

MDTools® 770

User Manual



MDTools[®] 770

manifold design software

Do more...

VEST, Inc. 3250 W, Big Beaver Road, Suite 440, Troy, MI 48084 USA

Tel: +1 248 649-9550 Email: sales@VESTusa.com Visit: VESTusa.com

VEST, Inc.

Software Product License Agreement

Notice: Read this before installing the software.

Carefully read the terms and conditions of this Agreement before opening the product package. Opening the package indicates your acceptance of these terms and conditions. If you do not agree with the terms and conditions of this Agreement, promptly return the unopened package to the place where you obtained it.

Definitions

The Software Product is licensed (not sold) to you. The Software product includes all copies of the Software Product and its related supporting materials.

License

VEST, Inc. (we, our, us) grants you a personal, non-transferable, and non-exclusive license to use the Software Product in the specified quantity only.

You may not:

1. distribute, sublicense or copy any portion of the Licensed Software product:
2. modify or prepare derivative works from the Licensed Software Product:
3. transmit the Licensed Software product electronically by any means: or
4. use the Licensed Software product in multiple computers or multiple user arrangements unless that use is covered by individual license for each computer or user.

You agree that the Licensed Software product belongs to us and you agree to keep confidential and use your best efforts to prevent and protect the contents of the Licensed Software Product from unauthorized disclosure.

Limited

1. For 90 days from the date of shipment, we warrant that the media (for example, CD) on which the Licensed Software Product is contained will be free from defects in materials and workmanship. The warranty does not cover damage caused by viruses, improper use or neglect.

We do not warrant the contents of the Licensed Software Product (it is furnished "AS IS" and without warranty as to the performance or results you may obtain by using the Licensed Software Product) or that it will be error free.

You assume the entire risk as to the results and performance of the Licensed Software Product.

To get media warranty service during the 90-day warranty period, you may return the Product (postage paid) with a description of the problem to the place where you obtained it. The defective media on which the Licensed Software Product is contained will be replaced at no additional charge to you.

2. If you do not receive media that is free from defects in materials and workmanship during the 90-day warranty period, you will receive a refund or credit to your account for the amount you paid for the returned Licensed Software Product.

Disclaimer of Warranty

YOU UNDERSTAND AND AGREE AS FOLLOWS:

1. Warranties in this agreement replace all other warranties, expressed or implied, including any warranties of merchantability or fitness for a particular purpose. We disclaim and exclude all other warranties.
2. We will not be liable for any loss or damage caused by delay in furnishing a Licensed Software Product or any other performance under this Agreement.
3. Our entire liability and your exclusive remedies for our liability of any kind (including liability for negligence except liability for personal injury caused solely by our negligence) for the Licensed Software Product covered by the Agreement and all other performance or non-performance by us under or related to this Agreement are limited to the remedies specified by this Agreement.
4. In no event will our liability of any kind include any special incidental or consequential damages, even if we have knowledge of the potential loss or damage.
5. Special notice to consumers: some states do not allow the exclusion of implied warranties so the above exclusion may not apply to you. The warranty gives you special legal rights, and you may also have other rights, which vary from state to state.

Termination

This Agreement is effective until terminated. You may terminate it at any time by destroying the Licensed Software Product. It will also terminate if you do not comply with any term or condition of this Agreement. You agree upon termination to destroy the Licensed Software Product.

General

You are responsible for installation, management and operation of the Licensed Software Product.

Contents

1.	Introduction	1
2.	Installation	4
3.	Import and Export Settings	8
	Basics	10
4.	MDTools Workspace	11
5.	Schematic Interface	19
6.	MDTools Cavities.....	21
7.	Nets (Flow paths)	24
8.	Design Check Basics	26
9.	Angle Holes	29
	DESIGN and CHECK COMMANDS	31
	Block Commands	32
10.	Create Block	33
11.	Modify Block	38
12.	Stretch Block	42
13.	Create Cutout.....	43
14.	Create Chamfer	45
15.	Convert Block	47
16.	Shrink Wrap	48
17.	Export Block Design.....	49
18.	Import Block Design	50
20.	Compare Manifolds.....	51
	Insert	53
21.	Insert Cavity (...from Library)	54
22.	Insert Cavities (...from HyDraw Schematic).....	62
23.	Insert Cavities (Non-Rectangular Manifold Block)	64
24.	Insert Construction Port (X-Port)	67
25.	Copy Cavity	69
26.	Copy Slot	74
27.	Copy Multiple.....	77
28.	Insert Offset Hole.....	78
29.	Insert Orifice Plug.....	79
30.	Merge with Cavity	80
31.	Insert Mounting Holes	81
32.	Insert Undercut	82
33.	Insert Slot	84
34.	Insert O-ring Groove	86
35.	Insert Outline	88
36.	Replace and Replace All	89
	Make Connections	90
37.	Connect Cavities.....	91
38.	Angular Connection.....	94
39.	Assign Net	96

	Relocate.....	97
40.	Rotate Footprint/Cavity	98
41.	Align Cavities	99
42.	Move Cavity	100
43.	Move Multiple.....	107
44.	Swap Cavities	109
45.	Change Face	110
	Modify	118
46.	Edit	119
47.	Flush X-drill Plugs	129
48.	Stretch Drill	130
49.	Match Properties	131
50.	Add Counter Bore	132
51.	Add Drill	133
52.	Delete Cavity	134
53.	Delete O-ring Groove	135
54.	Delete Outline	136
55.	Constrain/Unconstrain Cavities	137
56.	Suppress/Unsuppress Cavities	139
57.	Minimize Depth.....	141
58.	Update Precision	142
	Engravings	143
59.	Manage Engravings	144
60.	Copy Engravings	147
61.	Align Engravings	148
	Design Check.....	150
62.	Wall Thickness Check	151
63.	Measure Distance	154
64.	Connection Check	155
65.	Create Meet List.....	157
66.	Design Check	160
67.	Check Velocity in Block	166
68.	Check Bend	167
69.	Check Conformance to Schematic	168
70.	Manufacturing and Tooling Check	170
71.	Check Connection for Offset	172
72.	Check Pressure Rating	174
	Display Options.....	175
73.	View a Net.....	176
74.	Color Cavities	177
75.	Locate Cavity	178
76.	Show/Hide Outline.....	179
77.	Show/Hide Cavity ID	180
78.	Net Display	181
79.	Show/Hide Cavity Center	183
80.	Remove Color.....	185
	Part Model Drawing Commands.....	186
81.	Generate Machining ID	187

82.	Create Machining Drawing.....	192
83.	Set Assembly Constraints.....	202

Settings..... 206

84.	MDTools Settings.....	207
85.	MDTools License Option in Inventor.....	214

Help..... 215

86.	User Manual.....	216
87.	About MDTools.....	217

DRAWING COMMANDS..... 218

88.	Create Views.....	219
89.	Show Internal Details.....	221
90.	Hide Internal Details.....	222
91.	Auto Dimension.....	223
92.	Show Machining ID.....	224
93.	Show Component ID.....	225
94.	Mark Construction Port.....	226
95.	Footprint.....	227
96.	Show Angle Hole.....	228
97.	Show Origin & Axes.....	229
98.	Show Engraved Text.....	230
99.	Show Undercut.....	231
100.	Create Machining Callout.....	232
101.	Create Balloon.....	236
102.	Create Machining Chart.....	237
103.	Create Cavity List.....	247
104.	Create Component and Port List.....	248
105.	Create Engraved Text Chart.....	249
106.	Drawing Layers.....	250
107.	MDTools License option.....	251

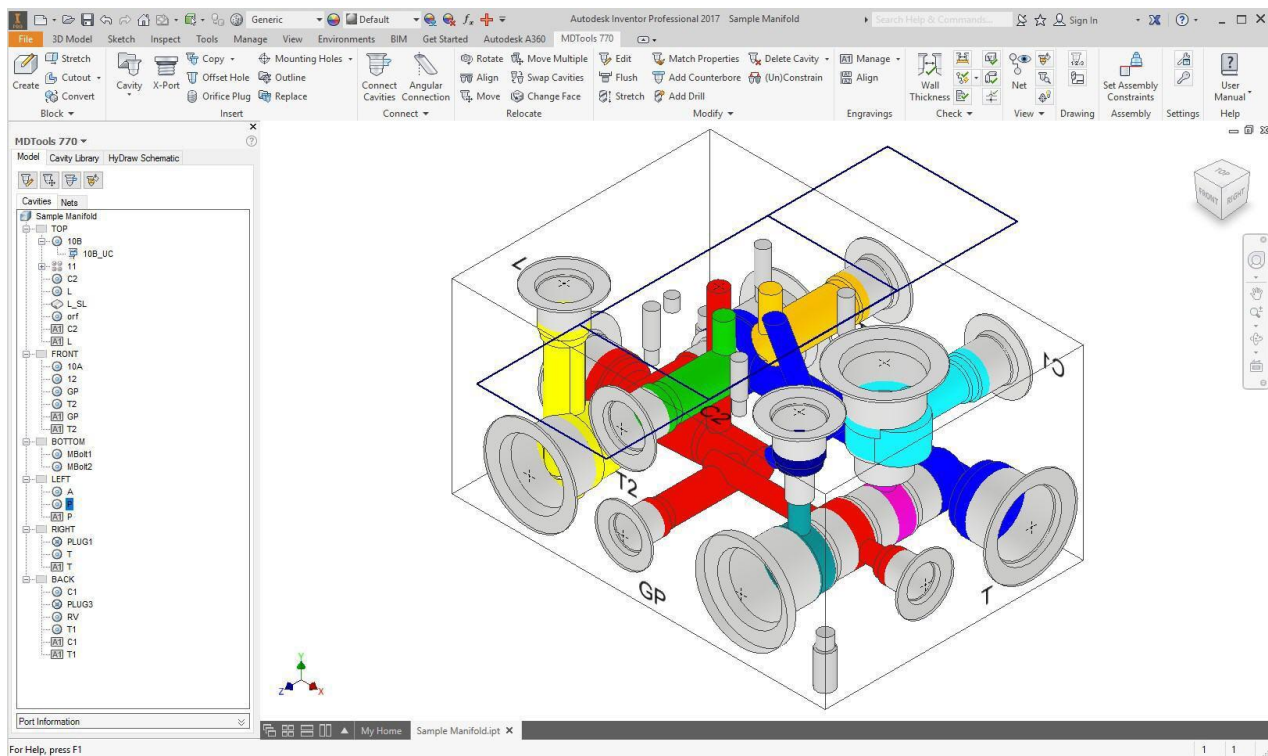
ASSEMBLY COMMANDS 252

108.	Auto Assemble.....	253
109.	Assemble Component.....	254
110.	Assemble Plugs.....	257
111.	Set Assembly Constraints.....	258
112.	Update Assembly.....	262
113.	Shrink Wrap.....	263
114.	MDTools Assembly Settings.....	264
115.	MDTools License Option.....	266

APPENDIX..... 267

116.	Energy Loss Considerations.....	268
117.	Command Overview.....	270

1. Introduction



VISUALIZES

- Color-coded cavities and flow paths
- Cavities divided into Port Areas and Dead Areas

DESIGNS

- Embedded Design Rules
- Simple and compound automated angle holes
- Parametric Move
- Undercuts, Chamfer
- Slots, O-ring grooves, Cutout
- Remove material from any part of the block
- Interactive Stretch Block
- Drag and move the cavities using move handle
- Layered 2D objects

CHECKS

- Correct connectivity
- Wall thickness
- Distance between selected surfaces
- Manufacturability
- Check against HyDraw® Schematic
- Holes cutting outside the port area of cartridge valve cavities
- Velocity in the block
- Bend, quality of intersections
- Connection Offset

AUTOMATES

- Auto Design Checks
- Auto Dimensioning
- Auto Machining Chart
- Auto Energy Efficient Connections
- Auto Energy Efficient Construction Drill Selection
- MDTools® HyDraw® Interface
- Auto Assembly from HyDraw Schematic

COMPREHENSIVE

- Uses both cartridge and interface valves
- Cavity libraries with machining details
- Includes major OEM libraries

...and more

1.1 Welcome to MDTools[®] 770

MDTools[®] 770, the 3D manifold design software, provides power tools to automate the manifold design, checking, documentation, and modeling process within the Autodesk Inventor environment.

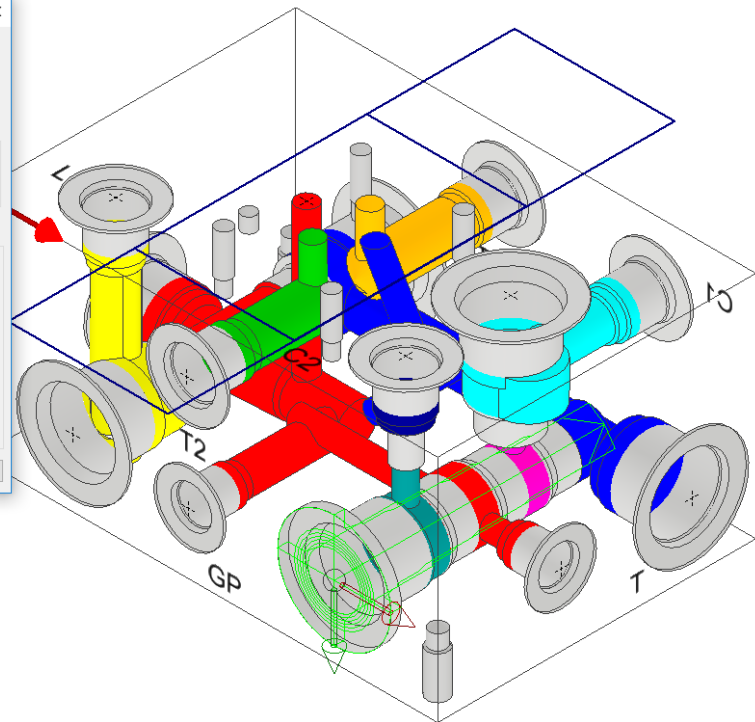
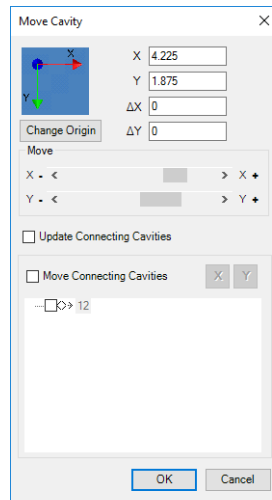
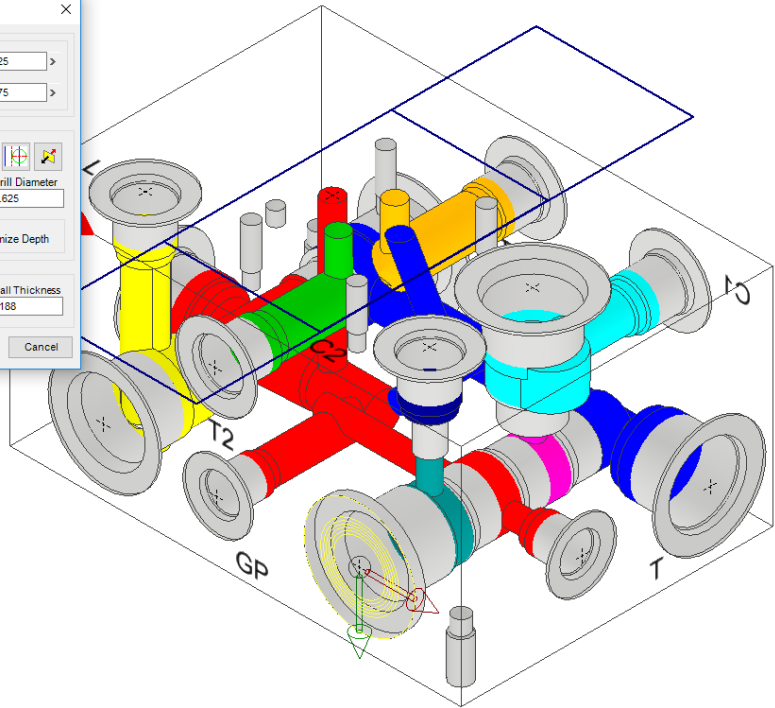
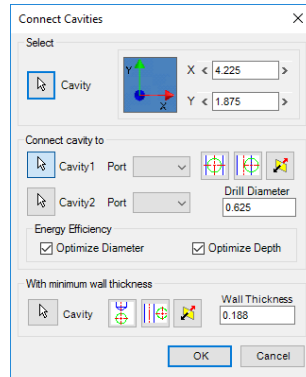
As a designer of hydraulic manifold blocks using both cartridge and interface valves, you will find MDTools 770 an invaluable tool enabling you to be more productive.

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

MDTools 770 provides efficient design tools to reduce your design time. Use the powerful Connect Cavities feature to 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 designs and actual machining.

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



Manifold Design with MDTools

1.2 Study Guidelines

The **MDTools® 770**

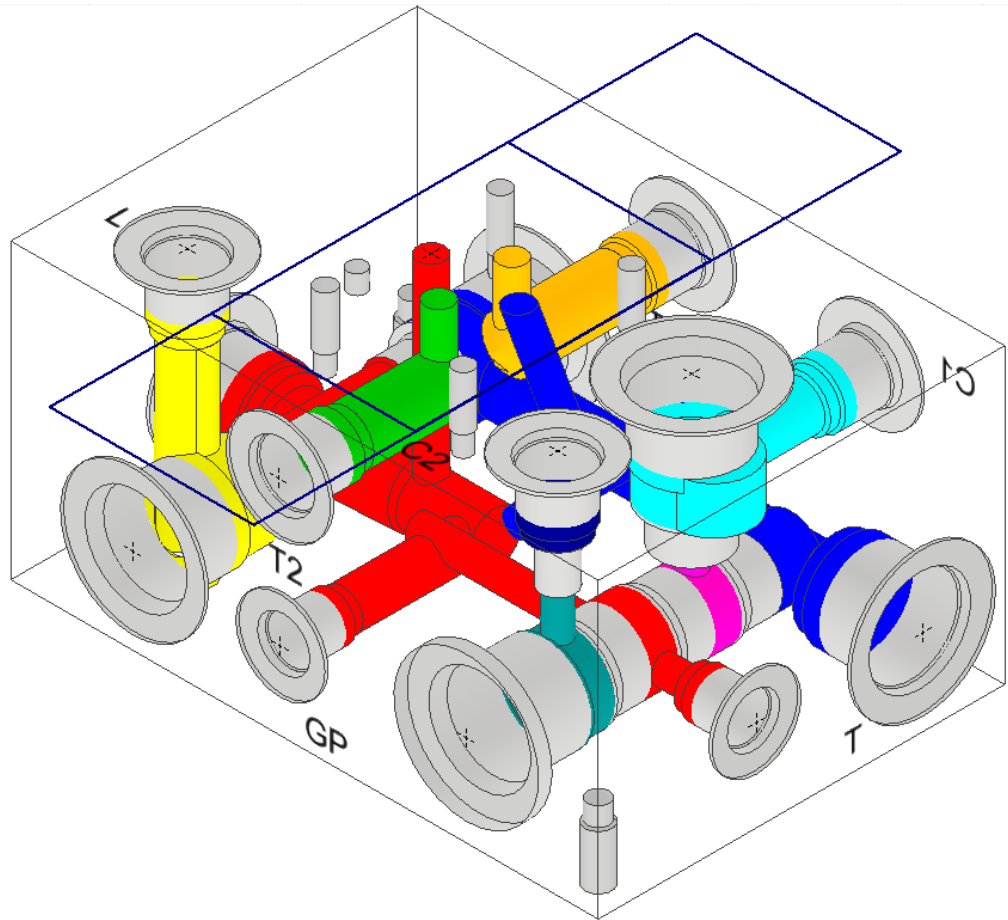
User Manual provides comprehensive information on the features, commands, usage, processes, and design methodology of MDTools 770.

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.

The User Manual may be used as a comprehensive reference to the command set and usage of MDTools 770.

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



1.3 If You Have a Question

If you have a question about MDTools 770, email us at support@VESTusa.com.

Please include the following:

- Version Number of the software you are using
To see the details of MDTools on your machine,
>MDTools 770 ribbon
 >Help panel
 >**About MDTools**
- Configuration of your machine
- Exact messages, if any.
 If possible, send a screen capture
- 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® 770 using the installation program. The installer creates all the required directories and installs MDTools 770 on your system.

2.1 System Requirements

- Intel Core i5 Processor 3.4 GHz.
- 8 GB RAM.
- Microsoft: Windows 7 SP1/Windows 8.1/Windows 10 (64 bit).
- Access Database Engine x64*, automatically installed by MDTools Installation.
- Autodesk Inventor 2017/2018 (64 bit).
- Other system requirements, per Autodesk Inventor version used.

* Not compatible with any other 32-bit version of Microsoft Office programs.

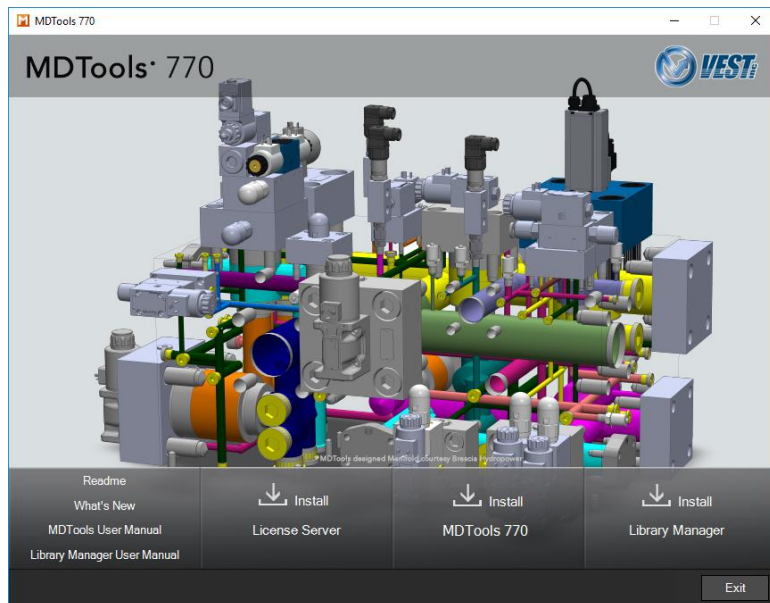
2.2 Software Installation

1. Insert the MDTools 770 CD in the CD drive of your system.
If auto-run is not set, then:

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 770 startup screen displays.



MDTools 770 CD startup screen

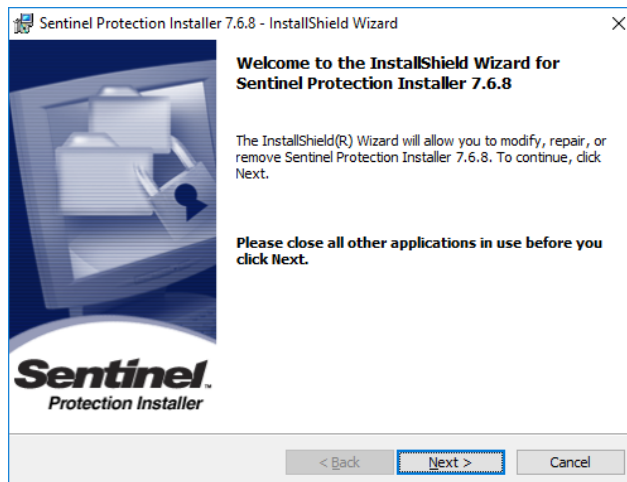
1 Install MDTools License Server Setup

1. Install the hardware lock manager on the system to which you have attached the MDTools hardware lock.
2. Click Install License Server.
3. Respond to all the setup program prompts.

Hardware lock driver is installed on your system.

Note

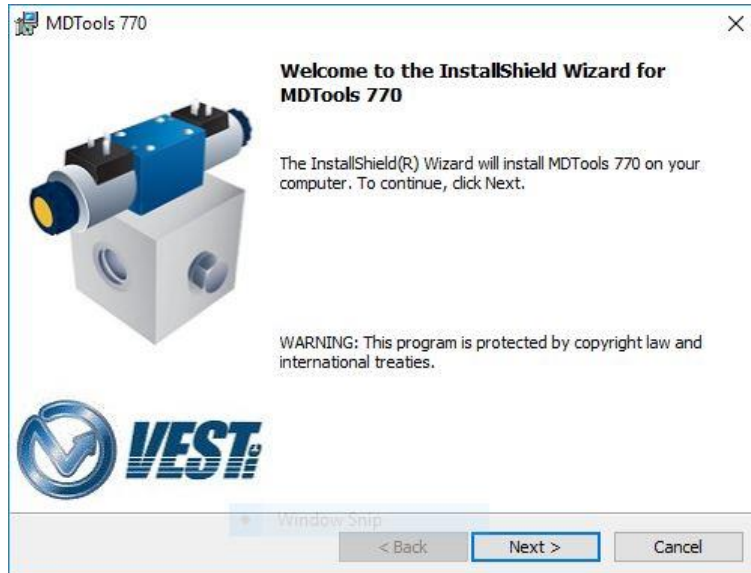
If you use the MDTools **Network License**, then install this program on the system with the hardware lock.



Hardware Lock Manager– InstallShield Wizard

2 Install MDTools 770

1. Click **Install MDTools 770**.
The MDTools® 770 InstallShield Wizard dialog box displays.
2. Respond to all the setup program prompts.
MDTools 770 is installed on your system.
The installation program automatically creates the required directories in the system.



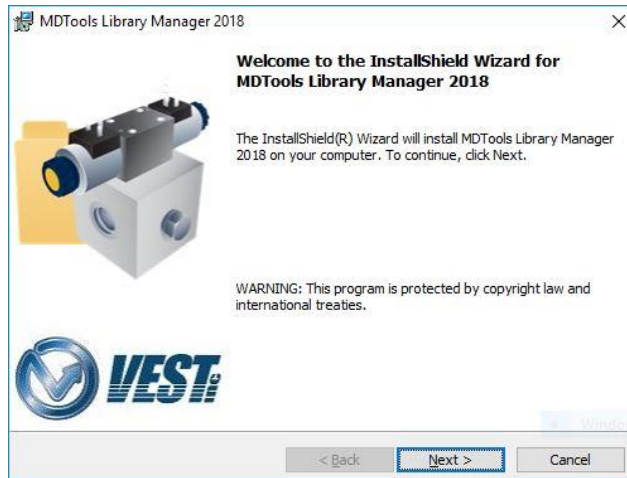
MDTools 770 InstallShield Wizard

3 Install MDTools Library Manager

1. Click **Install Library Manager**.
The MDTools® Library Manager 2018 dialog box displays.
2. Respond to all the setup program prompts.
The MDTools Library Manager 2018 program is installed on your system.

Note

- Install the MDTools Library Manager 2018 program on the server to share it over a network with your design team.
- MDTools uses different libraries for a period decimal separator and comma decimal separator settings.
- Select **MDTools Library Manager 2018 (German)**, if you use a comma as a decimal separator.
- You need to install the MDTools software and the MDTools Library Manager.



MDTools Library Manager – InstallShield Wizard

4 Set License Server Path (Only for Network License)

After installing MDTools® 770, set the license path.

The license path is the path to the computer or server, where MDTools hardware lock is located.

MDTools automatically checks for the license at the specified license path.

If the license path is not specified, then MDTools may not be able to validate the license.

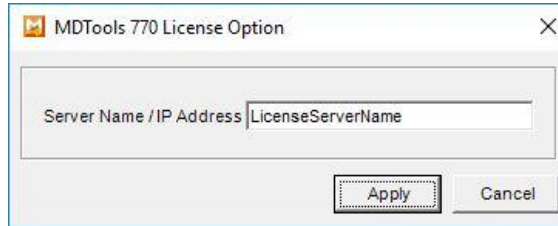
It will then work in the evaluation mode (cavity limit 10).

License Option in Program Menu

Set the license server through the Program menu.

1. Click Start
 - >All apps
 - >VEST
 - >**License Option**
2. Enter the server name or IP address of the system where the MDTools hardware lock is located.

MDTools directly picks the license from the remote server location.
3. Click **Apply**.



MDTools 770 License Option dialog box

Note

1. This option is available only in the MDTools 770 Network License version.
2. The MDTools 770 Standalone version automatically obtains the license from the hardware lock plugged in to the local machine.

5 License Option in Inventor MDTools Ribbon Menu (Only for Network License)

Set the license path through the MDTools[®] ribbon menu.

1. Click Inventor
 >MDTools 770 ribbon
 >Settings panel
 >License Option.

The MDTools License Option dialog box displays.

2. Enter the server name or the IP address of the system where the MDTools hardware lock is located.

This option is available only in the MDTools 770 Network license version.

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.

The screenshot shows the 'MDTools License Option' dialog box. It features a title bar with a close button (X). The main area is divided into two sections. The top section has a label 'Server Name / IP Address' followed by a text input field containing 'LicenseServerName' and an 'Apply' button. The bottom section is titled 'License Info' and contains two buttons: 'Get License' and 'Release License'. To the right of these buttons is a 'Key Info' section with two input fields: 'Licenses' and 'License in Use', both containing the number '5'. At the bottom right of the dialog are 'OK' and 'Cancel' buttons.

MDTools License Option dialog box

3. Import and Export Settings

Export your MDTools® custom settings from MDTools 750/755/760/765/770 and import to MDTools 770 on the same machine or different machines. MDTools export the selected MDTools settings to an XML file, which is imported in the MDTools settings.

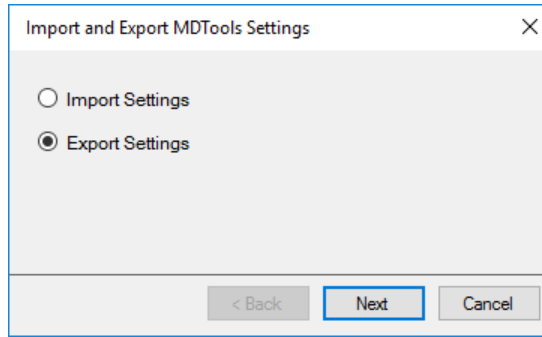
Start

>All apps

>VEST

>Import and Export Settings

The Import and Export MDTools Settings dialog box displays.

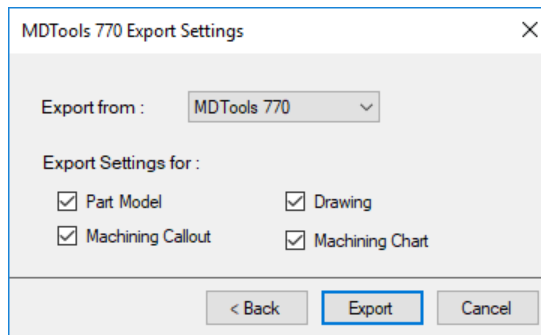


Import and Export MDTools Settings

Export Settings

Export MDTools Settings to an XML file.

1. Select the **Export Settings** option from the Import and Export MDTools Settings dialog box.
2. Click **Next**.
The MDTools 770 Export Settings dialog box displays.
3. Select the required **Export from** option.
4. Select the required **Export Settings for** option.



MDTools 770 Export Settings

Part Model:

Exports MDTools application settings in the Part model design, including Energy efficiency settings.

Drawing:

Exports Machining Drawing settings used to generate automatic 2D Machining drawing of part.

Machining Callout:

Exports Machining Callout settings.

Machining Chart:

Exports Machining Chart settings.

5. Click **Export**.
The Save XML file dialog box displays.
6. Enter the file name and click **Save**.

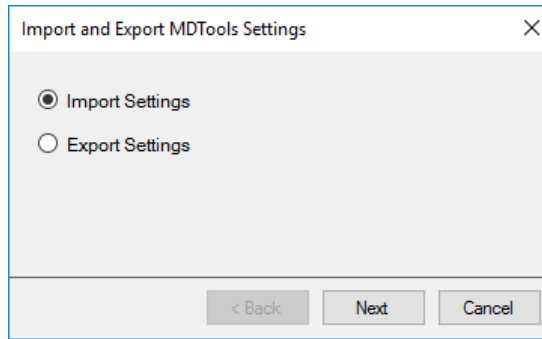
Import Settings

Import MDTools® settings from an XML file.

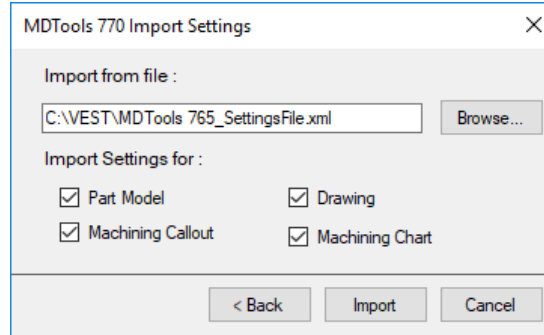
1. Select Import Settings.
2. Click **Next**.

The MDTools 770 Import Settings dialog box displays.

3. Click **Browse** and import the exported XML file.
4. Select the required **Import Settings for** options.
 - Part Model
 - Machining Callout
 - Drawing
 - Machining Chart
5. Click **Import**.
MDTools updates the settings.



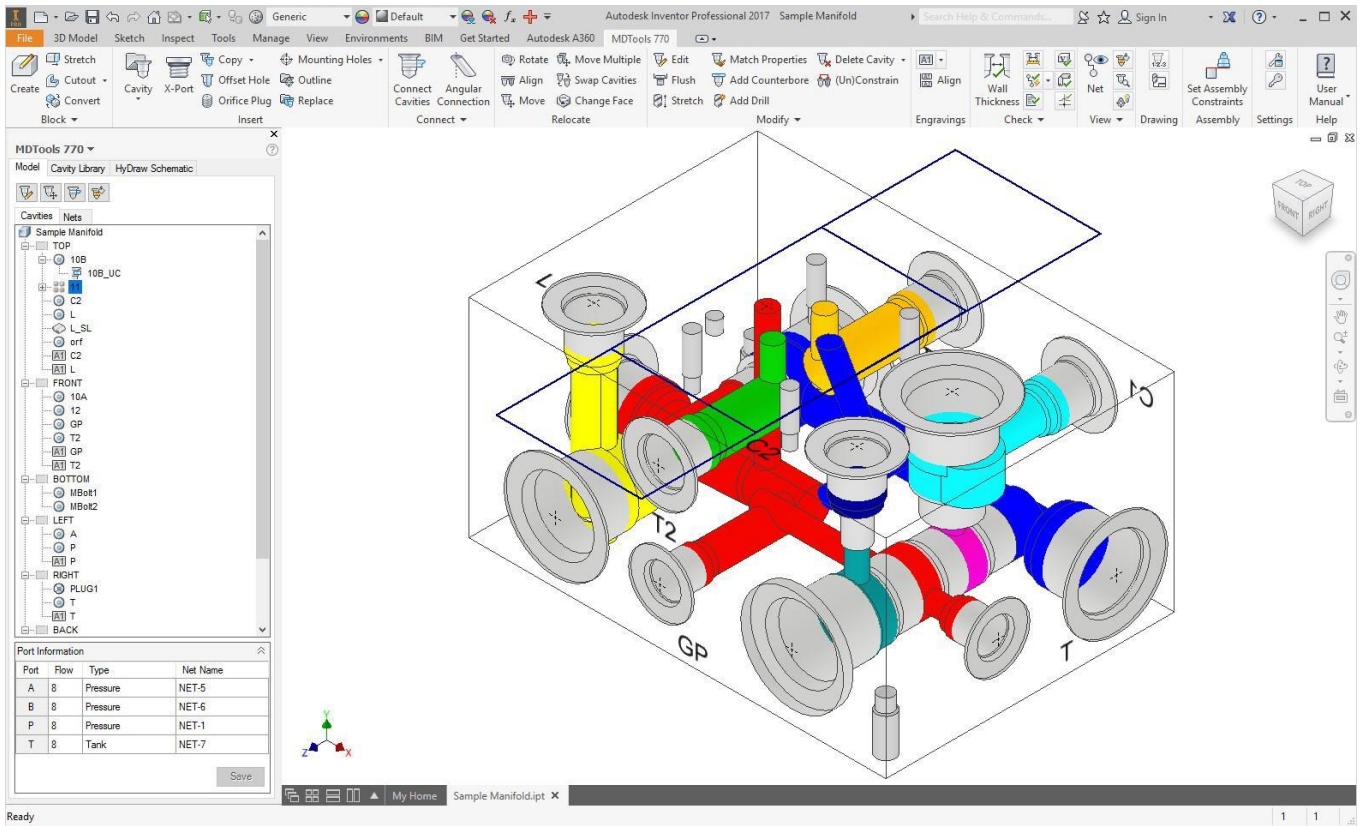
Import and Export MDTools Settings



MDTools 770 Import Settings

Basics

- 4 MDTTools Workspace
- 5 Schematic Interface
- 6 MDTTools Cavities
- 7 Net (Flow Paths)
- 8 Design Check Basics
- 9 Angle Holes



4. MDTools Workspace

MDTools 770 manifold design software enables you to design, check, draw, and model manifolds within the Autodesk Inventor environment.

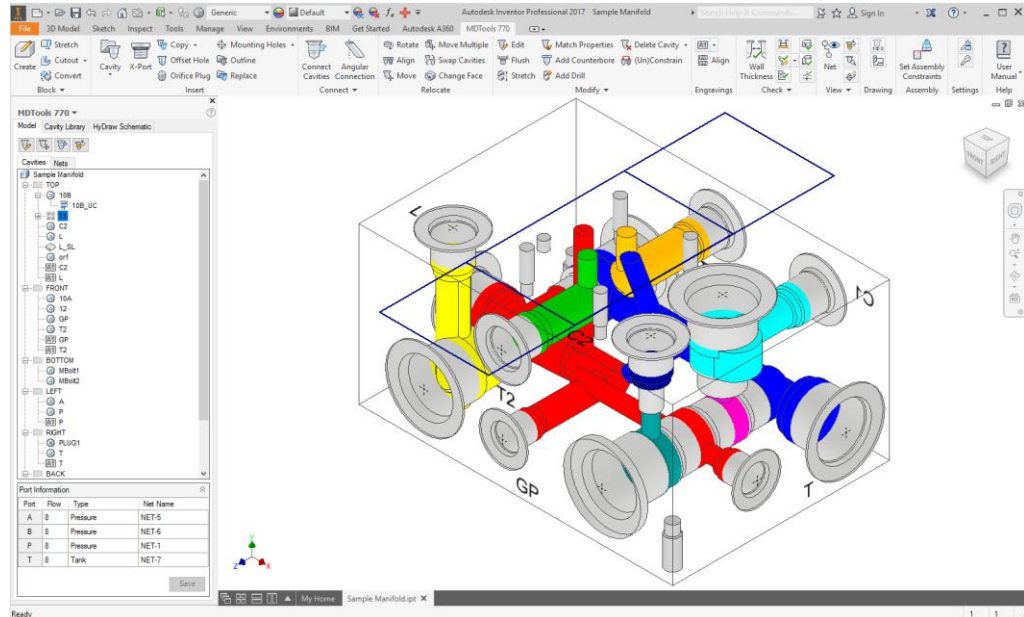
MDTools 770 ribbon menu, toolbar, and panel gives you easy access to the commands.

There are three sets of commands in MDTools

- Block design (Part model) commands
- 2D Drawing commands
- Assembly commands

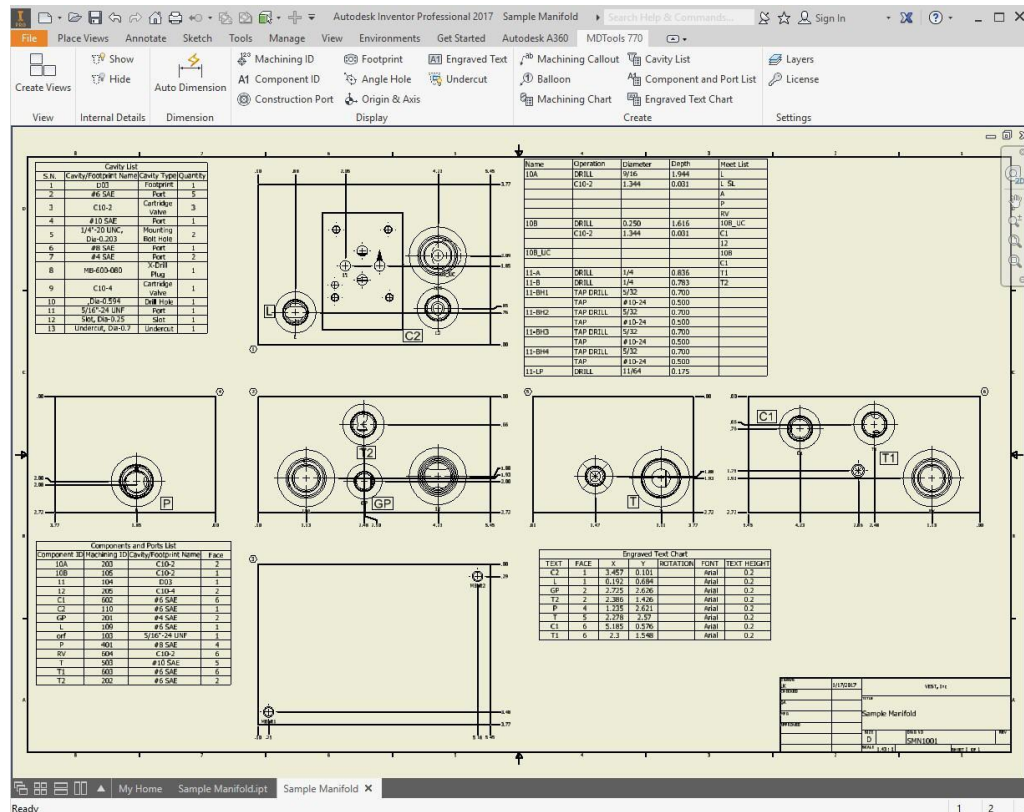
Note

- MDTools is loaded automatically in Inventor after installation.
- To modify the Load behavior:
Click Tools > Add-Ins > MDTools 770
- MDTools Part Model commands work only in the Part Model environment (.ipt file).



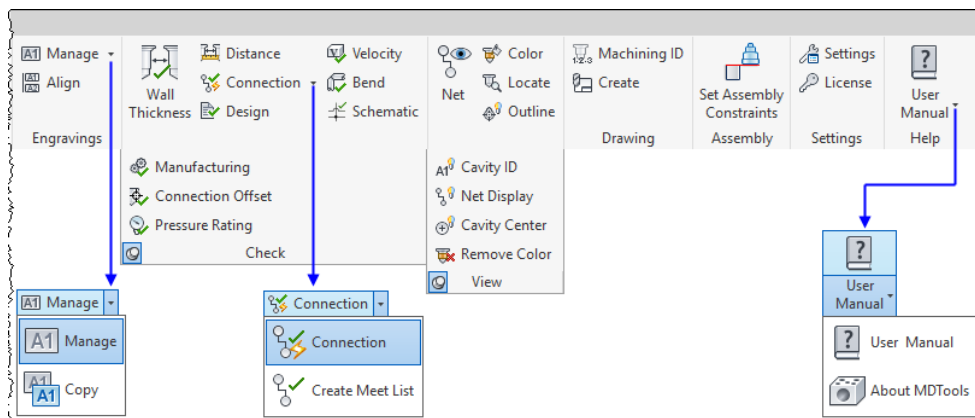
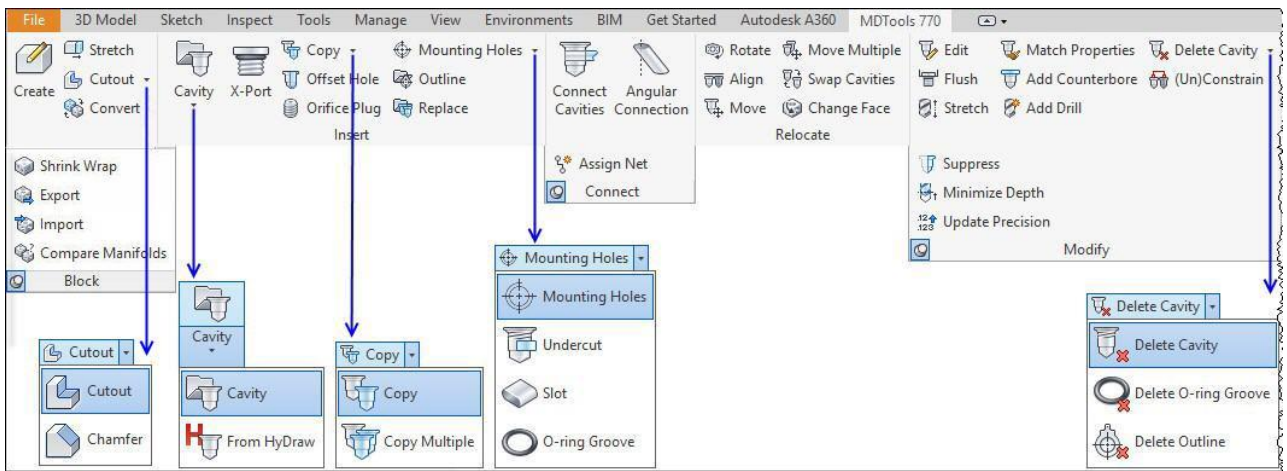
MDTools Part Model menu

- MDTools 2D Drawing commands work only in the 2D drawing environment (.idw/.dwg file).
- MDTools Assembly commands work only in the assembly environment (.iam file).
- MDTools menu displays when you edit part model in the assembly. This does not work from the Assembly file.

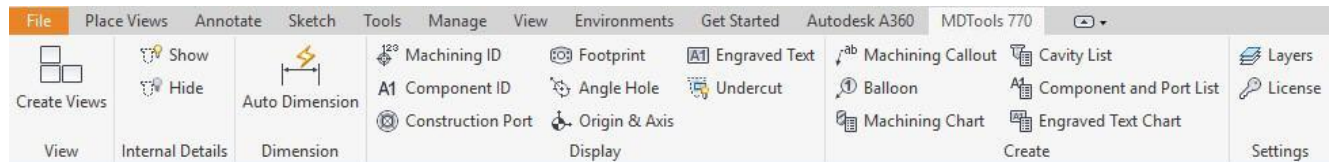


MDTools 2D Drawing menu

4.1 Part Model Commands



4.2 Drawing Commands



4.3 Assembly Commands



4.4 MDTools Browser Bar

MDTools* adds its own browser bar to the Inventor browser bar list.
The MDTools browser is displayed as the default browser bar of a Part document.

Browser Behavior

Loaded/Unloaded:

Switches between loading and unloading the browser.

Load on Startup:

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

Group Cavities by Face:

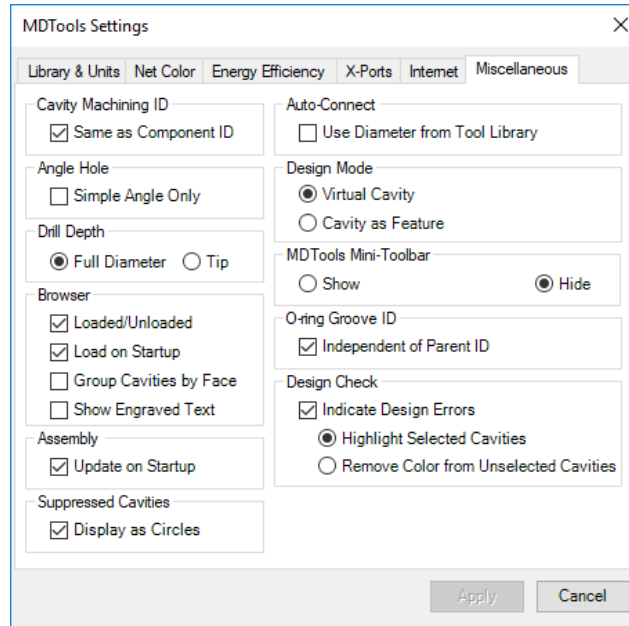
Lists the cavities by face name in the Model browser.

Show Engraved Text:

Shows or Hides engraved texts in the Model browser.

Note

Browser Load Behavior is updated only after clicking the Apply button.



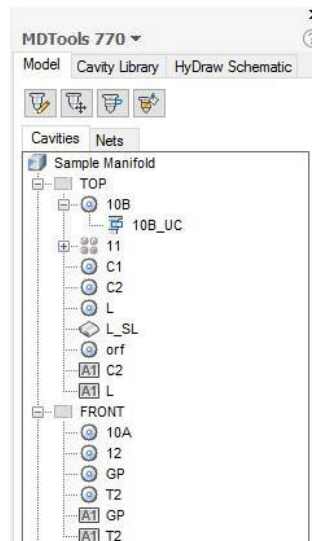
MDTools Settings dialog box: Miscellaneous

MDTools Browser Bar in Browser Pane

It displays a few basic commands in a small toolbar for the ease of use.

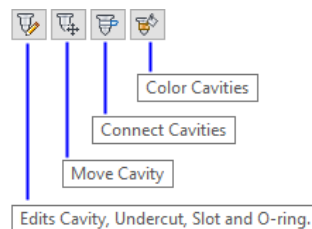
Note

MDTools browser only displays in the Part Model environment.



MDTools Browser Bar

MDTools frequently used tools are also available at the top of the browser pane.



