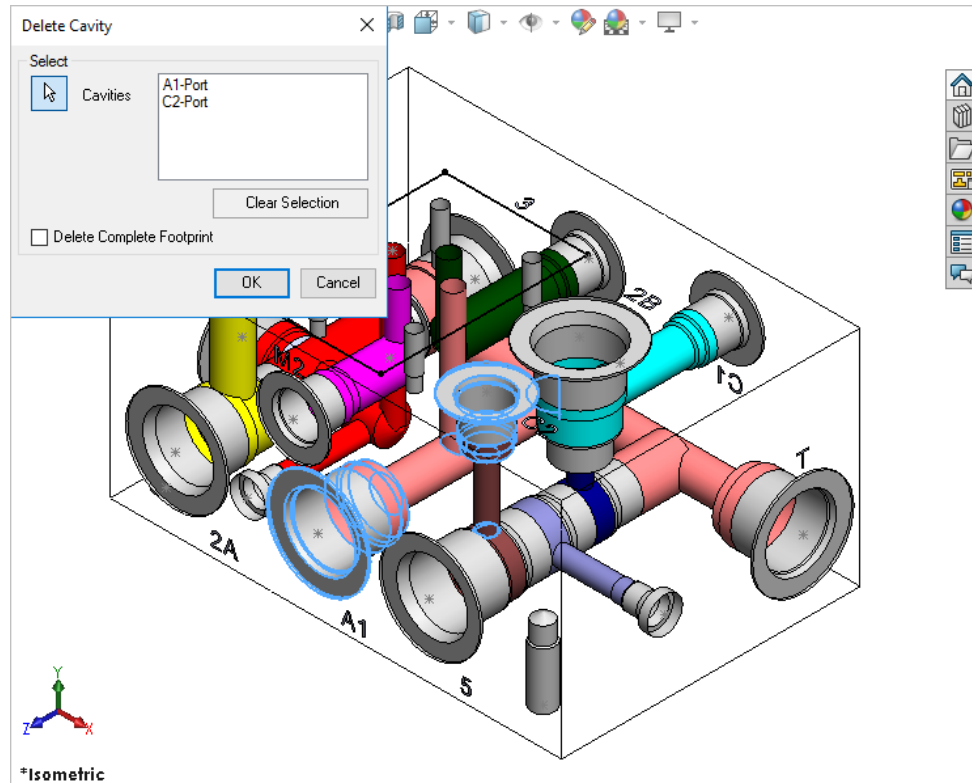
Or

Click **Clear Selection** to clear all selected cavities.

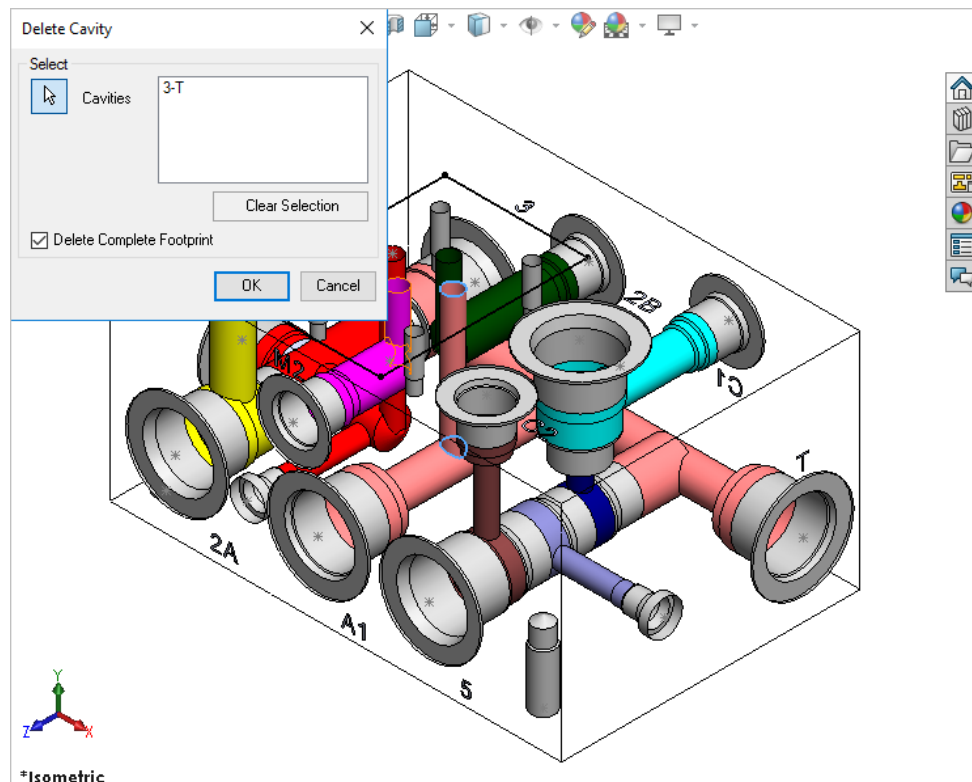
3. Select the **Delete Complete Footprint** option to delete the whole footprint.
4. Click **OK**.
MDTools deletes all the features used to create cavities/footprints in SolidWorks.

Note:

- If the parent cavity of a footprint is selected and the Select Complete Footprint option is not checked, the footprint is not deleted.
- If the cavity has slots, O-rings, or undercuts attached to it, then all these features will also be deleted with the cavity.



Cavity highlighted after selecting the cavity

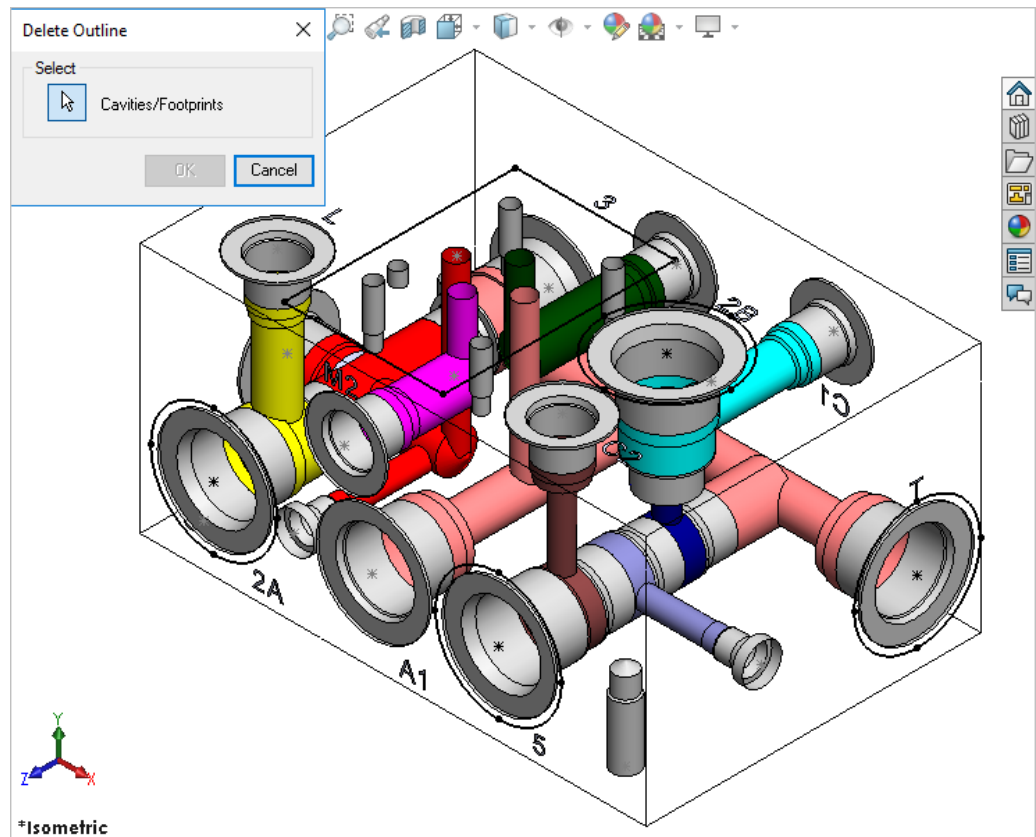


Deleting whole footprint

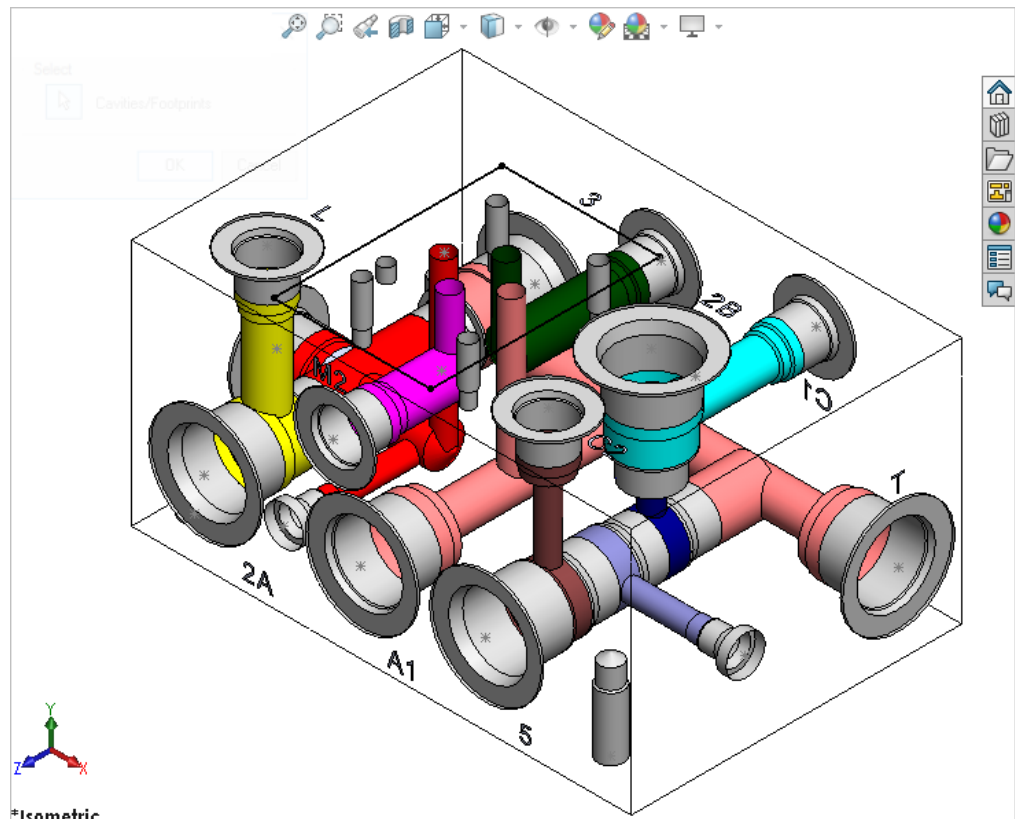
49. Delete Component Outline

Delete a component outline around the selected cavities/footprints that are created using MDTools®.

1. MDTools 960
> Delete
> **Delete Outline**
The Delete Outline dialog box displays.
2. Select the cavities/footprints from which you want to delete the component outline.
3. Click **OK**.
MDTools automatically deletes the component outline around the selected cavities/footprints.



Delete Outline dialog box

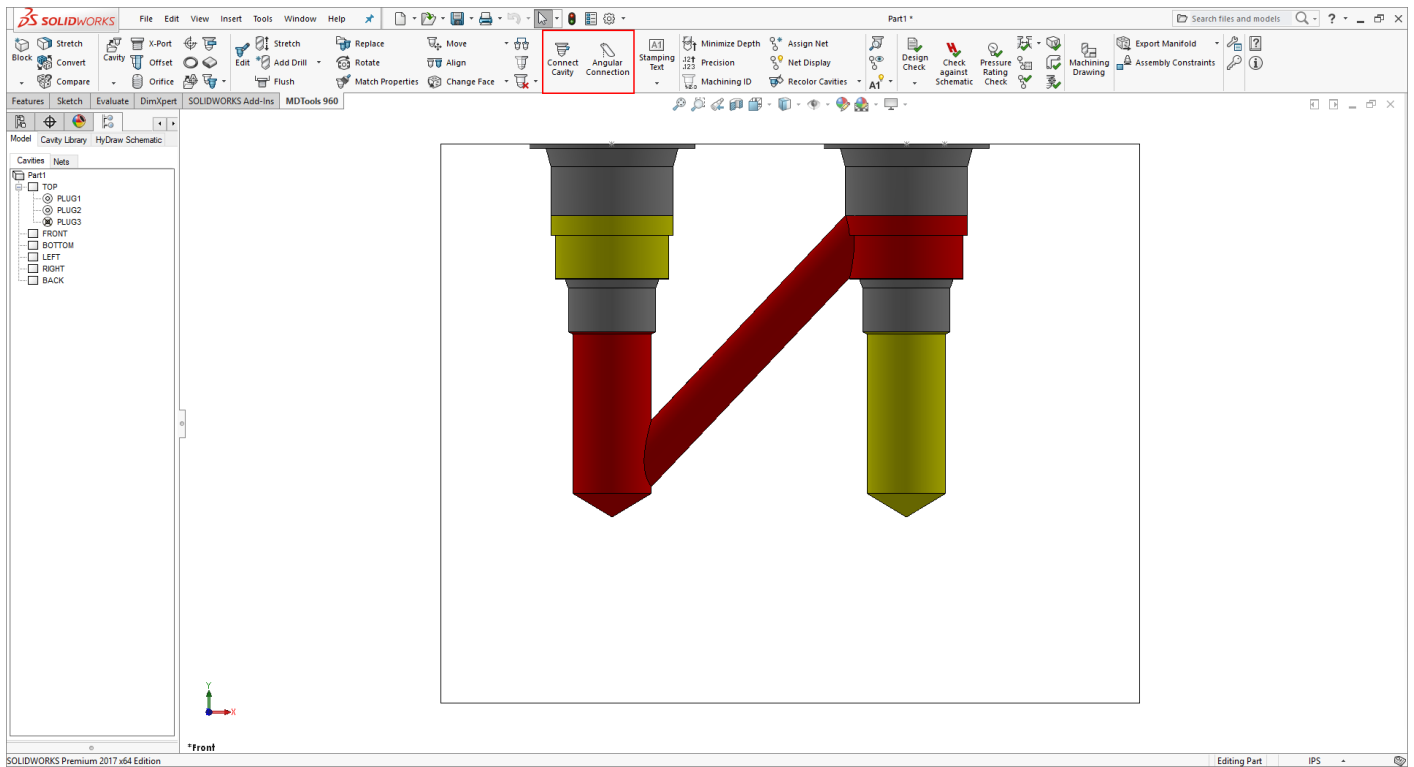


Component Outline automatically deleted

Make Connections

50 Connect Cavity

51 Angular Connection



50. Connect Cavity

Interactively create connections between cavities.

If a connection is not possible without relocating the cavity, then MDTools® automatically relocates the connecting cavity to the port center. In case of a bottom port, MDTools relocates the connecting cavity to the full diameter depth of the second cavity.

1. MDTools960
> **Connect Cavity**
The Connect Cavities dialog box displays.
2. Select the cavity to connect.
Select the cavity you want to move and connect to another cavity.
3. Select connecting cavity1.
4. Select the connecting port on cavity1.

Note:

If the connecting cavity is not a cartridge valve cavity or if you select a port area of the cavity, then port number will appear by default.

5. Click the selection button for cavity2.
6. Select connecting cavity2.
7. Select the connecting port on cavity2.

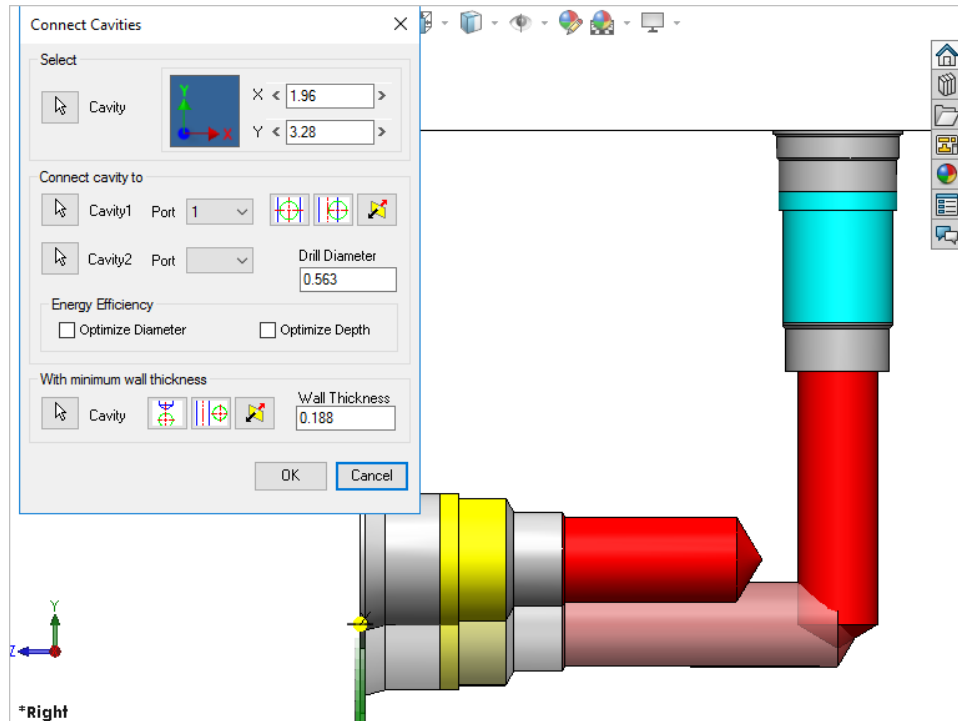
MDTools automatically relocates the cavity to the overlapping center of the two cavity ports.

8. Select **Energy Efficiency** options to make an energy efficient connection.
9. Click **OK**.

MDTools relocates the first cavity (cavity to connect) and updates the depth for all the cavities to create the specified connection.

Note:

- MDTools automatically selects the drill diameter when you connect the cavity to a side port of another cavity.
- Net name of all the cavities are updated with the net name for the selected port on cavity1.
- If the net name for the selected port on cavity1 is not defined, then the net name for the selected port on cavity2 is used.

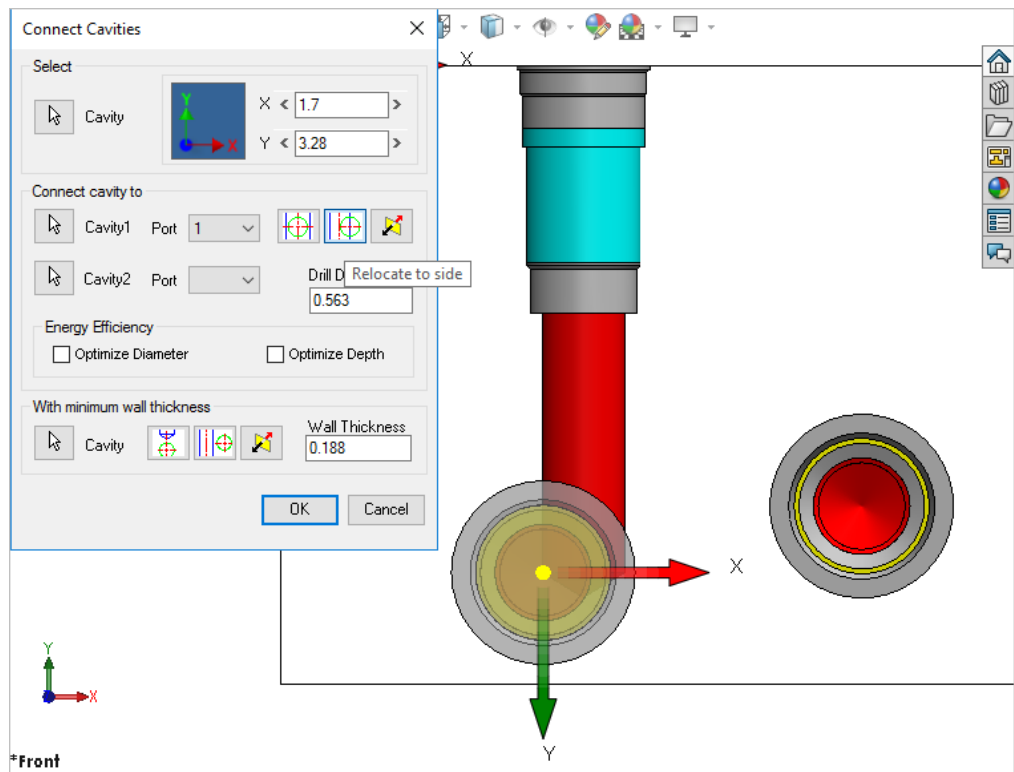


Connect Cavities dialog box

Cavities connected using the Connect Cavities command

Position the cavity

1. Click the *Relocate to center* button to locate the cavity on the port center of cavity1.
2. Click the *Relocate to side* button to relocate the cavity to the side.
3. Click the *Flip side* button to flip the sides.

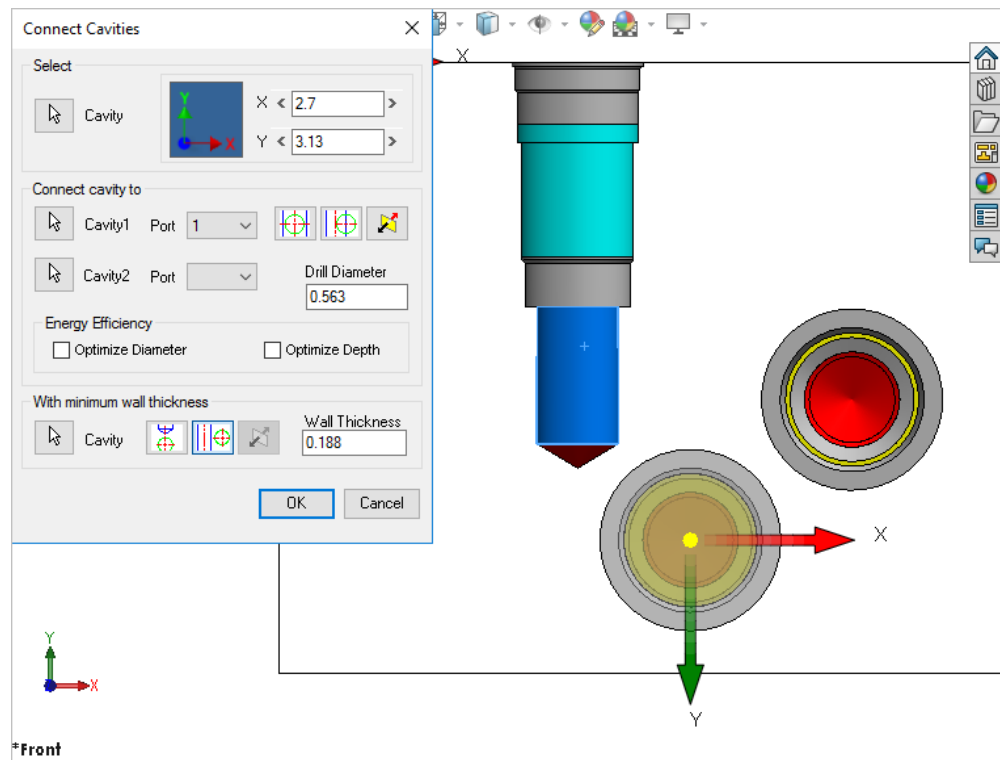


*Front
Positioning the cavity using the Relocate to side option

Position with minimum wall thickness

Position the cavity to connect while assuring minimum wall thickness with an existing cavity on the manifold.

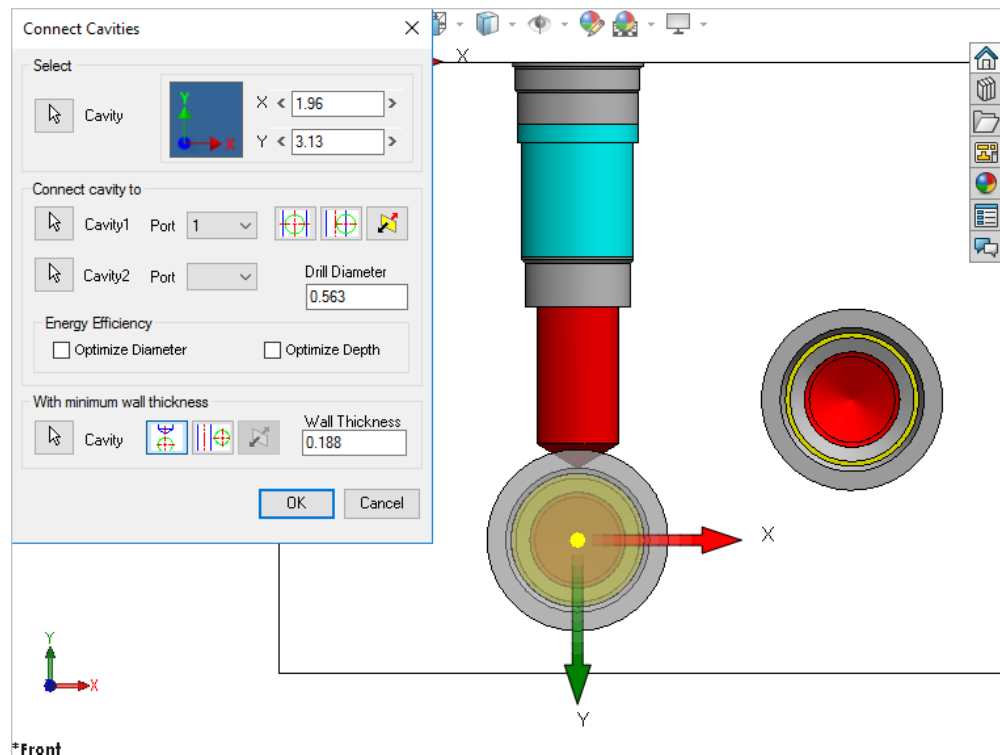
1. Click the selection button for cavity.
2. Select an existing cavity on the manifold.
3. Click the *Move to side* button to position the new cavity away from the selected cavity axis.
4. Click the *Flip side* button to change the side, if required.
5. Repeat the above steps to position the cavity with minimum wall thickness from a second cavity on the manifold.



Positioning the cavity using the Move to side option

Note:

Choose the Locate below cavity tip option to locate the cavity with the minimum wall thickness from the tip of an existing cavity.



Positioning the cavity below the cavity tip

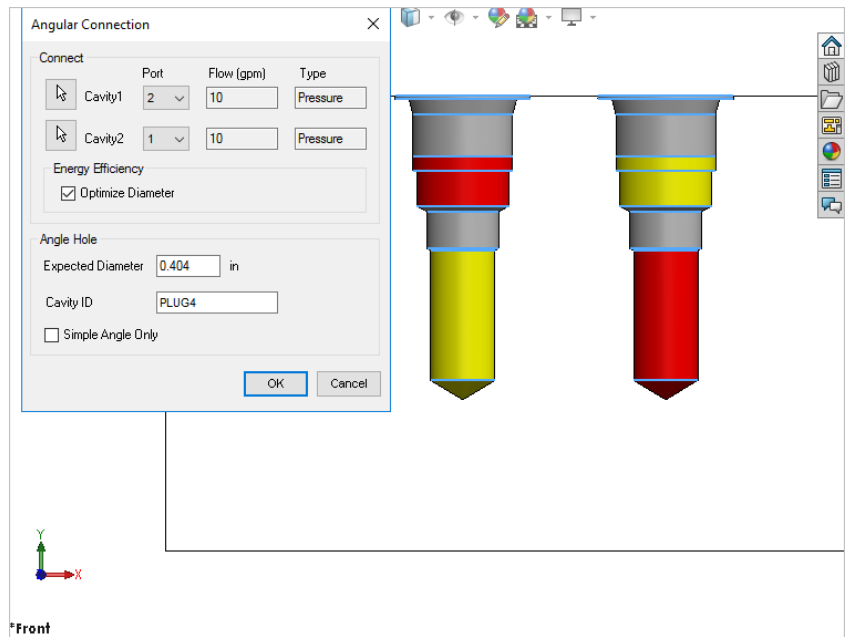
51. Angular Connection

Create a connection between two cavities using an angular drill. MDTools® creates an angular drill at the appropriate angle to make the best possible connection between two selected cavities.

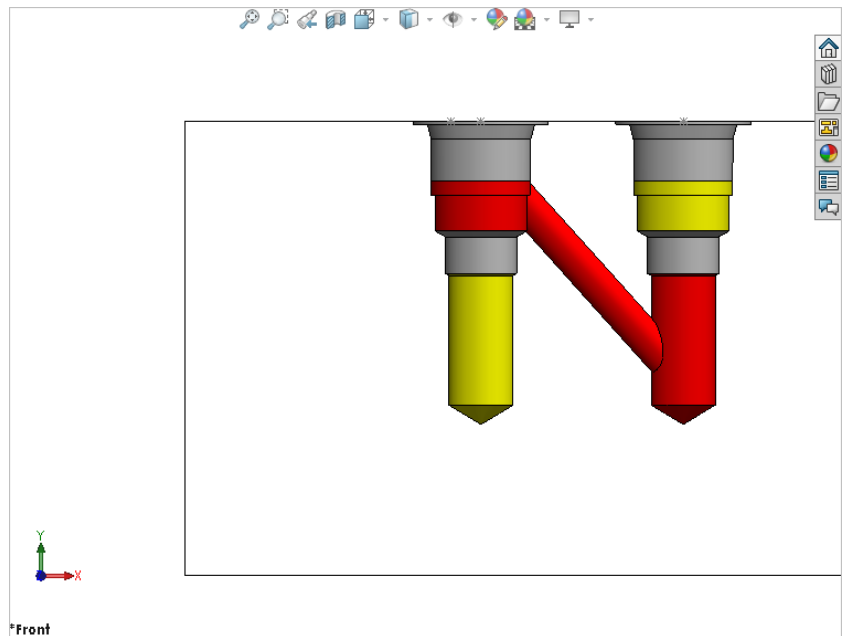
1. MDTools960
 - > **Angular Connection**
 - The Angular Connection dialog box displays.*
2. Select Cavity1, the connect button.
Select the cavity from which you want to make an angle drill.
3. Select the port of the first cavity.
Select the port of the first cavity you want to connect with the second cavity.
4. Select Cavity2, the connect button.
Select the second cavity to which the first cavity is to be connected by angle drill.
5. Select the port of the second cavity.
Select the port of the second cavity you want to connect to the selected port of the first cavity.
6. Enter the component ID for the angular hole.
7. Select the angular precision you want to set for the angular holes.
8. Enter the preferred drill diameter.
If possible, MDTools creates the angle hole with the specified diameter; else, it displays the maximum possible diameter.
If Energy Efficient options is checked then MDTools will automatically calculate the preferred diameter to connect the cavities.
9. Click **OK**
If there is a possibility of an angular connection between the selected ports of the selected cavities, then a dialog box displaying the maximum possible diameter for the angular hole displays. Otherwise another dialog box with message, 'Cannot Connect Ports' displays.
10. Click **Yes**.
MDTools automatically creates an angular connection between the selected cavity ports.

Note:

- Change the diameter, if needed, to accommodate the flow for the connection.
- Diameter of the connecting angular drill cannot be changed to a value larger than the calculated diameter.
- Angular connection can only be created between cavities located on the same face or on perpendicular faces.
- Cavities located on opposite faces cannot be connected using the Angular Connection command.
- To create a simple angle hole, select the No Compound Angle Hole option. Set the required default option from the MDTools Options dialog box.



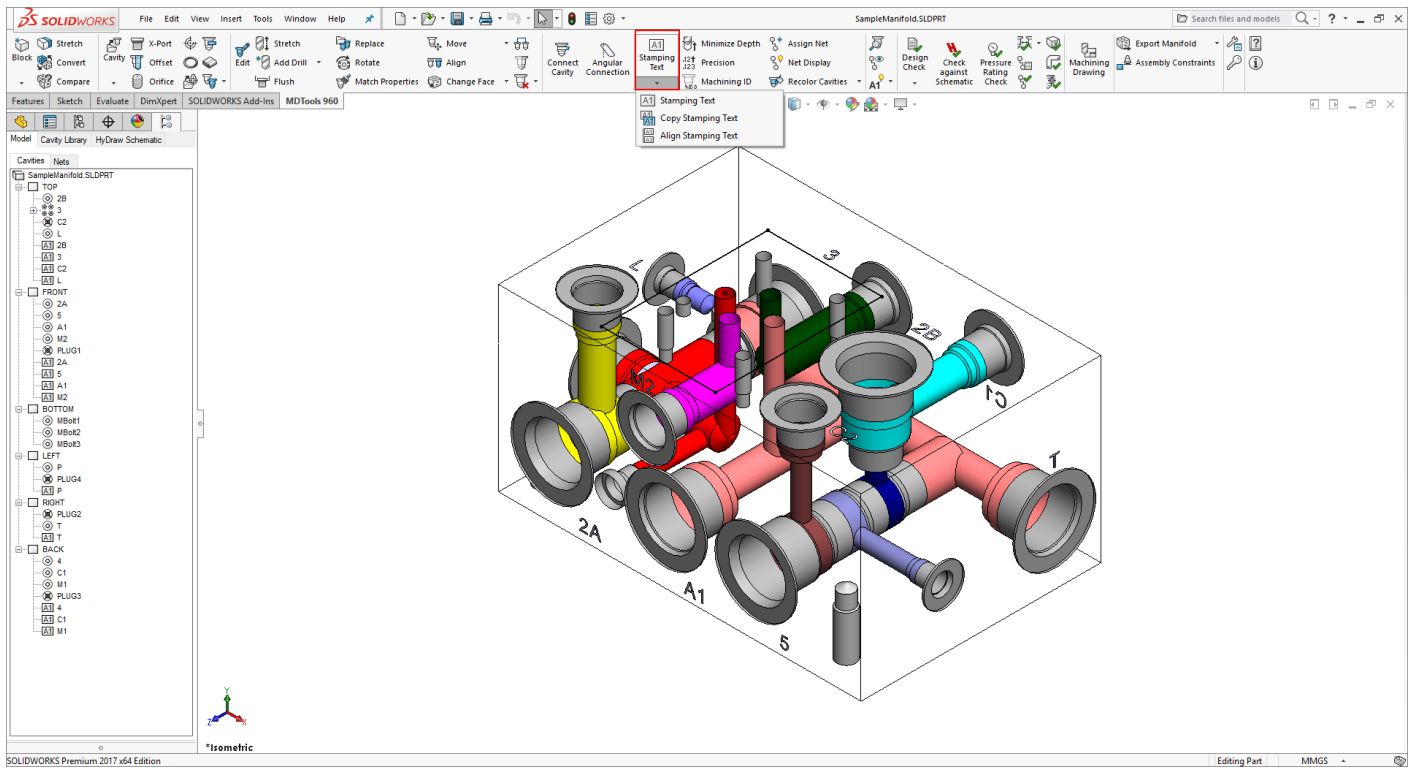
Angular Connection dialog box



Angular Connection Created

Stamping Text

- 52 Create/Edit Stamping Text
- 53 Copy Stamping Text
- 54 Align Stamping Text



52. Create/Edit Stamping Text

Create client graphics text and represent text embossing on the manifold.

1. MDTools 960
> **Stamping Text**

The *Create/Edit Stamping Text* dialog box displays.

2. Select the cavity.
MDTools® displays the component ID of the selected cavity as the default text.

You can change the stamping text, if required.

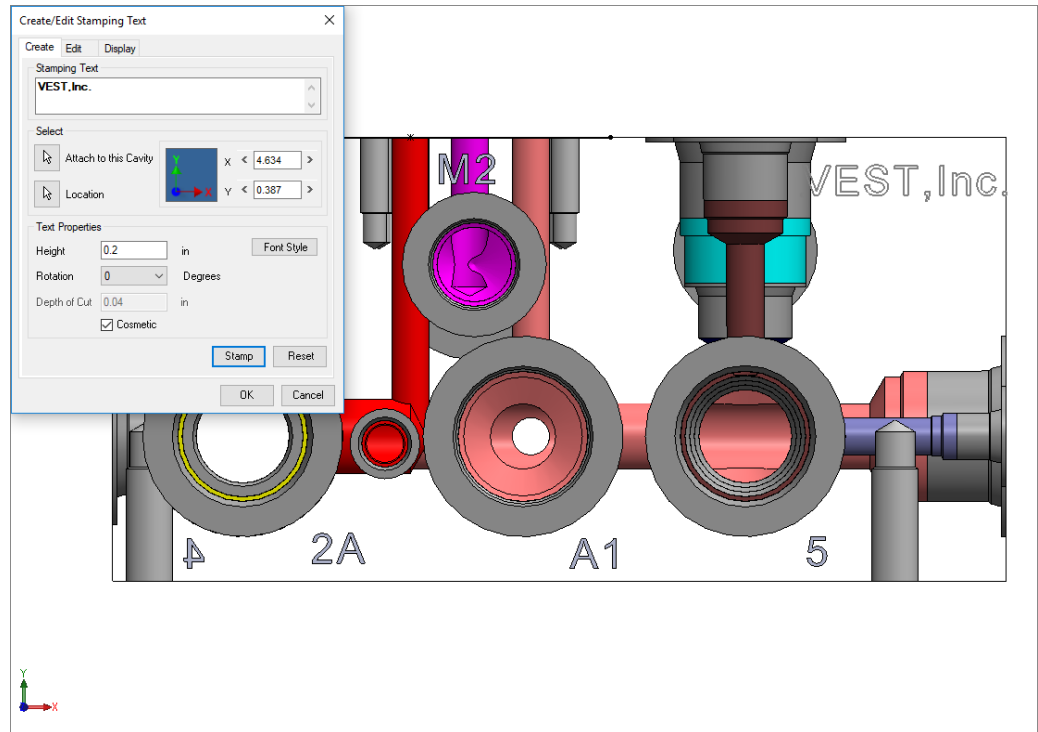
3. Select the stamp location.
4. Enter text **Height**.
5. Select text **Rotation**.
The default text rotation is 0.

6. Select **Cosmetic** option to create a sketch text feature, otherwise engraved text will be created.

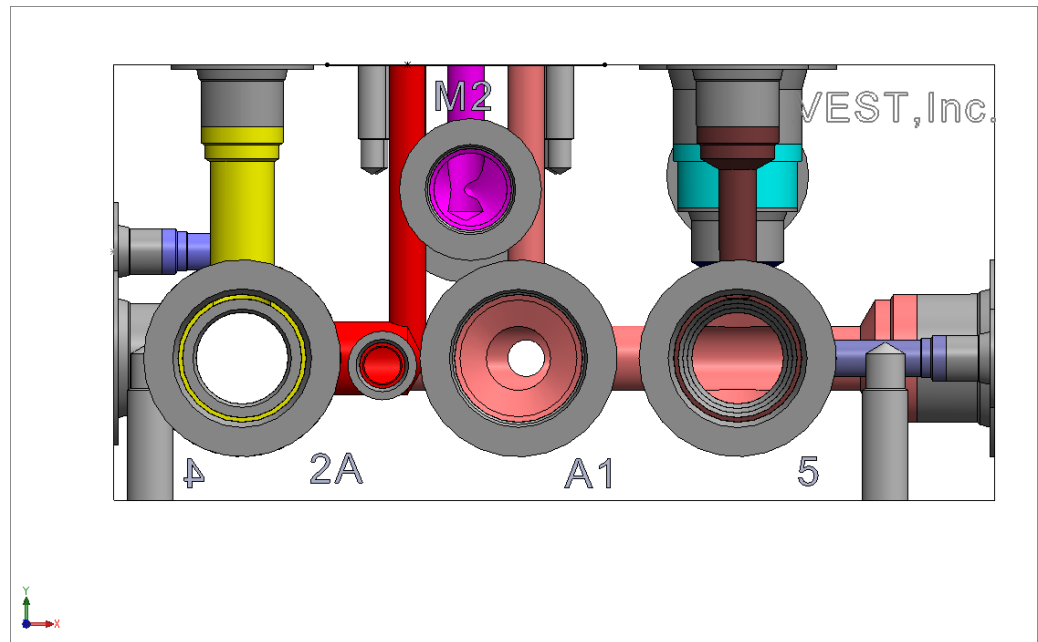
7. Click **Stamp**.
8. Repeat the above steps to create all the stamping text on the manifold.

Note:

When designing a manifold with a large number of cavities, it is recommended to use the 'Create text only' option.



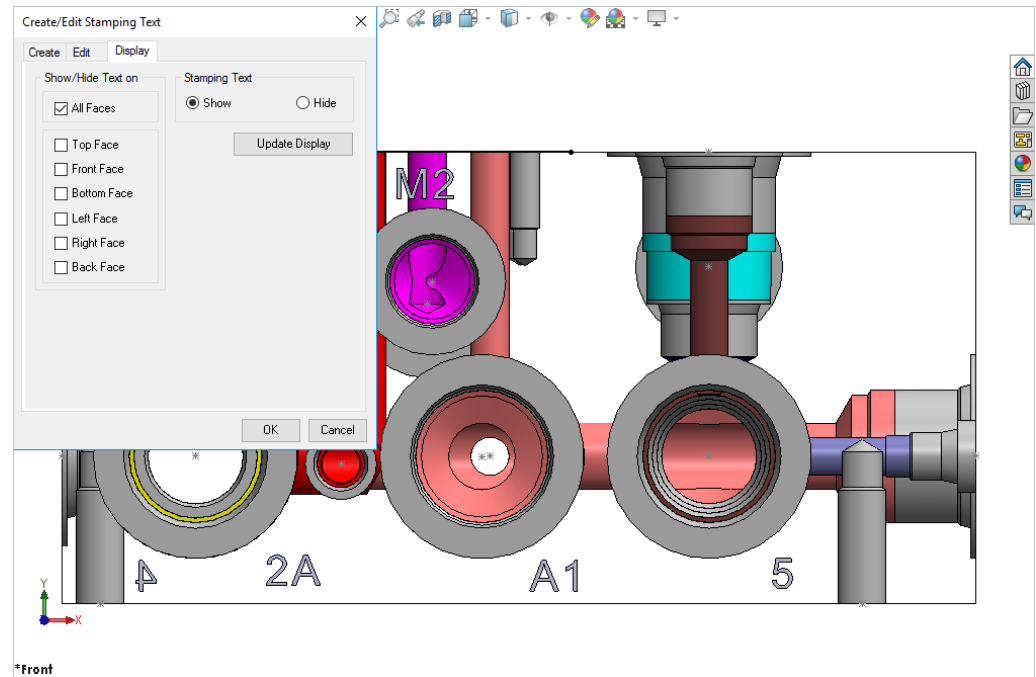
Create/Edit Stamping Text dialog box



Text Stamping on manifold

52.1 Show / Hide Stamping Text

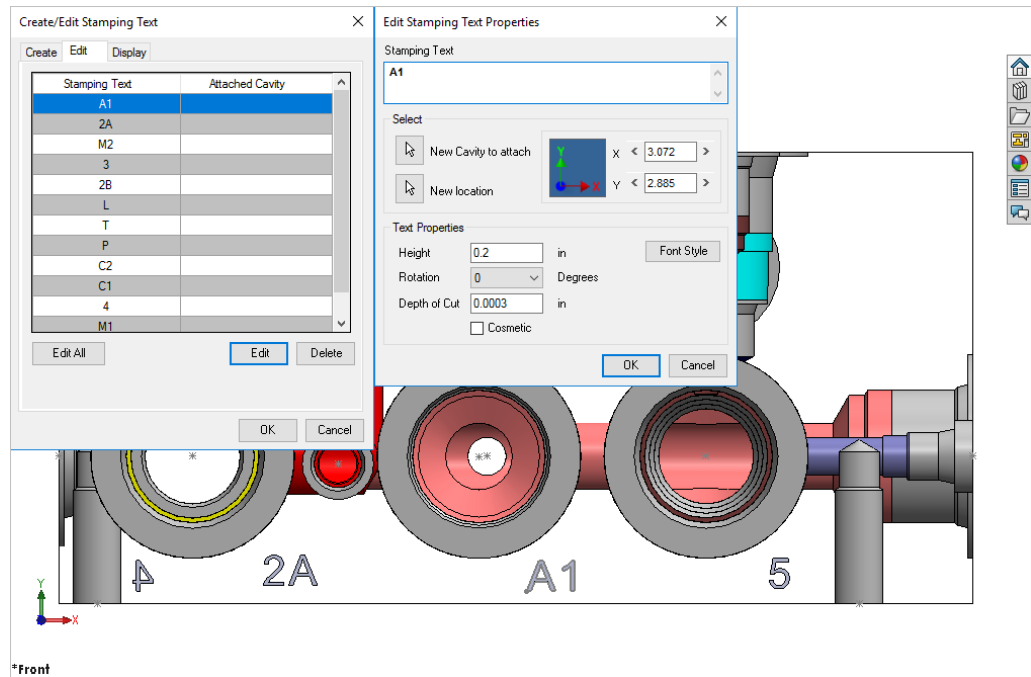
1. Select the **Display** tab on the Create/Edit Stamping Text dialog box.
2. Select the appropriate face.
The All Faces option is selected by default.
3. Select the required **Show** or **Hide** option.
Select the Show option to display the text or select the Hide option to hide the text.
4. Click the **Show/Hide** stamping text option.
If the Show option is selected, MDTools® displays all the stamping text on the selected faces; else, all the stamping text on the selected faces is made invisible.



Display Stamping text

52.2 Edit Stamping Text

1. Select the **Edit** tab on the Create/Edit Stamping Text dialog box. *MDTools® lists the stamping text on the manifold.*
2. Select the text you want to edit. *MDTools highlights the selected stamping text in the model.*
3. Click **Edit**. *The Edit Stamping Text Properties dialog box displays.*
4. Change the **Cosmetic** text option, if required.
5. Change the text properties.
6. Click **Save** to save modification.



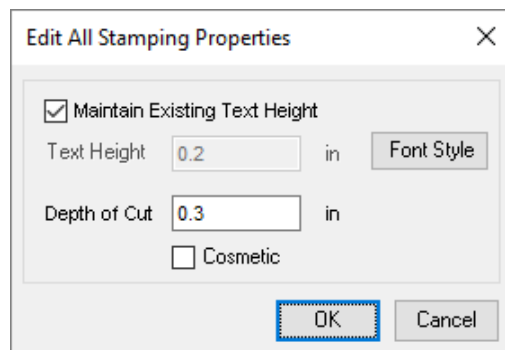
Editing Stamping text

Delete Emboss Text

7. Select the text you want to delete.
8. Click **Delete**. *MDTools deletes the selected text from the list and updates the text display.*

52.3 Edit All Stamping Text

1. Click **Edit All** button. *The Edit All Stamping Properties dialog box displays.*
2. Select **Maintain Existing Text Height**.
or
Enter the text height to change all the stamping text inside the model.
3. Click **Font Style** button to change font style, if required.
4. Select the **Cosmetic** option to convert all texts to texts without engravings.
5. Click **OK** to apply the changes.



Edit All Stamping Properties dialog box

53. Copy Stamping Text

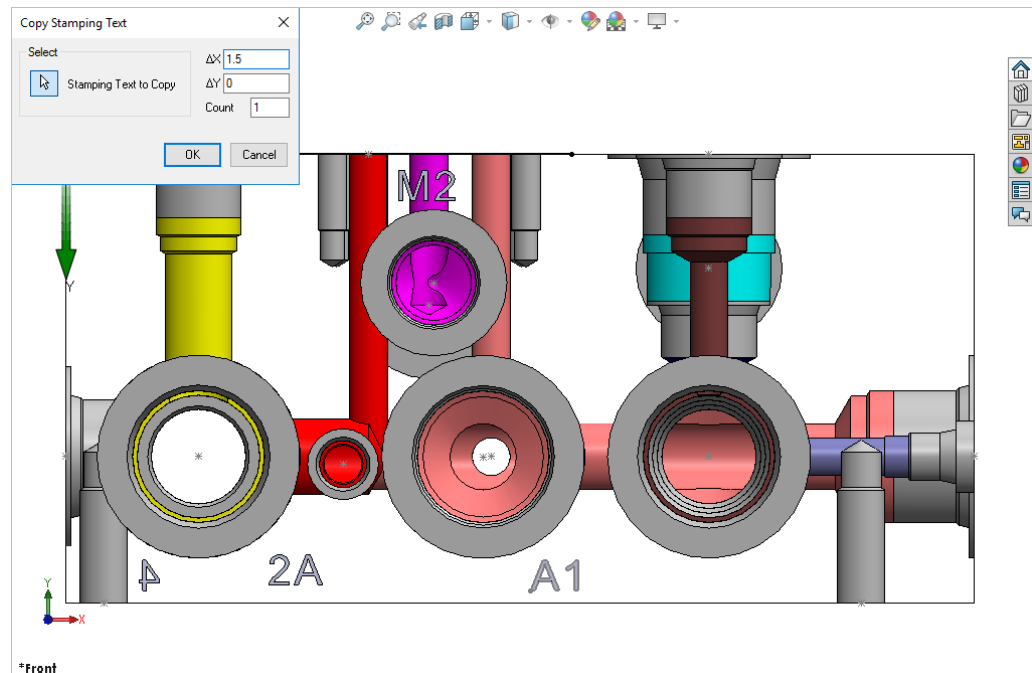
Create multiple copies of the selected stamping texts on the manifold at specified distance from the location of selected texts. Various properties of the selected texts also get copied.

1. MDTools 960
> Stamping Text
> **Copy Stamping**
Text
The Copy Stamping Text dialog box displays.
2. Select stamping texts to copy.
3. Enter values for ΔX and ΔY .
4. Enter count number to set the number of copies.
5. Click **OK** to create the copies of the selected stamping texts.

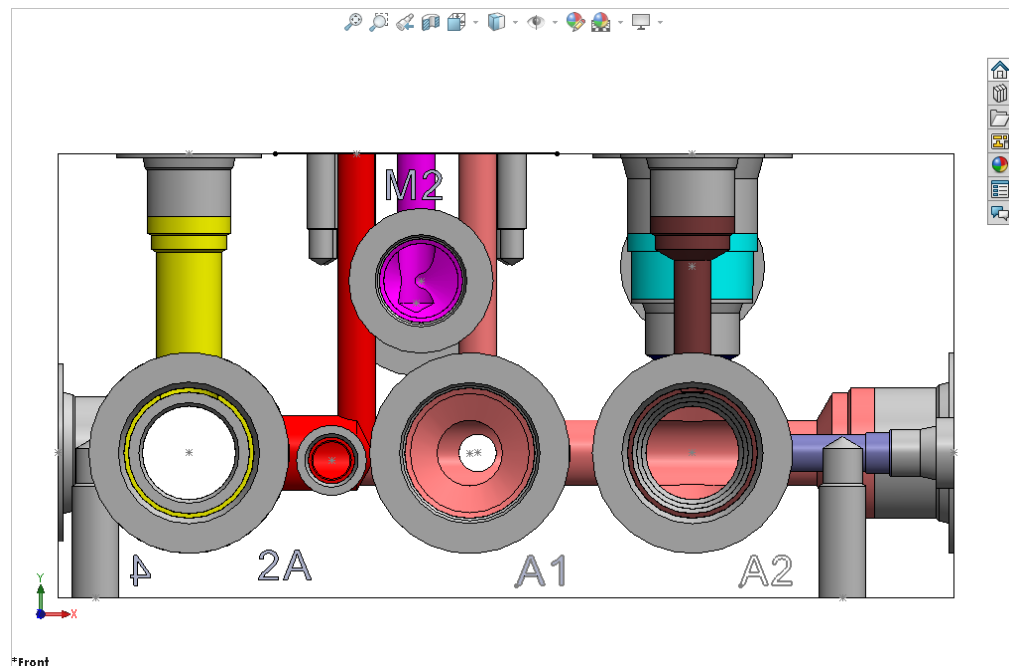
Note:

If the last letter is a number, then the newly copied text automatically increments the count.

However, if the last letter is an alphabet or a special character, then suffix a number starting from ... and then increments the number, per the count.



Copy Stamping Text dialog box

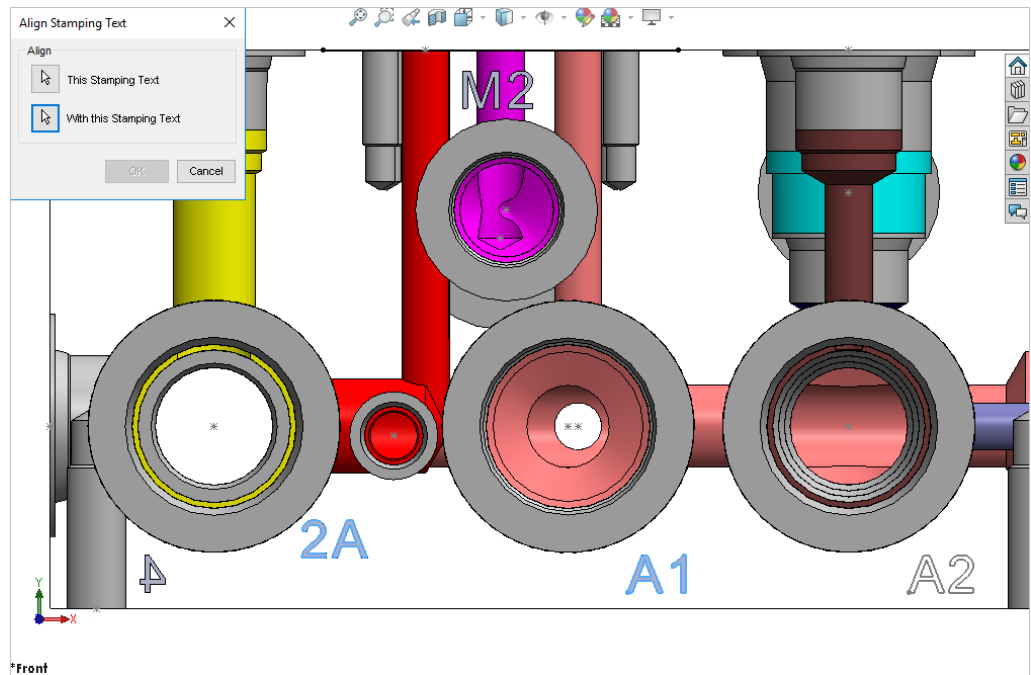


Stamping texts copied

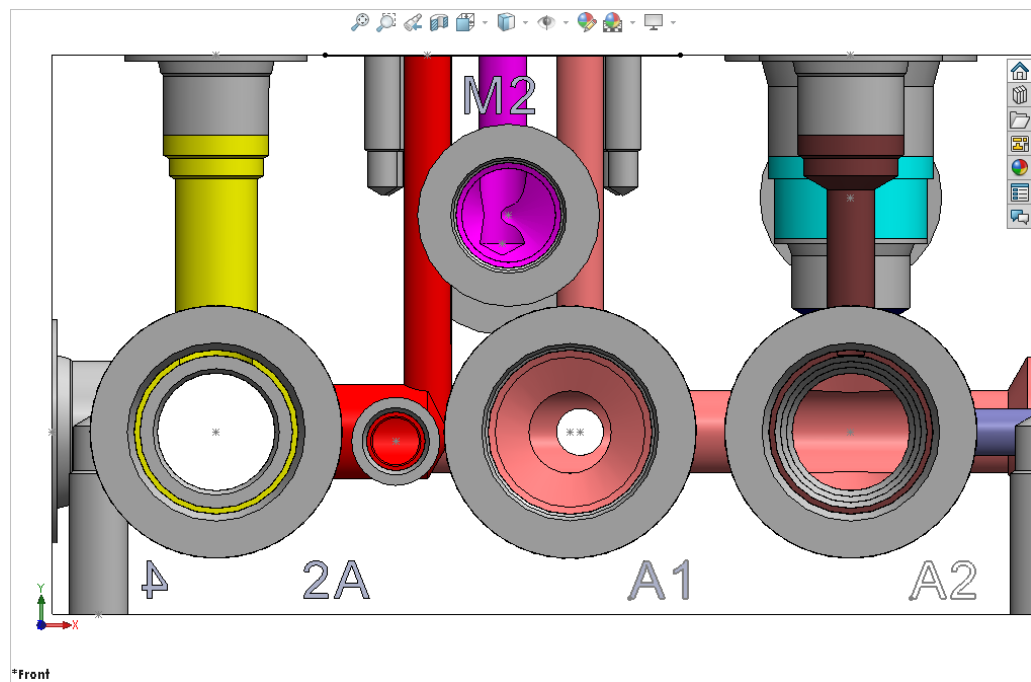
54. Align Stamping Text

When you align two stamping texts on the same face, the texts are aligned to the coordinate with the shortest distance.
When you align two texts on two perpendicular faces, the texts are aligned with reference to the common coordinate.