MDTools Browser Toolbar

4.5 MDTools Cavity Browser

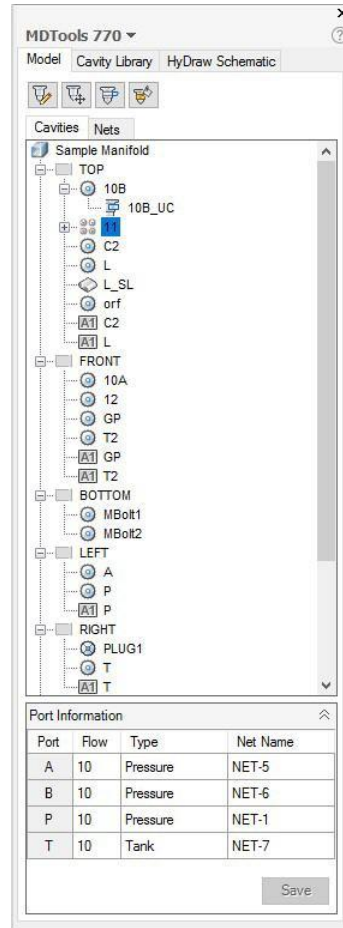
MDTools® Cavity Browser:

- Displays in the Inventor browser pane.
- Lists the cavities in the manifold.

On moving the cursor over any cavity in the cavity list or on selection, the selected cavity is highlighted in the part model.

Note

- MDTools displays the construction ports with the X-mark icon in the browser.
- Orifice plugs, Engraving, O-ring, undercut, and slot displays different icons.

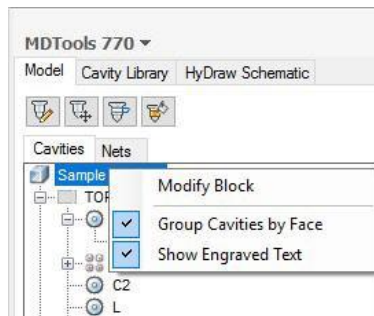


MDTools Cavity Browser

Cavity Browser Context Menu

Context menu (right click) for the manifold node enables you to:

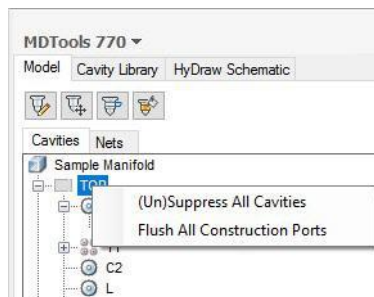
- Modify the manifold block.
- Group cavities by face.
- Show engraved text.



Context menu: Manifold Node

Context menu for the face node enables you to:

- Suppress/Unsuppress all cavities.
- Flush all construction ports on the face.



Context menu: Face Node

Cavity Browser Context Menu

Selected Cavity

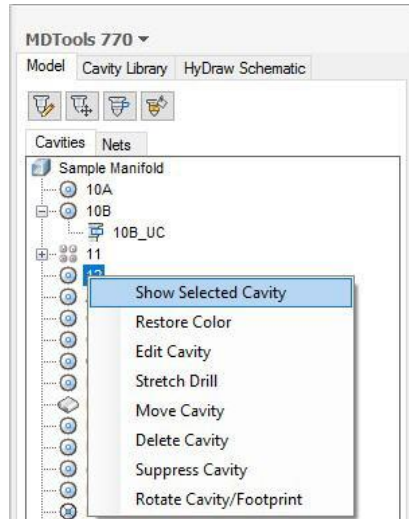
The context menu (right click) on the **selected cavity**:

Show Selected Cavity

MDTools[®] displays the selected cavity with its net color and the other cavities with the Dead Area color.

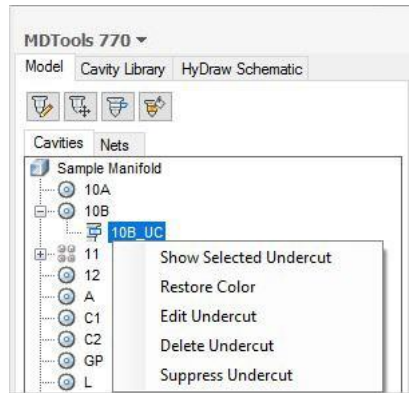
Restore Color

Restores the cavity shading.



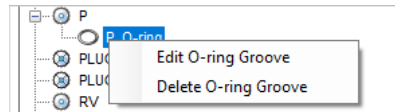
Selected Cavity - Cavity Browser context menu (right click)

Selected Undercut



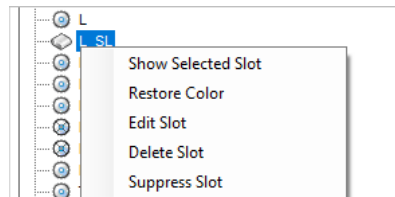
Cavity browser context menu with Selected Undercut

Selected O-ring Groove



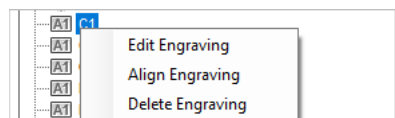
Cavity browser context menu with Selected O-ring Groove

Selected Slot



Cavity browser context menu with Selected Slot

Selected Engraving Text



Cavity browser context menu Selected Engraving Text

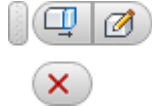
4.6 MDTools Part Model Context Menu

MDTools Part Model Context Menu
(left click):

- Displays in the Inventor Part Model drawing space.
- Invokes on left-clicking the block face, selected cavity, slot, undercut, O-ring and engraving.

Stretch block and modify block.

- Context menu (left click) on the selected face



Part Model Context Menu (left click) Face Selection

Edit, move, connect, align, copy, delete, rotate, and suppress cavity, stretch drill, and change face.

- Context menu (left click) on the selected cavity



Part Model Context Menu (left click) Cavity Selection

Edit, suppress and delete slot.

- Context menu (left click) on the selected slot



Part Model Context Menu (left click) Slot Selection

Edit, suppress and delete undercut.

- Context menu (left click) on the selected undercut enables you to:



Part Model Context Menu (left click) Undercut selection

Edit and delete O-ring.

- Context menu (left click) on the selected O-ring



Part Model Context Menu (left click) O-ring Selection

The context menu (left click) on the selected engraving enables you to:

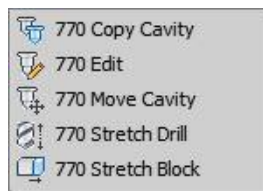
Edit, align, and delete engraving.



Part Model Context Menu (left click) Engraving Selection

The context menu (right click) on the Part Model Drawing space enables you to:

Copy cavity, edit, move cavity, stretch drill, and stretch block.



Part Model Context Menu Drawing space

4.7 MDTools Nets Browser

MDTools® Nets browser in the Inventor browser pane displays:

- The Connectivity (net) list.
- All cavities and ports in each net.

Nets Browser Context Menu

The context menu in the Nets browser enables you to change the visibility and color of nets:

Show Selected Net

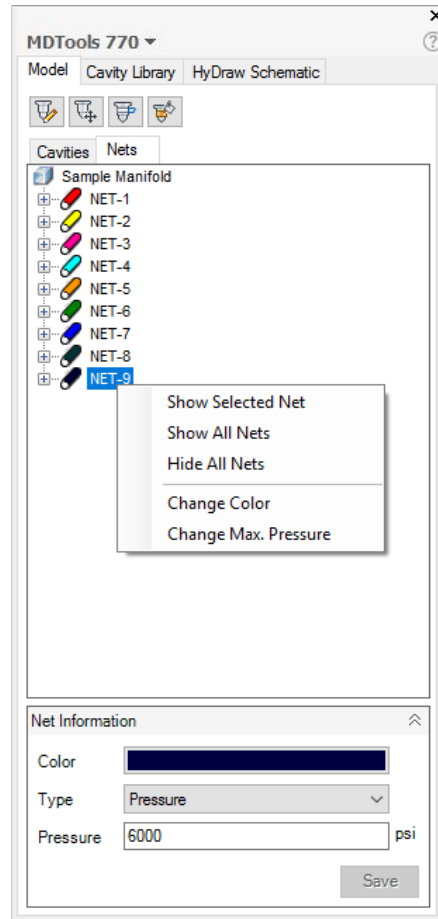
Displays the selected net with the net color and all other nets with the Dead Area color.

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 Dead Area color.



MDTools Nets Browser

Change Color

Changes the color of the selected net.

1. Select **Change Color** from the context menu.

The Color dialog box displays.

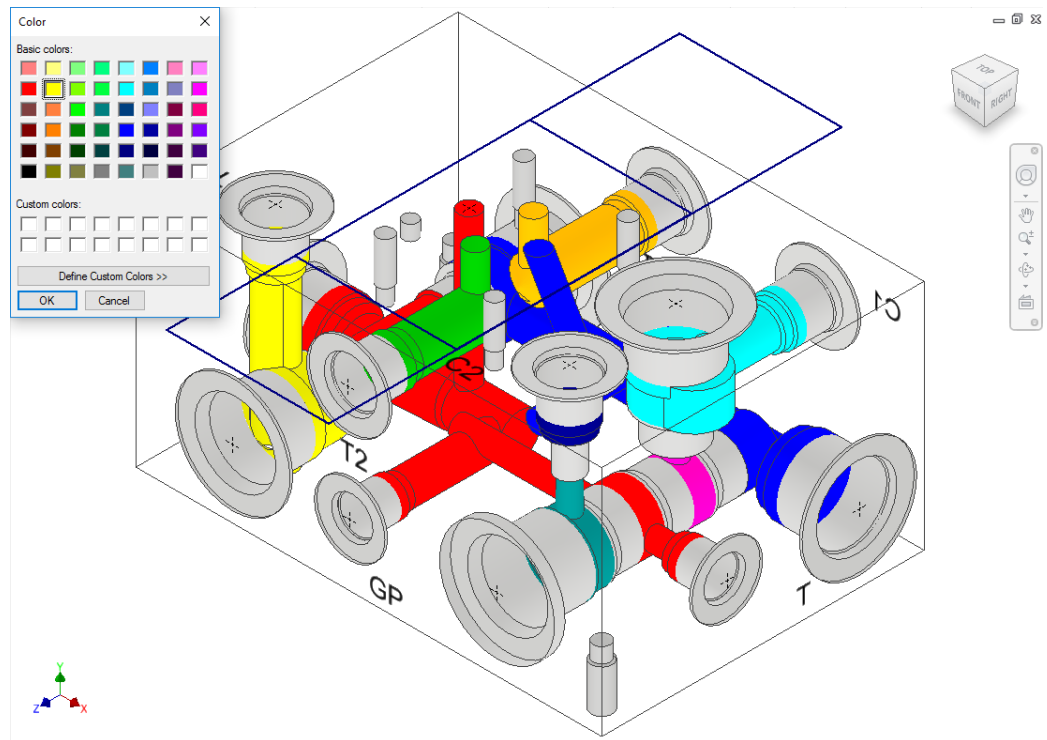
Select the new color for the selected net.

Click **OK**.

MDTools updates the selected net with the new color.*

Note

Color of the selected net can also be changed in the Net Information section.



Change net color

Change Max. Pressure

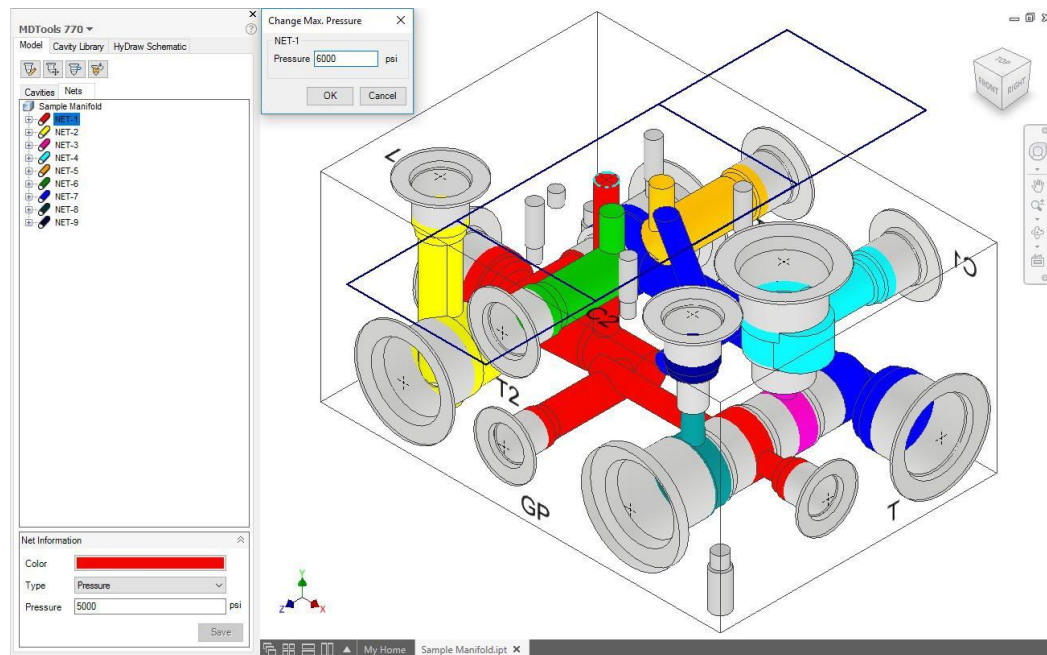
1. Select **Change Max. Pressure** from the context menu.

The Change Max. Pressure dialog box displays.

2. Enter the new pressure for the selected net.

3. Click **OK**.

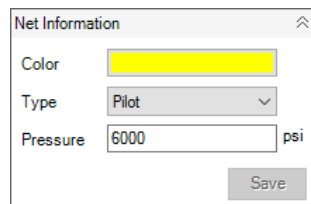
MDTools updates the selected net with the new pressure.



Change maximum pressure

Note


Selected pressure can also be changed in the Net Information section.



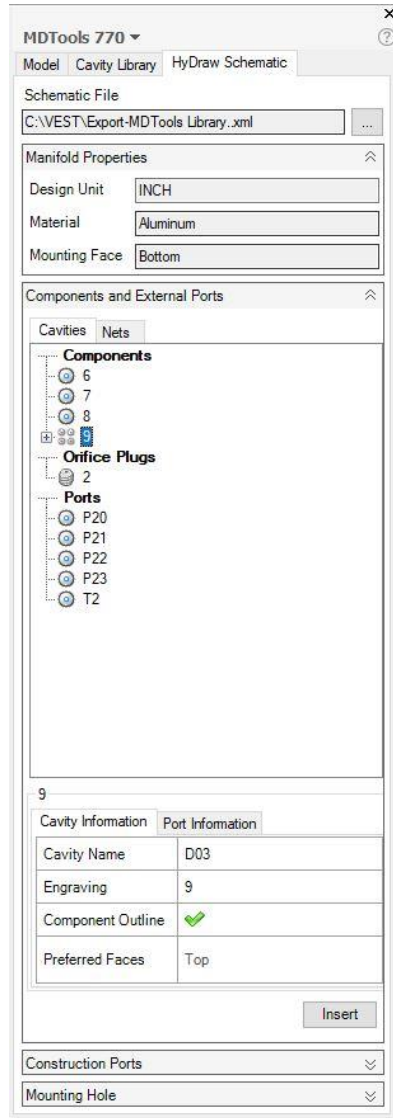
Net Information

5. Schematic Interface

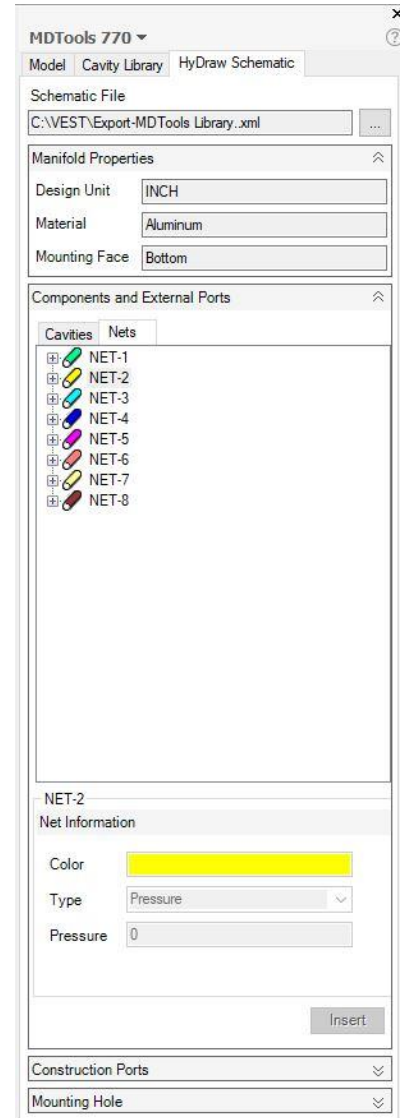
Automatically reads an XML/MBXML exported from HyDraw® schematic drawing.
 Insert all the required cavities with connectivity information into MDTools®.

1. MDTools 770 ribbon
 >Insert panel
 >From HyDraw
The MDTools HyDraw Schematic page displays in the MDTools 770 browser.
2. Click .
The Select HyDraw File dialog box displays.
3. Select the required HyDraw XML/MBXML.
4. Click **Open**.
MDTools automatically populates the Cavity Explorer with all the components from the schematic drawing.

Note
 To insert cavities, click Insert cavity from HyDraw Schematic.



MDTools HyDraw Interface

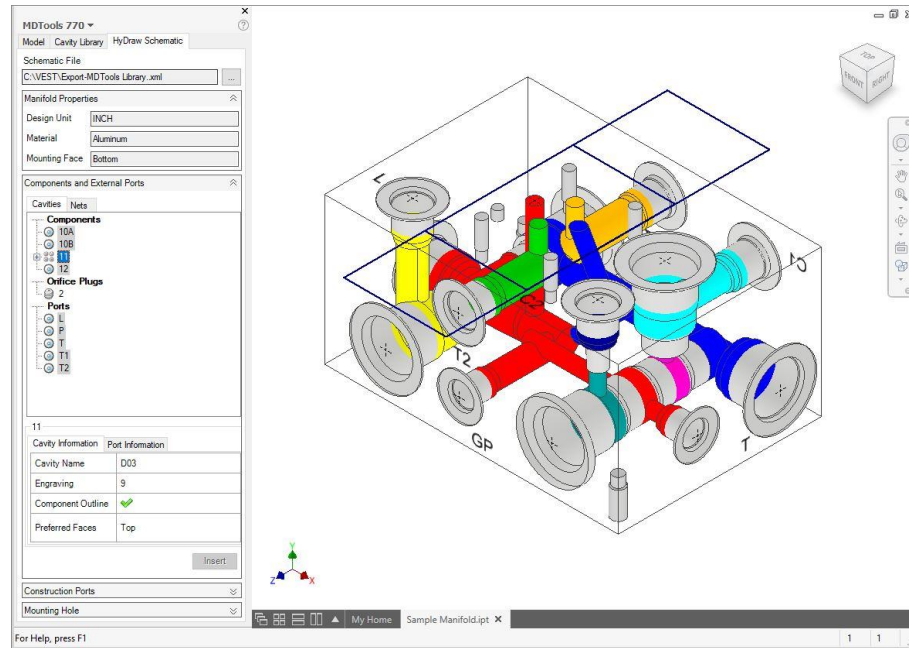


Components in Nets Browser

5.1 Cavities Browser

Cavities browser lists all the components in the schematic drawing and enables you to view the properties.

1. Select a component.
Details of the selected component are displayed in the Cavity Information and Port Information tab pages.
2. View the required properties.
3. Click **Insert** to insert a cavity.

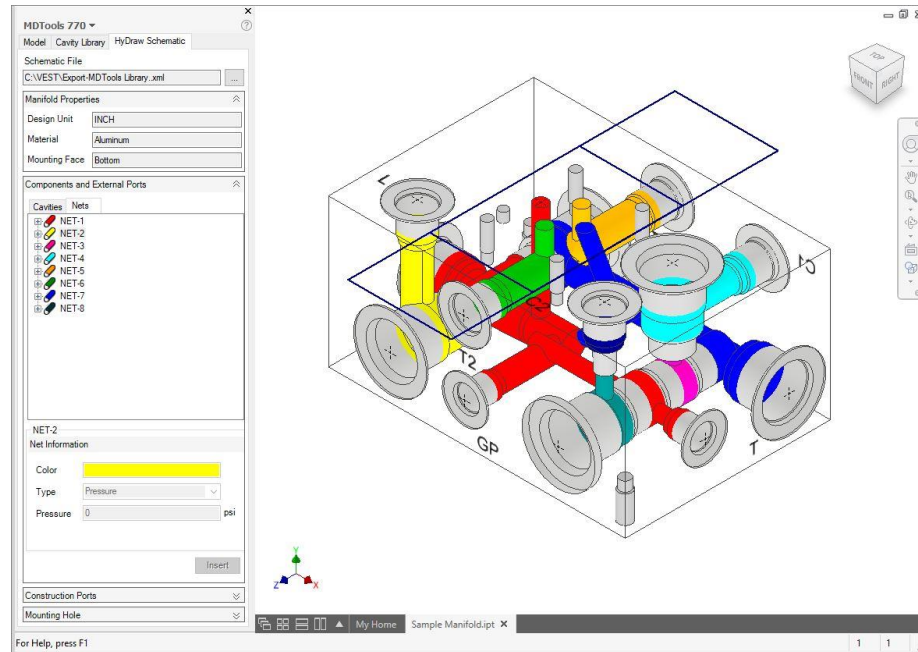


MDTools® HyDraw® Interface: Cavities Browser

5.2 Nets Browser

Nets browser displays the connectivity (net) list in the schematic drawing with all the cavities and ports in each net.

1. Expand the required Net and select a component.
Details of the selected component are displayed in the Cavity Information and Port Information tab pages.
2. View the required properties.
3. Click **Insert** to insert a cavity.



MDTools HyDraw Interface: Nets Browser

6. 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, or an undercut.

6.1 Modeling Cavities

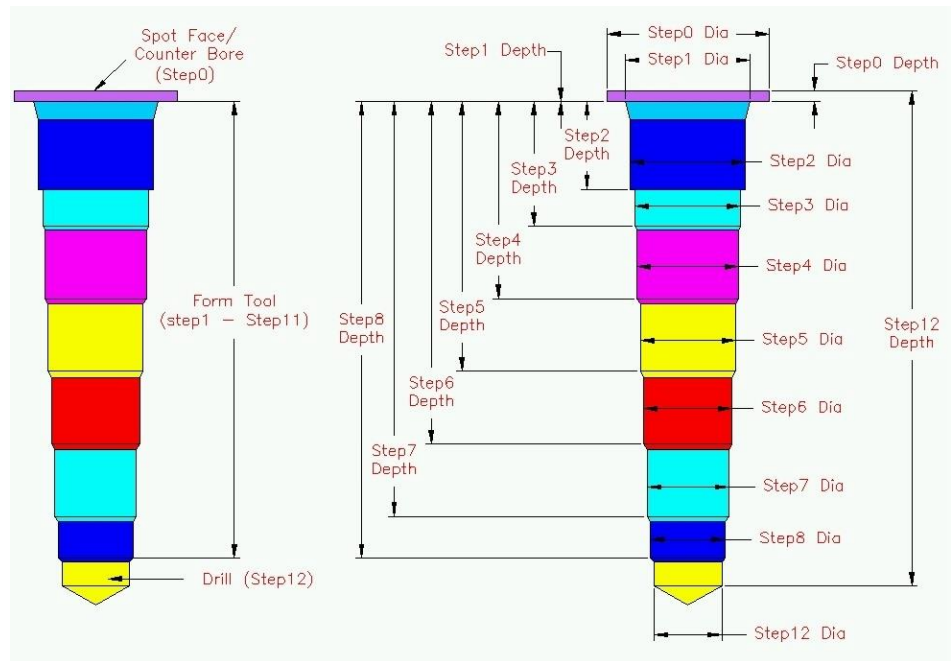
Geometry of a cavity is defined in terms of its dimensions and its relationship with the step number and step dimensions.

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.



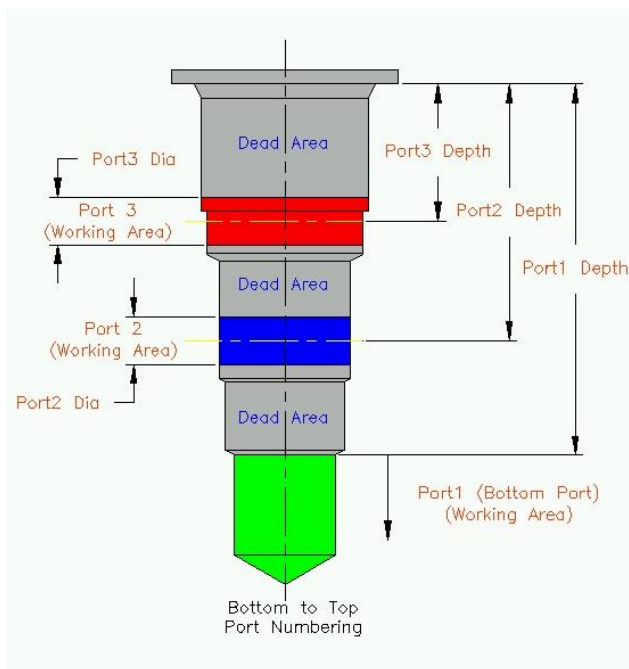
MDTools Cavity Geometry

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 port areas are considered the 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

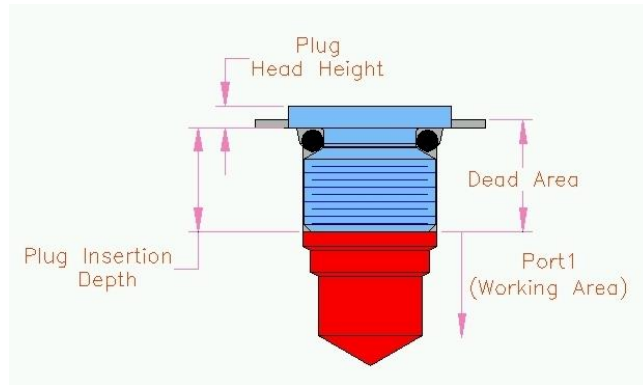
Cavities of ports are also divided into Working Areas and Dead Areas.

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

Area down to the insertion depth is the Dead Area.

Note

- For port cavities, the plug insertion depth must be specified.
- If the plug insertion depth is not specified, then the complete cavity is included in the Working Area.

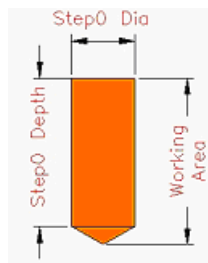


Plugs

3 Drill Holes

The complete cavity is considered as the Working Area.

Hole dimensions are entered in Step0 of the cavity.



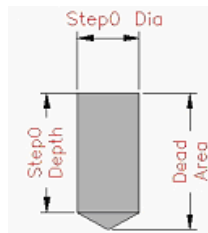
Drill Holes

4 Locating Pin Holes

The complete cavity is considered as the Dead Area.

Hole dimensions are entered in Step0 of the cavity.

All the dimensions are fixed.



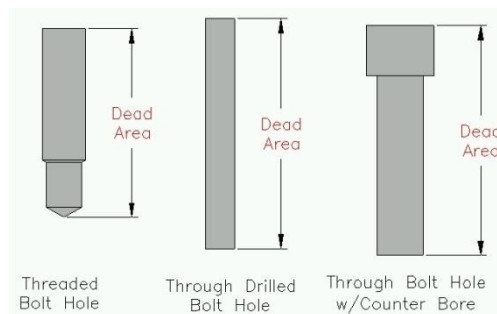
Locating Pin Holes

5 Bolt Holes

The complete cavity is considered as the Dead Area.

Three variations of bolt holes are used in manifold design.

- Threaded Bolt Holes
(for mounting components on manifolds and for mounting manifolds)
- Through Drilled Bolt Holes
- Through Bolt Holes with Counter Bore
(for mounting manifolds)

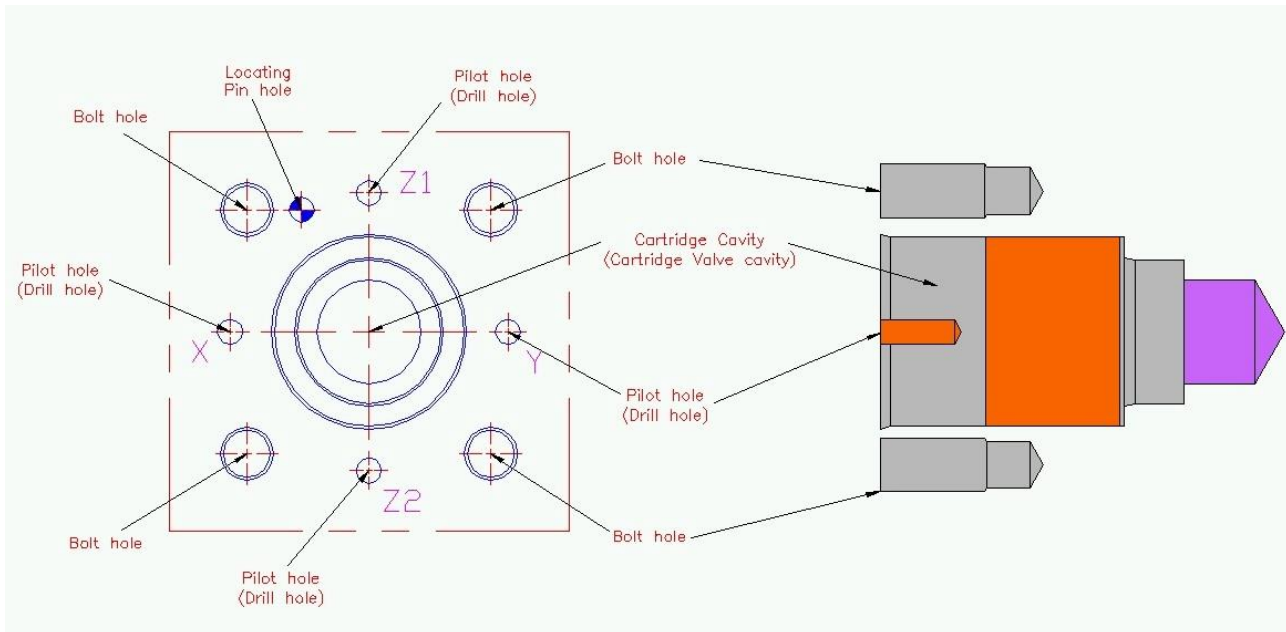


Bolt Holes

6.2 Footprints

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

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



Typical slip-in cartridge valve footprint

7. Nets (Flow paths)

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

1 Net List

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 knows its connectivity, per the System Circuit diagram or Schematic.

2 Meet lists

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

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

3 Connectivity Net List

Connectivity Net List gives the actual connectivity inside the manifold.

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

4 Design Net List

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.

5 Creating a Net List from a Schematic

MDTools[®] enables you to check a manifold design against the circuit diagram by enabling consistent naming conventions between the circuit diagram and the manifold design.

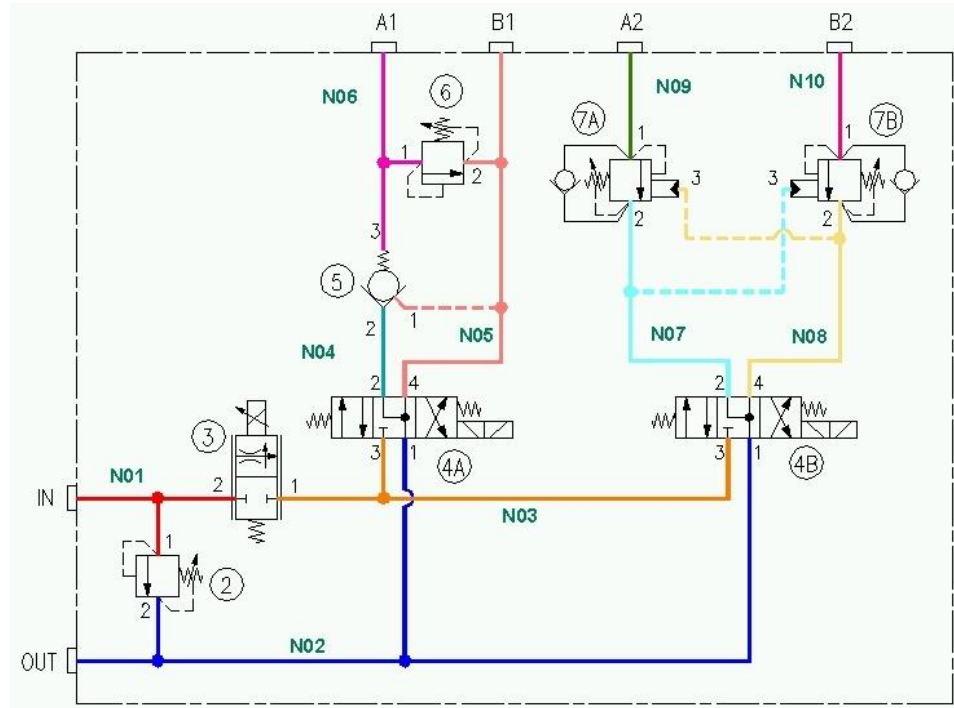
MDTools' consistent naming system between schematics and the manifold design encompasses:

- Component names in the schematics, with the cavity ID in the manifold.
The component name in the schematic is used as the Component ID for the cavity in 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 manifold design.

Observe the sample schematic diagram shown on the right.

- 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.
- The manifold has six ports: IN, OUT, A1, A2, B1, and B2.
- When designing the manifold, consider the ports as components and assign the component names as the port names.



Sample schematic showing nets

- Each unique path or a passage in the schematic/manifold is termed as 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.
- Upon 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.

8. Design Check Basics

MDTools[®] divides cavities into Working and Dead Areas.

MDTools accurately checks to find issues, such as thread eating or connections outside the port area.

MDTools Cavity

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

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

Modeling Cavities

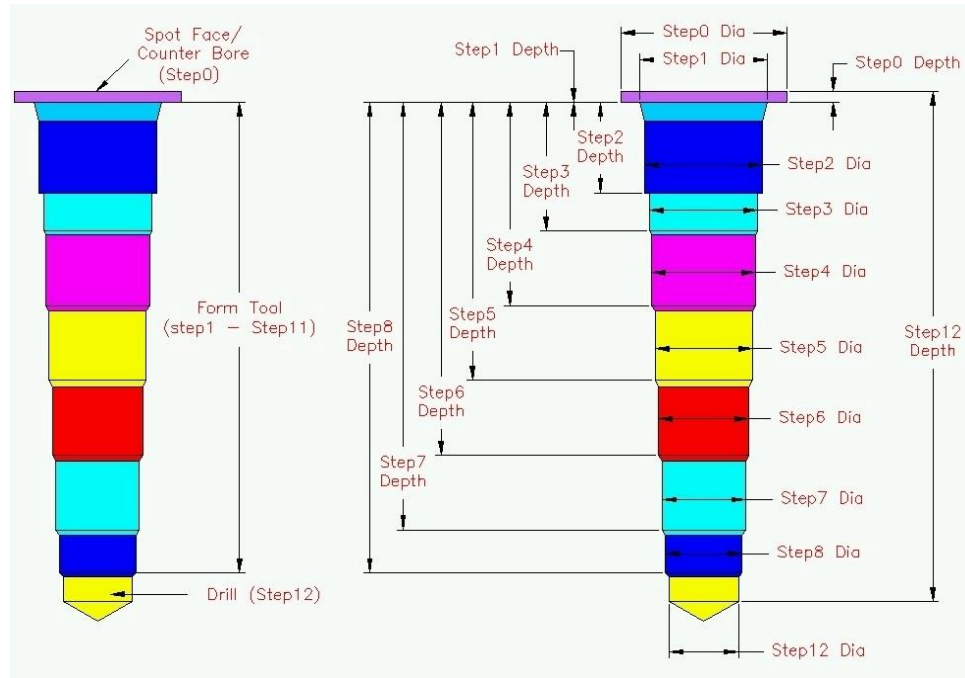
Geometry of a cavity is defined in terms of its dimensions and relationship with the step number and step dimensions.

Each step, generally consisting of a cylindrical and 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.



Modeling MDTools cavities

1 Ports

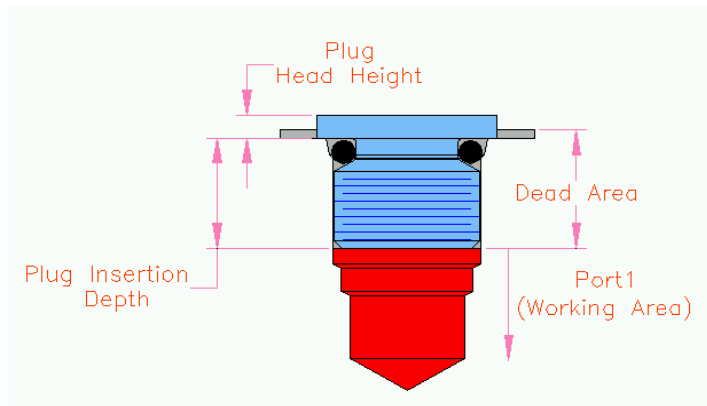
Cavities of ports are also divided into Working Areas and Dead Areas.

The area of a cavity below the insertion depth of plug/fitting is considered the Working Area.

The area down to the insertion depth is the Dead Area.

Note

For ports, the plug insertion depth must be specified. If it is not specified, then the complete cavity will be included in the Working Area during connectivity and wall thickness checks.



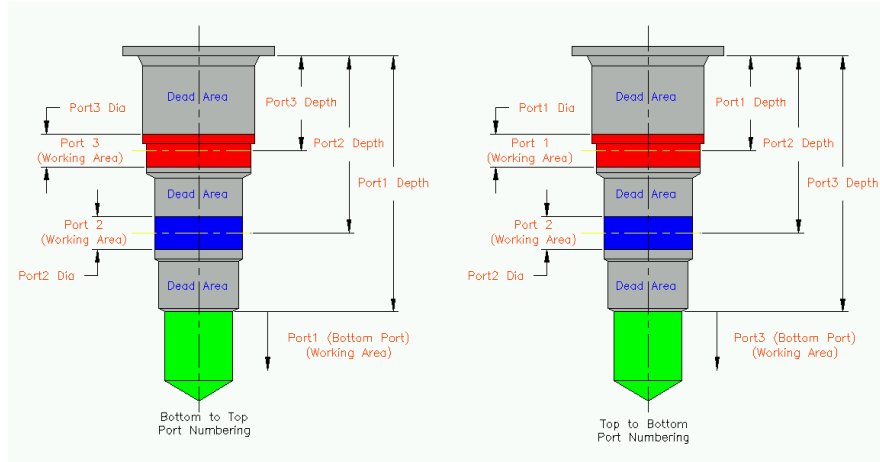
Plugs – Ports: Dead Area and Working Area

2 Cartridge Valve Cavity

Cartridge valve cavities are divided into Working Areas (port area) and Dead Areas. All parts of a cavity other than the port area are considered the Dead Area.

Note

Bottom port depth is the starting depth of bottom port from spot face.

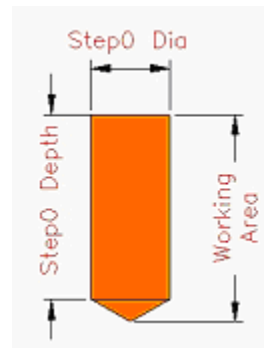


3 Port Cartridge Valve Cavity

3 Drill Holes

The complete cavity is considered the Working Area.

Hole dimensions are entered in Step0 of the cavity.



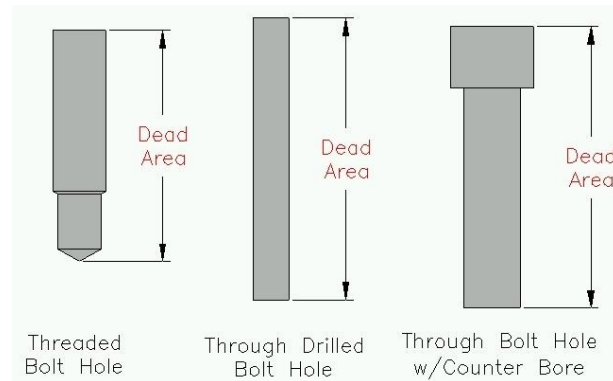
Drill Holes

4 Bolt Holes

The complete cavity is considered the Dead Area.

Three variations of bolt holes are used in manifold design:

- Threaded Bolt Hole (for mounting components on manifold and for mounting the manifold)
- Through Drilled Bolt Hole
- Through Bolt Hole with Counter Bore (for mounting the manifold)



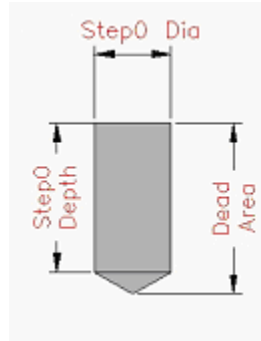
Types of Bolt Holes

5 Locating Pin Holes

The complete cavity is considered the Dead Area.

Hole dimensions are entered in Step0 of the cavity.

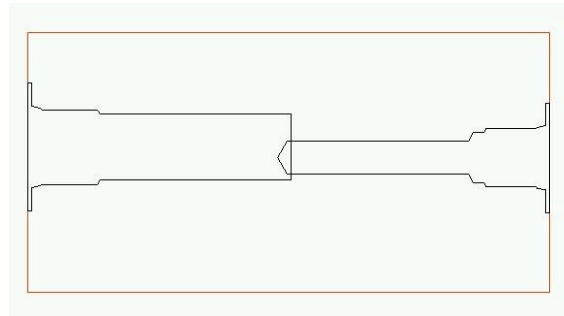
All the dimensions are fixed.



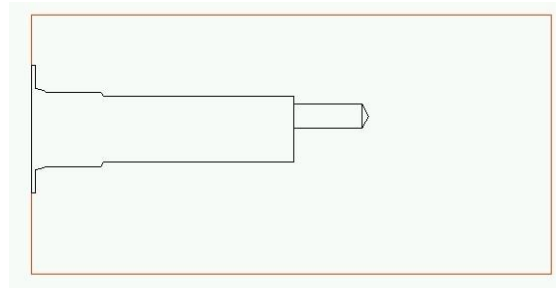
Locating Pin Holes

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 do not appear in the Meet List of a cavity.
- When you use flat bottom drills inside cavities, instead of making it exactly flat with a 0-degree angle, use a small angle (for example, 1 degree) and allow the formation of a very small cone at the bottom to get a correct result in design check. (This is a current limitation)



Cavity meeting a Flat Bottom Cavity



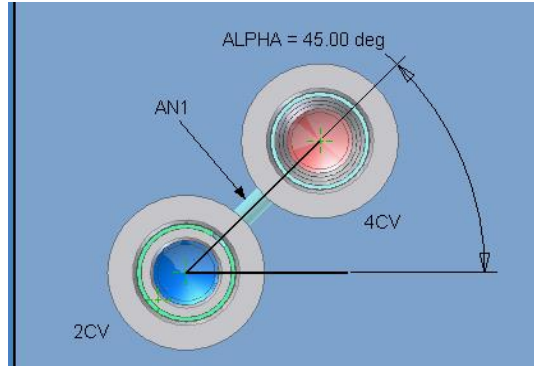
Offset hole passing through a Flat Bottom Cavity

9. Angle Holes

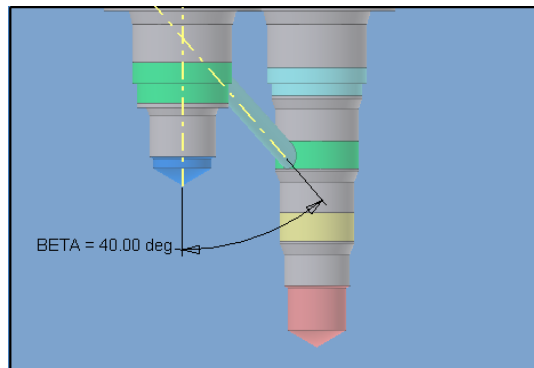
Compact manifolds, which use minimum number of cross drills, are often possible using angle drill holes. MDTools[®] is equipped to model, visualize, and design by using angle holes.

In MDTools, angle holes with Alpha angle of 0, 90, 180, or 270 are called **Simple Angle Holes** and angle holes with Alpha angle other than 0, 90, 180, or 270 are called **Compound Angle Holes**.

- Alpha angle is the rotation of an angle hole on the surface.
- Beta angle is the inclination of an angle hole from surface normal.
- Alpha and Beta values are the values entered in the Edit Cavity dialog box.



Alpha - rotation on the surface

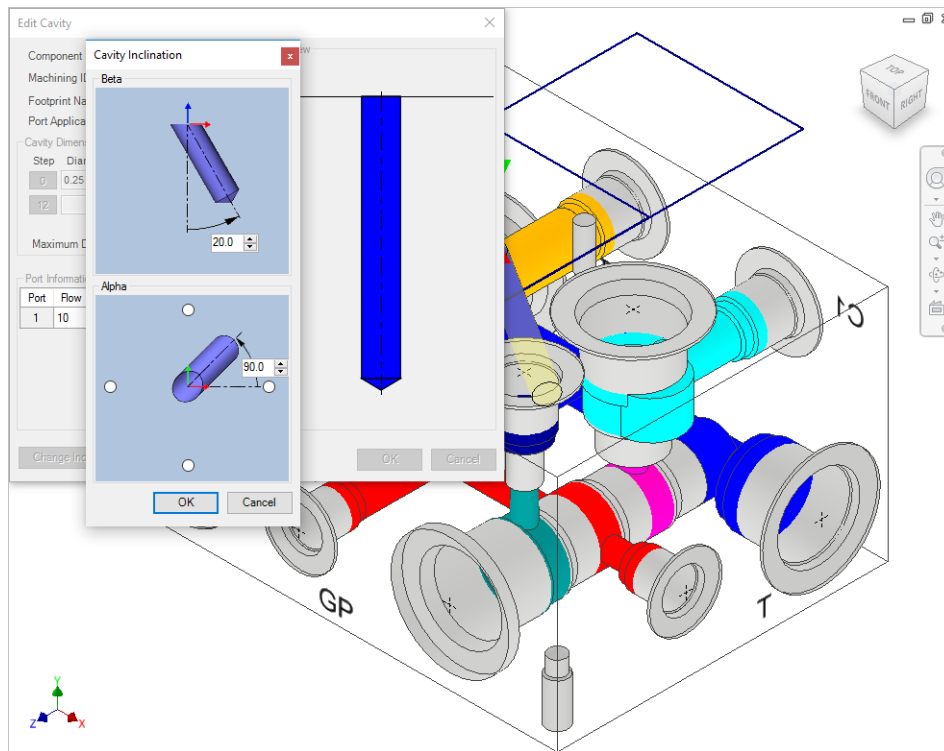


Beta - inclination from surface Normal

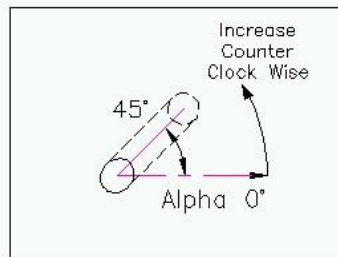
The figure on the right shows two cavities, 2CV and 4CV, which are connected using angle drill AN1, inside cavity 2CV.

- Cavity 2V is a 2-port cartridge valve cavity and Cavity 4CV is a 4-port cartridge valve cavity.
- Port 2 of 2CV is required to connect with Port2 of the 4CV valve.

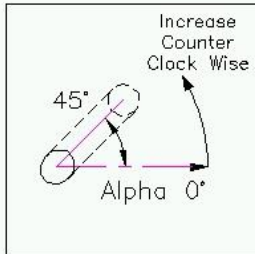
This connection is made using a compound angle drill AN1.



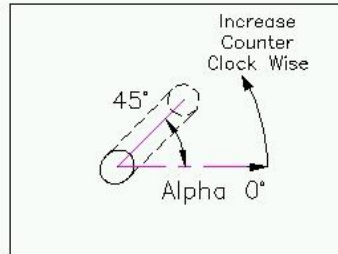
Edit Cavity dialog box: Alpha and Beta angles



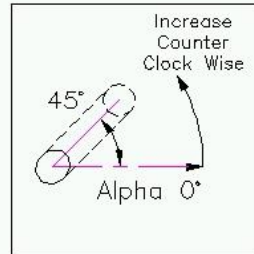
A Top



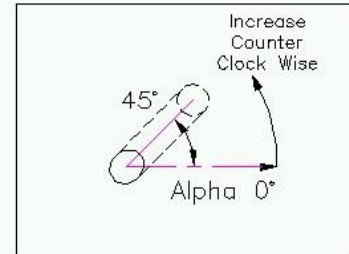
D Left



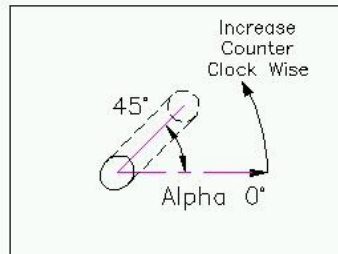
B Front



E Right



F Back



C Bottom

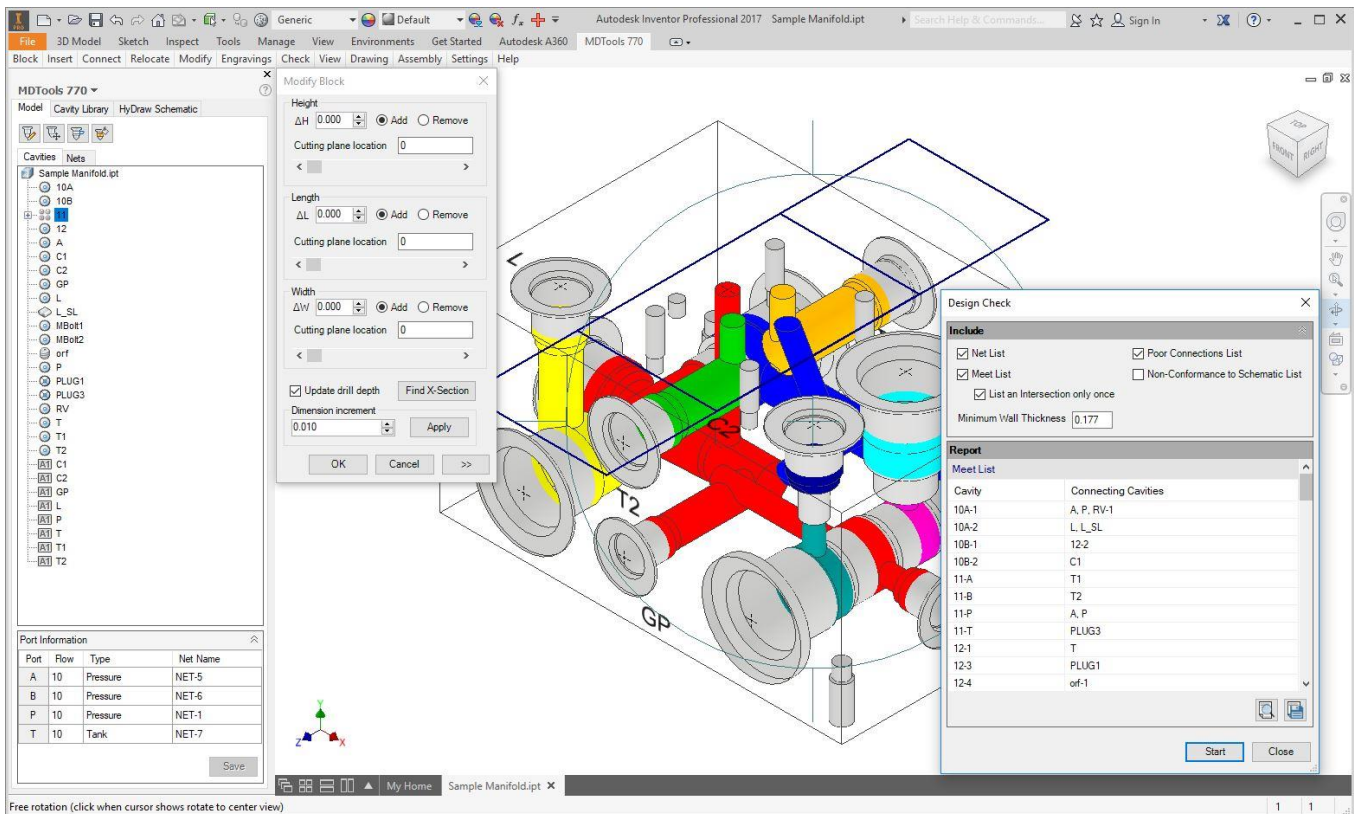
Alpha angle convention used in MDTools

Note

- MDTools* allows only ports, cartridge valve cavities, and drill holes to be at an angle.
- The Edit Cavity dialog box enables change of the Alpha and Beta angles only of ports and drill holes. These fields are disabled for all other types of cavities.
- The depth of an angle hole shown in the Edit Cavity dialog box is the depth along the axis of the angle hole.

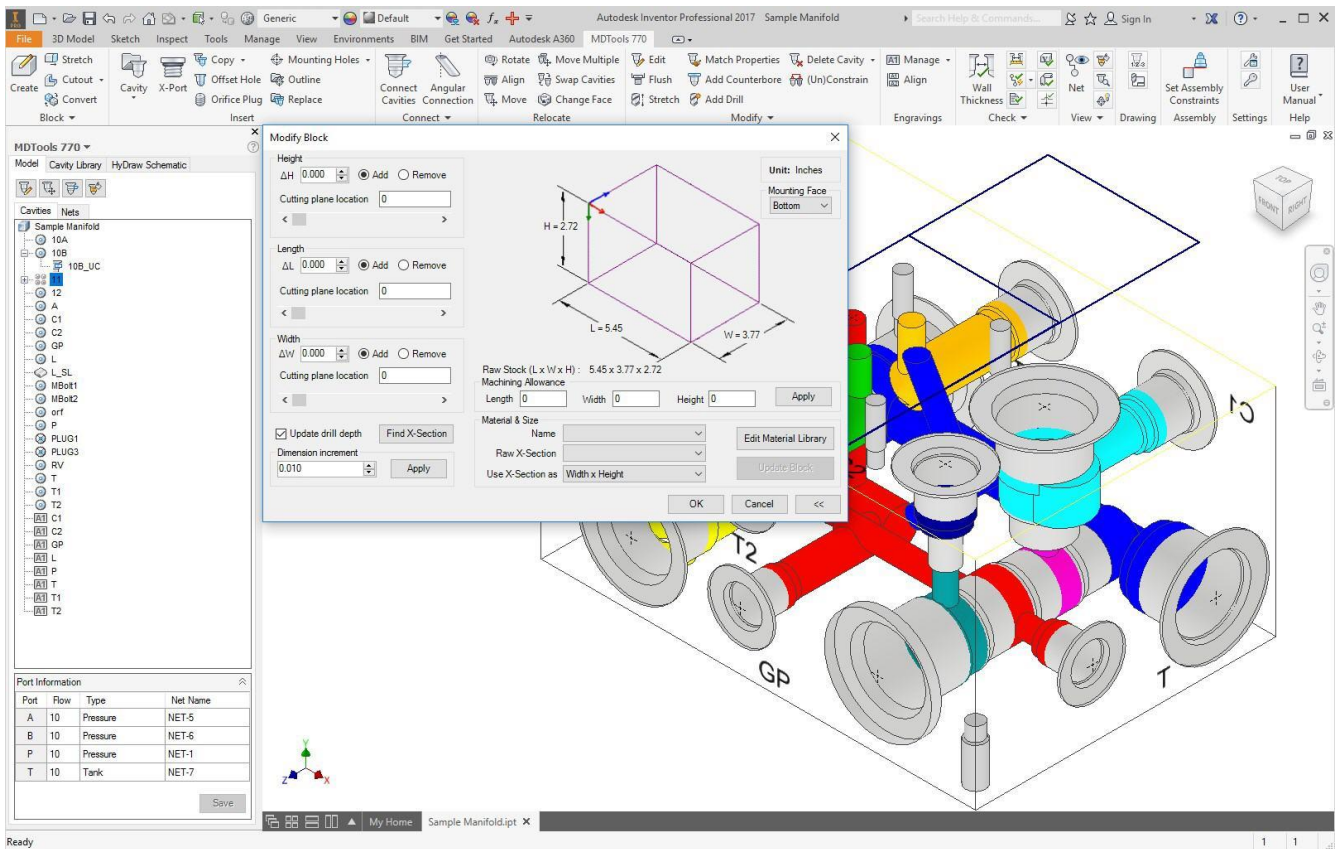
DESIGN and CHECK COMMANDS

10 - 19	Block Commands
20 - 35	Insert
36 - 38	Make Connections
39 - 44	Relocate
45 - 57	Modify
58 - 60	Engravings
61 - 71	Design Check
72 - 79	Display Options
80 - 82	Part Model Drawing Commands
83 - 84	Settings
85 - 86	Help



Block Commands

- 10 Create Block
- 11 Modify Block
- 12 Stretch Block
- 13 Create Cutout
- 14 Create Chamfer
- 15 Convert Block
- 16 Shrink Wrap
- 17 Export Block Design
- 18 Import Block Design
- 19 Compare Manifolds

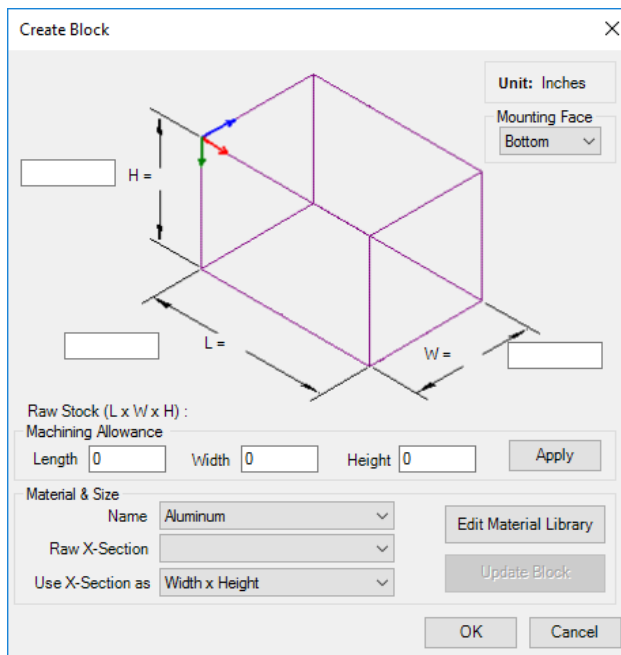


10. Create Block

The **Block (Create)** command automatically draws the manifold block in Inventor.

The manifold block is automatically drawn in Inventor, which is based on the required manifold length, width, and height, or by selection of required material cross section from an existing material cross section database and input of the corresponding length.

The machining allowance values on raw x-section can also be specified.



Create Block

1 Block - Dimensions entered manually

1. MDTools 770 ribbon
>Block panel
>Create(Block)

The Create Block dialog box displays.

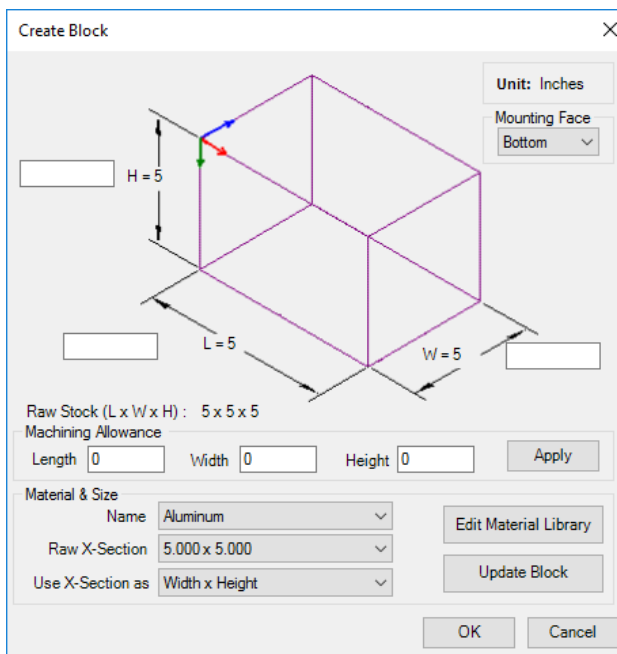
2. Enter the required dimensions manually.
3. Enter the **manifold dimensions** in the data fields
 - H (Manifold Height)
 - L (Manifold Length)
 - W (Manifold Width)
4. Enter the **Machining Allowance** for each of these dimensions.
5. Click **Apply**.

The machining allowance is subtracted from the respective manifold dimensions when drawing the manifold. The actual block dimensions are displayed on the dialog box.

For example, if the manifold width is 4.00 inches and the machining allowance is 0.05 inches, then the manifold width in the part model will be 3.95 inches.

The raw stock dimension is displayed separately on the dialog box.

6. Click **OK** after the required data is entered. MDTools* automatically creates the block inside Inventor.



Create Block dialog box

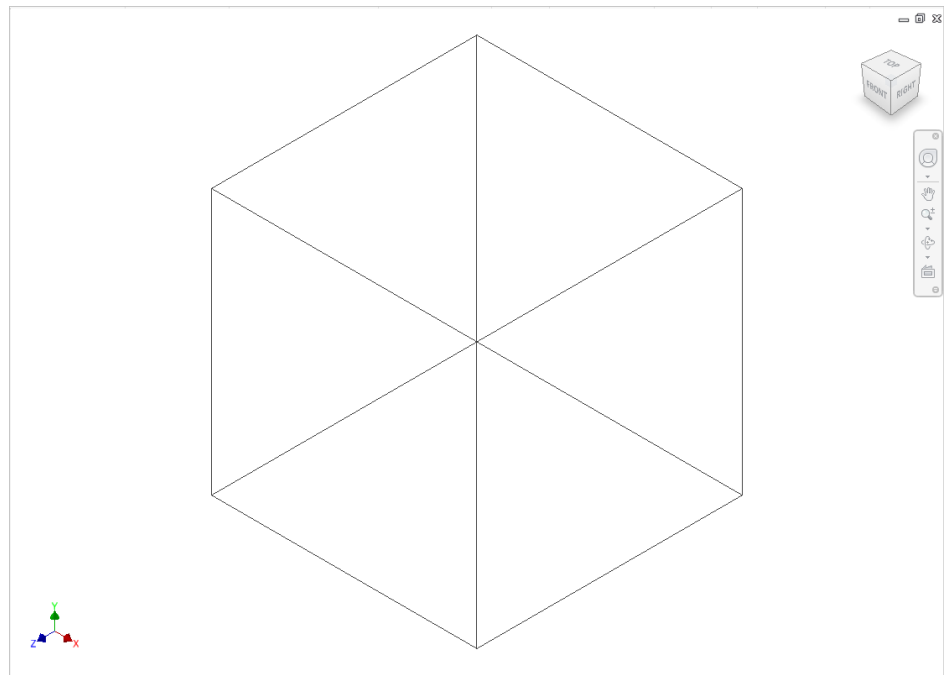
Note

- MDTools® uses the following model parameters to define the block dimensions:

BlockLength, BlockHeight, and BlockWidth.

- Do not change these parameter names. If you change any of these parameter names, the MDTools Modify Block command may give unexpected results.

To create a block manually, which works with MDTools, use the above names for the block model parameters.



A Block drawn in Inventor

2 Block - using Material X-Section Libraries

1. MDTools 770 ribbon menu
 >Block panel
 >Block (Create Block)

The Create Block dialog box displays.

2. Select the material from the **Name** drop-down list in the Material & Size section.

The default material is Aluminum. Change the material, if required.

3. Select a cross section from the **Raw X-Section** list of the selected material.

4. Select the required option from the **Use X-Section as** list.

You can use the X-section in any possible combination of length, width, and height.

5. Click Update Block.

MDTools* updates the block dimensions with the selected X-section, per the selection made in the Use X-Section as option.

6. Enter the third dimension for the block.

For example, if X-section is used for block width and height, then enter the block length.

7. Enter the **Machining Allowance** for each of these dimensions.

8. Click **Apply**.

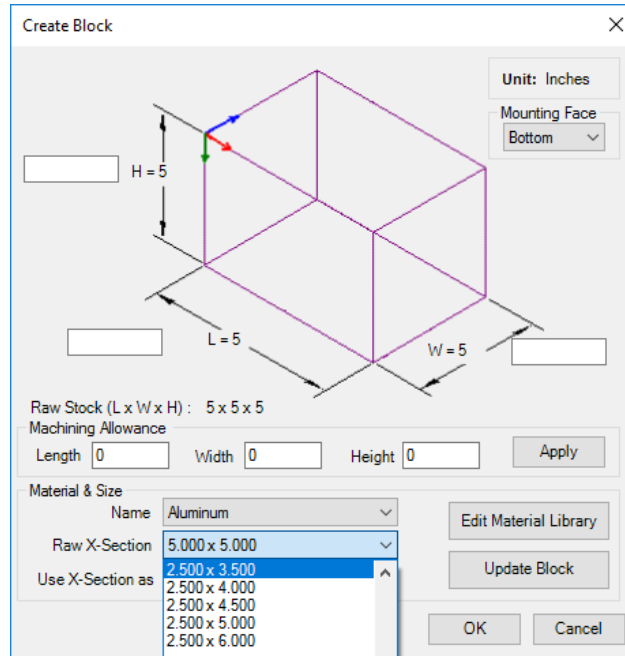
The machining allowance is subtracted from the respective manifold dimension, when drawing the manifold. The actual block dimensions are displayed in the dialog box.

For example, if the manifold width is 4.00 inches and the machining allowance is 0.05 inches, then the manifold width in the part model will be 3.95 inches.

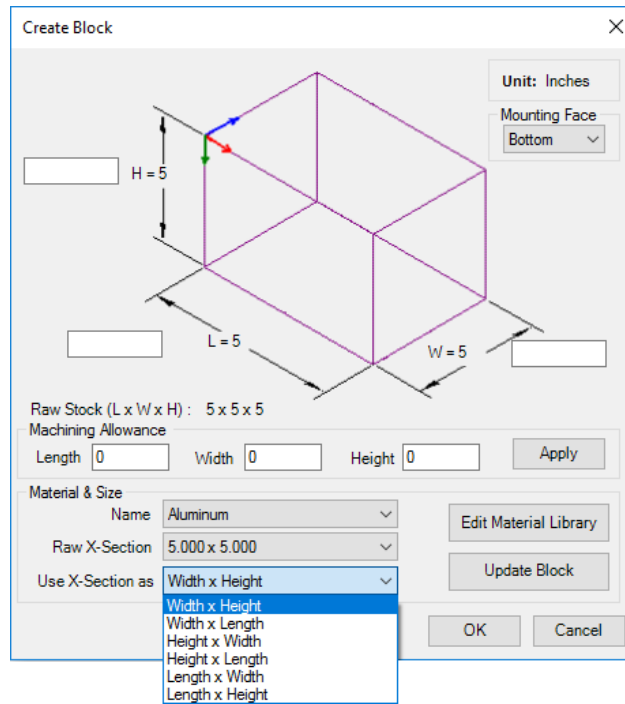
The raw stock dimension is displayed separately in the dialog box.

9. Click **OK** after the required data is entered.

MDTools automatically creates the block inside Inventor.



Create Block dialog box: Material X-section dimensions



Create Block dialog box: Use X-Section as

3 Creating Material X-Section Library

MDTools® enables new X-sections and material data to be added to the material X-Section library.

The existing X-sections or materials in the library can also be edited.

1. MDTools 770 ribbon
> **Block** panel
> **Block** (Create Block)

The *Create Block* dialog box displays.

Click Edit Material Library.

The *Edit Material Library* dialog box displays.

Add New Material

1. Enter the material name in the **Material** text box.
2. Click **Add**

Change Material Name

1. Select the material name you want to change from the **Material Name** list.
The selected material name is displayed in the Material text box.
2. Enter the new material name in the **Material** text box.
3. Click **Update**.

MDTools updates the material name with the new name.

Delete Material

1. Select the material you want to remove from the material library.
The selected material name is displayed in the Material text box.
2. Click **Remove**.
A message displays with text, 'Do you want to delete selected material name'.
3. Click **Yes**.
MDTools deletes the material from the Material library.

The screenshot shows the 'Edit Material Library' dialog box. At the top, there is a 'Material' text box containing 'New Material' and a 'Material Name' list containing 'Aluminum' and 'DuraBar'. Below the 'Material' text box are 'Add', 'Remove', and 'Clear' buttons. Below the 'Material Name' list is an empty list box. In the middle, there are radio buttons for 'Inches' and 'MM', and an 'X-Section' text box with 'x' between two empty boxes. Below the 'X-Section' text box are 'Add', 'Remove', and 'Clear' buttons. At the bottom right are 'OK' and 'Cancel' buttons. The 'OK' button is highlighted with a blue border.

Edit Material Library dialog box: Add new material

The screenshot shows the 'Edit Material Library' dialog box. At the top, there is a 'Material' text box containing 'Steel' and a 'Material Name' list containing 'Aluminum', 'DuraBar', and 'New Material'. 'New Material' is selected in the list. Below the 'Material' text box are 'Update', 'Remove', and 'Clear' buttons. Below the 'Material Name' list is an empty list box. In the middle, there are radio buttons for 'Inches' and 'MM', and an 'X-Section' text box with 'x' between two empty boxes. Below the 'X-Section' text box are 'Add', 'Remove', and 'Clear' buttons. At the bottom right are 'OK' and 'Cancel' buttons. The 'OK' button is highlighted with a blue border.

Edit Material Library dialog box: Update material name

Add New X-Section

1. Select the material name from the **Material Name** list.
A list of cross sections displays in the X-Sections list.

Select the unit: **Inches** or **MM**.

2. Enter the X-section dimensions in the **X-Section** text boxes.
3. Click **Add**.

Change X-Section dimension

1. Select the cross section you want to change from the **X-Sections** list.
X-section dimensions are displayed in the X-Section text box.
2. Select **X-Section** you want to change in the X-Section textbox.
Change the dimension, as required.
3. Click **Update** to save the changes.

The screenshot shows the 'Edit Material Library' dialog box. The 'Material' field is set to 'Aluminum'. The 'Material Name' list contains 'Aluminum' and 'DuraBar'. The 'X-Sections' list is visible, showing various dimensions. The 'X-Section' text boxes are set to '6' and '9'. The 'Add' button is highlighted.

Edit Material Library dialog box: Add new X-Section

Delete X-Section

1. Select the X-section you want to remove from the library.
X-section dimensions are displayed in the X-Section text box.
2. Click **Remove**.
A message displays with the text, 'Do you want to delete selected X-section?'
3. Click **Yes**.

The screenshot shows the 'Edit Material Library' dialog box. The 'Material' field is set to 'Aluminum'. The 'Material Name' list contains 'Aluminum' and 'DuraBar'. The 'X-Sections' list is visible, with '6.000 x 9.000' selected. The 'X-Section' text boxes are set to '6.000' and '10.000'. The 'Remove' button is highlighted.

Edit Material Library dialog box: Change X-Section dimensions

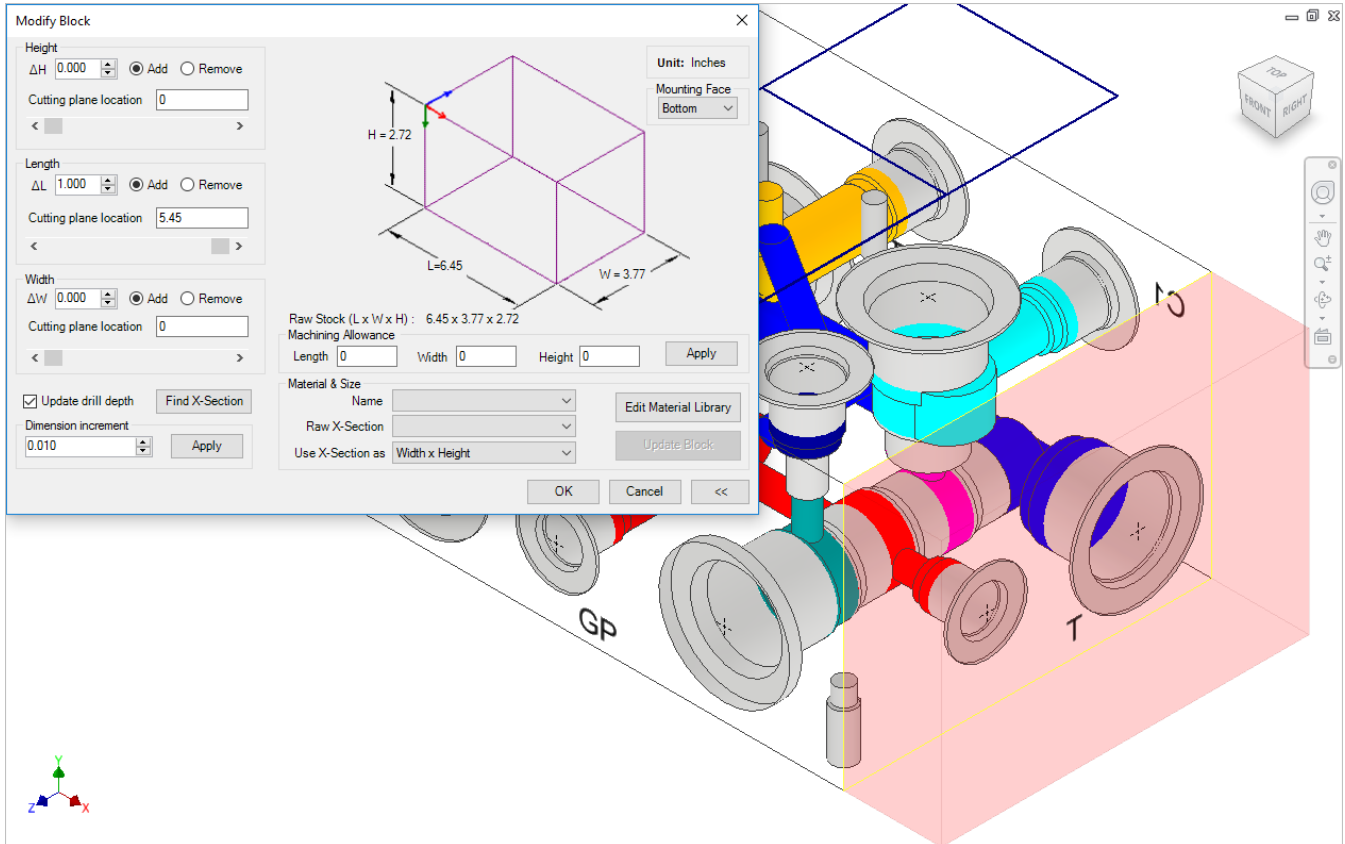
11. Modify Block

The **Block (Create)** command also enables you to modify the manifold block size during the manifold design process based on the required change in the manifold size.

The length, width, and height can be changed. Enter the values in the space provided or select the required material cross section from an existing material X-Section library.

Change the size of the block by making an incremental change in the size by entering a defined incremental value and defining the cutting plane location.

MDTools automatically updates through cavities depth. MDTools considers all unthreaded bolt holes as Through cavity, if height of the bolt hole is greater than 40% of the respective block dimension.



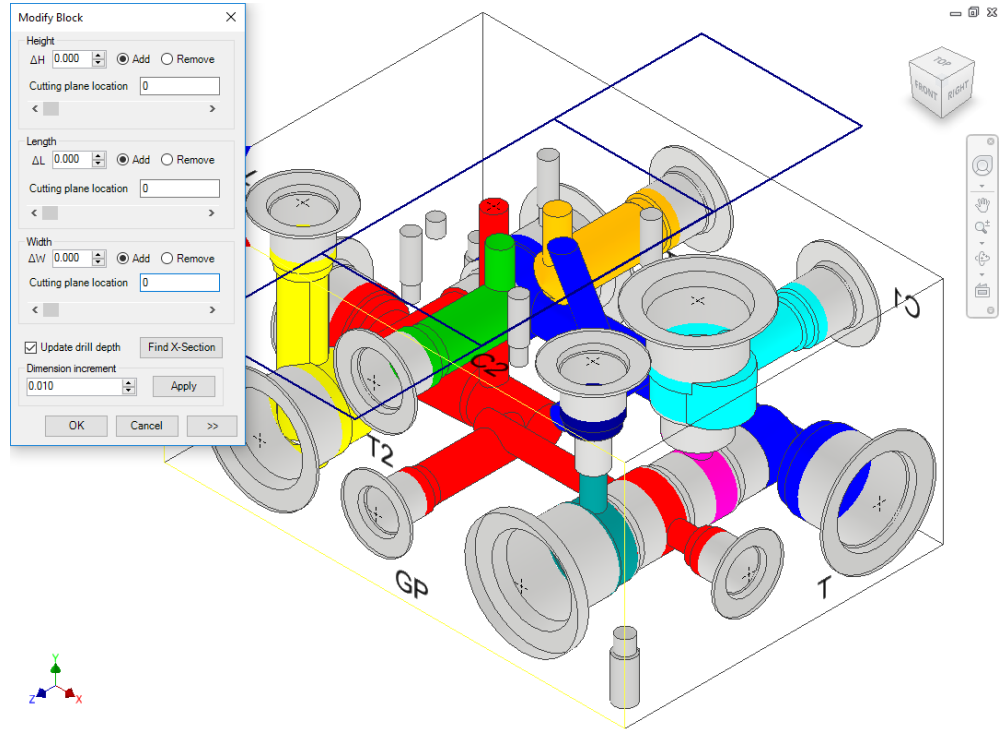
1 Modify Block Size

1. MDTools 770 ribbon
 >**Block** panel
 >**Create** (Modify Block)

The Modify Block dialog box displays.

2. Enter the change in dimensions in the data fields.
 - ΔH (Manifold Height)
 - ΔL (Manifold Length)
 - ΔW (Manifold Width)

*You may also use the up or down buttons for the required change and select **Add** to add the material.*



Collapsed View: Modifying Block by modifying the dimensions

3. To reduce any of the block dimensions, select the **Remove** option with the value.
4. Specify the location, where you want to add/remove the material, either by entering value in the **Cutting plane location** text box or using the left to right scroll bar.

The dialog box can be collapsed for ease of use when selecting the cutting plane location.

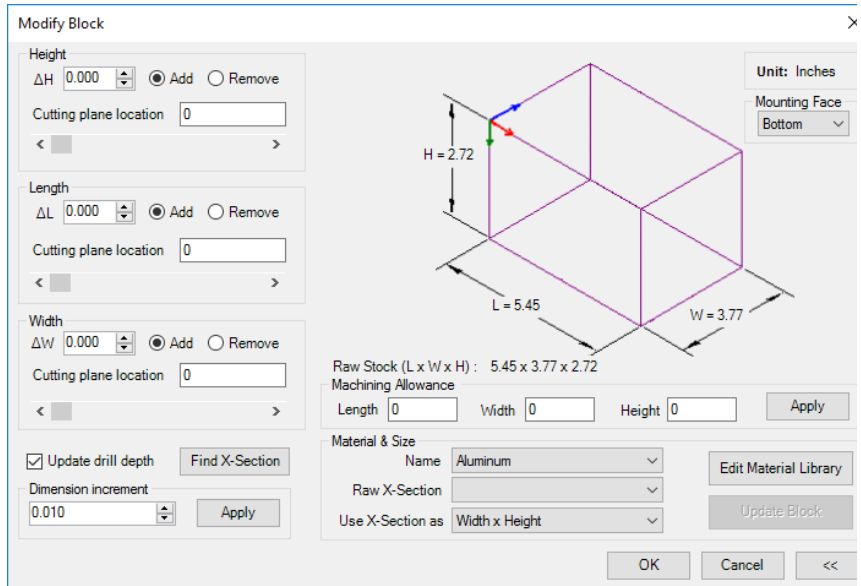
As soon as you change the focus, the value of the increment or decrement is shown added or subtracted from that dimension.

5. Select **Update drill depth** to update the drill depths of cavities according to the change in block dimensions.

The depth or location of the cavities located on the face for which the dimension has been changed is updated, per the change in the corresponding dimension of the manifold.

6. You can set **Dimension increment** to define the default incremental value for changing the Δvalues using the up or down buttons.
7. Click **Apply** to save the changes.

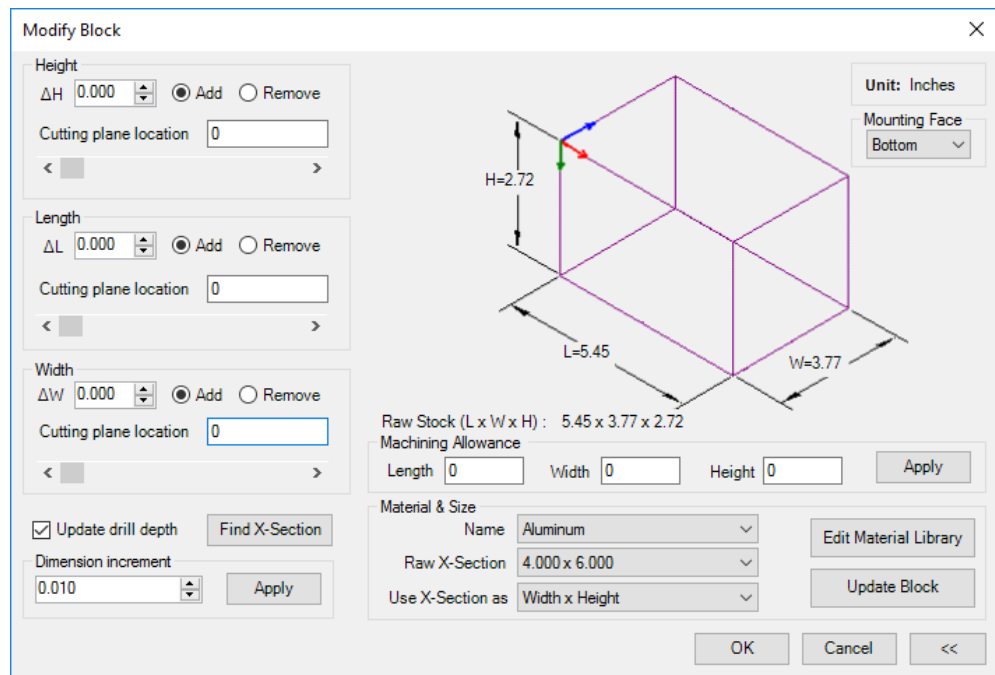
The block dimension modifications are shown immediately in the dialog box for the corresponding dimensions' values.



Expanded View: Modify Block

8. Select the desired option from the **Use X-Section as** option and then click **Update Block**.

When you change the dimensions of the block, the block size changes will reflect in the Inventor model of the block.



Modify Block dialog box: Updating Block dimensions

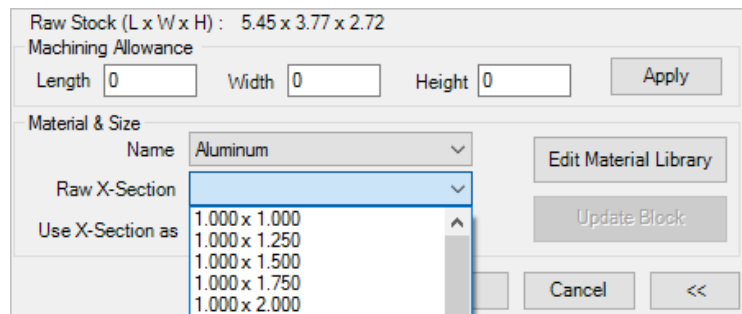
OR

1. Select a new X-section from the **Raw X-Section** list.

Select the desired option from the **Use X-Section as** option and then click **Update Block**.

Enter or change the Machining Allowance for each of the block dimensions, then click **Apply**.

Click **OK** to update the dimensions.



Sectional view of the Modify Block dialog box

2 Find X-Sections

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.

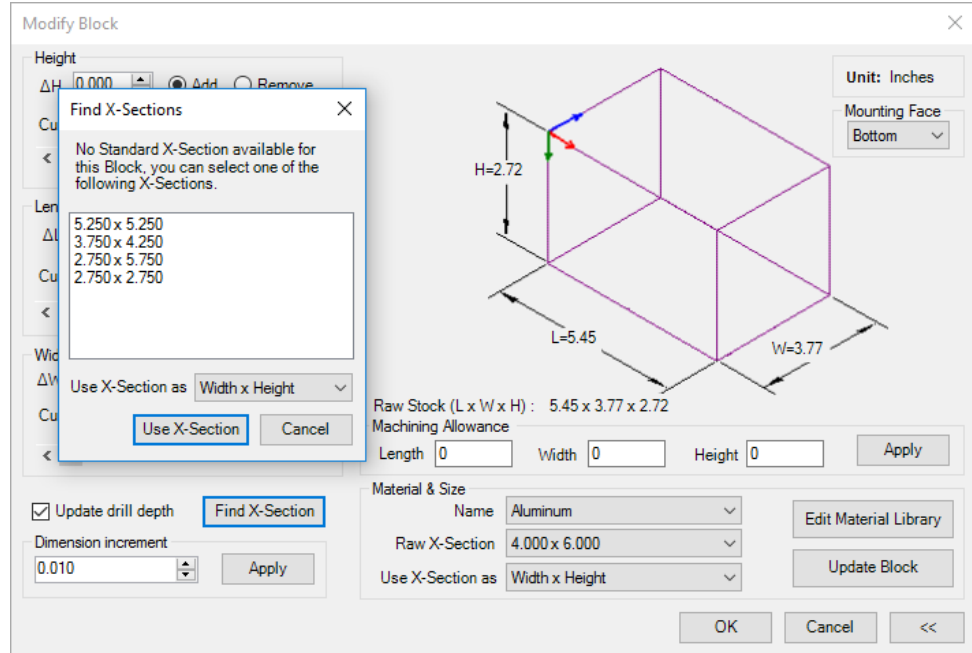
1. Select the desired material from the **Material Name** list.

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 in the Find X-Sections dialog box.



Find X-Sections dialog box

Updating Block Dimensions

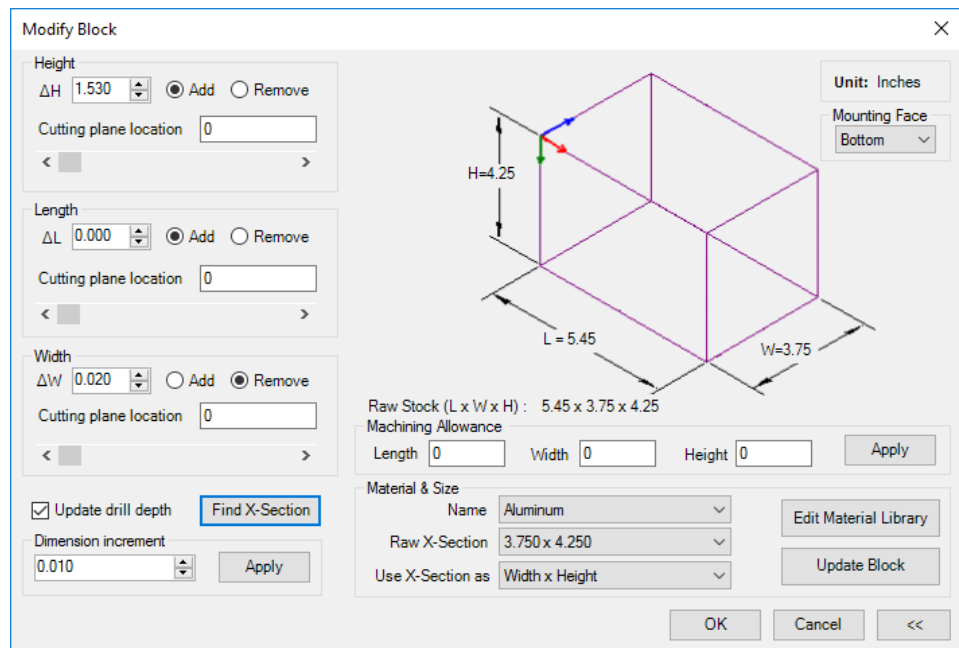
Use one of the X-sections listed in the Find X-Sections dialog box and update the block dimensions with the standard X-section.

1. Select the X-section you want to use for the block.
2. Select the **Use X-Section as** option from the drop-down list for any two combinations of the three dimensions, as required.
3. Click **Use X-Section** in the Find X-Section window.

The selected X-section displays in the Raw X-Section list and the Use X-Section as list in the Draw Block dialog box.

4. Click Update Block Dimensions.

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



Modify Block dialog box: Update Block Dimensions

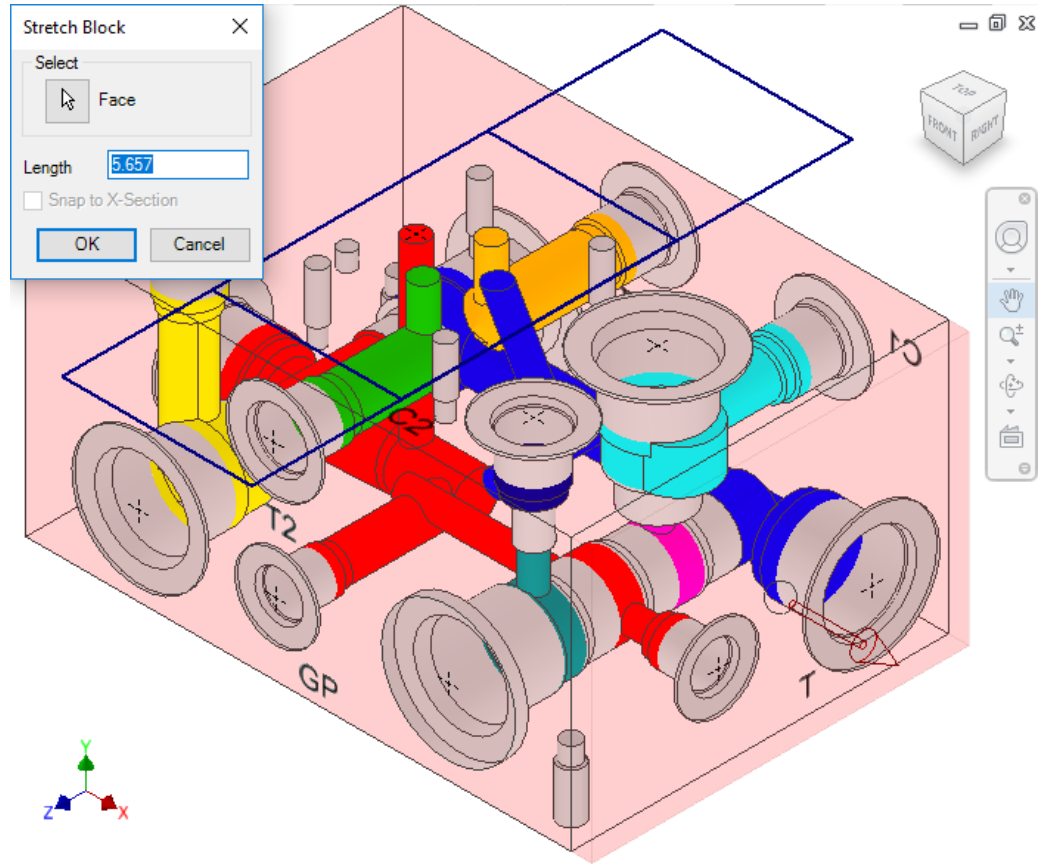
12. Stretch Block

Modify the manifold block size interactively by dragging the arrow handle on the selected face.

1. MDTools 770 ribbon
>**Block** panel
>**Stretch** (Block)
The Stretch Block dialog box displays.
2. Select a face.
3. Drag the arrow on the selected face.
Or,
Enter the value.

Note

- The Snap to X-Section option enables you to use a material cross section available in the library.
- MDTools automatically updates through cavities depth. MDTools considers all the unthreaded bolt holes as Through cavity, if height of the bolt hole is greater than 40 % of the respective block dimension.



Stretch Block dialog box

13. Create Cutout

Create cutouts on a selected face with specified values.
It helps you design non-rectangular manifold using MDTools*.

1. Create Cutout

1. MDTools 770 ribbon
>Block panel
>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. Modify the X and Y location as the start point of the profile (rectangle or rounded rectangle).
5. Specify the type of cutout required, i.e. rectangle or rounded rectangle.
6. Enter the **length** and **width**. Also, enter the corner radius, if the rounded rectangle option is selected.

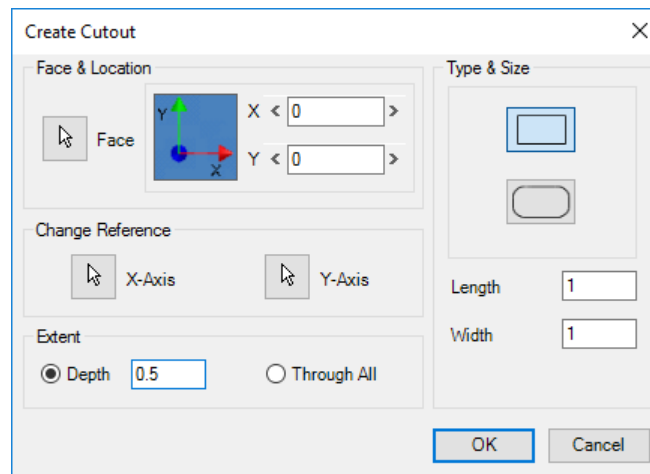
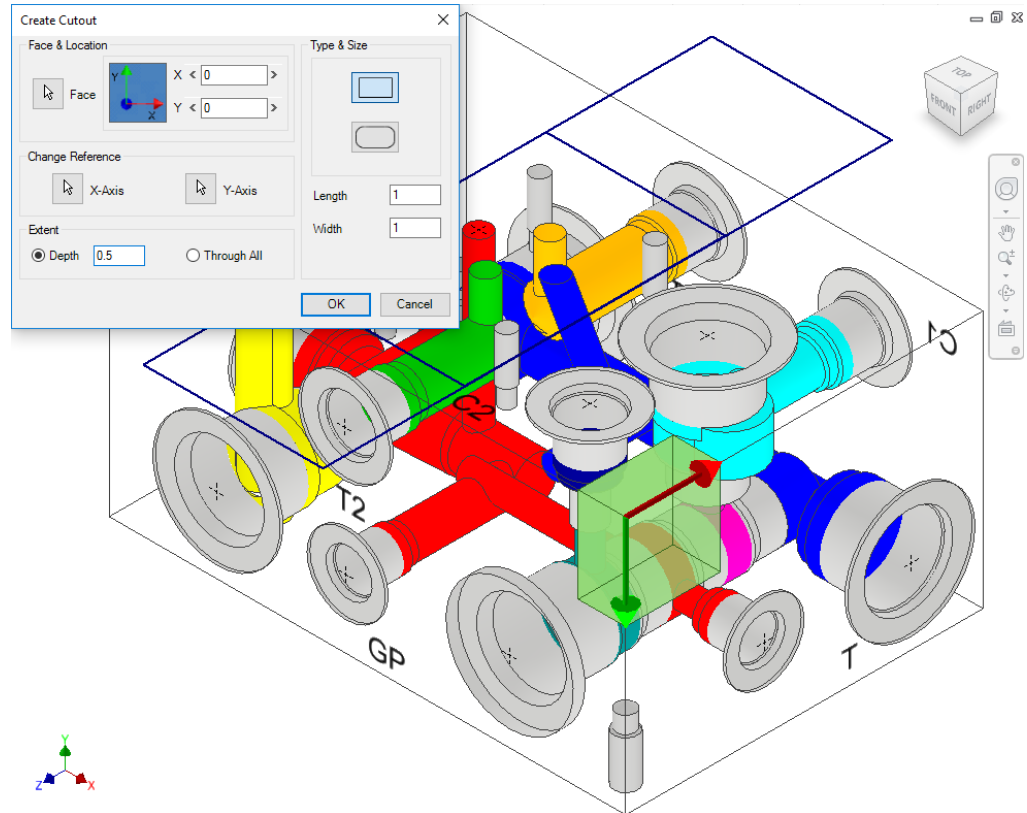


Create Cutout dialog box

The preview of the cutout displays.

7. Select the type of **Extent** required.
8. Enter the value of depth, if the Depth option is selected.
9. Click **OK** to create the cut out.

The cutout is created, per the specified dimensions or parameters.



Create Cutout dialog box

2. Delete Cutout

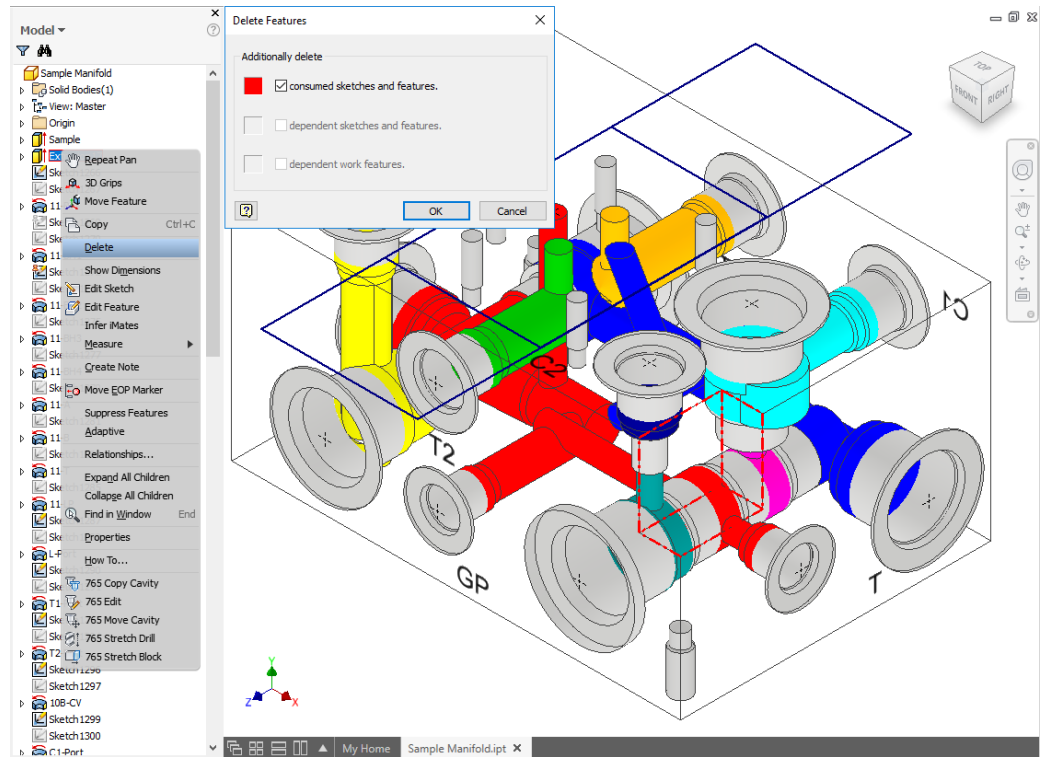
1. Select the Inventor Model Feature Design tree in the browser pane.
2. Right-click the Extrude option of the Cutout feature and select **Delete**.