1. MDTools 960
> Stamping Text
> **Align Stamping Text**
The *Align Stamping Text* dialog box displays.
2. Select the stamping text to be moved in order to align it with the other stamping texts.
3. Select the stamping text along with the previously selected stamping text to be aligned.
4. Click **OK** to align the two selected texts.



Align Stamping Text dialog box



Selected texts are aligned

54.1 Alignment of Stamping Texts

The Stamping text is aligned in three ways:

Same face – shortest distance alignment

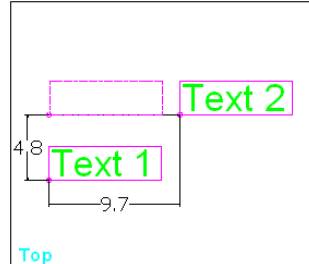
Perpendicular face – common axis alignment

Opposite face – point to point alignment

The left bottom corner of the textbox is taken as reference point for all alignment calculations.

1 Same Face Alignment

When Text 1 and Text 2 are on the same face, then the shortest distance is calculated.



Same Face Alignment

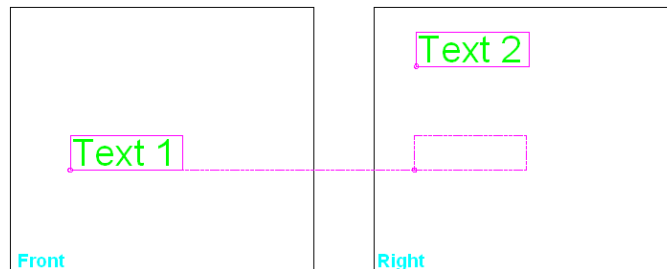
- If the vertical distance is shorter than the horizontal distance, then the vertical alignment takes place.
- If the horizontal distance is shorter than the vertical distance, then the horizontal alignment takes place.

The relocation of Text 2 is shown in dotted lines.

2 Perpendicular Face Alignment

When Text 1 and Text 2 are on perpendicular faces, then Text 2 is aligned with Text 1 on the common axis of both faces.

The relocation of Text 2 is shown in dotted lines.

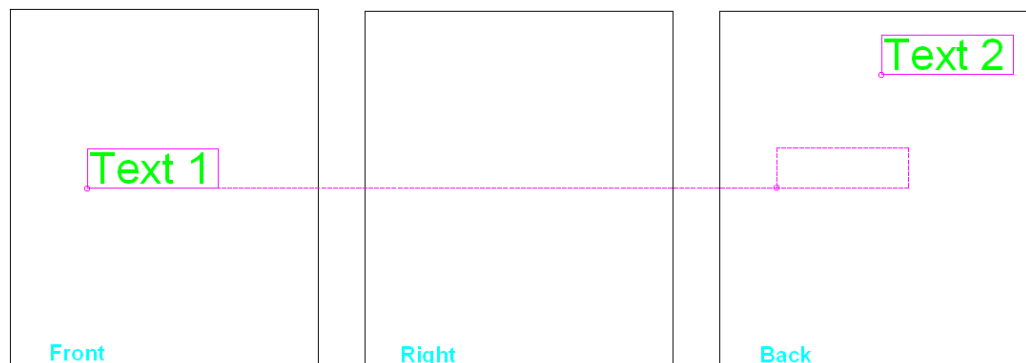


Perpendicular Face Alignment

3 Opposite Face Alignment

When Text 1 and Text 2 are on opposite faces, then Text 2 is aligned with the reference point of Text 1.

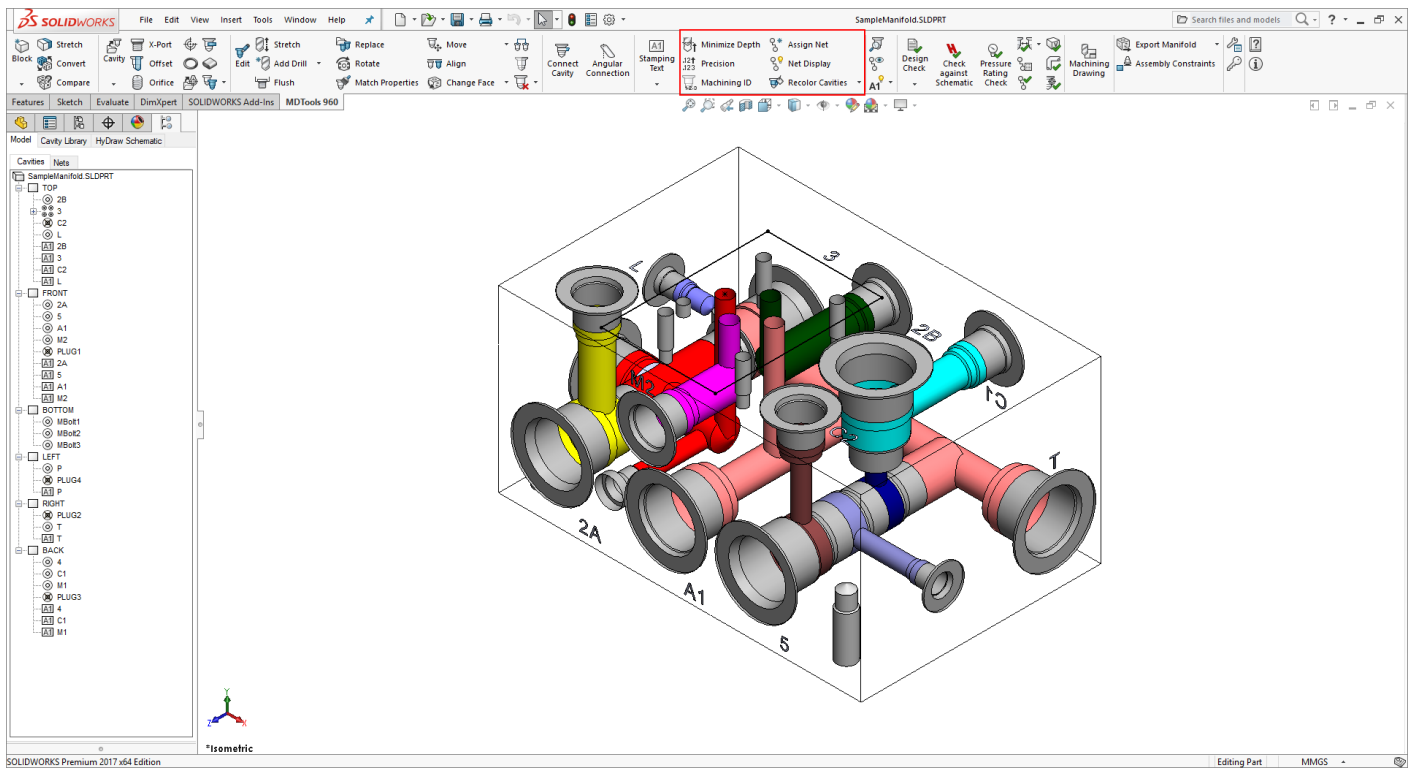
The relocation of Text 2 is shown in dotted lines.



Opposite Face Alignment

Update Block

- 55 Minimize Depth
- 56 Apply Manufacturing Precision
- 57 Generate Machining ID
- 58 Assign Net
- 59 Manage Colors
- 60 Recolor Cavities
- 61 Remove Color



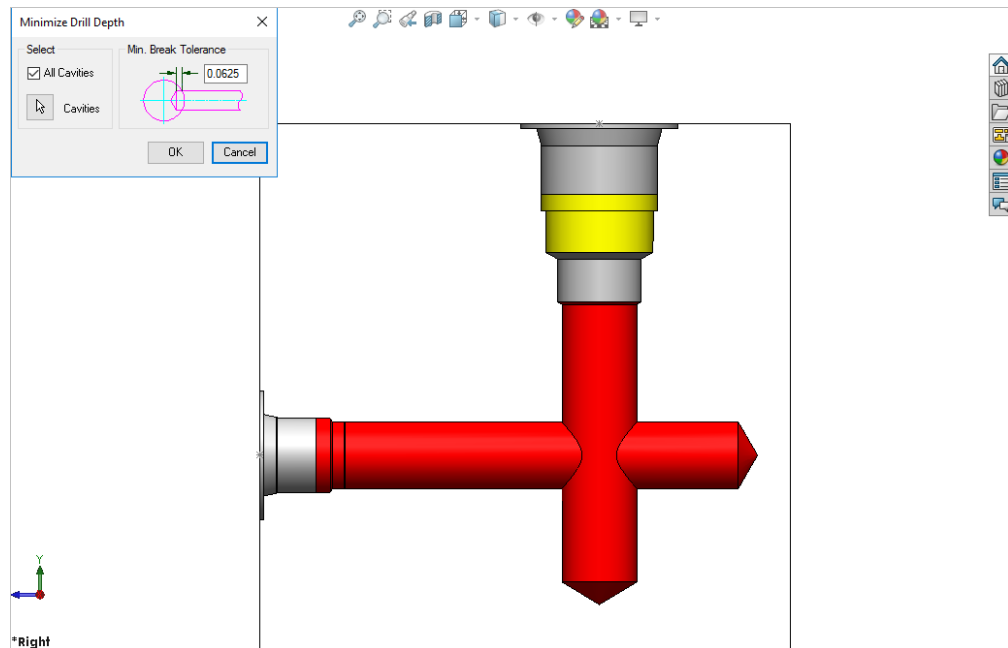
55. Minimize Depth

Ensure minimum drill travel in empty cavity space.

You can also reduce the drill depth to a minimum and remove any extra drilling created during the layout process.

1. MDTools 960
> **Minimize Depth**
The Minimize Drill Depth dialog box displays.

The All Cavities option is selected by default.
2. Click the **Cavities** selection button and select the required cavities, if you do not want to minimize the depth of all the cavities.
3. Enter the minimum break tolerance.
4. Click **OK**.
MDTools[®] updates the drill depth of all the selected cavities to the minimum specified.



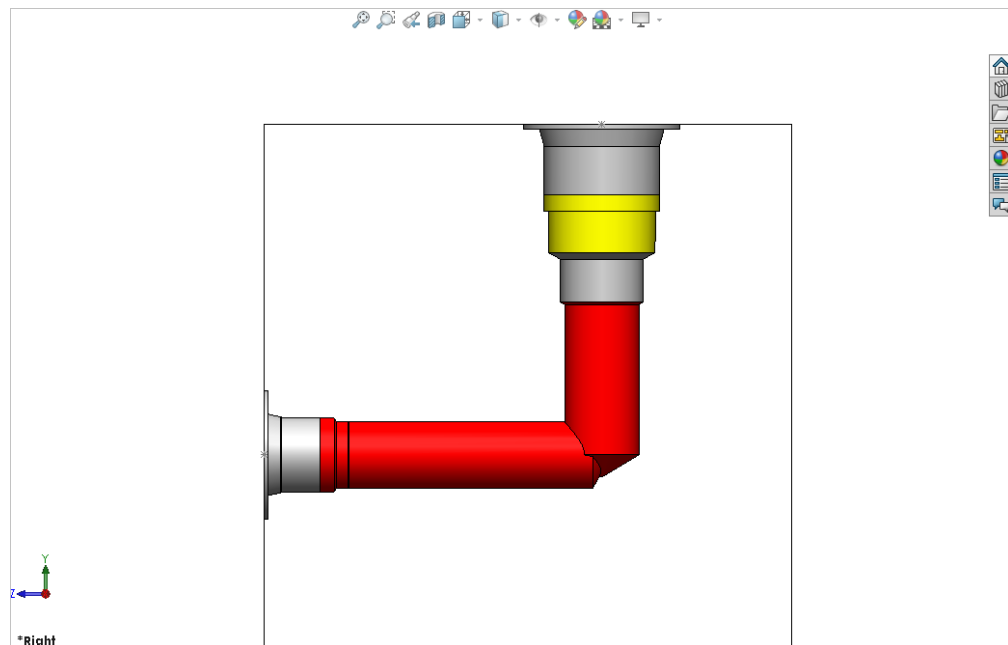
Minimize Drill Depth dialog box

Note:

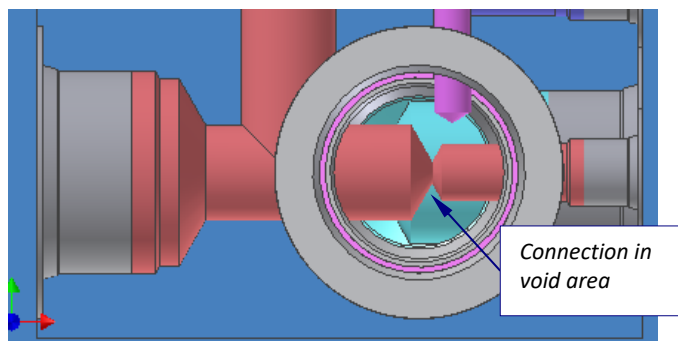
- If two cavities connecting another cavity intersect inside the empty cavity space, then MDTools will not be able to minimize the drill depth of connecting cavities.

In this case, you need to remove all such intersections inside the block, prior to running this command to get the best result.

- If *Energy Efficient Connection* option is enabled in *MDTools Options*, then program will use the depth required for energy efficient connection at bends.



Drill depth reduced to the minimum



56. Apply Manufacturing Precision

Change the precision for cavity location, drill depth, and the angle value of angle holes.

MDTools 960

> Precision

The Update Precision dialog box displays.

Location

Select the desired location precision from the Location Precision drop-down list.

Drill Depth

Select the desired drill depth precision from the Drill Depth Precision drop-down list.

Inclination

Select the desired angle precision from the Inclination Angle Precision drop-down list.

If you do not want to change any of the precision values, use the default Do Not Change option.

Click **OK**.

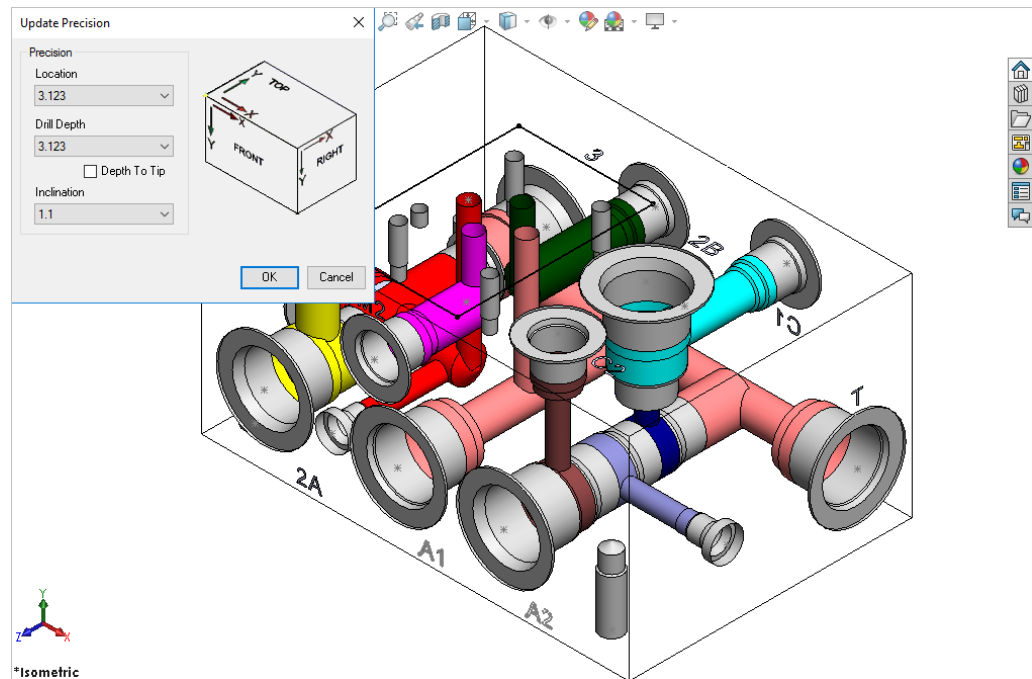
MDTools® updates the location, drill depth, and the angle values (both Alpha and Beta) of cavities.

Note:

- When you apply location precision, cavities will be relocated with respect to the default co-ordinate system.
- In case of footprints, MDTools applies location precision on the cavity marked as 'dimension from this cavity'.
- When updating the location, MDTools relocates the complete footprint and the relative distance between the cavities in the footprint remains the same.

CAUTION!

If you use cavity location precision (e.g. 2.12) less than that (e.g. 3.123) used for the side port locations of cartridge valve cavities, then the holes connecting the side ports of cartridge valve cavities may cut outside the port area.



Update Precision

57. Generate Machining ID

The *Machining ID* command enables you to automatically generate machining IDs for all the cavities on the manifold based on the diameter or distance naming options, and one of the four alternative numbering options. You can select between upper and lower case alphabets for cavity machining IDs.

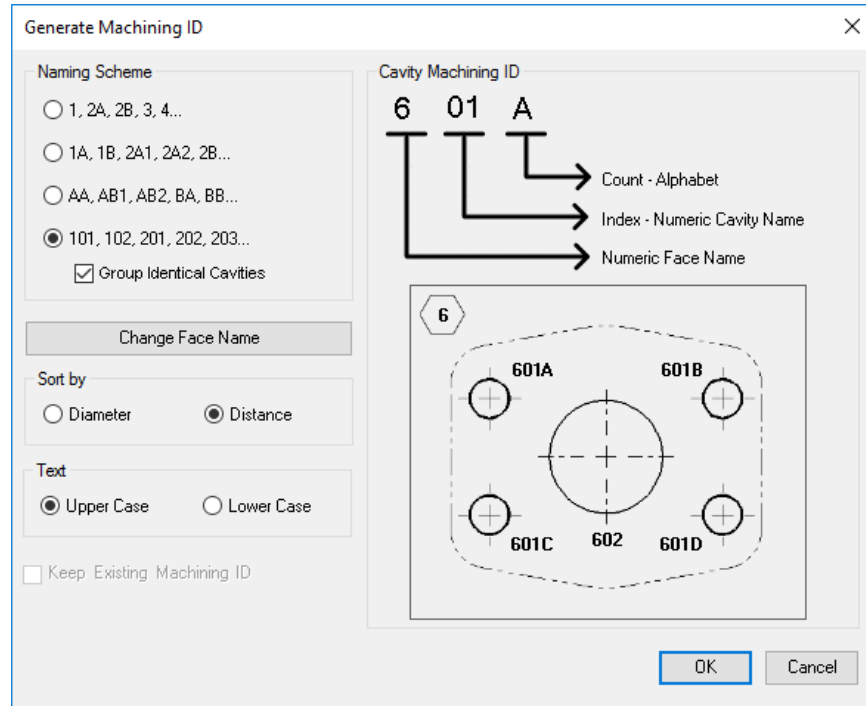
The *Generate Machining ID* command depends on the following.

- The naming option selected
- The naming (numbering) scheme selected
- The face on which the cavity is located
- Keep Existing Machining ID option selected

MDTools 960

> Machining ID

The *Generate Cavity Machining ID* dialog box displays.



Generate Cavity Machining ID dialog box

1. Select Naming Scheme.
 - 1, 2A, 2B, 2, 4...
 - 1A, 1B, 2A1, 2A2, 2B...
 - AA, AB1, AB2, BA, BB...
 - 101, 102, 201, 202, 203...
 2. Select the Group Identical Cavities option, if required.
- Note:
3. Grouping is not applicable for scheme 1, 2A, 2B, 2, 4...
 4. Use the **Change Face Name** option to configure the face name.
 5. You can have Alphabetic or Numeric Face name.
 6. MDTools* generates cavity-machining ID based on the selected option. The cavities on the different faces of the manifold are named in the default order of faces i.e. A, B, C, D, E, and F.
 7. Select the Sort by option
 8. Diameter
 - Cavities with smaller diameters (in Step0 or Step12) are assigned smaller numbers. Cavities are sorted by diameter.
 - Distance**
 - Cavities closer to the face origin point are assigned smaller numbers. Cavities are sorted by distance from the face origin
 9. Select the **Keep Existing Machining ID** option, if you want to retain an already existing assigned machining ID when a manifold is revised. This option will be unavailable if:
 - Current naming scheme is different than last used naming scheme when a manifold is revised.
 - or
 - Face names are different than the last used face names to assign machining IDs when a manifold is revised.
 10. Click Generate Cavity Machining ID.

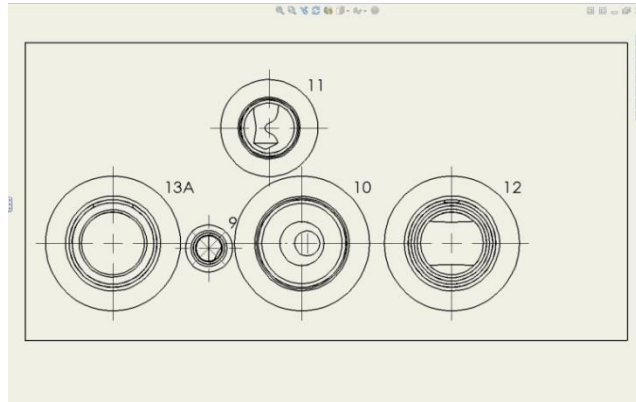
Cavities can be named using four different **naming schemes**.

Naming Scheme:

1,2A, 2B, 3, 4

- Name of the cavity is a Number.
- Count is an alphabet and Naming option: Diameter

The number is incremented with each non-identical cavity found on the face starting with the cavity found with the smaller diameter on the first face.

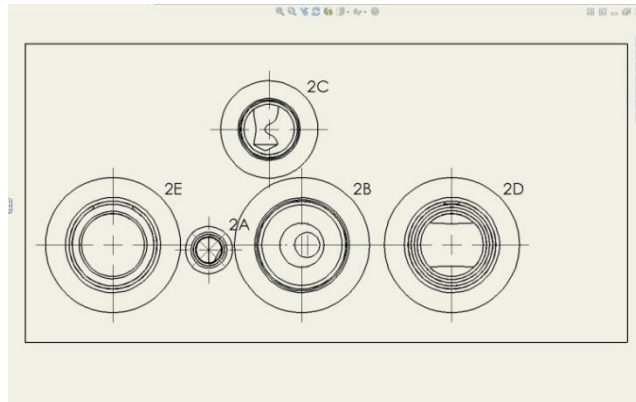


Naming Scheme: 1,2A, 2B, 3, 4

Naming Scheme:

1A, 1B, 2A1, 2A2, 2B

- Name of the cavity is a Numerical Face Name + Alphabetical Cavity Name.
- Count is an alphabet and Naming option: Distance

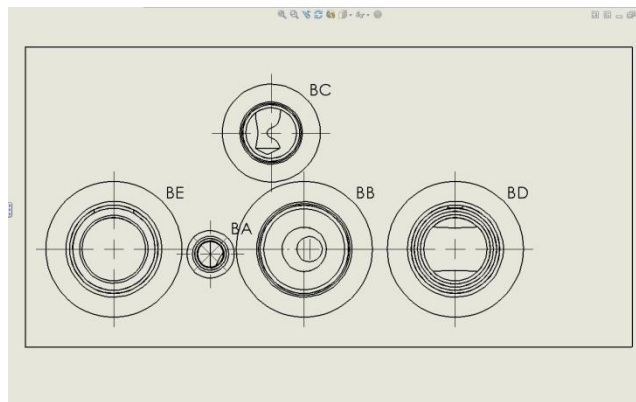


Naming Scheme: 1A, 1B, 2A1, 2A2, 2B

Naming Scheme:

AA, AB1, AB2, BA, BB

- Name of the cavity is an Alphabetical Face Name + Alphabetical Cavity Name.
- Count is an alphabet and Naming option: Diameter

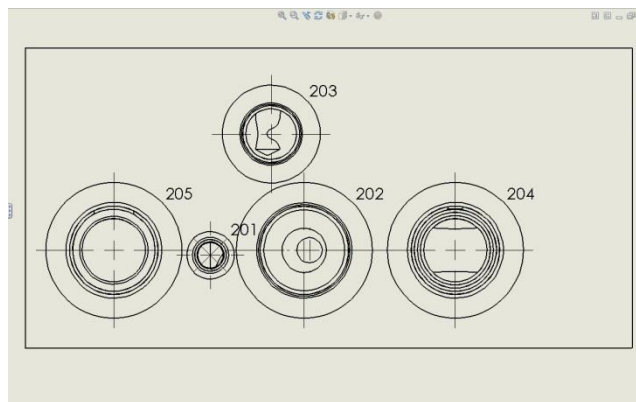


Naming Scheme: AA, AB1, AB2, BA, BB

Naming scheme:

101, 102, 201, 202, 203

Name of the cavity is a Numerical Face Name + Numerical Cavity Name.



Naming scheme: 101, 102, 201, 202, 203

NOTE

- **Number:** The number is incremented with each non-identical cavity found on the face starting with the smallest cavity on the first face.
- **Number + Alphabet:** The number designates the face name. The alphabets are incremented in alphabetical order (alphabets I & O are not included) with each non-identical cavity found on the face.
- **Alphabet + Alphabets:** The first alphabet denotes the face name, the second set of alphabets are incremented in alphabetical order (alphabets I & O are not included) with each non-identical cavity found on the face.
- **Count:** Count shows identical cavities. The count can either be a number or an alphabet.

Working: Keep Existing Machining ID

New cavity inserted

Insert/Copy/Copy multiple

- If the new cavity is identical to a group of existing cavities on the face (Whole manifold if Naming Scheme 1, 2A, 2B, 3, 4 is used) then add the cavity to the group and assign new machining ID after the last ID used in group.

Otherwise

- Assign new machining ID after the last ID used for the face (Whole manifold if Naming Scheme 1, 2A, 2B, 3, 4 is used).

Cavity deleted/suppressed

No change required.

Deleted ID will be missing in the new list.

Cavity face changed

Change Face/Swap cavities

- If Naming Scheme 1,2A, 2B, 3, 4 (no face name in ID) is used then no change is required.

Otherwise

- Consider it as a new cavity and update ID according to the Note section, New cavity inserted.

Cavity dimensions changed

Edit/Stretch/Add drill/Add counterbore/ Match properties/Flush Plugs/Replace etc.

- If a cavity does not belong to a group of identical cavities, then no change is required.

Otherwise

- If a cavity belongs to a group of identical cavities then, If same change is applied to all then no change is required.

Otherwise

- Split the group and retain ID of cavities in the sub group with majority.
Consider others as new cavities and assign new ID according to the Note section, New cavity inserted.

Note:

If more than one sub groups have number of cavities=max, then retain the IDs of sub group (number of cavities=max) whose dimensions are not changed.

58. Assign Net

Automatically assign the nets (flow paths) name and net color inside the manifold.

MDTools® automatically displays all nets with the default net color.

MDTools 960

> Assign Net

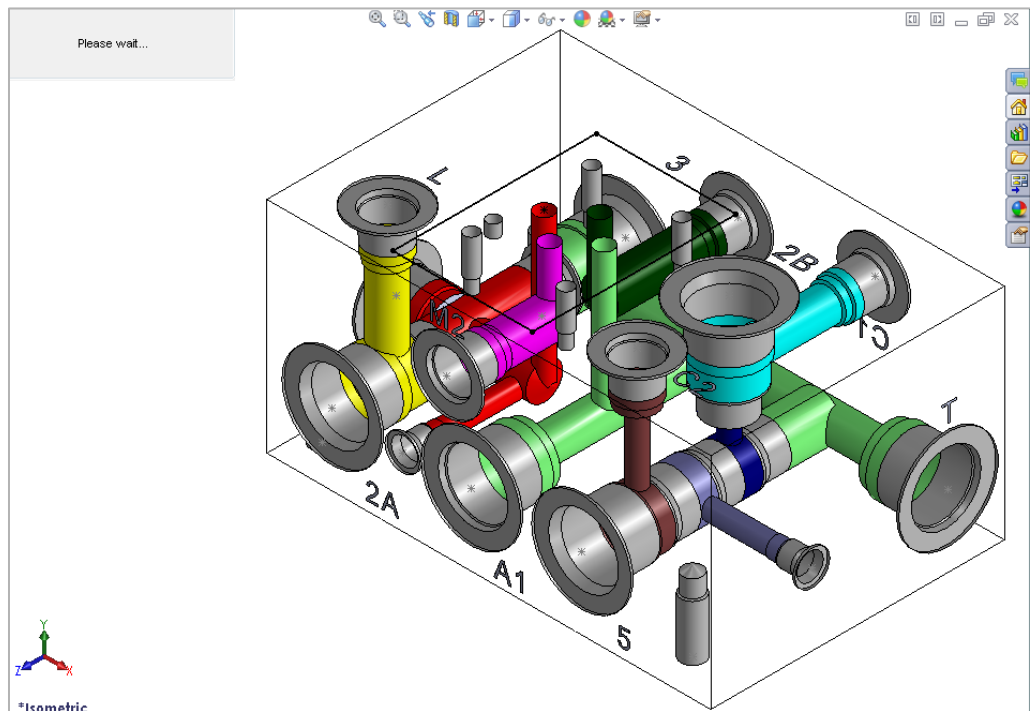
Automatically assign the MDTools default net name for all the net flow paths in the manifold data file.

Display the net flow path with the MDTools default net color in the manifold.

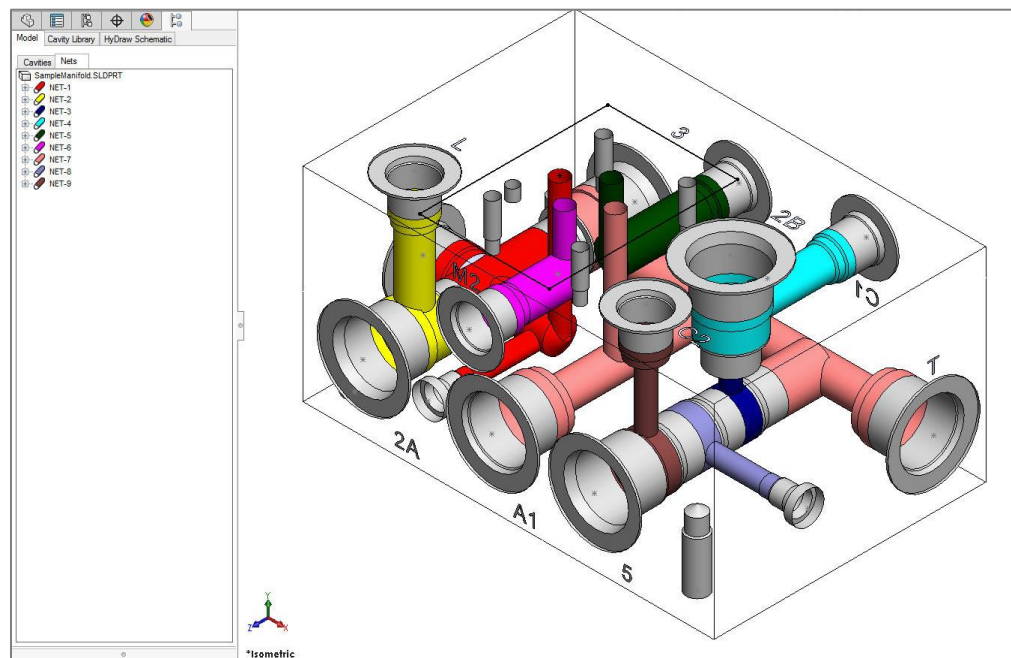
The MDTools Connectivity Browser shows all the assigned net names.

Note:

Change the default Net colors from MDTools Options.



Assign the Net (flow path) name



Connectivity Browser displays the assigned net name

59. Manage Colors

Toggle the nets (flow paths) color display between 'on' or 'off'. You can also change the color of nets inside the manifold.

MDTools 960

> Manage Colors

The *Net Display* dialog box displays.

MDTools[®] automatically assigns default colors for all the nets.

Net visibility shows the 'on' or 'off' status of the net.

Show/Hide Selected Net

Show or hide a single net in the manifold.

You can select one net at a time.

1. Select the net from the list.
MDTools displays the net name and color on the dialog box.

2. Click **Show** to display the selected net.
MDTools displays the selected net with the selected net color.

3. Click **Hide** to hide the selected net.
MDTools hides the selected net.

Show/Hide All Nets

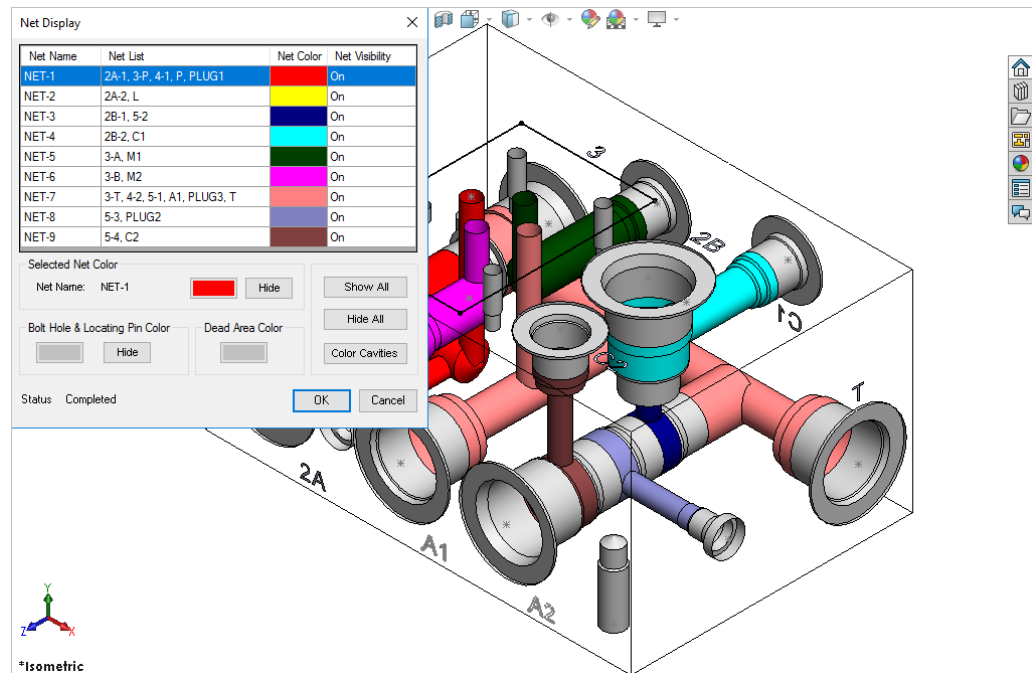
Show or hide all the nets in the manifold.

4. Click **Show All**.
MDTools shows each net in the manifold with a different color.

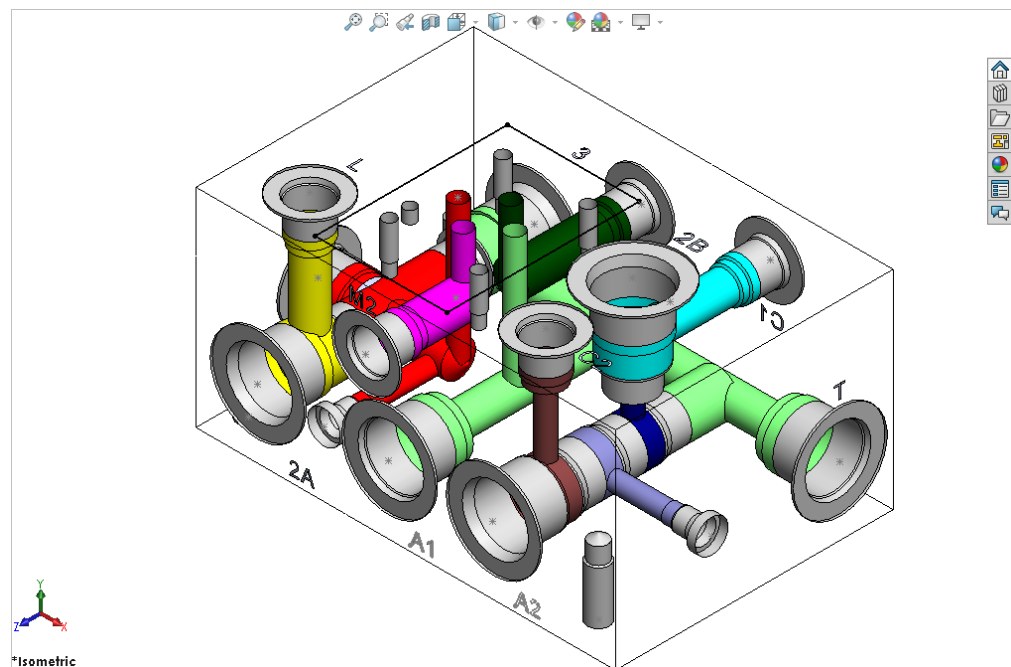
Show/Hide Bolt Holes and Locating Pins

Show or hide bolt holes and locating pins color in the manifold.

5. Click the **Show** button in the Bolt Holes & Locating Pin Color section.
MDTools displays the bolt holes and locating pins on the manifold.



Net Display dialog box



Nets displayed with different color

Note:

Use the Hide button to switch off the visibility of a single net.

Use the Hide All option to switch off the visibility of all the nets.

Change Color

Change the color of nets, bolt holes and locating pins, dead areas in ports, and cartridge valve cavities.

- 6. Click the **Color** button. *The Color dialog box displays.*

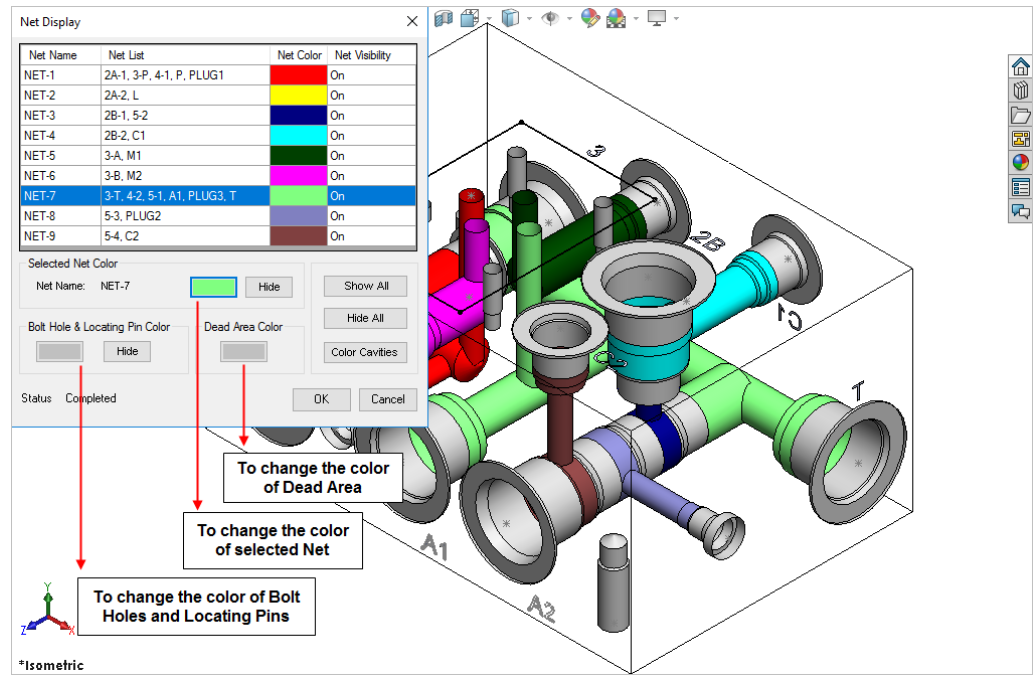
Note:

- Click the Color button to change the net color of a selected net.
- Click the Bolt Hole & Locating Pins Color button to change the color of bolt holes and locating pins.
- Click the Dead Area Color button to change the color of dead areas in cavities.

- 7. Select the required color from the Color dialog box.
- 8. Click **OK**. *MDTools[®] automatically updates the color and the net display.*

Note:

You can also change the default Net colors from MDTools Options.



Manage Colors: Change color

60. Recolor Cavities

Shade or update the shading of cavities on the manifold.

MDTools 960

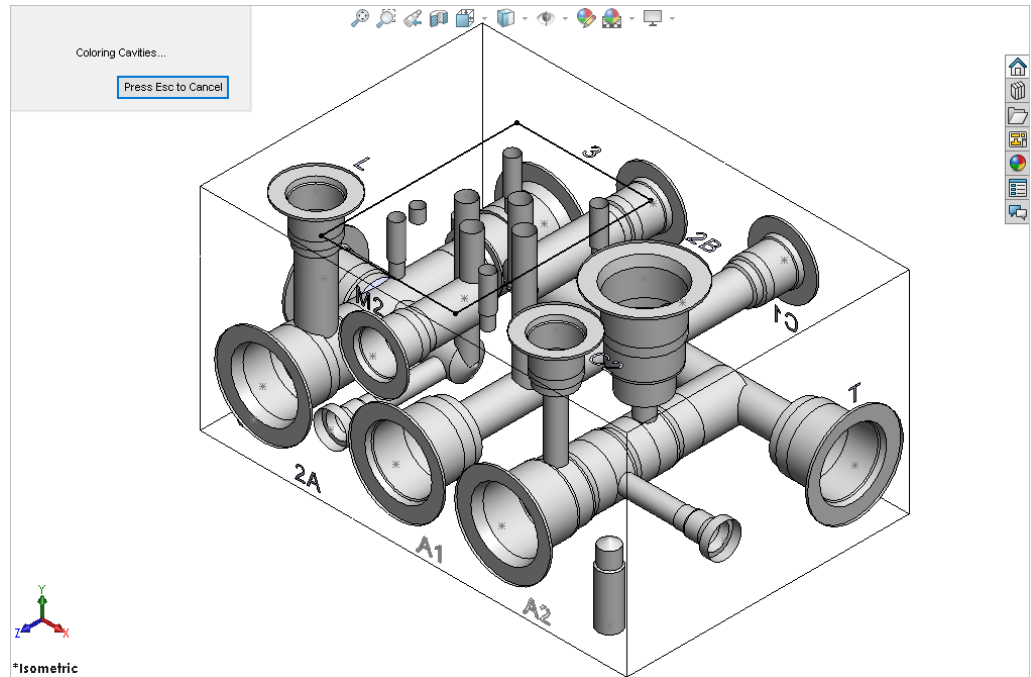
> Recolor Cavities

The Recolor Cavities message box displays.

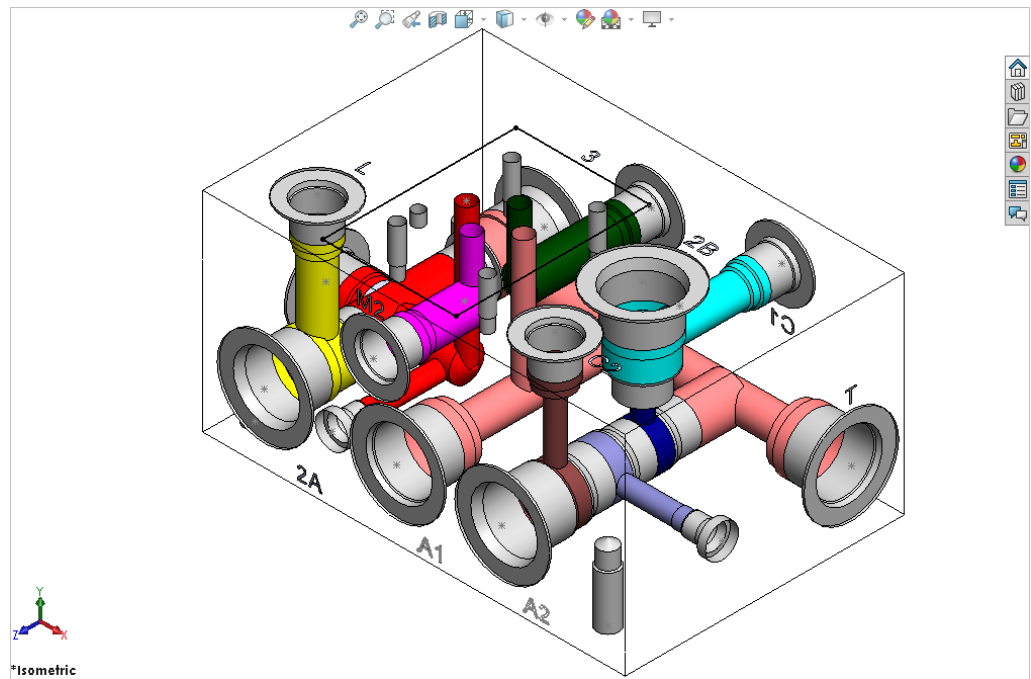
MDTools® shades all the cavities on the manifold.

Note:

You can terminate the Recolor Cavities command by pressing the Esc key.



Recolor Cavities



Cavities shaded automatically with their net colors

61. Remove Color

Remove the shading of cavities on the manifold.

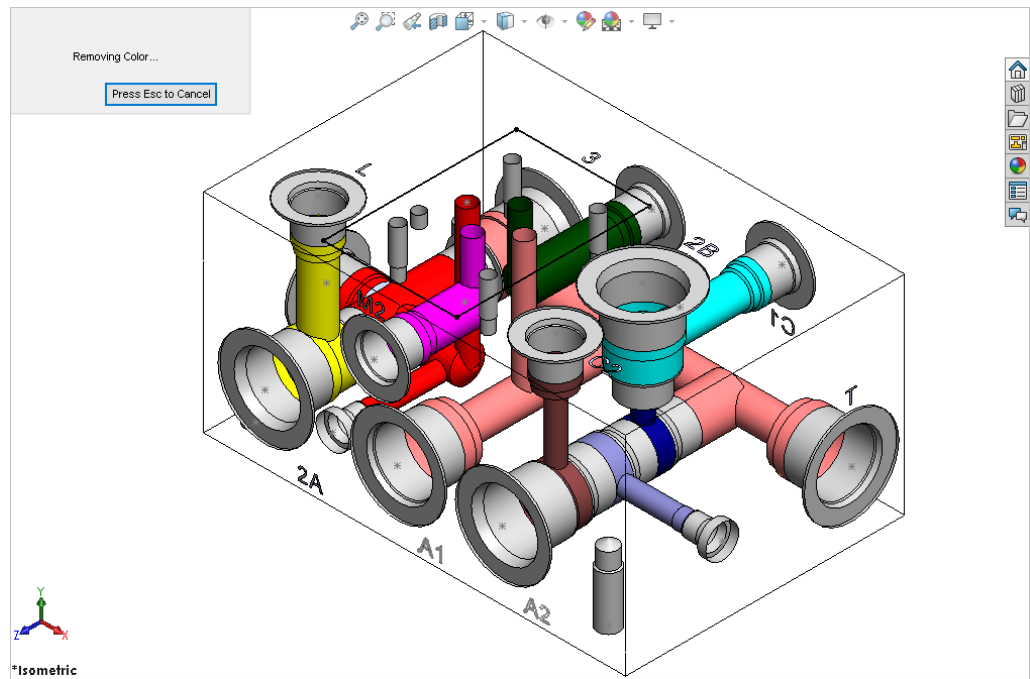
Removing Cavity Shading

MDTools 960

> Recolor Cavities

> **Remove Color**

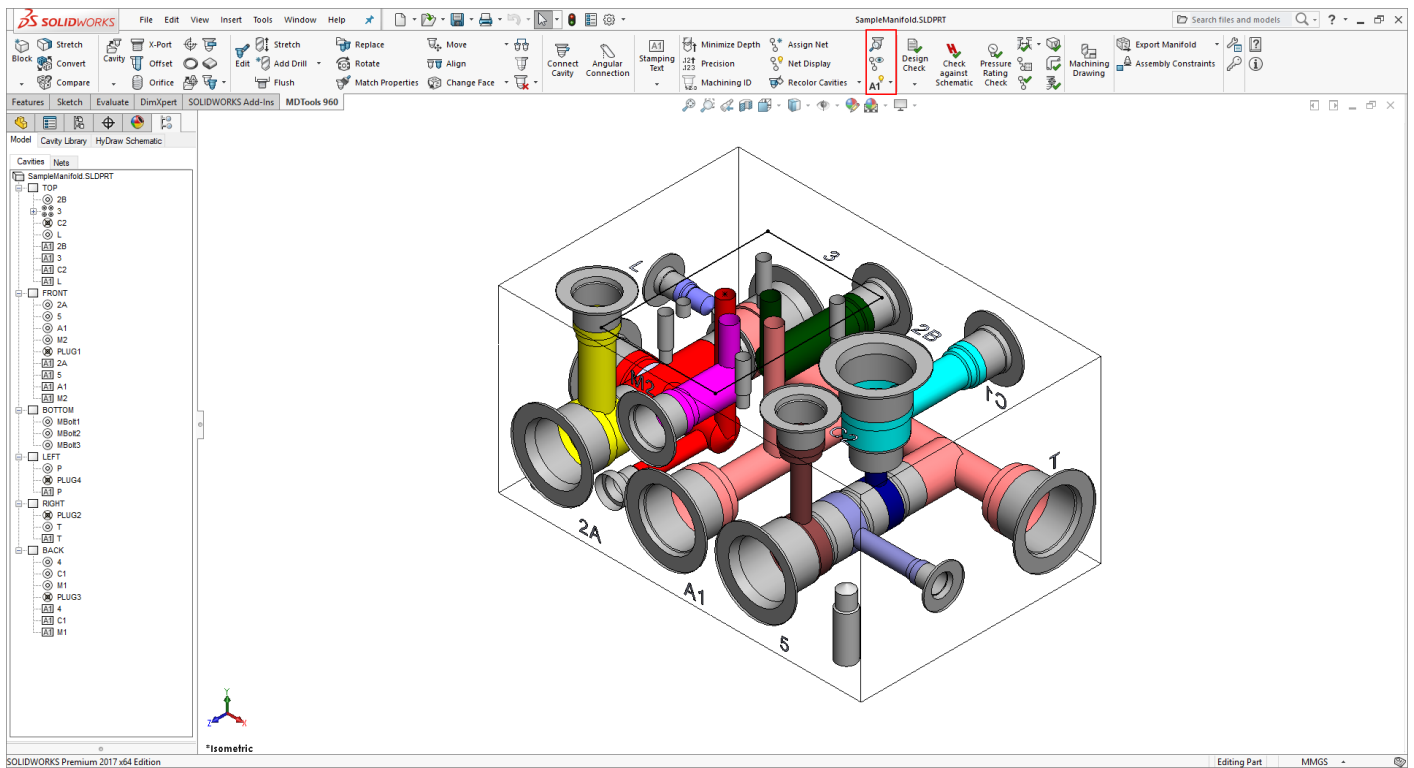
MDTools removes the shading of all the cavities on the manifold.



Remove color of the Cavities

Display Options

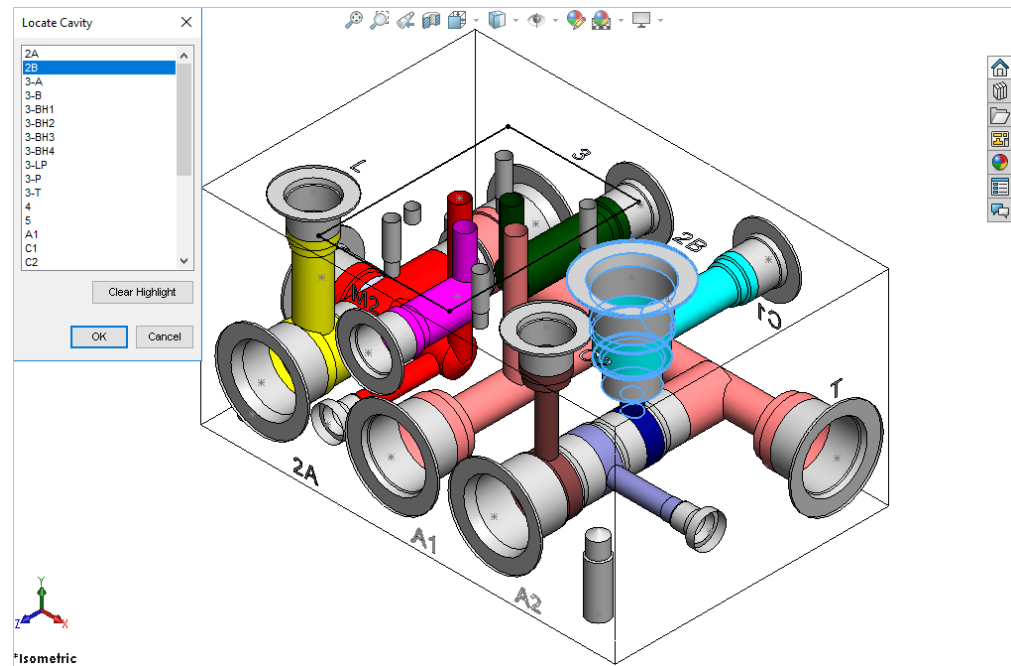
- 62 Locate Cavity
- 63 View a Net
- 64 Display Cavity ID
- 65 Display Cavity Center
- 66 Display Envelope/Outline



62. Locate Cavity

Easily locate cavities inside the model by selecting the cavities from the list.

1. MDTools 960
> **Locate Cavity**
The Locate Cavity dialog box displays with the list of cavities in the manifold.
2. Select the cavity name in the list.
MDTools® highlights the selected cavity.
3. Select the next cavity you want to locate.
MDTools highlights the selected cavity.
4. Click **Clear Highlight** to clear the highlighted cavities.
5. Click **OK**.



Locate Cavity dialog box

63. View a Net

Locate a position or an area on a selected manifold face where a cavity can be placed to connect with a selected net.
MDTools® displays the cavities/ports in the selected net in green and all other cavities/ports in the Dead Area color.

1. MDTools 960
> **View a Net**
The *View a Net* dialog box displays with the list of nets in the manifold.
2. Select the net from the Net name list.
MDTools displays the area in the selected net in green, and all other nets and dead areas of cavities in the default color for Dead Area.

The default color for Dead Area can be changed through, MDTools Settings > **Net Display**.
3. Select a **face**.
4. Click the face where you want to place a cavity to connect with the selected net.
MDTools displays the selected manifold face parallel to the screen.

Note:

Use the *Rotate* button to rotate the block.

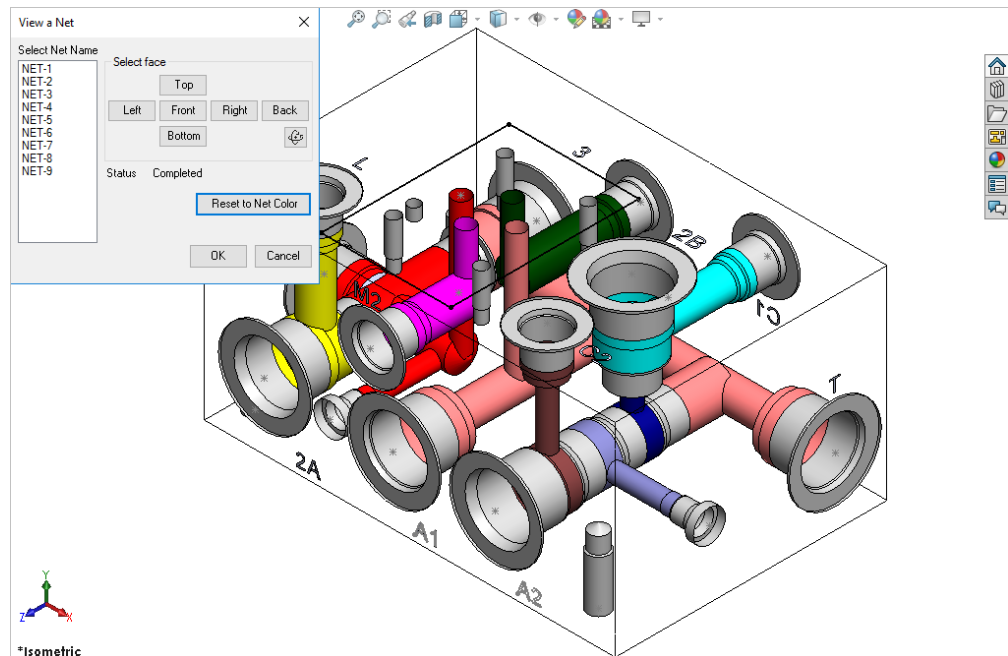
Reset to the Net Color

Click the **Reset to Net Color** button to revert to your default color setting for nets.