The Delete Features dialog box displays.

Select the consumed sketches and features option and click OK.

Note

Similarly, you can edit the cut out from the Inventor Feature Manager Design tree.



Inventor Feature Manager Design Tree - Cutout

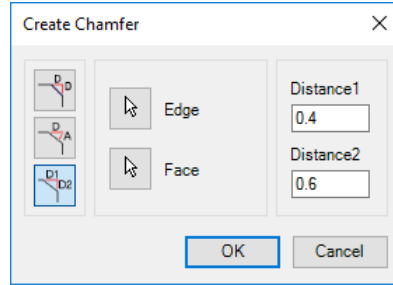
14. Create Chamfer

Create the chamfer feature in the MDTools® Part model of a block. It helps you design the non-rectangular manifold using MDTools.

1. Create Chamfer

1. MDTools 770 ribbon
>Block panel
>Chamfer

The Create Chamfer dialog box displays.



Create Chamfer dialog box

2. Specify a chamfer creation method by selecting the required icon:

- Equal Distance
- Distance-Angle
- Distance-Distance

3. Select an edge to create a chamfer.

4. Select a face adjacent to the selected edge to change the reference direction, if required.

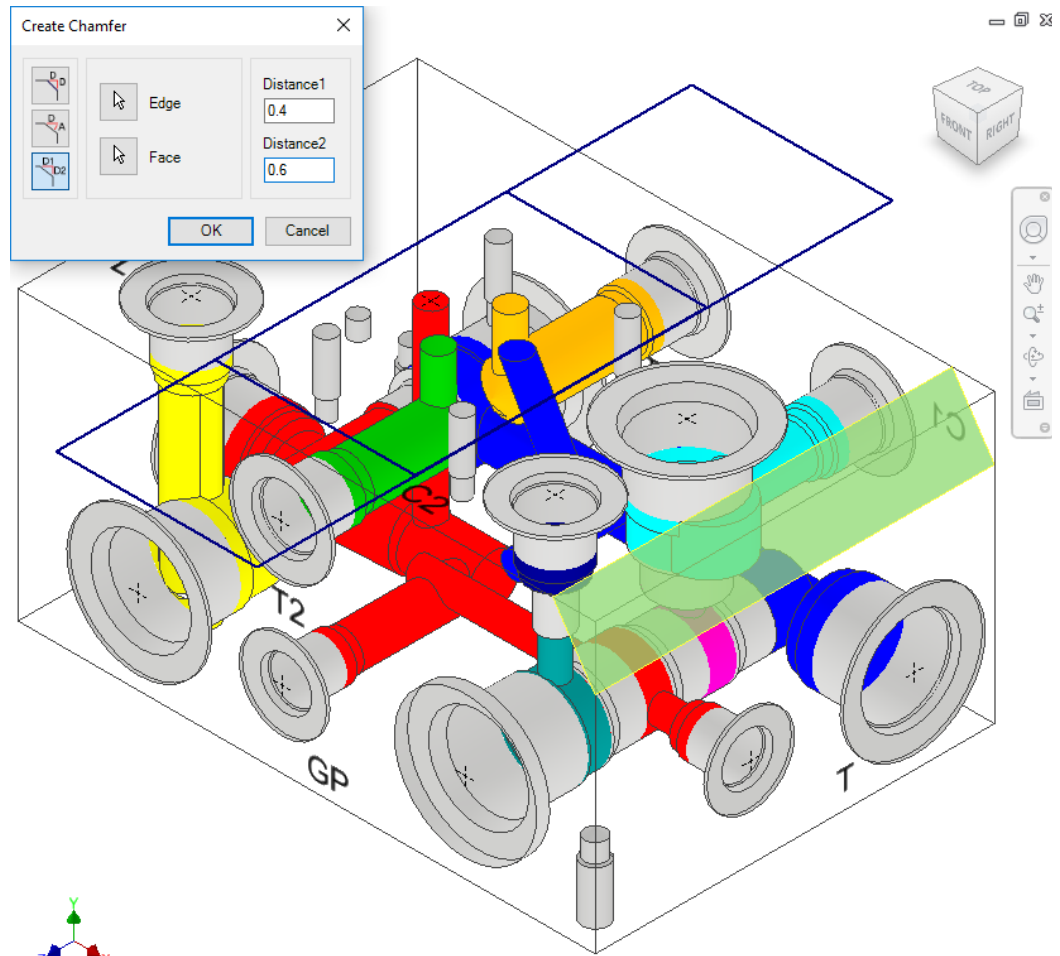
Ensure that the Distance-Angle or Distance-Distance option is selected.

5. Enter the required values.

The preview for the chamfer displays.

6. Click **OK** to create the chamfer.

MDTools adds a chamfer to the selected edge, per specified parameters.



Create Chamfer dialog box

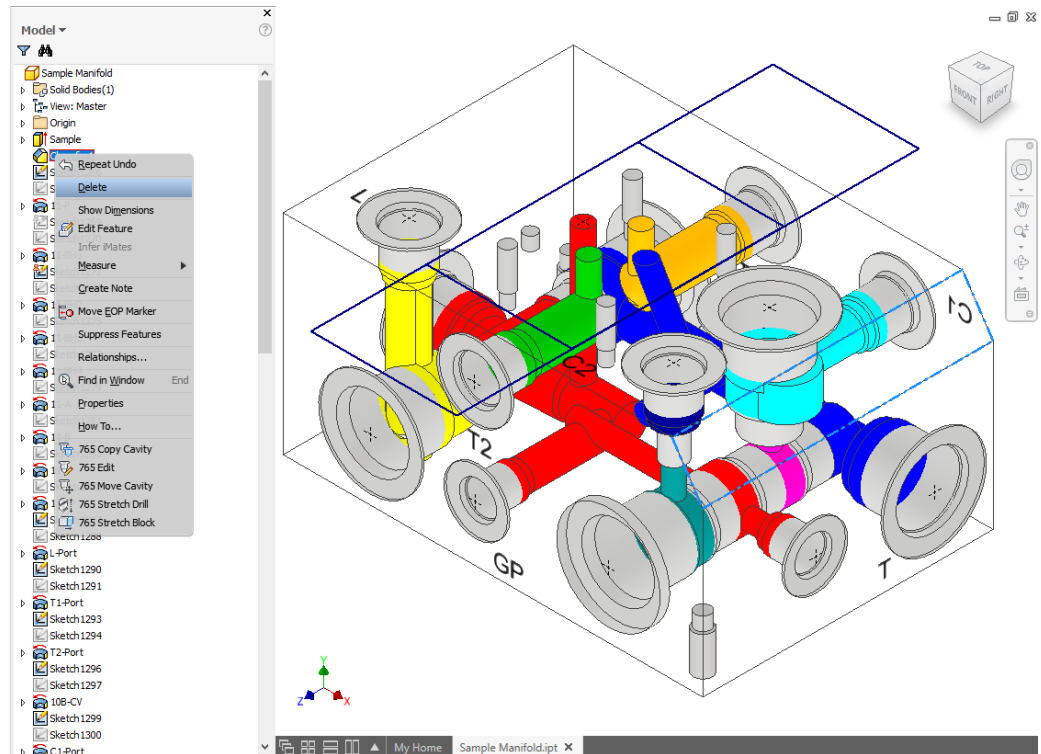


2. Delete Chamfer

1. Select the Inventor Model Feature Manager Design tree.
2. Right-click the Chamfer feature and select **Delete**.

Note

Similarly, edit the chamfer from the Inventor Model Feature Manager Design tree.



Inventor Model Feature Manager Design Tree – Delete Chamfer

Limitations:

The following commands may not function fully or might not produce expected results with the non-rectangular manifold having angled surfaces (Chamfered surfaces not parallel to the six manifold faces).

Part Commands

1. Create Cutout
2. Create Chamfer
3. Copy Multiple
4. Move Cavity
5. Move Multiple
6. Insert Mounting Holes
7. Connect to Cavity
8. Angular Connection
9. Stretch Drill
10. Velocity Check
11. Check Bend
12. Check Connection Offset
13. Export Manifold
14. Import Manifold
15. Shrink Wrap

Drawing Command

Show/Hide Internal Details

15. Convert Block

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

MDTools 770 ribbon

- > **Block** panel
- > **Convert**

Converting manifold... message displays.

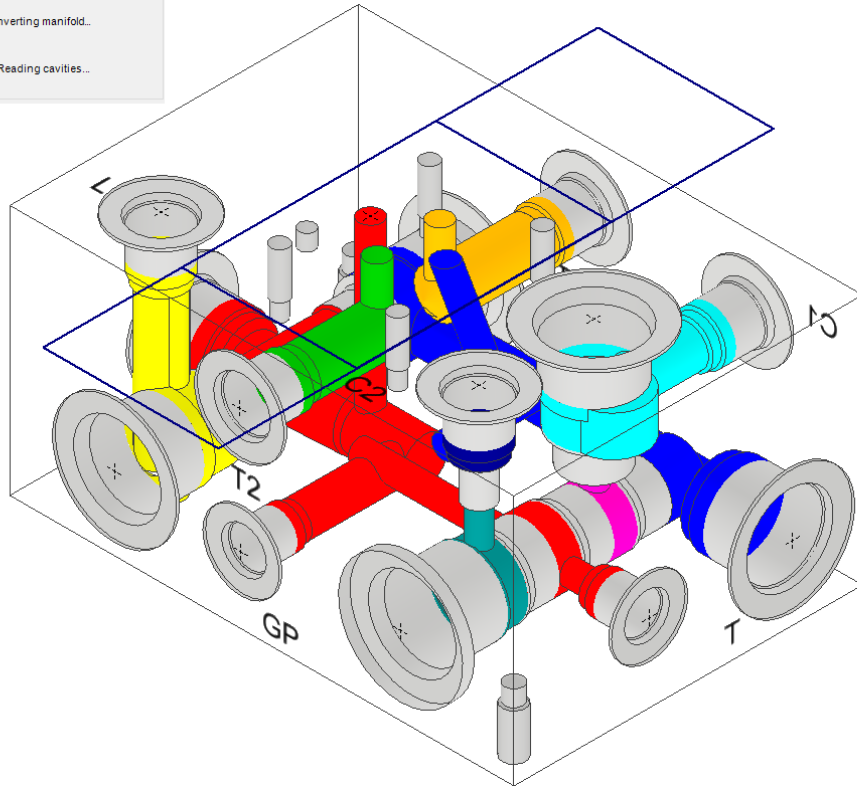
MDTools® automatically converts:

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

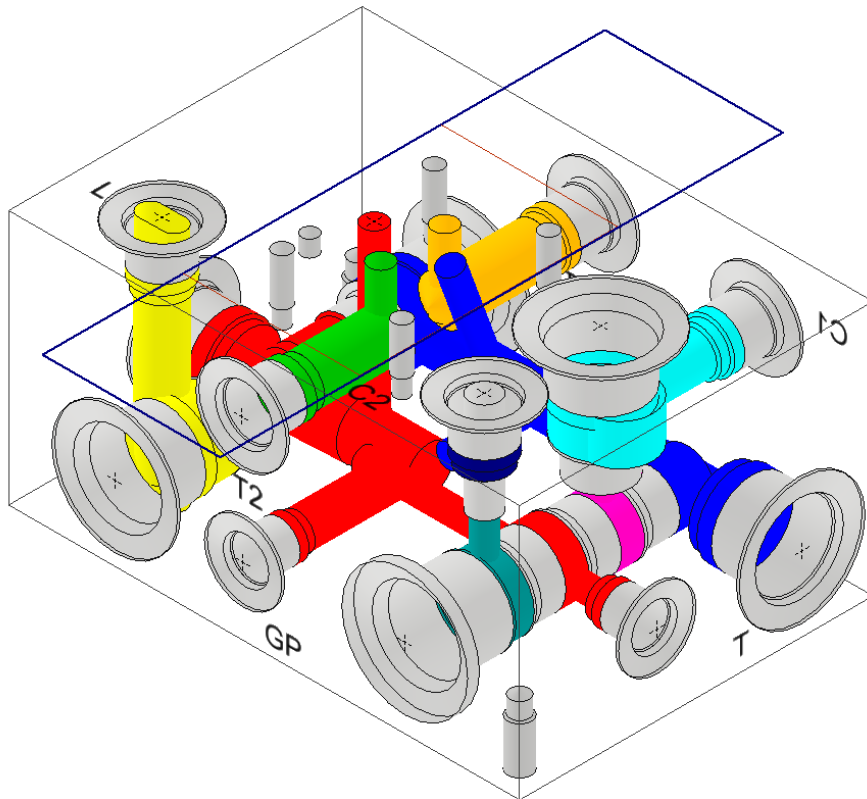
- A feature-based design into a virtual cavity design.

Note

- Constrained cavities are unconstrained when converting the manifold.
- Re-constrain the cavities after converting the manifold.
- An O-ring groove inserted in the Virtual design mode is also converted to a feature.



Converting manifold in process



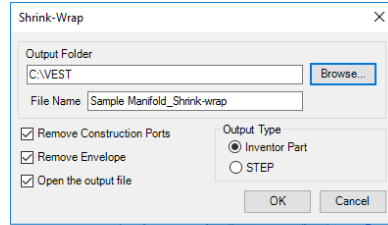
Converted manifold

16. Shrink Wrap

Removes all the internal design details and creates a separate block model without any connection details.

- MDTools 770 ribbon
 >**Block** panel
 >Slide out menu
 >**Shrink Wrap**

The Shrink-Wrap dialog box displays.



- Click **Browse** and select the output path.

The output file is saved to the specified path.

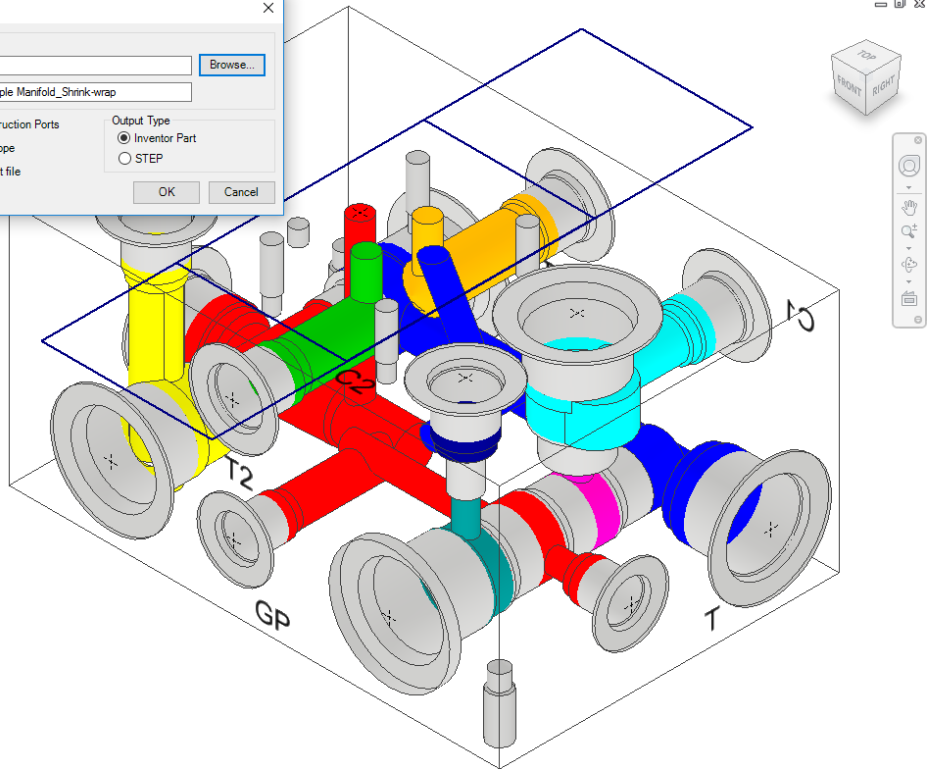
The default file name of the shrink-wrapped model is, "model name_Shink-Wrap".

- Select **Remove Construction Ports** to automatically remove construction port information.

- Select **Remove Envelope** to automatically remove the envelope (Footprint or Assembly both) information



Shrink-Wrap dialog box



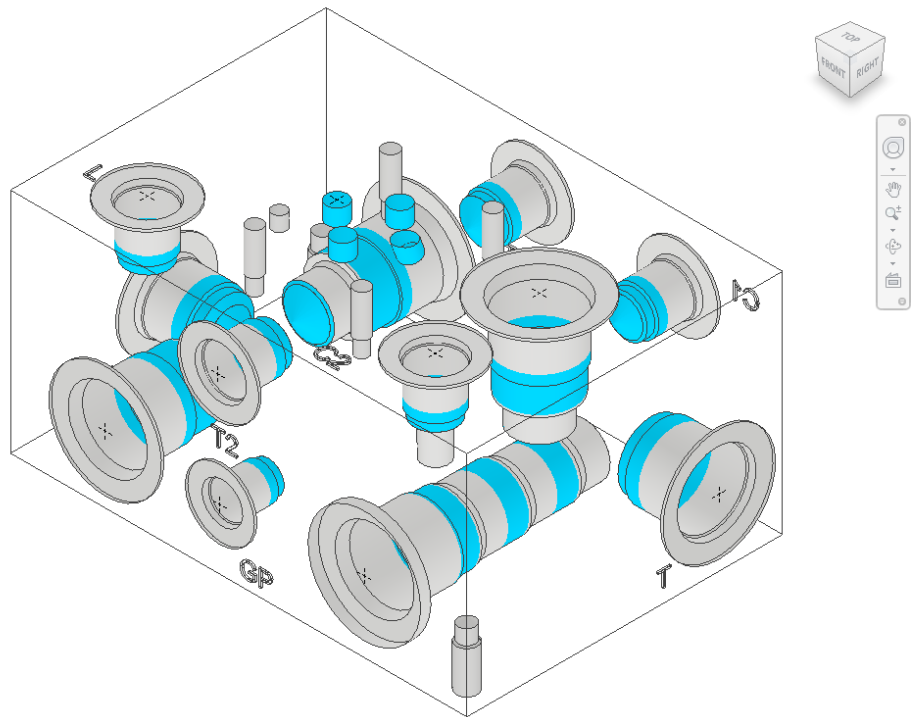
- Select the type of output required.

- Select **Open the output file**.

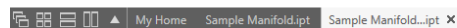
The Output Type- Inventor Part, automatically opens in Inventor.

- Click **OK**.

MDTools* automatically removes all the internal details.



Internal details removed automatically



17. Export Block Design

Export a manifold design and create an MDTools® manifold MBXML file.

1. MDTools 770 ribbon
 >Block panel
 >Slide out menu
 >Export (Block Design)

The Save XML File dialog box displays.

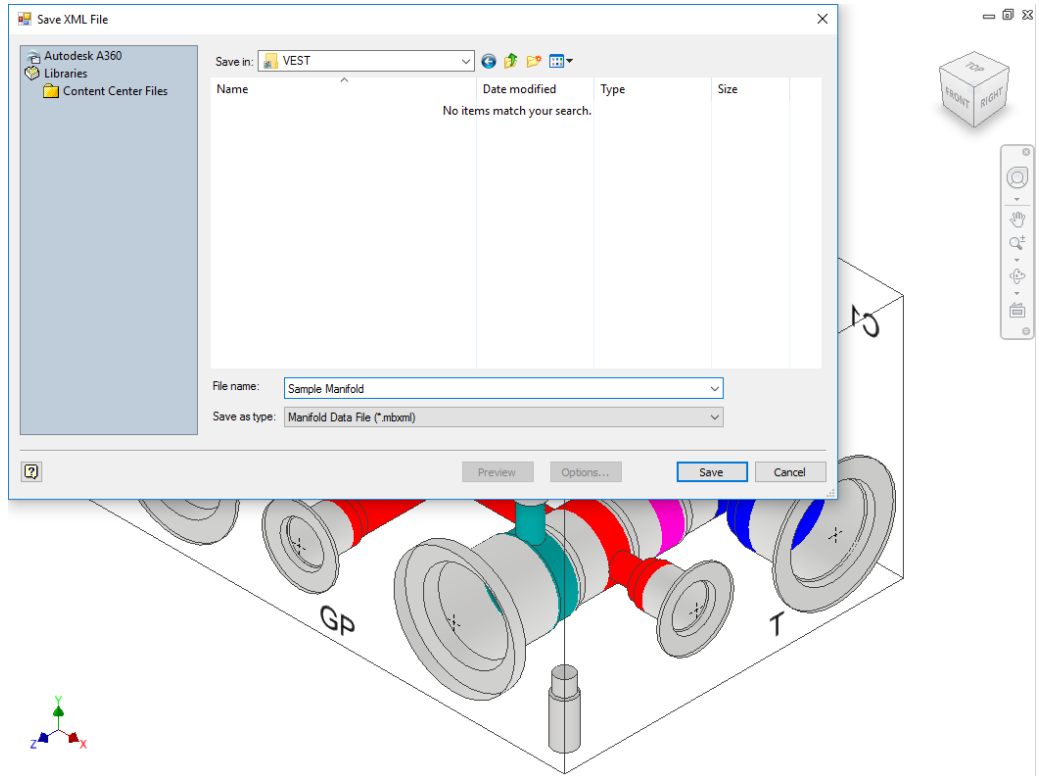
Enter the file name.

Click **Save**.

The program exports the manifold design into the MDTools manifold .mbxml file.

Note

Now, the functionality of exporting O-ring grooves is also supported in this command.



Export manifold data in MBXML file format

18. Import Block Design

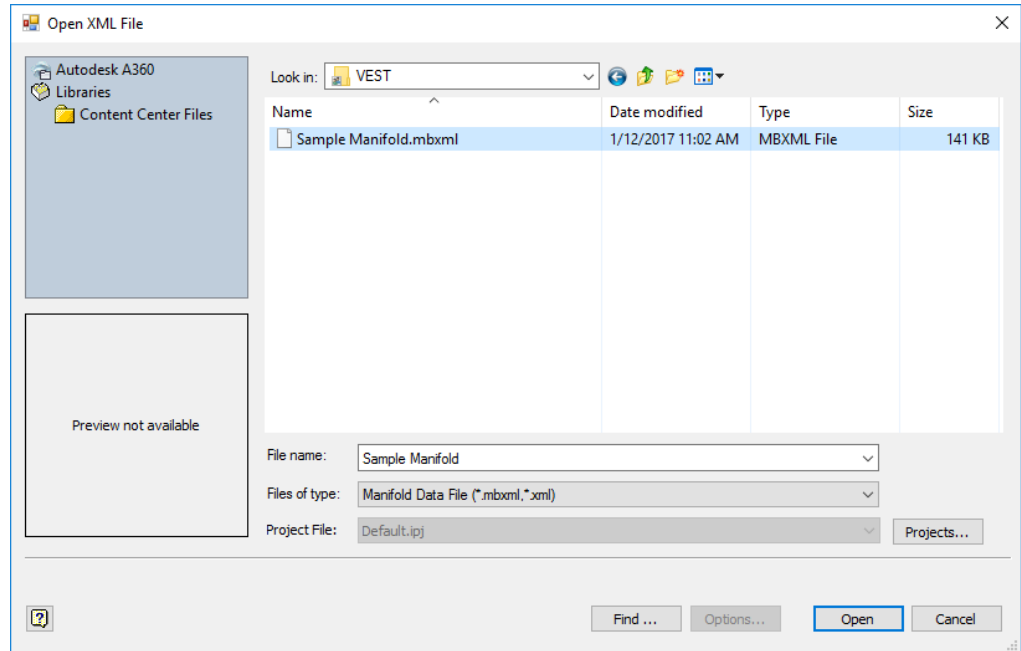
Import an MDTools® manifold XML/MBXML file and automatically create a new manifold in Inventor.

1. MDTools 770 ribbon
>**Block** panel
>Slide out menu
>**Import**

The *Open XML File* dialog box displays.

2. Select the MDTools manifold data file.
3. Click **Open**.

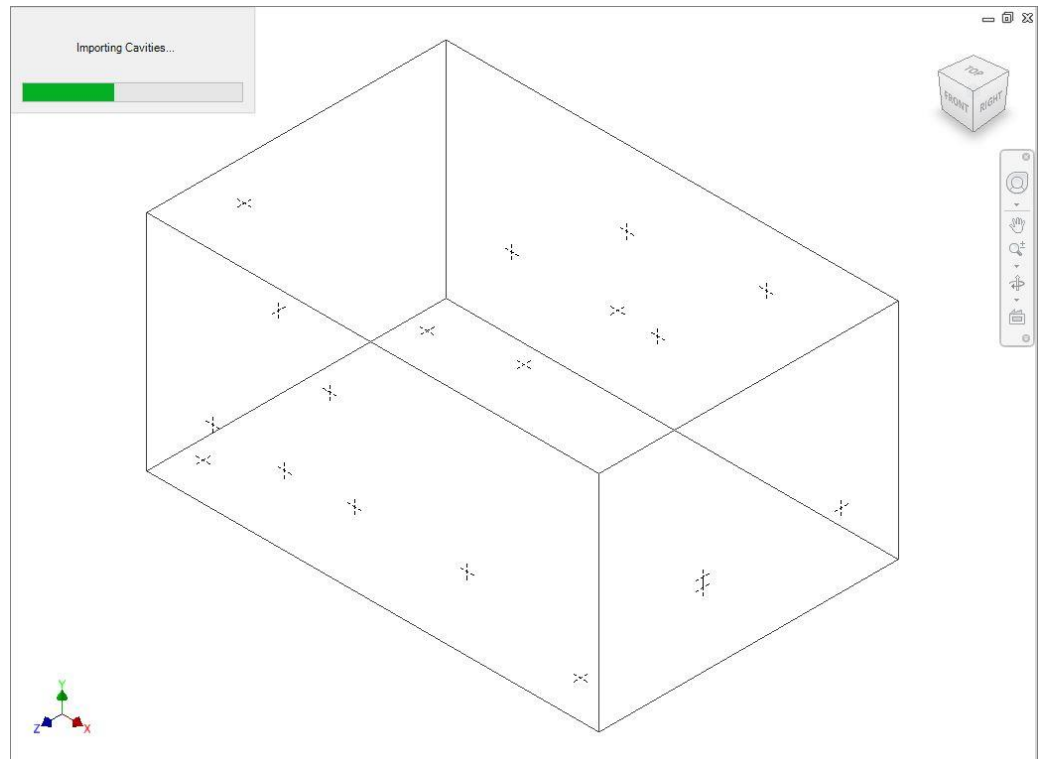
The program reads the input manifold data file and creates a new manifold in Inventor.



Open XML File dialog box

Note

- When you import a manifold, MDTools creates the manifold in the Virtual Cavity mode.
- Use the Convert Manifold command to convert the block design to a Feature-based cavity design.
- When you import a manifold, MDTools shows the current status of the block in the top-left corner of the model view.



Importing Manifold in Inventor

19. Compare Manifolds

Compare two selected manifolds.

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

1. MDTools 770 ribbon
> **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:
Includes these optional parameters 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 are,


- Missing engravings in Manifold A
- Missing engravings in Manifold B
- Modified engravings
- Renamed engravings
- Moved engravings

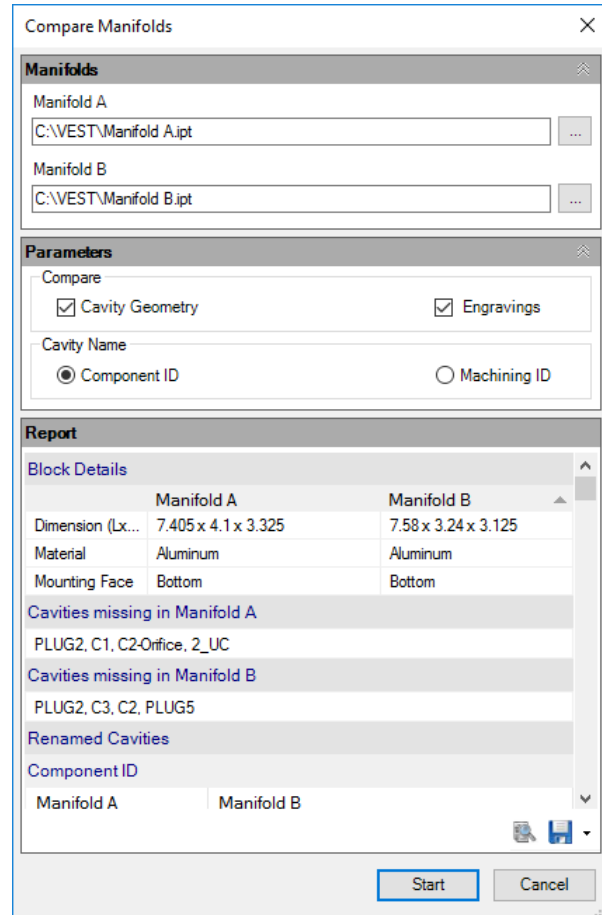
Component ID

Shows all the cavities name as component ID.

Machining ID

Shows all the cavities name as machining ID.

4. Click **Start**.
Report displays 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

The 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 exist in Manifold B.

Cavities Missing in Manifold B

Lists all cavities/ports deleted from Manifold B that exist 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.

Step0 Diameter Changed

Lists all cavities/ports of Manifold A, where step0 diameter is changed in Manifold B.

Step0 Depth Changed

Lists all cavities/ports of Manifold A, where step0 depth is changed in Manifold B.

Step0 Angle Changed

Lists all cavities/ports of Manifold A, where step0 angle is changed in Manifold B.

Step12 Diameter Changed

Lists all cavities/ports of Manifold A, where step12 diameter is changed in Manifold B.

Step12 Depth Changed

Lists all cavities/ports of Manifold A, where step12 depth is changed in Manifold B.

Step12 Angle Changed

Lists all cavities/ports of Manifold A, where step12 angle is changed in Manifold B.

Drill Added

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

Counterbore Added

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

Locating Shoulder Depth changed

Lists all Sun cavities of Manifold A in which Locating Shoulder Depth has been changed in Manifold B.

Step Dimension Changed

If the Cavity Geometry option is selected, MDTools compares all steps 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

List all the footprints which have a different rotation in Manifold A and Manifold B.

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

Engravings

Engravings Missing in Manifold A

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

Engravings Missing in Manifold B

Lists all engravings deleted from Manifold B that exist 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.

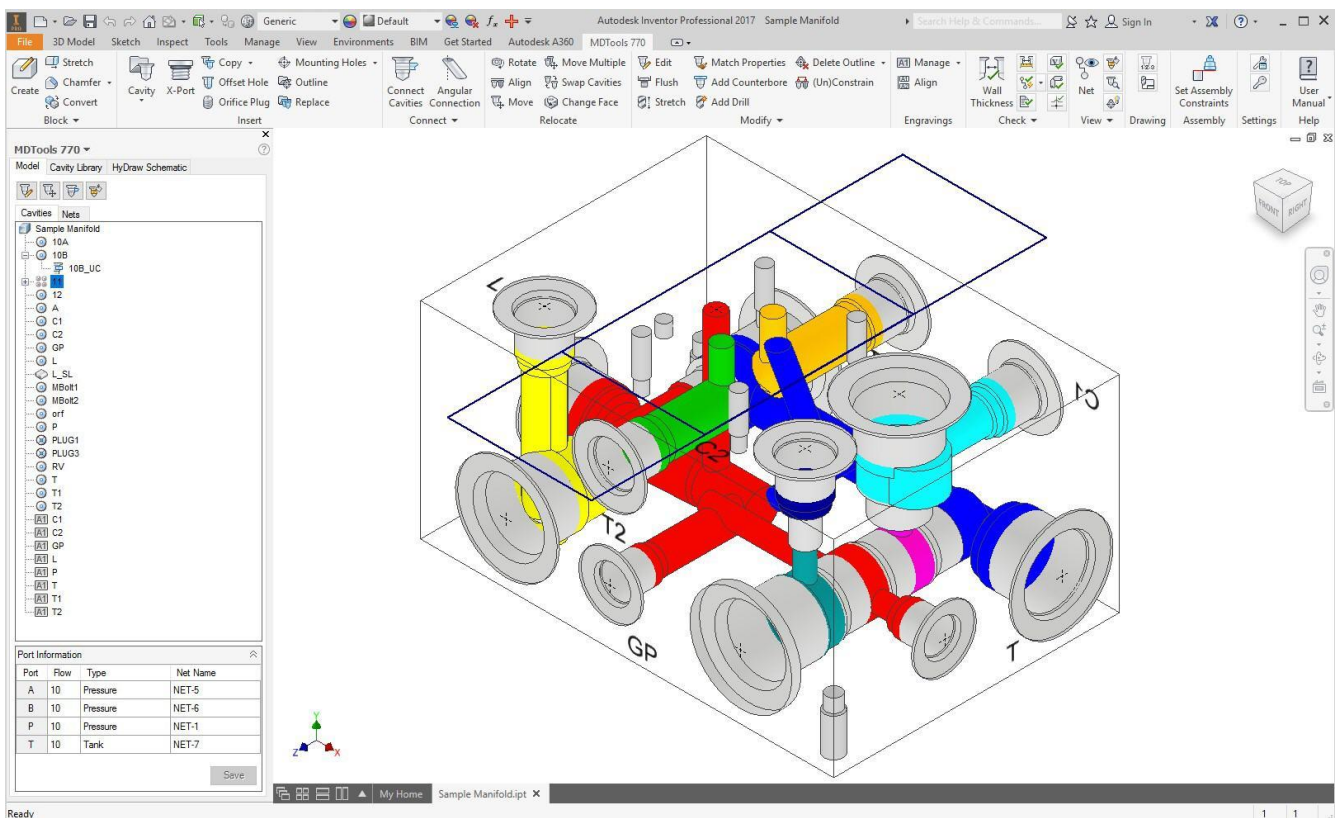
Note:

Engravings section is optional.

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

Insert

- 20 Insert Cavity (...from Library)
- 21 Insert Cavities (...from HyDraw Schematic)
- 22 Insert Cavities (Non-Rectangular Manifold Block)
- 23 Insert Construction Port (X-Port)
- 24 Copy Cavity
- 25 Copy Slot
- 26 Copy Multiple
- 27 Insert Offset Hole
- 28 Insert Orifice Plug
- 29 Merge with Cavity
- 30 Insert Mounting Holes
- 31 Insert Undercut
- 32 Insert Slot
- 33 Insert O-ring Groove
- 34 Insert Outline
- 35 Replace & Replace All



20. Insert Cavity (...from Library)

Select and insert cavities/footprints in the manifold from a standard cavity/footprint library.

Precisely position the cavity with reference to either an edge of the block or an existing cavity.

If required, connect the new cavity to either one or two existing cavities on the block. Also, position the cavity maintaining minimum wall thickness with an existing cavity.

Insert Cavity/Footprint

1. MDTools 770 ribbon
>Insert panel
>Cavity or dropdown
>Cavity

The Cavity Library tab page displays in the MDTools[®] 770 browser.

2. Select the required library name.

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

Note

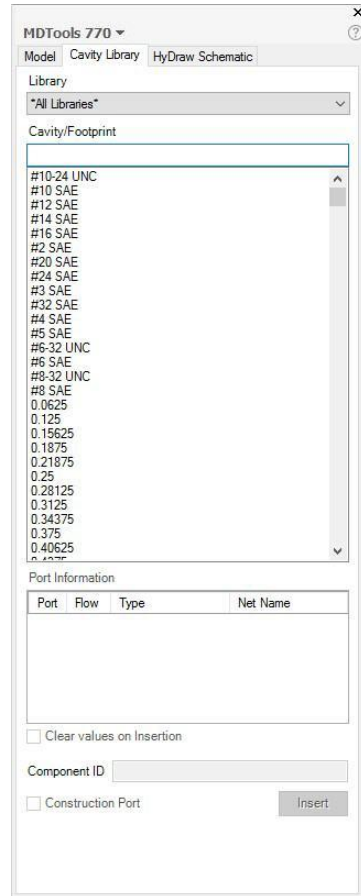
When you open the dialog box, the last selected library is the default library.

3. Enter the name to search for a cavity/footprint or select the required cavity/footprint from the list.
4. Enter **Port**, **Flow**, **Type**, and **Net Name** in the Port Information group box (also available on drop down). This data is not mandatory.
5. Select Clear values on Insertion, if required.
6. Enter the **component ID**.

Note

- When you insert a cavity/footprint for a component in the schematic, use the same component ID in the schematic as the component ID for the cavity/footprint.
 - When you insert a cavity for a construction hole, select the Construction Port option to automatically assign the component ID.
7. Click **OK**.

The Specify Cavity Location dialog box displays.



MDTools browser - Cavity Library tab

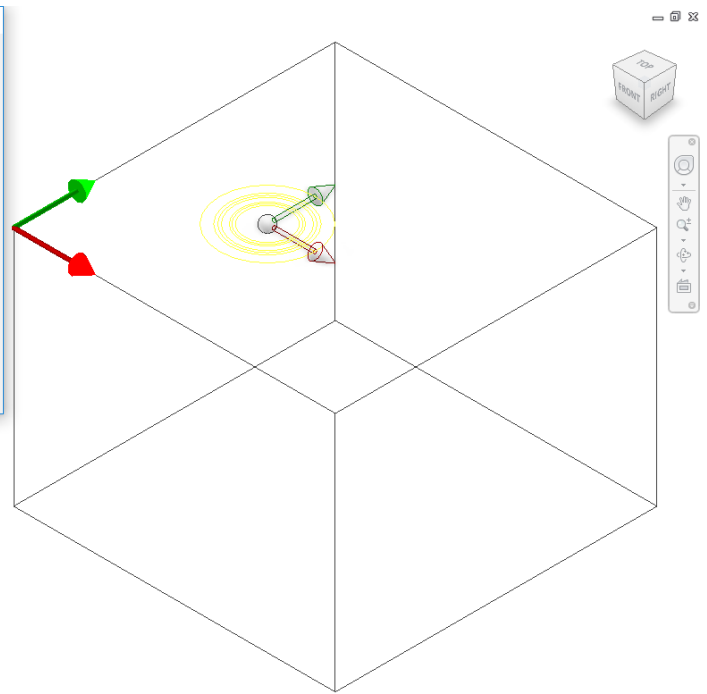
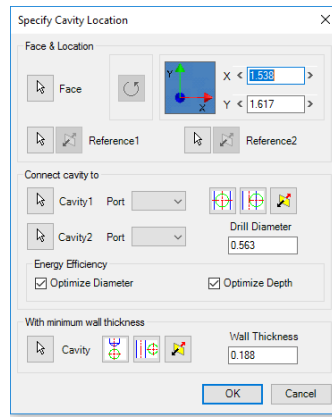
- Select the point on the manifold face where you want to insert the cavity.

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 on any axis. Or
 Drag the X and Y axis arrow to move cavity along a single direction.

- Click **OK**.

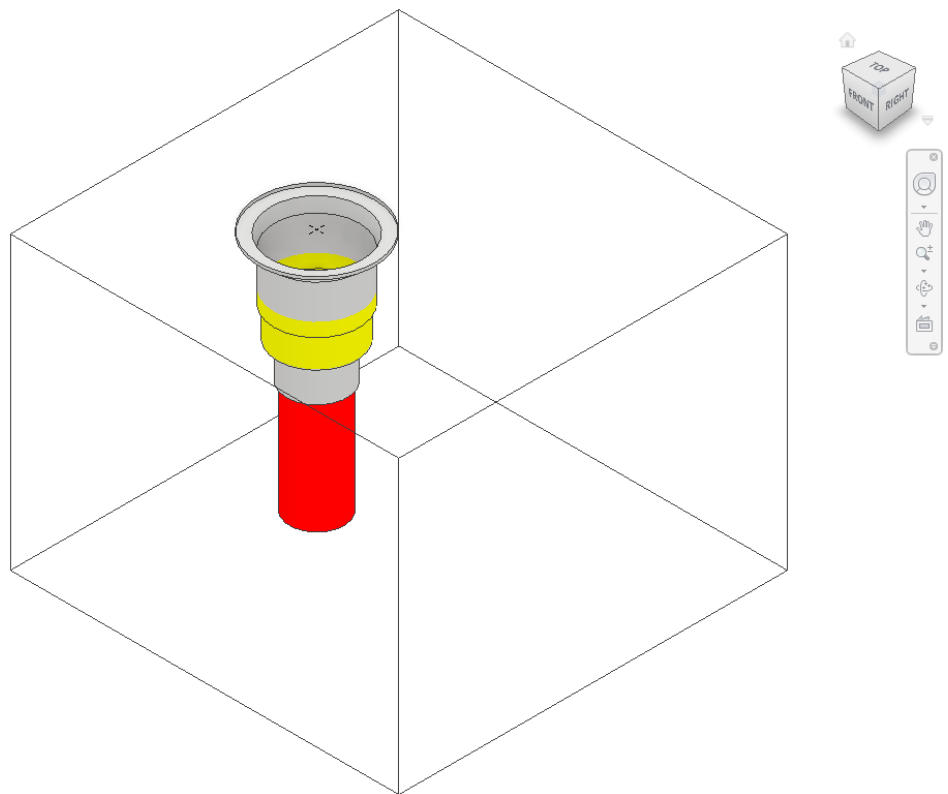
The cavity is inserted at the specified location.



Specify Cavity Location dialog box

Note

- Colored areas on a cartridge valve cavity represent the port areas.
- Port colors are set by default settings in *Net Default Color* for the corresponding Net name.

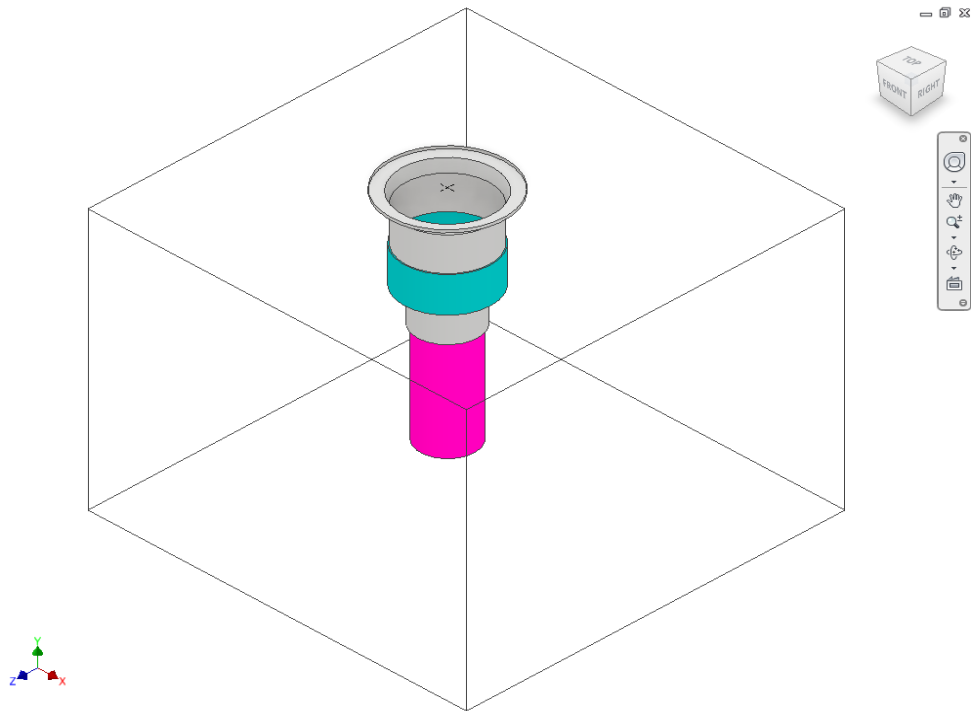


Cavity inserted with connectivity information

Undercut in Cavity Profile

MDTools[®] automatically inserts undercut stored with the cavity profile in the library.

The mandatory undercut can be defined with the cavity in MDTools Cavity Library and become integral profile of the cavity.



Undercut automatically inserted with cavity

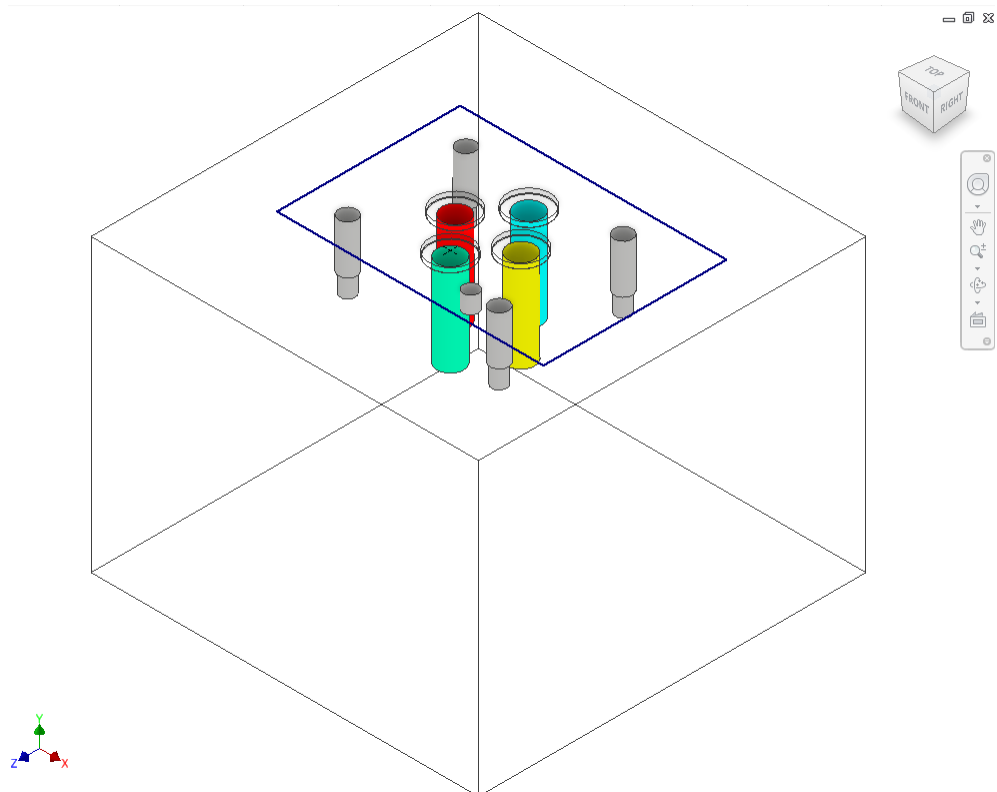
O-ring in Cavity Profile

MDTools automatically inserts O-ring grooves linked with the cavity data stored in the library.

Note

O-ring grooves can be linked with the cavity data stored in the MDTools Library Manager.

If **Check Rating at Connection** is selected in MDTools Settings and you are inserting a construction port, then MDTools validates the Construction port rated pressure with Net operating pressure of net selected for the construction port.



O-ring automatically inserted with cavity

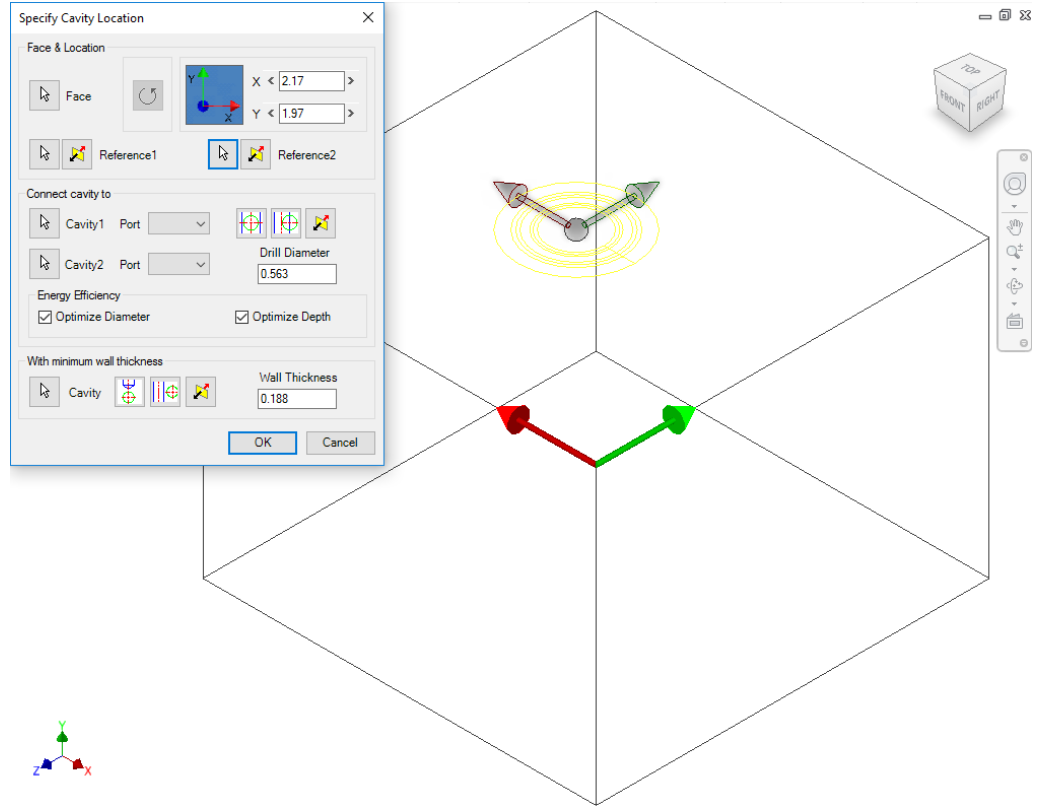
1 Position the cavity with reference to an edge or a cavity

1. Click the selection button for Reference1.
2. Select an edge or an existing cavity.

MDTools® automatically relocates the origin symbol and the X & Y axis arrow indicators to the selected reference and updates the X and Y values, per the new origin.

Note

- Select Reference2 when you want 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.

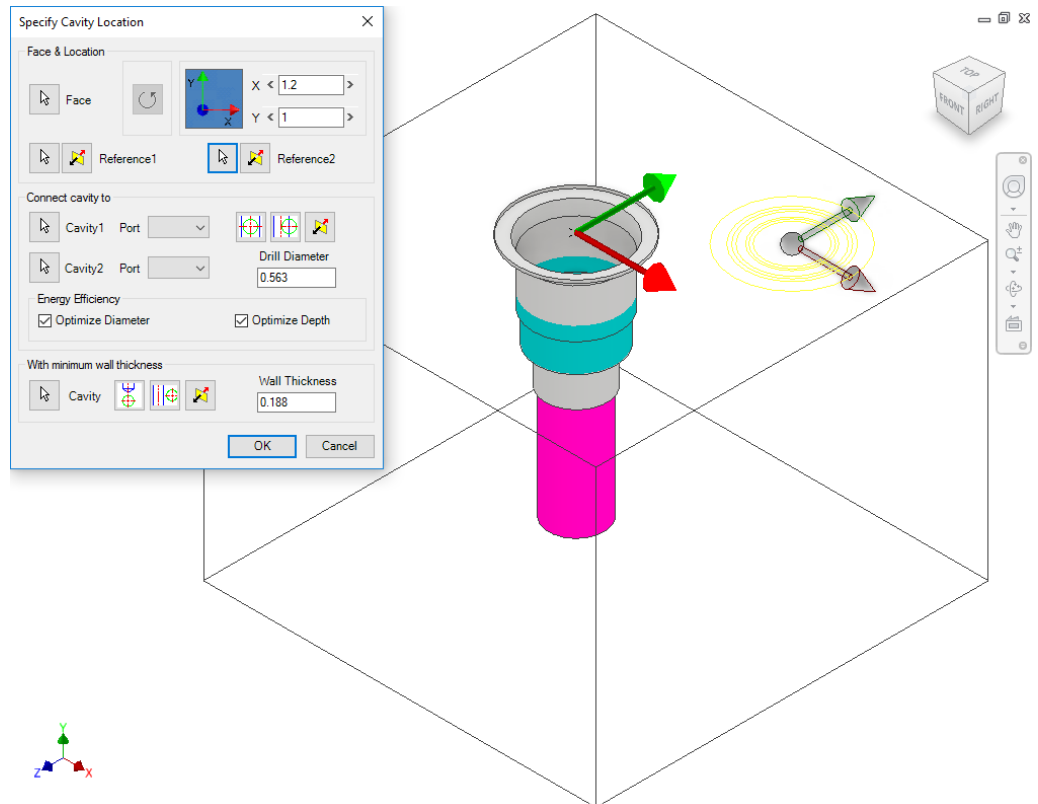


Position the new cavity with reference to an edge

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 the cavity/footprint upon changing the X and Y values.

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



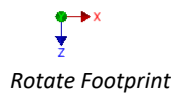
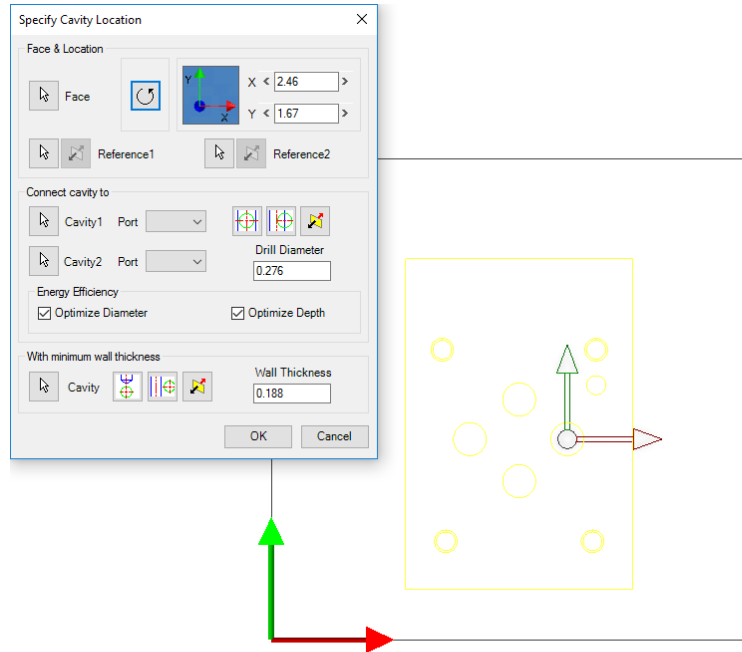
Position the new cavity with reference to an existing cavity

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.



3 Connecting existing cavities

Connect a new cavity to either one or two existing cavities in 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

1. Click the selection button for Cavity2.
2. Select the connecting Cavity2.
3. Select the connecting port on the second cavity.

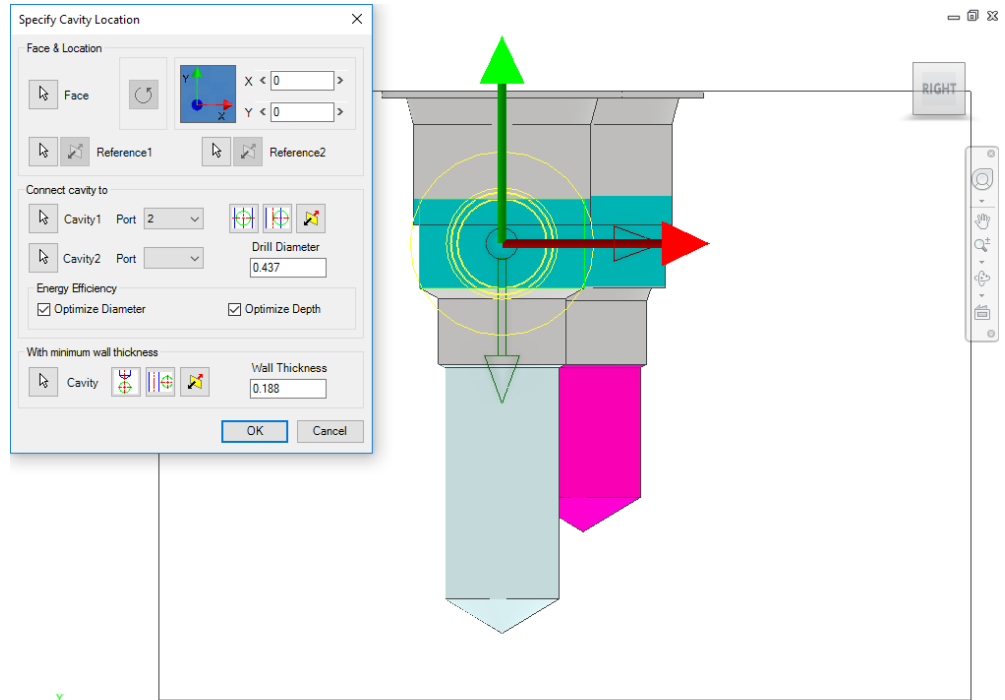
MDTools automatically relocates the cavity to the overlapping center of the two cavity ports.

4. Click **OK**.

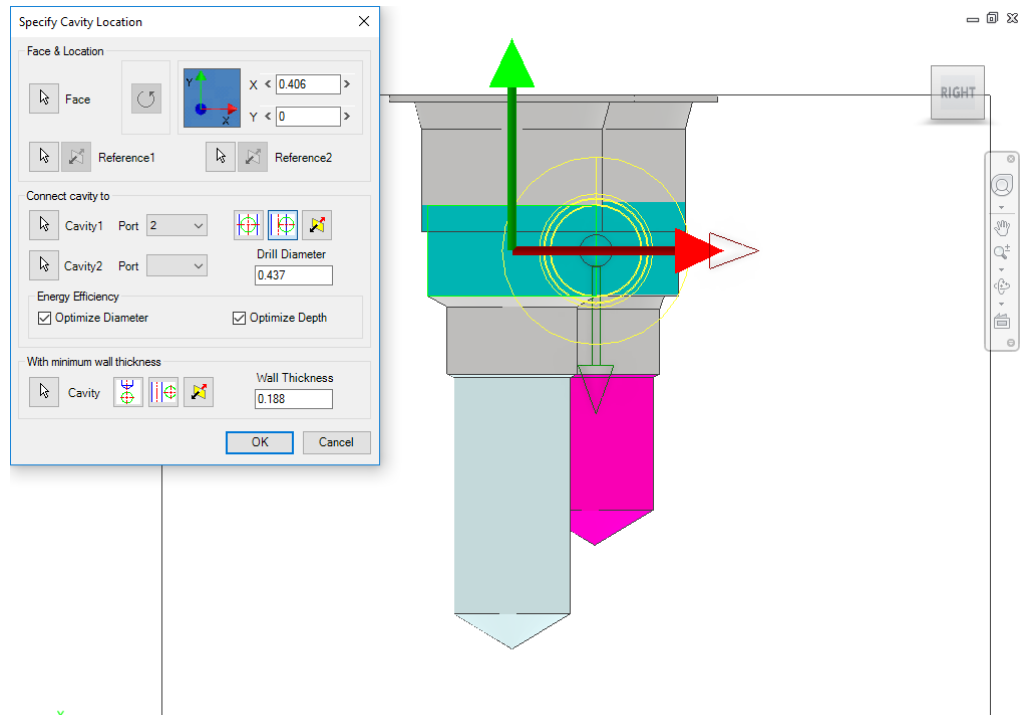
MDTools creates the new cavity at the specified location and connects the cavity to the selected connecting cavities.

Note

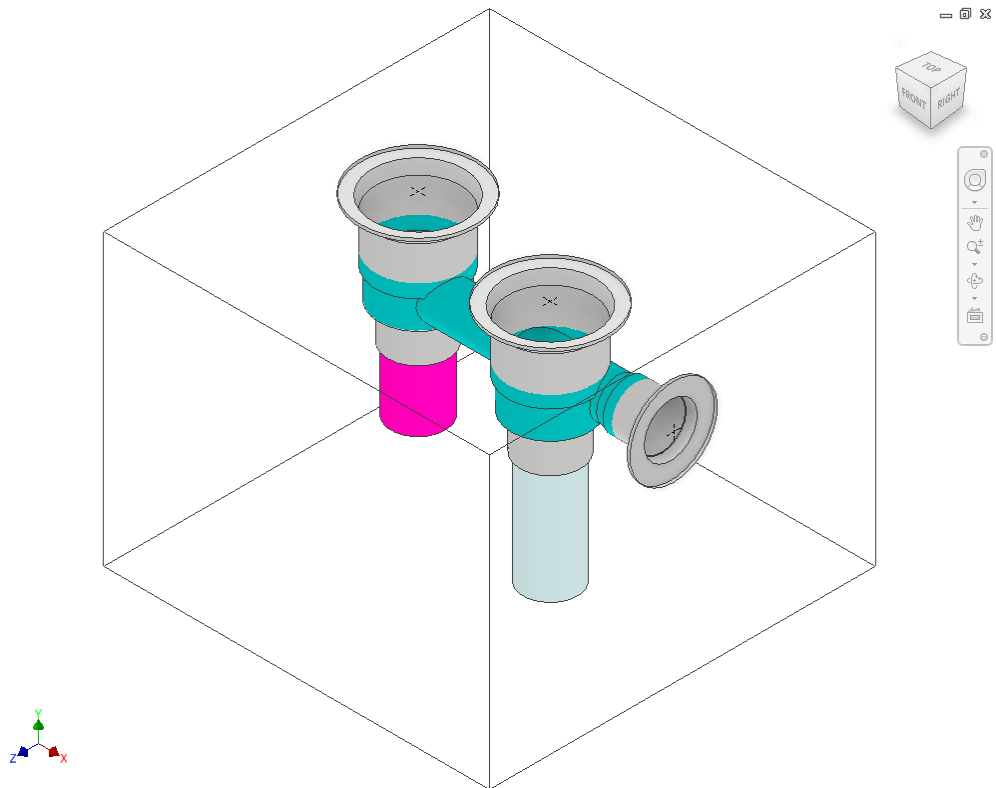
- The Energy Efficient connectivity is applied, if Optimize Diameter and Optimize Depth are selected.
- Click the **Relocate to side** button to relocate the cavity to a side.
- Click the **Flip side** button to flip the sides.
- MDTools automatically selects the best drill diameter from the tooling database based on the port diameter.



Position cavity from the center



Position cavity from sides

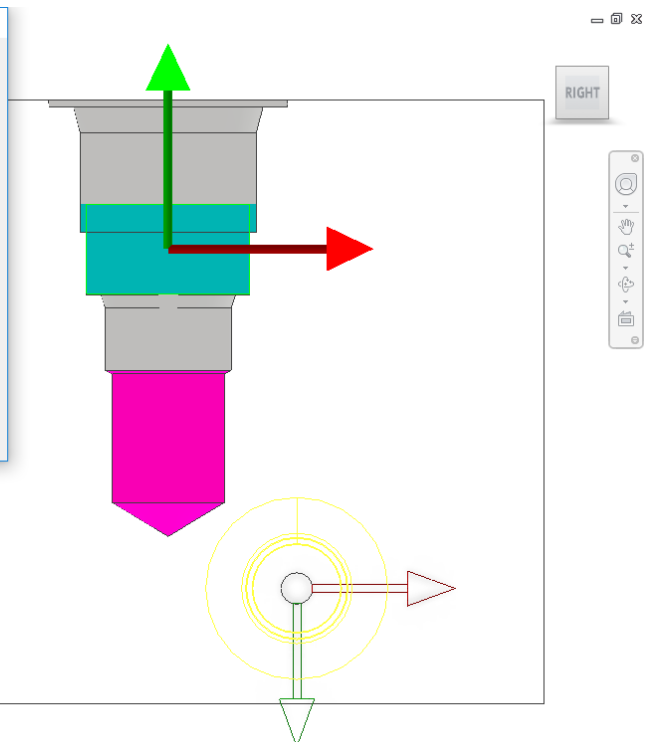
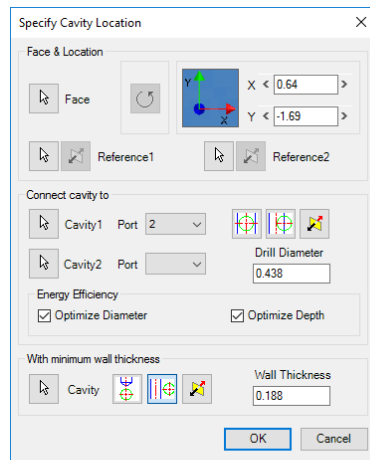


The two cavities are connected

4 Position with minimum wall thickness

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

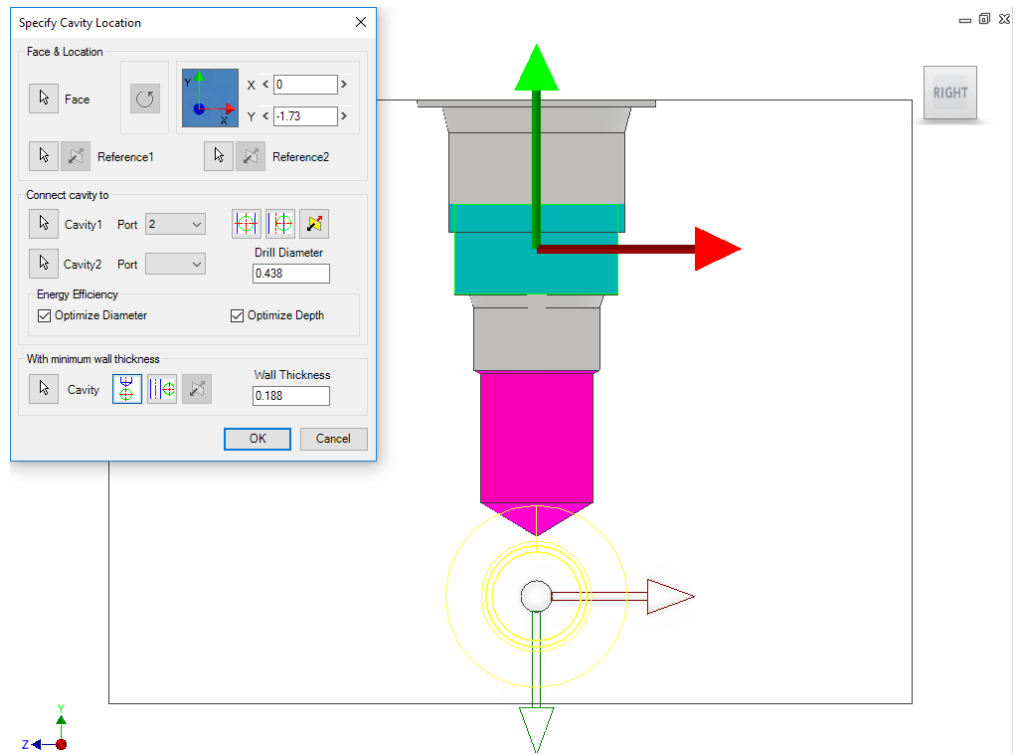
1. Click the selection button for cavity.
2. Select an existing cavity in the manifold.
3. Click the **Move to side** button to position a new cavity away from the selected cavity axis.
4. Click the **Flip side** button to change the side, if required.
5. Repeat the above steps to position the cavity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



Position the new cavity using the Move to side option

Note

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



Position the new cavity below the cavity tip

21. Insert Cavities (...from HyDraw Schematic)

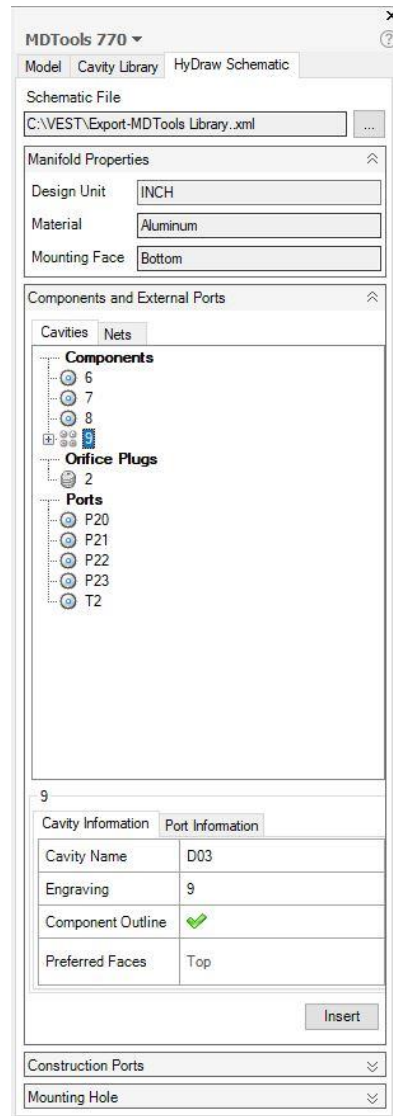
MDTools® **HyDraw® Schematic interface** enables you to automatically read an XML/MBXML exported from HyDraw® (schematic) and insert all the required cavities with connectivity information into MDTools.

1. MDTools 770 ribbon
 > **Insert** panel
 > **Cavity** dropdown
 > **From HyDraw**
The HyDraw Schematic tab page displays in the MDTools 770 browser.
2. Browse through the Schematic files to select the required HyDraw schematic xml/mbxml file.
3. Click **Open**.
MDTools automatically populates the Cavities browser with all the components from the schematic drawing.
4. Select a component.

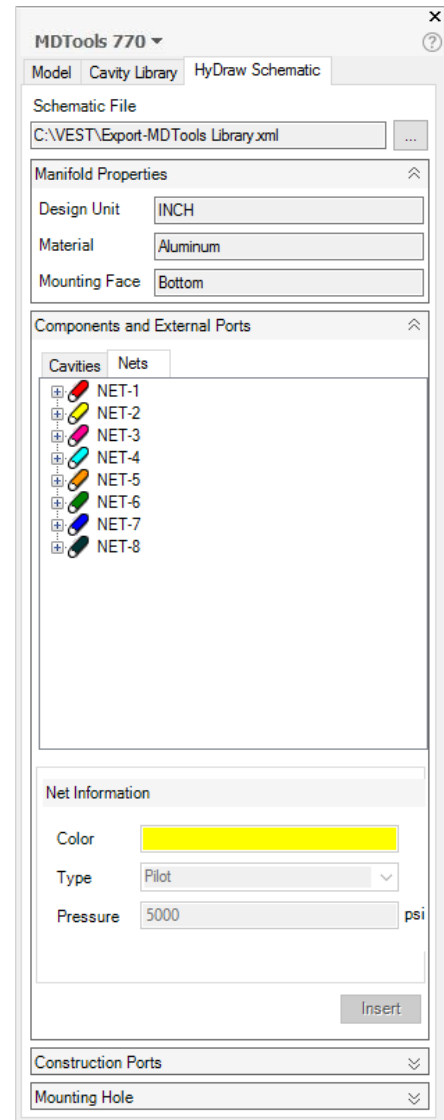
Note

- The cavity and port information are displayed in the respective grid.
- Cavities browser displays the cavities by the cavity ID and Nets browser displays by the net name.
- The information on engraving, component outline, and preferred faces is available only for MBXMLs imported from QuickManifolds.

5. Click **Insert**.
The Specify Cavity Location dialog box displays.



MDTools 770 Browser:
HyDraw Schematic page
– Cavities Browser



MDTools 770 Browser:
HyDraw Schematic page
– Nets Browser

Select the point on the manifold face, where you want to insert the cavity.

MDTools® displays a top-view preview with center point and X and Y axis arrow 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 on any axis. Or Drag the X and Y axis arrow to move cavity along a single direction.

Click **OK**.

The cavity is inserted at the specified location.

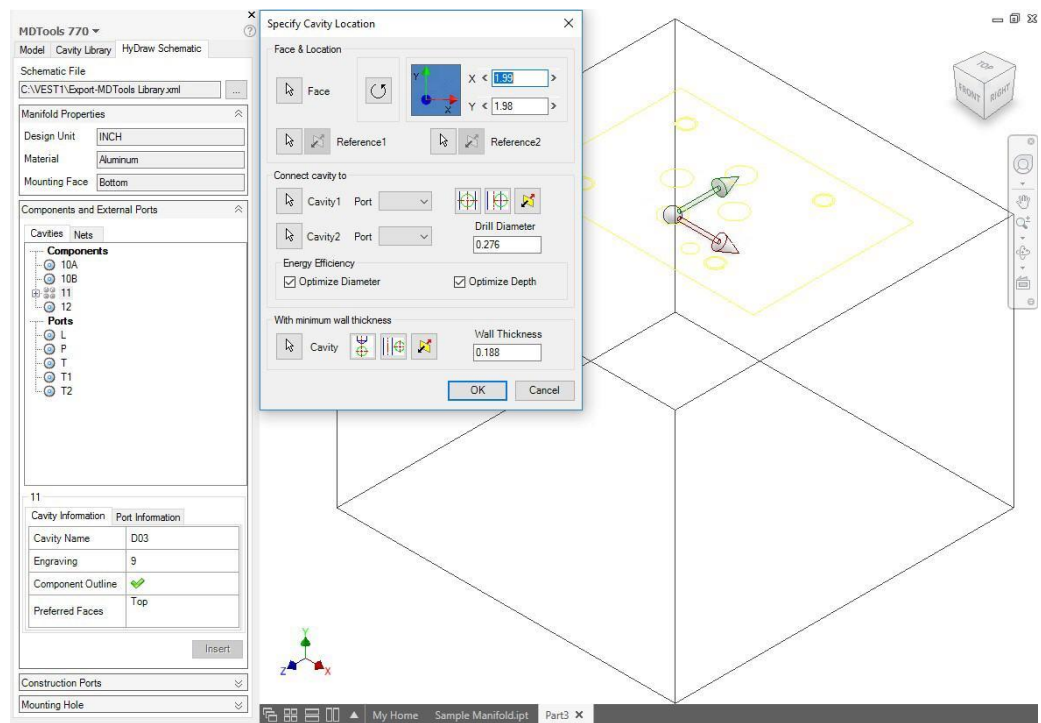
MDTools automatically suppresses the blocked/terminated footprint port defined in HyDraw Schematic.

*In MDTools Settings ->Miscellaneous tab, select **Display as Circles**.*

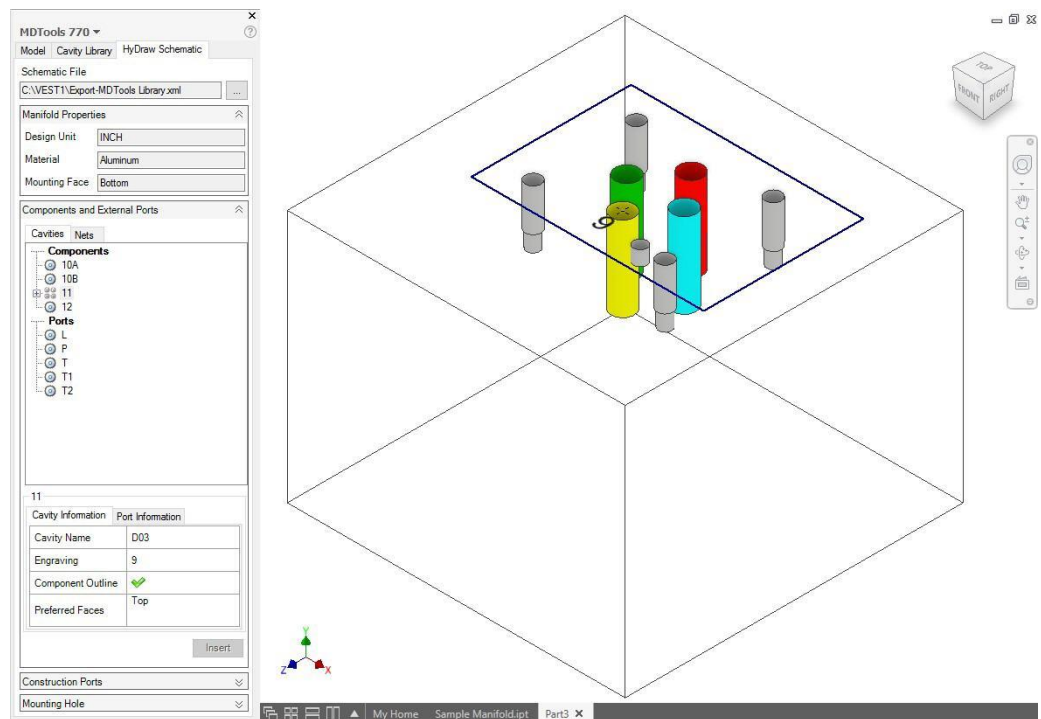
MDTools automatically displays the circle for blocked/terminated footprint ports.

Note

- Once a cavity is inserted into the manifold it is displayed in black against a shaded background in the Cavities browser and Nets browser.
- Refer HyDraw® Schematic page.



Specify Cavity Location dialog box



Footprint inserted with Cavities and Port information

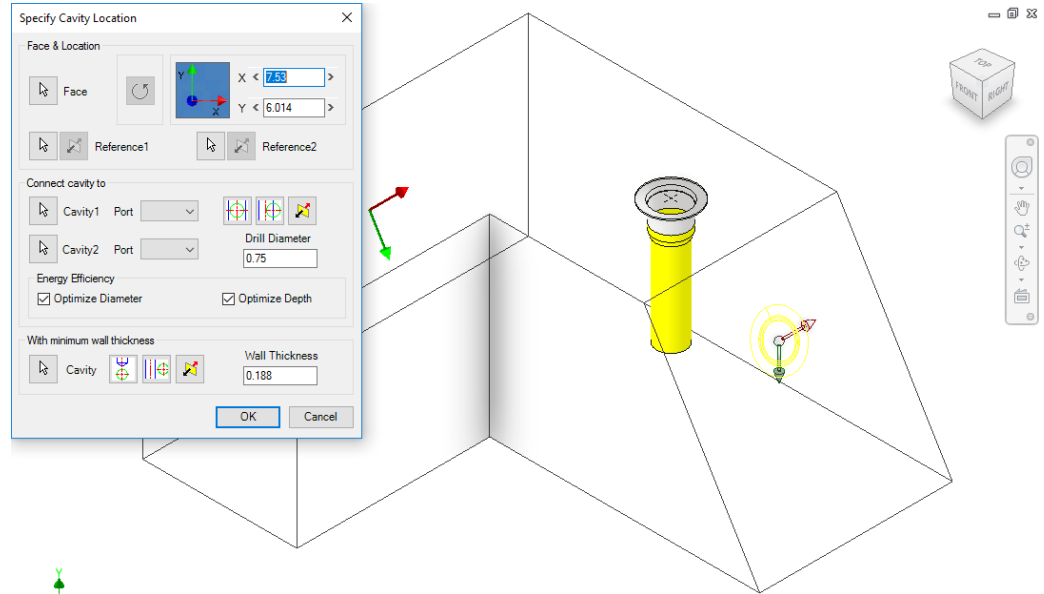
22. Insert Cavities (Non-Rectangular Manifold Block)

Inserting Cavities

Use the MDTools' **Insert Cavities** command to insert cavities on planar faces of the non-rectangular block.

Note

- MDTools cavity can only be inserted on a planar face.
- In case of cavities on the inclined faces, the **Connect cavity to** option in the Specify Cavity Location dialog box may not work properly.

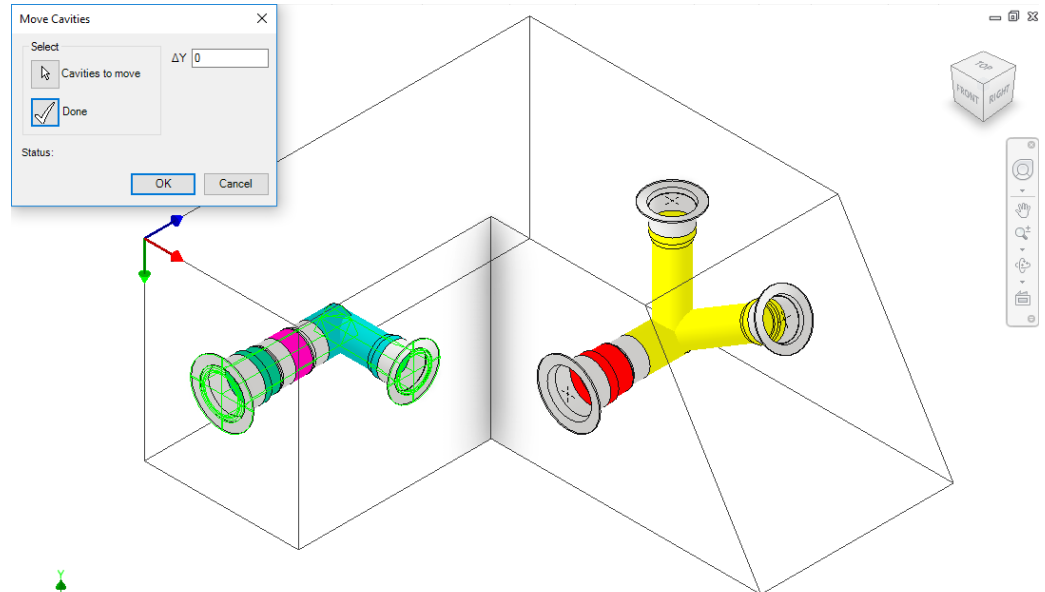


Specify Cavity Location dialog box

Repositioning of Cavities

MDTools[®] provides various commands, such as Move Cavity, Change Face, Move Multiple, or Swap Cavities, to reposition the cavities.

Use these commands to reposition the cavities.



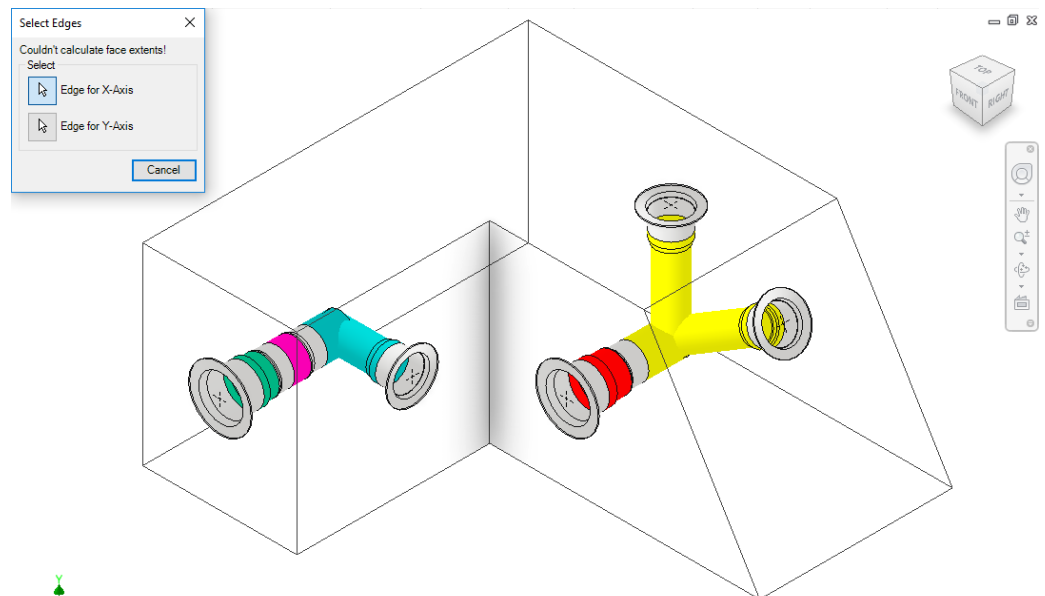
Move Cavities dialog box

When using **Move Cavity**, specify the X and Y axis for the face on which the selected cavity is placed.

The Move Cavity dialog box displays.

Note

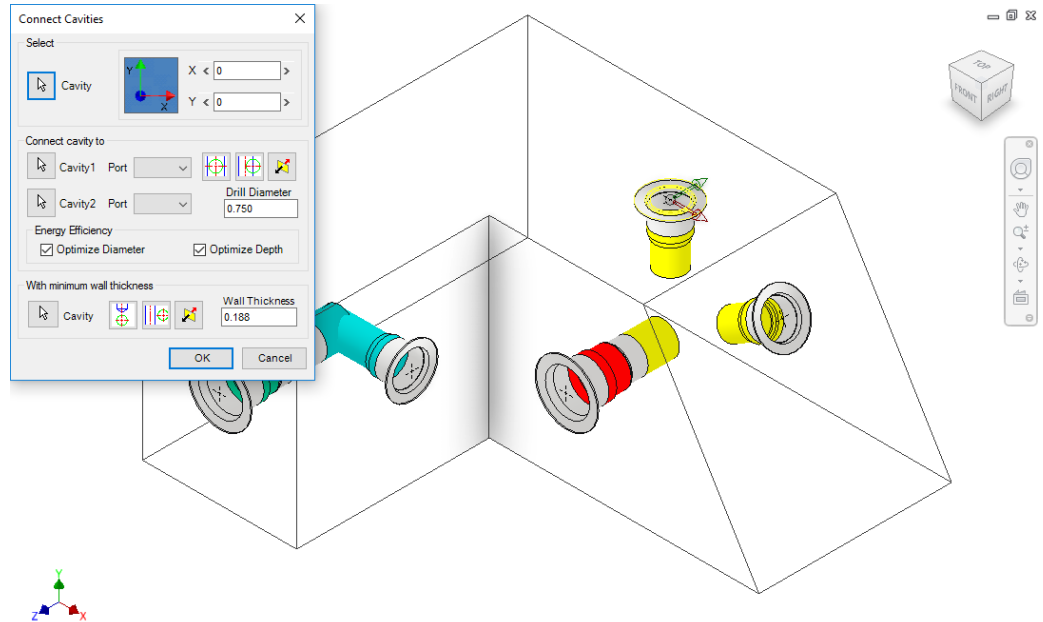
The Parametric Move command does not work with the non-rectangular manifold.



Select Edges dialog box: Specify the axis

Creating Connections between Cavities

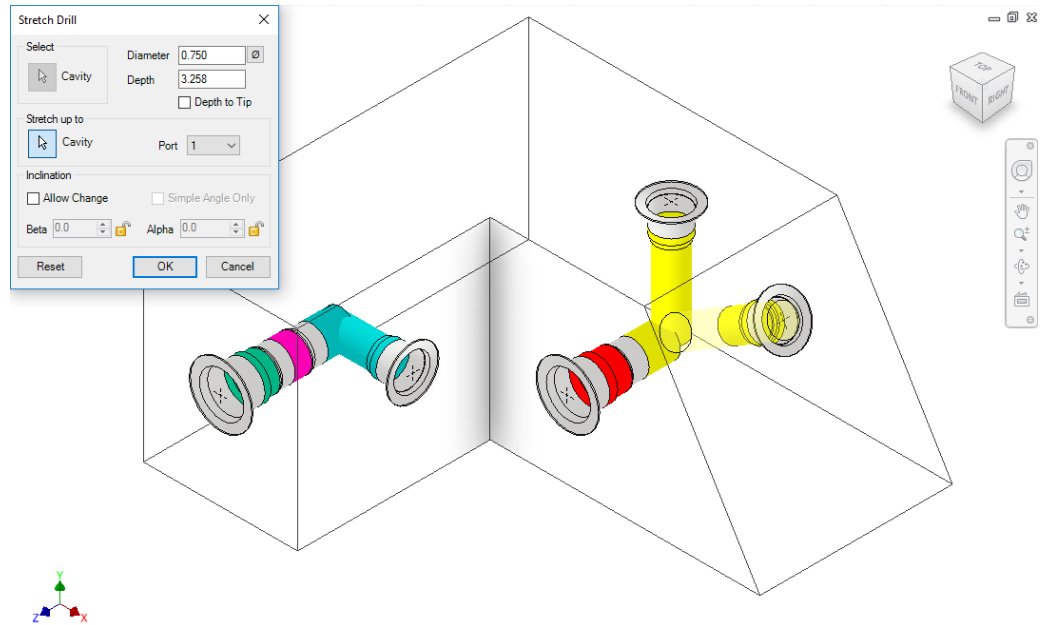
Use the MDTools® **Connect Cavities** command to create connections between cavities on the non-inclined faces.



Connect Cavities dialog box

Note

- The Connect Cavities command does not work properly with cavities on inclined faces.
- Use the Edit Cavity/Stretch Drill command to modify the drill depth and create a connection with a cavity on an inclined face.



Stretch Drill dialog box: Cavity is stretched to create connection

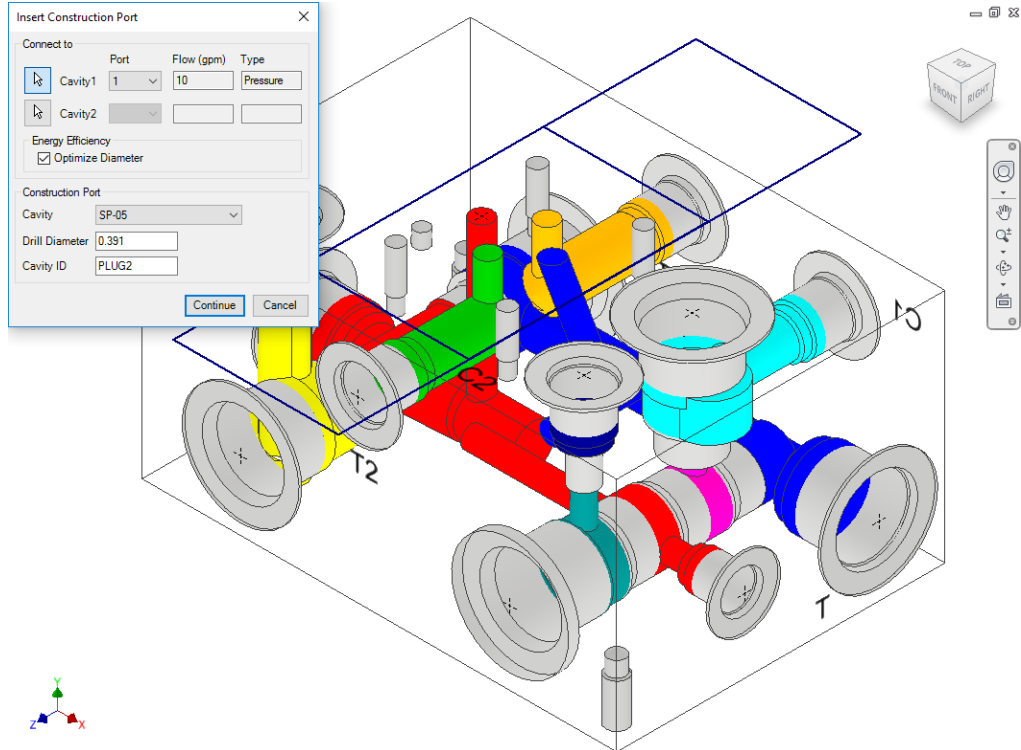
23. Insert Construction Port (X-Port)

Automatically selects a suitable construction port, per the connecting cavities. If energy efficient connection is active, then MDTools* suggests drill diameter and a construction port to minimize bend losses.

1. MDTools 770 ribbon
>Insert panel
>X-Port
2. Select **Cavity1**.
3. Select the **port** for the first cavity.

The *Insert Construction Port dialog box* displays.

MDTools automatically displays the *Flow and Type* for the selected port. The *Construction Port* displays recommended *Cavity, Drill Diameter*.



Insert Construction Port dialog box

Note

If *Optimize Diameter* is selected in the *Energy Efficiency* section, then the proposed X-port recommendation follows the criteria set in MDTools Settings > Energy Efficiency tab, *Construction Port Sizing* section.

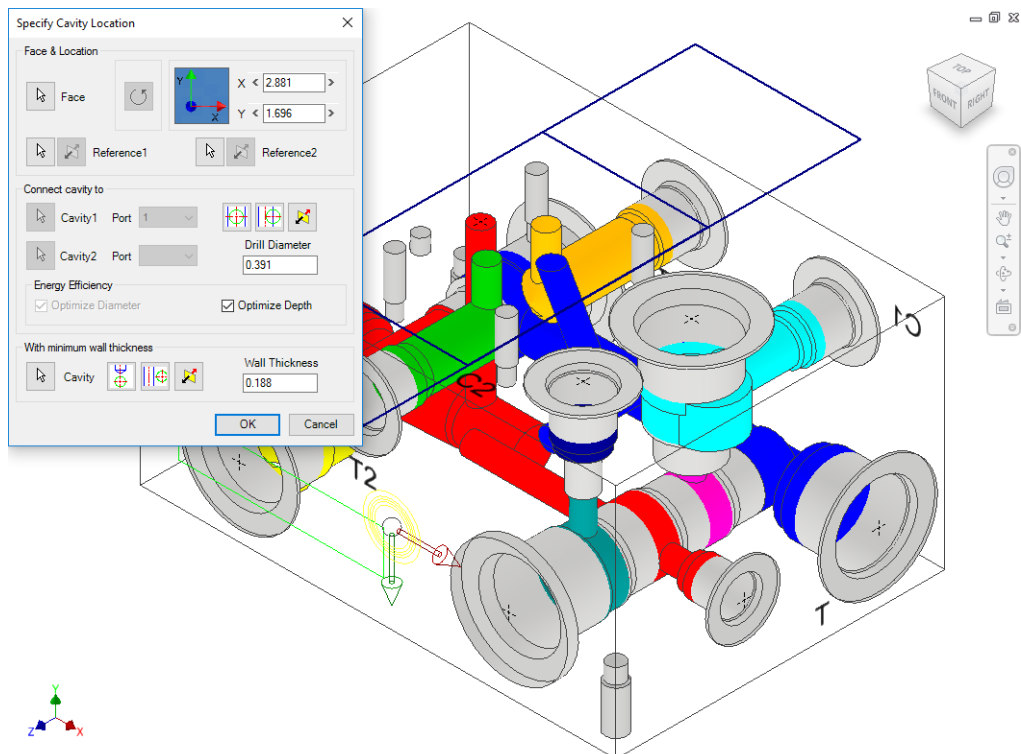


4. Select **Cavity2**.
5. Select the **port** for the second cavity.

MDTools automatically displays the *Flow and Type* for the selected port. The *Construction Port* displays recommended *Cavity, Drill Diameter*.

6. Click **Continue**.

The *Specify Cavity Location dialog box* displays.



Specify Cavity Location dialog box



7. Select the point on the manifold face, where you want to insert the cavity.

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

The Optimize Depth checkbox is selected by default to make a smooth connection.

8. Click **OK**.

The construction port is inserted at the specified location and the connection is made automatically.

Note

The Optimize Depth option is set in the MDTools® Settings > Energy Efficiency tab.

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.

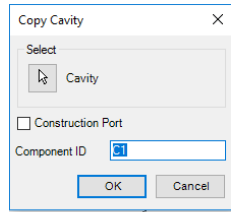
24. Copy Cavity

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

All parameters including the connectivity information are copied to the new cavity. You can connect the new cavity to either one or two existing cavities on the block.

1. MDTools 770 ribbon
 >Insert panel
 >Copy dropdown
 >Copy

The Copy Cavity dialog box displays.



2. Select the cavity you want to copy.
3. Enter the **component ID** for the new cavity/footprint.
4. Select the **Construction Port** checkbox to use the new cavity as a construction port.

MDTools® automatically assigns the component ID when you select this option.

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.



Copy Cavity dialog box

MDTools display a top-view preview with center point and X and Y axis arrow indicator of the selected cavity at the selected point on the manifold.

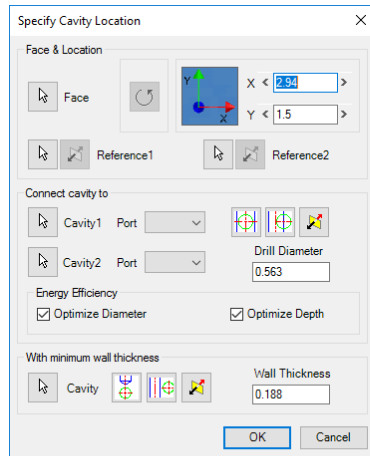
7. Enter the X and Y distance from the block origin.

Or
 Drag the center point to move cavity along any axis.

Or
 Drag the X and Y axis arrow to move cavity along a single direction.

8. Click **OK**.

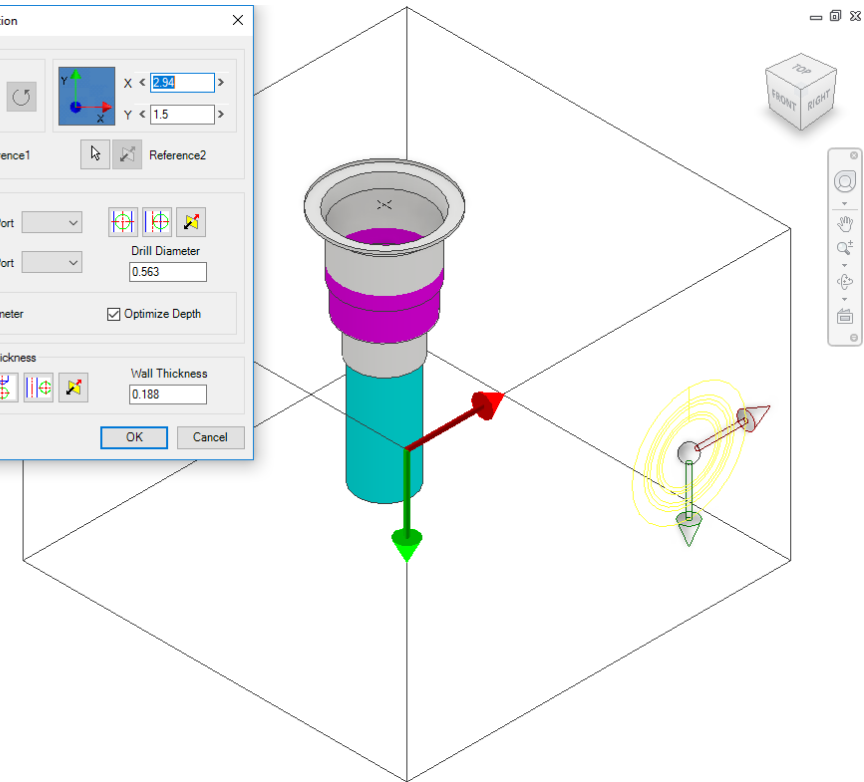
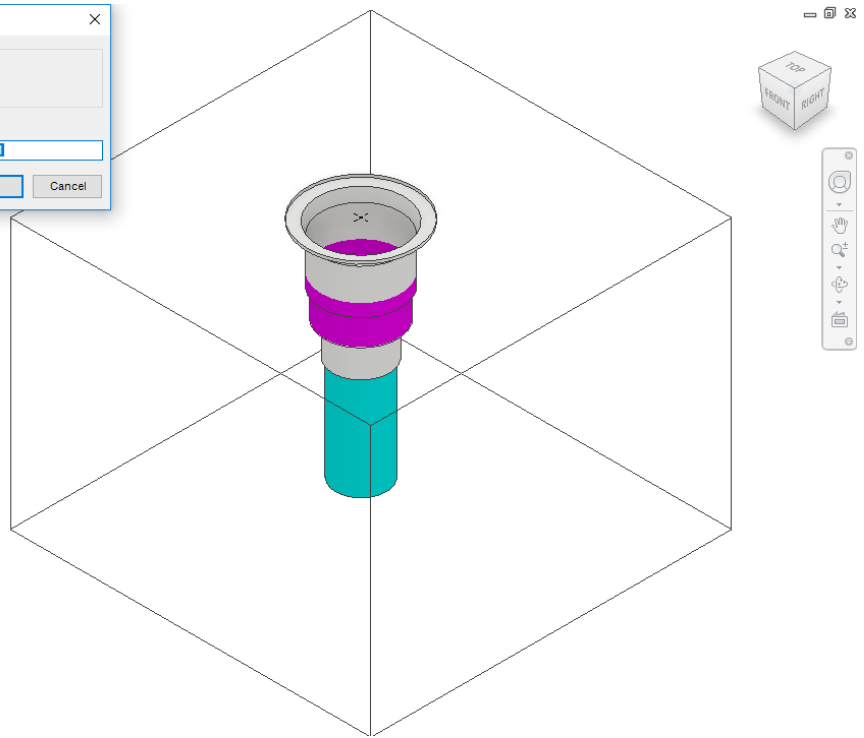
MDTools creates a copy of the selected cavity at the specified location.