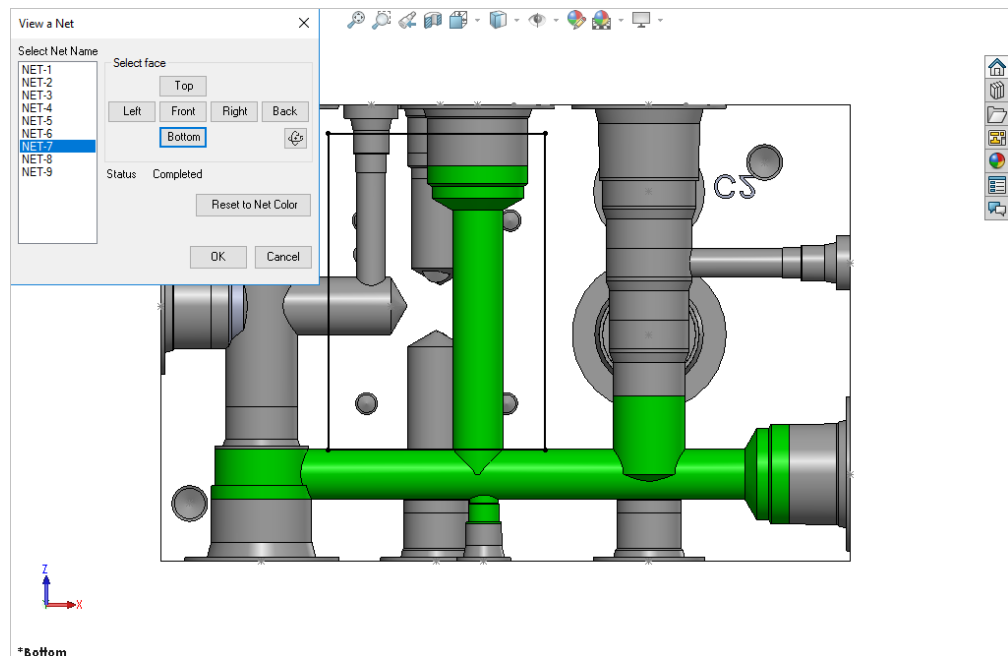
MDTools resets the display to the default net colors automatically.

Note:

Default colors are the colors assigned to the nets in MDTools Options or in Net Display.



View a Net dialog box

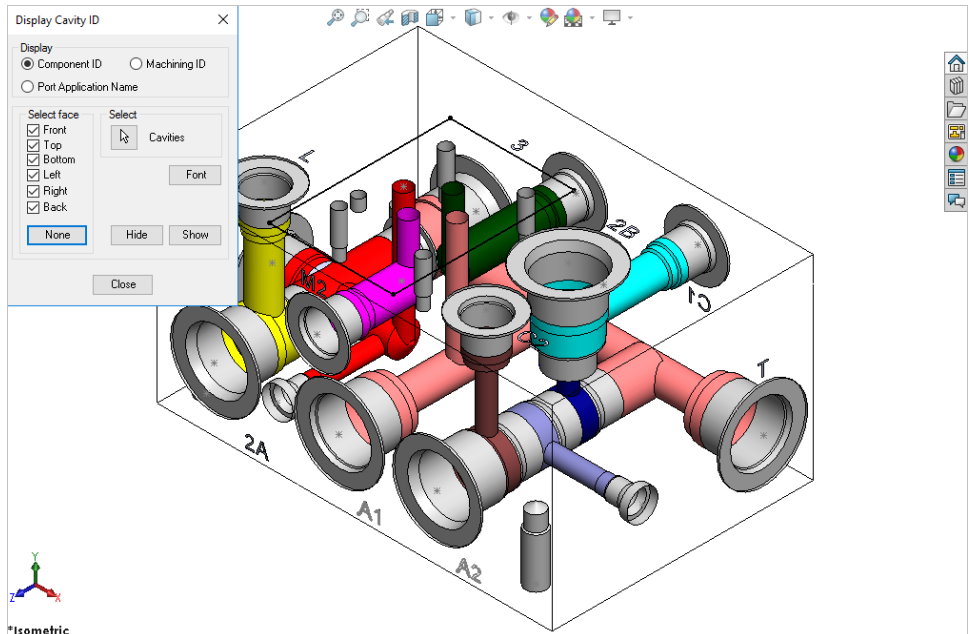


Areas in the selected net displayed in green

64. Display Cavity ID

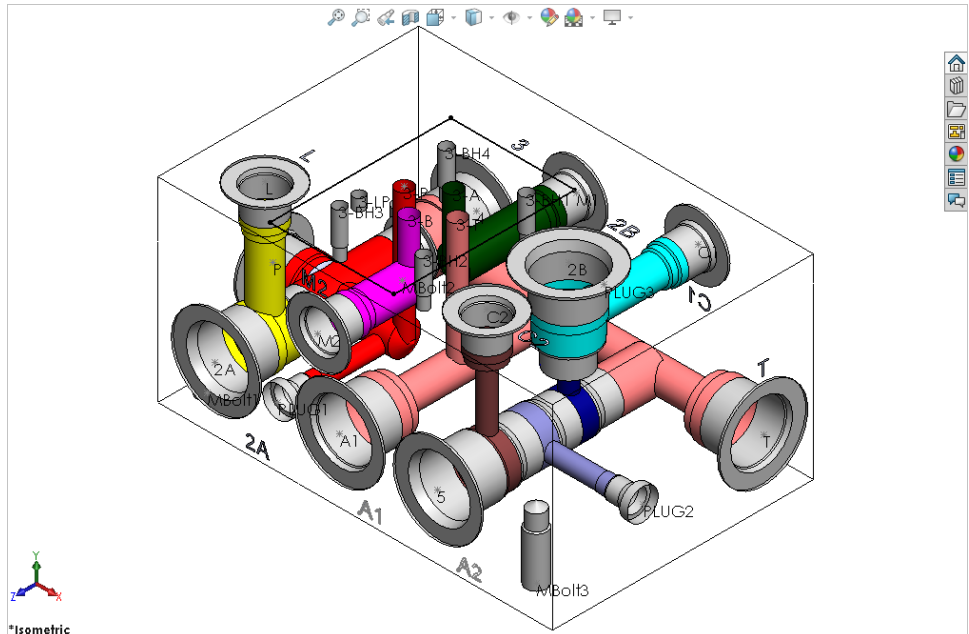
Display the cavity ID at the center of a cavity. This enables you to easily identify the cavity on the manifold. You can show or hide cavity IDs of cavities on selected faces or the cavity ID of a selected cavity.

1. MDTools 960
 > **Cavity ID**
 The *Display Cavity ID dialog box* displays.
2. Select the **display** option.
 Component ID is selected by default.
3. Select the faces.
 Front and Top faces are selected by default.
 Select the All option to display the cavity IDs of all the cavities on the manifold.
4. Select the **Show** or **Hide** option.
 The Show option is selected by default. Select the Hide option to hide the cavity ID.



Display Cavity ID dialog box

5. Click **Font** to change the font style.
 The *Font dialog box* displays with default styles.
- | | |
|-------|---------|
| Font | Arial |
| Style | Regular |
| Size | 16 |
| Color | Black |
6. Change the font properties, if required.
 7. Click **OK**.
 MDTools® displays the cavity ID on the cavity center.



Cavity ID displayed at the center of cavities

Show/Hide Single Cavity ID

1. Click the Cavity selection.
2. Select the cavity.
 MDTools displays the cavity ID on the cavity center.

Note:
 The cavity ID is always displayed parallel to the screen.

65. Display Cavity Center

Change the visibility of the cavity center points.

MDTools 960

> Cavity ID

> Cavity Center

To Hide a Cavity Center

1. Select the **Hide** option.
2. Click **OK**.
MDTools® makes the cavity center points invisible.

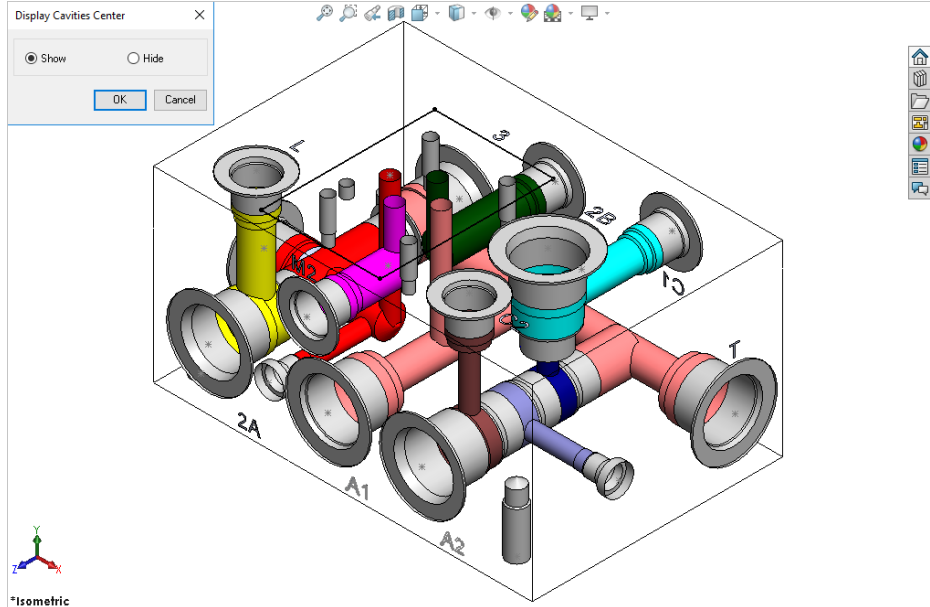
To Show a Cavity Center

1. Select the **Show** option.
2. Click **OK**.
MDTools makes the cavity center points visible.

Note:

When you hide or show the cavity center points, MDTools hides or shows all the cavity center points.

If you want to hide or show the center point of a single cavity, then you need to do it manually.



Show / Hide Cavities Center dialog box

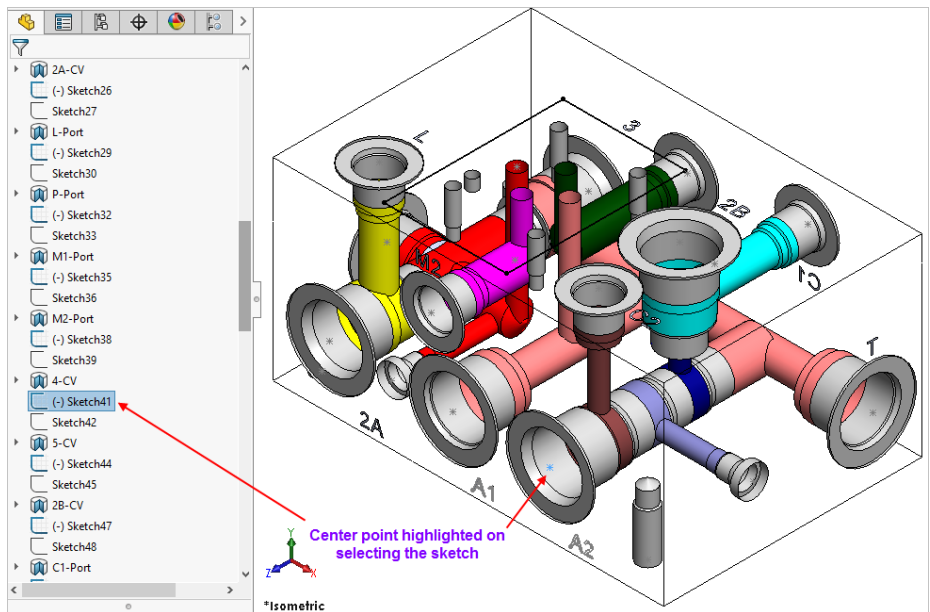
Show/Hide Center Point Manually

The visibility of a cavity center point is controlled by the visibility of the sketch containing the cavity center point.

1. Select the sketch containing the center point from the SolidWorks browser.
When you select the sketch, the center point is highlighted.
2. Right-click the selected sketch.
3. Select **Hide/Show** from the context menu.
If the center point is visible, then it becomes invisible, if it is invisible, then it becomes visible.

Note:

- The cavity center point is inside the second unconsumed sketch above the revolve feature of the cavity.
- The name of the revolve feature is the Cavity ID-Cavity Port application name, so you can easily identify the revolve feature for a particular cavity.



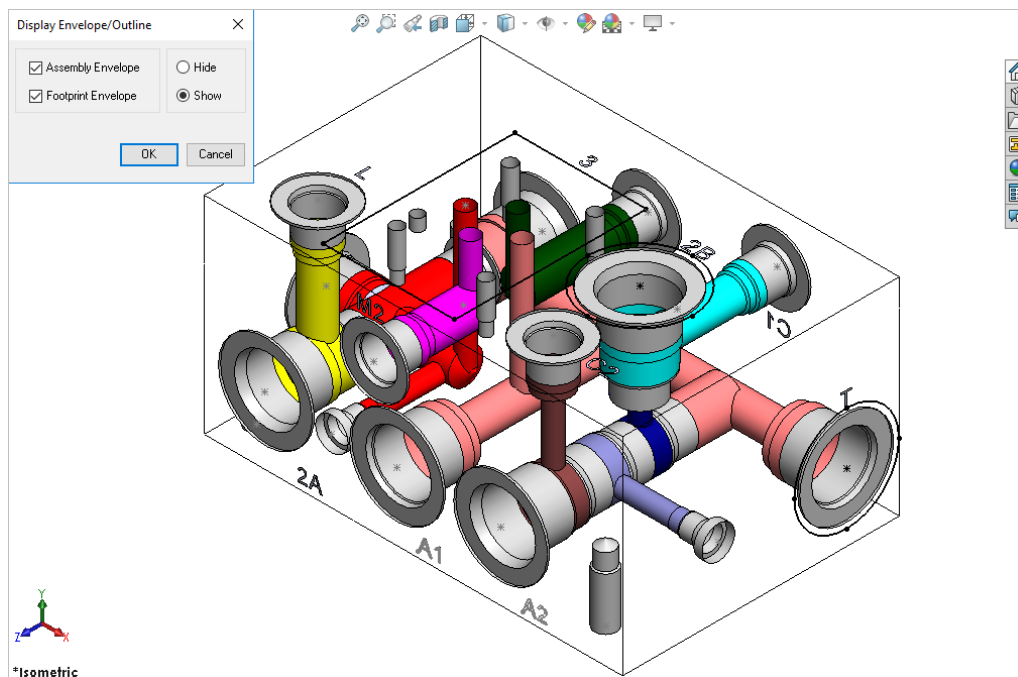
Controlling the visibility manually

66. Display Envelope/Outline

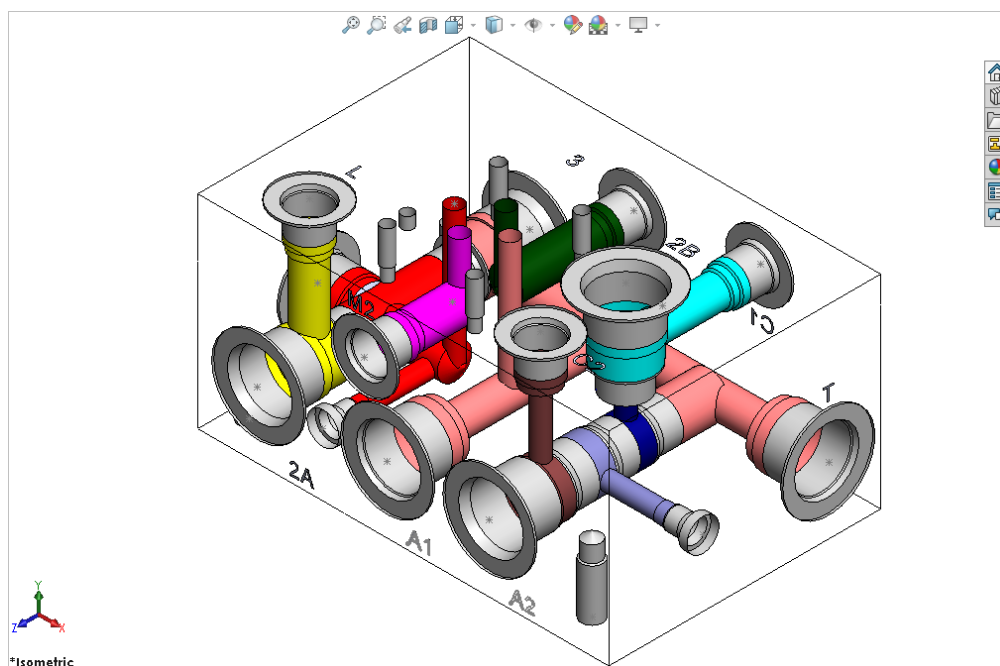
Toggle the visibility of component outlines and footprint envelopes on the manifold.

1. MDTTools 960
> Cavity ID
> **Envelope/Outline**
The Display Envelope/Outline dialog box displays.
2. Select the Envelope type.
Both the Assembly Envelope and Footprint Envelope options are selected by default.
3. Select the display option.
To turn the visibility 'off', select the Hide option. Else, select the Show option

Show is the default state.
4. Click **OK**.
If the Hide option is selected, then MDTTools® turns the visibility of the entire selected envelope types on the manifold to 'off', else all the envelopes are visible.



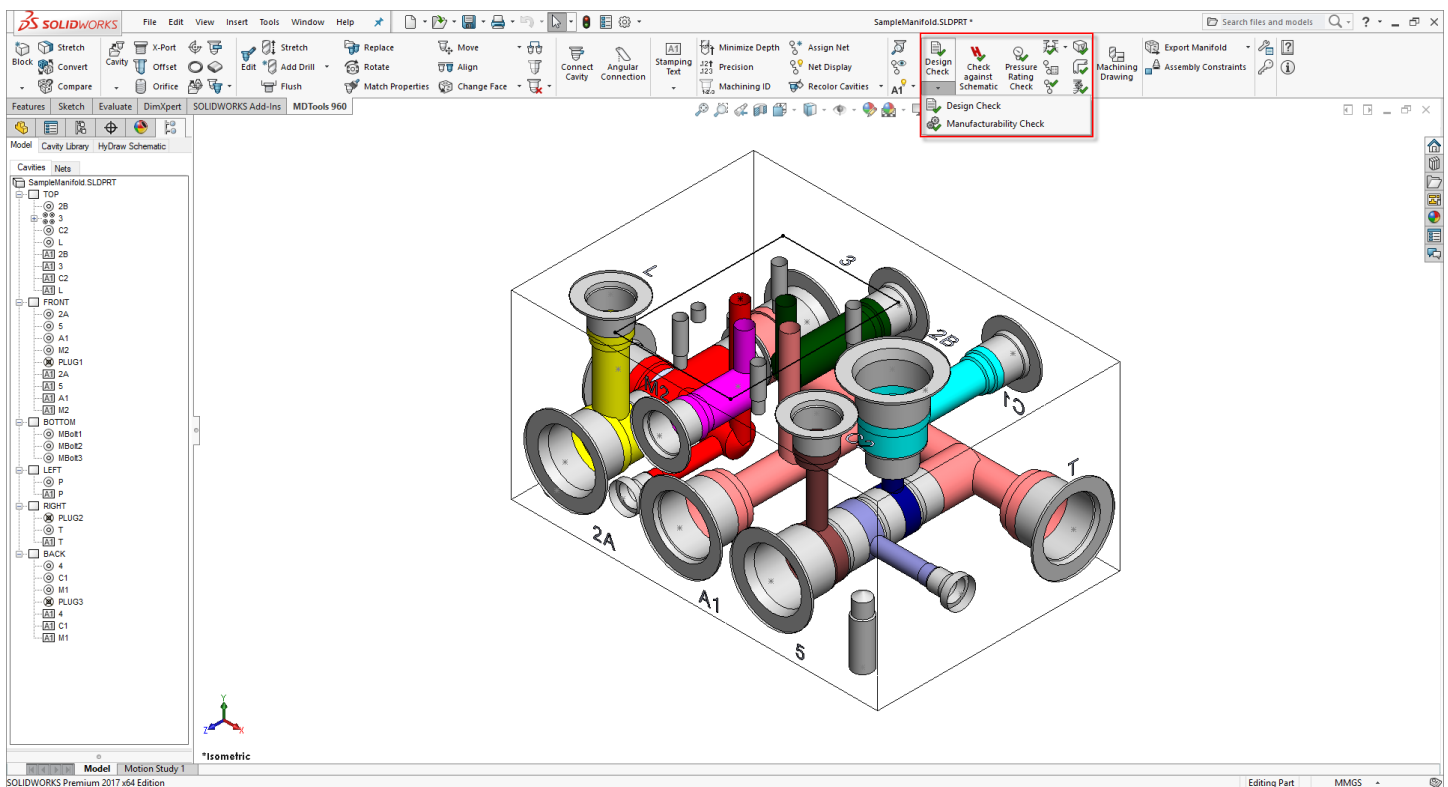
Display Envelope/Outline dialog box



Visibility of envelopes switched off

Design Check

- 67 Design Check
- 68 Check Manufacturability
- 69 Check Conformance to schematic
- 70 Pressure Rating Check
- 71 Check Wall Thickness
- 72 Measure Wall Thickness
- 73 Connection Check
- 74 Create Meet List
- 75 Check Velocity in Block
- 76 Check Bend
- 77 Check Connection for Offset



67. Design Check

Perform connection and wall thickness checks and automatically creates a detailed design report.

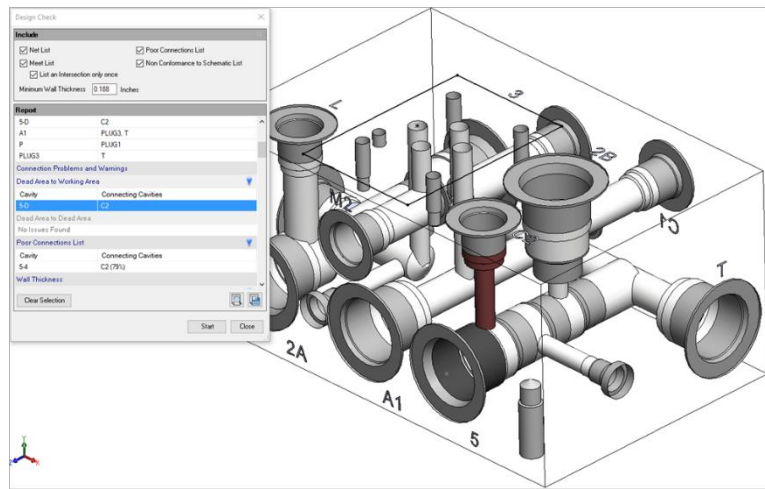
The design check report will contain the following information: -

- Connection checklist
- Quality of connection
- Interference between working area of one cavity and dead area of another cavity
- Interference between dead area of one cavity and dead area of another cavity
- Unconnected cavities/ports of cavities
- Wall thickness checklist
- Design Net list
- Connectivity Net list
- Net comparison list
- Broken nets
- Wrong connection inside manifold
- Conformance to Schematic check list

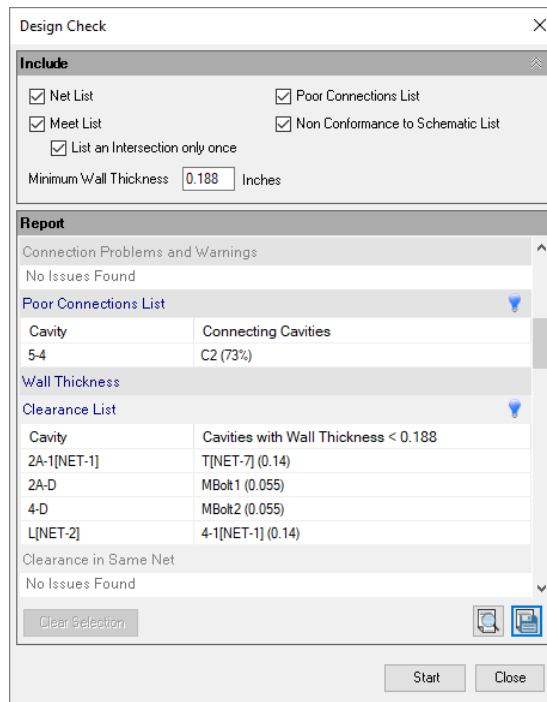
1. MDTools 960
 - > **Design Check**

The Design Check dialog box displays.
2. Select the **Net list** option to include three sections in the report.
 - Design Net list
 - Connectivity Net list
 - Net list comparison
3. Select the **Meet List** option to include the Meet List section in the report.

'List an intersection only once' is part of the Meet List option. If this option is selected, MDTools® removes the repetitive information from the Meet List section.
4. Select **Poor Connection** to include the Poor Connection section in the report.
5. Select the **Conformance to schematic** option to view alerts in the report:
 - Missing Component and ports.
 - Extra Component and ports.
 - Wrong Cavities.
 - Non-Preferred Construction ports.
 - Cavities on Non-Preferred face.
 - Wrong Net Name.
 - Wrong Port Type.
 - Wrong Flow.
6. Enter the minimum wall thickness required.



Display issue between Dead Area to Working Area

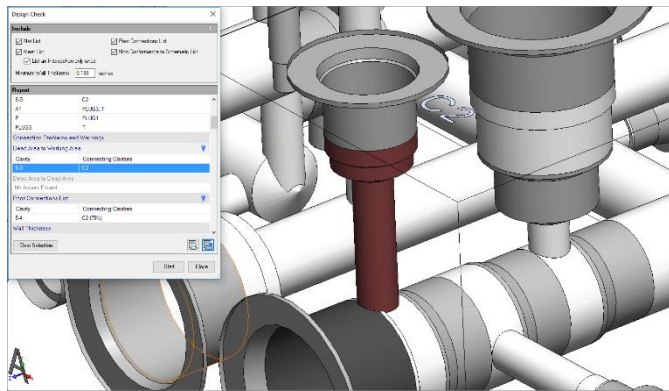


Design Check dialog box

The default minimum wall thickness is displayed according to the settings.

MDTools® checks the wall thickness and connectivity inside the manifold and creates a detailed design check report.

All the cavities in the manifold are grayed out.





Zooms the issue on double click.

7. Select a row,
8. Right click on row selection and then select the Show Selected Nets option to highlight issues for Design Net list and Connectivity Net list section.

Similarly compare Net list.


9. Double click on row selection to zoom into the issues.
 - MDTools automatically zooms into the problem area for the Wall thickness section.
 - MDTools automatically zooms into cavities for the Meet list section.
 - MDTools automatically zooms into the Design net section.

10. Click  to highlight the particular section issues.

11. Click  to hide the particular section issues.

12. Click on the **Clear Selection** option to clear the highlighted issues.

You can view and print the report

in a text file by clicking  option.

13. Click  to save the list.

The Save As dialog box displays.

14. Enter an appropriate file name.

CAUTION!

The Undercuts and Slots are not considered in the Design report.

Note:

- Selecting 'Highlight Design Errors' in MDTools Options > Misc. enables automatic zoom into the Error section of the design.
- Sections with no issues are grayed out.
- MDTools® displays darker shades of gray to show dead area of cavities in order to highlight the cavities.
- MDTools displays actual port net color of cavities in order to highlight the cavities.
- On closing the Design Check dialog, MDTools restores cavity color and cavity center points.

MDTools 900 Series Design Check Report

Drawing Name: C:\VEST\MDTools 960\SampleManifold.SLDPRT
Date/Time: 04-05-2017 11:29:39
Revision:

Meet List

Cavity	Connecting Cavities
2A-1	4-1, P
2A-2	L
2B-1	5-2
2B-2	C1
3-A	M1
3-B	M2
3-P	P, PLUG1
3-T	A1
4-1	P
4-2	T
5-1	T
5-3	PLUG2
5-4	C2
A1	PLUG3, T
P	PLUG1
PLUG3	T

Connection Problems and Warnings

No Issues Found

Poor Connections

Cavity	Connecting Cavities
5-4	C2 (73%)
4-2	T (30%)
3-P	PLUG1 (28%)

Wall Thickness

Clearance List

Cavity	Cavities with Wall Thickness < 0.188
4-1[NET1]	L[NET5] (0.14)
MBolt1	2A-D (0.055)
MBolt2	4-D (0.055)
T[NET7]	2A-1[NET1] (0.14)

Clearance with Spot face

Cavity	Cavities with Wall Thickness < 0.188
A1-D	PLUG1-D (0.117)
PLUG1-D	2A-D (0.137)

Clearance with Manifold face

MBolt1-D	Left Face (0.094)
MBolt2-D	Left Face (0.094)

Net List

Design Net List

NET1	2A-1, 3-P, 4-1, P, PLUG1
NET2	3-A, M1
NET3	2B-1, 5-2

NET4	2B-2, C1
NET5	2A-2, L
NET6	3-B, M2
NET7	3-T, 4-2, 5-1, A1, PLUG3, T
NET8	5-3, PLUG2
NET9	5-4, C2

Connectivity Net List

Net-1	5-3, PLUG2
Net-2	3-T, 4-2, 5-1, A1, PLUG3, T
Net-3	2A-1, 3-P, 4-1, P, PLUG1
Net-4	5-4, C2
Net-5	2B-2, C1
Net-6	2B-1, 5-2
Net-7	3-B, M2
Net-8	3-A, M1
Net-9	2A-2, L

Net List Comparison

Net Name :	NET1
Design Net List :	2A-1, 3-P, 4-1, P, PLUG1
Connectivity Net List :	2A-1, 3-P, 4-1, P, PLUG1

Net Name :	NET2
Design Net List :	3-A, M1
Connectivity Net List :	3-A, M1

Net Name :	NET3
Design Net List :	2B-1, 5-2
Connectivity Net List :	2B-1, 5-2

Net Name :	NET4
Design Net List :	2B-2, C1
Connectivity Net List :	2B-2, C1

Net Name :	NET5
Design Net List :	2A-2, L
Connectivity Net List :	2A-2, L

Net Name :	NET6
Design Net List :	3-B, M2
Connectivity Net List :	3-B, M2

Net Name :	NET7
Design Net List :	3-T, 4-2, 5-1, A1, PLUG3, T
Connectivity Net List :	3-T, 4-2, 5-1, A1, PLUG3, T

Net Name :	NET8
Design Net List :	5-3, PLUG2
Connectivity Net List :	5-3, PLUG2

Net Name :	NET9
Design Net List :	5-4, C2
Connectivity Net List :	5-4, C2

Wrong Connections

No Issues Found

Error in Nets

No Issues Found

Missing Components and Ports

Component ID	Cavity Name
MBolt1	5/16"-18 UNC
MBolt2	5/16"-18 UNC
MBolt3	5/16"-18 UNC

Extra Components and Ports

No Issues Found

Wrong Cavity

No Issues Found

Non-Preferred Construction Ports

No Issues Found

Cavities on Non-Preferred Face

No Issues Found

Wrong Net Name

Cavities/Ports	Net Name in Model	Net Name in Schematic
2A-2	NET5	NET2
3-A	NET2	NET5
L	NET5	NET2
M1	NET2	NET5

Wrong Flow

No Issues Found

Wrong Port Type

No Issues Found

68. Check Manufacturability

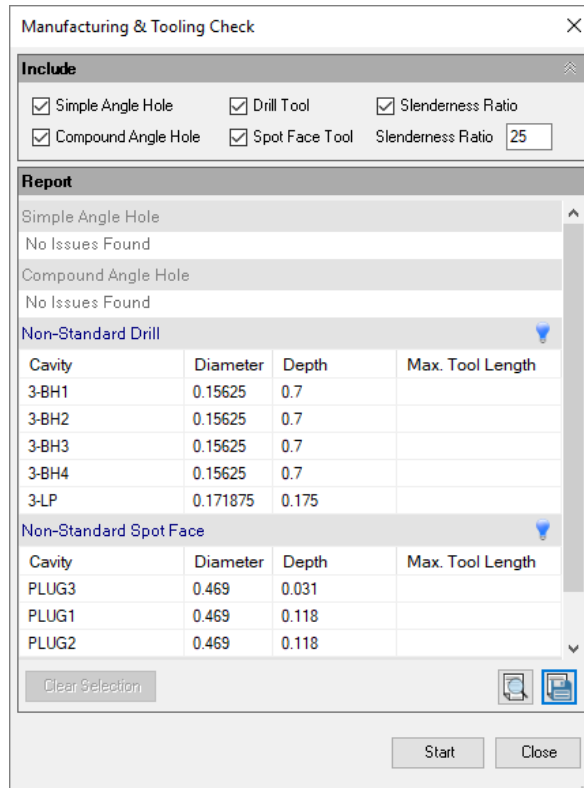
Check the design for manufacturing and tooling limitations.
This feature enables you to check the manifold for:

- Angle holes
- Compound angle holes
- Non-standard drills
- Non-standard spot faces
- Drills with slenderness ratio more than a specified value

1. MDTools 960
> Design Check
> **Check Manufacturability**
The Check Manufacturability dialog box displays.
2. Select the parameters you want to check.
3. Enter the slenderness ratio.
The default slenderness ratio value is 25.
4. Click **Start** Manuf. & Tooling Check.
MDTools® checks the manifold design for selected parameters, and lists the cavities deviating from the rule in the dialog box.

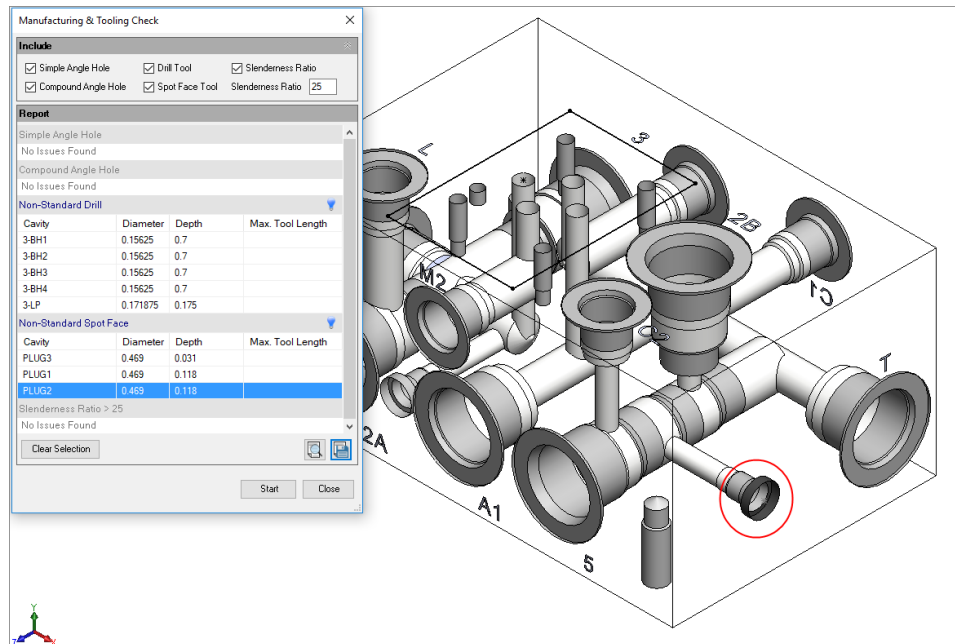
All the cavities in the manifold are grayed out.

5. Select a row, MDTools highlights the specified issues
6. Double click on row selection to zoom into the issues.
MDTools automatically zooms into the cavity.



Check Manufacturability dialog box

7. Click to highlight the particular sections issues.
8. Click to hide the particular sections issues.
9. Click on the **Clear Selection** option to clear the highlighted issues.
10. Click button to save the list.
The Save As dialog box displays.
11. Enter an appropriate file name.
12. Click **Save**.
You can also view and print the report in a text file by clicking button.



Displays Non-Standard Spot Face issue on single click





Note:

- If the drill diameter is not available in the Drill Tool database, then MDTools® considers the drill as a non-standard drill.
- If the drill depth is greater than the maximum tool depth in the database, then MDTools considers the drill as a non-standard drill.
- If only Step0 is present in the cavity, then Step0 is considered as drill, else, Step12 in the cavity is considered as drill.
- If drill diameter exists in tool library and drill depth is greater than the available drill depth for that diameter in tool library, then **Maximum tool length in Non-Standard drill section** shows the maximum tool length value.
- If the spot face diameter is not available in the Spot Face Tool database, then MDTools considers the spot face as a non-standard spot face.
- If the spot face depth is greater than the maximum spot face tool depth in the database, then MDTools considers the spot face as a non-standard spot face.
- Step0 of ports and cartridge valve cavities is considered as Spot Face.
- If Spot face diameter exists in the tool library and Spot face depth is greater than the available spot face depth for that diameter in tool library, then **Maximum tool length in Non-Standard spot Face section** shows that maximum tool length value.

69. Check Pressure Rating

Check the pressure rating of all construction ports (including SAE flanges used as construction ports).

1. MDTools 960
 > **Pressure Rating**
The Pressure Rating Check dialog box displays.
2. Click **Start**.
MDTools® lists all the construction ports which have lower pressure rating than the net operating pressure of their respective nets.
 - All the cavities in manifold are grayed out.
3. Select a row, MDTools highlights the specified issues.
4. Double click row selection to zoom into the issue.
MDTools automatically zooms into the cavities for X-ports below net operating pressure and ports without rated pressure section.

MDTools automatically zooms into the nets for Nets without operating pressure section.
5. Click  to highlight particular sections issues.
6. Click  to hide particular sections issues.
7. Click Clear Selection option to clear the highlighted issues.
8. Click  to view and print the report in a text file.
9. Click  to save the list.
The Save As dialog box displays.

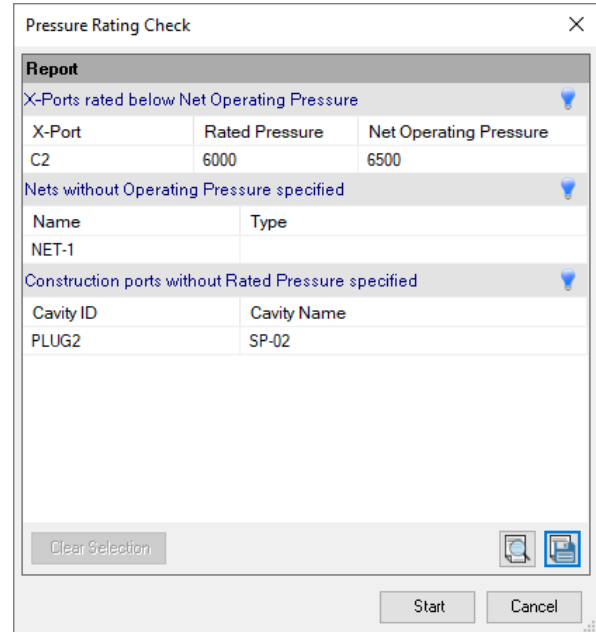
Report:

Check Pressure Rating report contains three sections.

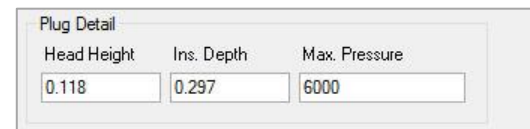
1. **X-Ports rated below Net Operating Pressure:**
 Lists all construction ports that have lower rated pressure than Net operating pressure.
2. **Nets without Operating Pressure specified:**
 Lists all the nets that do not have Operating pressure value or the value is 0.
3. **Construction ports without Rated Pressure specified:** Lists all the construction ports which do not have the pressure value or the value is 0.

Note:

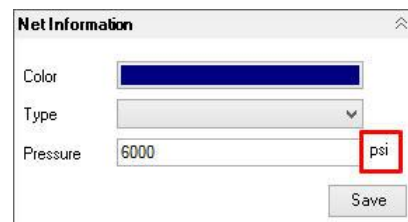
- If you have not specified, the unit in the Max. Pressure section of Plug Detail in the Edit All cavity parameter dialog box, then MDTools takes default unit from the unit specified in the Net information section in the Cavity Browser > Net Information section.
- If the unit is also specified with value in the Max. Pressure section of the Plug Detail and the unit is different to the unit defined in the Cavity Browser > Net information section, then MDTools converts the value to the current unit (specified in the Cavity Browser Net tab) to compare pressure values.
- If Design Unit in MDTools Options is Inch, then the default Pressure unit is “psi”.
- If Design Unit in MDTools Options is Millimeter, then the default Pressure unit is “bar”.



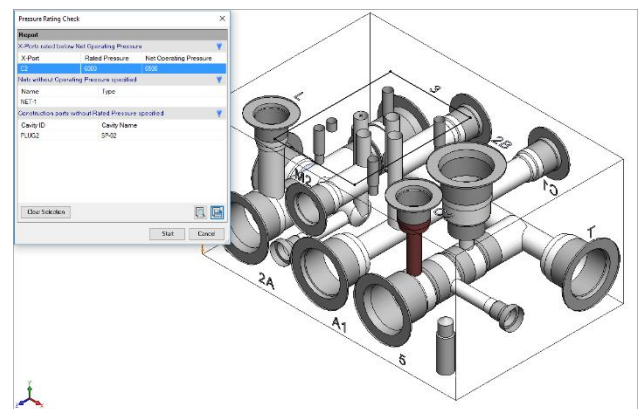
The Pressure Rating Check dialog box



Plug Detail in Edit All cavity parameter



Net Information on Nets Browser



Displays X-Ports rated below Net Operating Pressure issue on single click

70. Check Conformance to Schematic

Check the manifold design against the HyDraw® schematic.

This feature enables you to check the manifold for:

- Missing component and ports
- Extra component and ports
- Wrong cavity
- Non-preferred construction ports
- Cavities on non-preferred face
- Wrong net name
- Wrong flow
- Wrong port type

1. MDTools 960
2. Check Conformance to Schematic



The *Check against Schematic* dialog box displays.


3. Click **Start** for conformance check. MDTools® checks the manifold design against the HyDraw schematic.

All the cavities in the manifold are grayed out.

4. Select a row, MDTools highlights the specified issues.
5. Double click on row selection to zoom into the issues.

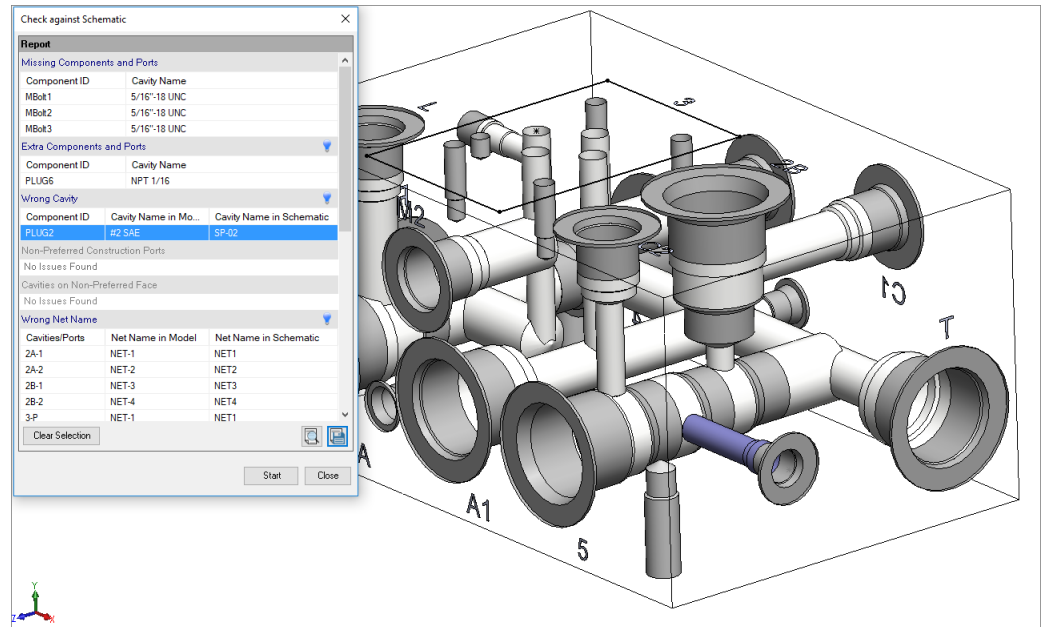
MDTools automatically zooms into the cavity for every section.

6. Click  to highlight the particular section issues.
7. Click  to hide particular section issues.
8. Click **Clear Selection** option to clear the highlighted issues.

9. Click  button to save the list. The *Save As* dialog box displays.

10. Enter an appropriate file name.
11. Click **Save**. You can also view and print the report in a text file by clicking

 button.



Displays Wrong Cavity issue on single click

Report Contains the following sections:

Missing Components and Ports section

Lists components and ports not inserted in the design or deleted from the design.

Extra Components and Ports section

Lists any additional components and ports inserted in the design which is not specified in the Schematic.

Wrong Cavity section

Lists wrong (different cavity name) cavities used in the design.

Cavities on Non-Preferred Face section

Lists cavities placed on a face that is not preferred in schematic interface.

Non-Preferred Construction Ports section

Lists non-preferred construction ports that is not listed in schematic interface but used in the design.

Wrong Net Name section

Lists cavities and ports which has net name different than that specified in the schematic.

Wrong Flow section

Lists cavities/ports having different flow than that specified in schematic.

Wrong Port Type section

Lists cavities/ports having different port type than the value specified in schematic.

Note

This command will not validate the mounting hole information.

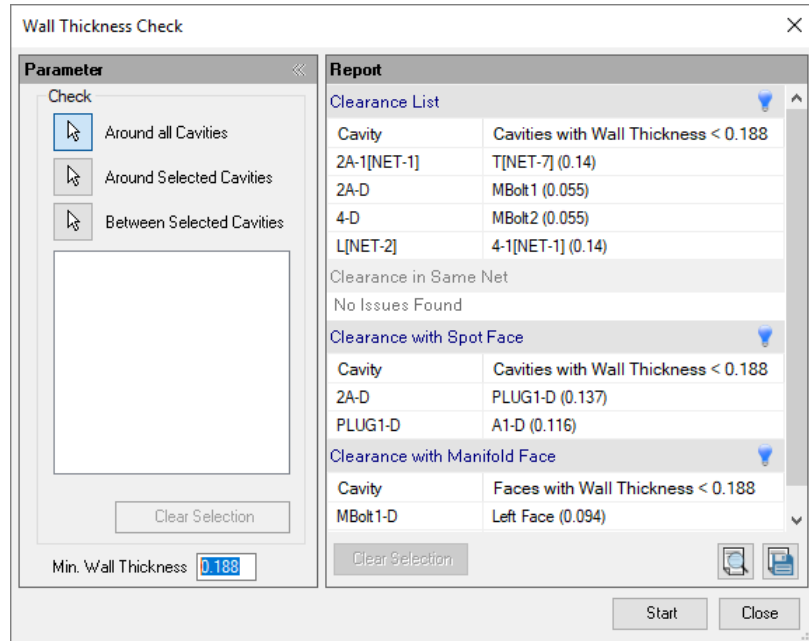
71. Check Wall Thickness

Check the Wall Thickness –Around all cavities, around selected cavities, and between selected cavities.

If the wall thickness between the cavities is less than the minimum required value specified, then wall thickness check will list in parenthesis, the actual wall thickness between the cavities next to the cavity name.

1. MDTools 960
> **Check Wall Thickness**
The Check Wall Thickness dialog box displays.
2. Enter the minimum wall thickness required.
The default minimum wall thickness is displayed according to the value defined in MDTools Options.

Select the required option for the wall thickness check.
3. Check wall thickness as required:
Around all cavities, around selected cavities and/or between selected cavities.
4. Click **Start** Wall Thickness Check.
MDTools® checks the internal wall thickness between cavities and displays the list of cavities with wall thickness less than the specified value.

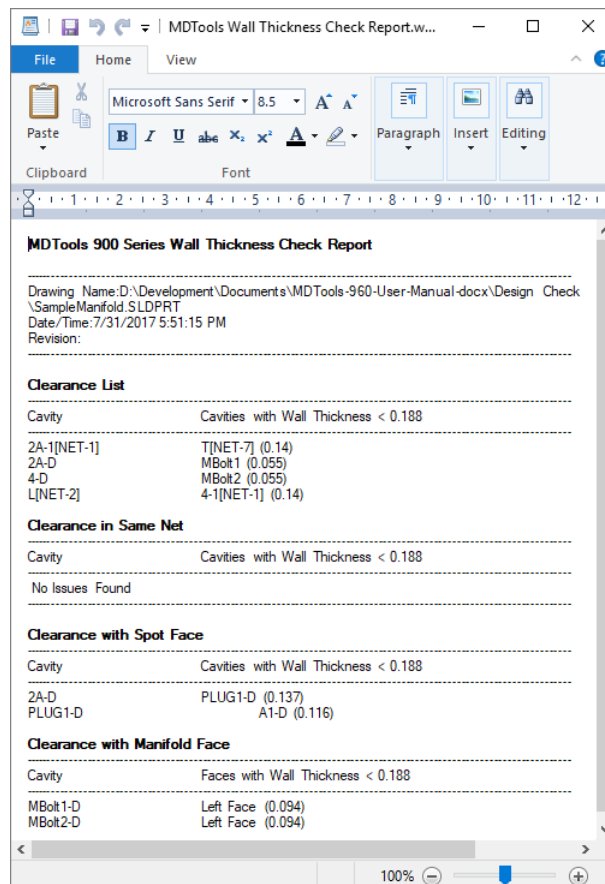


Check Wall Thickness dialog box

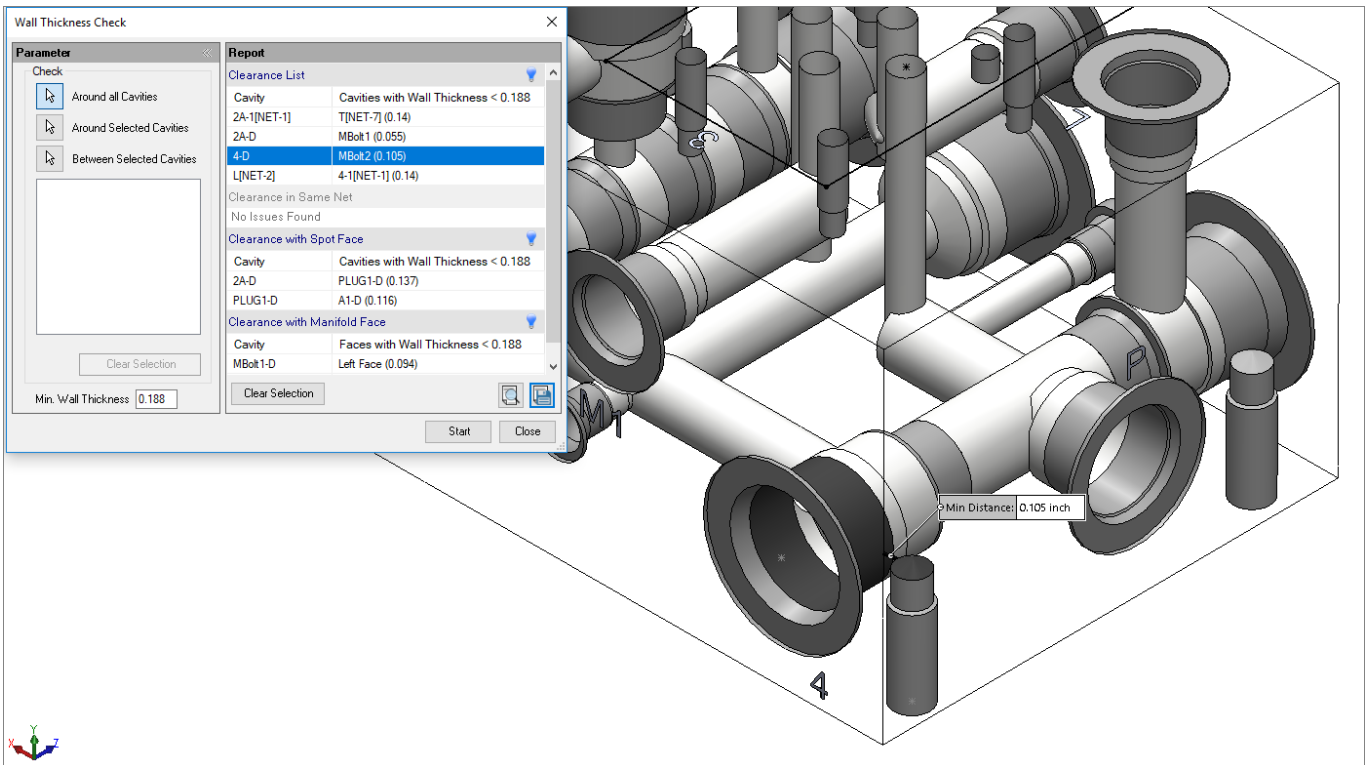
All the cavities in the manifold are grayed out.

5. Select a row.
MDTools highlights the specified issues.
6. Double click on row selection to zoom into the problem areas for each section.
7. Click to highlight particular sections issues.
8. Click to hide particular sections issues.
9. Click on the **Clear Selection** option to clear the highlighted issues.
10. Click button to save the list.
The Save As dialog box displays.
11. Enter an appropriate file name.
12. Click **Save** to save the list.

You can also view and print the report in a text file by clicking button.



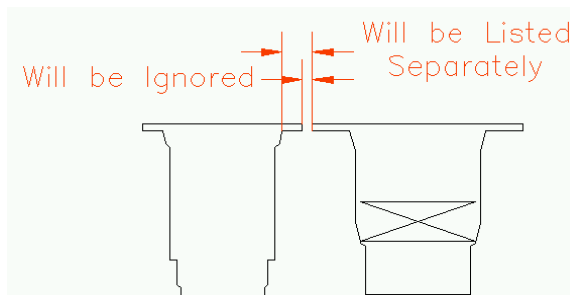
Wall Thickness Check Report



Displays Clearance List issue on single click

Note:

- Wall thickness between spot faces of two cavities is ignored in the wall thickness check.
- Other than the spot face to spot face clearance, clearance problems between the spot face of one cavity and other cavities in the manifold is listed separately.



Wall thickness between spot face

CAUTION!

- MDTools® lists the minimum wall thickness between the cavities.
- If a cavity is listed in the spot face clearance list, then it is possible that the wall thickness between other parts of cavities may also be less than the minimum value specified.
- Make sure that there is enough wall thickness around other parts of cavities before making any decision regarding the clearance issues listed in the spot face clearance list.

72. Measure Wall Thickness

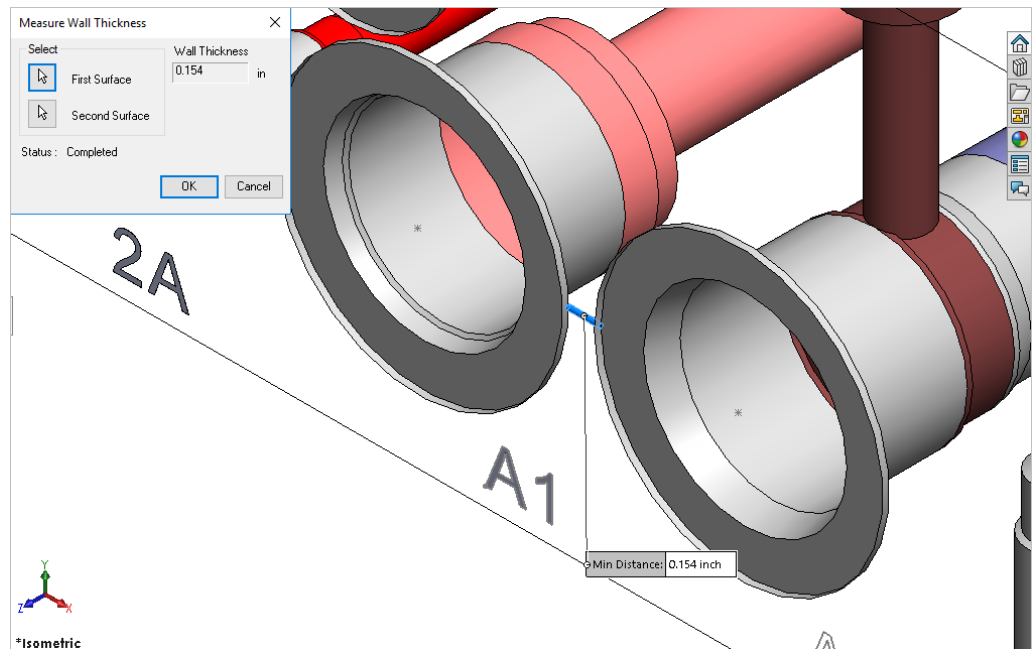
Measure the wall thickness between two cavities or measure the wall thickness between a cavity and a manifold surface.

1. MDTools 960
> Check Wall Thickness
> **Measure Wall Thickness**

The Measure Wall Thickness dialog box displays.

2. Click the **First Surface** button.
3. Select the first surface.
4. Select the second surface.

MDTools® displays the minimum distance between the selected surfaces on the dialog box.



Display of the wall thickness between two surfaces

Note:




- The surfaces selected can be any one of the planar surface, cylindrical surface, or conical surface.
- The command automatically computes the surface type and evaluates distance only if the surface is one of the three surface types.

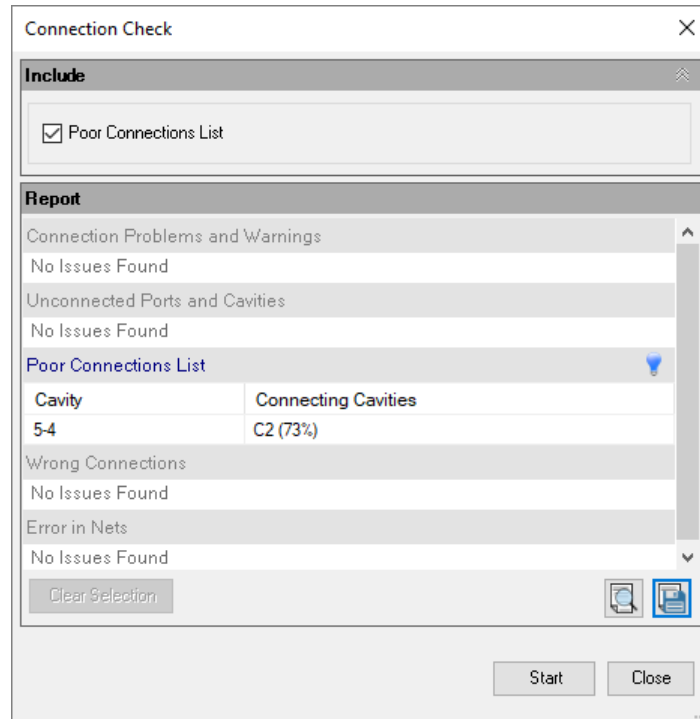
73. Connection Check

The Connection Check feature checks:

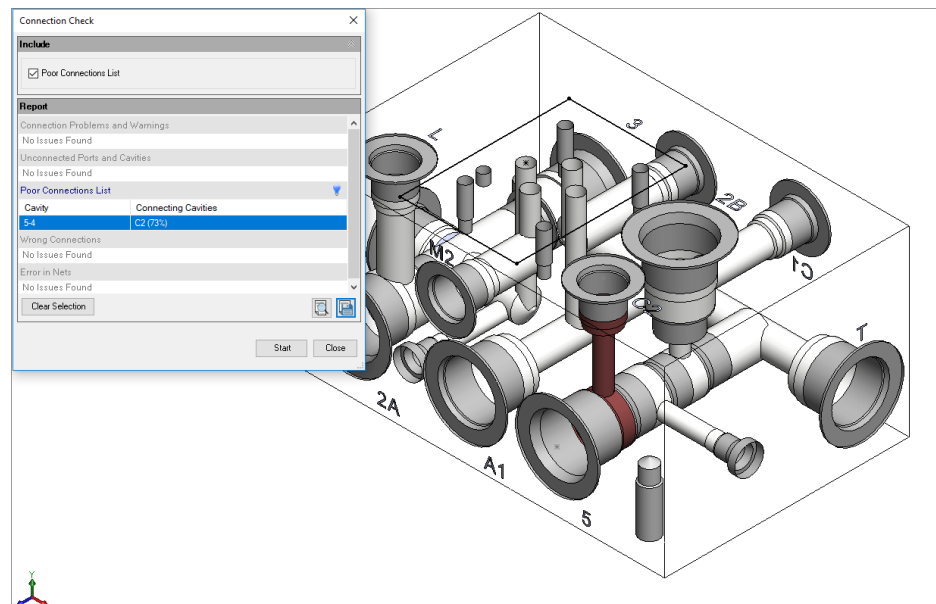
- Interference between working area on one cavity and dead area on another cavity
- Interference between dead area on one cavity and dead area on another cavity
- Unconnected cavities/ports of cavities
- Broken net
- Wrong connection inside a manifold

If the design net name of two connected cavities / cavity ports are different, MDTools® list the connection as a wrong connection, assuming net information in all the cavities are correct.

1. MDTools 960
> **Connection Check**
The Connection Check dialog box displays.
2. Select the **Include Poor Connection** option to add a new section, Poor Connections, in the report.
If the area of the connection is less than the area of the cross-section of smaller diameter hole in the connection, then this connection will be listed in this section with approximate % of intersection area.
3. Click **Start** Connection Check. MDTools checks the manifold for the following design issues: interference between working area or dead area in one or more cavities, unconnected cavities/ports of cavities, broken nets, or wrong connections inside a manifold.
All the cavities in the manifold are grayed out.
4. Select a row, MDTools highlights the specified issues.
5. Double click on row selection to zoom into the issues.
MDTools automatically zooms into the problem area for following sections: **Connection Problems and Warnings, Poor Connection.** Unconnected Ports and Cavities, Wrong Connections and Error in Nets.
6. Click  to highlight particular sections issues.
7. Click  to hide the particular sections issues.
8. Click the **Clear Selection** option to clear the highlighted issues.
9. Click  to save the list.
The Save As dialog box displays.



Connection Check dialog box




Displays Poor Connection List issue on single click

10. Enter an appropriate file name.

11. Click **Save**

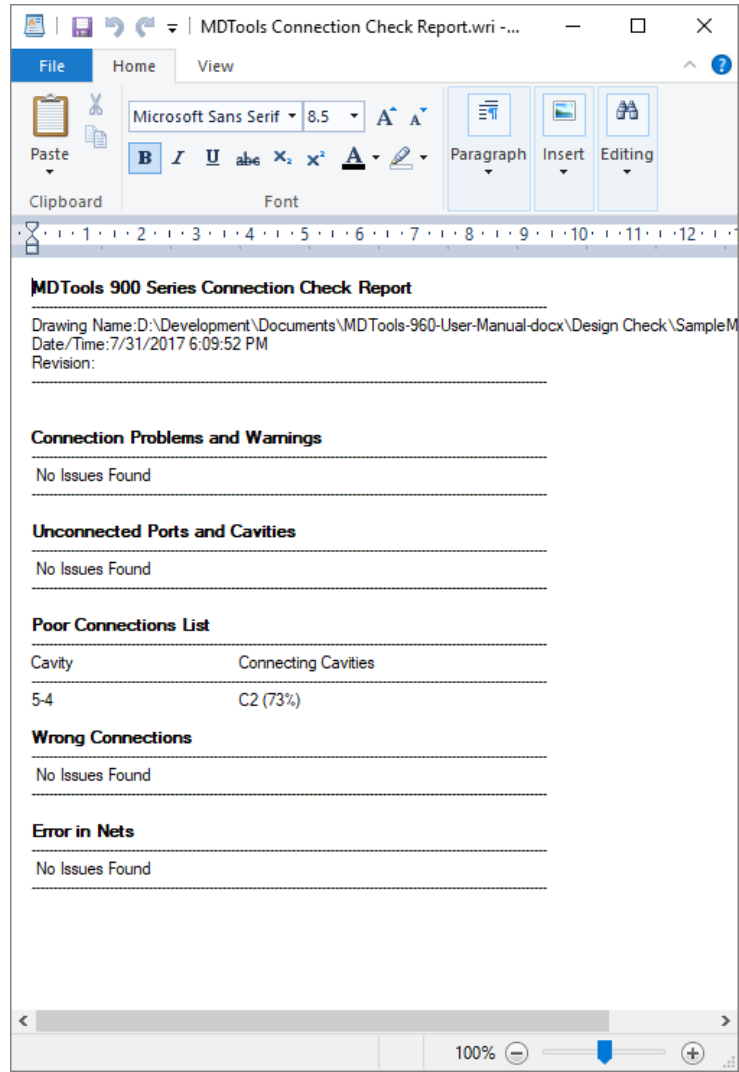
The list is saved

You can also view and print the report

in a text file by clicking 

Note:

- The list of cavities in **wrong connections** indicate that either the net name entered in the cavity is wrong, or the cavities have been incorrectly connected.
- If quick connectivity shows any error, fix the error, and then recheck the manifold.
- Repeat until the report confirms that all errors are resolved.



MDTools Connection Check Report

74. Create Meet List

Check connectivity inside the manifold.

Easily find dead area intersections inside the block. For example, using this feature you can easily locate holes cutting outside the port area of a cartridge valve cavity.

1. MDTools 960
> **Connectivity in Block**
The *Connectivity in Block* dialog box displays.

2. Select **Machining ID** or **Component ID** as the preferred ID display for the cavities.
3. Select the **List an Intersection only once** option to remove the repetitive information from the report.
4. Click **Start** to create the Meet List.


MDTools® checks the internal connectivity and displays the list of connecting cavities.

The Create Meet List dialog box displays.

All the cavities in the manifold are grayed out.

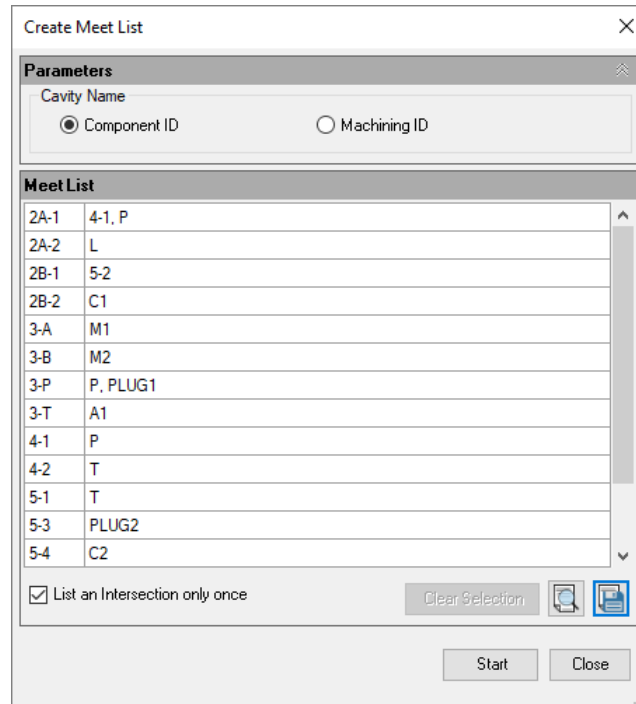
5. Select a row, MDTools highlights the cavity in first column and colored cavity in the other column of specified issues.
6. Double click on row selection to zoom into the issues. *MDTools automatically highlights the problem area for every section.*

7. Click on **Clear Selection** to clear the highlighted issues.

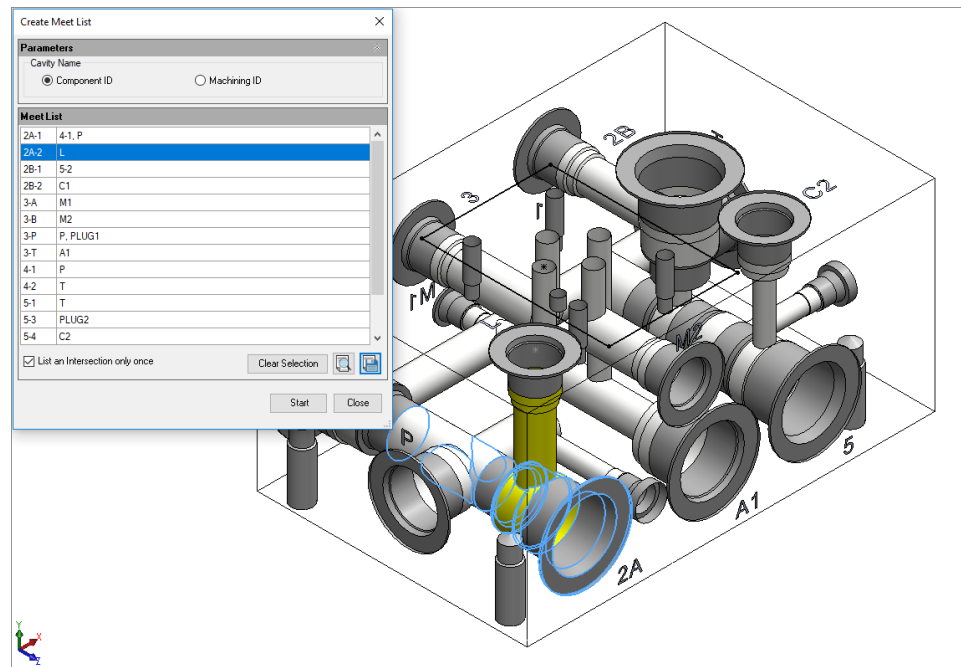
8. Click  to save the list. *The Save As dialog box displays.*

9. Enter an appropriate file name.
10. Click **Save**. *You can also view or print the report in a text file by clicking*

 button.



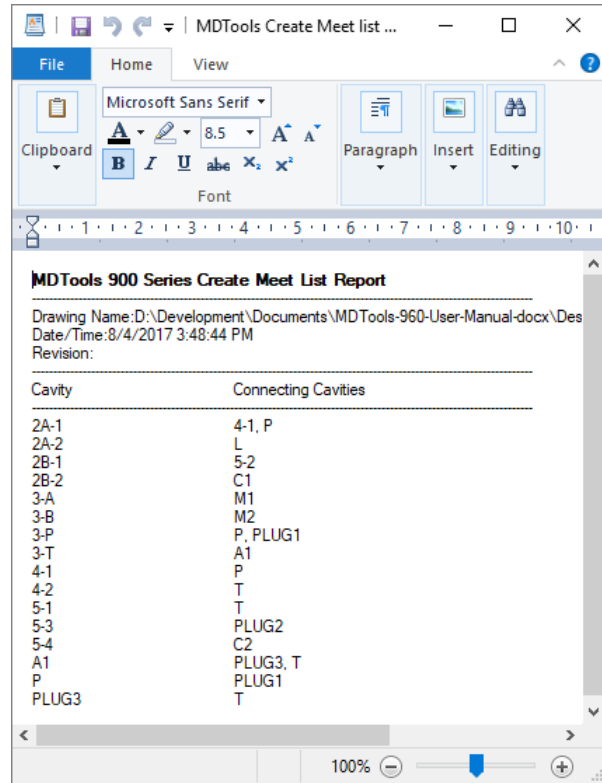
Connection Check: Connectivity in Block dialog box



Displays Meet List issue on single click

Note:

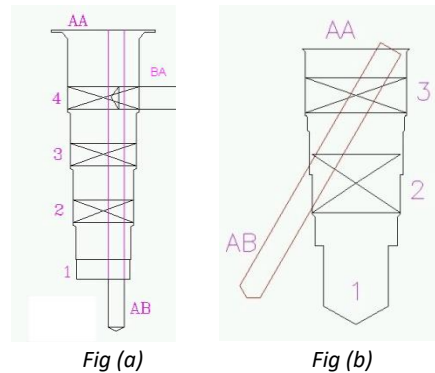
- The Connectivity check shows that cavities are meeting. But this alone does not assure the quality of connections.
- Bottom port starting depth must be specified for all cartridge valve cavities.
- If the bottom port depth is not specified, the area below the side port, just above the bottom port, will be considered as Dead Area.
- Area below the spot face (Step0) will be considered as Working Area, if the insertion depth for port cavity is not entered.
- Holes cutting outside the port area of cavity will be listed in the dead area connection list.



Connectivity Check Report

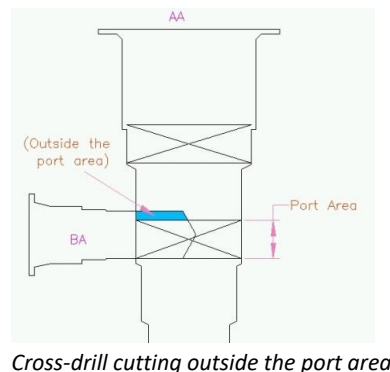
Offset holes and Angle drills

- When an offset drill is used inside a cavity, the Create Meet list will only list the bottom port of the cavity in the meet list. None of the side ports will appear in the meet list of the offset hole. For example, meet list of offset hole AB in Fig (a) will show only port 1 of cavity AA.
- When an angle drill is used inside a cavity, the connection check will only list the port connected to the angle drill in the meet list. For example, meet list of angle hole AB in Fig (b) will show only port 2 of cavity AA.



Cartridge valve side port connection

- The Connection Check feature checks drill breakage outside the specified port area of a cartridge valve cavity.
- Cavities connecting outside the port area are listed in the Dead Area meet list. For example, for the connection shown in the figure, dead area of AA will appear in the meet list of hole BA. BA AA-2, AA-D
- This helps automatically locate holes cutting outside the port area.



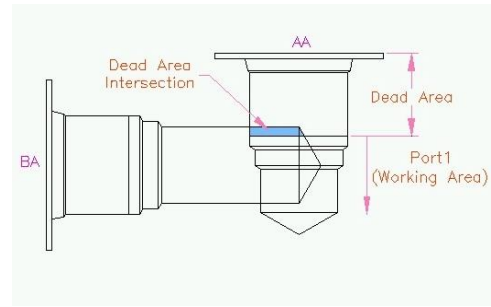
Thread Eating of ports

In MDTools®, ports are divided into working and dead areas. MDTools automatically detects the holes cutting into the dead area of a port.

This helps identify the 'thread eating' problems inside the manifold.

Note:

- Any connection above the plug insertion depth is considered as dead area connection.
- If the plug insertion depth is not specified, the complete area below spot face is considered as Working Area.
- In some instances, you may decide that despite loss of some threads there is sufficient thread engagement and the design is acceptable.



Thread Eating of ports

75. Check Velocity in Block

Check the velocity in the manifold with respect to the Nominal Velocity Range specified in MDTools Options. MDTools[®] will display the cavities/ports in different colors in model.

1. MDTools 960
> **Check Velocity in Block**
The *Check Velocity in Block* dialog box displays the pressure and tank nets.
2. Select required net(s).
The *Cavity/Port, Drill/Port Dia, Flow, and Velocity of each port* are displayed in the grid.


The *Velocity legend* indicates:

Red – High

Green – Nominal

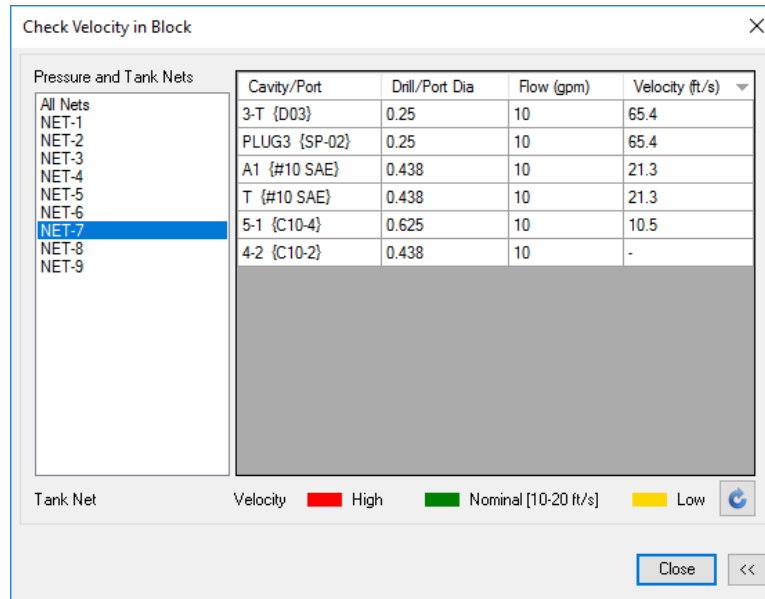
Yellow – Low

Note:

- Selected nets or all the nets are colored, and unaffected areas are grayed out.
 - Velocities inside valve cavities are not checked.
 - The Nominal Velocity range can be specified on the MDTools Settings > **Energy Efficiency** tab page.
3. Double click on a cavity/port to change its flow value, if required.
 4. Click  to recolor cavities for the selected net.
 5. Click **Close**.
Manifold is recolored.

Note:

- If a pilot/drain port/cavity in the circuit is used to create pressure/tank flow path in the manifold, then the designer must change the port connection type in the manifold to pressure/tank; and also update the flow.
- If flow is merging in a connection, then the designer has to manually update the flow.



Check Velocity in Block dialog box

76. Check Bend

Check the design for quality of intersection for Energy Efficient connections. For bend and stretched connections, it recommends depth to achieve smooth and trimmed connection.

1. MDTools 960
> **Check Bend**

The *Check Bend* dialog box displays the cavity, connecting cavity, current depth, and recommended depth.

2. Select the check box for each cavity.
The selected cavity gets highlighted in the model.
3. Click the **All** button to select all the affected cavities.

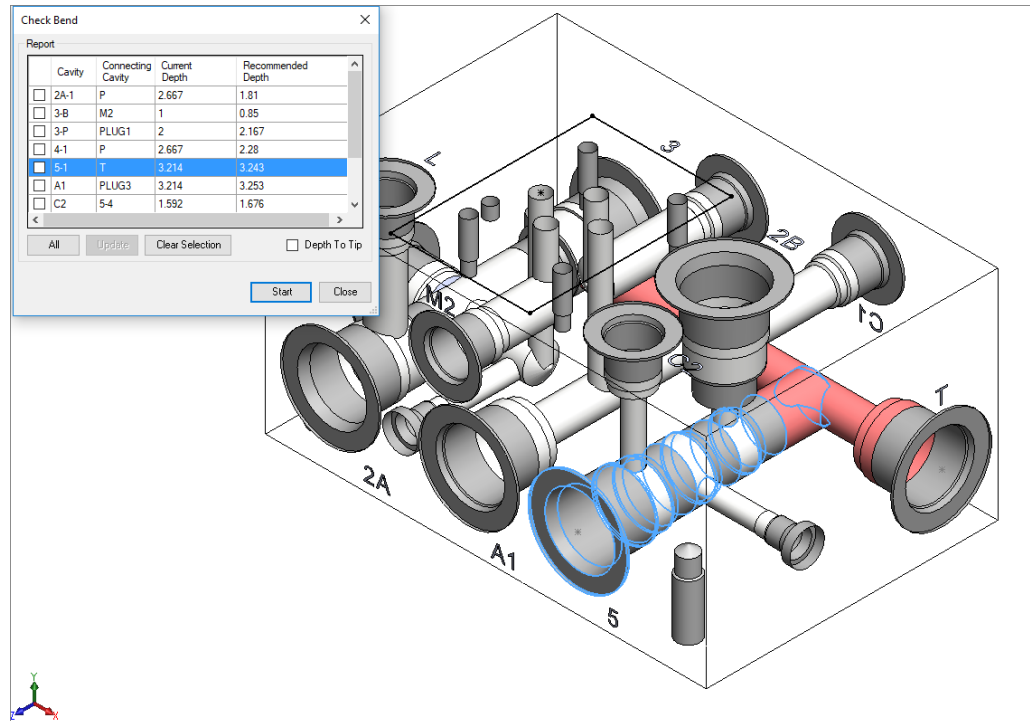
Note:

The **All** button turns **None** when all the items are selected.

4. Select a row, MDTools® highlights the specified issues.
5. Double click on row selection to zoom into the issue.
MDTools automatically zooms into the problem area for selected row.
6. Click the **Clear Selection** option to clear the highlighted issue.
7. Click **Update**.
The recommended depth is applied to the current depth and the affected rows turns green.

Note:

Select **Depth to Tip**, to view the depth till the drill tool tip.



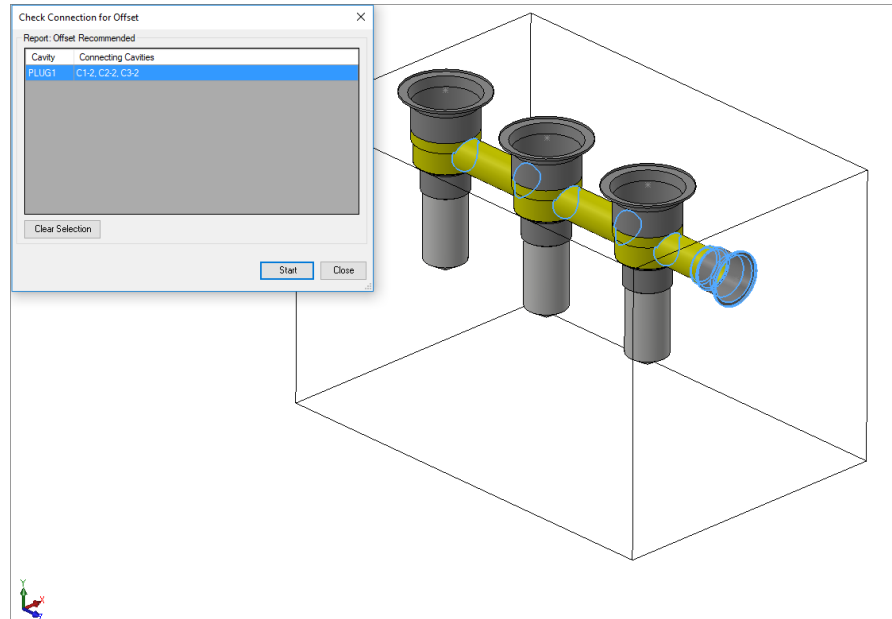
Check Bend in Block dialog box

77. Check Connection for Offset

Check the connection, which has three or more cartridge valve side ports for the offset. MDTools® will list the connection where offset is recommended in the dialog box.

1. MDTools 960
> **Check Connection for Offset**
The Check Connection for Offset dialog box displays.
2. Click **Start**, Connection Check
MDTools checks manifold for the connection with 3 or more cartridge valve side ports.

All the cavities in the manifold are grayed out.
3. Select a row,
MDTools highlights the specified issues.
4. Double click on row selection to zoom into the issues.
MDTools automatically zooms into the cavities for selected issues.
5. Click the **Clear Selection** option to clear the highlighted issues.

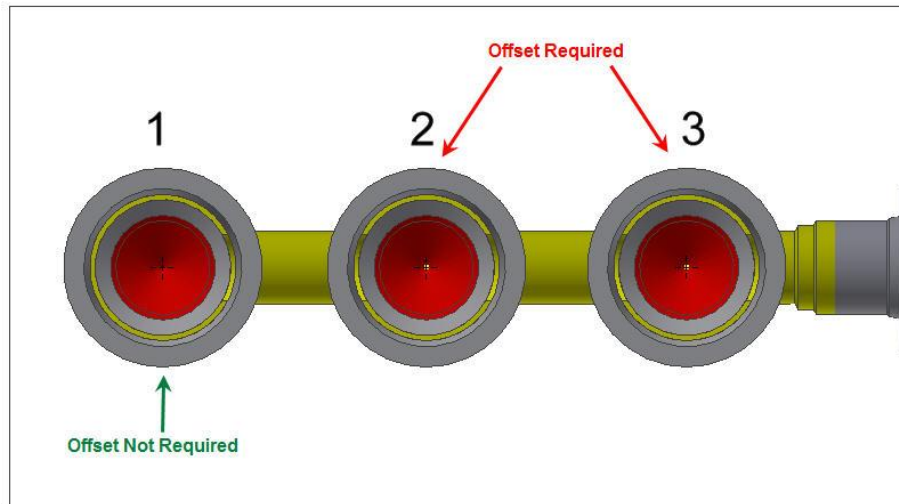


Check Connection for Offset dialog box

Offset Connection Rules

Case 1:

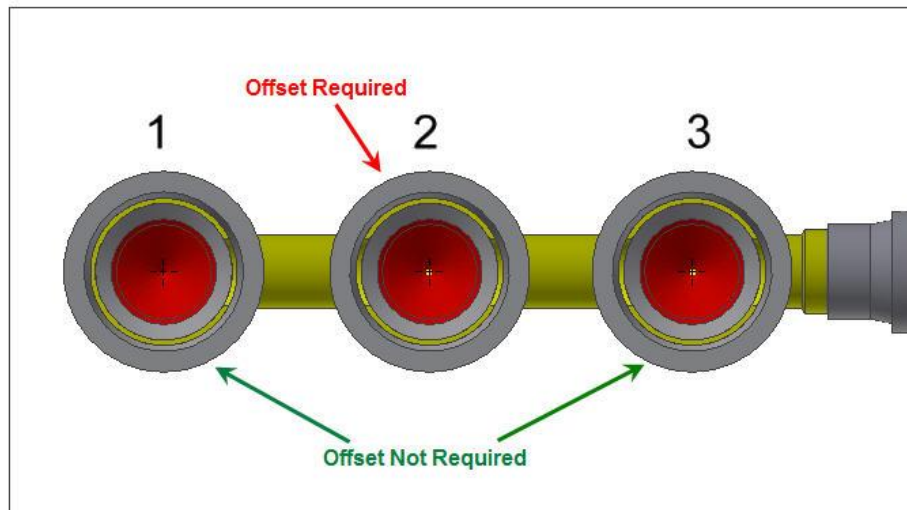
Work port/CV bottom port is connected to more than two Cartridge valve side ports



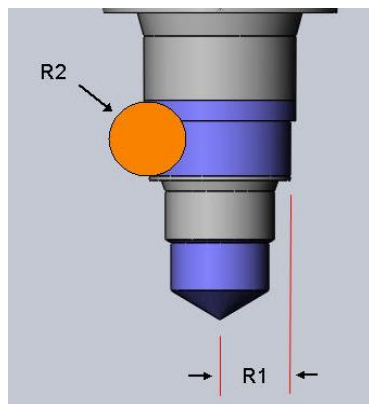
All CVs except the last one should be placed at an offset from the connecting cavity

Case 2:

X-drill plug is connected to more than two Cartridge valve side ports

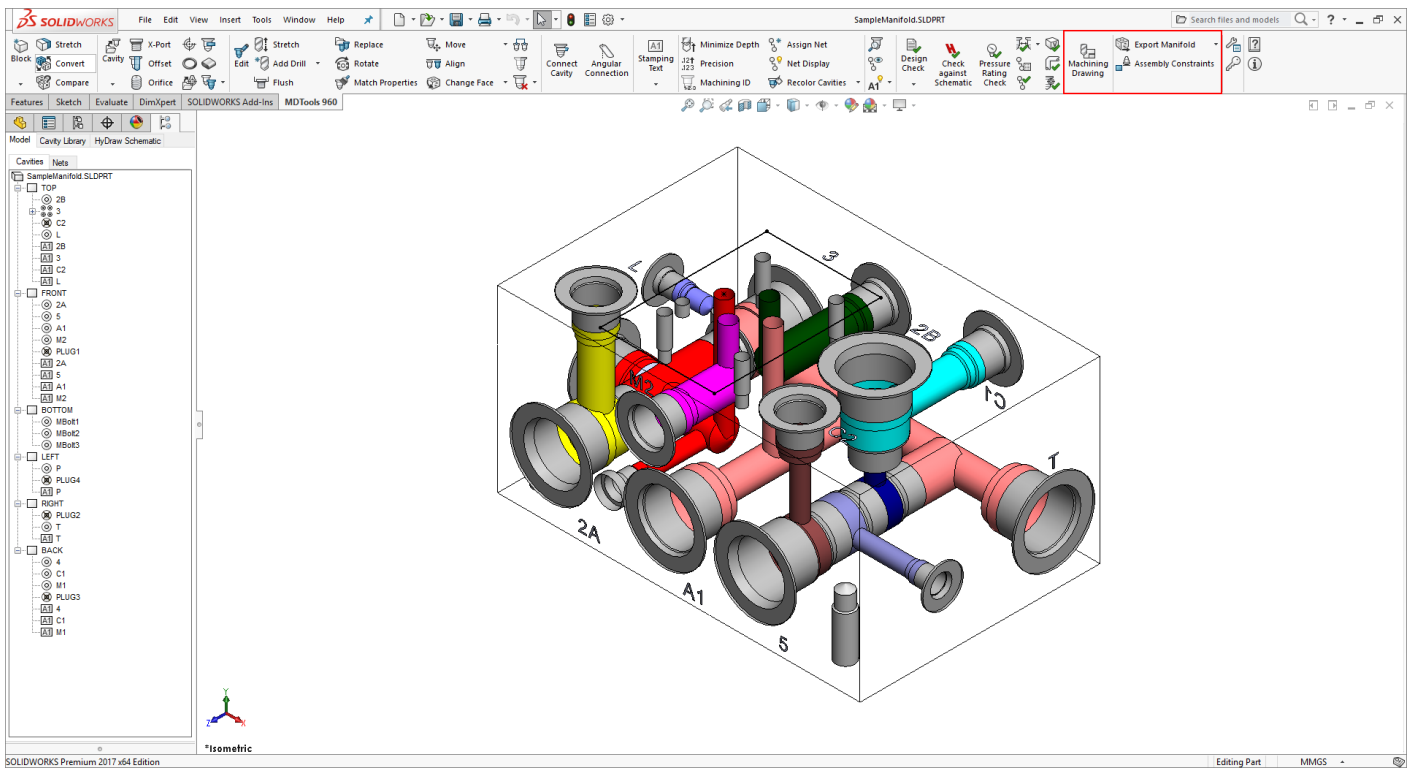


All CVs except the first and last, should be placed at an offset from the connecting cavity



Miscellaneous Commands

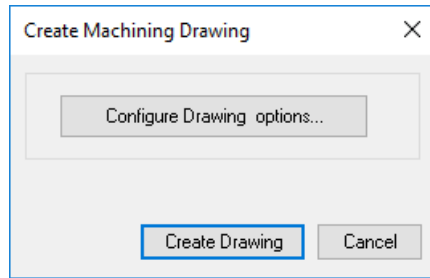
- 78 Create Machining Drawing
- 79 Export Manifold
- 80 Import Manifold
- 81 Shrink Wrap
- 82 Set Assembly Constraints



78. Create Machining Drawing

Automatically create the machining drawing for a manifold. It creates the drawing, per the various options specified in Machining Drawing Options.

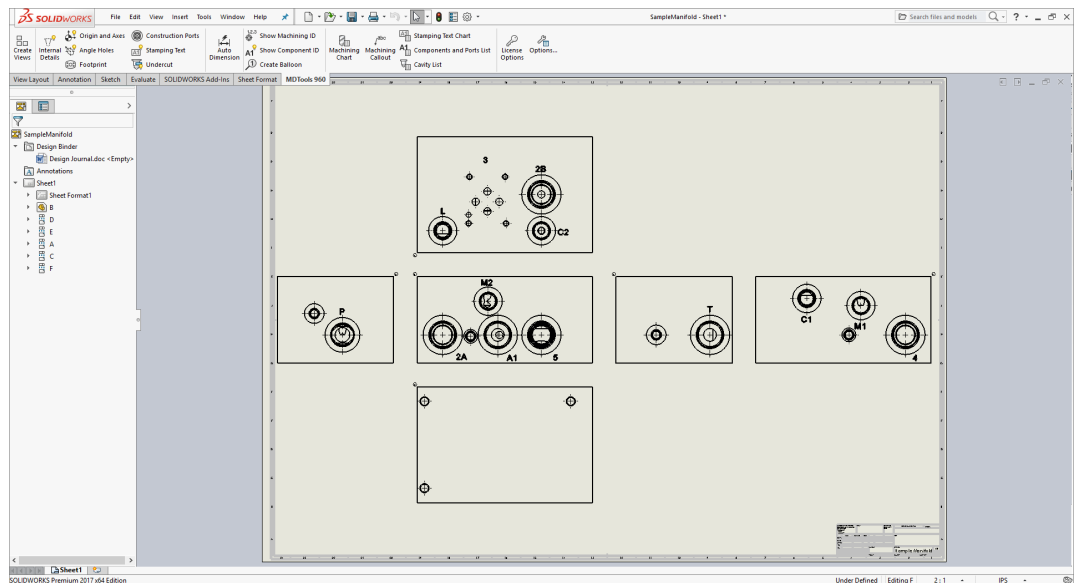
1. MDTools 960
> **Create Machining Drawing**
The Create Machining Drawing dialog box displays.



Create Machining Drawing dialog box

2. Click **Configure Drawing Options...**, if you want to change the preset options.
The Machining Drawing Options dialog box displays.

3. Click **Create Drawing** to initiate the automatic creation of the machining drawing.
MDTools[®] automatically creates the complete machining drawing, per the specified options.



Machining Drawing Created Automatically

Note:

Save the Part file before running this command.

Machining Drawing Options

Configure the various options to automatically create the machining drawing for the manifold block.

Format tab

Templates

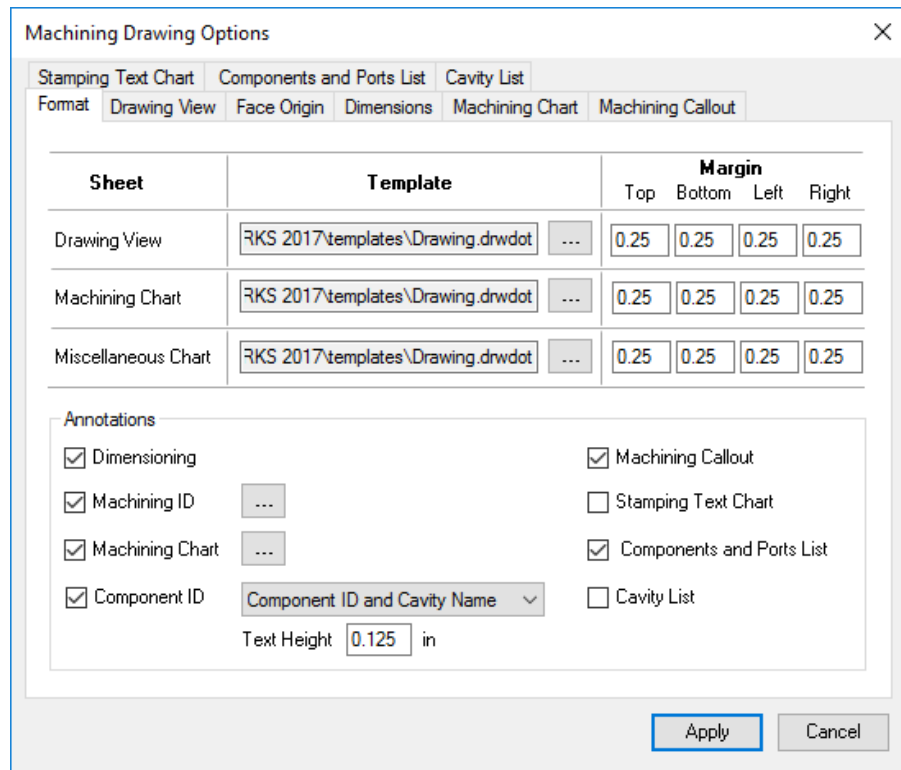
- Specify the templates for Drawing View, Machining Chart, and Miscellaneous Charts.
- Enter the Margin value, if you want to have clearance from the sheet border for each template. This will enable that there is no overlapping between views/tables and sheet border or any supplementary items (notes, revision tables etc.) on the sheet.

Annotations

- Select **Dimensioning**, if you want to display cavity or block dimension in the drawing.
- Select **Component ID** and its option from the drop-down list, if you want to display component IDs of the cavities.
- Select **Machining ID** to display machining ID of the cavities.
- Select **Machining Chart**.
- Select **Machining Callout** to create machining callouts for cavities in the drawing.
- Select **Stamping Text Chart**.
- Select **Components and Ports List** to create Components and Ports List, per the specified options.
- If the **Create List** option is selected, then Cavity List will be created automatically.
- Click **Apply** to save the changes.

Note:

Refer the **MDTools Drawing Options** section of this document for other setting changes.



Machining Drawing Options Format Tab

Working of Margin feature

Drawing View:

Views will be placed considering the given clearance value.

- Top - Distance between top most view and sheet inner border
- Bottom - Distance between bottom most view and sheet inner border
- Left - Distance between left most view and sheet inner border
- Right - Distance between right most view and sheet inner border

Machining Chart:

These clearance values are used for placing the Machining Chart on the sheet.

- Top - Distance between top of machining chart and sheet inner border
- Bottom - Distance between bottom of machining chart and sheet inner border
- Left - Distance between left end of machining chart and sheet inner border
- Right - Distance between right end of machining chart and sheet inner border

Miscellaneous Chart:

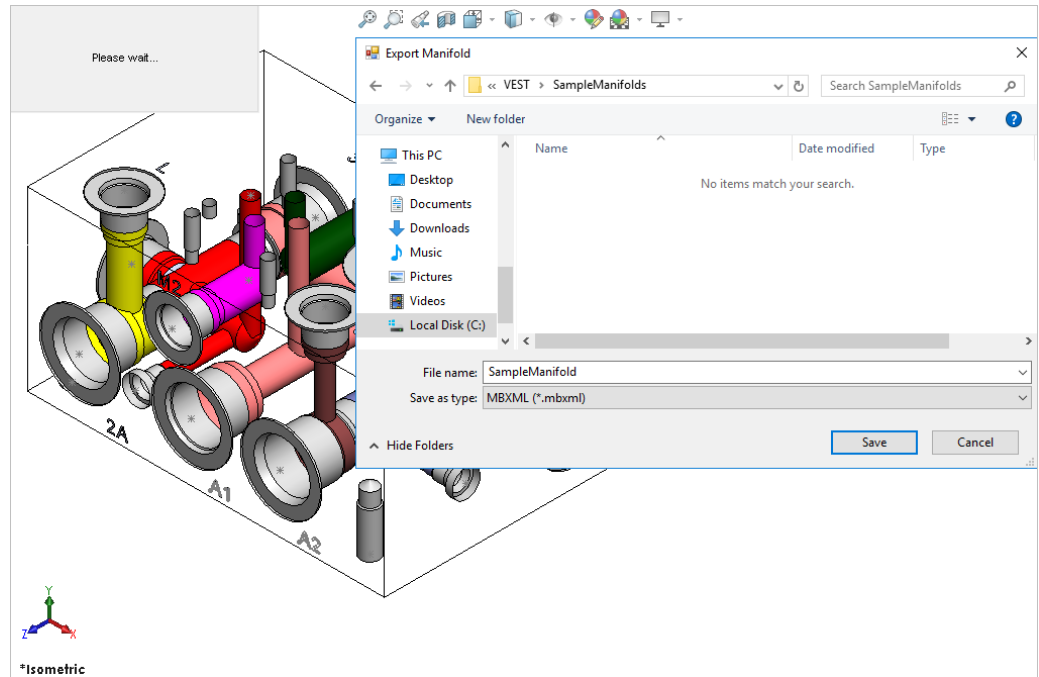
These clearance values are used for placing the Miscellaneous Chart on the sheet.

- Top - Distance between top of the chart and sheet inner border
- Bottom - Distance between bottom of the chart and sheet inner border
- Left - Distance between left end of the chart and sheet inner border
- Right - Distance between right end of the chart and sheet inner border

79. Export Manifold

Export the manifold design and create the MDTools® manifold XML file.

1. MDTools 960
> Export/Import
> **Export Manifold**
The Save XML File dialog box displays.
2. Select the MDTools manifold data file.
3. Enter the file name.
4. Click **Save**.
The program exports the manifold design into the MDTools manifold .xml file.

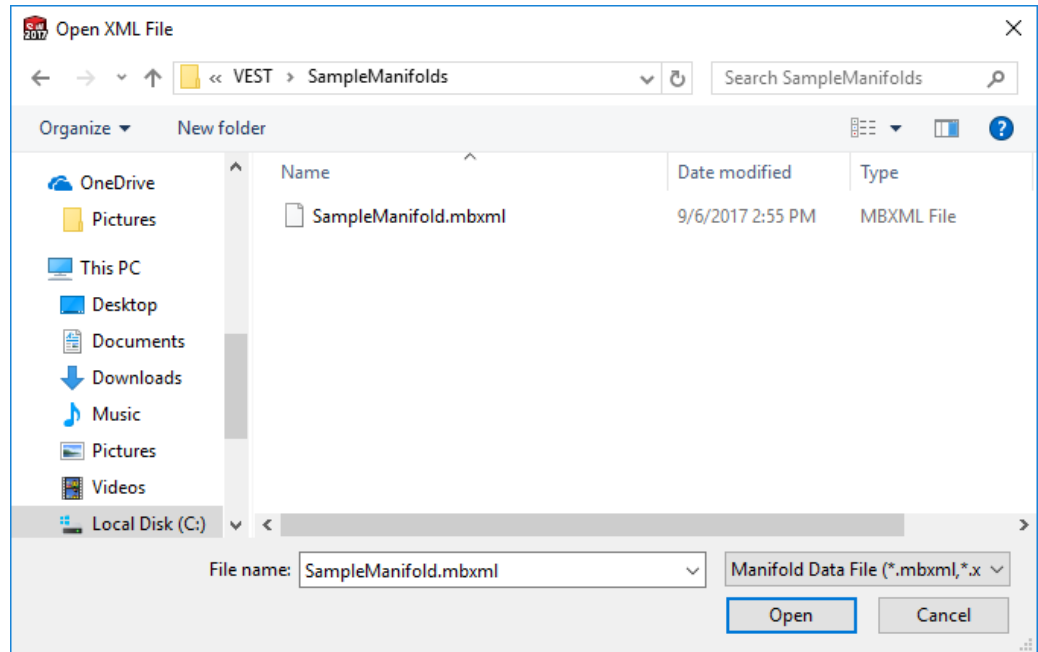


Export manifold data in XML file format

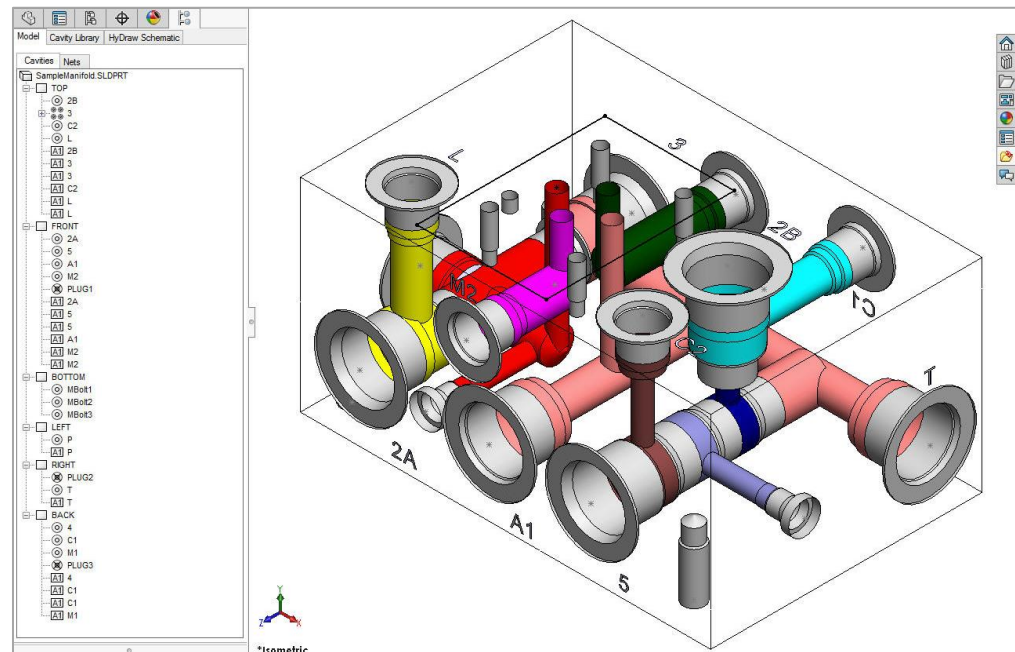
80. Import Manifold

Import the MDTools® manifold XML file and automatically create a new manifold in SolidWorks.

1. MDTools 960
> Export/Import
> **Import Manifold**
The Open dialog box displays.
2. Select the MDTools manifold data file.
3. Click **Open**.
The program reads the input manifold data file and creates a new manifold in SolidWorks.



Open XML File dialog box

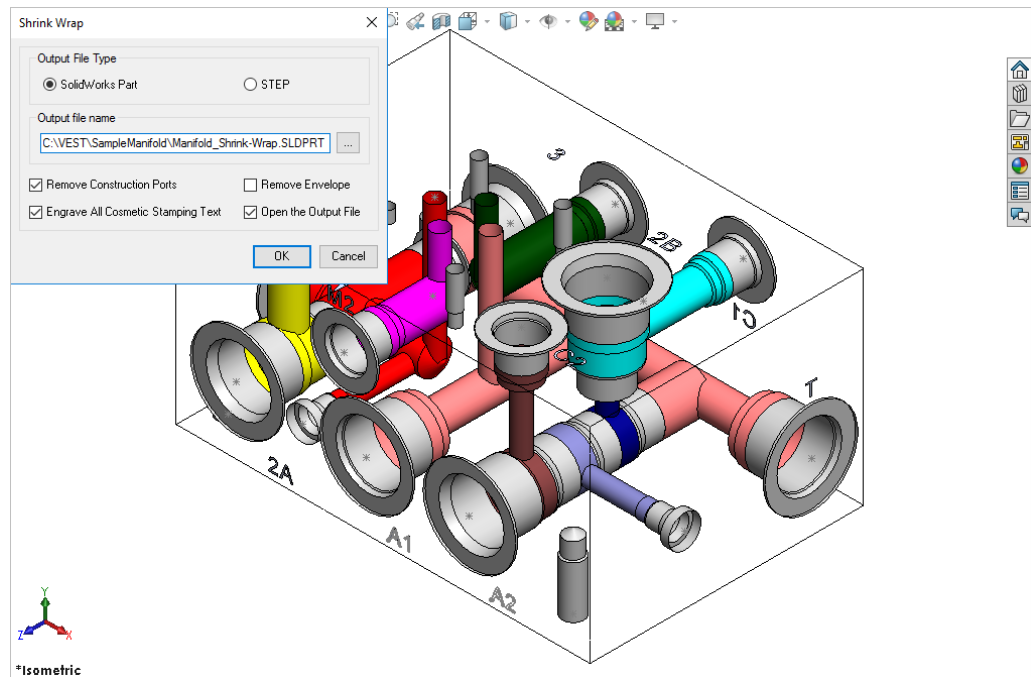


Imported Manifold in SOLIDWORKS

81. Shrink Wrap

Remove all the internal design details and create a separate block model without any connection detail.

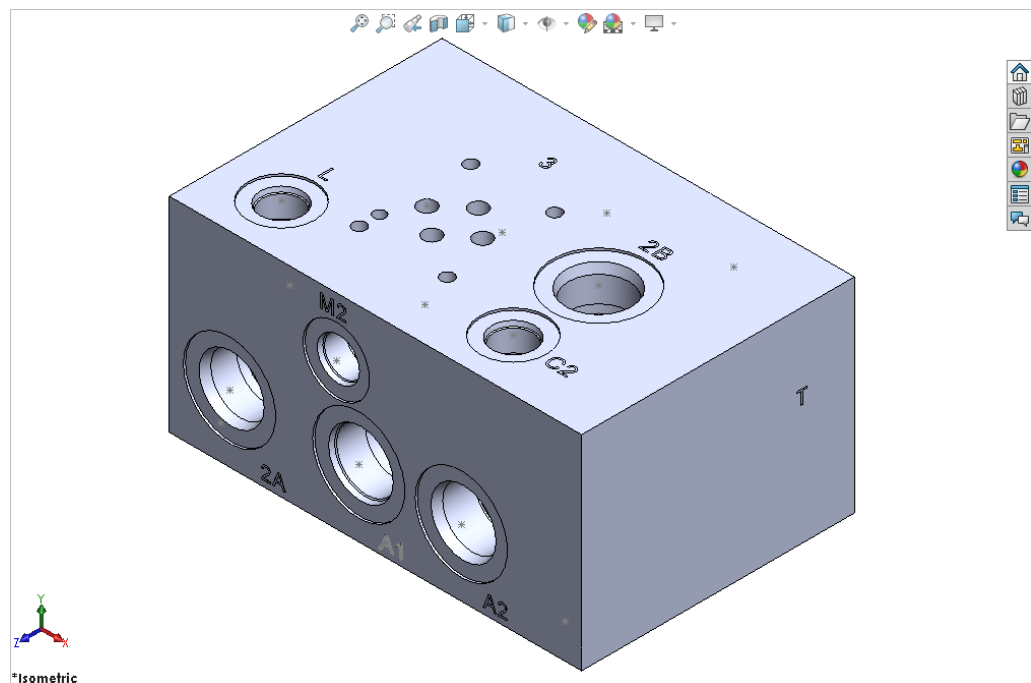
1. MDTools 960
> Export/Import
> **Shrink Wrap**
The Shrink-Wrap dialog box displays.



Shrink-Wrap dialog box

2. Select output type.
If you want to save output file as SolidWorks part file (.sldprt) select option, SolidWorks Part.
3. Enter the output file name.
The output file is saved into a file with the given name.
4. Select **Remove Construction Ports** to automatically remove the construction port information.
5. Select **Remove Envelope** to automatically remove the envelope (Footprint or Assembly) information
6. Select **Engrave all cosmetic stamping text** to change all stamping into Engraved stamping.
7. Select **Open the Output File** to automatically open the output file.
8. Click **OK**.
MDTools[®] automatically removes all the internal details below the specified depth.

If the Open the output file option is selected, then the output file is automatically opened in SolidWorks.



Internal details removed automatically

Note:

Shrink wrap now also works for Non-rectangular manifolds.

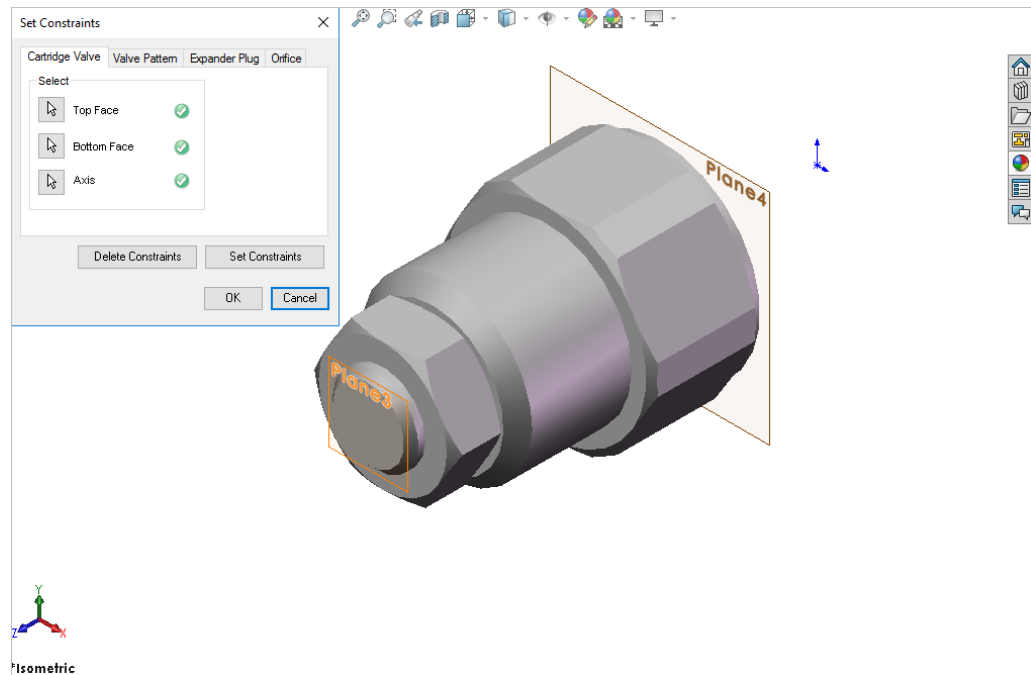
82. Set Assembly Constraints

Set assembly constraints on all the part/assembly models to make them work with the Assembly Interface. Parts without the assembly constraints will not get assembled on the manifold.

1. Open the part/assembly model of valve in SolidWorks.
2. MDTools 960 > **Assembly Constraints**
The Set Constraints dialog box displays.

The Set Constraints dialog box contains the following tabs.