Specify Cavity Location dialog box

Note

- If a cavity on a footprint is selected, then the complete footprint is copied.
- When a footprint is copied, the main cavity on the footprint is created at the selected location.
- If cavity has undercut, it is copied along with it. If cavity has slot, Copy Slot option is available.



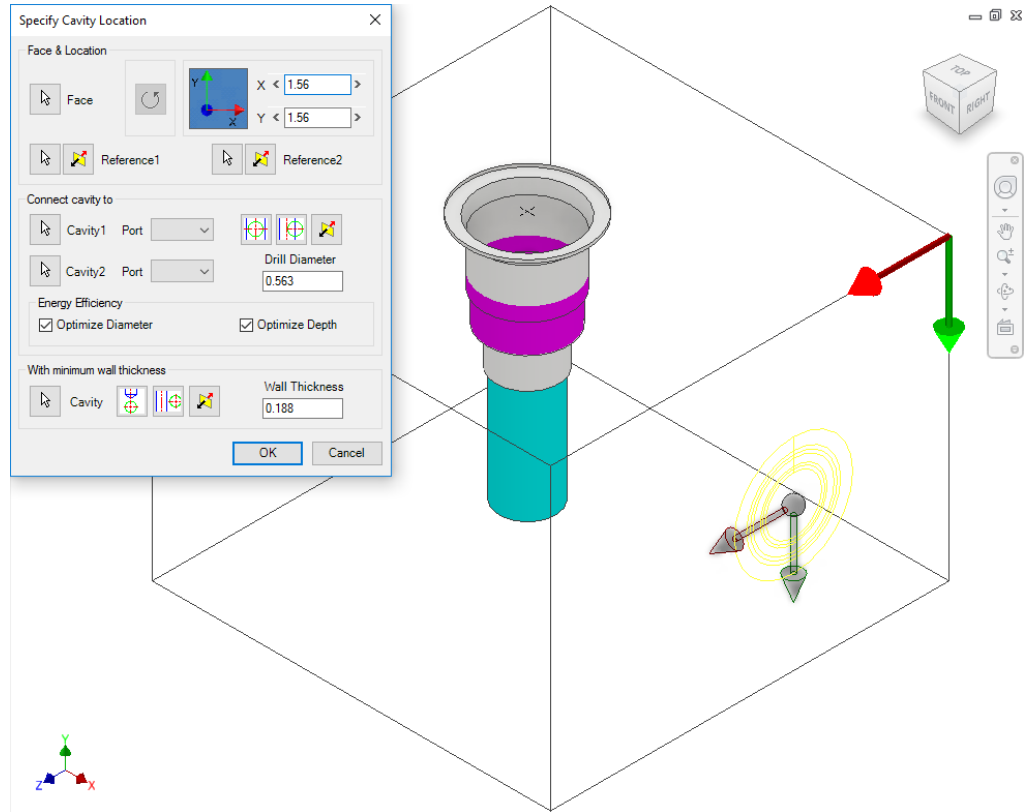
1 Position the cavity with reference to an edge or a cavity

1. Click the selection button for Reference1.
2. Select an edge or an existing cavity.

MDTools® automatically relocates the origin symbol to the selected reference and updates the X and Y values, per the new origin.

Note

- Select Reference2 when you want 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.

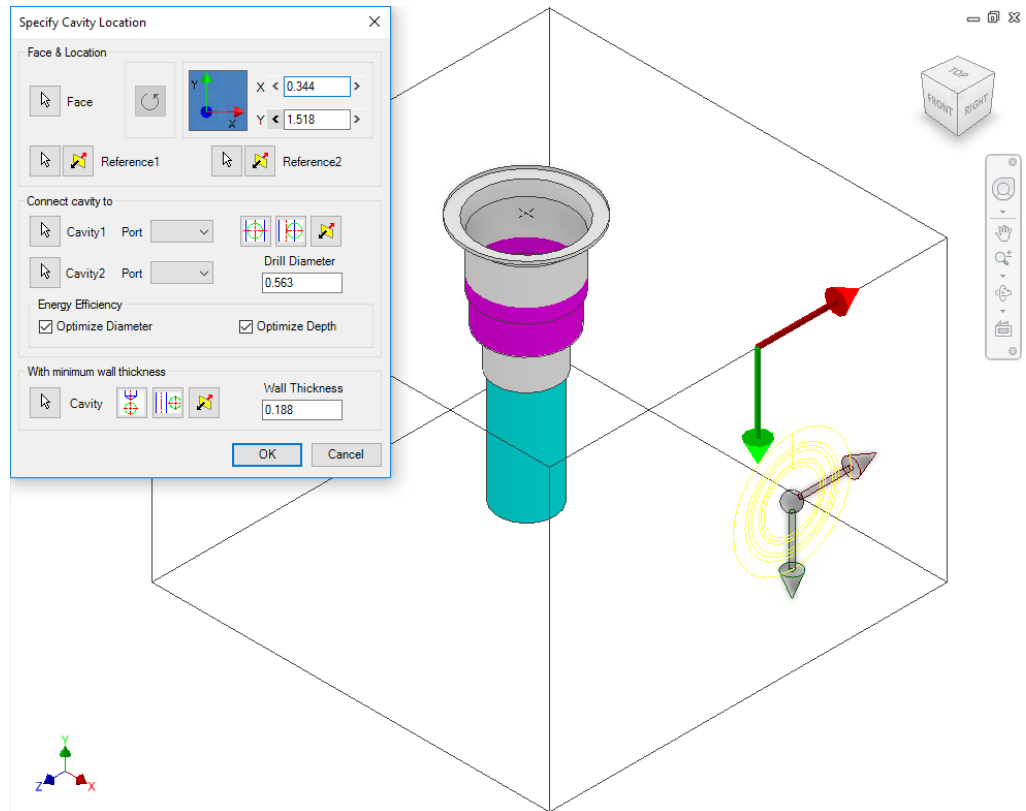


Position the new cavity with reference to an edge

3. Change the X and Y values to precisely position the new cavity.

MDTools automatically updates the preview of cavity/footprint upon 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 existing cavity

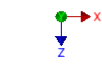
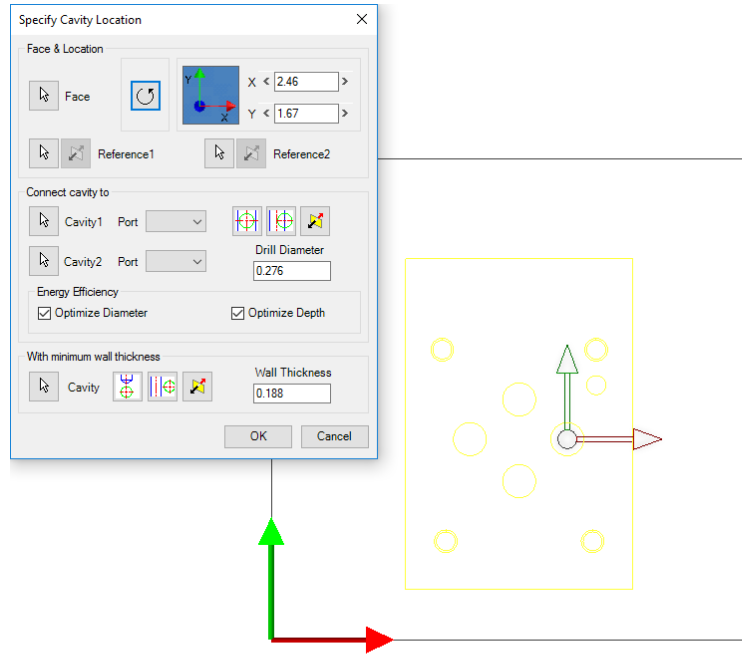
2 Rotate Footprint

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.



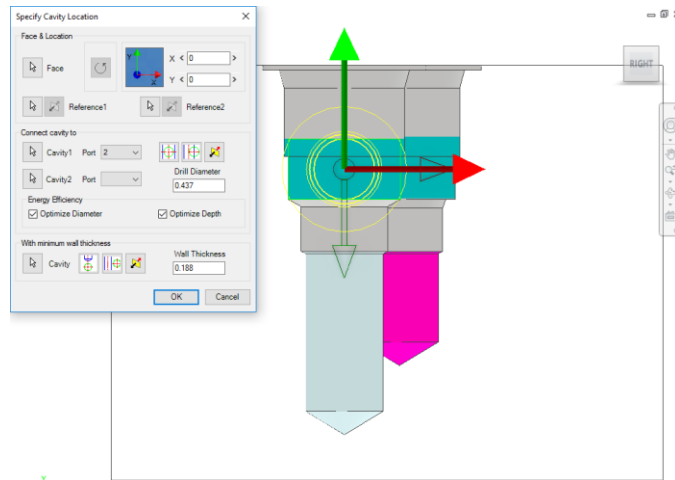
Rotate Footprint

3 Connecting two existing cavities

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

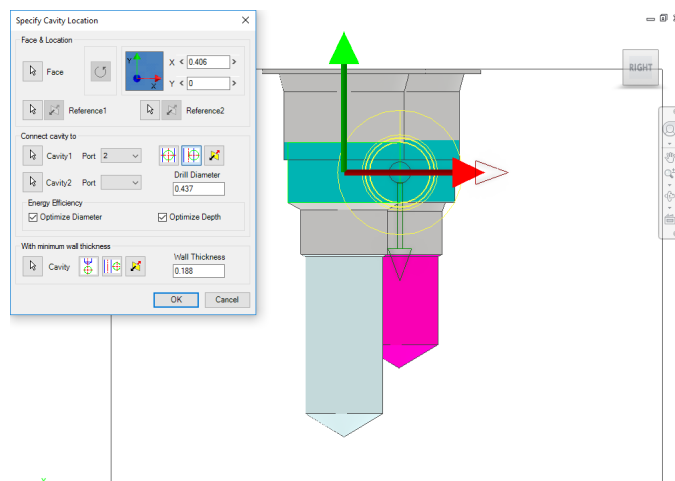


OR

1. Click the selection button for Cavity2.
2. Select the connecting Cavity2.
3. Select the connecting port on the second cavity.

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

Position the cavity from the center



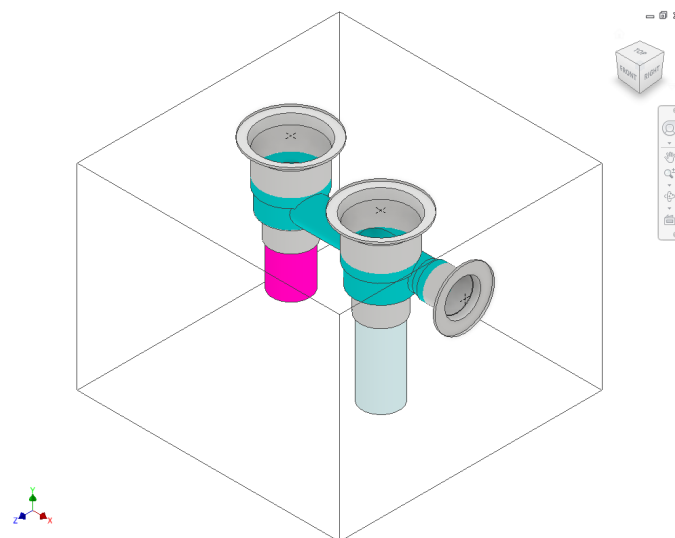
4. Click **OK**.

MDTools creates the new cavity at the specified location and connects the cavity to the selected connecting cavities.

Position the cavity from the side

Note

- The Energy Efficient connectivity is applied, if either Optimize Diameter or Optimize Depth is selected.
- 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.

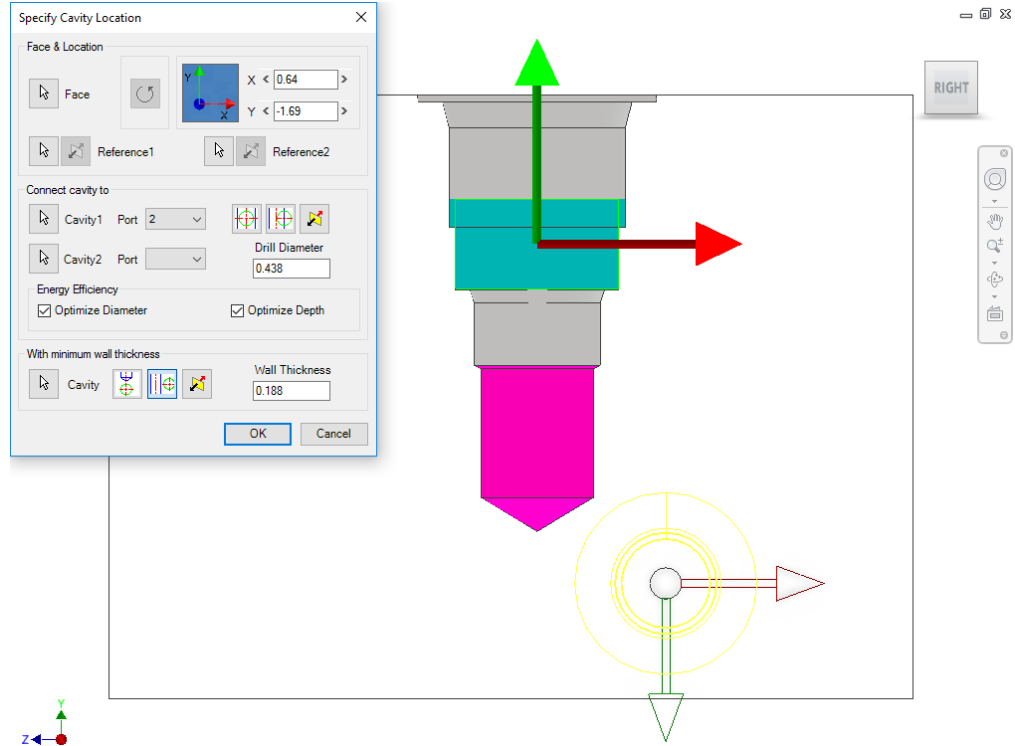


The two cavities are connected

4 Position with minimum wall thickness

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

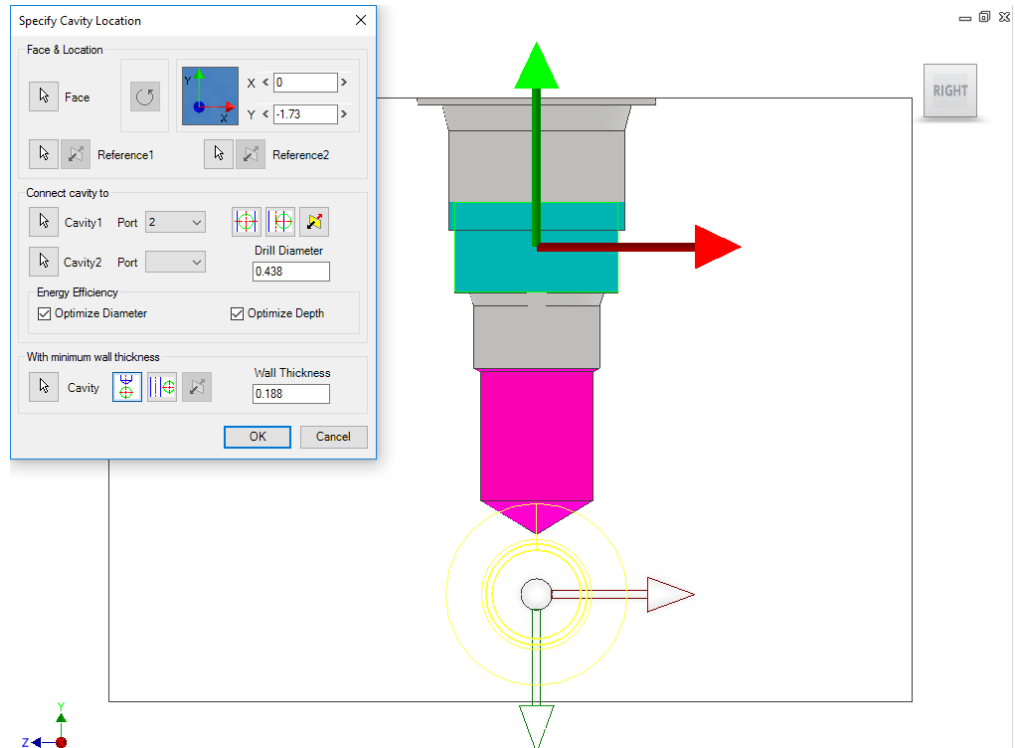
1. Click the selection button for Cavity.
2. Select an existing cavity in the manifold.
3. Click the **Move to side** button to position the new cavity away from the selected cavity axis.
4. Click the **Flip side** button to change the side, if required.
5. Repeat the above steps to position the cavity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



Position the new cavity using the Move to side option

Note

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

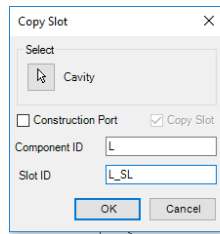


Position the new cavity below the cavity tip

25. Copy Slot

- MDTools 770 ribbon
 >Insert panel
 >Copy drop-down menu
 >Copy

The MDTools® Select Cavity dialog box displays.



- Select the slot you want to copy.

By default, the Copy Slot option is selected.

- Enter the component ID for the new cavity/footprint.

- Enter the slot ID for the new slot.

- Select the **Construction Port** checkbox to use the new cavity as a construction port.

MDTools automatically assigns the component ID and slot ID when you select this option.



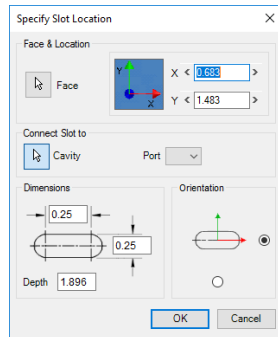
- Click **OK**.

The Specify Slot Location dialog box displays.

Copy Slot dialog box

- Select the point on the manifold face where you want to insert the slot with cavity.

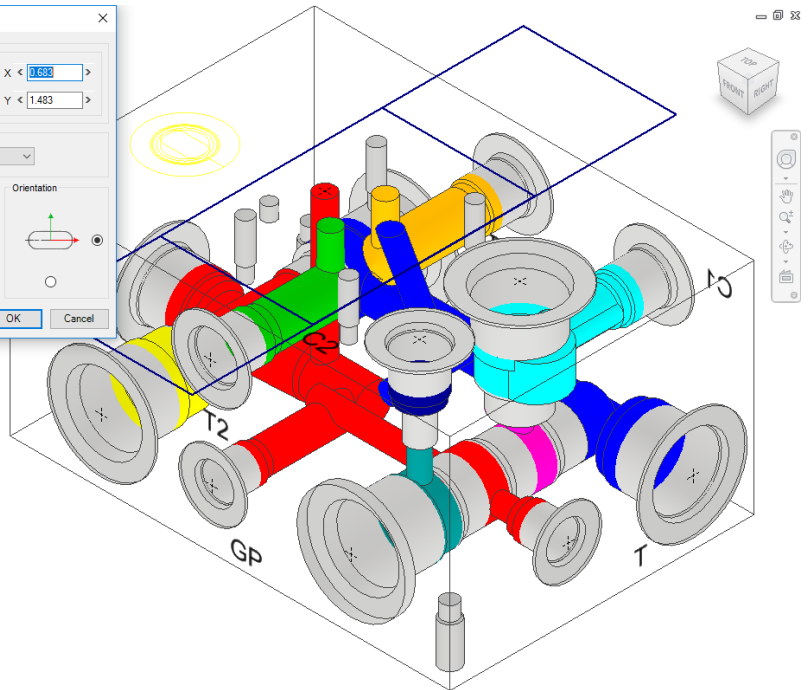
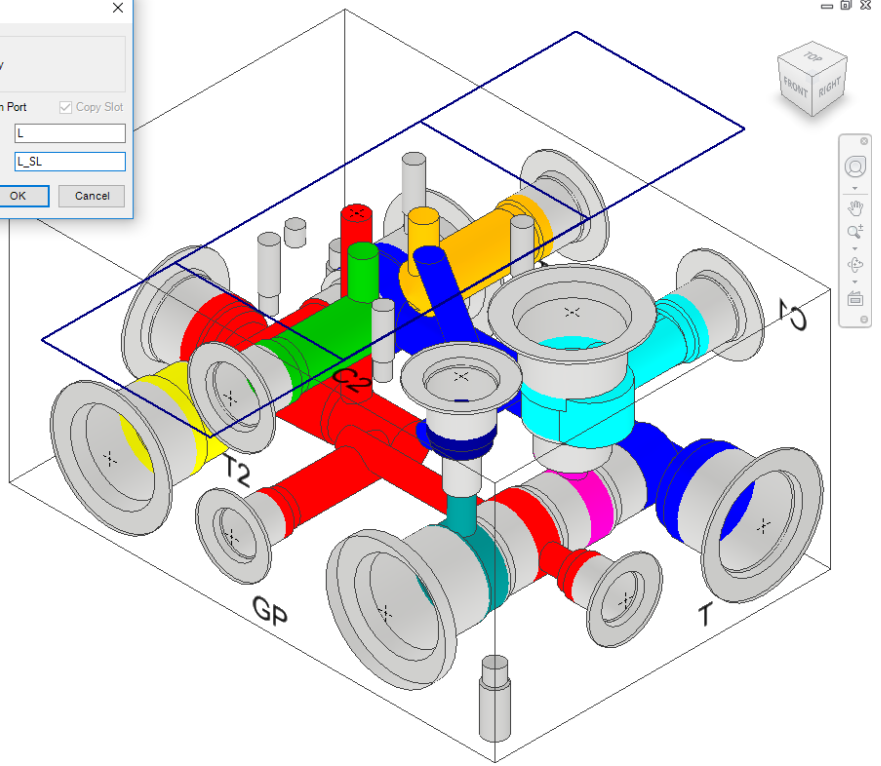
MDTools display a top view with center point and X and Y axis arrow indicator of the selected slot with parent cavity at the selected point on the manifold.



- Enter the X and Y distance from the block origin.



Specify Slot Location dialog box



9. Modify slot dimensions.

Default value of slot diameter and slot width would be maximum drill diameter of parent cavity/2.

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

10. Modify the depth of the slot.

Default value would be 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.

Note:

- If a slot on an origin of the 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.

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 cavity to the port center and displays the slot diameter, width and depth.*

4. Modify slot dimensions.

Default value of the slot diameter would be the connecting cavity port diameter.

Slot diameter plus 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 would be the center distance between the parent cavity and the connecting cavity.

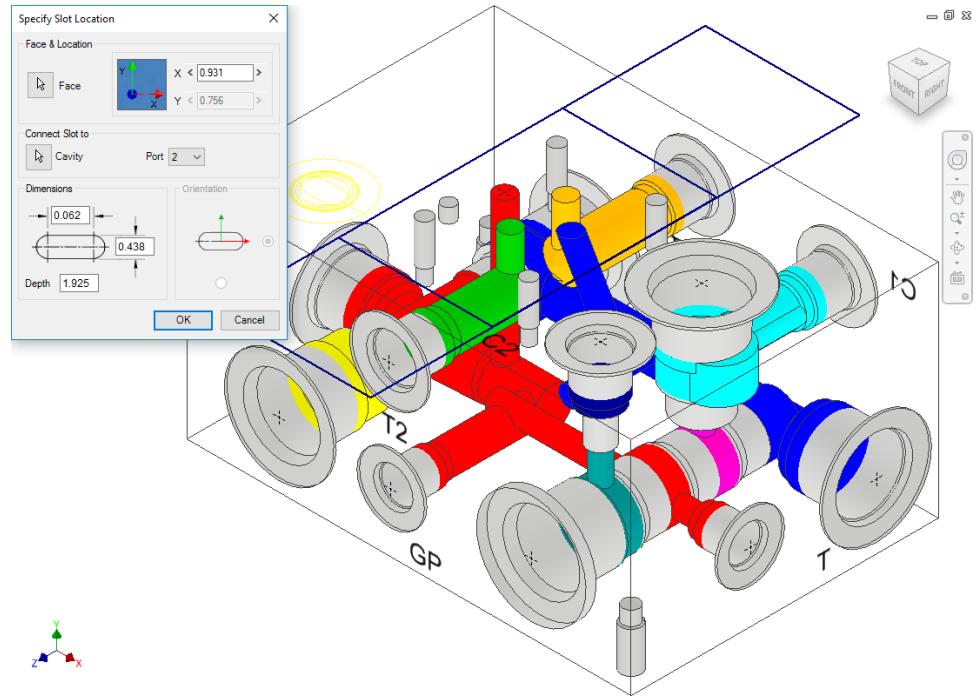
Slot depth should not be less than the center distance between the parent cavity and the connecting cavity.

6. Click **OK**.

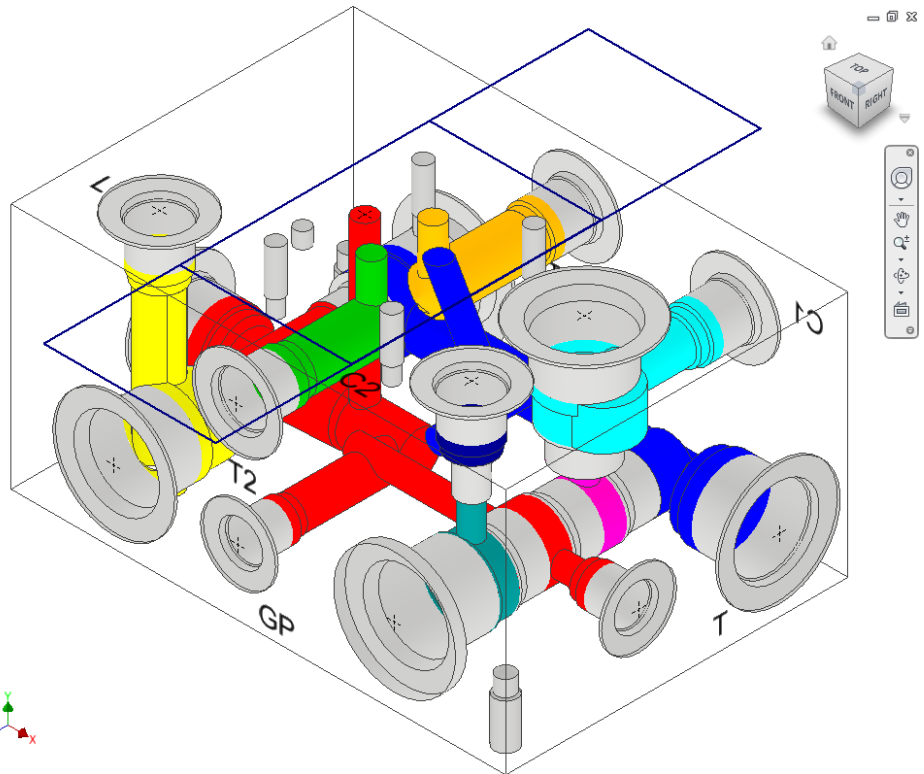
MDTools creates a new slot with the cavity at the specified location and connects the slot to the selected connecting cavity.

Note

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



Connecting slot to cavity



Slot connected with cavity

26. Copy Multiple

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

- MDTools 770 ribbon
 >Insert panel
 >Copy dropdown
 >Copy Multiple

The Copy Cavities dialog box displays.

MDTools display the coordinate symbol, indicating the direction of coordinates at the manifold origin.

- Select the cavities you want to copy.
 - Click the **Done** selection button to complete the selection.
- A data field to enter the displacement along the common axis displays in the dialog box.
- Enter the required displacement along each axis.

If you select cavities on perpendicular faces, MDTools display only one field to enter displacement, as the cavities have only one common axis.

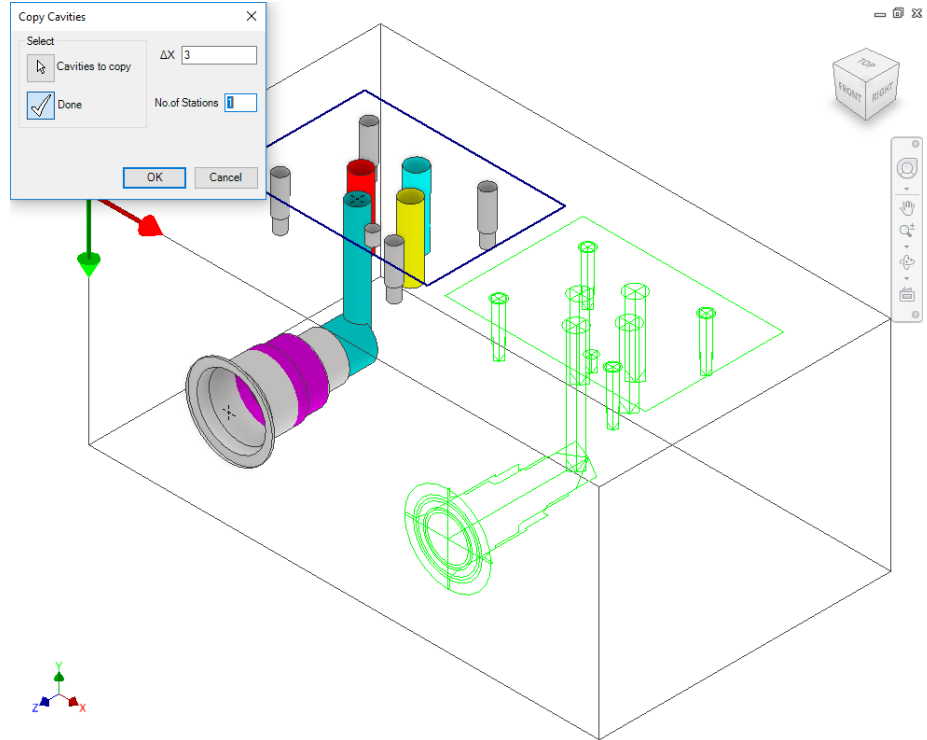
- Enter the number of stations.
- Enter the number of copies, if you want to create multiple copies.

- Click **OK**.

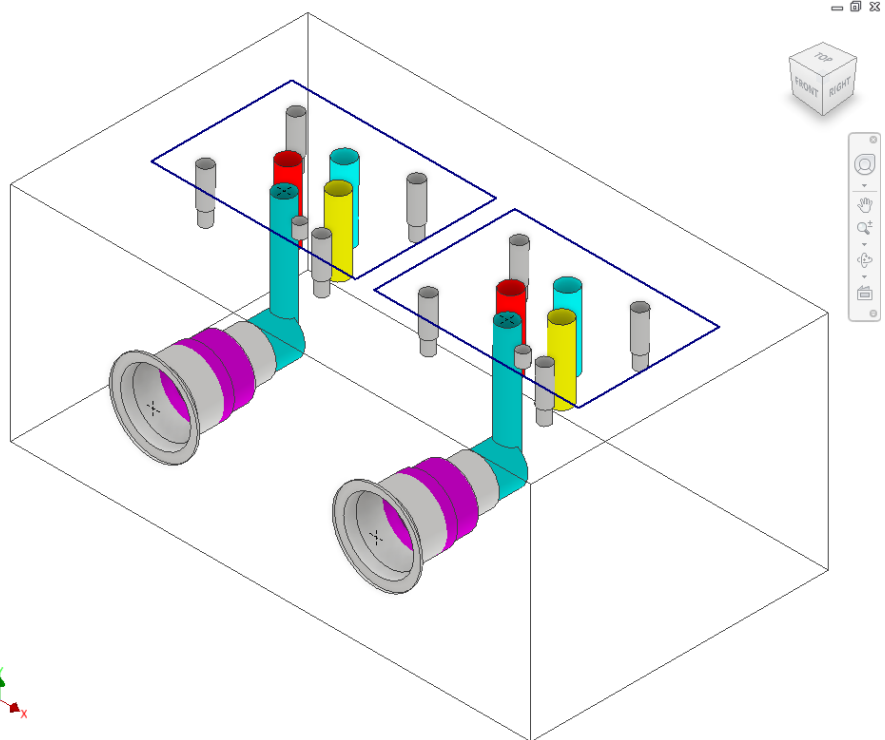
MDTools create copies of the selected cavities/footprints.

Note

- Cavity ID of the original cavity followed by '_Copy' will be 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'.
- 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.
- If selected cavities contain undercuts and slots, undercuts and slots are also copied along with the selected cavities.



Copy Cavities dialog box: Enter displacement and No. of Stations

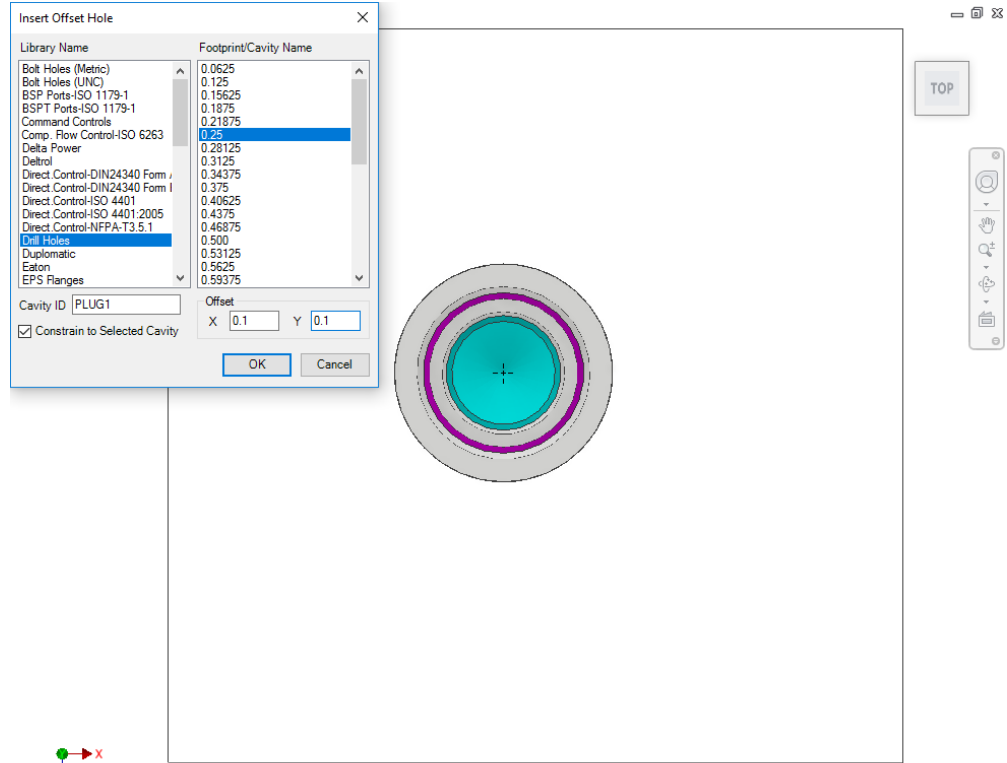


Multiple copies of selected cavities created

27. Insert Offset Hole

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

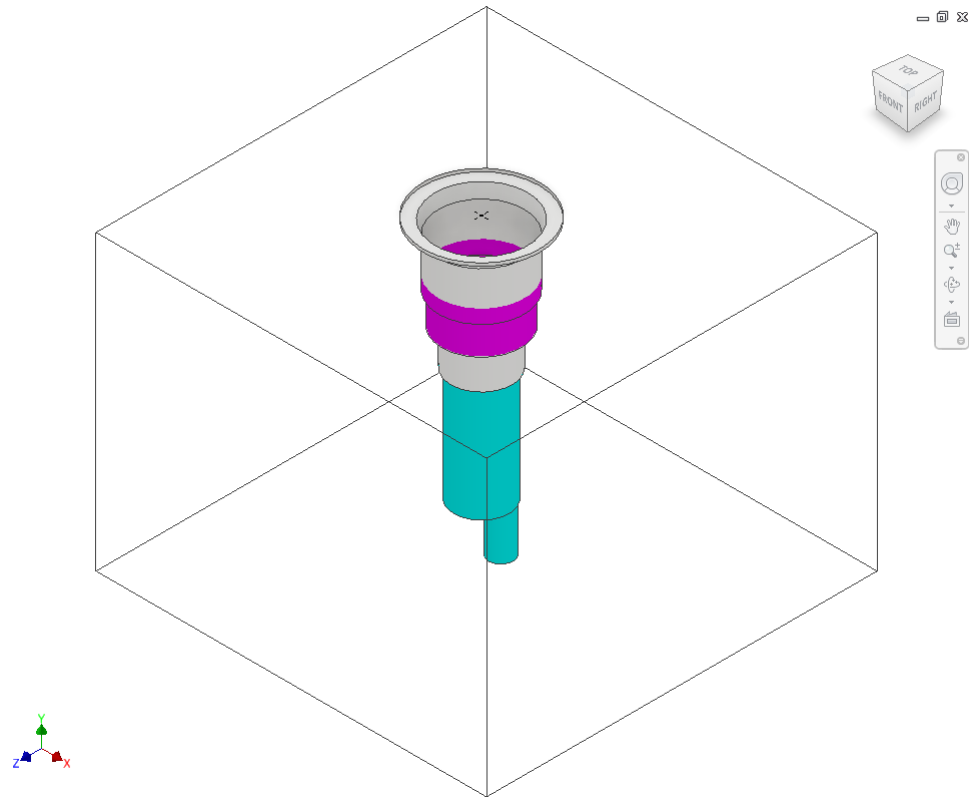
- MDTools 770 ribbon
>Insert panel
>Offset Hole
The MDTools® Select Cavity dialog box displays.
- Select a cavity to insert the offset hole.
The Insert Offset Hole dialog box displays.
- Select the offset hole from the library.
- Enter X and Y distances from the parent cavity center.
MDTools displays a preview of the drill hole at the specified location.
- 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 made 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 0 for X and Y distances to create a concentric hole.



Offset hole inserted into the cavity

28. Insert Orifice Plug

Insert a cavity for an orifice plug at the bottom port of the selected cavity.

MDTools[®] automatically updates the Step0 depth of the orifice cavity so that the cavity starts from the bottom of the main cavity.

- MDTools 770 ribbon
 >Insert panel
 >Orifice Plug

The MDTools Select Cavity dialog box displays.

- Select a cavity to insert into the port plug.

Orifice plug cavity is inserted into the center of this cavity.

The Insert Orifice Plug dialog box displays.

- Select the cavity for the orifice plug from the library.

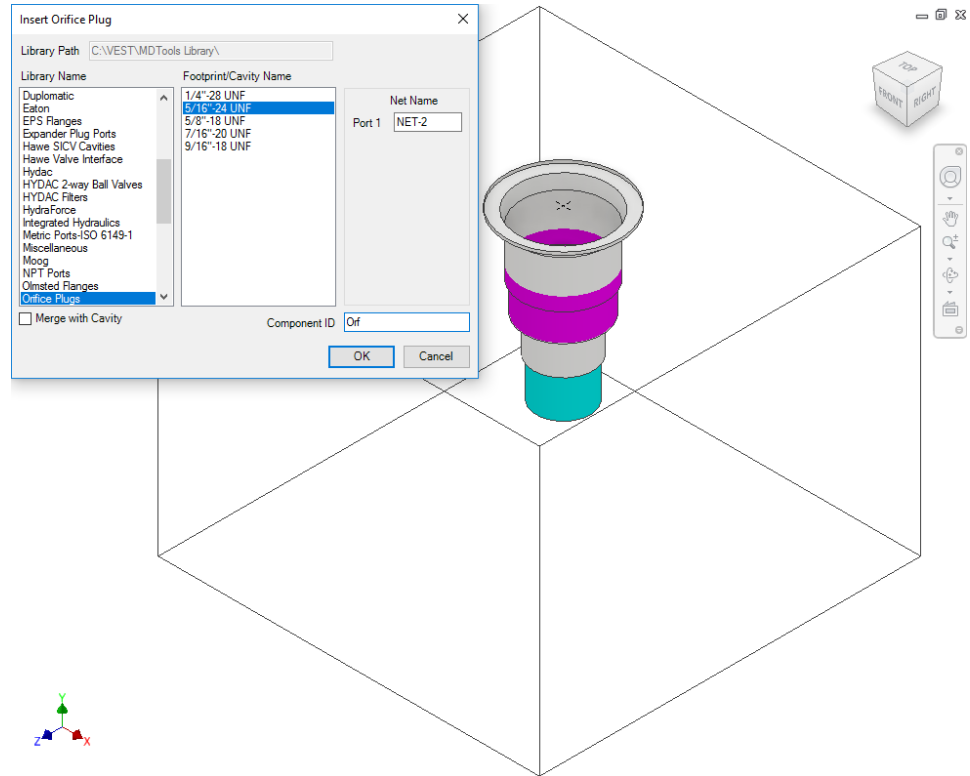
- Enter the port Net name for the orifice plug.

Or
 Click the **Net Name** textbox to select a net from the existing net names.

- Enter **Component ID** for the orifice plug cavity.

- Click **OK**.

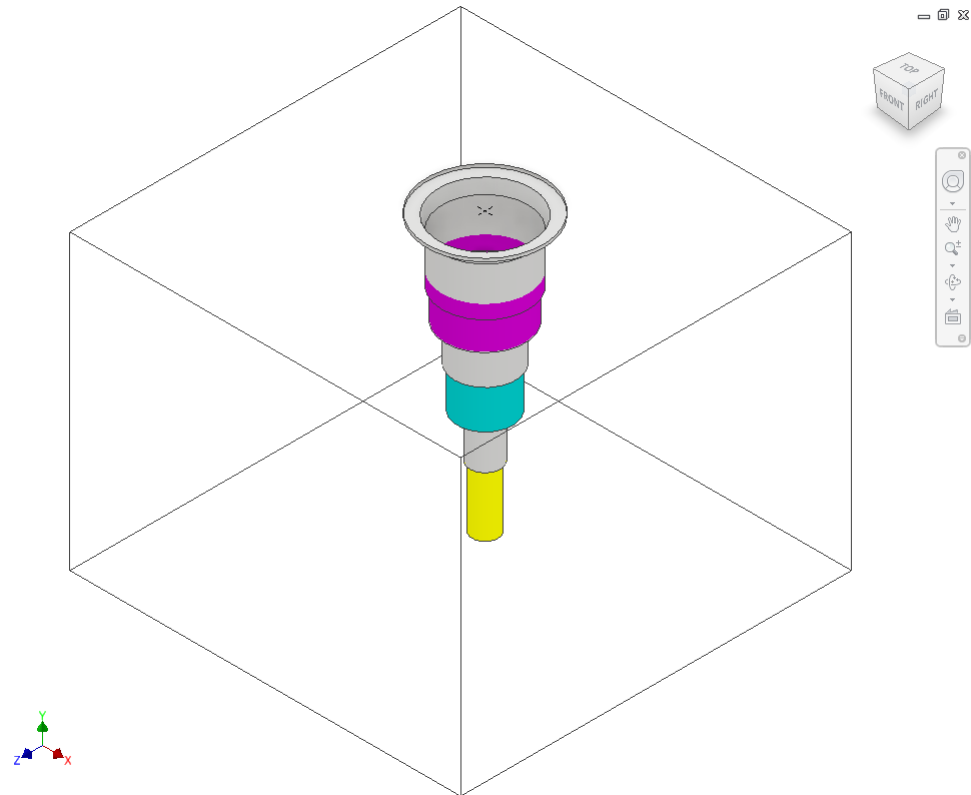
MDTools insert the orifice cavity at the center of the selected cavity and automatically updates the spot face depth of the orifice cavity.



Insert Orifice Plug dialog box

Note

- The Step0 depth of an orifice cavity is made equal to the depth of the main cavity plus the standard Step0 depth of the orifice cavity, in the MDTools library.
- The orifice cavity and main cavity are two separate cavities and considered two different cavities in MDTools.
- The orifice cavity is automatically constrained to the main cavity.
- The orifice cavity automatically relocates when the main cavity is relocated.
- Orifice plug will not automatically follow the cavity when you change the face.



5/16"-24 UNF orifice plug in C10-2 cavity

29. Merge with Cavity

Merges the orifice plug with the existing cavity. This deletes the original cavity and creates a merged cavity at the same location.

- MDTools 770 ribbon
 >Insert panel
 >Orifice Plug

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.
- Enter the port Net name.
 Or
 Click the **Net Name** textbox to select a net from the existing net names.

- Select Merge with Cavity.
- Enter **Component ID** for the orifice plug cavity.

Default Component ID is Cavity Component ID + _Orifice

- Click **OK**.

MDTools evaluates the possibility of merging and displays the Update Machining Sequence dialog box.

Note

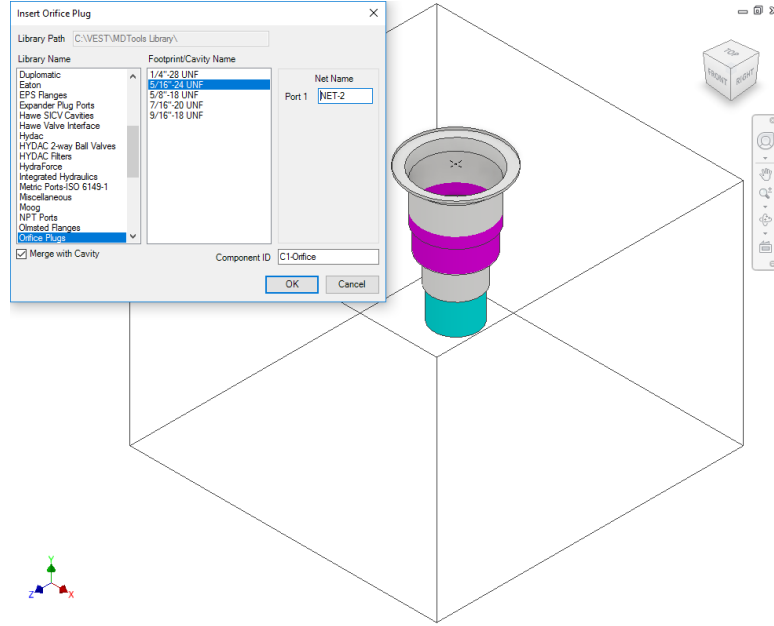
The dialog box shows the machining sequence extracted from both the cavities.

You can reorder the processes as required.

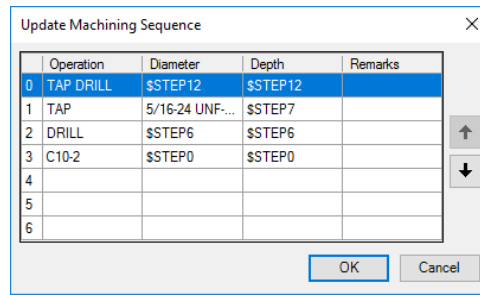
- Click **OK**.

Note:

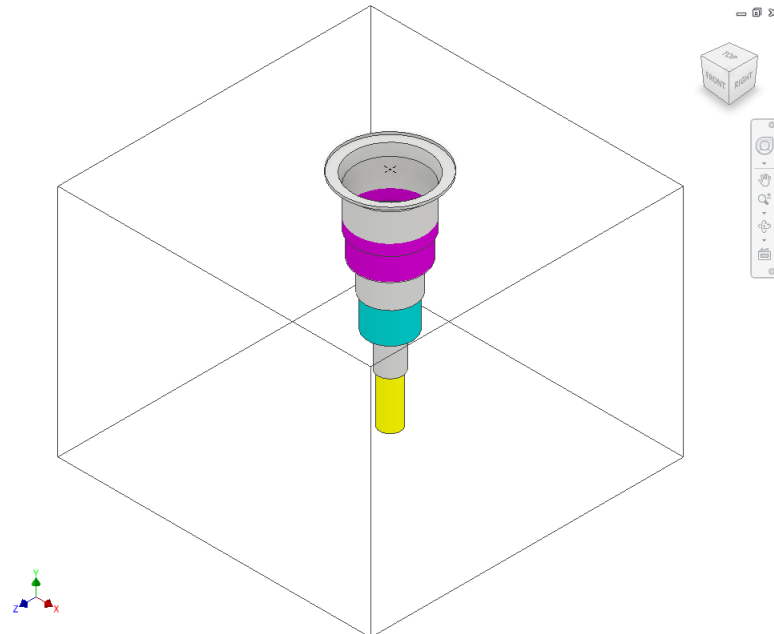
- The Merge with Cavity option converts all the cavity types to the Cartridge Valve (CV) cavity type.
- The area from the bottom port plug to the drill end is considered the Working Area. Thus, the merged cavity has a side port in this area.
- The machining parameters for both the cavities are also automatically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



Insert Orifice Plug dialog box



Update Machining Sequence dialog box



Orifice Plug: Merged with Cavity

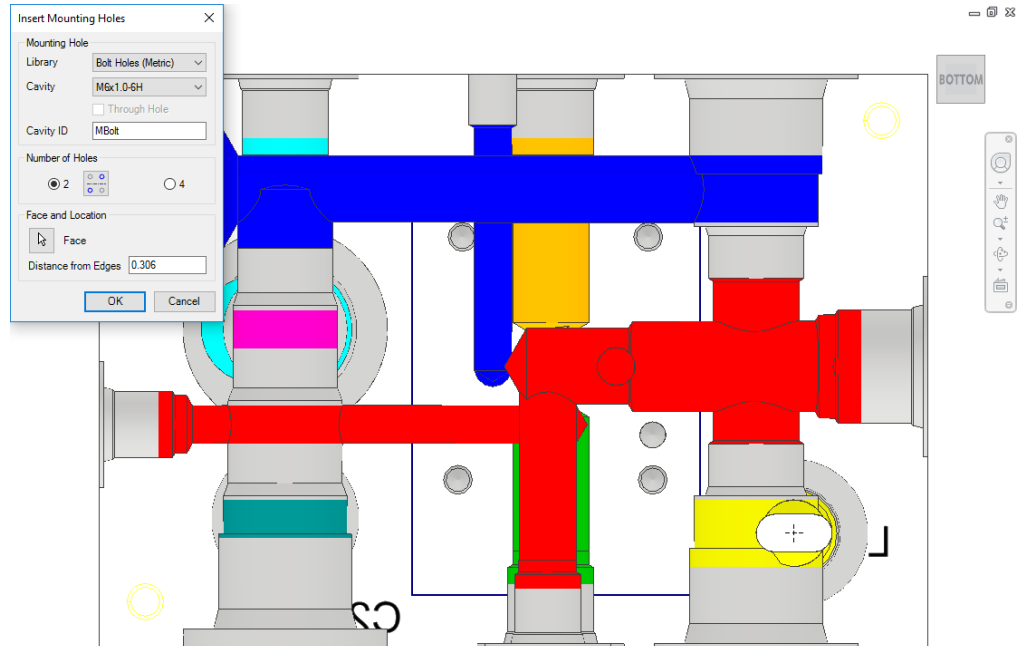
30. Insert Mounting Holes

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

- MDTools 770 ribbon
>**Insert** panel
>**Mounting Holes**

The *Insert Mounting Holes* dialog box displays.

- Select the bolt hole you want to use for mounting the manifold.



Note

- If the unit is set to Inches, then the library named, Bolt Holes (UNC) is selected by default.
 - If the unit is set to MM, then the library named, Bolt Holes (Metric) is selected by default.
- Select **Through Hole**, if required.

- Enter the **Cavity ID**.
MBolt is the default Cavity ID.



- Select **Number of Holes** 2 or 4.
- Select the **face**.
- Enter Distance from Edges.

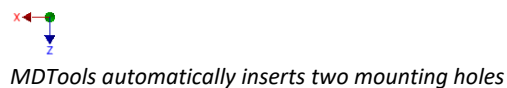
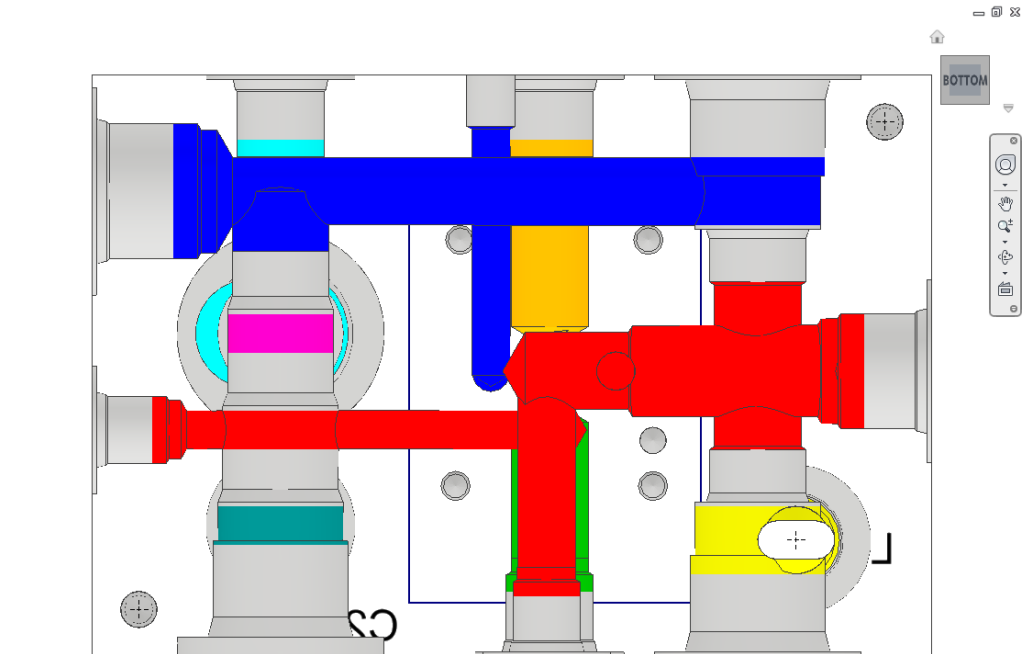
Enter the desired distance between the center of the bolt hole and the manifold edge.

- Click **OK**.
- Select the manifold face to insert bolt holes.

MDTools automatically inserts four bolt holes on the selected face.

Note

When inserting the bolt holes, MDTools adds suffix 1, 2, 3, and 4 to the component ID entered for mounting holes to make the ID unique.



31. 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.

Insert an undercut in a selected cavity on a manifold.

MDTools insert 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. MDTools 770 ribbon
>**Insert** panel
>**Mounting Holes** dropdown
>**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** of the cavity.

Default values for the undercut as 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 the default component ID for the undercut will be 23_UC.*

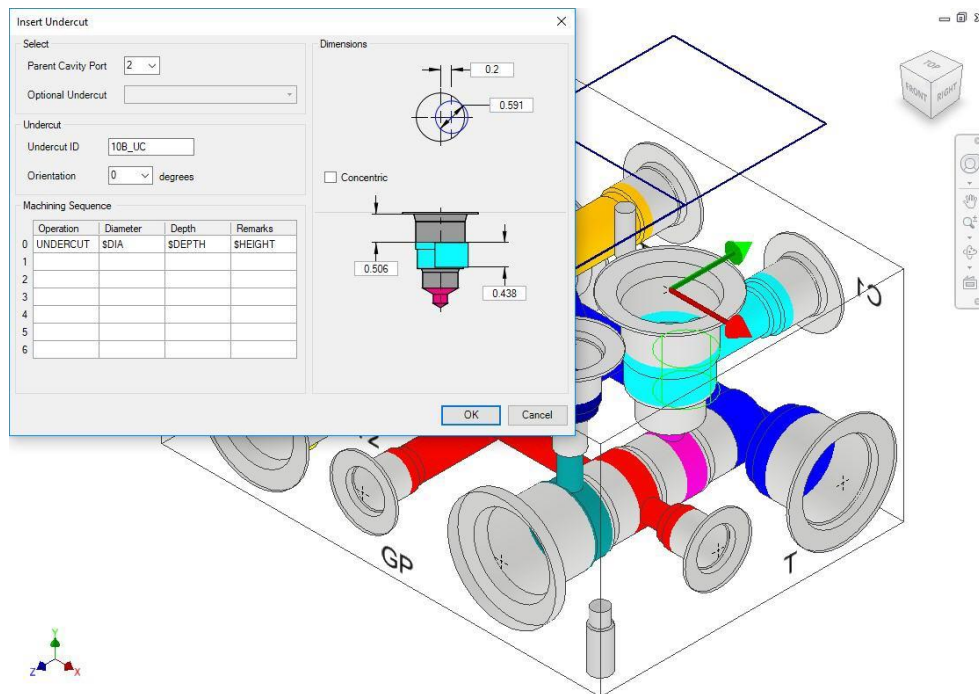
7. Modify the **Offset distance**, as required.

Change the desired distance between the center of the undercut and the selected cavity.

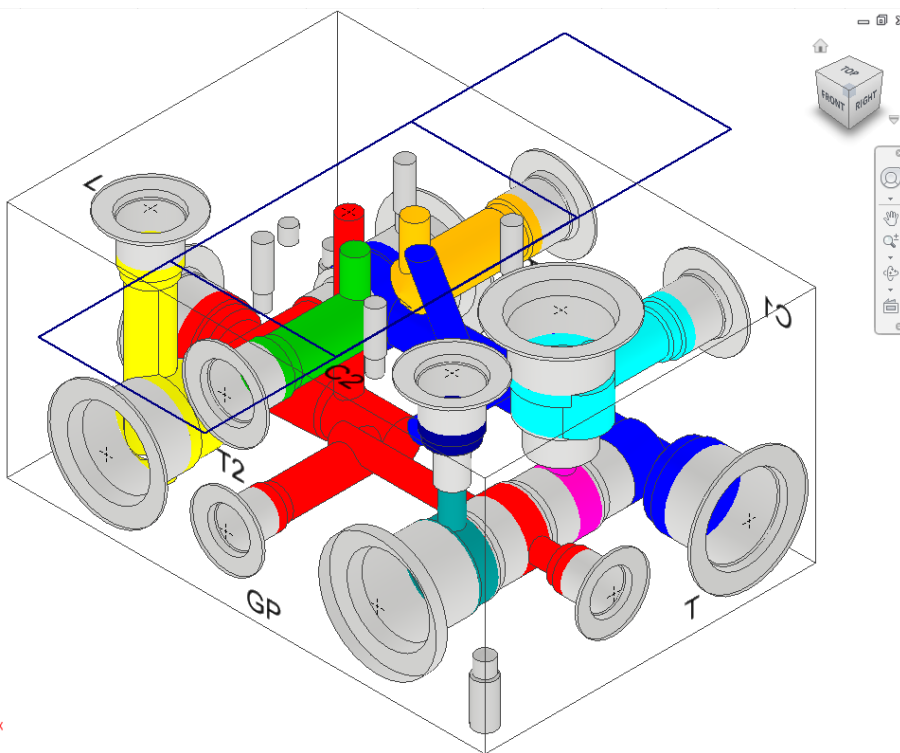
8. Modify the **Undercut diameter**, as required.

Undercut diameter should be larger than the selected port diameter.

9. Modify the **undercut depth** from the spot face of the cavity, as required.



Insert Undercut dialog box



MDTools Inserts Undercut in the selected cavity

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

Note

- You can use \$DIA, \$DEPTH, \$OFFSET & \$HEIGHT for machining sequence any field for easily maintaining of 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.
- Mandatory undercuts can be defined inside the Library Manager for a cavity. and the same Undercut is created automatically when that 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.

32. Insert Slot

Increased flow requirements often need the use of slots within cavities.
This section shows how such cavities are modeled using MDTools[®] 770.

Insert a slot in a selected cavity at the specified depth from the manifold surface.

- MDTools 770 ribbon
> **Insert** panel
> Mounting Holes dropdown
> **Slot**

The *Insert Slot* dialog box displays.

- Select the cavity in which you want to insert the slot.
- Select any **pre-defined slots** from the Slot list, if defined for the cavity.

Values as per the selected pre-defined slot is displayed.

- Modify the **Slot ID**.

Selected cavity ID_SL 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.

- Modify the slot **dimensions**.

Default value of the slot diameter and the slot width would be maximum drill diameter of the parent cavity by half.

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

- Modify the **depth** of the slot.

Default value would be parent cavity depth + 0.5 inches/12 mm.

- Select the **orientation**.

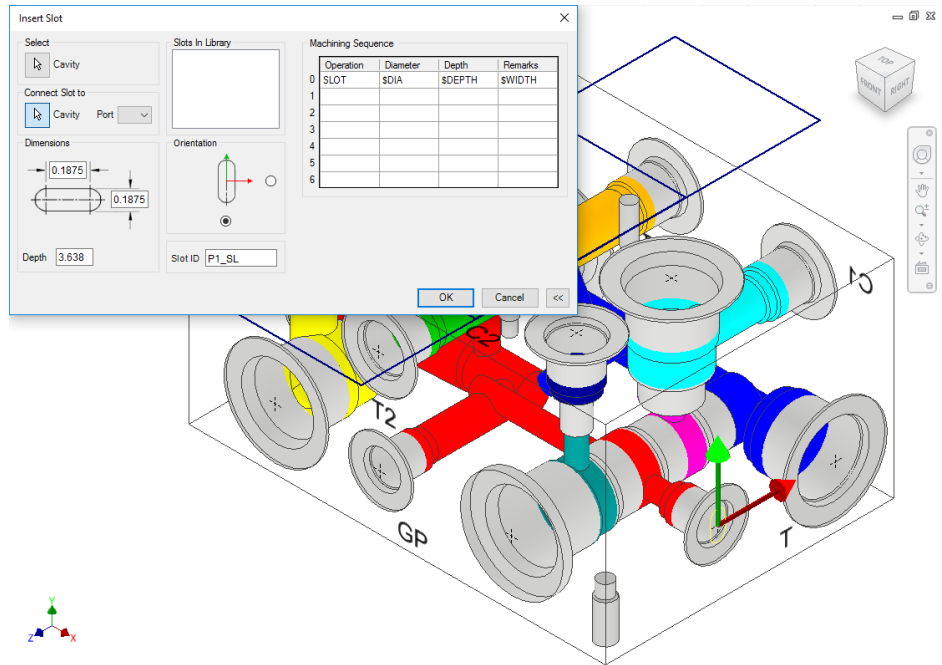
Select the orientation of the slot from the axis or center of the selected cavity.

- Modify the machining sequence.

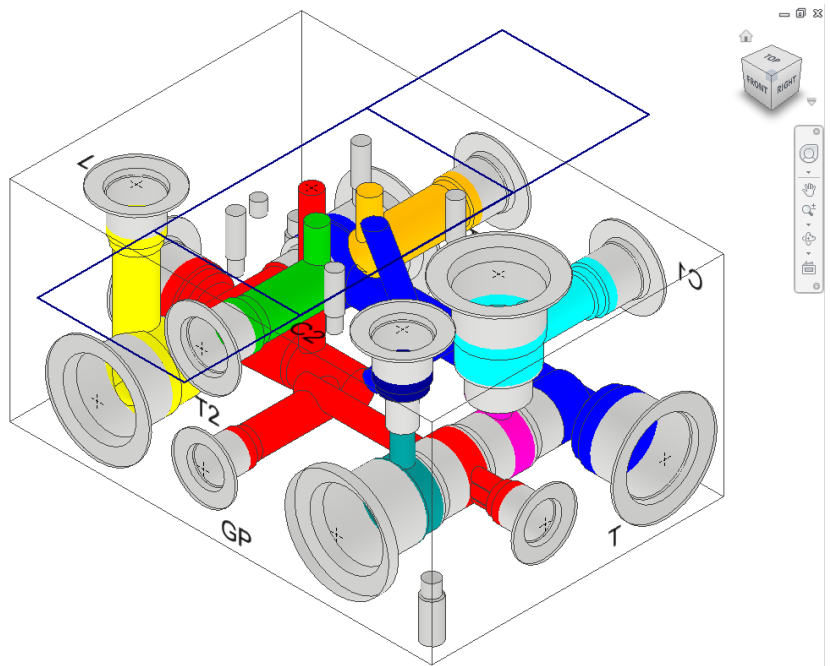
Default values would be SLOT, \$DIA, \$DEPTH & \$WIDTH.

- Click **OK**.

MDTools automatically inserts a slot in the selected cavity.



Insert Slot dialog box



MDTools automatically inserts a slot in the selected cavity

Note

- You can use \$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**.

Default value of the slot diameter would be 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 would be the center distance between the parent cavity and the connecting cavity.

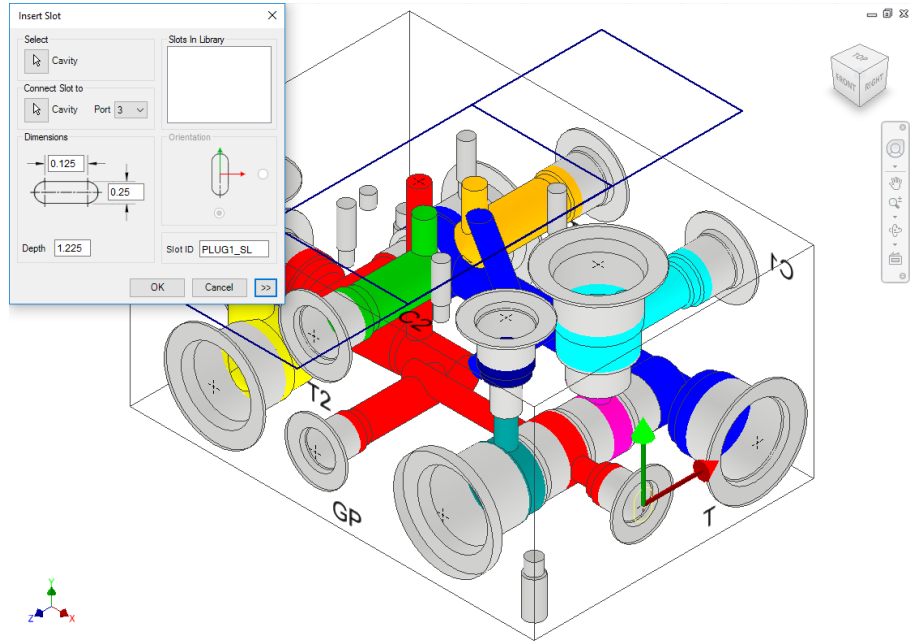
Slot depth should not be less than the center distance between the parent cavity and the connecting cavity.

6. Click **OK**.

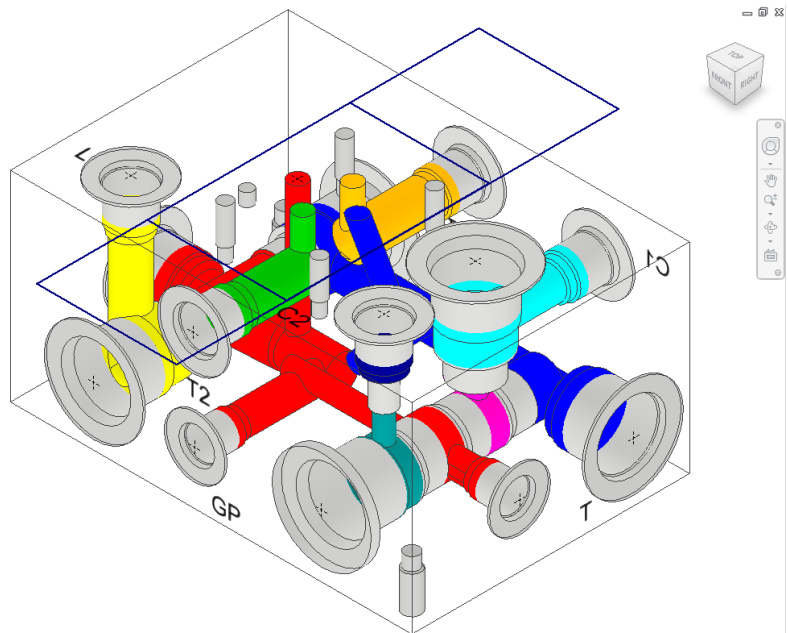
MDTools inserts the slot with the cavity at the specified location and connects the slot to the selected connecting cavity.

Note

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



Connecting slot to cavity



Slot connected with cavity

33. 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 modelled using MDTools® 770.

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

- MDTools 770 ribbon
>Insert panel
>Mounting Holes dropdown
> **O-ring Groove**

The MDTools Select Cavity dialog box displays.

- Select the cavity in which you want to insert the O-ring groove.

The Insert O-ring Groove dialog box displays.

- Modify the **Component ID**.
Selected component ID of O-ring is the default Component ID.

For example, if the component ID of the selected cavity is 23, then the default component ID of O-ring is 23 O-ring.

- Select the O-ring size to automatically specify the groove dimensions.

- Click **OK**.

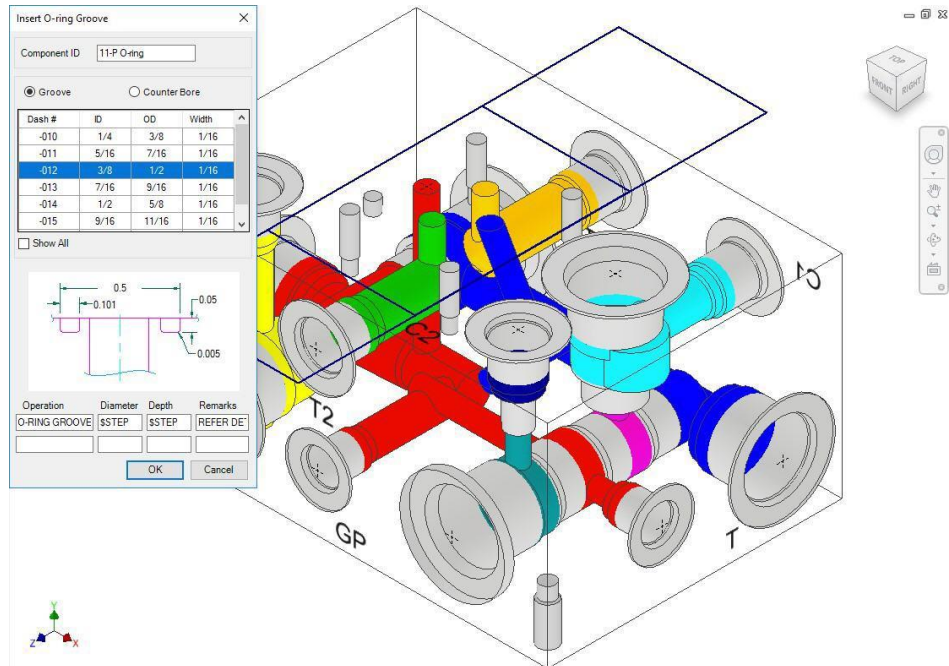
MDTools inserts a groove to the specification.

Note

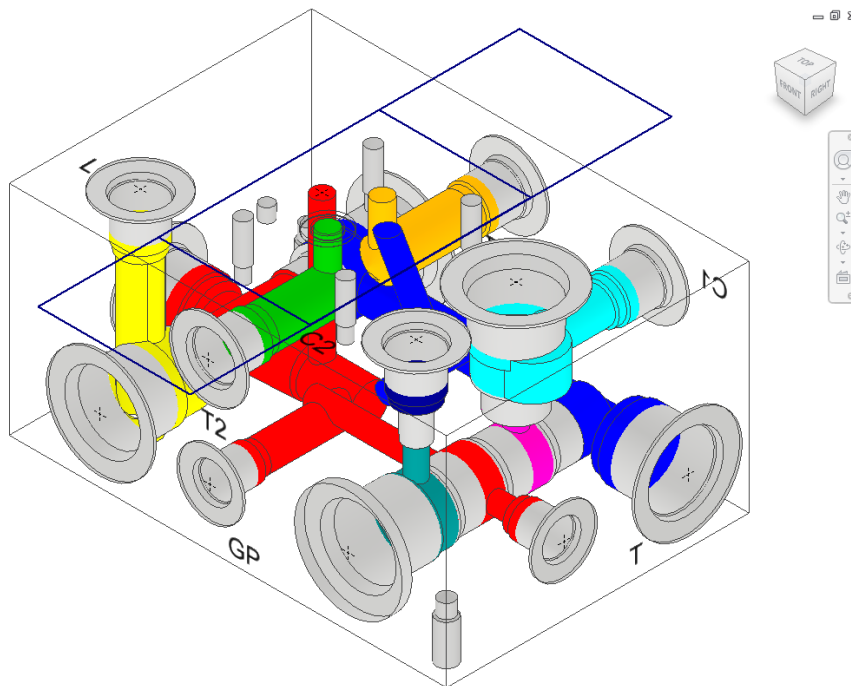
- Select **Show All**, to view all the O-ring grooves available in the library.
- O-ring data is now stored in MDTools Cavity Library.
- You can add/modify the O-ring data through MDTools Library Manager.
- You can add the machining details such as Operation, Tool Name, Diameter, and Depth with the cavity.
- O-ring details are displayed in the drawing sheet via Bore Chart.

MDTools automatically creates a groove when inserting a cavity, if an O-ring is attached to that cavity in MDTools Library Manager.

- You can use \$STEP for the Diameter and Depth field for easy maintenance of the Machining Chart information.



Insert O-ringGroove dialog box



O-ring groove created

- \$STEP for depth is measured from the surface of the manifold in the Machining Chart.
- \$STEP *takes the outer diameter as the Diameter value in the Machining chart.*
- You can modify the component ID of an O-ring only if the **Independent of Parent ID** option is selected in MDTools Settings -> Miscellaneous tab.
- If **Independent of Parent ID** is selected, MDTools considers **O-ring Groove** as a separate item in following commands:
 - Machining ID
 - Component ID
 - Machining Callout
 - Machining Chart
 - Balloon

34. Insert Outline

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

1. MDTools 770 ribbon
>Insert panel
>Outline

The Insert Outline dialog box displays.

2. Select the required **outline** from the Outline list.

MDTools® display a preview of the selected assembly envelope or outline.

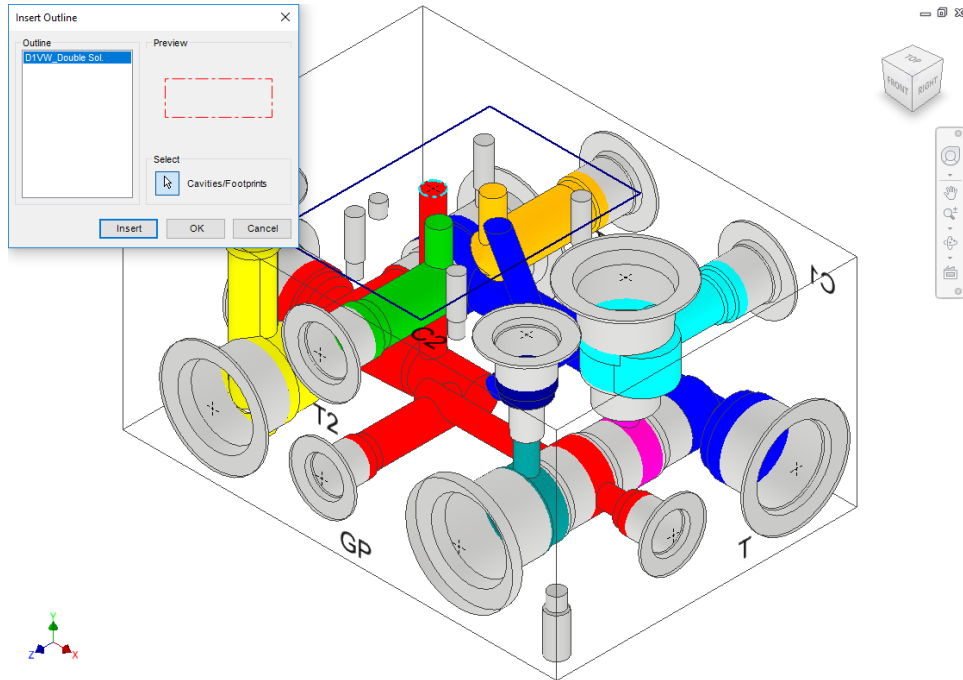
3. Click the **Cavities/Footprints** selection button.

When you move the cursor over a cavity, it gets highlighted

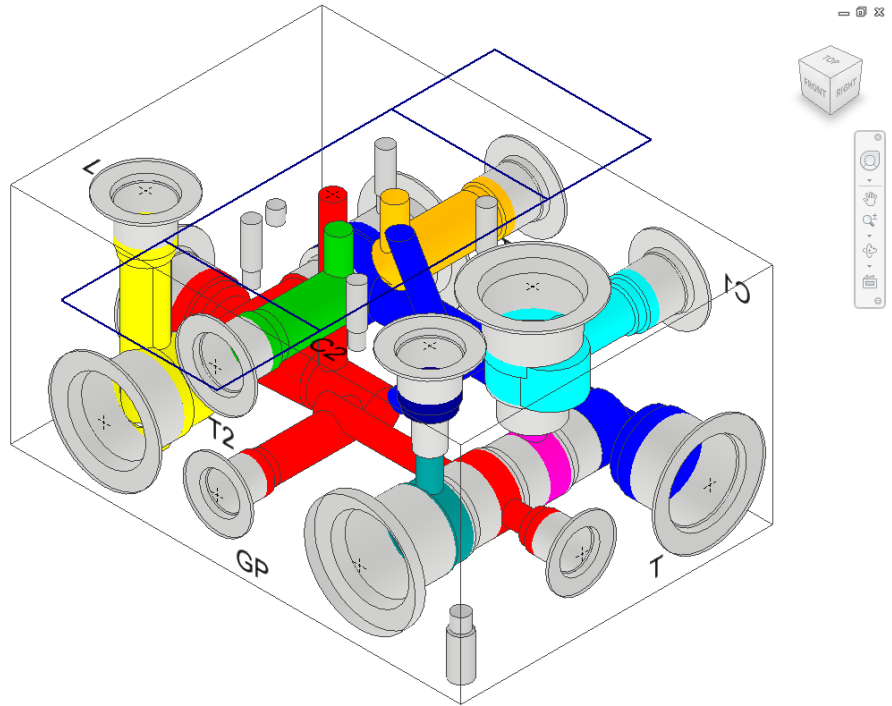
4. Click **Insert**.

MDTools automatically creates an assembly outline around the selected cavities.

5. Click **OK**.



Insert Outline dialog box



Assembly envelope created on selected cavities

Note

Use MDTools' Library Manager to create the Outline (Assembly Outline) library.

Rotating Outline

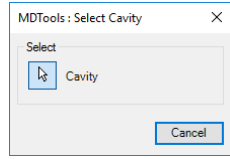
The outline, which is attached to a cavity or footprint, is automatically rotated when you rotate the cavity/footprint using the **Rotate Footprint** command on the Relocate panel.

35. Replace and Replace All

Replace a cavity or all similar cavities, located on a manifold, with any cavity in the MDTools® library. The new cavity will replace all the similar cavities at the same position on the manifold.

1. MDTools 770 ribbon
>Insert panel
>Replace

The MDTools: Select Cavity dialog box displays.



Select Cavity dialog box

2. Select the cavity to replace.

The Replace Cavity dialog box displays.

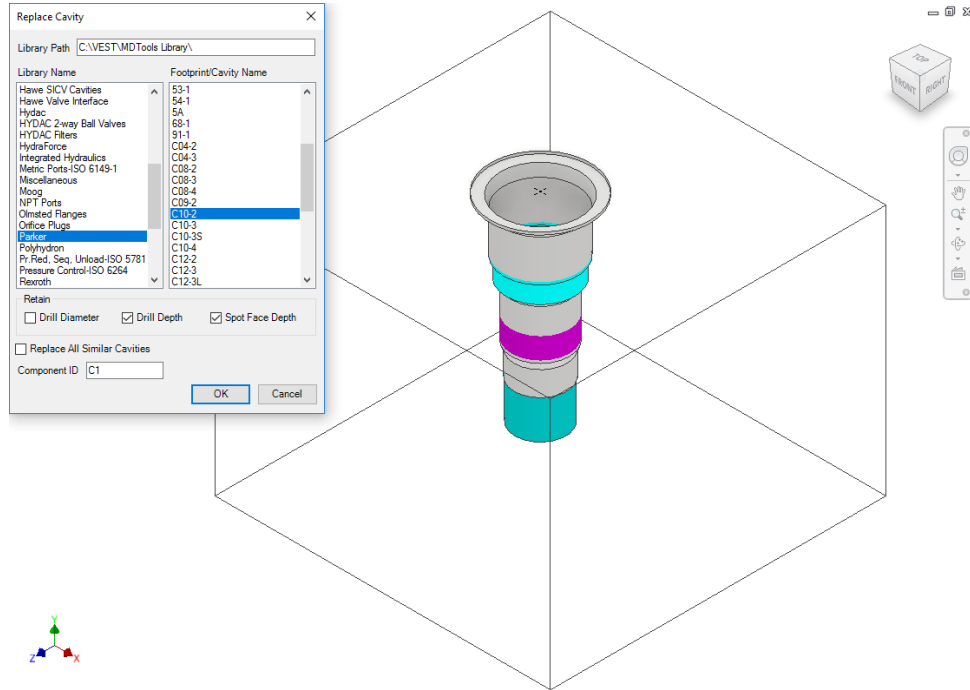
3. Select the cavity from the library to replace the existing cavity.

The new cavity automatically takes the cavity ID from the existing cavity.

4. Retain the **Drill Diameter**, **Drill Depth**, and **Spot Face Depth**, as required.

5. Click **OK**.

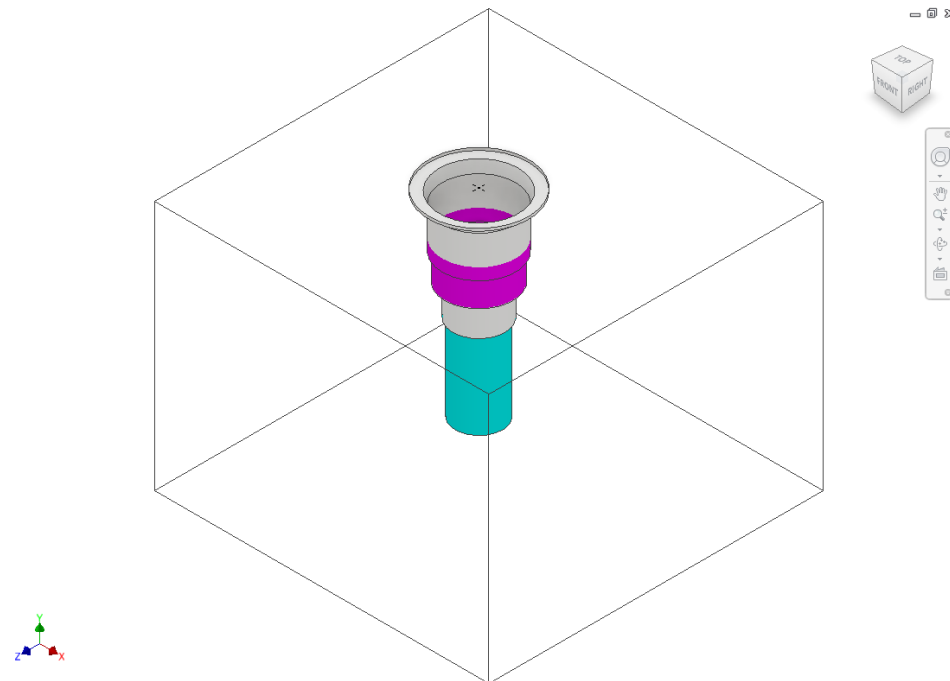
MDTools replace the selected cavity in the manifold with the new cavity from the library.



Replace Cavity dialog box

Note

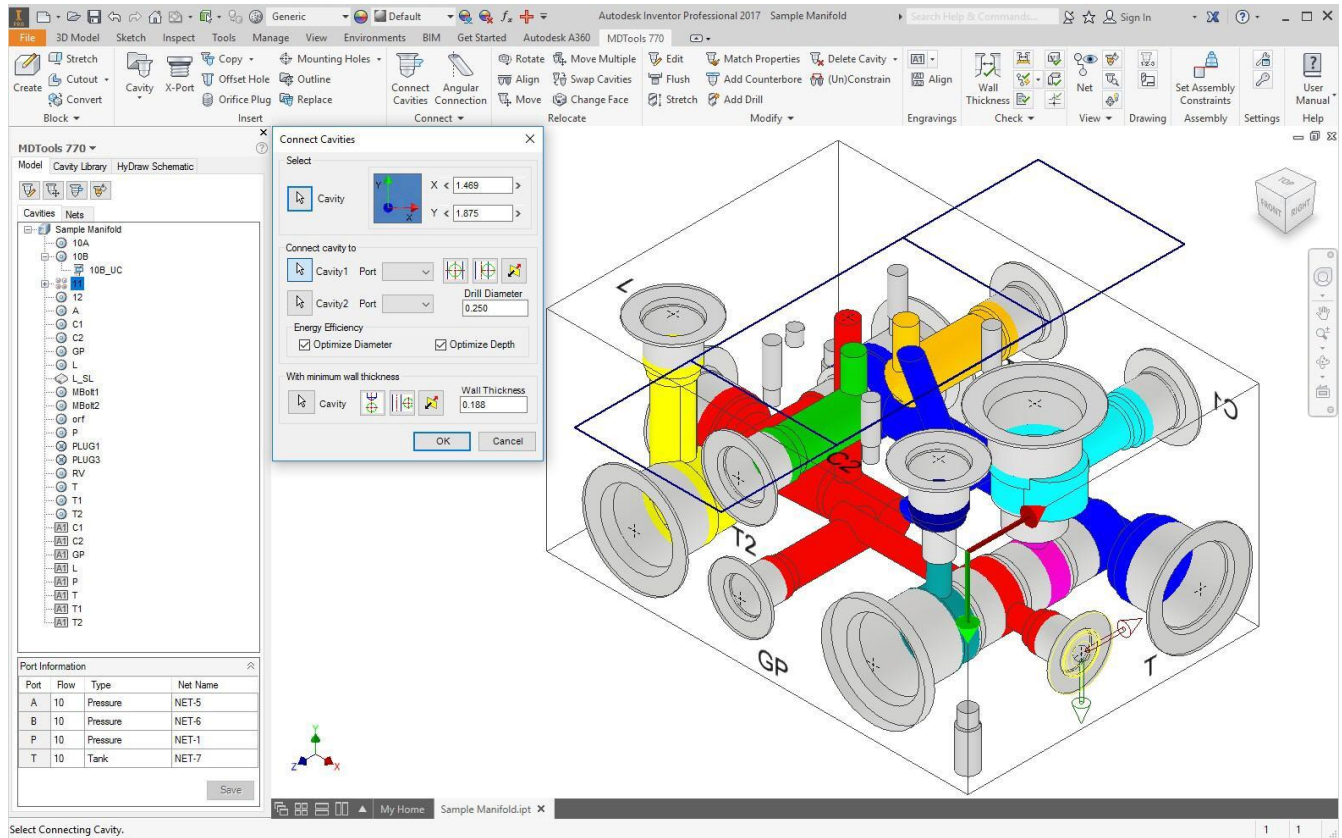
- **Replace All Similar Cavities** option enables you to replace all similar type of cavities with the selected cavity.
- If a footprint is selected for replacement, by default the whole footprint is replaced with the specified cavity. The replaced item could be another footprint or a cartridge cavity.
- Select the **Replace Cavity** option to replace only a single cavity in a footprint.



Selected cavity is replaced with the new cavity

Make Connections

- 36 Connect Cavities
- 37 Angular Connection
- 38 Assign Net



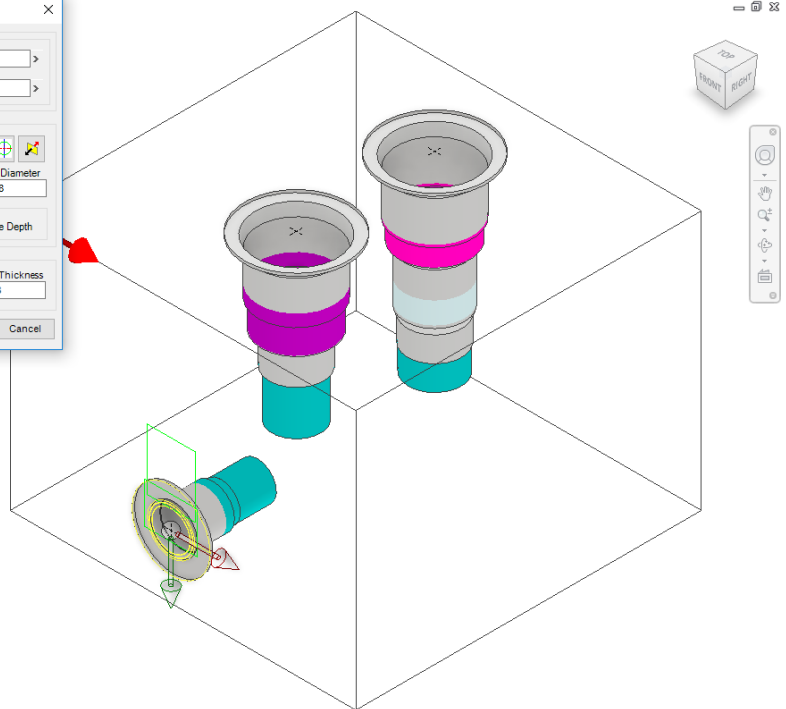
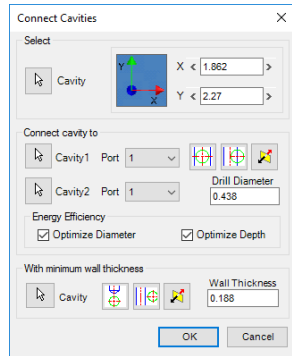
36. Connect Cavities

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 relocate the connecting cavity to the full diameter depth of the second cavity.

1. MDTools 770 ribbon > **Connect** panel > **Connect Cavities**
The *Connect Cavities* dialog box displays.
2. Select the cavity you want to move and connect to another cavity.
3. Select the connecting **Cavity1**.
4. Select the connecting port on Cavity1.



Note

If the connecting cavity is not a cartridge valve cavity, then port 1 will appear by default.

1. Click the selection button for **Cavity2**.
2. Select the connecting Cavity2.
3. Select the connecting port on Cavity2.



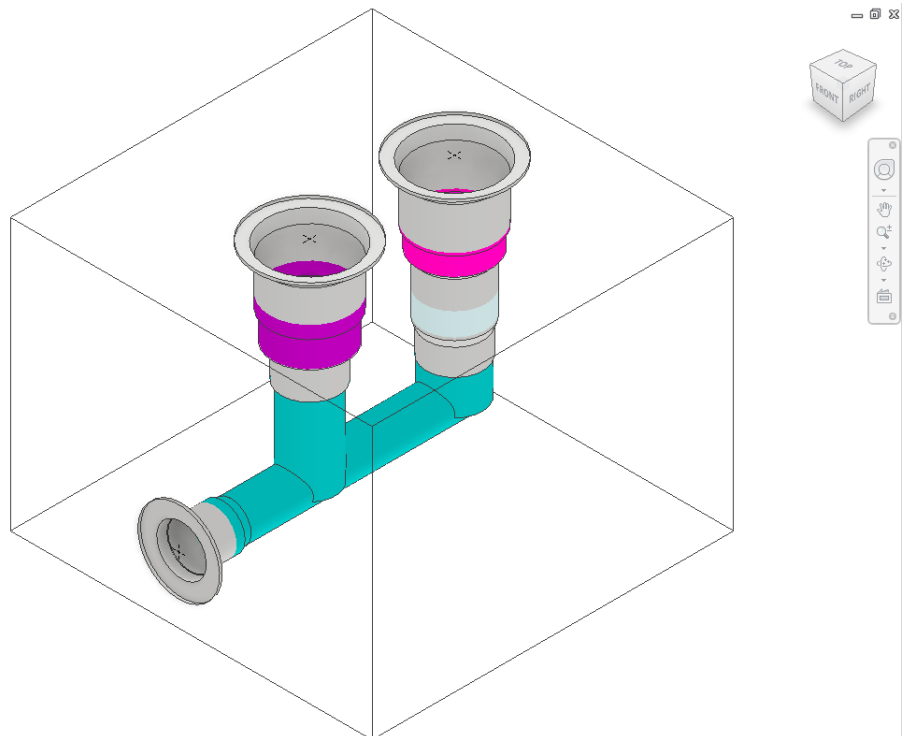
Connect Cavities dialog box

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

4. Click **OK**.
MDTools relocate the first cavity (cavity to connect) and updates the depth for all cavities to create the specified connection.

Note

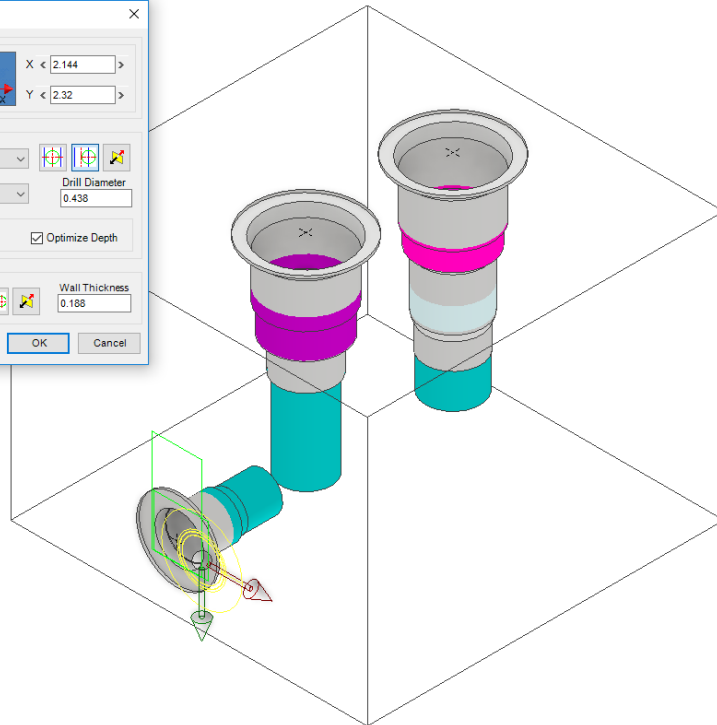
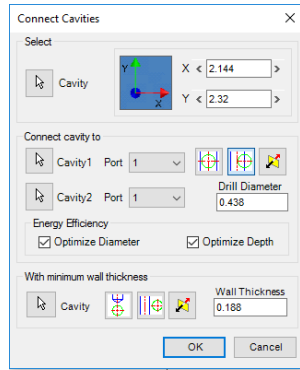
MDTools automatically selects the drill diameter, when you connect the cavity to a side port of another cavity. You can override the selection by modifying the drill diameter.



Cavities connected using the Connect to Cavity 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.



Note

- The Energy Efficient connectivity is applied, if Optimize Diameter and Optimize Depth options are selected.
- 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.



Positioning the cavity using the Relocate to side option

Position with minimum wall thickness

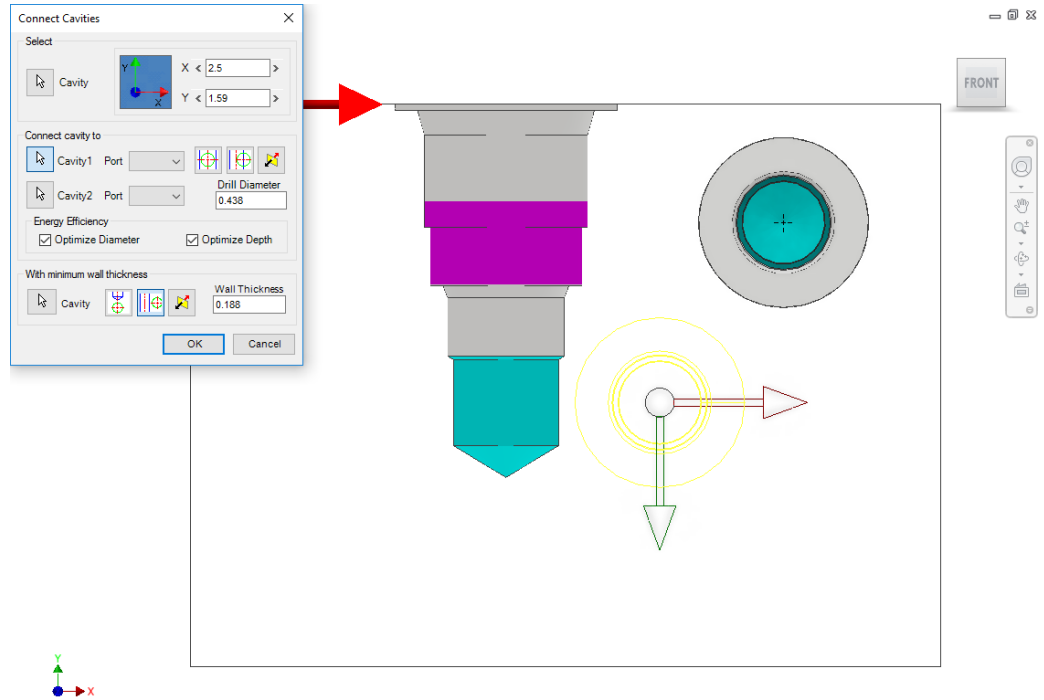
Position the cavity to connect while assuring minimum wall thickness with an existing cavity on the manifold.