- Cartridge Valve
- Valve Pattern
- Expander Plug



Set Constraints: Cartridge Valve tab

1 Cartridge Valve Tab

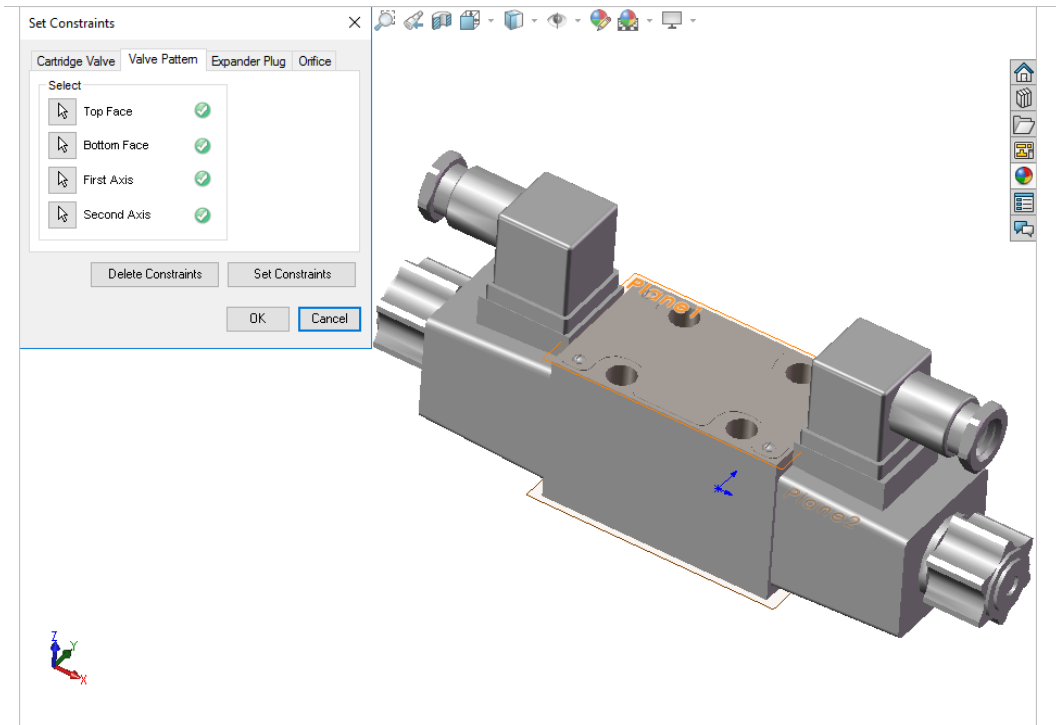
1. Set assembly constraints for the cartridge valves, port fittings, and plugs.
For these components, you need to specify three parameters, Top Face, Bottom Face, and Axis.
2. Select the **Top Face** button.
3. Select a planar face as the top face.
MDTools® automatically creates a work plane passing through selected face.
4. Select the **Bottom Face** button.
5. Select a planar face as the bottom face.
MDTools automatically creates a work plane passing through the selected face.
6. Select the **Axis** button.
7. Select a cylindrical face of valve body.
MDTools automatically creates an axis line passing through the axis of the selected cylindrical face.
8. Click **Set Constraints** to set assembly constraints.
MDTools sets all the assembly constraints. The Set Constraints dialog box closes. Now, this part is ready for use with the Assembly Interface.
9. Save the model.

Note:

- Use this option to set assembly constraints for solenoid coils and lock nut/manual overrides on the Screw-in cartridge solenoid valves.
- *Bottom work plane will mate with the spot face of cavity during assembly. So, the bottom work plane must be created on the face that needs to mate with the spot face of the cavity.*

2 Valve Pattern Tab

1. Set the assembly constraints for the surface mounted valves, slip in cartridge valves, or flanges.
For these components, you need to specify four parameters: Top Face, Bottom Face, First Axis, and Second Axis.
2. Select the **Top Face** button.
3. Select the top face work plane.
4. Select the **Bottom Face** button.
5. Select the bottom face work plane.
6. Select the first **Axis** button.
7. Select the axis passing through LP/LP1/BH1.
8. Select the second Axis button.
9. Select the axis passes through LP2/BH2.
10. Click **Set Constraints** to set assembly constraints.
MDTools® sets all the assembly constraints. The dialog box closes. Now, this part is ready for use with Assembly Interface.
11. Save the part model.
12. Click **OK** to close the dialog box.



Set Constraints dialog box: Valve Pattern tab

Note:

First Axis

- Create axis passing through the locating pin for valves with one locating pin.
- Create axis passing through the locating pin LP1 for valves with two locating pin.
- Create axis passing through the bolt hole BH1 for valves with no locating pin.

BH1 is the bolt hole with port application name BH1 and BH2 is bolt hole with port application name BH2 on the footprint.

Second Axis

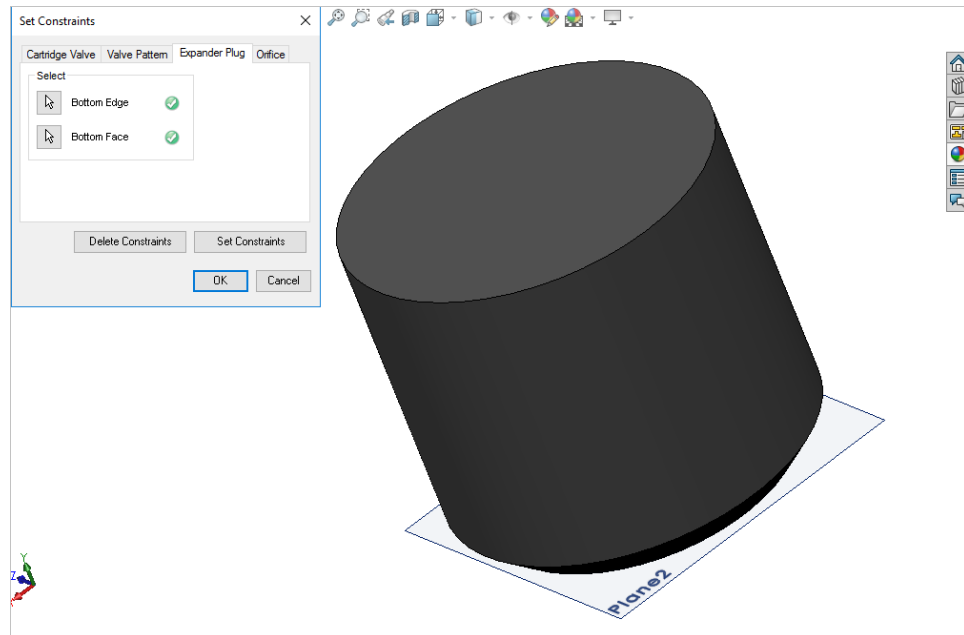
- Create axis passing through the bolt hole BH1 for valves with one locating pin.
- Create axis passing through the locating pin LP2 for valves with two locating pin.
- Create axis passing passes through the bolt hole BH2 for valves with no locating pin.

LP1 is the locating pinhole with port application name LP1 and LP2 is locating pinhole with port application name LP2 on the footprint.

3 Expander Plug Tab

If there is no spot face in the cavity (Step0 angle is not equal to 90), then you must use the Expander Plug tab to set the assembly constraints, for example in the expander plug ports. In such cases, you need to set only one constraint, i.e., Bottom Edge.

1. Select the **Bottom Edge** button.
2. Select the bottom edge on the model that mates with the bottom edge of Step 0 of the cavity.
3. Select the Bottom Face button.
4. Select the Bottom Plane.
5. Click **Set Constraints** to set the assembly constraints.
6. Save the part model.

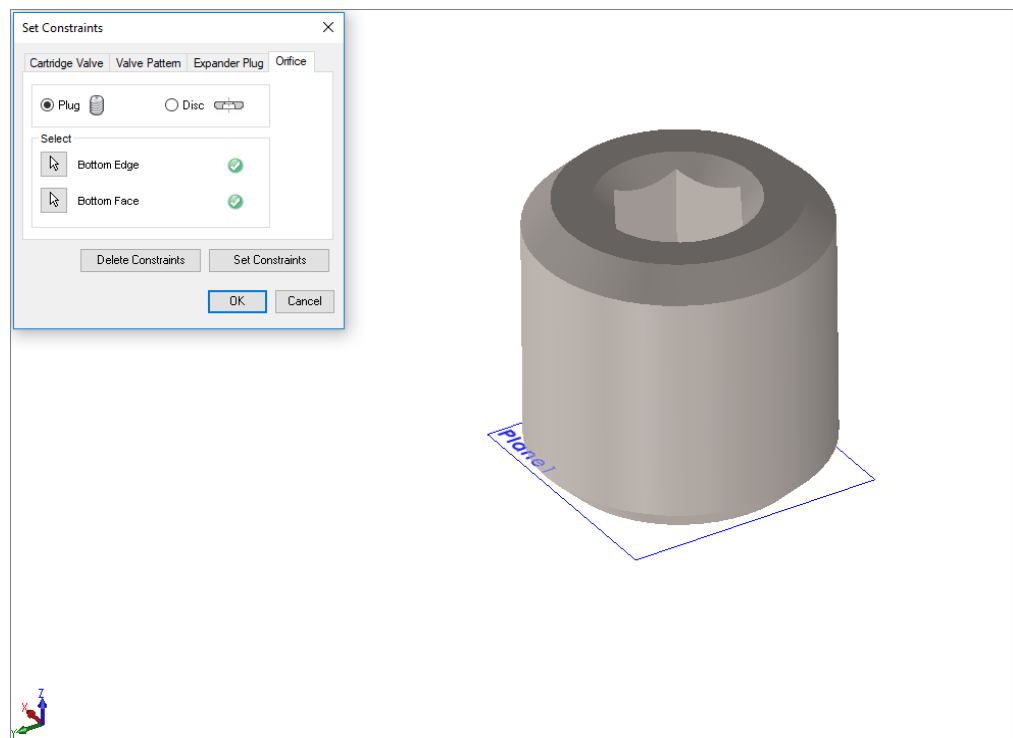


Set Constraints dialog box: Expander Plug tab

4 Orifice Tab

For Orifice type cavity, select the Orifice tab to set the assembly constraints. You need to set only one constraint, i.e., Bottom Edge.

3. Select the **Bottom Edge** button.
2. Select the bottom edge on the model that mates with the bottom edge of Step 0 of the cavity.
3. Select the Bottom Face button.
4. Select the bottom plane.
5. Click **Set Constraints** to set the assembly constraints.
6. Save the part model.

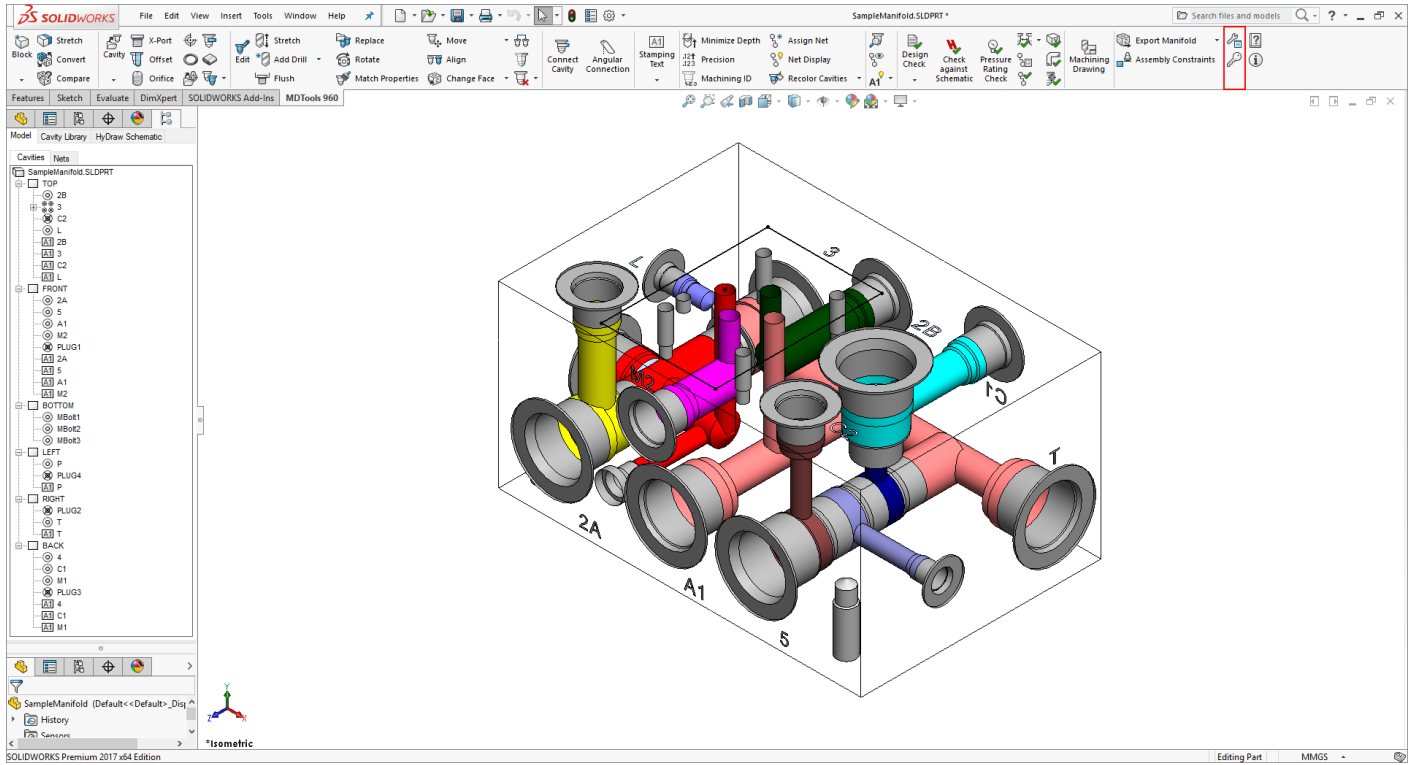


Set Constraints dialog box: Orifice tab

MDTools Settings

83 MDTools Options

84 License Options



83. MDTools Options

Set the library path, net color, design unit, internet options, and other miscellaneous options.

MDTools® enables you to share the library with all the designers in your organization so that all of them use the same data. You can easily manage changes in standards or libraries within your organization.

MDTools 960

> MDTools Options

The MDTools Options dialog box displays.

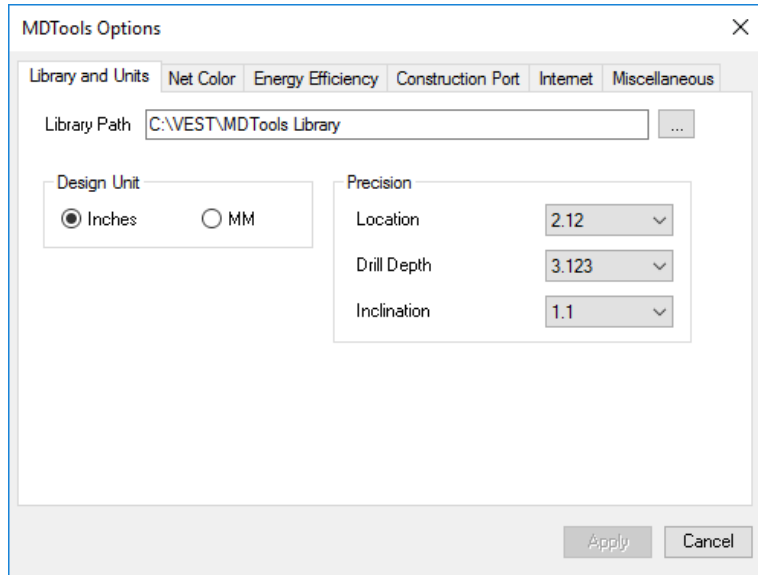
1 Units

- Design Unit: Sets the design unit. Inches or MM
- Precision: Sets the manufacturing precision for the design Location, Drill Depth and Inclination.

CAUTION!

Set the design units before inserting the first cavity.

You cannot change the unit, if any MDTools feature exists in the manifold.



Library and Units Tab

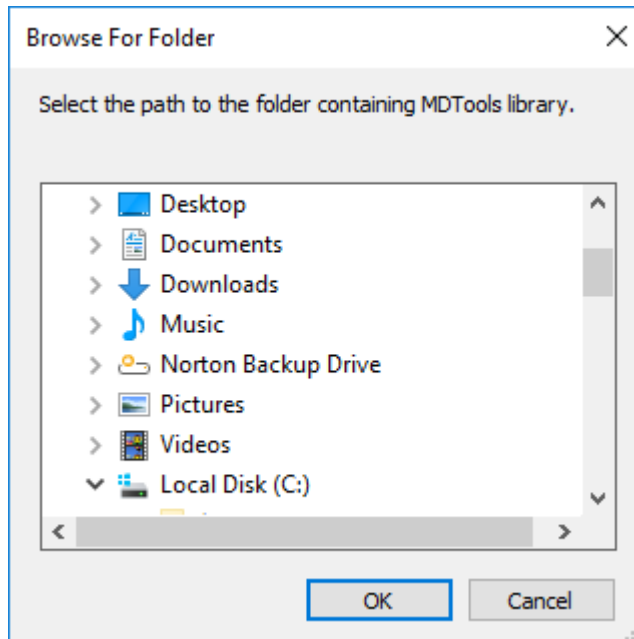
2 Library Path

The Library Path sets the location of the MDTools library.

1. Click the browse button to search the Library Path....
The Browse for Folder dialog box displays.
2. Browse and select the folder containing the MDTools library.
You can also change the library path by entering the new library path in the Library Path text box.
3. Click **OK** to confirm the selection.
4. Click **Apply**.
MDTools saves the change in the Library Path and Unit Settings.
5. Click **OK**.
The Browse for Folder dialog box closes.

Note:

Set the library path on all the systems independently.



Browse for Folder dialog box

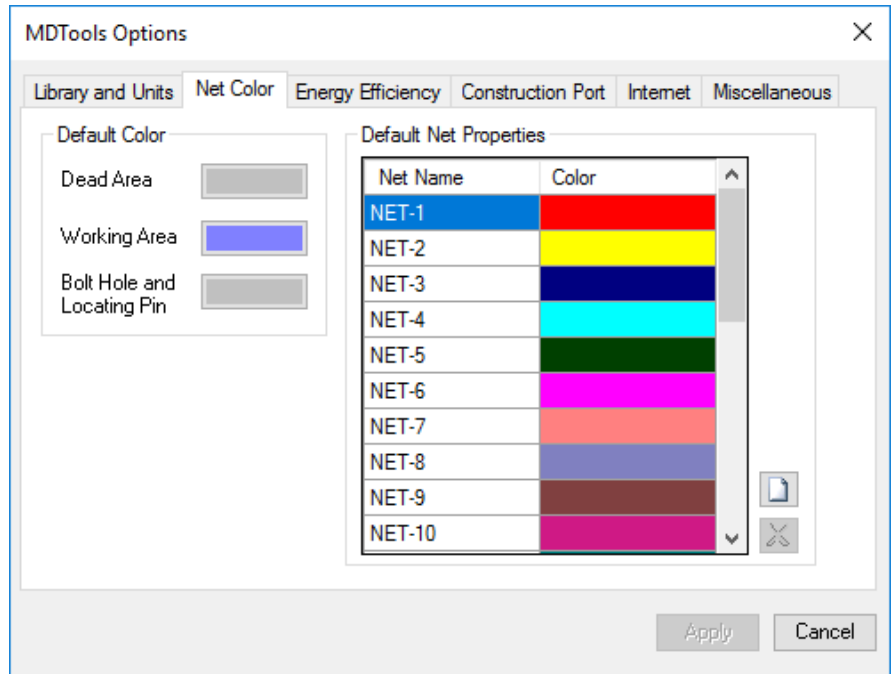
2 Net Color

Default Color

- Dead Area Sets the color for the dead areas on the cavity
- Working Area Sets the default color of the working areas on the cavity
- Bolt Hole & Locating Pin Sets the color for locating-pin holes and bolt holes

Default Net Properties

- Default Nets View the default name and color for a number of defined nets (flow paths)
- Add a Net To add a new net, click Add
Change the default net name assigned, by clicking the newly added net name
- Delete a Net To delete a net, select a net from the list and click Delete.
- Change Net Color Click the color band against a net name to change the color of the net name
Click **Apply** to save settings.



Net Color Tab

Note:

- Number of nets cannot be less than 25.
- MDTools automatically assigns a new color to the newly added net.

Ensure that you use a visibly distinct color for the net.

3 Energy Efficiency

Set the required parameters to make Energy Efficient connections using the Check Velocity, Check Bend, Insert Construction (X) Ports, Angular Connection, and Connect to Cavities commands.

Refer Appendix: Energy Loss Considerations

Optimize

Diameter Optimize the connection drill diameter

Depth Optimize the depth of the connecting drill

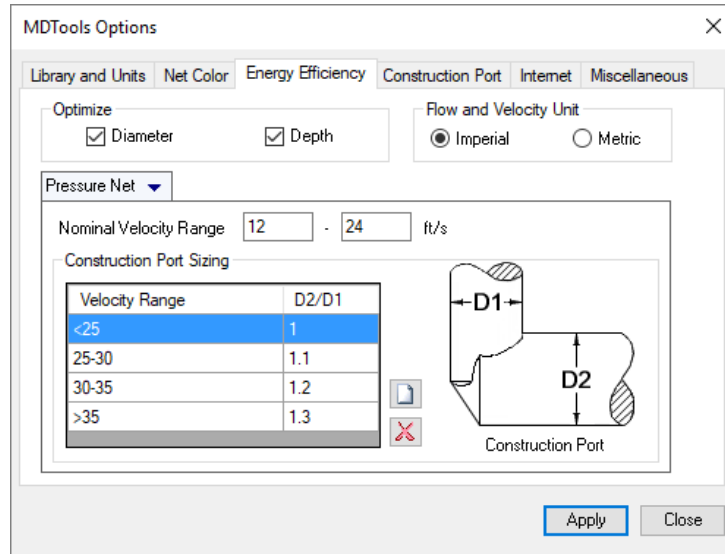
Flow & Velocity Units

Flow Units: Specify the flow values for each port of a cavity in Model Browser.

Velocity Units: Calculate the velocity in for a specific cavity/port on a net in the Check Velocity command.

Imperial Sets the unit to Inch.

Metric Sets the unit to MM.



MDTools Settings: Energy Efficiency

Note:

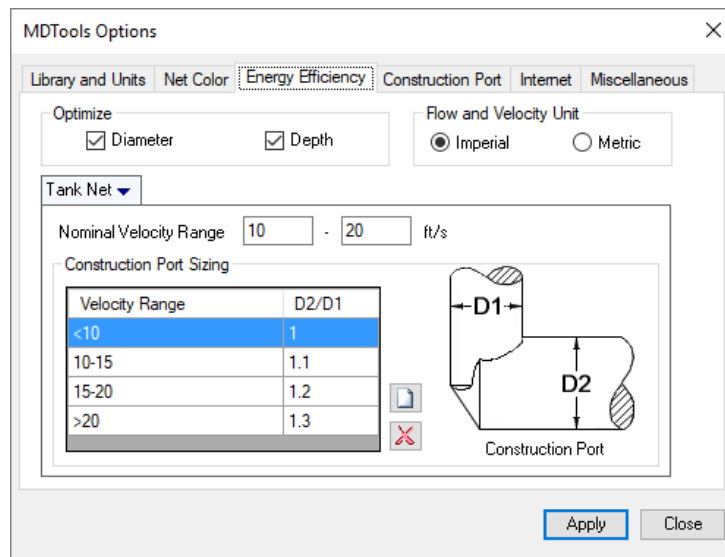
The Flow & Velocity units do not change the design units.

Pressure Net/Tank Net

Nominal Velocity Range The range defined is used for making Energy Efficient connections.



In the Check Velocity command; it is used to check if the velocity range is high, low, or nominal.

Construction Port Sizing The construction port is selected on the basis of the Velocity Range and D2/D1.



MDTools Settings: Energy Efficiency

Note:

- You can directly edit the Construction Port Sizing grid values.
- Click  to add a new diameter expansion ratio for a new range of oil velocity in drilled holes.
- Click  to delete an existing diameter ratio.

4 Construction Port.

Setup the preferred cavities to make Energy Efficient connections used in the Insert X-Port command.
Recommend a construction port from the list, based on the flow of the connecting cavity/port

Default ID

Set the default component ID for construction ports in the manifold.

Pressure Check

Select the **Check Rating at connection** option, if you want to validate construction port pressure as per the Net operating pressure.

MDTools checks pressure ratings automatically when inserting a construction plug.*


If a plug is not rated for the connected Net pressure, a warning dialog displays.

Check Rating at Connection option validates construction ports in the following MDTools command.


- Insert Construction port from MDTools browser.
- Insert Construction port from MDTools ribbon menu.
- Edit Cavity
- Connect Cavities

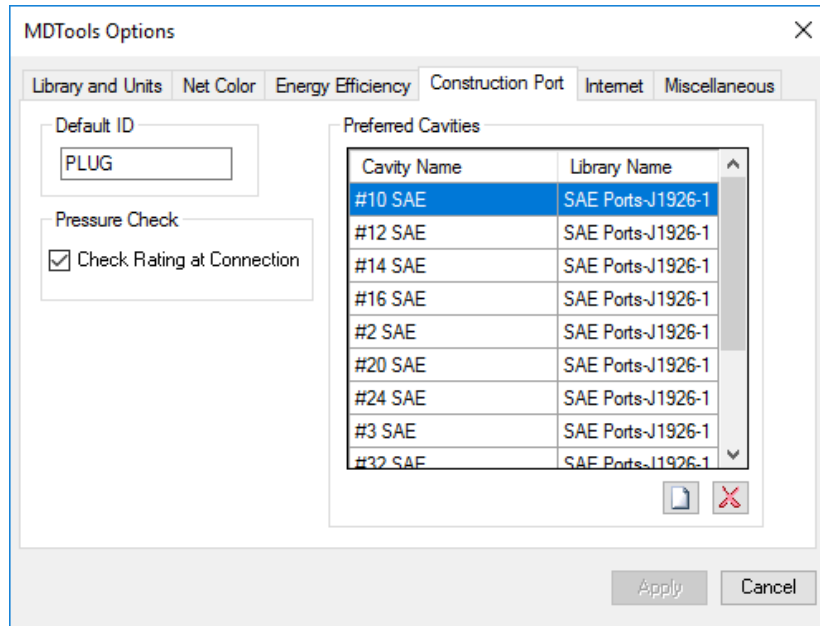
Preferred Cavities

Add Preferred Cavities:

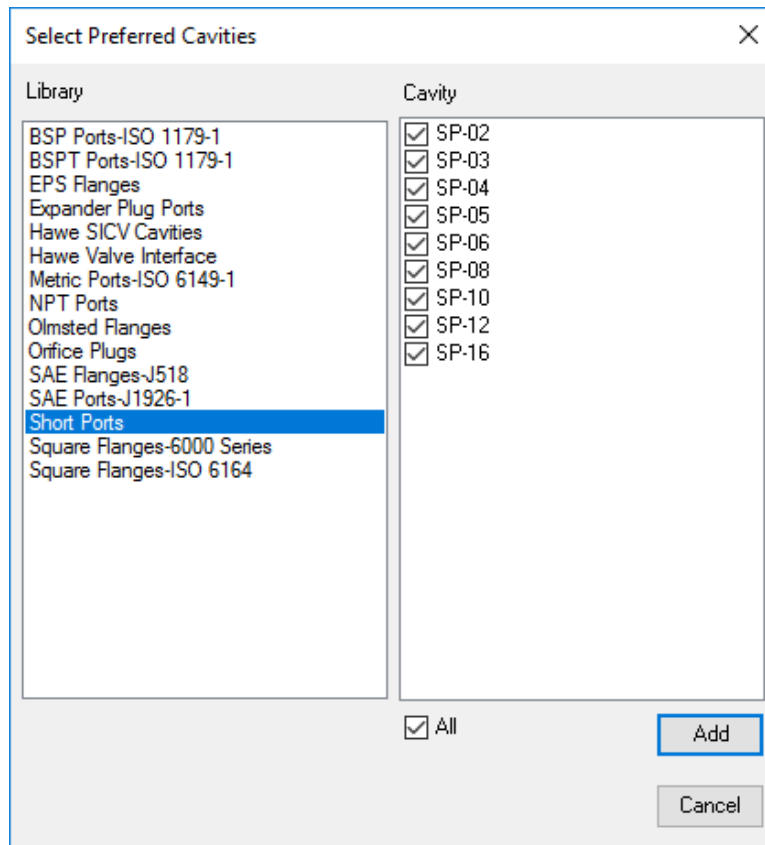
- Click  button.
- The Select Preferred Cavities dialog box displays.
- Select a library and cavities in the selected library.
- Click the **Add** button.
- Click the **Close** button.
- Click **Apply** to save the settings.

Delete Preferred Cavities:

- Select cavities to be deleted from the list.
- Click  button to delete the selected cavities.
- Click **Apply** to save the settings.



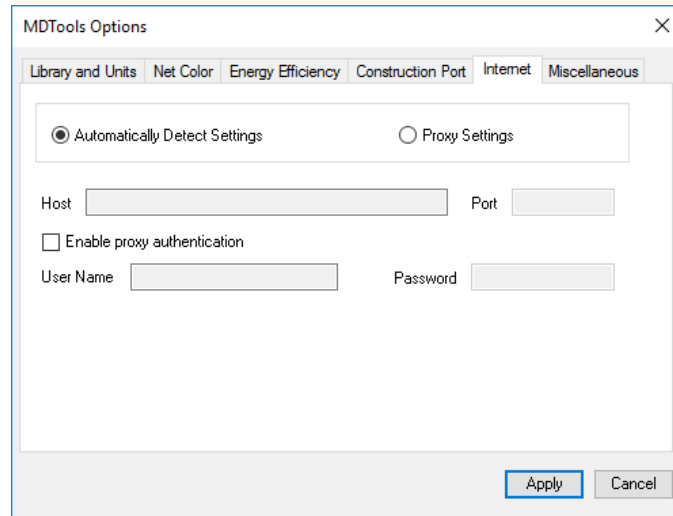
MDTools Settings: Construction Port Tab



Select Preferred Cavities dialog

Internet Options

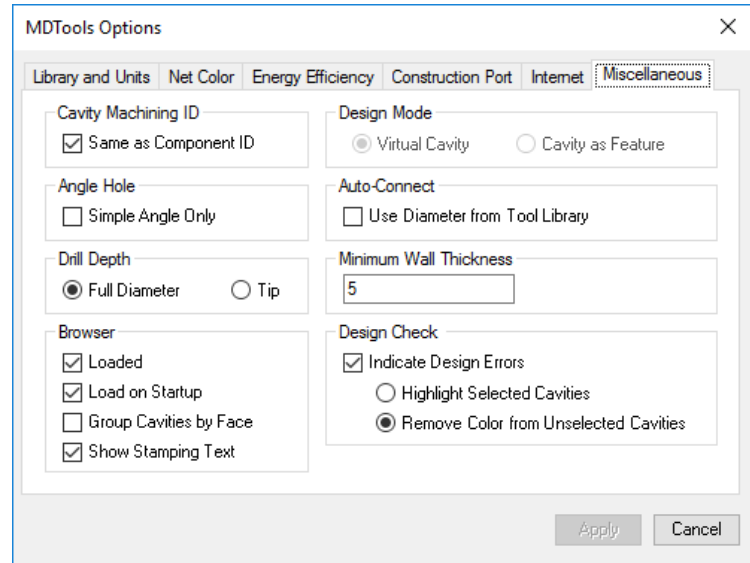
1. Specify the correct settings to enable MDTools to access Internet.
2. Enable proxy settings, if required and provide related information such as **Host** and **Port**.
3. Select **Enable Proxy authentication** and provide User Name and Password, if required.
4. Click **Apply**.



Internet Options Tab

Miscellaneous

- | | |
|---------------------------|---|
| 1. Cavity Machining ID | Switches between Cavity Machining ID, same as the component ID or not. |
| 2. Angle Hole | Switches between Compound angle hole and a Simple angle hole. |
| 3. Auto-Connect | Enables/Disables use of diameter available in <i>Tool Library</i> as connection diameter. |
| 4. Minimum Wall Thickness | Sets the default minimum wall thickness. |
| 5. Design Check | Indicate Design Errors has two options, Highlight Selected Cavities and Remove Color from Unselected Cavities to zoom in and highlight the reported errors of all Design Checks. (includes Wall Thickness Check, Manufacturability Check, Connection Check, etc...) |
| 6. Drill Depth | |
| Full Diameter | Drill depth excluding the drill tip. <i>Depth to Tip option appears unchecked by default, for applicable commands.</i> |
| Tip | Drill depth up to the drill tip. <i>Depth to Tip option appears checked, by default for applicable commands.</i> |



Miscellaneous Tab

7. Browser

Loaded	Switches the browser between Loaded and Unloaded
Load on Startup	Switches the browser setting between loading the browser on startup and loading the browser manually
Group cavities by Face	Switches between grouping of cavities in manifold by face or not
Show Stamping Text	Enables/Disables listing of stamping text in browser.

8. Design Mode

MDTools® now works faster using a new Virtual Cavity design mode.

Virtual Cavity	<i>Enables quick designing of manifold and then switching to the feature-based manifold design mode using the new Convert Manifold command. Dummy SOLIDWORKS imported body features are created for cavities in the Virtual Cavity design mode.</i>
Cavity as Feature	<i>Enables creation of cavities as parametric features in SOLIDWORKS.</i>

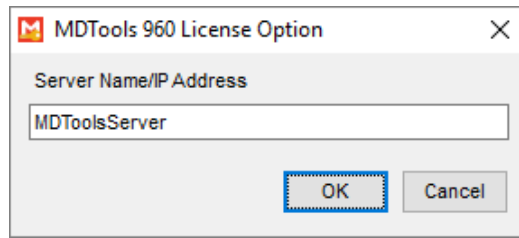
84. License Options

1. Set the license path through the Part Model menu.

MDTools 960

> **License Options**

The MDTools License Options dialog box displays.



MDTools 960 License Option dialog box

2. Enter the server name or the IP address of the system, where the MDTools hardware lock is located.
3. Click **Apply**.

MDTools automatically selects a license and displays the license information in the License info form.

If a license is selected successfully, then the Get License button is disabled and the Release License button is enabled.

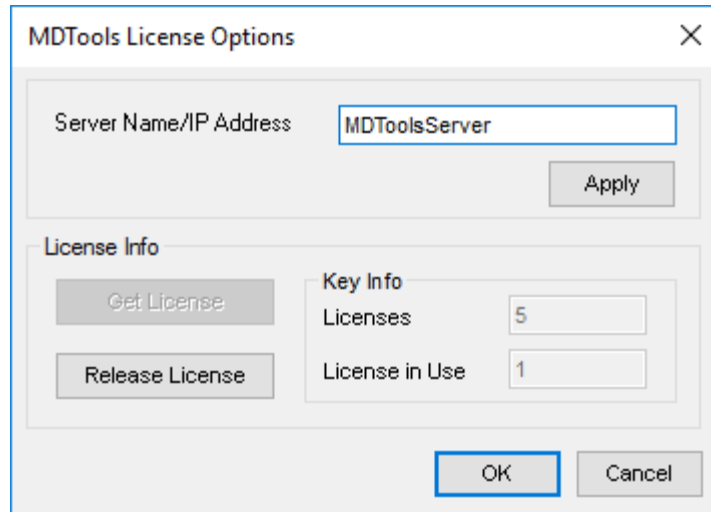
4. To release a license, click the **Release License** button.

This releases your license, the Release License option is disabled and the Get License button is enabled.

5. To get a license, click the **Get License** button.

If MDTools® successfully gets a license, then the Get License button is disabled and the Release License button is enabled.

6. Click **OK** to continue.



License Options dialog box

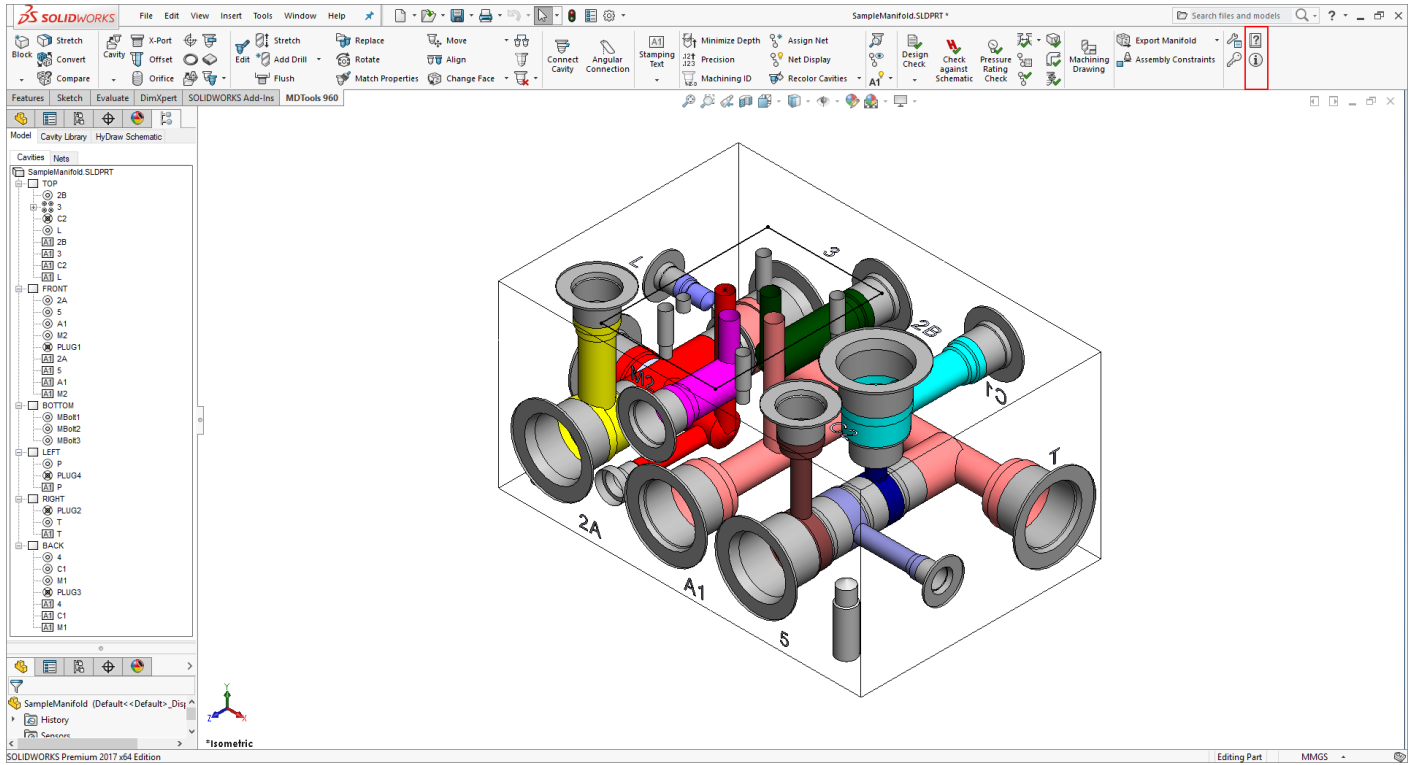
Note:

This option is available only in the MDTools 960 Network license version.

Help

85 User Manual

86 About MDTools



85. User Manual

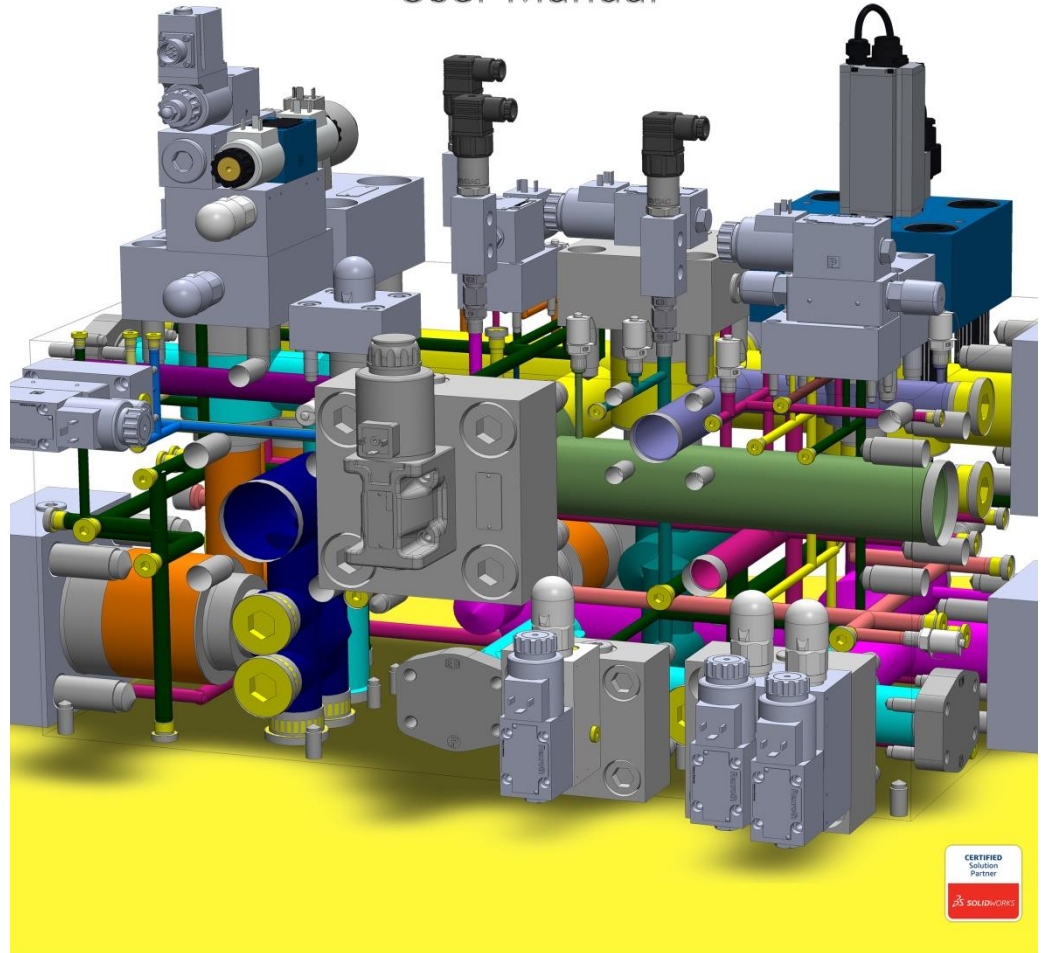
Open the MDTools 960 user manual in the PDF format.

MDTools 960
> **MDTools Help**

*The MDTools® User Manual
opens in the PDF format.*

MDTools® 960

User Manual

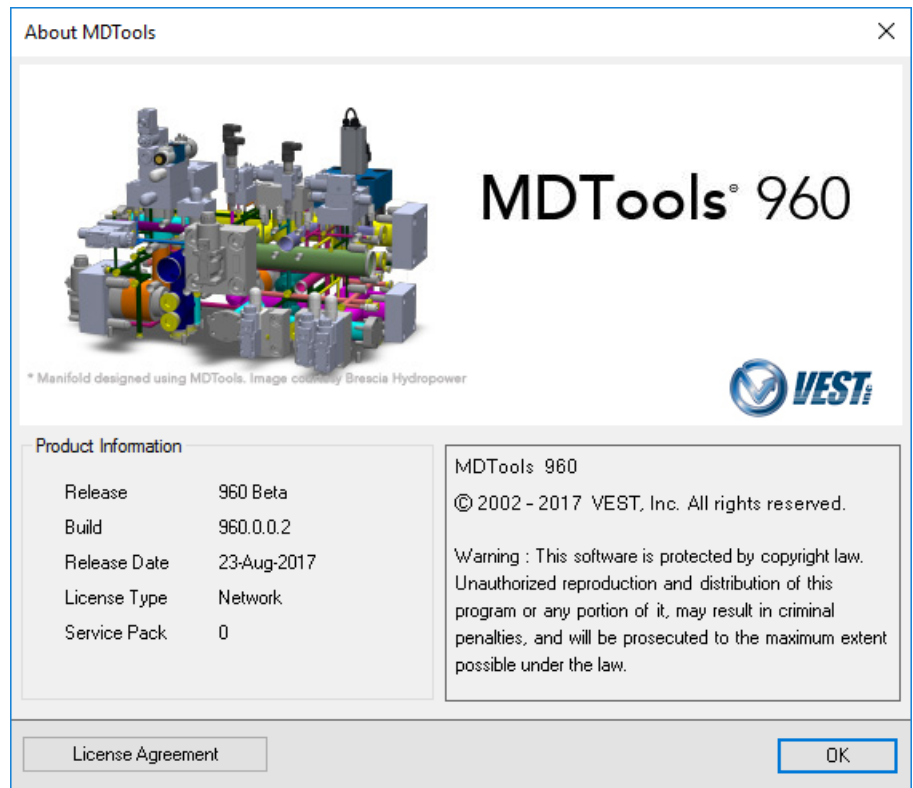


86. About MDTools

View the MDTools® version and build number.

MDTools 960
> **About MDTools**

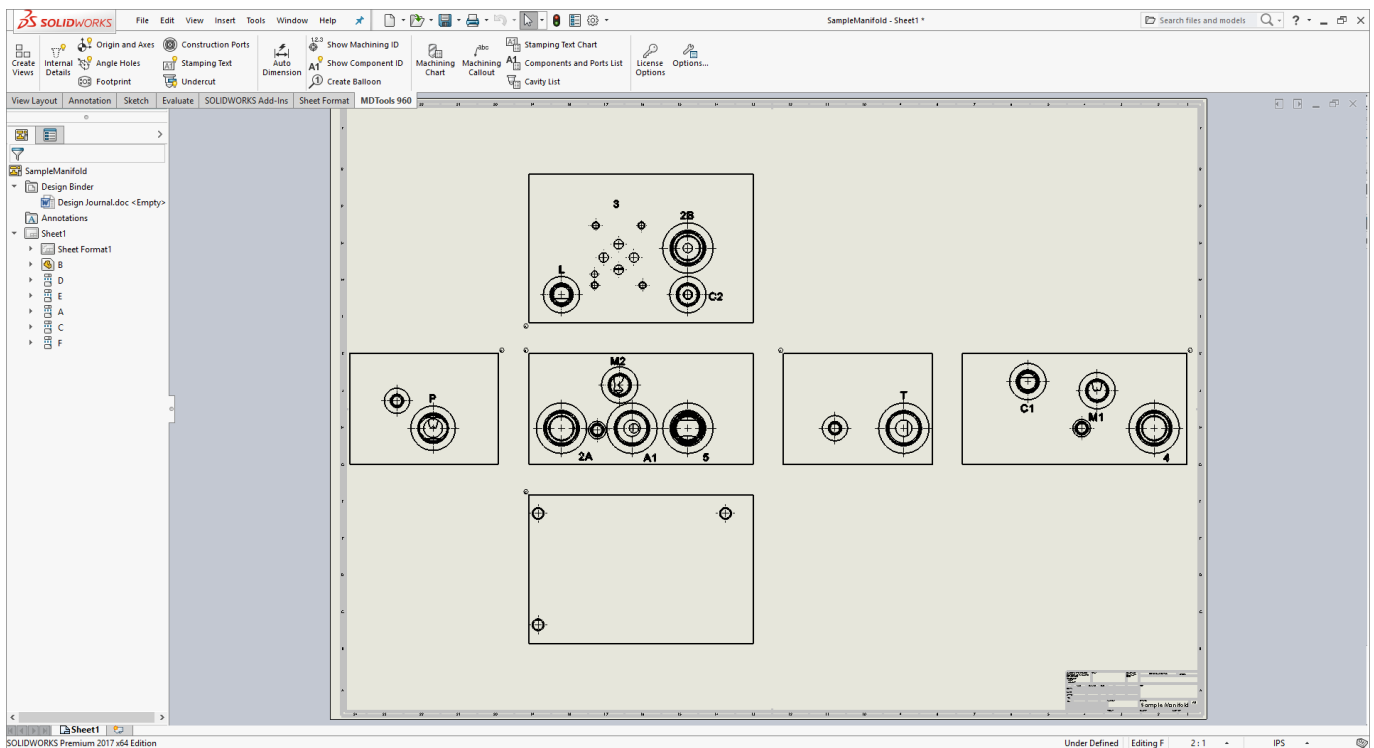
The About MDTools dialog box opens and displays the MDTools version and build number.



About MDTools dialog box

DRAWING COMMANDS

- 87 Create Views
- 88 Show Origin & Axes
- 89 Show Angle Holes
- 90 Show Footprint
- 91 Show Stamping Text
- 92 Show Undercuts
- 93 Mark Construction Holes
- 94 Show/Hide Internal Details
- 95 Auto Dimension
- 96 Show Machining ID
- 97 Show Component ID
- 98 Create Balloon
- 99 Machining Chart
- 100 Create Machining Callout
- 101 Create Stamping Text Chart
- 102 Create Components and Ports List
- 103 Create Cavity List
- 104 MDTools License Options
- 105 MDTools Drawing Options



CAUTION!

- MDTools 2D commands work only if the views are created using the **Create Views** command.
- MDTools 2D commands can be undone only if the model is not rebuilt after using the command.

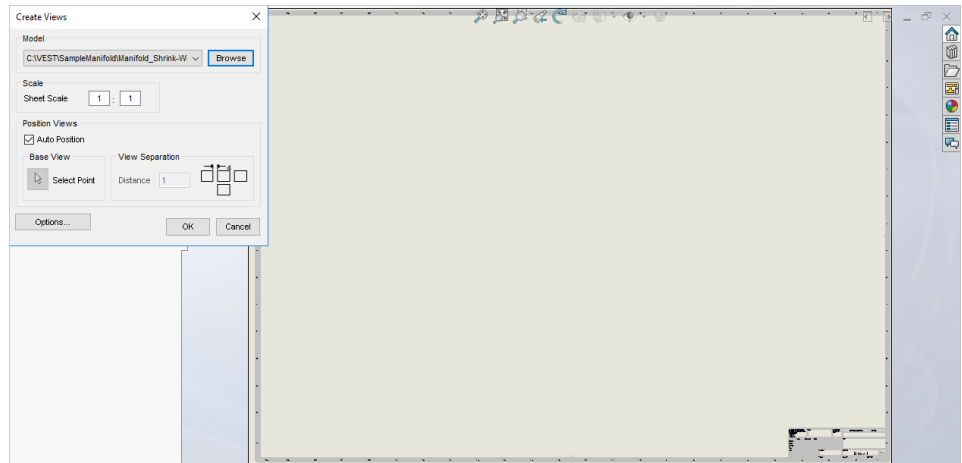
87. Create Views

Automatically create 2D views of a manifold.

1. MDTools 960
> **Create Views**
The Create Views dialog box displays.
2. Click **Browse** and select the block part model.
3. Click **Open**.

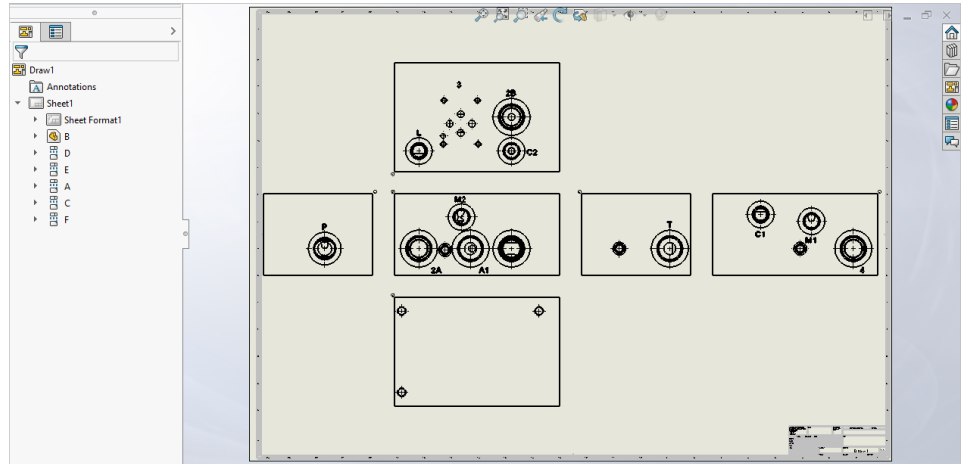
Note:

- Names of the part models, which open in SolidWorks are listed in the File name drop-down list.
- You can also select the part model from the list.



Create Views dialog box

4. Select the positioning option.
*The Auto Position option is selected by default.
The distance between views is automatically calculated.
The views are placed with the center of the front view at the center of the sheet.*
5. Deselect **Auto Position**, if you want to specify your own position style.
You can select a placement point.
This is the point at which the center of the Front view is placed on the sheet.
6. Specify the inter-view distance and the scale factor.
7. Click **OK**.



Six views of the manifold created automatically

MDTools[®] automatically creates six views of the selected manifold block as per the options specified in the MDTools Drawing Options dialog box.

MDTools automatically names the views, per the MDTools 2D view naming convention.

- Top view as **A**
- Front view as **B**
- Bottom view as **C**
- Left view as **D**
- Right view as **E**
- Back view as **F**

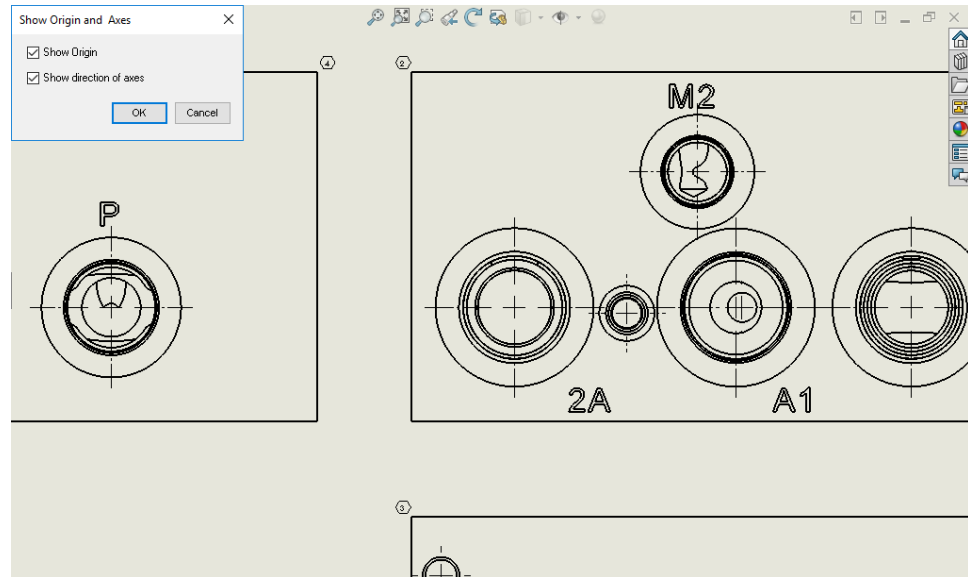
Note:

- The scale values in the Create View dialog box denote the sheet scale values.
- Refer **MDTools Drawing Options** for drawing view options.

88. Show Origin and Axes

Automatically display the origin and the direction of the X and Y axis in each view of the 2D drawing.

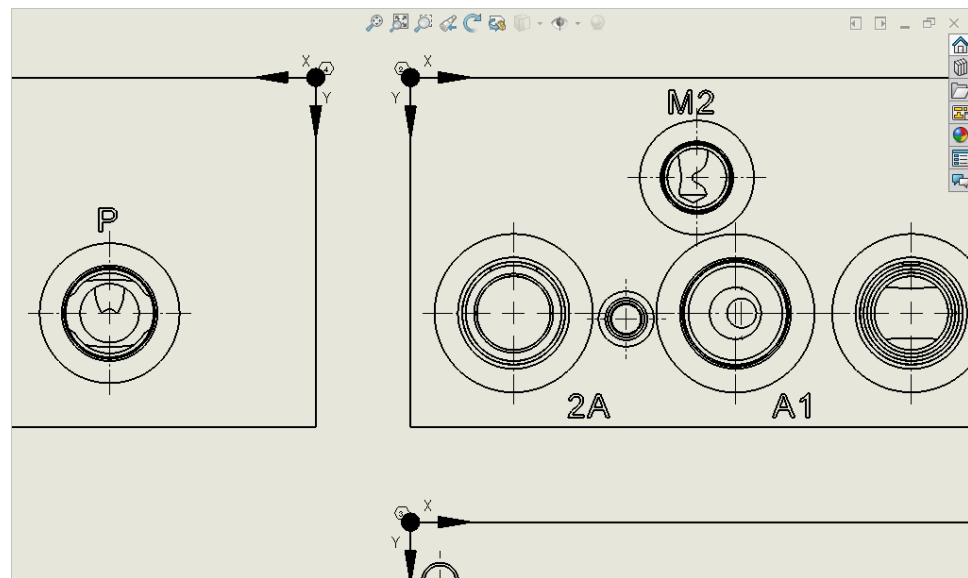
1. MDTools 960
> **Show Origin and Axes**
A selection box displays.
2. To display in each view, select one of the following:
 - Origin
 - X and Y directions
 - Both origin and directions
3. Click **OK**.
MDTools® automatically displays origin and directions in the placed view.



Show Origin and Axes dialog box

Note:

- The direction lines and origin circles are created in the selected layer properties.
- The origin and direction arrowheads are filled, per the user settings.
- To make the origin and direction head more prominent, change the document hatch fill settings to Solid Fill.
- The height of the X and Y text does not change on changing the view scale.



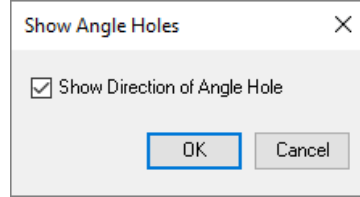
Origin and X and Y directions in a view

89. Show Angle Holes

Automatically display the top view of angle holes in the 2D drawing views.

The Show direction of angle hole option enables you to display the direction of angle hole.

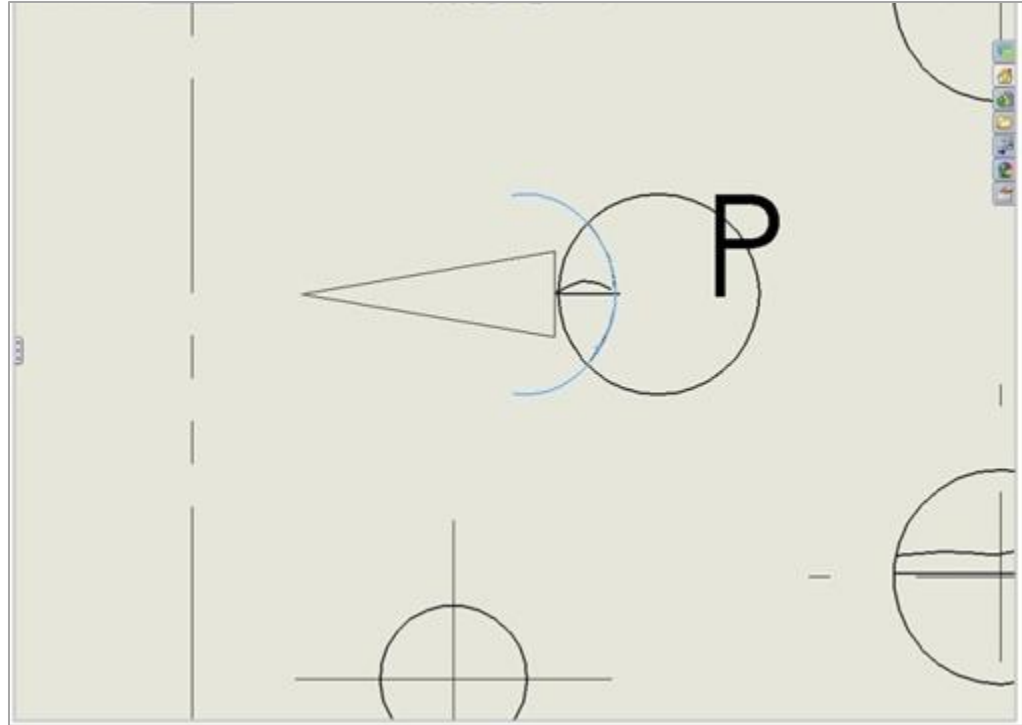
1. MDTools 960
> **Show Angle Holes**
The Show Angle Holes dialog box displays.



Show Angle Hole dialog box

2. Select **Show direction of angle hole** to display the direction of the angle hole.
The Show direction of angle hole option is selected by default.

3. Click **OK**.
MDTools® displays the top view of the angle holes in the 2D drawing views.

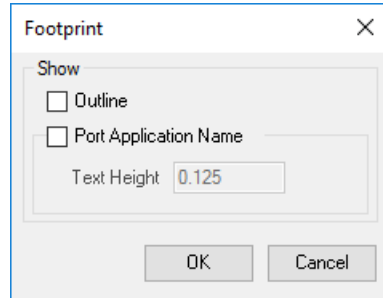


Angle holes displayed in 2D drawing

90. Show Footprint

Automatically display the port application name for footprint cavities near the cavities in 2D drawing views.

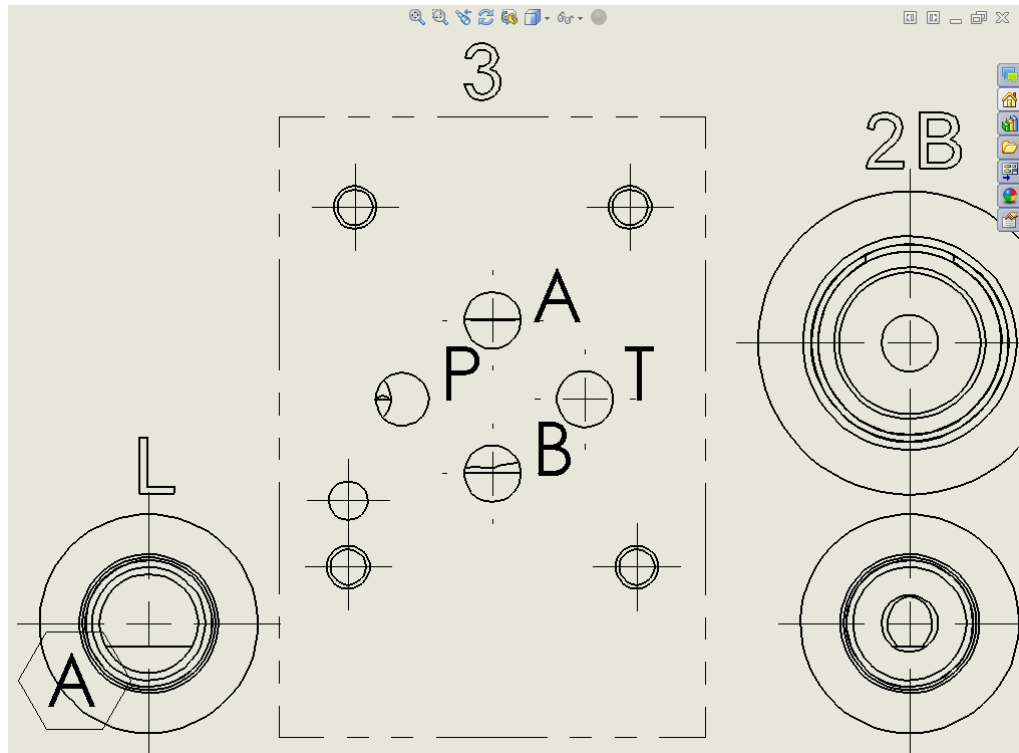
1. MDTools 960
> **Show Footprint**
The Footprint dialog box displays.
2. Select the options you want displayed.
3. Enter the **text height** for Port Application Name.
The port application name for footprint cavities is automatically displayed.



Show Footprint dialog box

Note:

- The port application name is shown next to the cavity in 2D views.
- If a footprint has only one cavity of the type Cartridge Valve/ Port or Drill Hole, then the port application name for this cavity is not shown.



Port application name with cavity in 2D drawing

91. Show Stamping Text

Display the stamping text, which is enclosed within a rectangle, in 2D drawing views.

Stamping text is displayed at the locations specified when creating the text in the part model.

MDTools 960

> Show Stamping Text

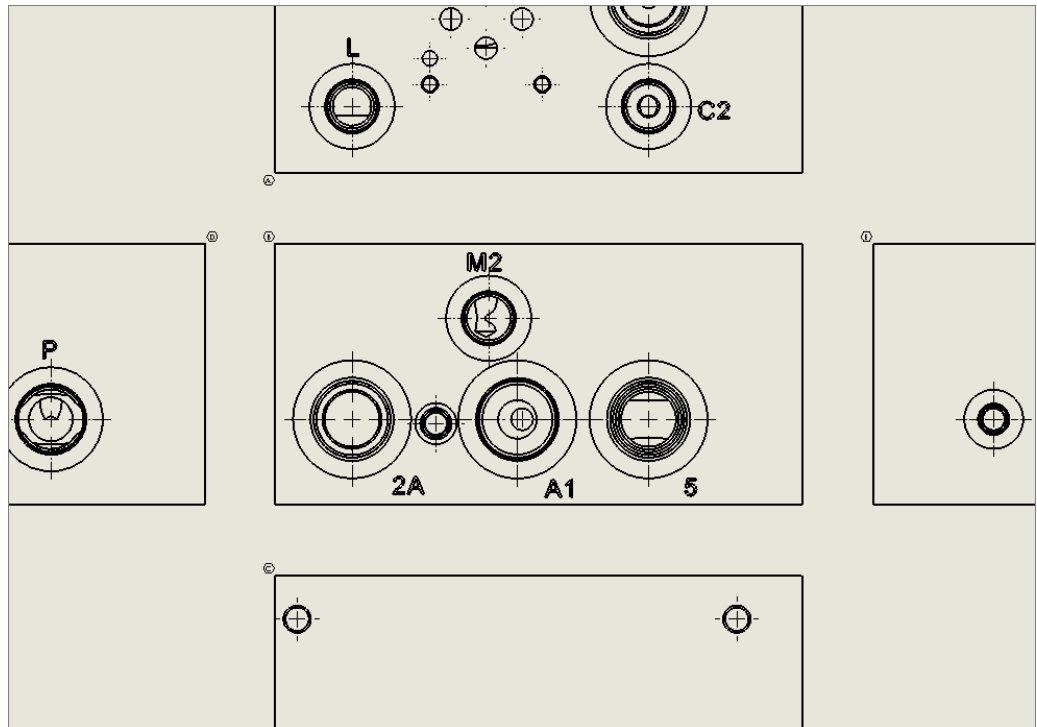
MDTools® displays the stamping text, which is enclosed within a rectangle, near the cavity.

Note:

- All the stamping text in a view, move together when you drag the stamping text.
- If 2D views are created manually, then use the following naming convention for the manifold views.

Top	A
Front	B
Bottom	C
Left	D
Right	E
Back	F

- The Show Stamping Text command will not work, if you do not use the view names, per naming conventions.



Stamping Text displayed (enclosed in a rectangle)
on 2D drawing

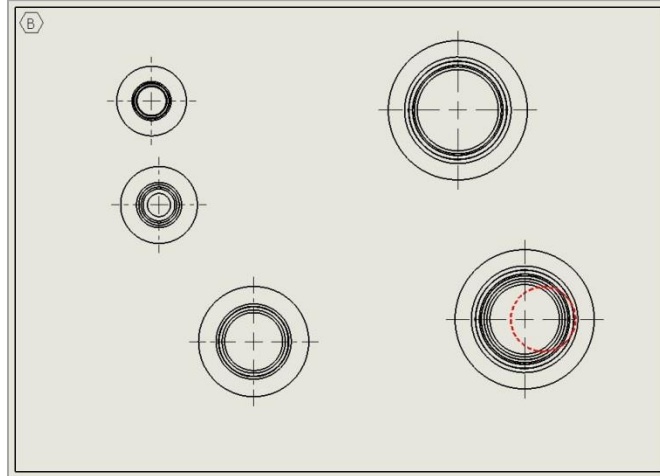
92. Show Undercut

Automatically displays the top view of undercuts as circle in 2D drawing.

MDTools 960

> Undercut

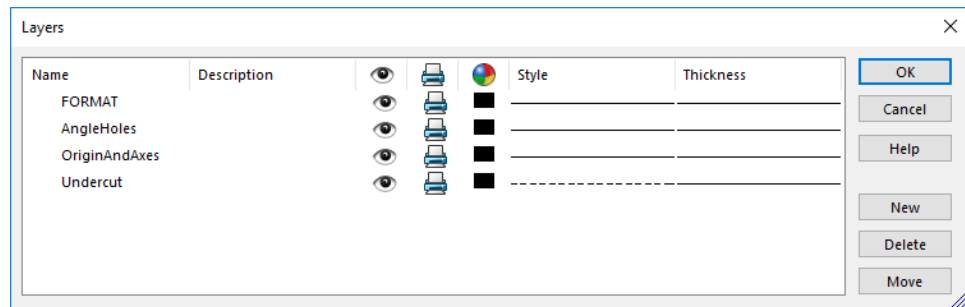
MDTools* displays the Top View of undercuts as circle in 2D drawing.



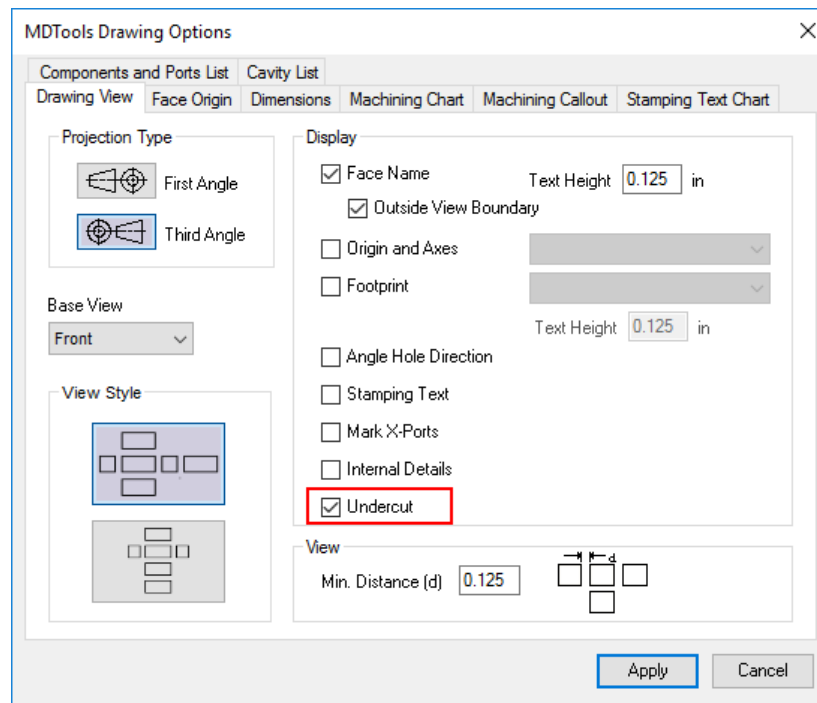
Top View of undercut in view

Note:

- Undercuts are placed on a separate layer.
- The Create views command displays the top view of undercut while creating the drawing views. This is possible if the Undercut option is checked in the Drawing view page of MDTools Drawing Options.



View Undercut Layer in Layers Properties dialog box



Undercut in MDTools Drawing Options

93. Mark Construction Holes

Automatically mark the construction holes in the 2D drawing view.

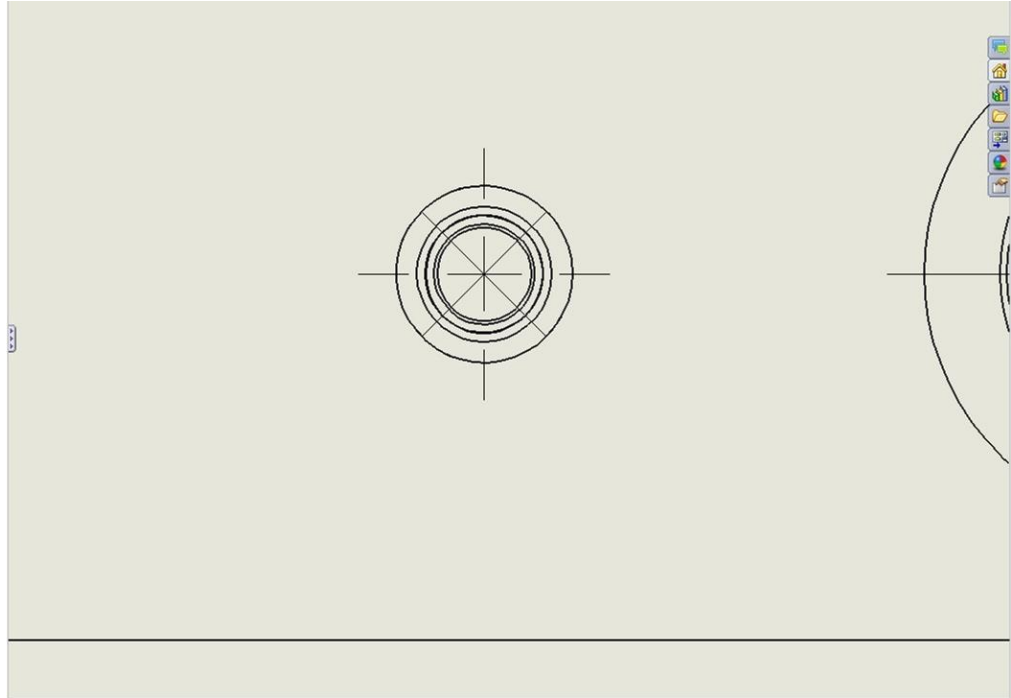
MDTools 960

> Mark Construction Ports

MDTools® marks the construction ports by creating a circle and a cross inside it.

Note:

If the construction plug is at an angle, it is marked with an ellipse enclosing the cross.

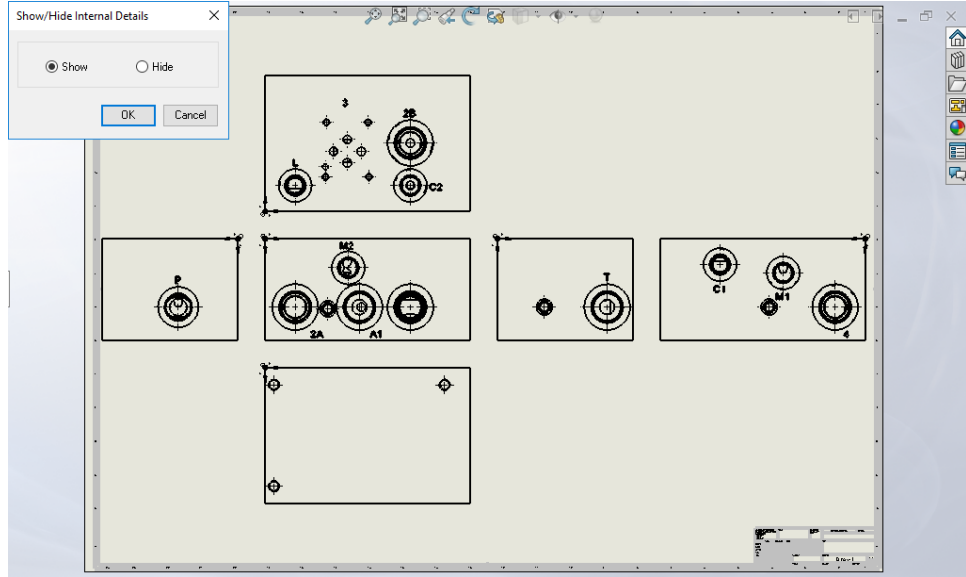


Construction holes marked in 2D drawing

94. Show/Hide Internal Details

Automatically display or hide the internal details of the drawing views created using MDTools®.

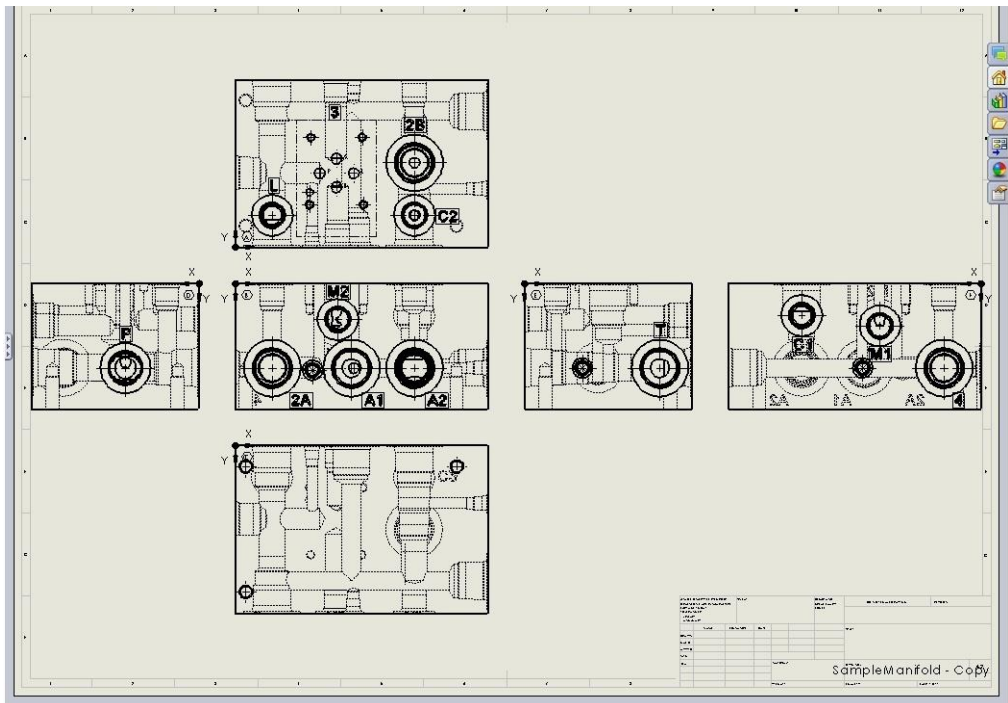
1. MDTools 960
 > **Show/Hide Internal Details**
 The *Show/Hide Internal Details* dialog box displays.
2. Select the **Show** option to display the internal details of the drawing views.
 or
 Select the **Hide** option to hide the internal details of the drawing views.
3. Click **OK**.
 MDTools automatically displays/hides the internal view details for all the MDTools created drawing views.



Show/Hide Internal Details dialog box

Note:

- If the part document is modified, then the changes will not be reflected automatically. Re-run the program to update the hidden view details.
- An additional part document will be created with the same name as the part document name suffixed with “_Internal”. Do Not Delete this File.



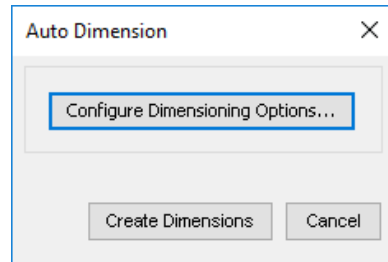
Internal details displayed for the views

95. Auto Dimension

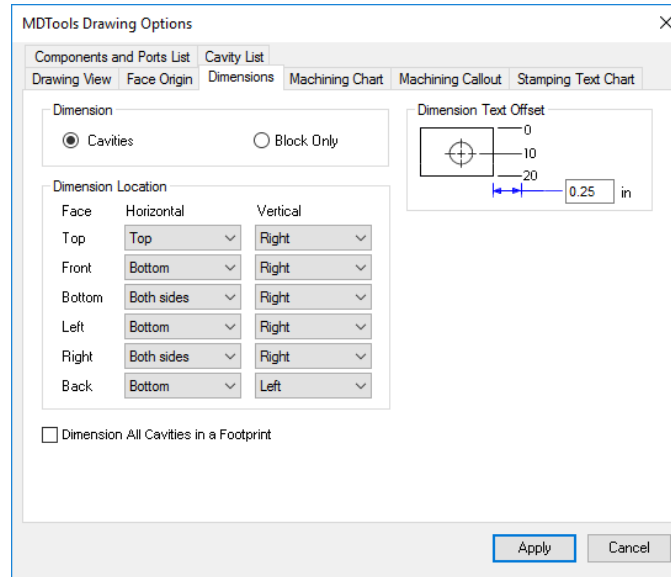
Automatically dimension all the cavities on all the six views of the manifold in the 2D drawing.

1. MDTTools 960
> **Auto Dimension**
The Auto Dimension dialog box displays.
2. Click Configure Dimensioning Options....
The MDTTools® Drawing Options dialog opens the Dimensions tab.
3. Configure, as required.
4. Click **Apply**.
5. Click **Close**.
6. Click **Create Dimensions** in the Auto Dimensions dialog box.
MDTools starts creating dimensions, per the options selected in the MDTTools Drawing Options dialog box.

All the dimensions will be created with the properties set in the current dimension style.



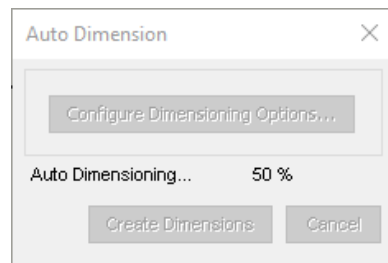
Auto Dimension



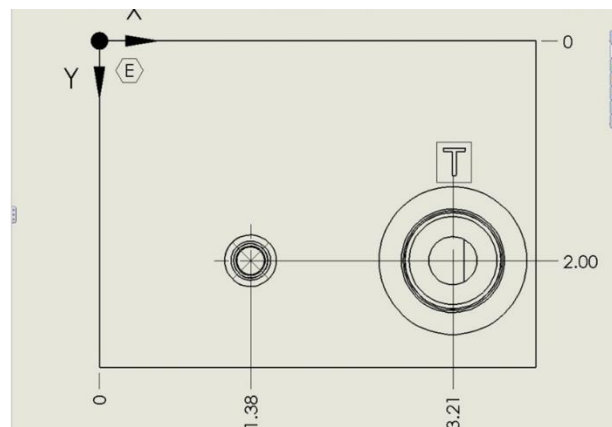
Auto Dimension Options

Note:

- If the 2D views are created manually, then use the following naming convention for the manifold views.
- Top A
Front B
Bottom C
Left D
Right E
Back F
- The Auto Dimension command of MDTTools will not work, if you do not use the view names, per naming conventions.
- The dimension text height does not change on scaling the views.



Auto Dimension wait box

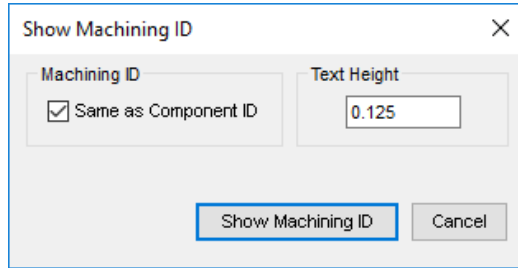


Cavity dimensioned automatically

96. Show Machining ID

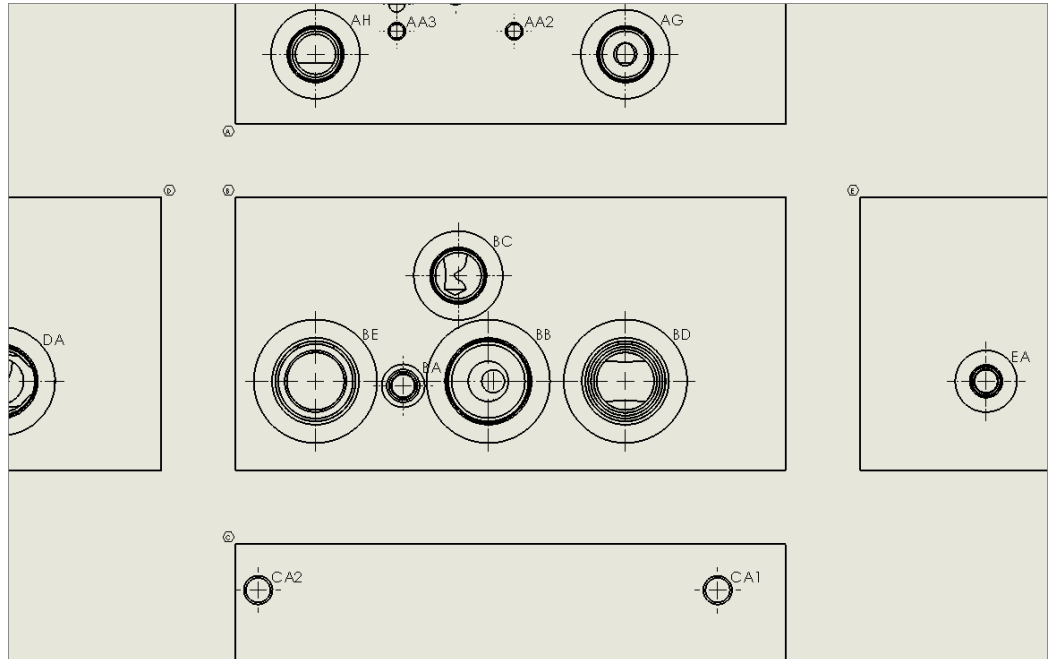
Automatically display the cavity machining ID near the cavities in the 2D drawing views.

1. MDTools 960
> **Show Machining ID**
The Show Machining ID dialog box displays.



Show Machining ID dialog box

2. Select **Same as Component ID**, if you want to use the component ID as the cavity machining ID. Set the default option from the MDTools Settings dialog box.
3. Enter text height.
4. Click Show Machining ID. MDTools® displays the cavity machining ID near the outermost circle at 45 degrees from the center of each cavity.



Cavity machining ID on 2D drawing

Note:

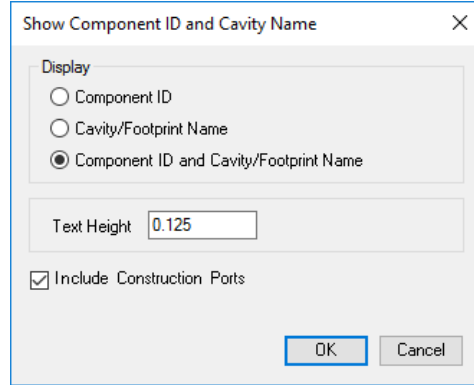
- If the 2D views are created manually, then use the following naming convention for the manifold views.

Top	A
Front	B
Bottom	C
Left	D
Right	E
Back	F
- The Show Machining ID command will not work, if you do not use the view names, per naming conventions.
- If the manifold views are scaled, the machining ID text size and location are not scaled automatically. Therefore, it is advisable to first set the view scale and then insert machining ID on the views.
- If the view scale is modified after inserting the machining ID, then you need to manually delete the machining ID and recreate the IDs using the Show Machining ID command.

97. Show Component ID

Automatically display the component ID near the cavities in the 2D drawing views.

1. MDTools 960
> **Show Component ID**
The Show Component ID and Cavity Name dialog box displays.



2. Select the required **Display** options.
Select the Component ID option to display the component ID.
Component ID is the default selection.

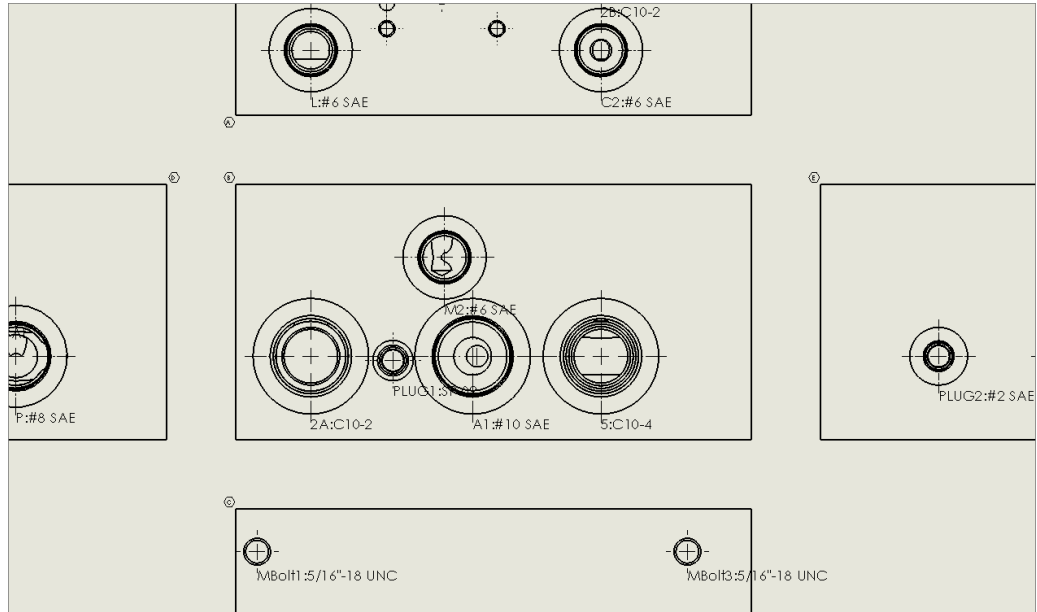
Select the Cavity/Footprint Name option to display the cavity/footprint name.

Select the Component ID and Cavity/Footprint Name option to display the cavity/footprint name with the component ID.

Select the Include Construction Ports option to display the construction ports.

3. Enter Text Height.
4. Click **OK**.
MDTools® displays the component ID near the outermost circle at the bottom of the cavity.

Show Component ID dialog box



Component ID with cavity name in 2D drawing

Note:

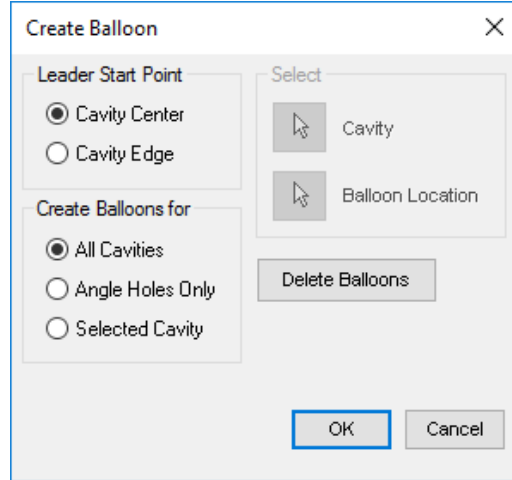
- If the 2D views are created manually, then use the following naming convention for the manifold views.

Top	A
Front	B
Bottom	C
Left	D
Right	E
Back	F
- The Show Component ID command will not work, if you do not use the view names, per naming conventions.

98. Create Balloon

Automatically create balloons around the cavity machining ID for all cavities in the 2D drawing.

- MDTools 960
> **Create Balloon**
The *Create Balloon* dialog box displays.
- Select the required **Leader Start Point**.
- Select the Cavity Center option to start the leader from the cavity center.
- Select the Cavity Edge option to start the leader from the cavity edge.
The *Cavity Edge* option is selected by default.

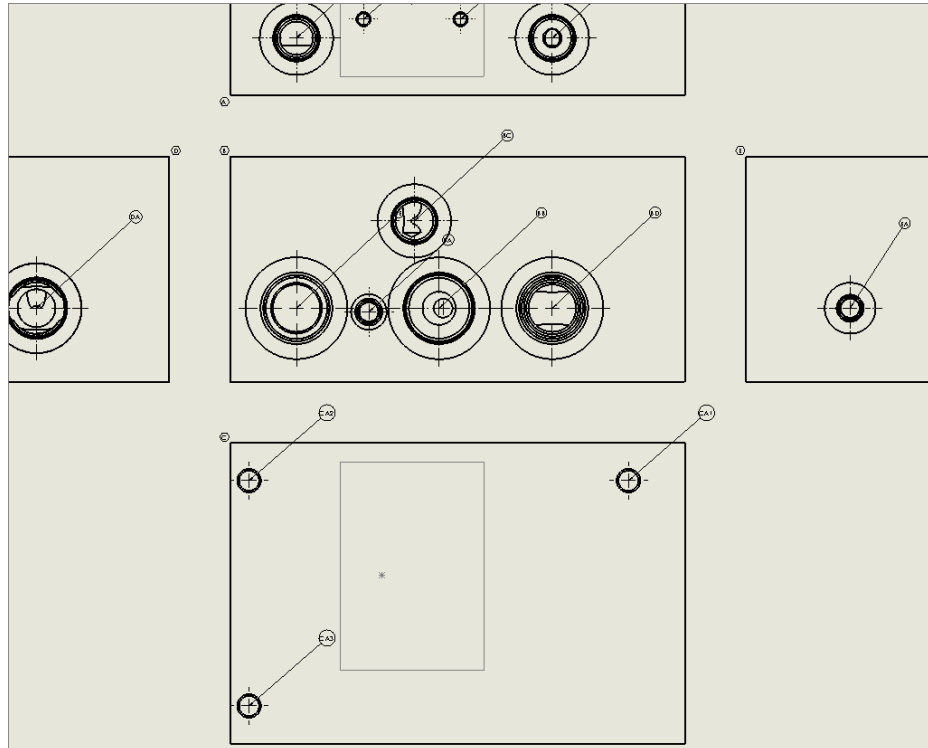


Create Balloon dialog box

Create Balloons for:

All Cavities

MDTools® inserts balloons on all the cavities consisting of the machining ID. The leader is placed at an angle of 45 degrees from the cavity's edge or center, per the selected leader option, in 2D drawing views.



Balloon displayed for all cavities

Angle Holes Only

Selected Cavity

- Select the **Selected Cavity** option in the Create Balloon for group box.
The *select Cavity* button and *Balloon Location* options become active automatically.
- Click the **Balloon Location** select button.
- Select the point where you want to place the balloon.
- Click **OK**.

To move a balloon,

Drag the balloon to the desired location.

The text automatically moves with the balloon.

To delete all balloons,

Click the **Delete Balloons** button.

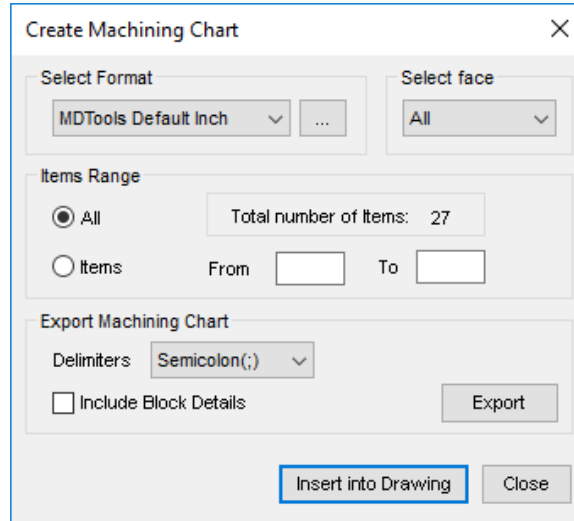
99. Machining Chart

Once the design of a manifold is complete and checked, the machining chart of the design can be automatically extracted from the manifold and inserted into the 2D machining drawing.

The Machining Chart command enables you to automatically extract the machining data from all the cavities and create the machining chart.

Creating the Machining Chart

1. MDTools 960
> **Machining Chart**
The Loading Cavities List message box displays followed by the Create Machining Chart dialog box.



Create Machining Chart dialog box

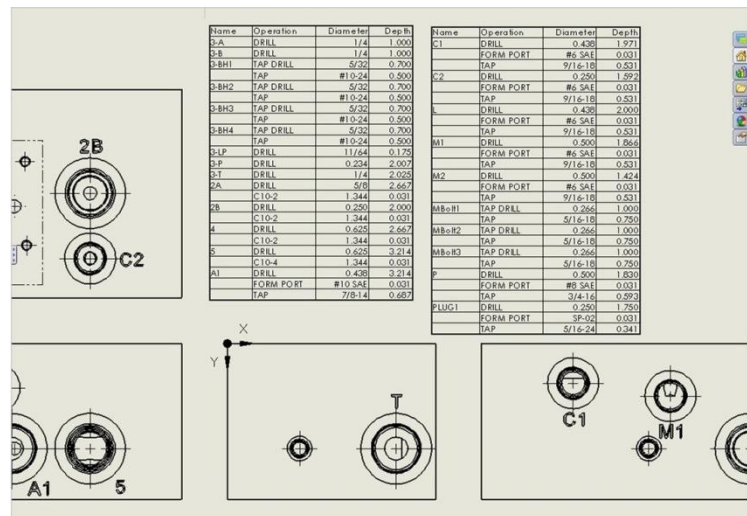
2. Select a format for the machining chart from the **Select Format** dropdown.
3. Click(...), the Configure Machining Chart Formats button to edit or create a machining chart format, if required.
The MDTools Drawing Options dialog box displays. Create or edit a machining chart format using this dialog box.

4. Select a face from the dropdown, if you want to create machining chart for any particular face otherwise select **All**. (**All** is the default option)
5. Select **All** in the **Items Range** group, if you want to create a complete machining chart.

Or,

Select the **Items** option and enter the start and end item index to create a list of specific item range.

6. Click Insert into Drawing.
The Select Top Left Corner (Point1) message displays.



Machining Chart inserted into Drawing

7. Click **OK**.
8. Select top left corner to define a rectangular window for the machining chart.
The Select Bottom Right Corner (Point2) message displays.
9. Click **OK**.
10. Select bottom right corner to define a rectangular window to place the machining chart.
MDTools® creates the machining chart in the selected window, per the selected machining chart format.

If the selected area is insufficient to create the complete machining chart, the Select Top Left Corner (Point1) message reappears.

11. Repeat the above steps until the complete machining chart is created in the drawing.

Note:

- The General Tables style in SolidWorks is used to create the machining chart.
- Use the word 'AND' instead of '&' in cavity machining information. Using '&' will result in bad data in the machining chart. (Limitation in SolidWorks)
- The machining chart is not associated with the model. When the model changes, the machining chart needs to be re-generated.

Name	Operation	Diameter	Depth
C1	DRILL	0.438	1.971
	FORM PORT	#6 SAE	0.031
	TAP	9/16-18	0.531
C2	DRILL	0.250	1.592
	FORM PORT	#6 SAE	0.031
	TAP	9/16-18	0.531
L	DRILL	0.438	2.000
	FORM PORT	#6 SAE	0.031
	TAP	9/16-18	0.531
M1	DRILL	0.500	1.866
	FORM PORT	#6 SAE	0.031
	TAP	9/16-18	0.531
M2	DRILL	0.500	1.424
	FORM PORT	#6 SAE	0.031
	TAP	9/16-18	0.531
MB0H1	TAP DRILL	0.266	1.000
	TAP	5/16-18	0.750
MB0H2	TAP DRILL	0.266	1.000
	TAP	5/16-18	0.750
MB0H3	TAP DRILL	0.266	1.000
	TAP	5/16-18	0.750
P	DRILL	0.500	1.830
	FORM PORT	#8 SAE	0.031
	TAP	3/4-16	0.593
PLUG1	DRILL	0.250	1.750
	FORM PORT	SP-02	0.031
	TAP	5/16-24	0.341

Machining Chart

Exporting the Machining Chart

- Select various options for the machining chart, as explained above.
- Specify the delimiter in the **Delimiters** dropdown, per the selected option.
Each of the columns in the machining chart can either be:
 - Space Delimited
separated by spaces
 - Semi Colon (;) Delimited
separated by semi colons
 - Tab Delimited
separated by tabs
 - Comma (,) Delimited
separated by commas
- Select **Include Block Details** to include the manifold block details in the exported machining chart text file.
- Click the **Export** button.
The Save As dialog box displays.
- Specify the file name and the path, press **OK**.
The Machining chart is saved as a text file at the specified location.

```

NAME;OPERATION;DIAMETER;DEPTH
2A;DRILL;5/8;2.667
;C10-2;1.344;0.031
2B;DRILL;0.250;2.000
;C10-2;1.344;0.031
3-A;DRILL;1/4;1.000
3-B;DRILL;1/4;1.000
3-BH1;TAP DRILL;5/32;0.700
;TAP;#10-24;0.500
3-BH2;TAP DRILL;5/32;0.700
;TAP;#10-24;0.500
3-BH3;TAP DRILL;5/32;0.700
;TAP;#10-24;0.500
3-BH4;TAP DRILL;5/32;0.700
;TAP;#10-24;0.500
3-LP;DRILL;11/64;0.175
3-P;DRILL;0.250;2.000
3-T;DRILL;1/4;2.025
4;DRILL;0.625;2.667
;C10-2;1.344;0.031
5;DRILL;0.625;3.214
;C10-4;1.344;0.031
A1;DRILL;0.438;3.214
;FORM PORT;#10 SAE;0.031

```

Exported Machining Chart

100. Create Machining Callout

Automatically create leader-type cavity machining callout for all the cavities in the 2D drawing.

It automatically extracts the cavity machining detail from all the cavities and inserts with the leader on the cavities.

Position of existing machining callouts will be retained.

MDTools 960

> Machining Callout

The Create Machining Callout dialog box displays.

Create Machining Callout for Cavities

To create the machining callout for all cavities, Click **All Cavities**.

MDTools® inserts the leader on all cavities consisting of machining detail and places the leader from the cavities center at an angle of 45 degrees.

To create the machining callout for the angle holes.

Click **Angle Holes Only**.

Note: Angle Holes only option does not delete existing cavity callouts.

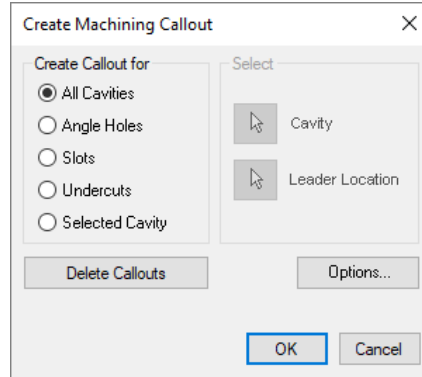
To create the machining callout for a cavity

1. Click the **Cavity** select button.
The **Select Leader point** button becomes active automatically.
2. Click the **Leader Location** select button.
3. Select the point where you want to place the leader.
4. Click **OK**.

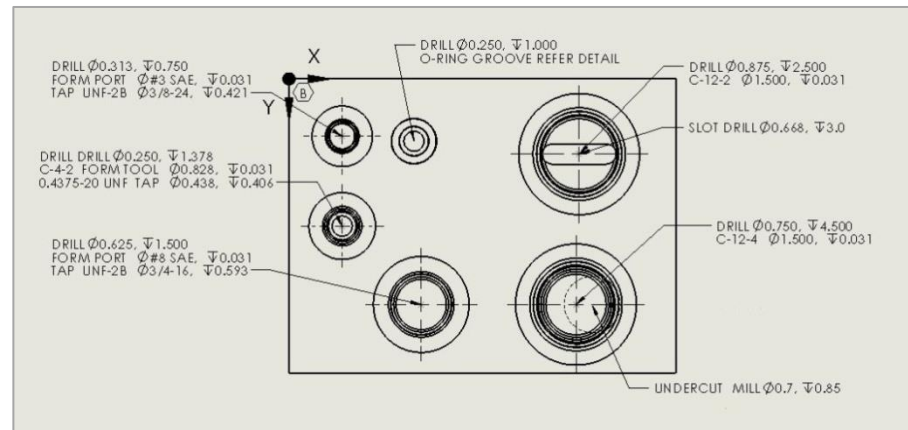
To delete callouts, click **Delete Callouts**.

Note:

- To move a machining detail, drag the leader endpoint to the desired location.
The text moves automatically.
- **All cavities** and **Angle Hole Only** option doesn't change the location of existing callout.



Create Machining Callout dialog box



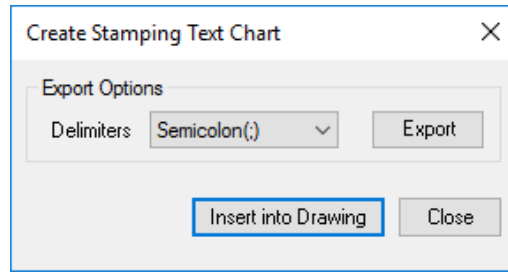
Machining Callout displayed for all the cavities in the 2D drawing

101. Create Stamping Text Chart

Automatically insert a Stamping text chart in the drawing sheet.
 The chart includes Stamping text, location, view name, rotation angle, size, and font.
 You can also export the table as a text file.

1. MDTools 960
 > **Stamping Text Chart**

The Create Stamping Text Chart dialog box displays.



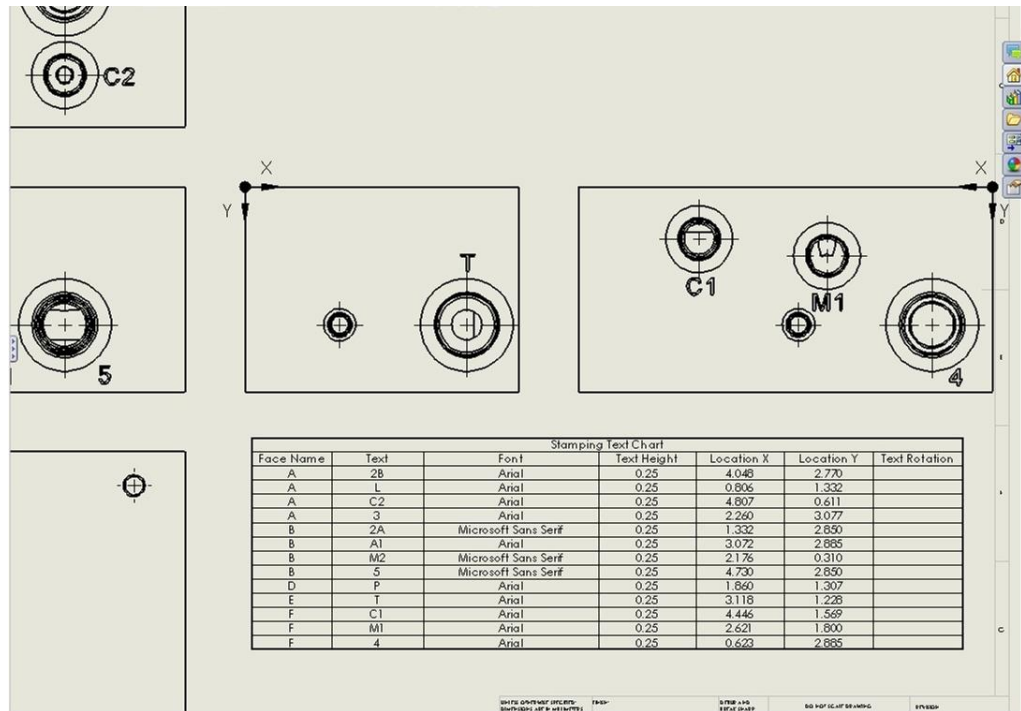
Stamping Text Chart dialog box

2. Click **Insert into Drawing** to insert the table in the drawing.
 The Select Point dialog box displays.

3. Choose a point for inserting the table.
 MDTools[®] automatically creates a table at the selected point.

Note:

- The list displays only the stamping texts, which is shown in the model.
- Suppressed stamping is not listed in the Stamping Text Chart.

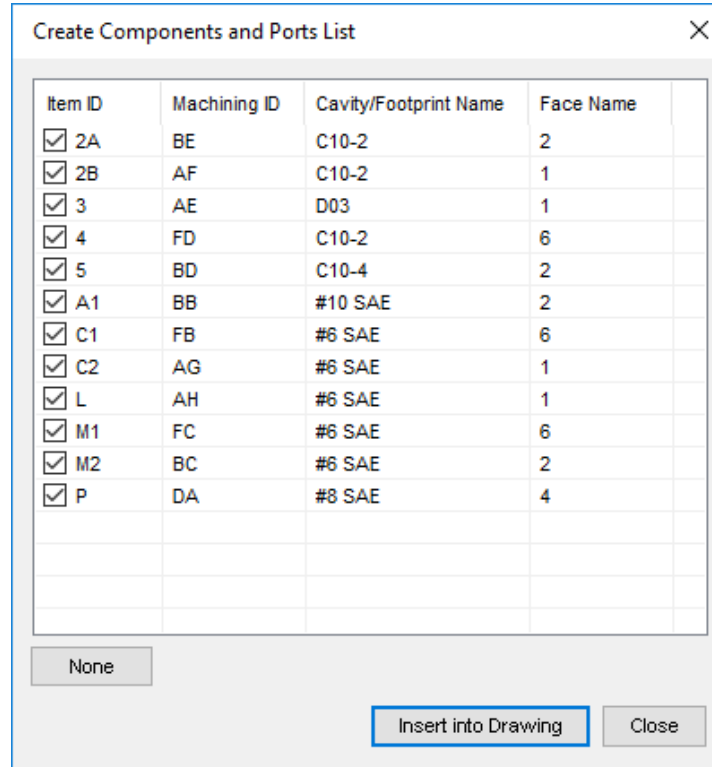


Stamping Text Chart in the drawing

102. Create Components and Ports List

Insert a cavity table consisting of the component ID, cavity name, and face name in the 2D drawing.

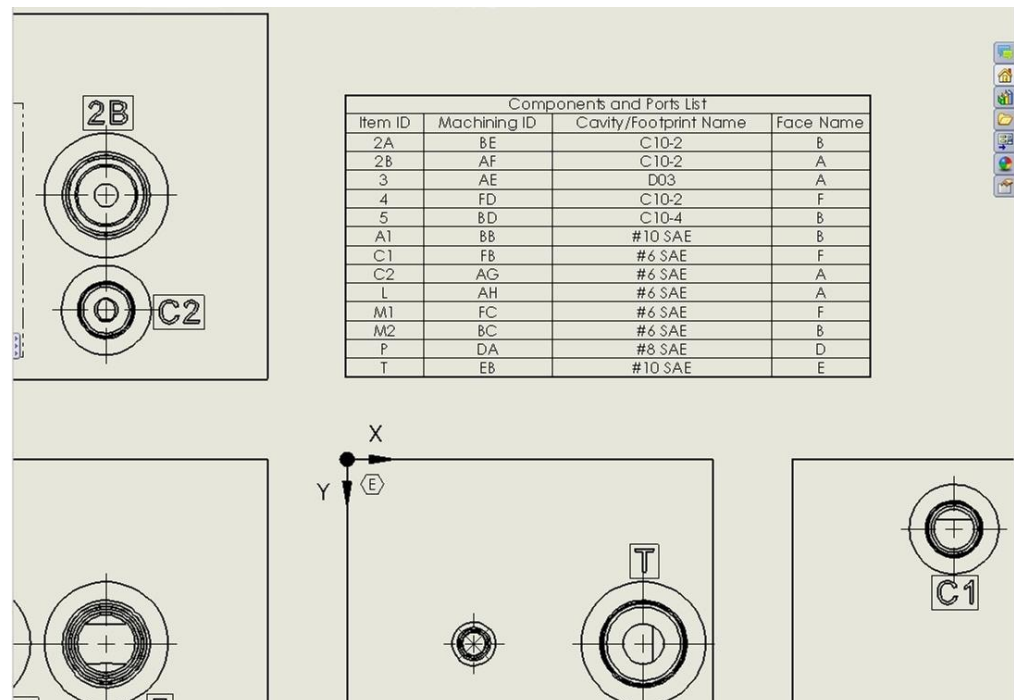
- MDTools 960
> **Components and Ports List**
The Create Components and Ports List dialog box displays.
- Select the cavities to be included in the table.
- Click Insert into Drawing.
The Select Top Left Corner message displays.
- Click **OK**.
- Select the top left corner to define a rectangular window for the Components and Ports list.
The Select Bottom Right Corner message displays.



Create Components and Ports List dialog box

- Click **OK**.
- Select the top left corner to define a rectangular window for the Components and Ports list
MDTools® creates the Components and Ports list in the selected window.

When the selected window is insufficient to create the complete Components and Ports list, the Select Top Left Corner message displays.



Components and Ports List inserted into a 2D drawing

- Repeat the above steps, till the complete Components and Ports list is created in the drawing.

Note:

You can configure Components and Ports List options using MDTools Drawing Options.

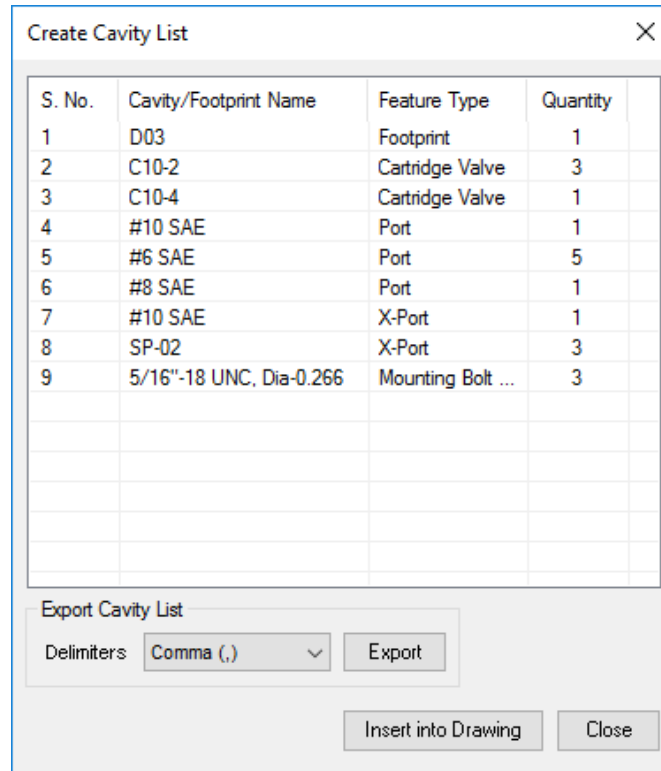
103. Create Cavity List

Insert the list of the cavities including, X-drill plugs, mounting bolt holes, drill holes, slots, undercuts, and O-ring grooves into the drawing, per options specified in MDTools Drawing Options. All similar cavities will be grouped.

You can sort the list either by Cavity/Footprint Name or Cavity Type.

You can also export the list into a text file with the selected delimiter.

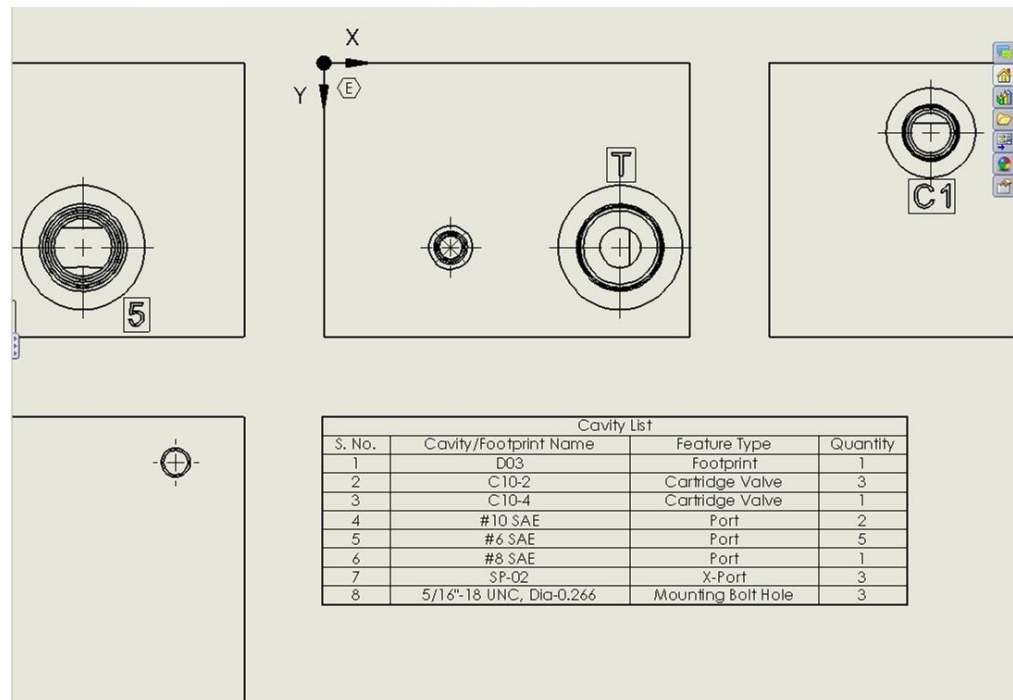
1. MDTools 960
> **Cavity List**
The Create Cavity List dialog box displays.
2. Click **OK**.
The Select Top Left Corner message displays.
3. Click **OK**.
4. Select the top left corner to define a rectangular window for the cavity list.
The Select Bottom Right Corner message displays.
5. Click **OK**.
6. Select the top left corner to define a rectangular window for the cavity list.
MDTools® creates the Construction port table in the selected window.



Create Cavity List dialog box

When the selected window is insufficient to create the complete cavity list, the Select Top Left Corner message displays.

7. Repeat the above steps, till the complete cavity list is created in the drawing.



Cavity List inserted into a 2D drawing

Note:

You can configure the cavity list using MDTools Drawing Options.

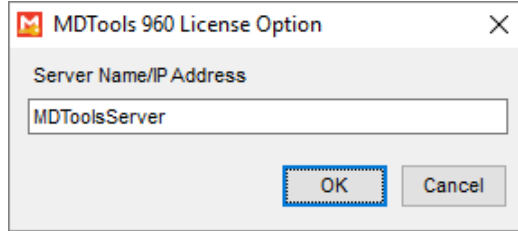
104. License Options

Set the license path through the Part Model menu.

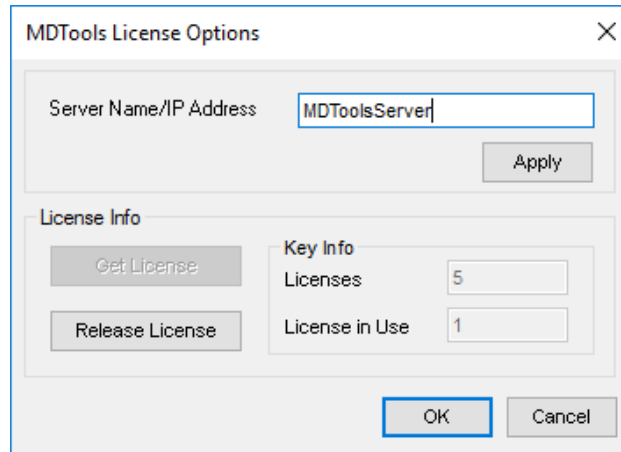
1. MDTools 960
> **License Options**
The MDTools License Options dialog box displays.
2. Enter the server name or the IP address of the system, where the MDTools hardware lock is located.
3. Click **Apply**.
MDTools® automatically selects a license and displays the license information in the License info form.

If a license is selected successfully, then the Get License button is disabled and the Release License button is enabled.

4. To release a license, click the **Release License** button.
This releases your license, the Release License option is disabled and the Get License button is enabled.
5. To get a license, click the **Get License** button.
If MDTools successfully gets a license, then the Get License button is disabled and the Release License button is enabled.
6. Click **OK** to continue.



MDTools 960 License Option dialog box



License Options dialog box

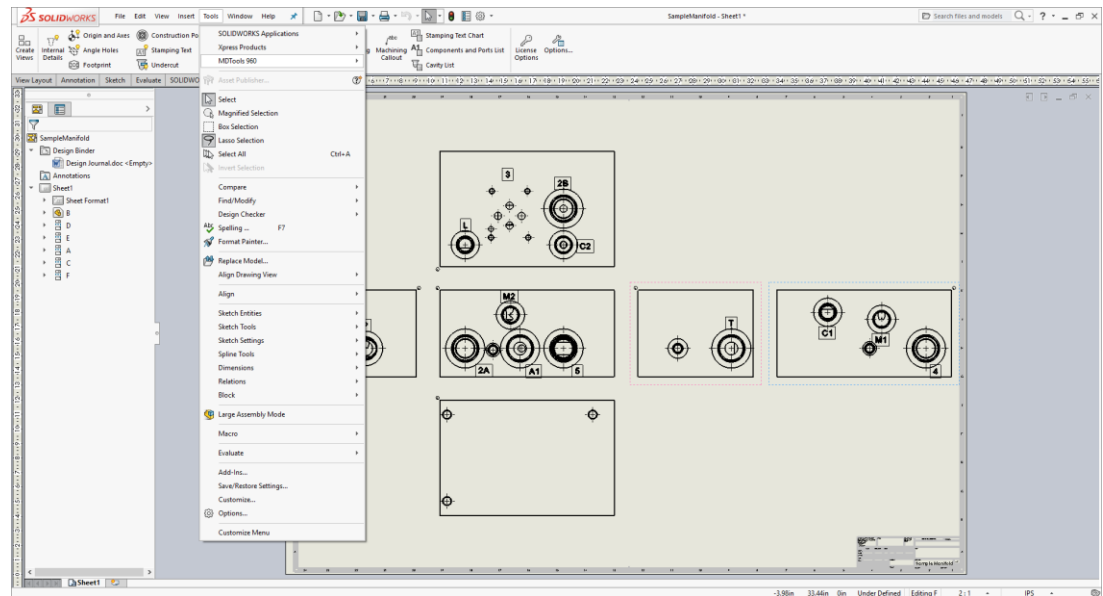
Note:

This option is available only in the MDTools 960 Network license version.

105. MDTools Drawing Options

Configure the various options and settings used by MDTools® drawing commands to create machining drawing in the Part model environment.

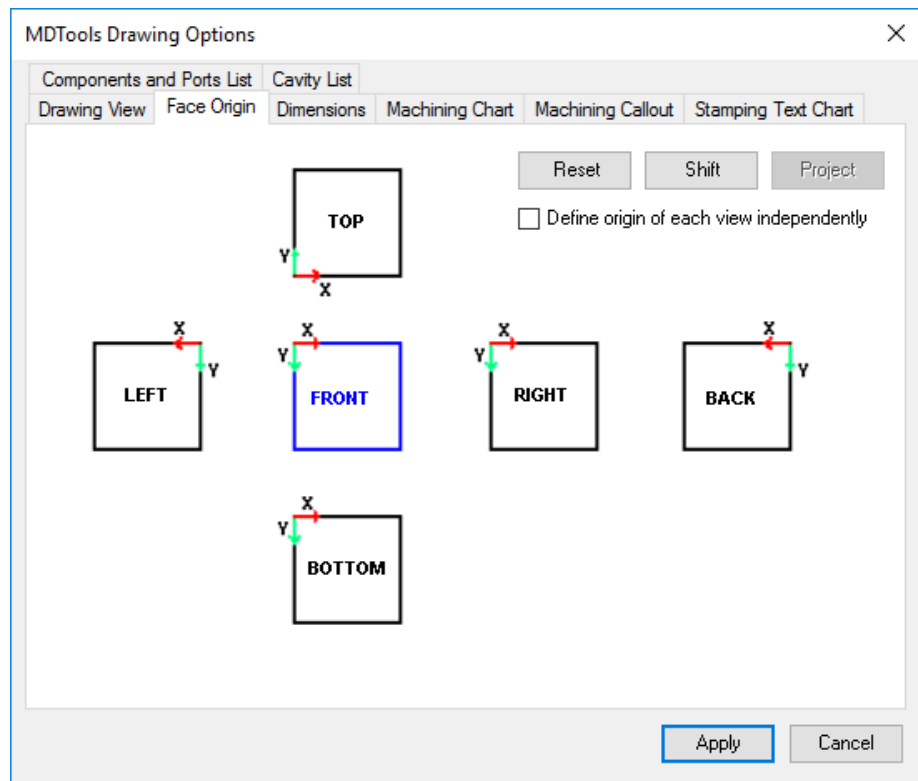
1. MDTools 960
 > MDTools
 Drawing Options
 The MDTools Drawing Options dialog box displays.
2. Specify various options, per requirement.
3. Click **Apply** to save the changes.



MDTools Drawing Options menu

Face Origin tab

1. Select projection type option to update the view orientation in display.
2. Select a face to change the origin.
3. Click **Shift Origin** to shift the origin of the selected face in the counter-clockwise direction.
4. Click **Project Origin** to project the current origin of the selected face to other faces.
5. Click **Reset** to reset the origin of all faces to default, per the MDTools standard.
6. Select **Define origin of each view independently**.
7. If unselected, the **Shift** option will shift the current face origin and then project other face origins according to the current face origin.



Face Origin tab

Note:

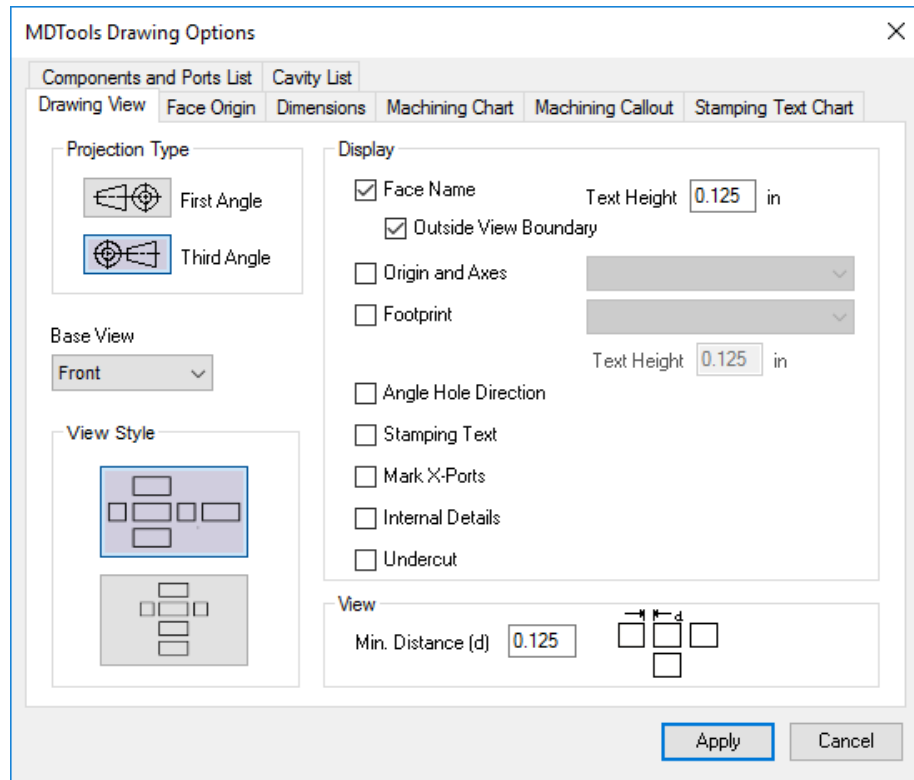
The face origin setting will be used by various drawing commands, such as Origin and Axes, Auto Dimension, Machining Chart etc.

Drawing View tab

1. Specify the projection type for the drawing views.
2. Specify a view you want to use as the base view from the **Base View** dropdown.
3. Select a style from the **View Style** group for positioning of views.
4. Select **Face Name** in the Display group and select the **text height** to display the face name for all the drawing views.
5. Select **Origin and Axes** to display origin and axes for the drawing views, per the selected option in the dropdown.
6. Select **Footprint** and the required option from the dropdown list to display the footprint envelope and the **port application name** in the drawing views.
7. Select **Angle Hole Direction**, if you want to show the direction of angle holes in the drawing views.
8. Select **Stamping Text** to display stamping text in the drawing views.
9. If **Mark X-Ports** is selected, then all the X-ports will be automatically marked when creating the drawing views.
10. Select **Internal Details** to display the internal details for the drawing views.
11. Select the **Undercut** option,
MDTools displays undercuts as circles in Drawing views.
12. Specify the **Min. Distance value** between the views.

Note:

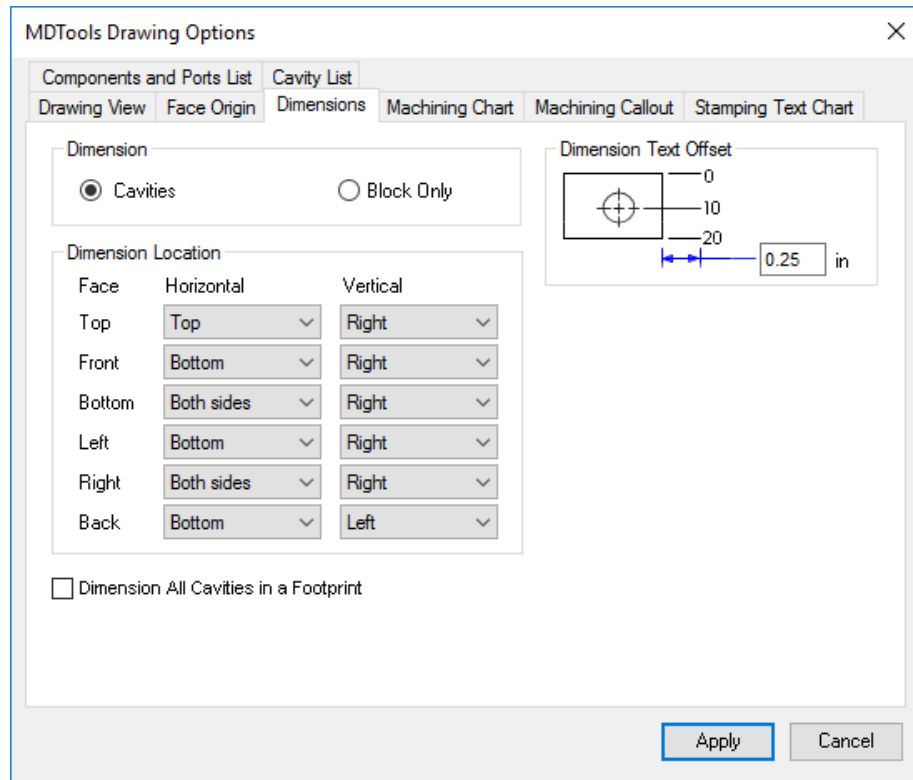
The Drawing View options will be used by the Create Machining Drawing and Create Views commands when creating the drawing views.



Drawing View tab

Dimensions tab

1. Select the **Cavities** option from the Dimension group to dimension all cavities in the drawing views.
 - a. Specify dimension location for all the drawing views.
 - b. Select the **Dimension All Cavities in a Footprint** option to create dimensions for all cavities in a footprint, else only the parent cavity will be dimensioned.or,
Select the **Block Only** option to dimension only the manifold block in the drawing.
2. Specify the offset value for the dimension text.



Dimensions tab

Note:

Options specified in the Dimensions tab will be used by the Auto Dimension command and the Create Machining Drawing command during the automatic drawing creation process.

Machining Chart tab

Manage the machining chart formats in this tab.
You can create, edit, and delete a machining chart format.

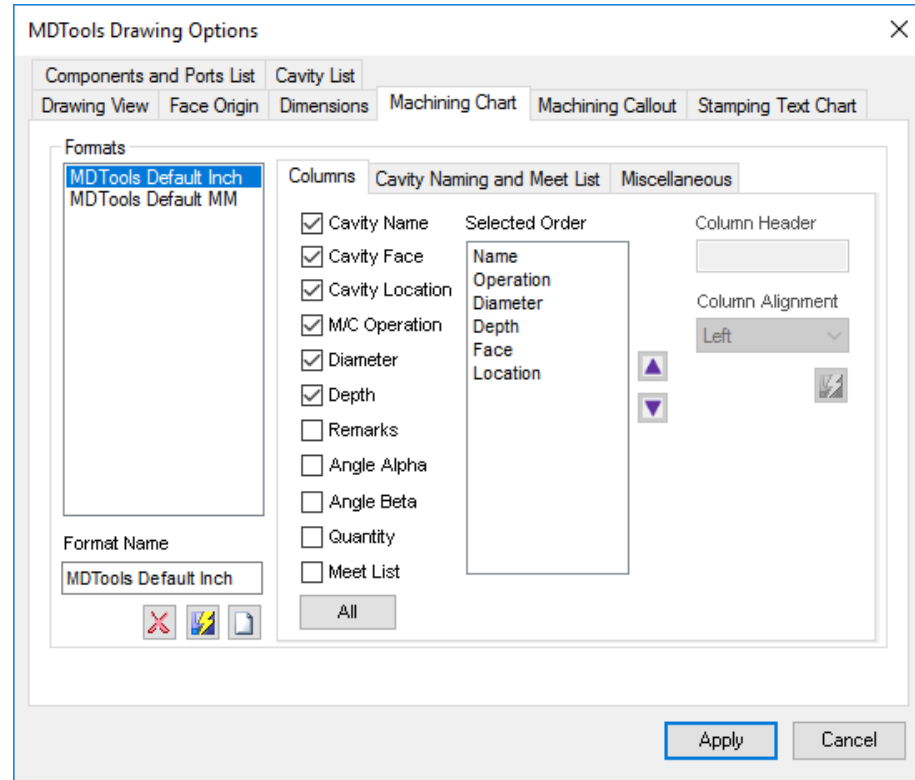
Formats

Create a new
Machining Chart
Format.

1. Enter name of the format in the **Format Name** text box.
2. Click the **Add New Format** icon.
A new format is added to the Formats list box.

Columns tab

1. Select or deselect columns, per requirement.
2. Rearrange the sequence of the columns using the up and down buttons, if required.
3. Edit the header text for the selected column by providing new header text in the **Column Header** text box, if required.
4. Specify the alignment for the selected column in the **Column Alignment** combo box.
5. Click the *Update Selected Column* icon, if the column header or alignment is changed for the selected column.

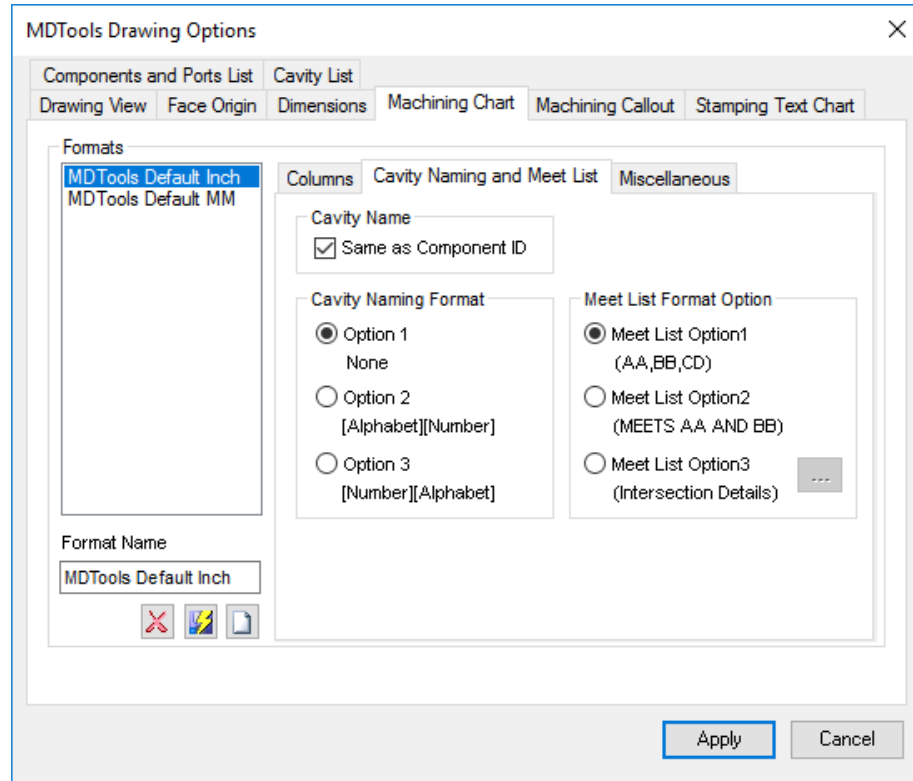


Machining Chart: Columns Tab

Cavity Naming and Meet List tab

Cavity Name

Select **Same as Component ID**, if you want to use the component ID as the cavity name in the machining chart.



Machining Chart: Cavity Naming and Meet List Tab

Cavity Naming Format

Option1:

No Cavity Numbering System

Use this option, if you have not named the cavities using the MDTools Generate Machining ID command. e.g. RV1, SV2-1, SV2-2...

Option2:

[Alphabet][Number] naming

Use this option to add the quantity of identical holes in the machining chart, if the cavity name is 'Alphabets Or Number + Alphabets' and count is a number. e.g. AA, AB1, AB2 AC...

Option3:

[Number][Alphabet] naming

Use this option to add the quantity of identical holes in the machining chart, if you have used it in the MDTools Generate Machining ID command. e.g. 1,2A, 2B, 3...

Meet List Format

Select a Meet List Format option.

Meet List option 1

MDTools lists the meeting cavities in the meet list for a cavity, separated by comma (,).*

Name	Operation	Diameter	Depth	Meet List
FA	DRILL	0.250	0.756	B,B,EB
	FORM PORT	SP-02	0.031	
	TAP	5/16-24	0.341	
FB	DRILL	0.438	1.971	A,F
	FORM PORT	#6 SAE	0.031	
	TAP	9/16-18	0.531	
FC	DRILL	0.500	1.866	A,C1
	FORM PORT	#6 SAE	0.031	
	TAP	9/16-18	0.531	
FD	DRILL	0.625	2.667	B,E,DA,EB
	C10-2	1.344	0.031	

Meet List Option 1

Meet List option 2

MDTools lists the meeting cavities in the meet list for cavity. For clarity, it prefixes the list with the word, MEETS.

Name	Operation	Diameter	Depth	Meet List
FA	DRILL	0.250	0.756	MEETS B,B AND EB
	FORM PORT	SP-02	0.031	
	TAP	5/16-24	0.341	
FB	DRILL	0.438	1.971	MEETS A,F
	FORM PORT	#6 SAE	0.031	
	TAP	9/16-18	0.531	
FC	DRILL	0.500	1.866	MEETS A,C1
	FORM PORT	#6 SAE	0.031	
	TAP	9/16-18	0.531	
FD	DRILL	0.625	2.667	MEETS B,E,DA AND EB
	C10-2	1.344	0.031	

Meet List Option 2

Meet List option 3

MDTools lists the meeting cavities in the meet list for a cavity with Intersection details.

Name	Operation	Diameter	Depth	Meet List	Start Dia	End Dia	Start Depth	End Depth	Edge Offset	Center Offset
FA	DRILL	0.250	0.756	EB	0.250		0.537			
	FORM PORT	SP-02	0.031	B,B	0.250		0.671		0.053	0.053
	TAP	5/16-24	0.341							
FB	DRILL	0.438	1.971	A,F	0.438		1.534			
	FORM PORT	#6 SAE	0.031							
	TAP	9/16-18	0.531							
FC	DRILL	0.500	1.866	A,C1	0.500		1.745	1.995	0.003	0.003
	FORM PORT	#6 SAE	0.031							
	TAP	9/16-18	0.531							
FD	DRILL	0.625	2.667	B,E	1.344					
	C10-2	1.344	0.031	EB	0.875		0.537	0.975		
DA				0.625		1.845	2.595			

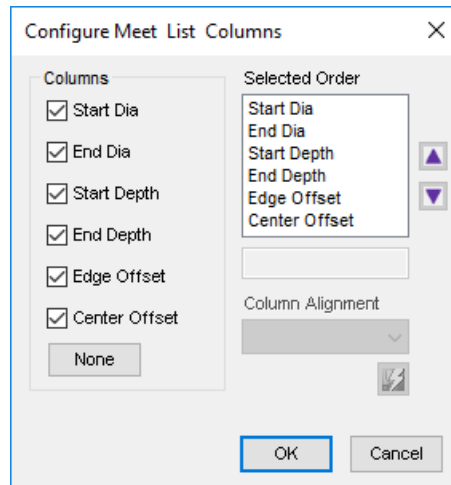
Meet List Option 3

Configure Meet List Columns

Click the **Configure Meet List Columns (...)** button.

Configure the Intersection details column heading, per your requirement in the **Configure Meet List Columns** dialog box.

1. Select columns to include in the Meet list.
2. Rearrange the sequence of columns using the up and down buttons.
3. Edit the column header text for the selected column, if required.
4. Change the column alignment of the selected column by selecting the required alignment from the drop-down list.
5. Click the *Update Selected Column* icon to update the column properties.
6. Click **OK** to save the changes.



Configure Meet List Columns dialog box

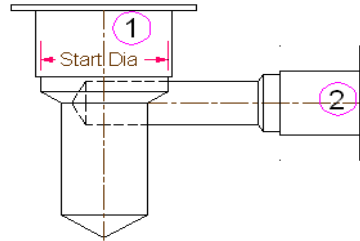
Intersection Details of the Connected Cavities:

MDTools® uses the following fields in the Bore Chart for displaying the intersection details: Meet List, Start Dia, End Dia, Start Depth, End Depth, Edge offset and Center Offset. These properties define the intersection details between two connected cavities.

Start Dia

The Start Dia in the Machining Chart defines the Step diameter of the first cavity at the meet point of the second cavity.

The larger step diameter of the first cavity in the intersecting area is considered as **Start Dia**.

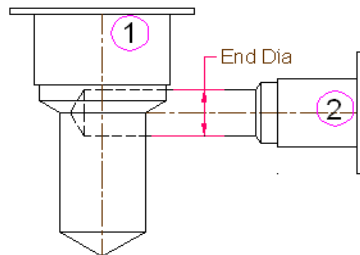


Start Dia

End Dia

The End Dia in the Machining chart defines the Step diameter of the second cavity at the meet point of the first cavity.

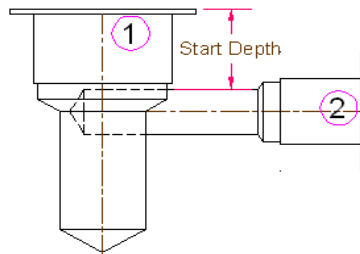
The larger step diameter of the second cavity in the intersecting area is considered as **End Dia**.



End Dia

Start Depth

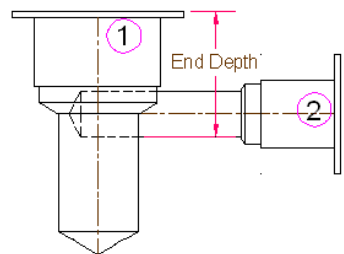
Start Depth is the distance from the spot face of the first cavity to the nearest connecting edge of the second cavity.



Start Depth

End Depth

End Depth is the distance from the spot face of the first cavity to the end connecting edge of the second cavity. If the first cavity is terminated before the second cavity center axis, then the End Depth is considered as null value.

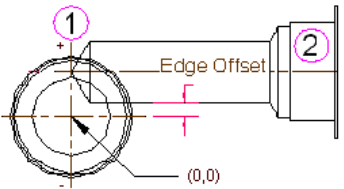


End Depth

Edge Offset

The **Edge Offset** is the distance between the center of the first connecting cavity to the nearest connecting edge of the second connecting cavity.

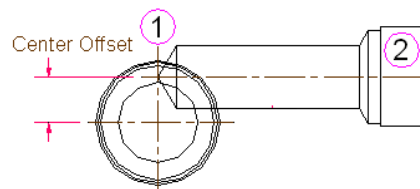
It may be a +ve or a -ve value with respect to the origin.



Edge Offset

Center Offset

Center Offset is the center-axis offset distance between two connected cavities.



Center Offset

Miscellaneous tab.

Depth

The machining depth in the Machining chart can be as follows.

- Full Bore Depth
- Depth to tool tip (For Step0 and Step12)
- Depth to tool tip (For Step0 to Step12)

The machining depth is calculated according to the selected option.

Text Height

Specify the text height for the machining chart

Cell Margins

Specify distances between the text in the chart from top, bottom, left, and right cell boundaries (row and column lines) in the **Cell Margins** group.

Diameter Precision

Select precision for the machining diameter from the **Diameter Precision** dropdown.

Depth Precision

Select precision for the machining depth from the **Depth Precision** dropdown.

Location Precision

Specify precision for the location value of the cavities in the **Location Precision** dropdown.

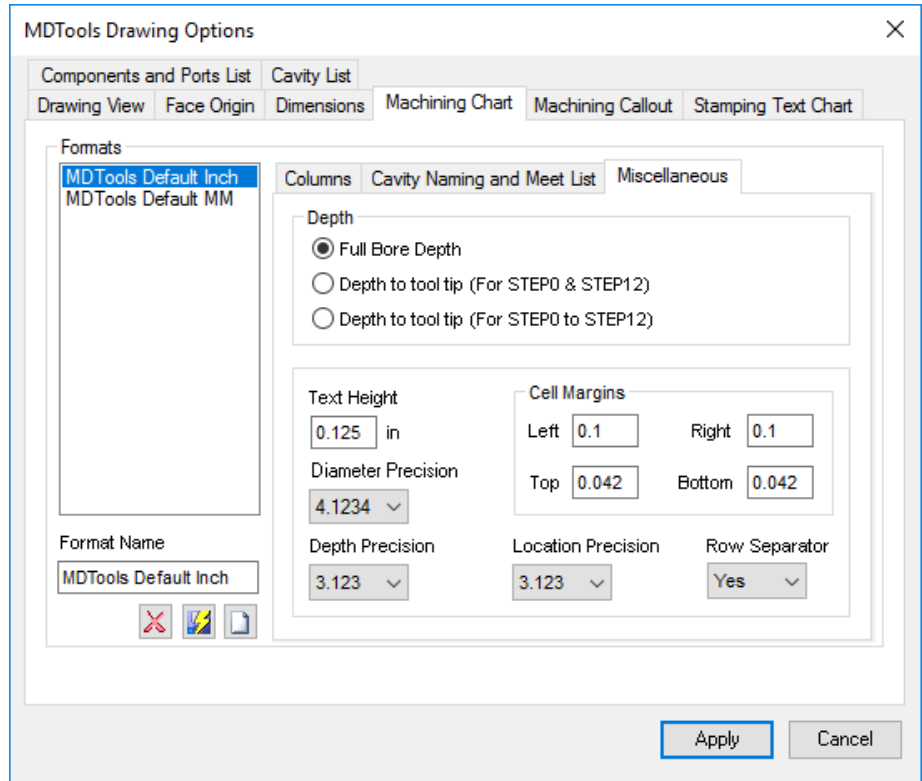
Row Separator

Specify whether a line needs to be drawn for each row of entries in the machining chart.

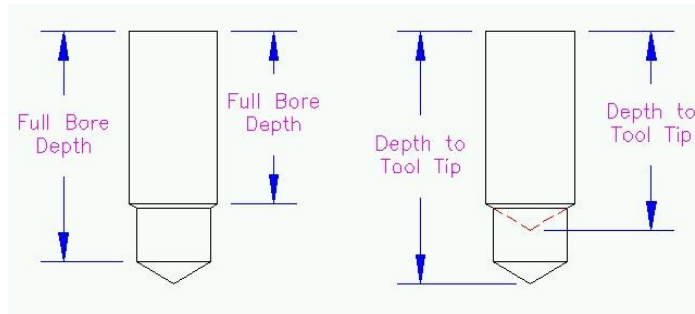
The default option is **Yes**.

If the No option is selected, lines appear above the first row and below the last row of the machining chart, for each cavity in the chart.

Click **Apply** to save new format.



Machining Chart : Miscellaneous Tab



Machining Depth Calculation

Name	Operation	Diameter	Depth	Meet List
EA	DRILL	0.250	1.458	B D
	FORM PORT	SP-02	0.031	
	TAP	5/16-24	0.341	
Eb	DRILL	0.438	5.125	B B, B D, FA, FD
	FORM PORT	#10 SAE	0.031	
	TAP	7/8-14	0.687	

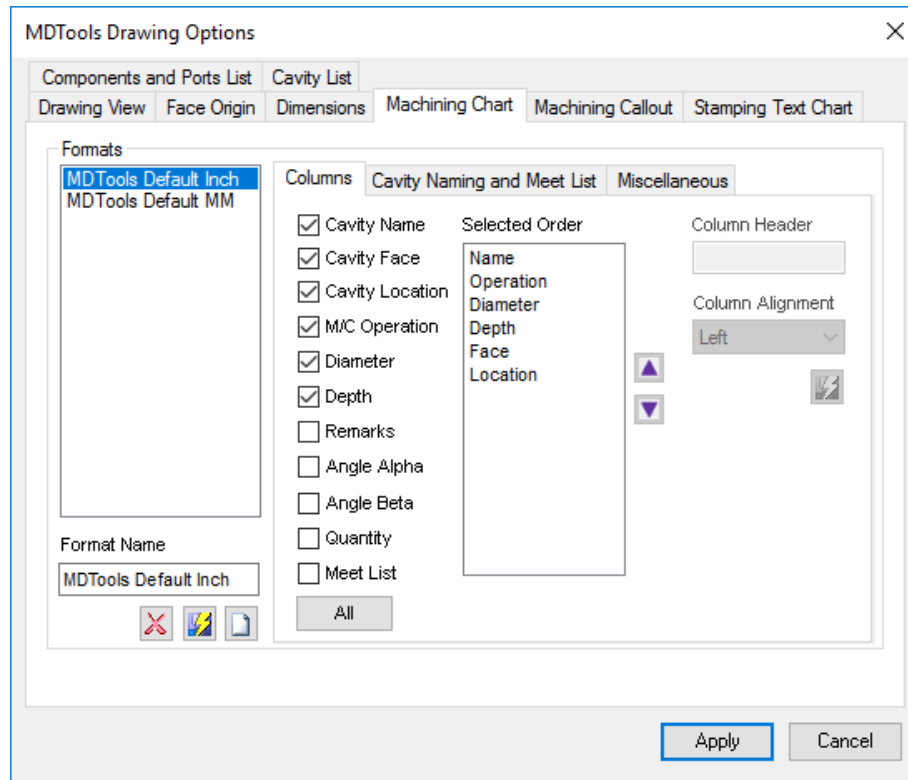
Machining chart with row separator

Name	Operation	Diameter	Depth	Meet List
EA	DRILL	0.250	1.458	B D
	FORM PORT	SP-02	0.031	
	TAP	5/16-24	0.341	
Eb	DRILL	0.438	5.125	B B, B D, FA, FD
	FORM PORT	#10 SAE	0.031	
	TAP	7/8-14	0.687	

Machining chart without row separator

Edit an Existing Format

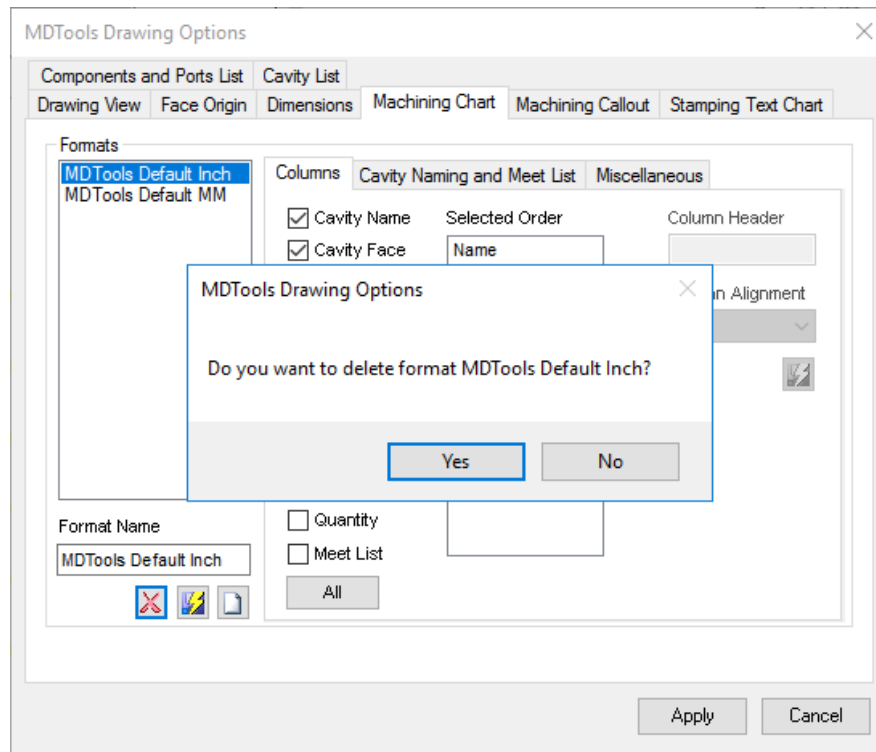
1. Select a format from the **Formats** list.
The data is populated for the selected format.
2. Edit the text in the **Format Name** text box and click the *Rename Selected Format* icon button, if you want to rename a format.
3. Edit or define various options and parameters for the Machining chart as explained in the previous chapter.
4. Click **Apply** to save the changes.



Machining Chart tab

Delete a Format

1. Select a format from the **Formats** list.
2. Click Delete Selected Format.
A confirmation message displays.
3. Click **Yes** in the message box to delete or **No** to abort.
4. Click **Apply** to save the changes.

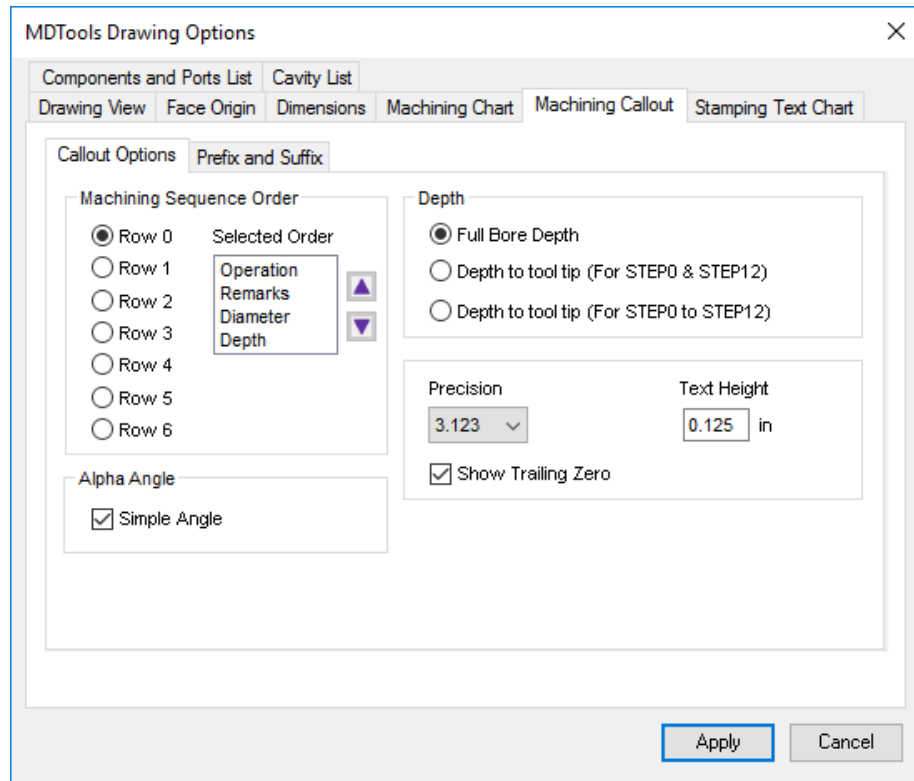


Machining Chart: MDTTools Drawing Options

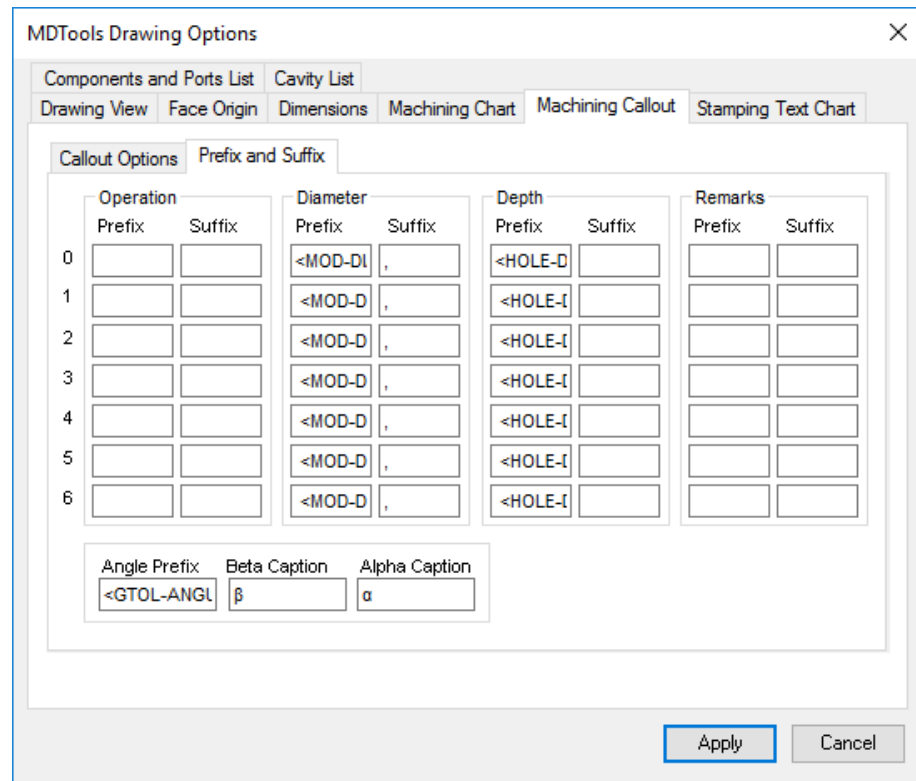
Machining Callout tab

These options enable you to configure the output of the Machining Callout.

- Specify the order of the machining sequence with the options available in the **Machining Sequence Order** group.
- The **Selected Order** list shows the order in which the machining operation sequence are created for a particular row.
- There are 7 row options available.
- The order list is easily built by selecting a machining sequence row and clicking the up or down arrow button, in the desired order.
- Select the number of decimal places for the Depth and Diameter entries in the callout from the dropdown.
- Specify the value of text height for the callout text.
- Select the **Show Trailing Zero** option to display the trailing zero in the cavity diameter and depth.
- Select the **Simple Angle** option to show the alpha angle for the simple angle holes in the machining callout.
- Specify prefixes and suffixes for all the machining sequence rows and columns in the **Prefix and Suffix** tab.
- Specify **Angle Prefix** for the Alpha and Beta angle to display in the machining callout. For example, /Angle:
- Specify **Beta Caption** for the Beta angle in the machining callout. For example, Beta =
- Specify **Alpha Caption** for the Alpha angle in the machining callout. For example, Alpha =
- Click **Apply** to save changes.



Machining Callout: Callout Options



Machining Callout: Prefix and Suffix

Stamping Text Chart tab

1. Enter/Edit the **header text** for the columns of Stamping Text Chart.
2. Specify the title for the chart in the **Title** text box.
3. Edit **Text Height** for the chart, if required.
4. Specify precision for the location field in the Stamping text chart.
5. Click **Apply** to save the changes.

The screenshot shows the 'MDTools Drawing Options' dialog box with the 'Stamping Text Chart' tab selected. The 'Components and Ports List' and 'Cavity List' tabs are also visible. The 'Stamping Text Chart' tab contains the following fields:

- Title:** Stamping Text Chart
- Text Height:** 0.125 in
- Location Precision:** 3.123
- Columns:**
 - Header Text: Face Name
 - Text: Text
 - Font: Font
 - Text Height: Text Height
 - Location X: Location X
 - Location Y: Location Y
 - Rotation: Text Rotation

Buttons for 'Apply' and 'Cancel' are located at the bottom right of the dialog.

Stamping Text Chart tab

Components and Ports List tab

1. Select **Items** to be included in the Components and Ports List.
2. Enter/Edit the header text for the columns of the Components and Ports list.
3. Set the visibility of **Machining ID** and **Face Name** columns, if required.
4. Specify the title for the list in the **Title** text box.
5. Edit the text height for the list, if required.
6. Click **Apply** to save the changes.

The screenshot shows the 'MDTools Drawing Options' dialog box with the 'Components and Ports List' tab selected. The 'Drawing View', 'Face Origin', 'Dimensions', 'Machining Chart', and 'Machining Callout' tabs are also visible. The 'Components and Ports List' tab contains the following fields:

- Items Included:**
 - Components
 - Ports
- Title:** Components and Ports List
- Text Height:** 0.125 in
- Columns:**
 - Header Text: Item ID
 - Cavity/Footprint Name: Cavity/Footprint Name
 - Machining ID: Machining ID (with a lightbulb icon)
 - Face Name: Face Name (with a lightbulb icon)

Buttons for 'Apply' and 'Cancel' are located at the bottom right of the dialog.

Components and Ports List tab

Cavity List tab

1. Select/Deselect the item types in the **Items Included** group to filter the Cavity List.
2. Enter/Edit the header text for the columns of the Cavity list.
3. Set the visibility of **Serial Number** and **Feature Type** columns, if required.
4. Specify the title for the list in the **Title** text box.
5. Edit the text height for the list, if required.
6. Click **Apply** to save the changes.

The screenshot shows the MDTools Drawing Options dialog box with the Cavity List tab selected. The dialog has a title bar with a close button (X) and a tabbed interface with the following tabs: Drawing View, Face Origin, Dimensions, Machining Chart, Machining Callout, Stamping Text Chart, Components and Ports List, and Cavity List. The Cavity List tab is active and contains the following settings:

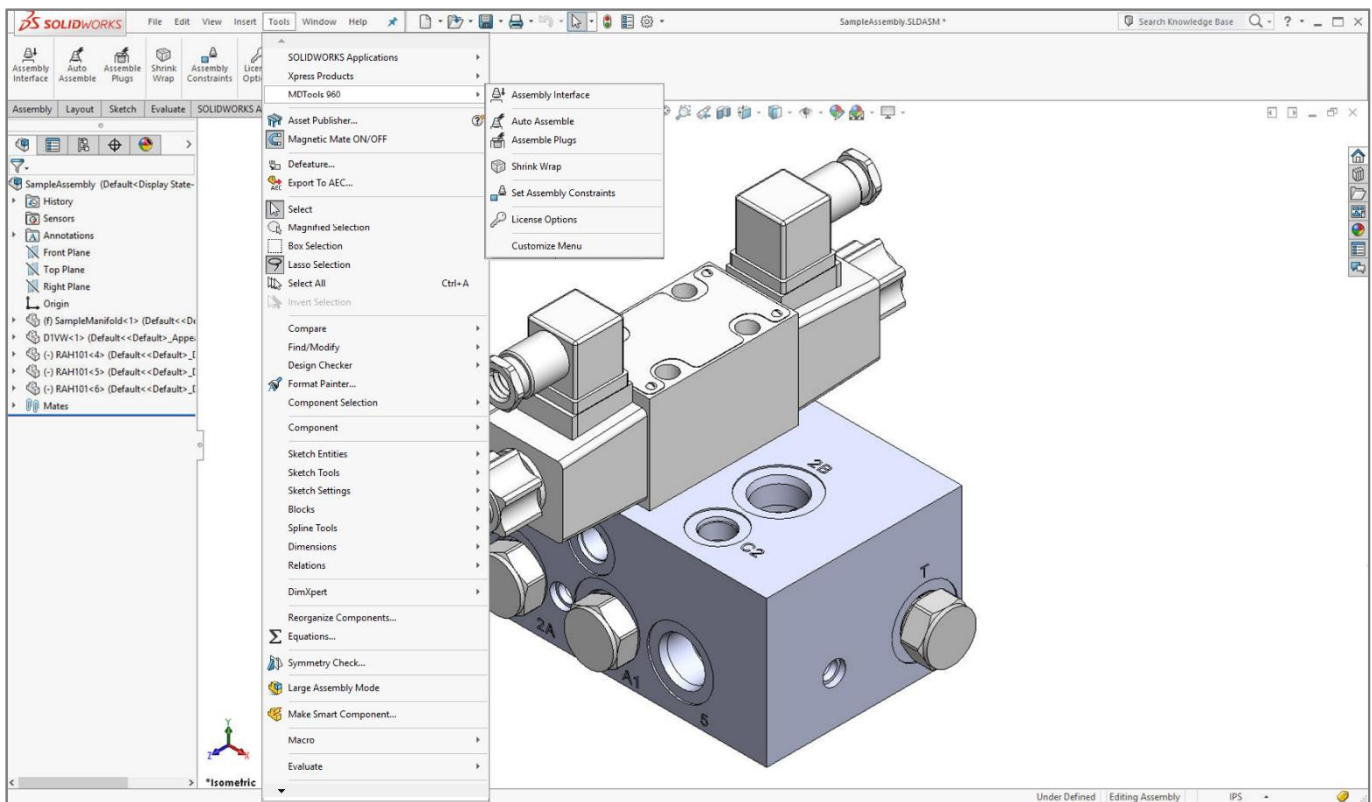
- Items Included:** A list of feature types with checkboxes: Footprint, Cartridge Valve, Ports, X-Port, Drill Holes, Mounting Bolt Holes, Slots, Undercuts, and O-Ring Grooves. All are checked. A "None" button is present.
- Title:** A text box containing "Cavity List".
- Text Height:** A text box containing "0.125" followed by "in".
- Columns:** A table with two columns: "Header Text" and a lightbulb icon. The rows are:
 - Serial Number: S. No.
 - Feature Type: Feature Type
 - Cavity/Footprint Name: Cavity/Footprint Name
 - Quantity: Quantity

At the bottom right, there are "Apply" and "Cancel" buttons.

Cavity List tab

ASSEMBLY COMMANDS

- 106 Assemble Interface
- 107 Auto Assemble
- 108 Assemble Plugs
- 109 Shrink Wrap
- 110 Set Assembly Constraints
- 111 License options



106. Assembly Interface

Automatically assemble all the components on a manifold. MDTools® automatically creates all the required constraints and assembles the components at the correct location.

Create a new assembly drawing (.sldasm) and place the manifold into the assembly drawing using the **Insert Component** command in SolidWorks.

1. MDTools 960
 > **Assembly Interface**
 The *Assembly Interface dialog box displays. MDTools displays the Component IDs of all the cavities in the dialog box.*

Note:

If there is no manifold placed in the assembly, MDTools shows a message box to check if you want to place a manifold in the assembly.

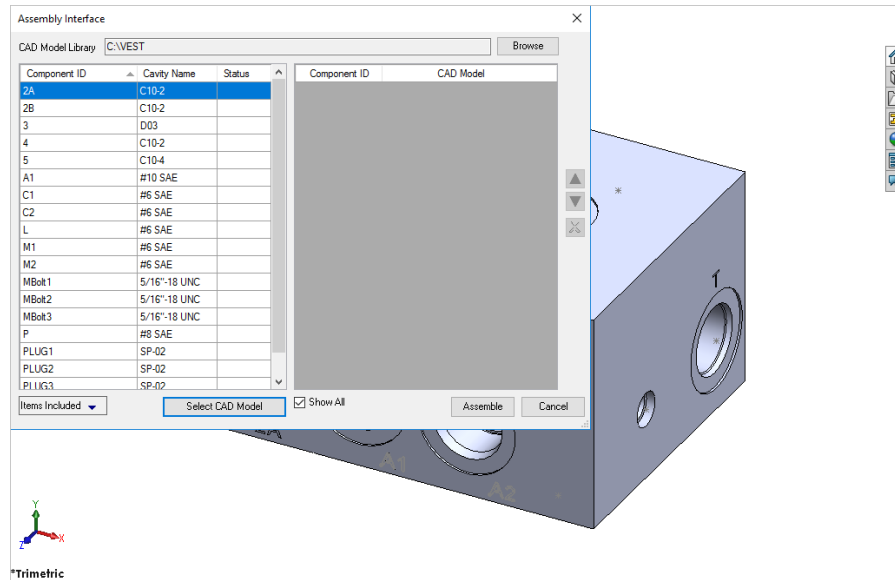
2. Click **Yes**.
 The *Place Component dialog box displays.*
3. Click **Browse** and select the folder containing the part files.
4. Click **OK**.
5. Select a component using Selected CAD Models option.
 MDTools automatically places the selected component in the assembly drawing.

The *Assembly Interface dialog box displays.*

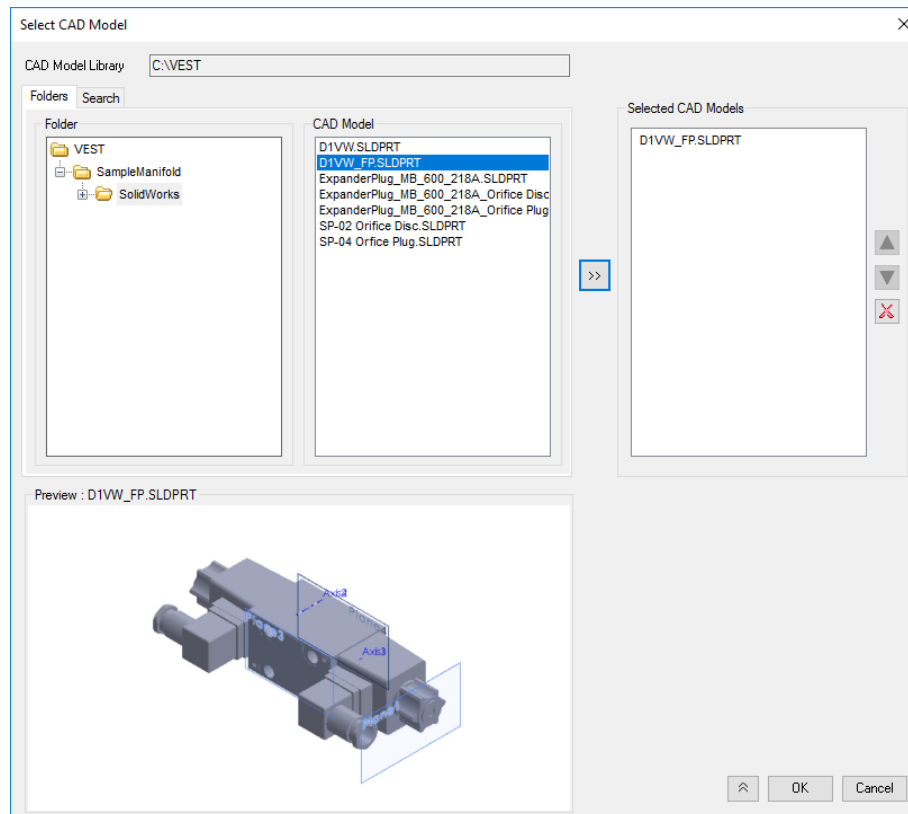
MDTools displays the *Component IDs of all the cavities in the dialog box.*

Separate components IDs for orifice are merged with the footprint cavities (Parent/child).

The status column shows the status of component assembled for that cavity.
 The **Items included** option filters the cavity according to the Cavity/Footprint/Orifice type.



Assembly Interface dialog box



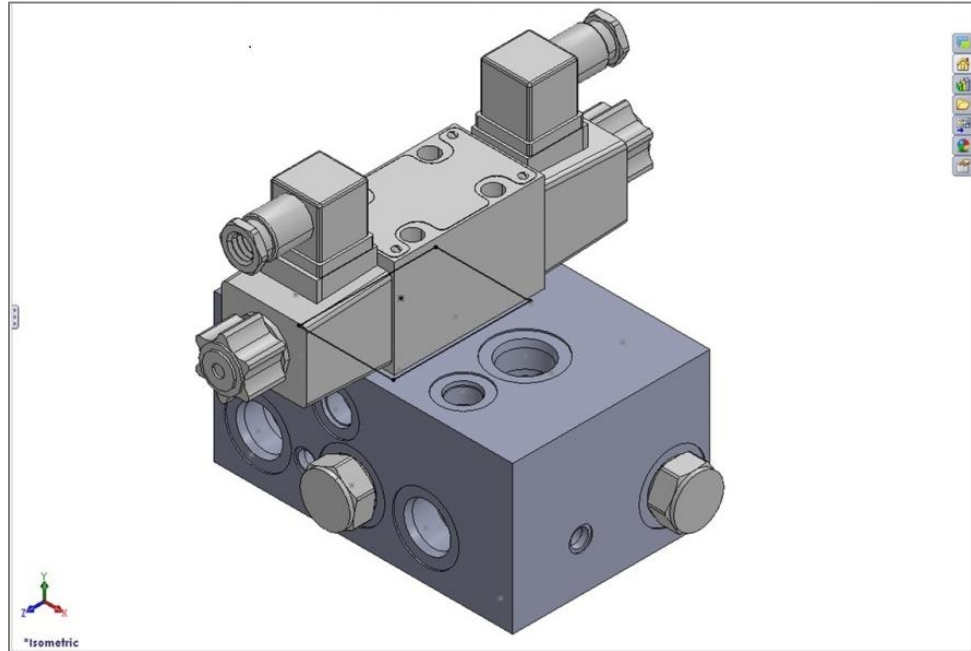
Select Part File dialog box

Note:

The library path is stored in the system registry; therefore, you must have administrative privilege to save changes to the library path.

Selecting Valves

1. Select the cavity by selecting the component ID.
2. Click Select CAD Model.
The Select CAD model dialog box displays.
3. Select the required CAD model.
4. Click **OK**.



Assembly created using MDTools

Note:

If the selected cavity is a Solenoid valve cavity, then you should select the solenoid coil and manual override/lock nut before adding the cavity into the assembly list.

5. Similarly, select part files for all the cavities on the manifold.
6. Click Assemble.
MDTools® automatically assembles all the selected components at their locations on the manifold.

Same Component for Multiple Cavities

When multiple cavities use the same component, you can select the component for all the cavities together.

6. Select the cavities from the list, one by one.

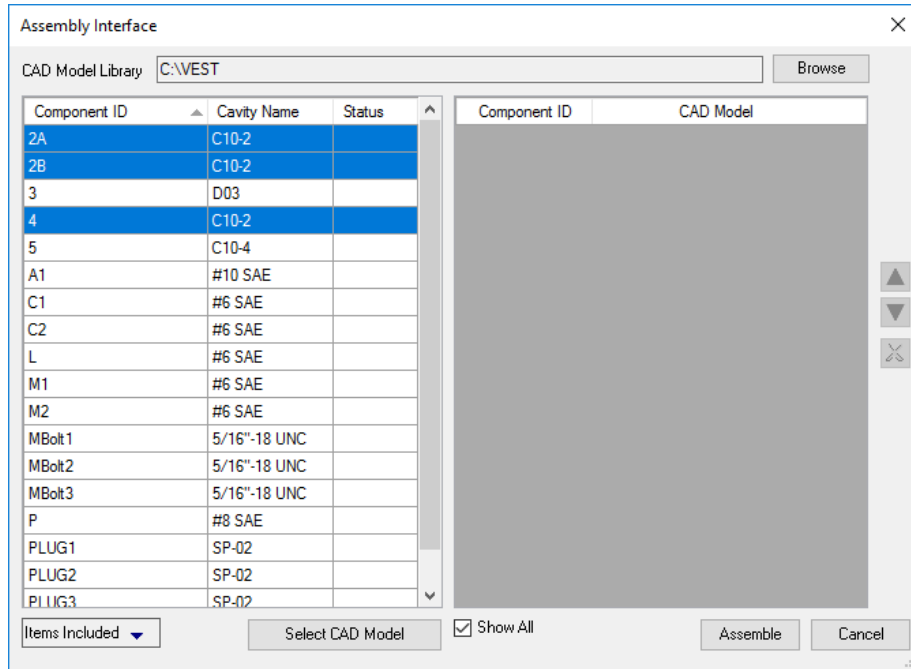
Note:

Hold the **Ctrl** key to enable multiple cavity selection.

7. Select the component using the **Select CAD Model** option.

Note:

- Set assembly constraints on all the part models using the MDTools Set Assembly Constraints program to make it work with the Assembly Interface.
- Parts without the assembly constraints will not get assembled on the manifold.
- Refer Chapter 106, *Set Assembly Constraints*, for details about assembly constraints.
- *For two Port Orifice Plug Model assembled at the thread step index of cavity, if thread step information does not exist in the cavity then MDTools displays a warning message.*



Multiple Cavity selection

Status Description

- ✓ Component already assembled, no action required.
- 🔄 Updating required for that component.
(e.g. Component deleted, new component added, component assembly order changed, if multiple component and one or more component deleted etc.)
- ✗ Component was assembled previously, but has some error that needs to be resolved. (e.g. change face, swap cavity, suppress cavity etc.)

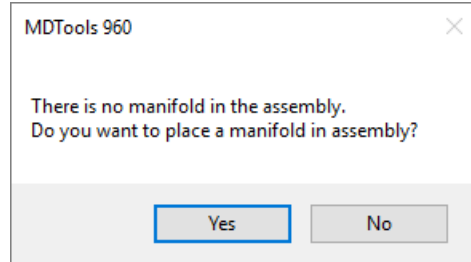
Note:

You can also see the assembled model by selecting a model from the CAD Model column.

107. Auto Assemble

Automatically assemble all the components and plugs on a manifold created by importing HyDraw® Schematic XML file. MDTools® automatically creates all the required constraints and assembles the components at the correct location.

Create a new assembly drawing (.sldasm) and place the manifold into the assembly drawing using the Insert Component command in SolidWorks.



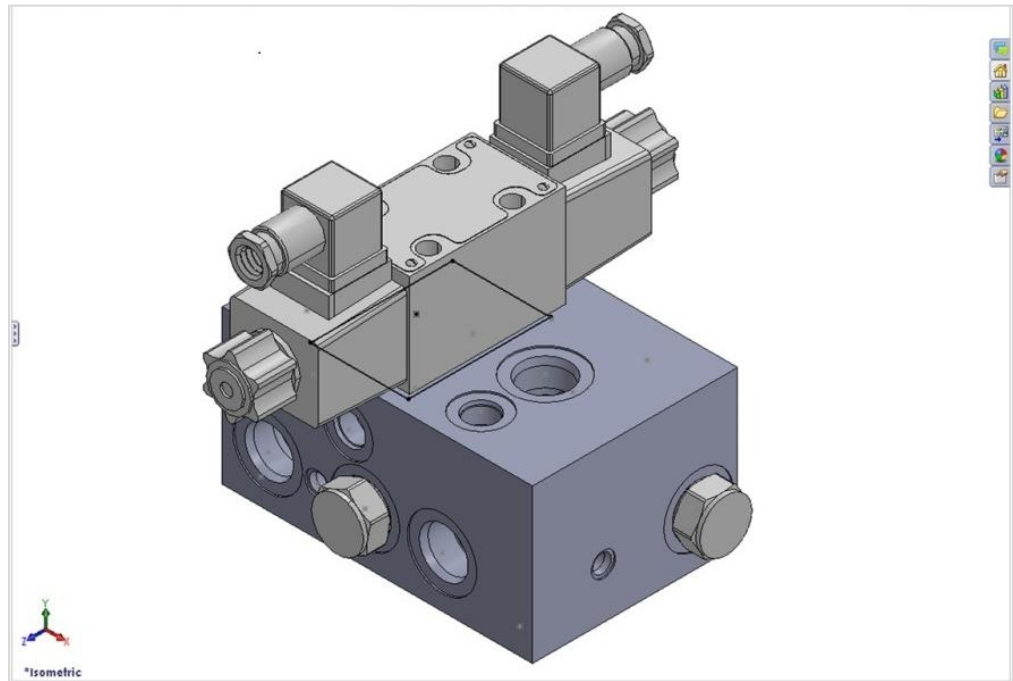
Assembly Drawing

1. MDTools 960
> **Auto Assemble**
The component Models assigned in HyDraw Schematic are automatically assembled to the manifold.

Note:

If there is no manifold placed in the assembly, MDTools shows a message box to check if you want to place a manifold in the assembly.

2. Click **Yes**.
The Place Component dialog box displays.
3. Select a component.
MDTools automatically places the selected component in the assembly drawing. The component models assigned in the HyDraw schematic are automatically assembled to the manifold.



Component Models Assembled on the Manifold

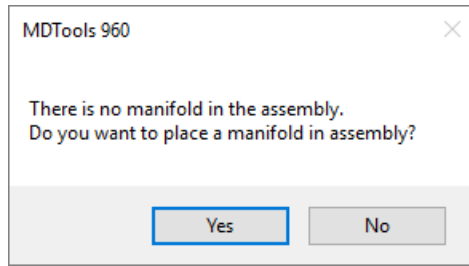
108. Assemble Plugs

Automatically assemble plugs on all the construction (X-Drill) ports on a manifold.
MDTools® automatically creates all the required constraints and assembles the plugs at the correct location.
You can specify cavity and plug file path location using the MDTools Assembly Library.

1. Open the Assembly model in SolidWorks.

Note:

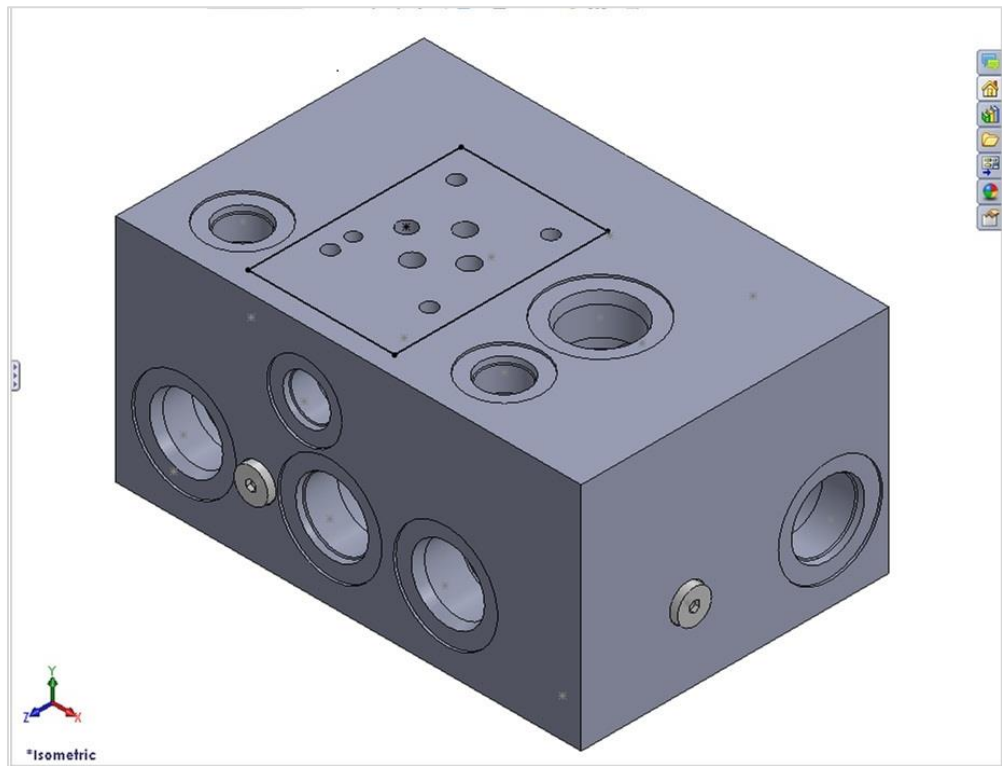
If there is no manifold placed in the assembly, MDTools shows a message box to check if you want to place a manifold in the assembly.



No manifold in the assembly

2. Select a component.
MDTools automatically places the selected component in the assembly drawing and assembles the plugs onto all the construction (X-Drill) ports, which are assigned in the MDTools Assembly Library, in a manifold.

3. MDTools 960 > **Assemble Plugs**
Automatically assembles the plugs onto all the construction (X-Drill) ports, which are assigned in the MDTools Assembly Library, in a manifold.

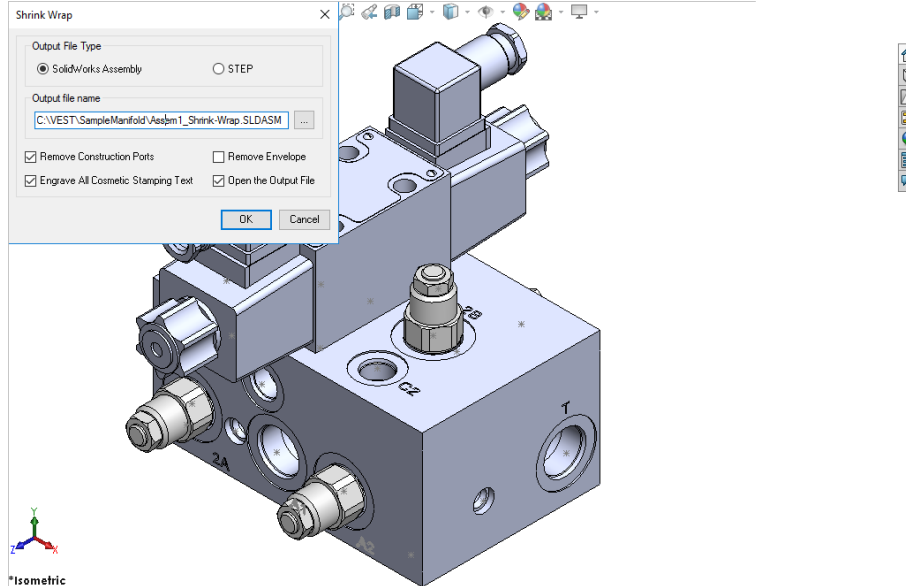


Assemble the plugs on the construction ports in a manifold

109. Shrink Wrap

Remove all the internal design details and create a separate block model without any connection detail.

1. MDTools 960
> **Shrink Wrap**
The Shrink-Wrap dialog box displays.

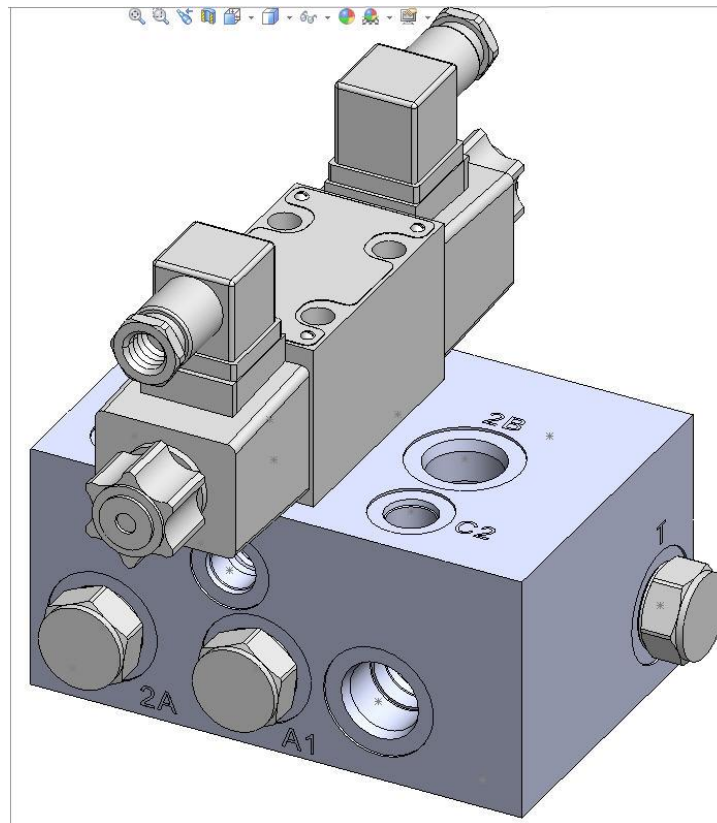


2. Select output type. If you want to save output file as SolidWorks Assembly file (.sldasm), select option **SolidWorks Assembly**. if you want to save output as STEP(.step/.stp) file, select option **STEP**.
3. Enter the output file name.
The output file is saved into a file with the given name.

4. Select **Remove Construction Ports** to automatically remove the construction port information.
5. Select **Remove Envelope** to automatically remove the envelope (Footprint or Assembly) information
6. Select **Engrave All Cosmetic Stamping Text** to change all stampings into engraved stamping.
7. Select **Open the Output File** to automatically open the output file.
8. Click **OK**.
MDTools[®] automatically removes all the internal design details.

Shrink-Wrap dialog box

If the Open the output file option is selected, then the output file is automatically opened in SOLIDWORKS.



Internal details removed automatically

110. Set Assembly Constraints

Set assembly constraints on all the part/assembly models to make them work with the Assembly Interface. Parts without the assembly constraints will not get assembled on the manifold.

Open the part/assembly model of valve in SolidWorks.

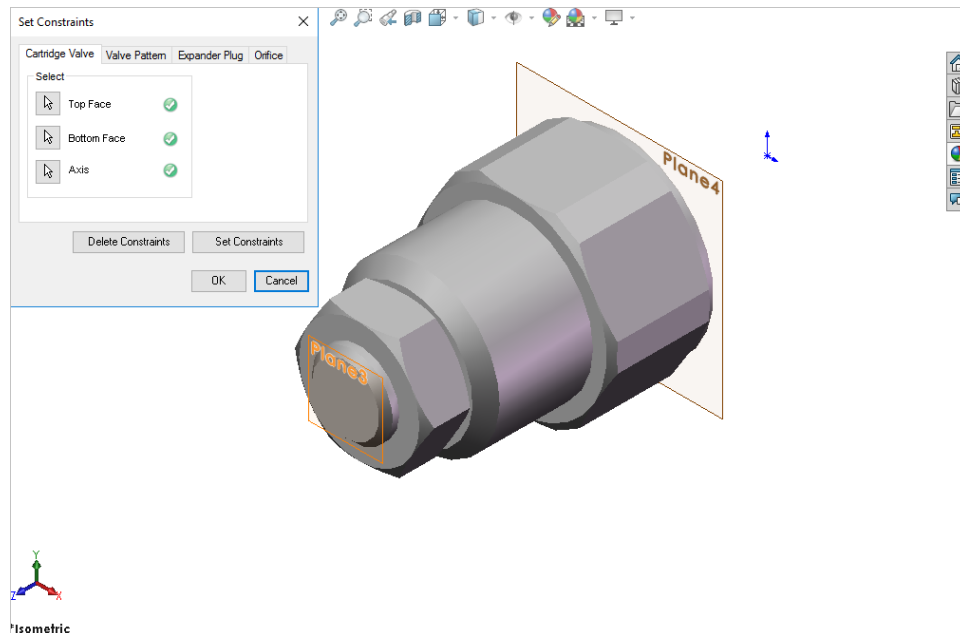
MDTools 960

> Assembly Constraints

The Set Constraints dialog box displays.

The Set Constraints dialog box contains the following tabs.

- Cartridge Valve
- Valve Pattern
- Expander Plug



Set Constraints: Cartridge Valve tab

1 Cartridge Valve Tab

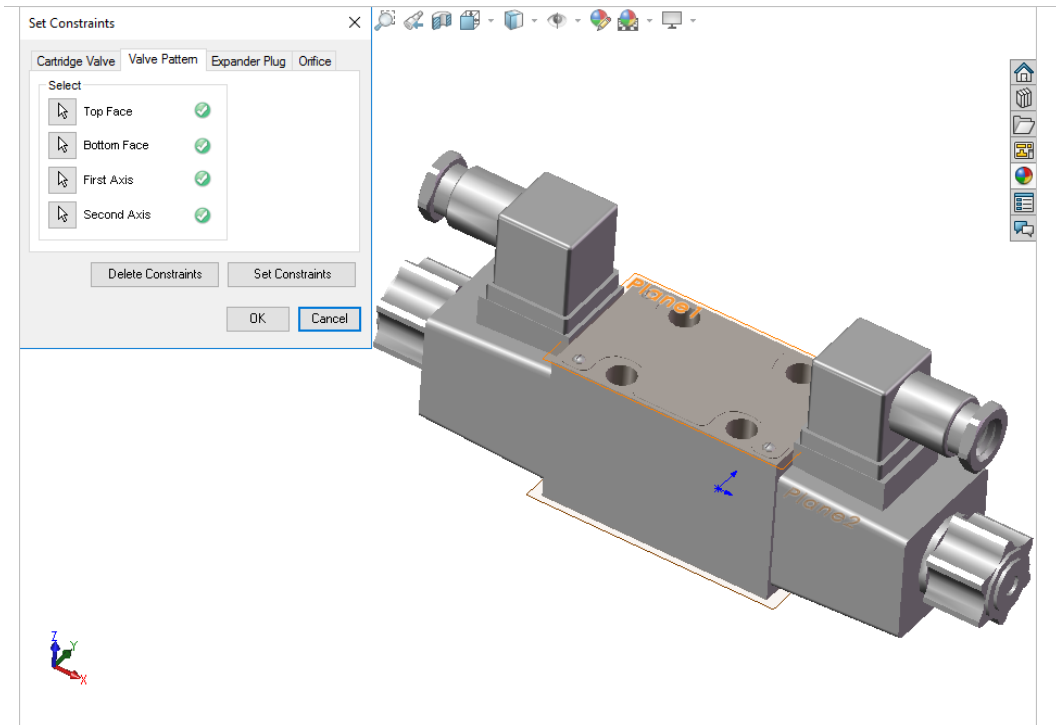
1. Set assembly constraints for the cartridge valves, port fittings, and plugs.
For these components, you need to specify three parameters, Top Face, Bottom Face, and Axis.
2. Select the **Top Face** button.
3. Select a planar face as the top face.
MDTools[®] automatically creates a work plane passing through selected face.
4. Select the **Bottom Face** button.
5. Select a planar face as the bottom face.
MDTools automatically creates a work plane passing through the selected face.
6. Select the **Axis** button.
7. Select a cylindrical face of valve body.
MDTools automatically creates an axis line passing through the axis of the selected cylindrical face.
8. Click **Set Constraints** to set assembly constraints.
*MDTools sets all the assembly constraints.
The Set Constraints dialog box closes.
Now, this part is ready for use with the Assembly Interface.*
9. Save the model.

Note:

- Use this option to set assembly constraints for solenoid coils and lock nut/manual overrides on the Screw-in cartridge solenoid valves.
- *Bottom work plane will mate with the spot face of cavity during assembly. So, the bottom work plane must be created on the face that needs to mate with the spot face of the cavity.*

2 Valve Pattern Tab

1. Set the assembly constraints for the surface mounted valves, slip in cartridge valves, or flanges.
For these components, you need to specify four parameters: Top Face, Bottom Face, First Axis, and Second Axis.
2. Select the **Top Face** button.
3. Select the top face work plane.
4. Select the **Bottom Face** button.
5. Select the bottom face work plane.
6. Select the first **Axis** button.
7. Select the axis passing through LP/LP1/BH1.
8. Select the second Axis button.
9. Select the axis passes through LP2/BH2.
10. Click **Set Constraints** to set assembly constraints.
MDTools® sets all the assembly constraints. The dialog box closes. Now, this part is ready for use with Assembly Interface.
11. Save the part model.
12. Click **OK** to close the dialog box.



Set Constraints dialog box: Valve Pattern tab

Note:

First Axis

- Create axis passing through the locating pin for valves with one locating pin.
- Create axis passing through the locating pin LP1 for valves with two locating pin.
- Create axis passing through the bolt hole BH1 for valves with no locating pin.

BH1 is the bolt hole with port application name BH1 and BH2 is bolt hole with port application name BH2 on the footprint.

Second Axis

- Create axis passing through the bolt hole BH1 for valves with one locating pin.
- Create axis passing through the locating pin LP2 for valves with two locating pin.
- Create axis passing passes through the bolt hole BH2 for valves with no locating pin.

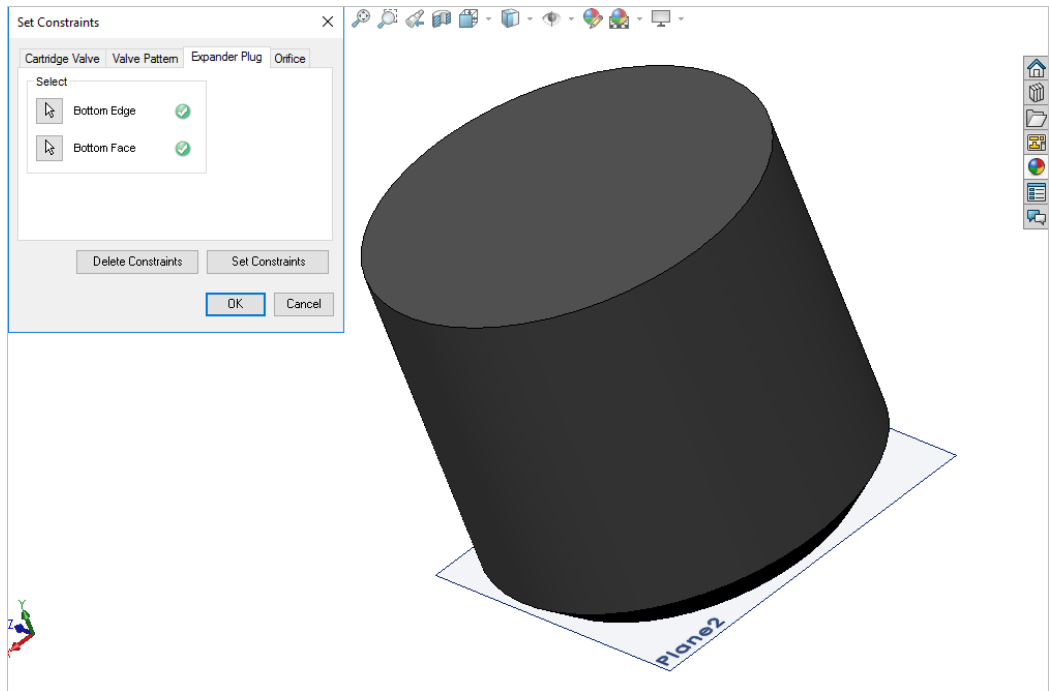
LP1 is the locating pinhole with port application name LP1 and LP2 is locating pinhole with port application name LP2 on the footprint.

3 Expander Plug Tab

If there is no spot face in the cavity (Step0 angle is not equal to 90), then you must use the Expander Plug tab to set the assembly constraints, for example in the expander plug ports.

In such cases, you need to set only one constraint, i.e., Bottom Edge.

1. Select the **Bottom Edge** button.
2. Select the bottom edge on the model that mates with the bottom edge of Step 0 of the cavity.
3. Select the Bottom Face button.
4. Select the bottom plane.
5. Click **Set Constraints** to set the assembly constraints.
6. Save the part model.



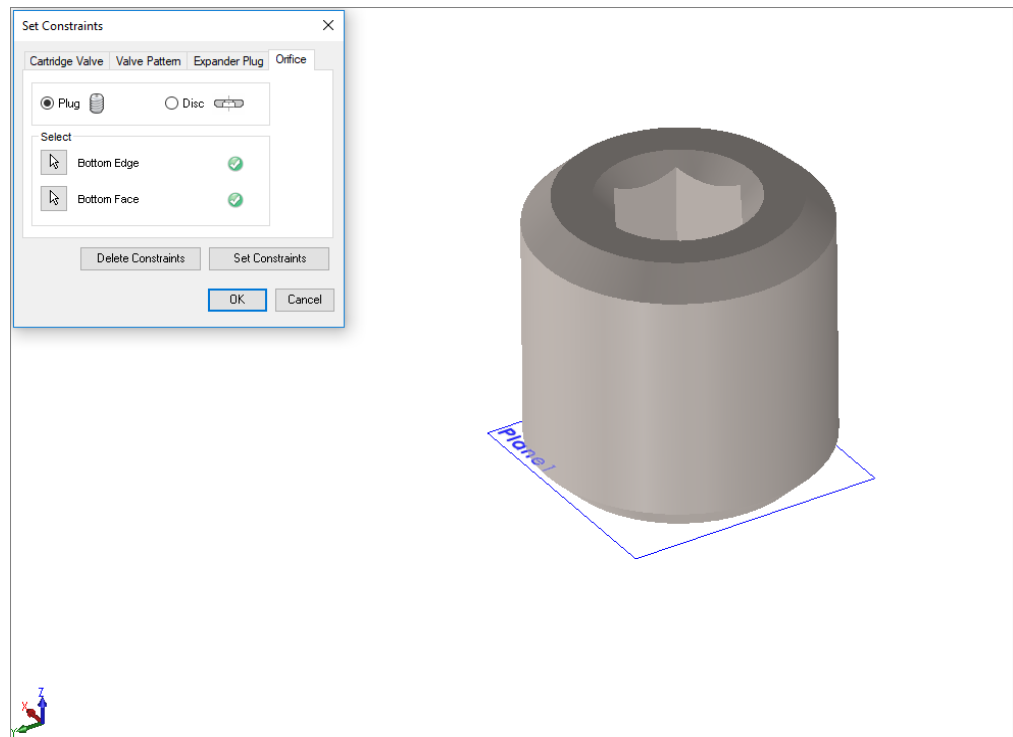
Set Constraints dialog box: Expander Plug tab

4 Orifice Tab

For Orifice type cavity, select the Orifice tab to set the assembly constraints.

You need to set only one constraint, i.e., Bottom Edge.

1. Select the **Bottom Edge** button.
2. Select the bottom edge on the model that mates with the bottom edge of Step 0 of the cavity.
3. Select the Bottom Face button.
4. Select the bottom plane.
5. Click **Set Constraints** to set the assembly constraints.
6. Save the part model.

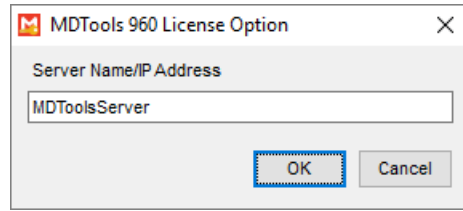


Set Constraints dialog box: Orifice tab

111. License Options

1. Set the license path through the Part Model menu.

MDTools 960
> **License Options**
The MDTools License Option dialog box displays.

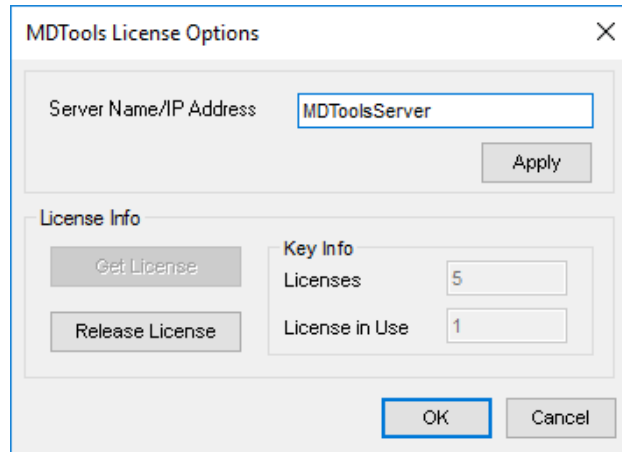


MDTools 960 License Option dialog box

2. Enter the **server name** or the **IP address** of the system, where the MDTools® hardware lock is located.

3. Click **Apply**.
MDTools automatically selects a license and displays the license information in the License info form.

If a license is selected successfully, then the Get License button is disabled and the Release License button is enabled.



License Options dialog box

4. To release a license, click the **Release License** button.
This releases your license, the Release License option is disabled and the Get License button is enabled.

5. To get a license, click the **Get License** button.
If MDTools successfully gets a license, then the Get License button is disabled and the Release License button is enabled.

6. Click **OK** to continue.

Note:

This option is available only in the MDTools 960 Network license version.

Appendix

- 112 Energy Loss Considerations
- 113 Ribbon and Dropdown Menu
- 114 Command Overview

112. Energy Loss Considerations

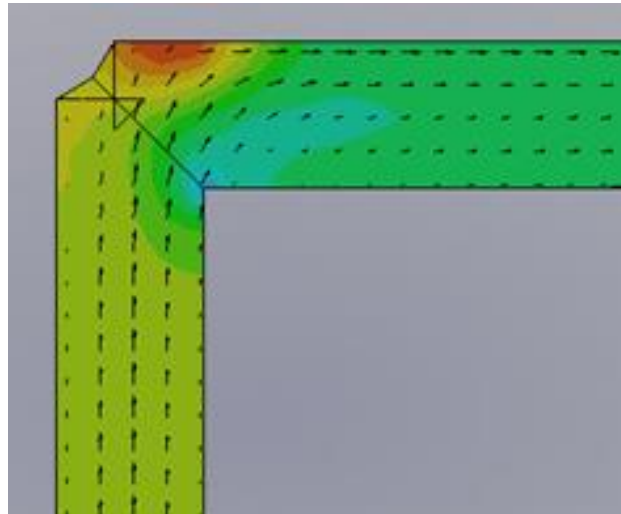
1 Bends in Drilled Circular Passages

Drill Tip to Drill Tip Relationship

VEST research indicates that a good bend design is where the drill-tips are “blended”.

A smooth blending of surfaces is more important than extra volume in the holes.

Intentional or accidental extension of drill points past the opposite edge of the connecting hole results in poor fluid flow. This is detrimental to energy efficiency of the manifold.



Finite Element Analysis based simulation of flow in drilled circular passages show the impact of different bend geometry on the energy loss across the bend. The images in Figure 1 show different geometry for bends.

The velocity vectors in Figure 1d show an anti-clockwise vortex formed in extended drill spaces. This results in higher energy drop.

The relative energy loss for each geometry is tabulated below:

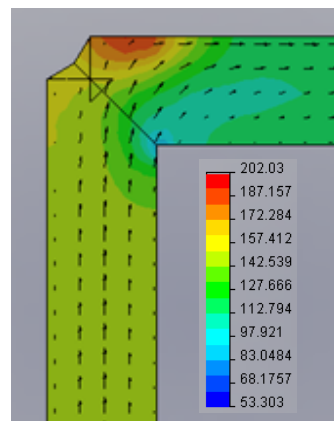


Fig 1a

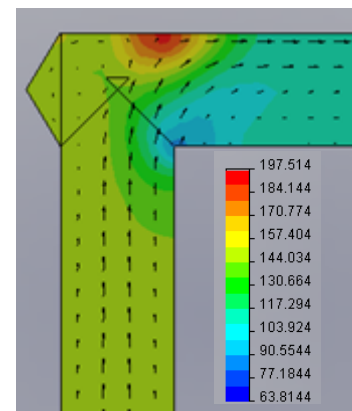


Fig 1b

Energy Drop
(psi)

- a MDTools - "Connect to Cavity"
- b Outlet Extended
- c Inlet Extended
- d Both Extended

- 35
- 35
- 44
- 48

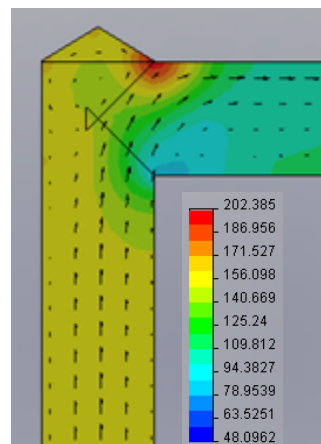


Fig 1c

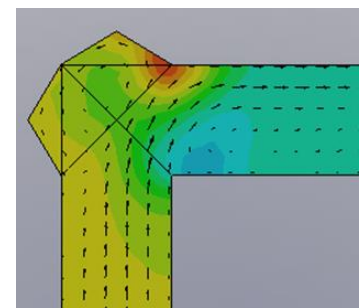


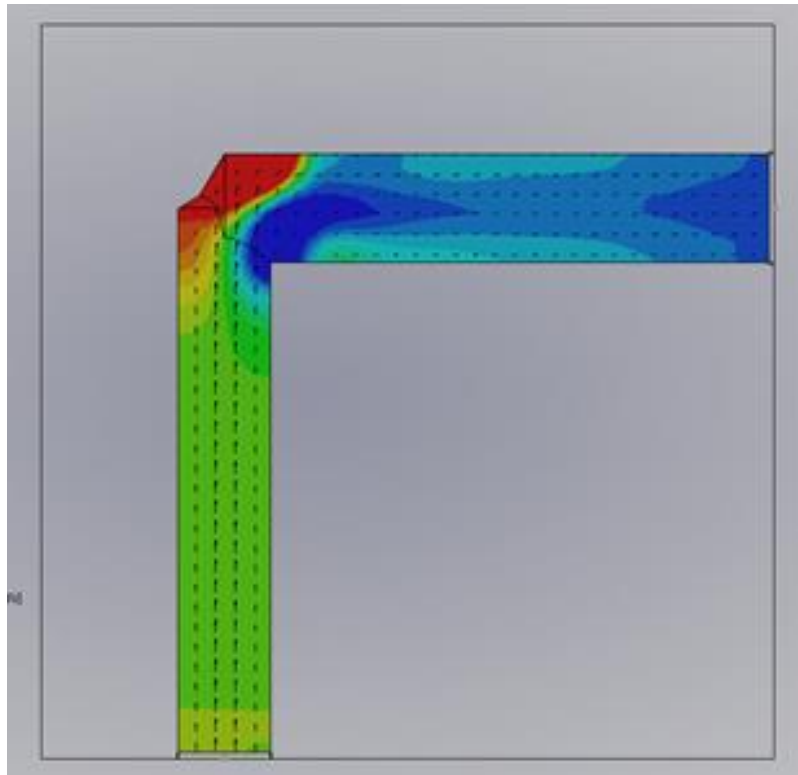
Fig 1d

2 Sizing the Diameter of Construction Holes

When selecting a construction hole to make a connection, designers often maintain diameter of the target hole. Neither increasing nor decreasing the construction-hole diameter.

VEST conducted Finite Element Analysis based flow simulation research on holes which conduct hydraulic power, i.e. pressure and tank connections.

Expansion and contraction effects of the flow cause energy loss as flow bends and transits from one hole to another. A larger diameter for the construction hole results in lower pressure drop, regardless of the direction of flow. Beyond a certain relative size, upsizing of the diameter results in only marginal energy efficiency improvement.



MDTools automatically selects an optimal upsized construction hole diameter.

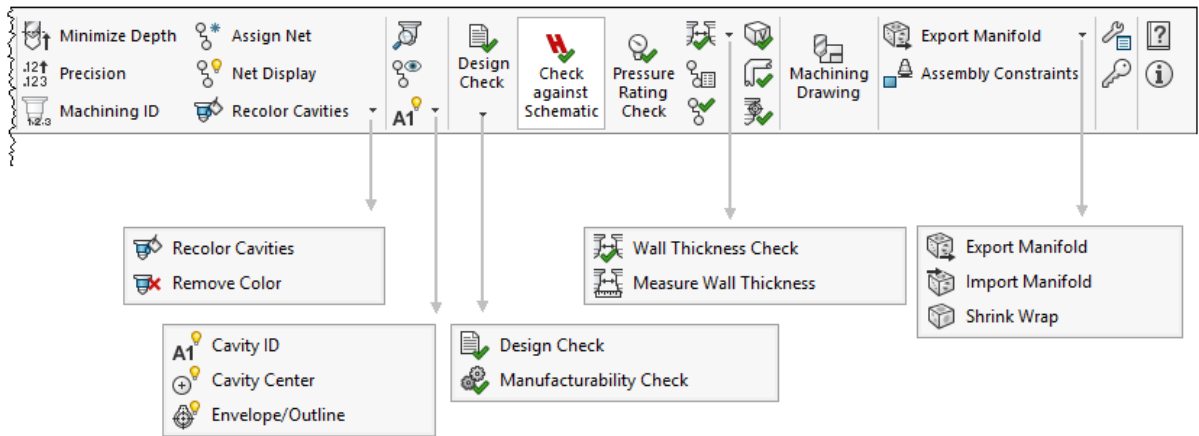
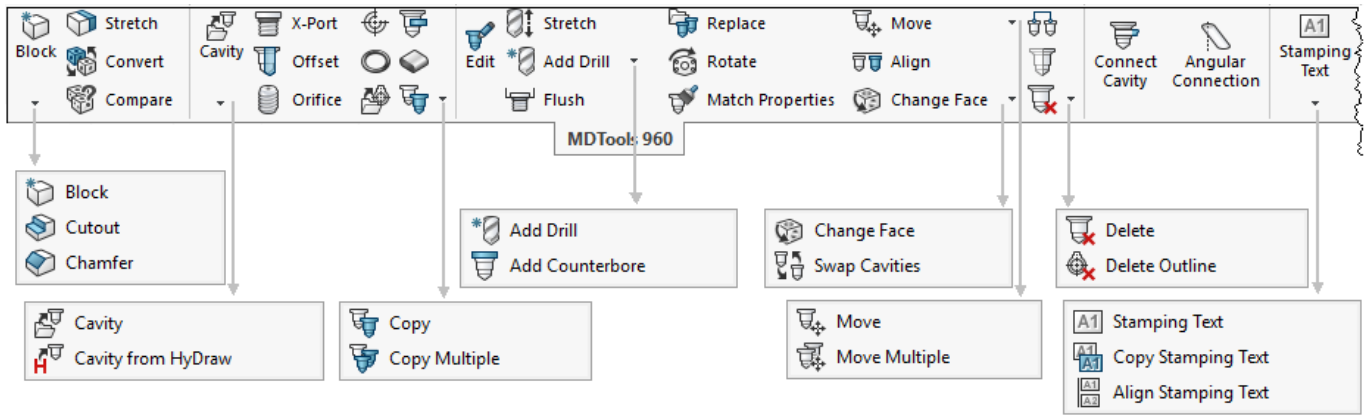
Oil velocity ranges that can be defined by users:

- High velocity range, where energy concerns dominate and dictate upsizing of holes
- Low oil velocity range, where energy concerns are not significant and manufacturing costs dictate downsizing of holes
- Nominal range

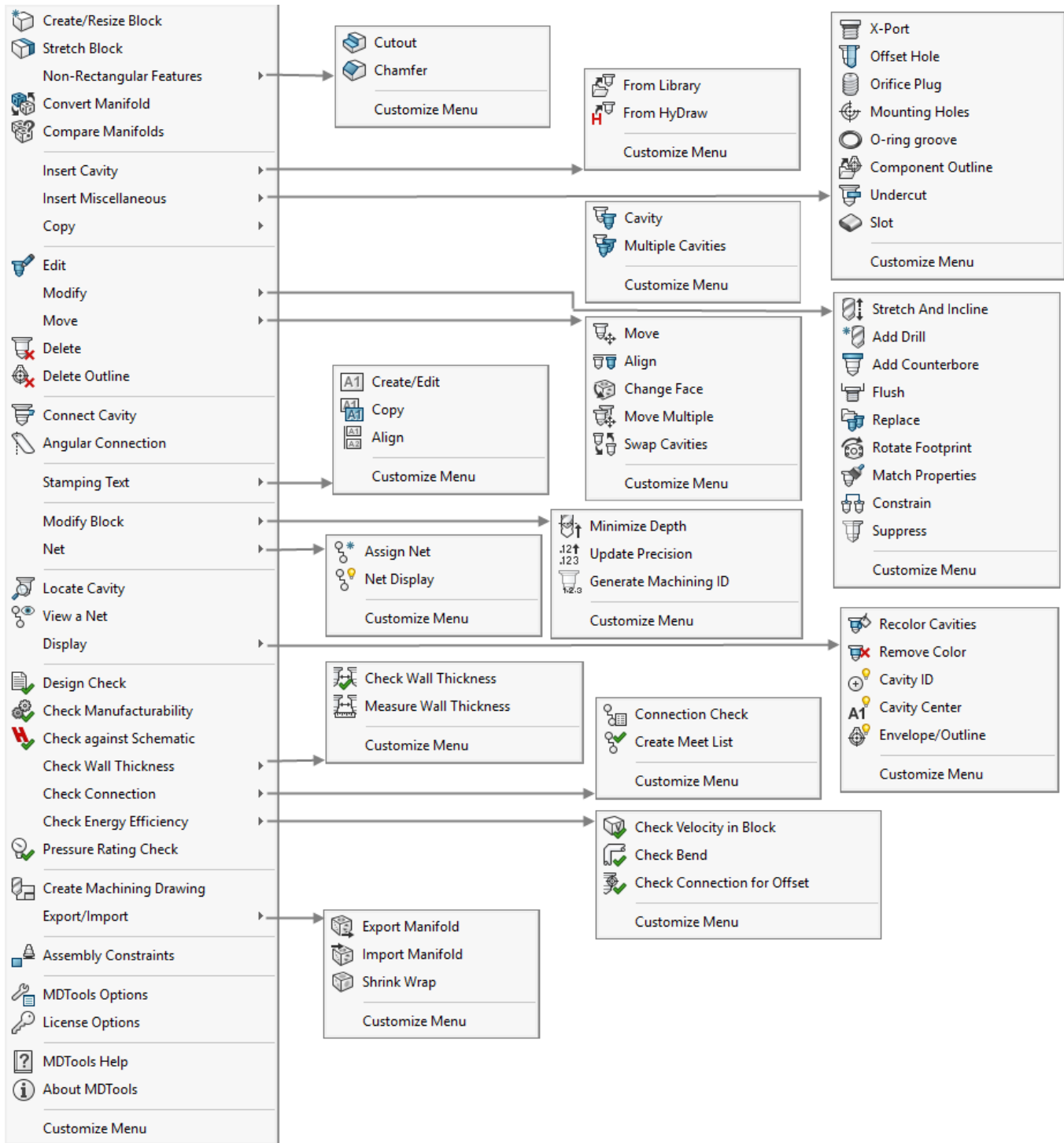
Pilot and Signal lines do not carry power and energy efficiency is of no concern. Diameters can be chosen on the basis of geometry, stress, and manufacturability.

In rare cases, when a valve operates at flows significantly lower than the rated flow, then the bend losses are low and diameters can be downsized.

113. Ribbon and Dropdown Menu






























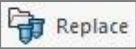
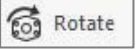
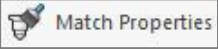



















MDTools 960 Part Ribbon Menu

















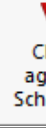













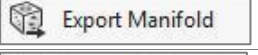

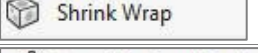
















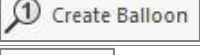
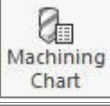
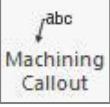
MDTools 960 Part Dropdown Menu






114. Commands Overview

Command Name	Function	Ch
1. DESIGN and CHECK COMMANDS		
	▼	
 Block	Creates a block or modifies the block dimensions.	8,9
 Stretch	Stretches the block in the specified direction.	10
 Convert	Converts block from virtual design to feature design and vice-versa.	13
 Compare	Compares two selected manifolds.	14
 Cutout	Creates a rectangular cutout on the block.	11
 Chamfer	Creates a chamfer on a block edge	12
	▼	
 Cavity	Inserts a cavity or footprint from the library.	15
 Cavity from HyDraw	Imports a HyDraw schematic and inserts cavities with net information.	16
 X-Port	Inserts construction ports for Energy Efficient connections	17
 Offset	Inserts offset hole in a cavity.	18
 Orifice	Inserts orifice plug in a cavity.	19
	Inserts mounting holes in the manifold.	20
	Inserts O-ring groove for a cavity.	21
	Inserts component outline for a cavity or footprint.	22
	Inserts undercut in a cavity.	23
	Inserts slot in a cavity.	24
	▼	
 Copy	Inserts copy of a cavity or footprint.	25
 Copy Multiple	Inserts multiple copies of cavities and footprints.	26
 Edit	Edit cavity, slot, undercut and O-ring.	27-32,
 Stretch	Stretches and tilts a cavity in the specified direction.	33







Command Name	Function	Ch
 Add Drill ▾	▼	
 Add Drill	Adds drill to a cavity.	34
 Add Counterbore	Adds counterbore to a cavity.	35
 Flush	Increases the spot face depth of construction port to flush plug below manifold surface.	36
 Replace	Replaces a cavity or footprint with a new cavity or footprint from the library.	37
 Rotate	Rotates a footprint or a cavity.	38
 Match Properties	Matches the properties of two or more cavities.	39
 Move ▾	▼	
 Move	Moves a cavity or footprint.	40
 Move Multiple	Moves multiple cavities or footprints by a specified distance.	41
 Align	Moves a cavity to align with another.	42
 Change Face ▾	▼	
 Change Face	Relocates a cavity or footprint to another face.	43
 Swap Cavities	Swaps the location of two cavities.	44
	Constrains cavities with manifold edge or a cavity.	45
	Suppresses or un-suppresses cavities.	46
 ▾	▼	
 Delete	Deletes cavities, footprints, undercuts, slots and O-rings.	47
 Delete Outline	Deletes component outlines.	48
 Connect Cavity	Creates connection between specified cavities.	49
 Angular Connection	Creates connection between two cavities by inserting an angled hole.	50
 A1 Stamping Text ▾	▼	
 A1 Stamping Text	Creates or modifies stamping text on the block.	51
 A1 Copy Stamping Text	Creates multiple copies of stampings text.	52
 A1 Align Stamping Text	Moves a stamping text to align with another.	53
 Minimize Depth	Reduces drill depth to minimum depth required to make a connection.	54

Command Name	Function	Ch
 Precision	Updates precision of location, angle and depth of all cavities.	55
 Machining ID	Generates machining ID for all cavities in the specified format.	56
 Assign Net	Automatically assigns net name and color to all connected cavities in the block.	57
 Net Display	Manages net visibility and display colors.	58
 Recolor Cavities ▾	▼	
 Recolor Cavities	Updates color of cavities.	59
 Remove Color	Removes color from cavities.	60
	Locates and highlights a cavity.	61
	Displays a net and hides all other nets.	62
 A1 ▾	▼	
 A1 Cavity ID	Manages visibility of component ID, machining ID and port name.	63
 Cavity Center	Manages visibility of cavity center.	64
 Envelope/Outline	Manages visibility of footprint envelop and component outline.	65
 Design Check ▾	▼	
 Design Check	Creates consolidated report of design errors.	66
 Manufacturability Check	Checks the block for manufacturing and tooling limitations.	67
 Check against Schematic	Check Conformance of design to HyDraw® schematic.	69
 Pressure Rating Check	Checks the pressure rating of all construction ports.	68
 Wall Thickness Check ▾	▼	
 Wall Thickness Check	Checks wall thickness around cavities.	70
 Measure Wall Thickness	Measures distance between two surfaces.	71
	Checks connection errors in the block.	72
	Checks connectivity in the block.	73
	Checks velocity in cavities/ports.	74
	Checks quality of intersections for energy efficient bends.	75
	Check connection with three or more cartridge valve side ports to recommended offset.	76

Command Name	Function	Ch
 Machining Drawing	Creates 2D machining drawing of the block.	77
 Export Manifold		
 Export Manifold	Exports the manifold into MBXML file format.	78
 Import Manifold	Imports the manifold from MBXML file.	79
 Shrink Wrap	Creates a shrink-wrapped model.	80
 Assembly Constraints	Sets assembly constraints to a component model.	82
	Displays MDTools® Options dialog box, where you can configure design options.	83
	Displays MDTools License Options dialog box, where you can configure license options.	84
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2. DRAWING COMMANDS		
 Create Views	Creates six orthogonal views of a manifold or manifold assembly.	87
 Internal Details	Displays or hides internal details of the manifold in each view.	94
 Origin and Axes	Displays the face origin and X/Y direction of each view.	88
 Show Angle Holes	Displays the top view and direction of angular holes in the 2D drawing.	89
 Footprint	Displays the port names and footprint envelop in the 2D drawing.	90
 Construction Ports	Marks construction ports in the 2D drawing.	93
 Stamping Text	Displays a rectangle around all stamping text in the 2D drawing.	91
 Undercut	Displays the top view of undercuts.	92
 Auto Dimension	Dimensions cavities in the 2D drawing.	95
 Show Machining ID	Displays the machining ID for cavities in the 2D drawing.	96
 Show Component ID	Displays the component ID, cavity/footprint name for cavities in the 2D drawing.	97
 Create Balloon	Creates balloon with cavity machining ID for the cavities in the 2D drawing.	98
 Machining Chart	Creates and inserts manifold machining chart into the 2D drawing.	99
 Machining Callout	Create machining callout for the cavities in the 2D drawing.	100

Command Name	Function	Ch
 Stamping Text Chart	Creates and inserts stamping text chart into the 2D drawing.	101
 Components and Ports List	Creates and inserts component and port list into the 2D drawing	102
 Cavity List	Creates and inserts cavity list into the 2D drawing	103
 License Options	Displays MDTools® License Options dialog box where you can configure license options.	104
 Options...	Displays MDTools Drawing Options dialog box where you can configure drawing options.	105

3. ASSEMBLY COMMANDS

Command Name	Function	Ch
 Assembly Interface	Interactively assembles components.	106
 Auto Assemble	Automatically assembles components and construction plugs.	107
 Assemble Plugs	Automatically assembles construction plug.	108
 Shrink Wrap	Creates a shrink-wrapped model.	109
 Assembly Constraints	Sets assembly constrains to a component model.	110
 License Options	Displays MDTools License Options dialog box where you can configure license options.	111

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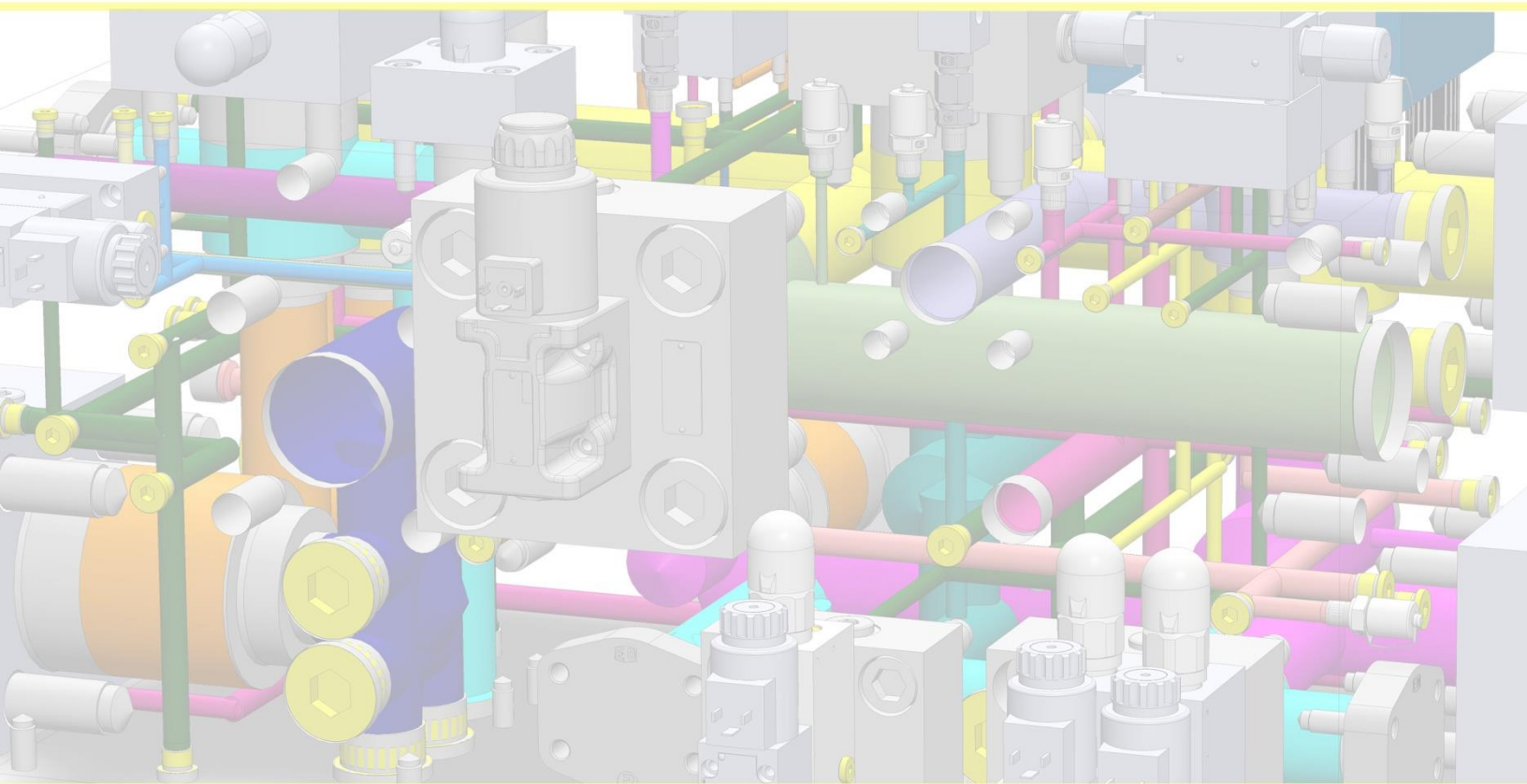
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