1. Click the selection button for Cavity.
2. Select an existing cavity on the manifold.

Click the **Move to side** button to position the new cavity away from the selected cavity axis.

Click the **Flip side** button to change the side, if required.

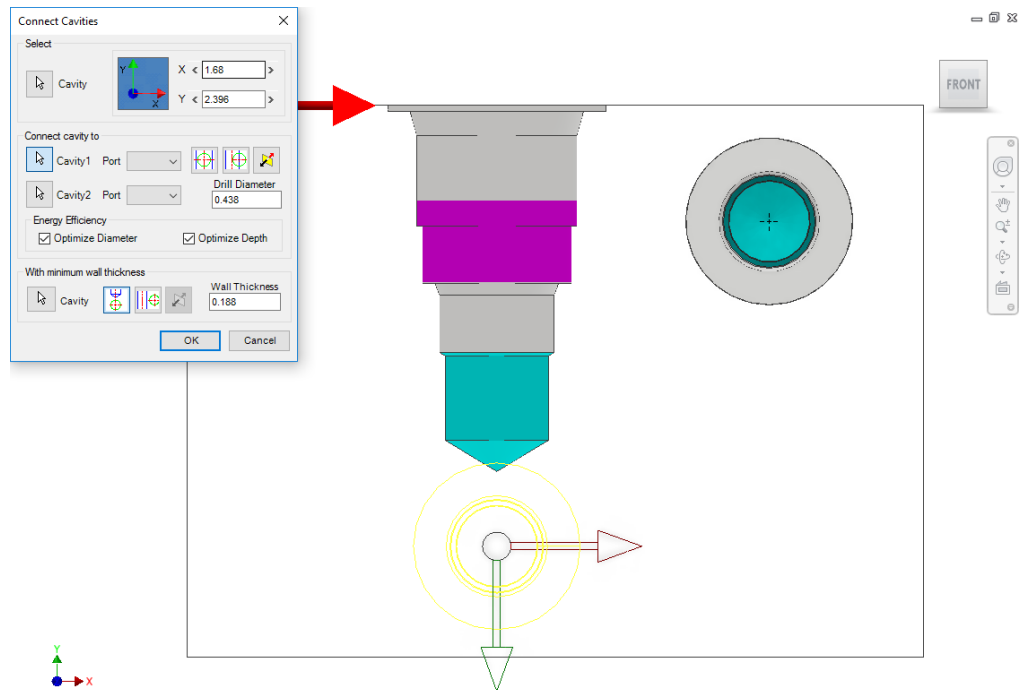
Repeat the above steps to position the cavity with minimum wall thickness from a second cavity on the manifold.



Positioning the cavity using the Move to side option

Note

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

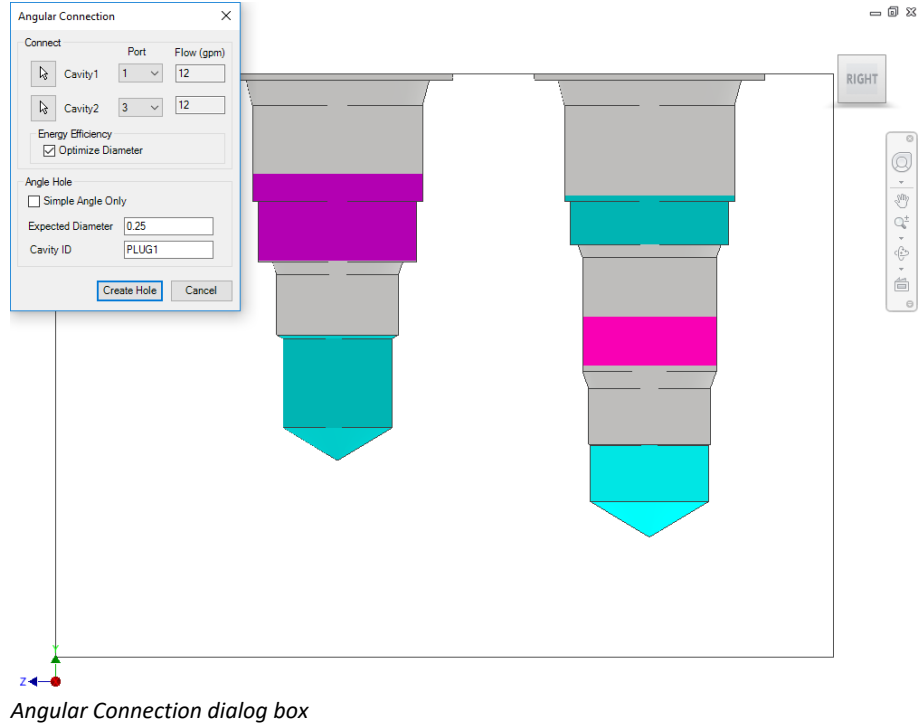


Positioning the cavity below the cavity tip

37. Angular Connection

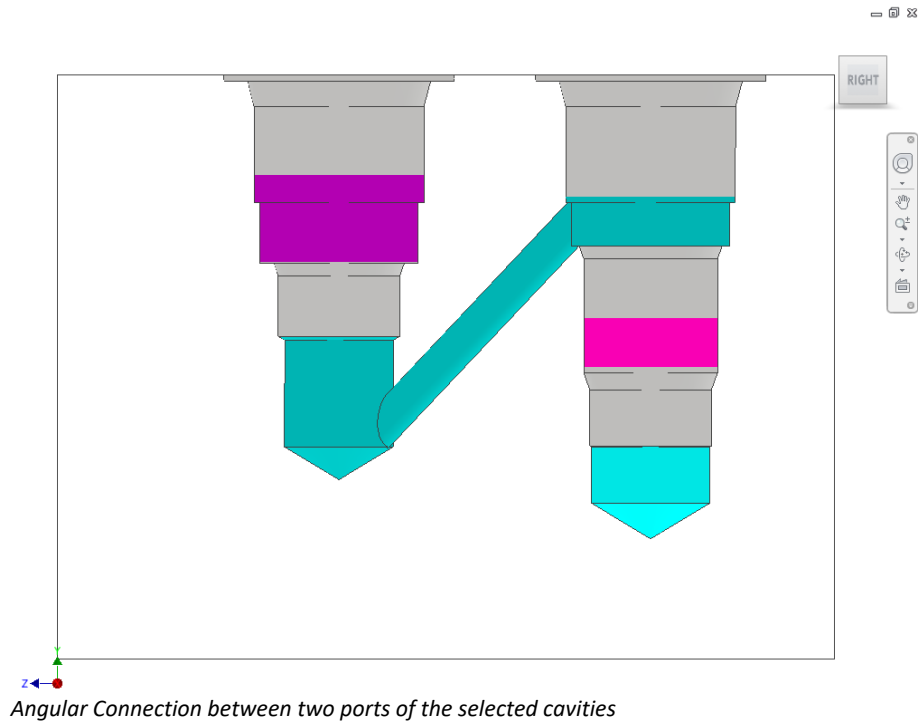
Create a connection between two cavities by using an angular drill. MDTools® creates an angular drill at the appropriate angle to make the best possible connection between two selected cavities.

1. MDTools 770 ribbon
>Connect panel
>**Angular Connection**
The Angular Connection dialog box displays.
2. Select **Cavity1**.
Select the cavity from which you want to make an angle drill.
3. Select the **Port** of Cavity1.
Select the port of Cavity1, which you want to connect with Cavity2.
4. Select the **Cavity2** button.
Select Cavity2 to which Cavity1 is to be connected by an angle drill.



Select the port of Cavity2, which you want to connect to the selected port of Cavity1.

5. Select the Energy Efficiency option, **Optimize Diameter**, if required.
6. Select **Simple Angle Hole only**, if required.
7. Enter **Expected Diameter**.
If possible, MDTools create the angle hole with the specified diameter. Otherwise, it displays the maximum possible diameter.
8. Enter **Cavity ID**.
9. Click **Create Hole**.
If there is a possibility of an angular connection between the selected ports of the selected cavities, then a dialog box displays the maximum possible diameter for the angular hole. Otherwise, another dialog box displays with a message, 'Cannot Connect Ports'



10. Click **Yes**.
MDTools automatically creates an angular connection between the selected cavity ports.

Note

- Change the diameter to accommodate the flow for the connection, if required.
- Diameter of the connecting angular drill cannot be changed to a value greater 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.
- Set the required default option in the MDTools® Settings dialog box.

38. Assign Net

Automatically assign net (flow path) names and net color inside the manifold.

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

- MDTools 770 ribbon
- >Connect panel
- >Slide out menu
- >Assign Net

MDTools automatically assigns the default net name for the entire net flow path in the manifold data file.

It displays the net flow path with default net color in the manifold.

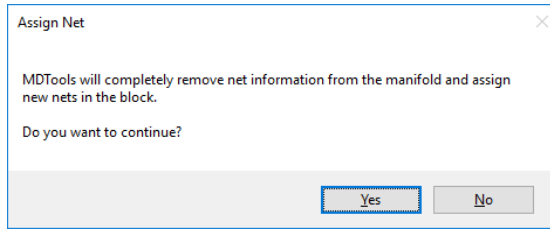
The Nets browser shows all the assigned net names.

Caution!

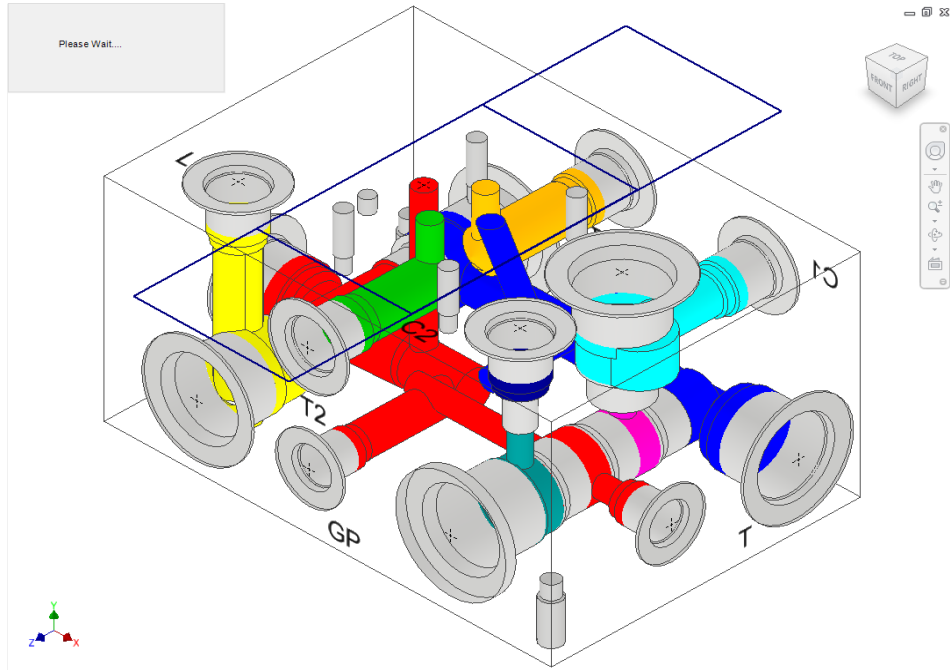
MDTools will completely remove net information from the manifold and assign new nets in the block.

Note

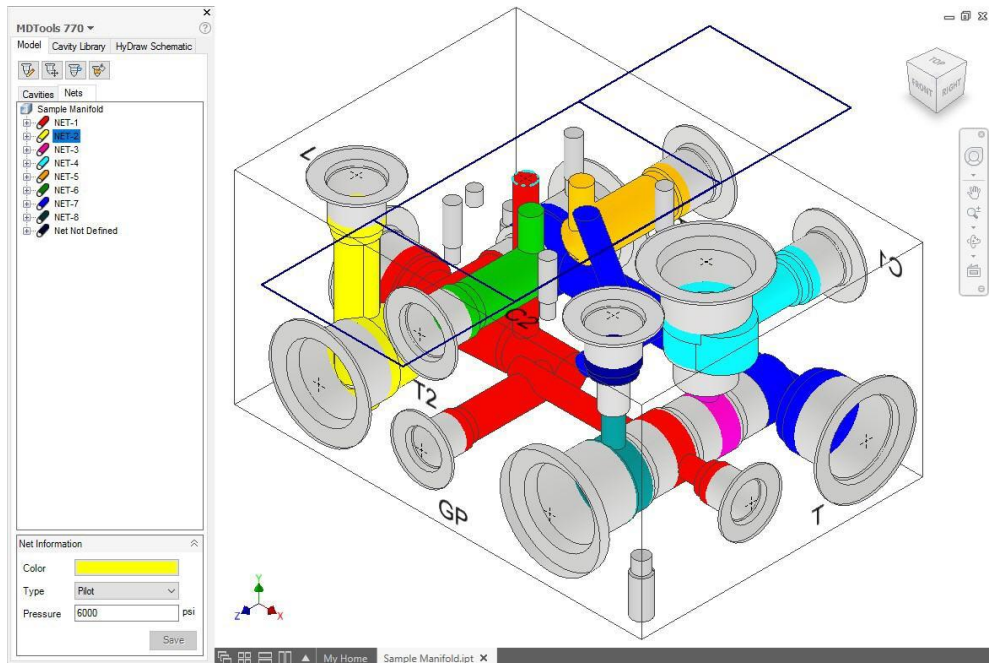
Change the default Net colors in the MDTools Settings dialog box.



Assign Net - Warning Message



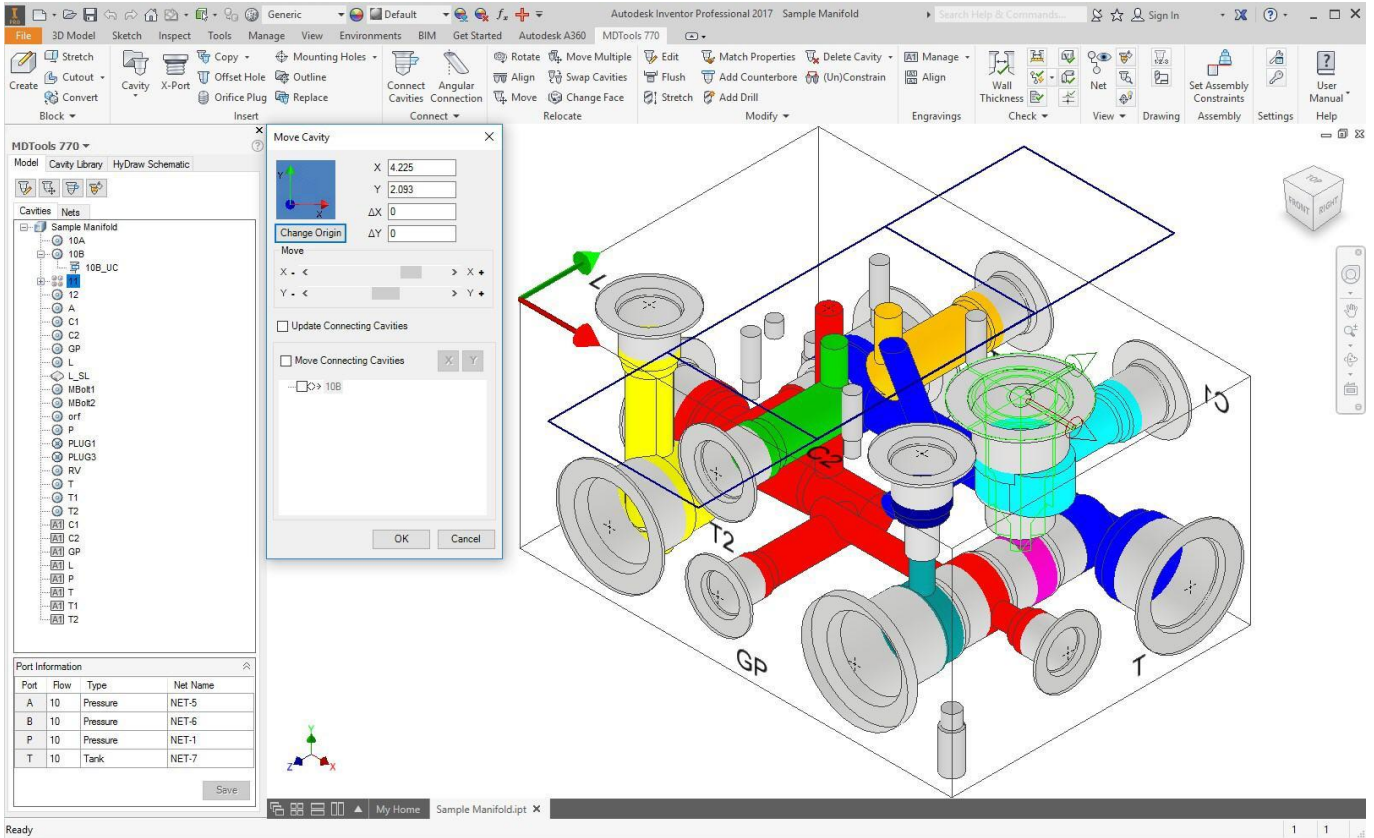
Assign the Net(flow path) name



Nets Browser displays the assigned net name

Relocate

- 39 Rotate Footprint/Cavity
- 40 Align Cavities
- 41 Move Cavity
- 42 Move Multiple
- 43 Swap Cavities
- 44 Change Face



39. Rotate Footprint/Cavity

Rotate a footprint or cavity on a manifold surface.

The footprint/cavity is rotated by the angle specified about the center of the main cavity of the footprint in steps of 90 degrees.

1. MDTools 770 ribbon
>**Relocate** panel
>**Rotate**

The Rotate dialog box displays.

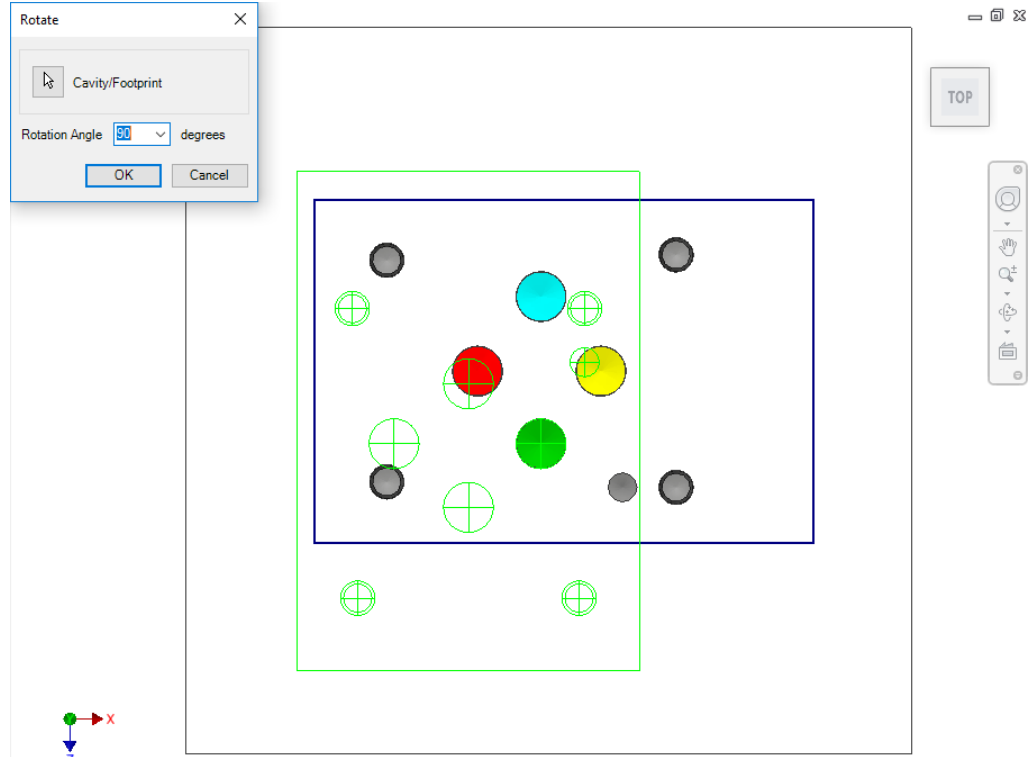
2. Select a cavity on the footprint or an independent cavity.

When you move the cursor over a cavity, it gets highlighted.

3. Enter the **Rotation Angle** in degrees.

4. Click **OK**.

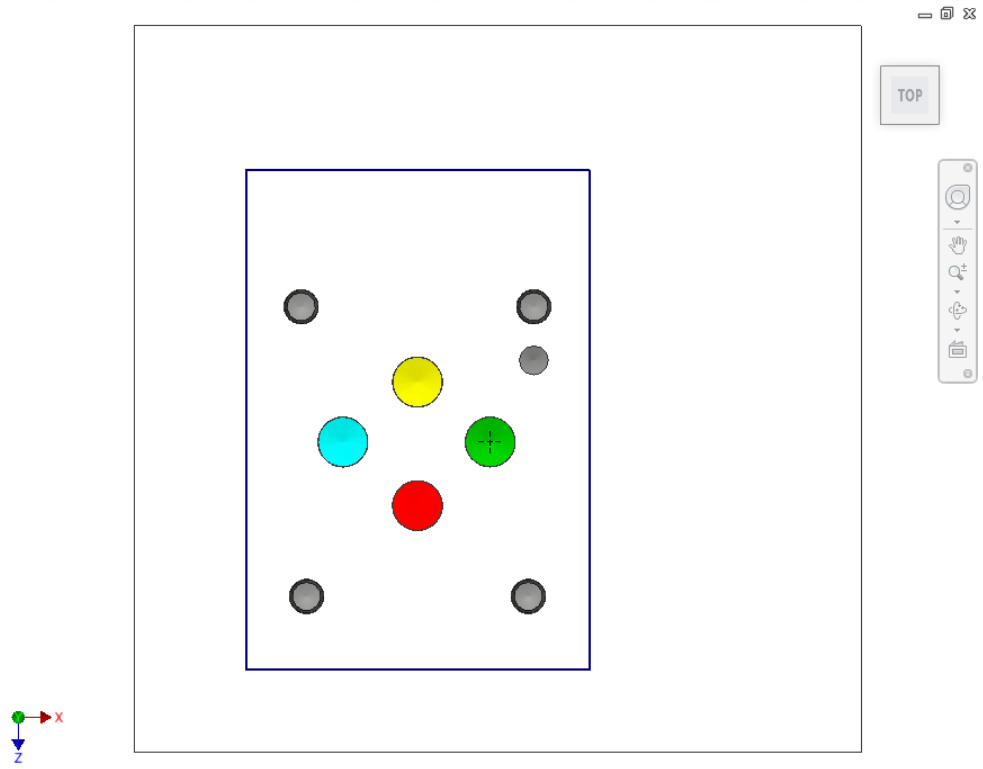
MDTools® rotates the footprint by the entered rotation angle about the center of main cavity of the footprint.



Rotate Footprint dialog box

Note

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



Footprint rotated by 90°

40. Align Cavities

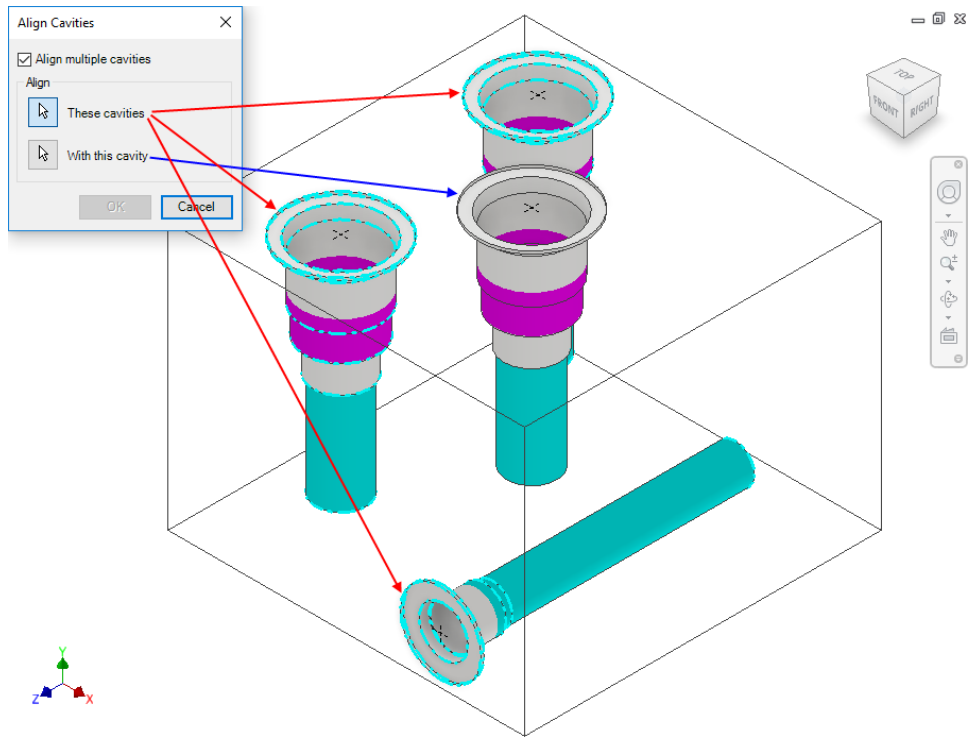
Align multiple cavities on the manifold.

When you align 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 770 ribbon
>Relocate panel
>Align
The Align Cavities dialog box displays.
2. Select **Align multiple cavities** option if you want to align multiple cavities. Else, a single cavity is selected.
3. **These cavities:**
Select the cavities you want to move and align with another cavity.
4. **With this cavity:**
Select the cavity with which you want to align the selected cavities.
5. Click **OK**.

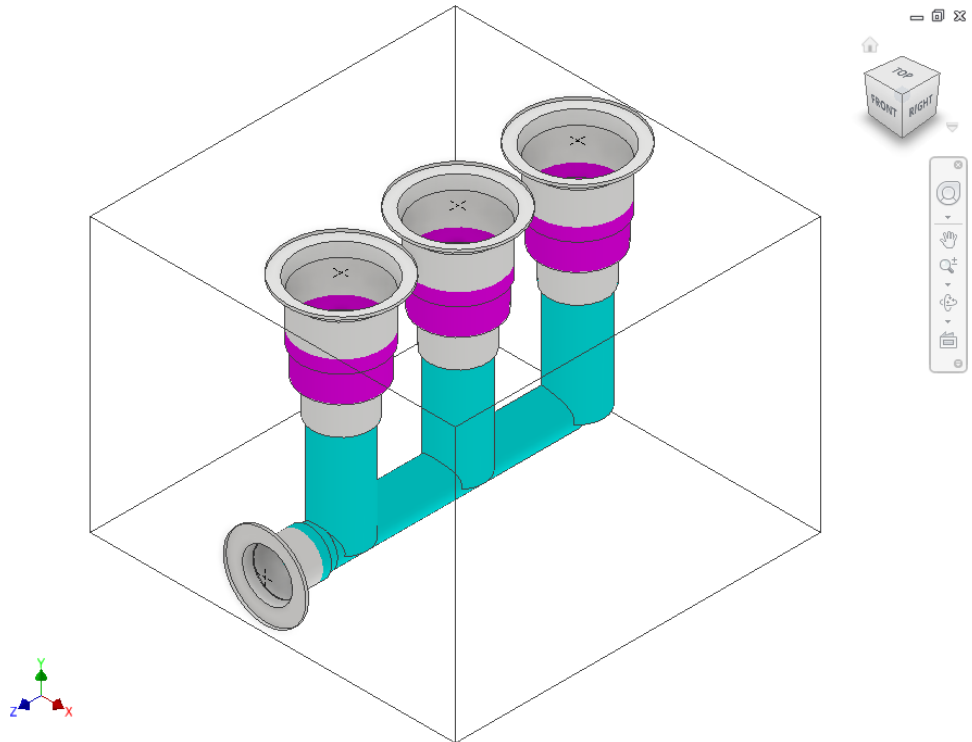
MDTools automatically relocates the selected cavities to align with the selected cavity.*



Align Cavities dialog box

Note

When you align cavities on opposite faces, cavities are aligned to both the common coordinates.



Cavities aligned

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.

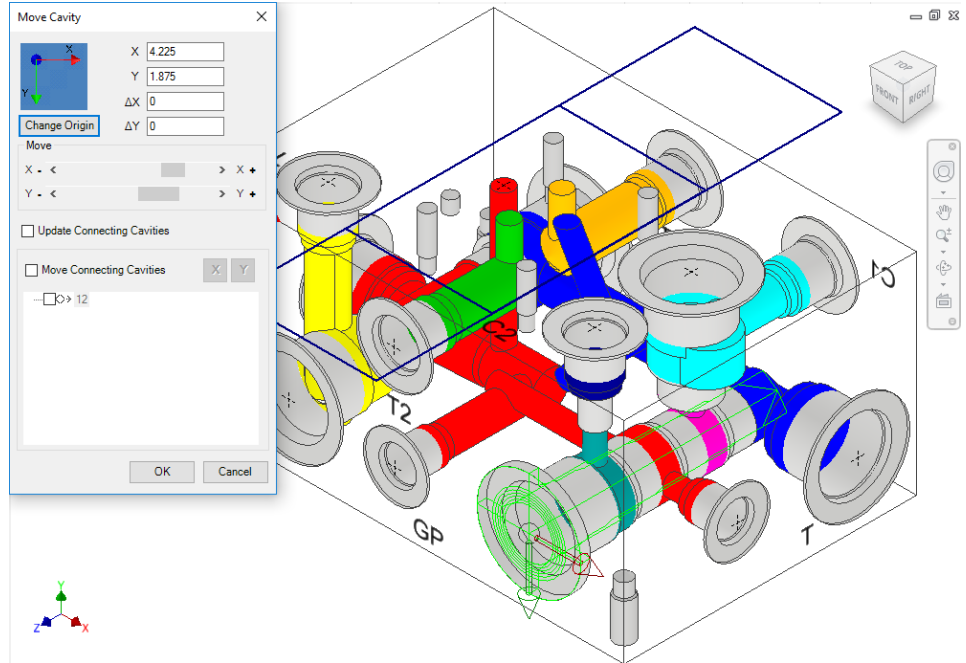
1. MDTools 770 ribbon
>Relocate panel
>Move
2. Select a cavity on the manifold.

The Select Cavity dialog box displays.

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.

If a cavity is selected on a footprint, then the location of the main cavity on the footprint is displayed.



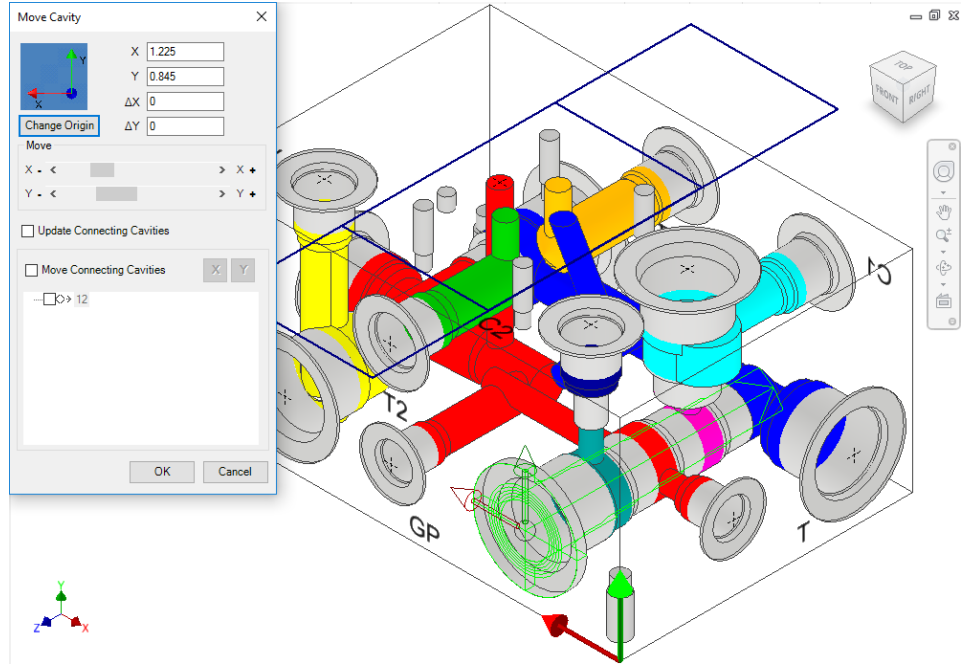
Move Cavity dialog box

Moving by Entering X and Y

1. Enter X, Y, or both, as required.
 2. Click **OK**.
- MDTools relocates the cavity to the new location.

Moving by Entering ΔX and ΔY

- This option enables you to relocate the cavity by entering displacement.
1. Enter the required ΔX and ΔY.
 2. Click **OK**.
- MDTools moves the cavity by the ΔX and ΔY values entered.



Origin changed and X and Y values updated

Moving by Increment

MDTools enables you to move a cavity by an incremental distance (0.05 inches/1.00 mm)

Click the scroll bar button.

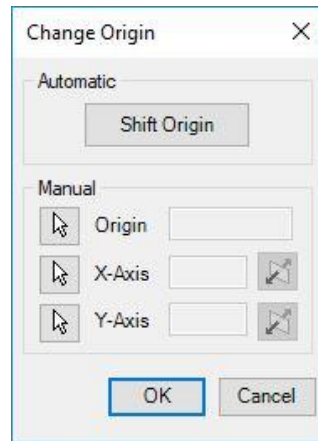
After one click, MDTools moves the cavity by 0.05 inches/1 mm.

- 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.

Change Origin

1. Click **Change Origin**.
The Change Origin dialog box displays.
2. Click **Origin** for Manual selection.
3. Select a cavity.
Origin is moved to the center point of the selected cavity.
4. Select the edges to make changes in the X and Y-axis reference.
5. Flip the axis direction by clicking the corresponding Flip axis button.



Change Origin Dialog

Note:

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

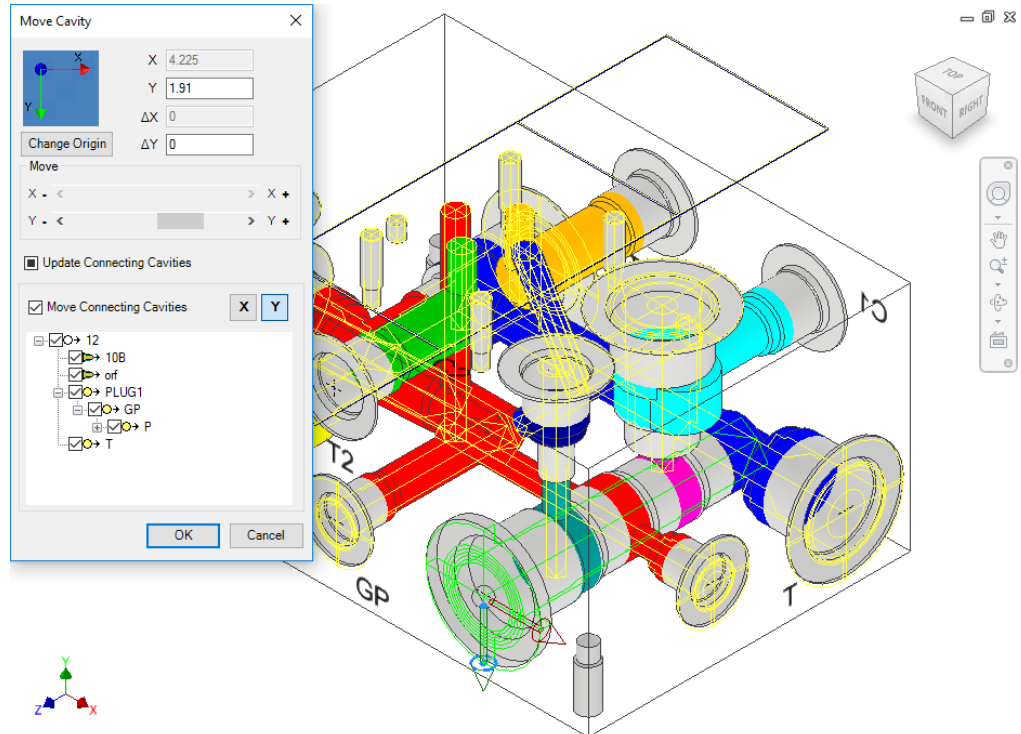
Update Connecting Cavities

1. Select **Update Connecting Cavities** option.
2. Specify the new location.
3. Click **OK**.

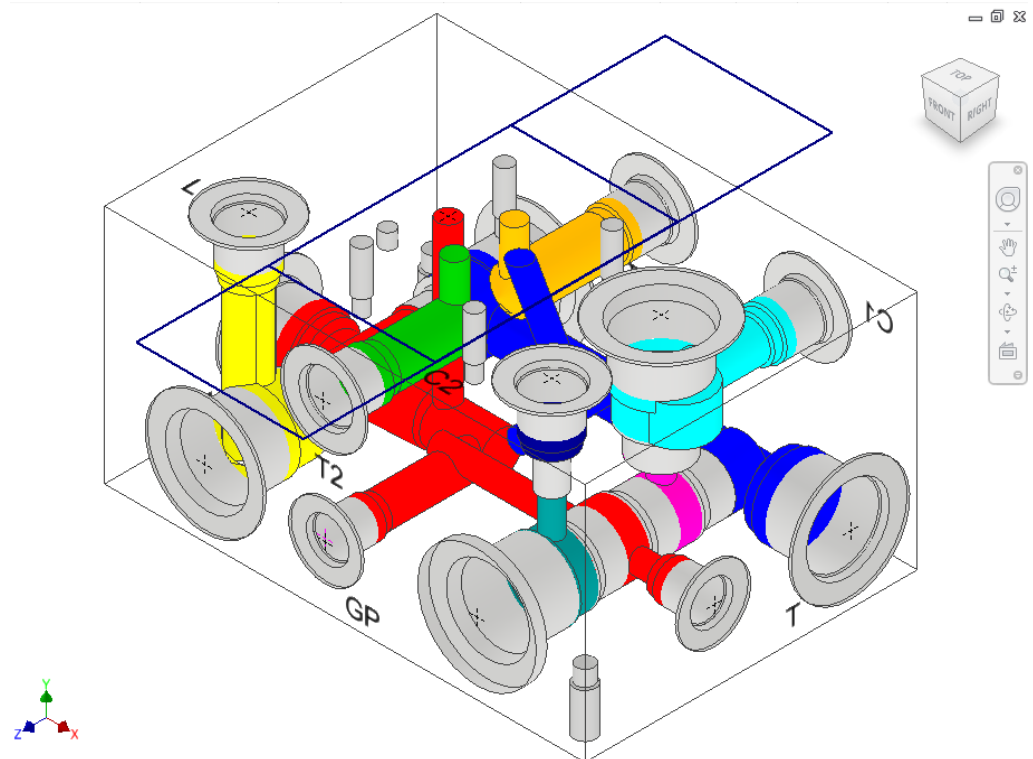
MDTools relocates the cavity to the new location and automatically updates the connecting cavity depth.

Note

Constrained Offset Hole is not moved along with the parent cavity; need to recolor cavities to view the change.



Parametric Move Cavity dialog box: Update Connecting Cavities



Cavity relocated: Depth of connecting holes updated

Move Connecting Cavities

1. Select **Move Connecting Cavities** option.

MDTools displays the preview of the connecting cavities.*

2. Select the axis on which you want to move the cavity.

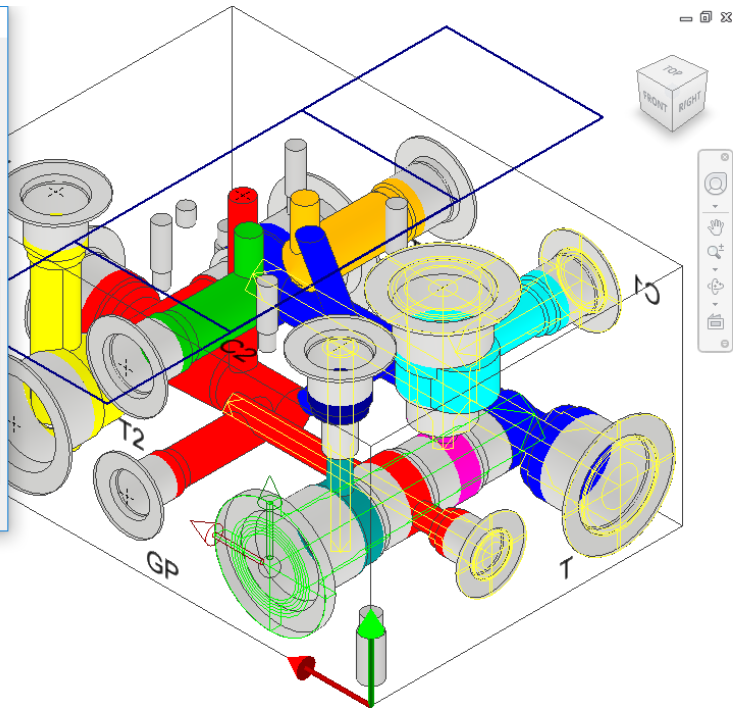
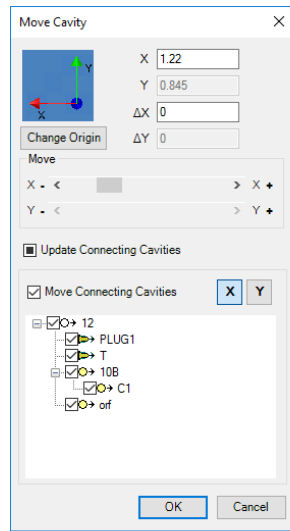
X-axis is selected by default.

3. Deselect the connecting cavities you don't want to move with the cavity.

All the connecting cavities are selected by default.

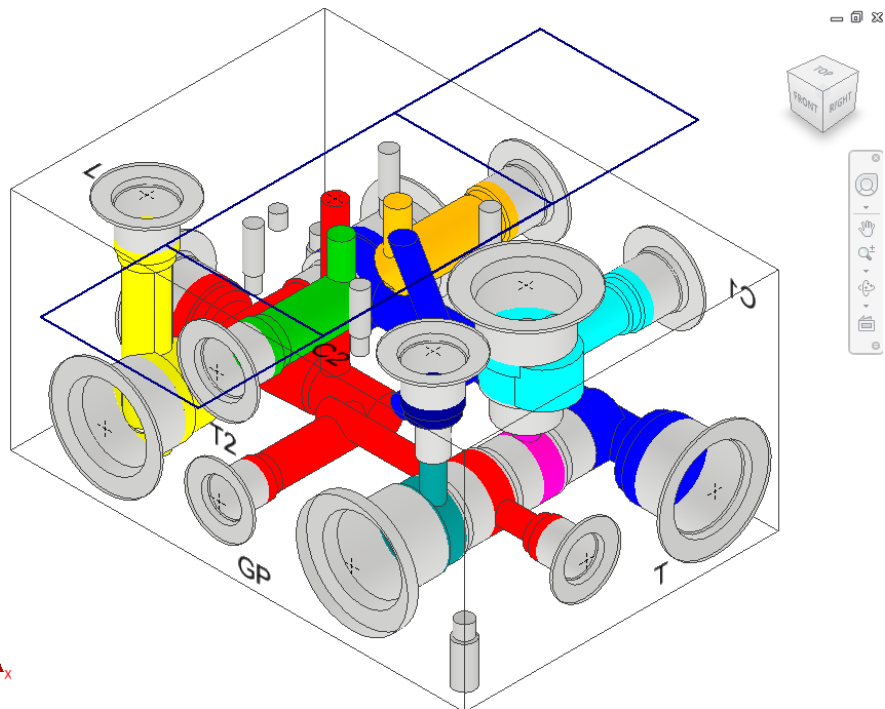
4. Click **OK**.

MDTools relocates the cavity to the new location.



Parametric Move Cavity dialog box: Move Connecting Cavities

MDTools automatically relocates the connecting cavities and updates the connecting cavities depth.



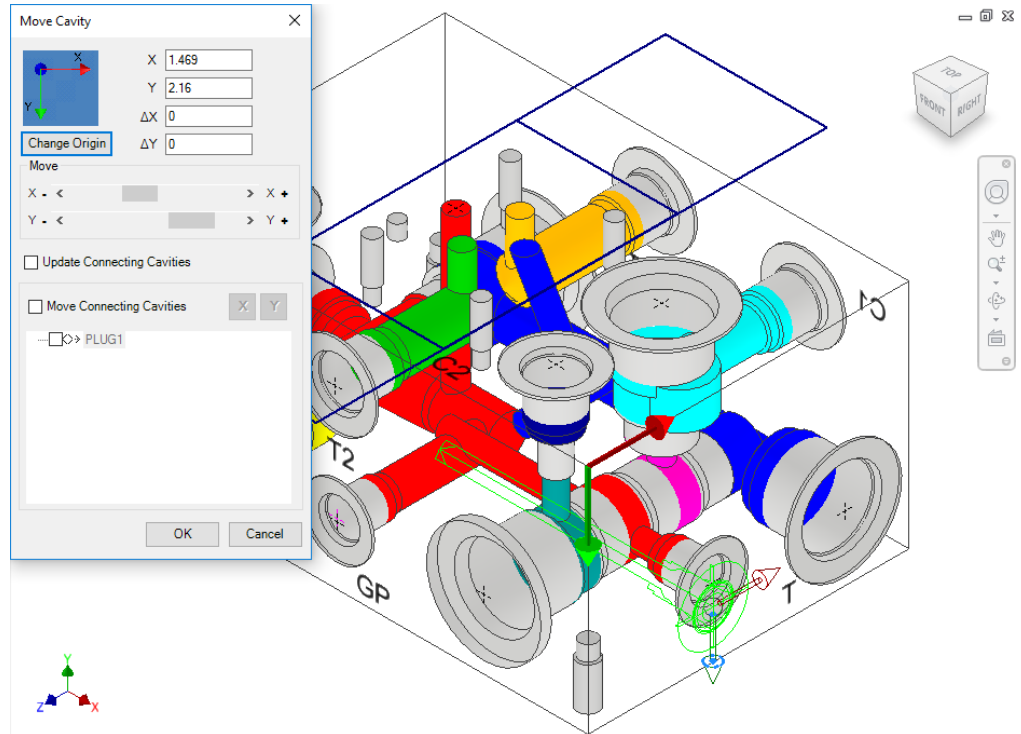
Cavity relocated: Location of connecting holes updated

Move the Cavity by dragging the Move Handle

1. MDTools 770 ribbon
>Relocate panel
>Move

The MDTools® Select Cavity dialog box displays.
2. Select a cavity on the manifold.

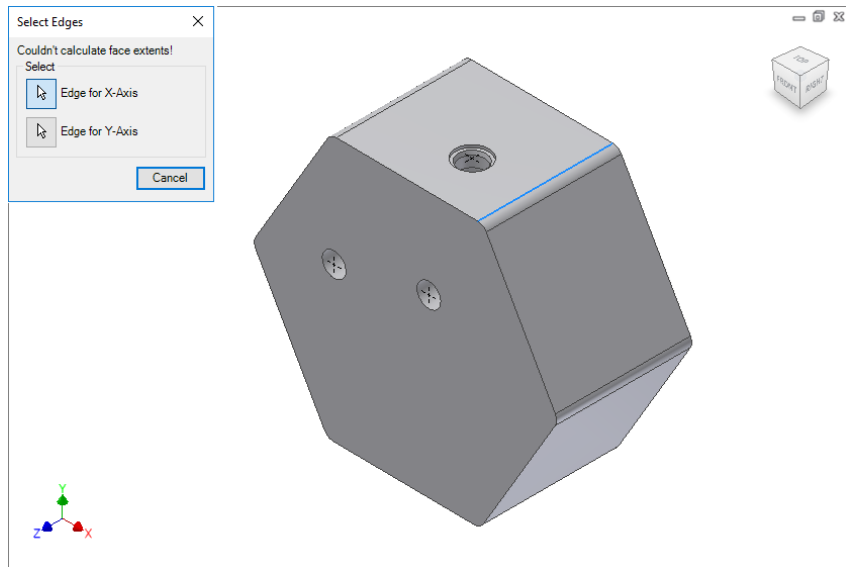
The Cavity Preview shows Move handle with a center point and X and Y axis arrow indicator.
3. Drag the center point to move on any axis.
4. Drag the X or Y axis arrow to move the cavity along a single axis.



Move Cavity – using Move Handle

Move a Cavity on a Non-Rectangular Manifold

1. MDTools 770 ribbon
>**Relocate** panel
>**Move**
The MDTools Select Cavity dialog box displays.*
2. Select a cavity on the manifold.
The Select Edges dialog box displays.
3. Select edges by defining the X and Y axis.
The Move Cavity dialog box displays with the current X and Y values of the cavity location from the selected reference edges.



Select Edges dialog box

Moving by Entering X and Y

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

Moving by Entering ΔX and ΔY

Relocate the cavity by entering a displacement.

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

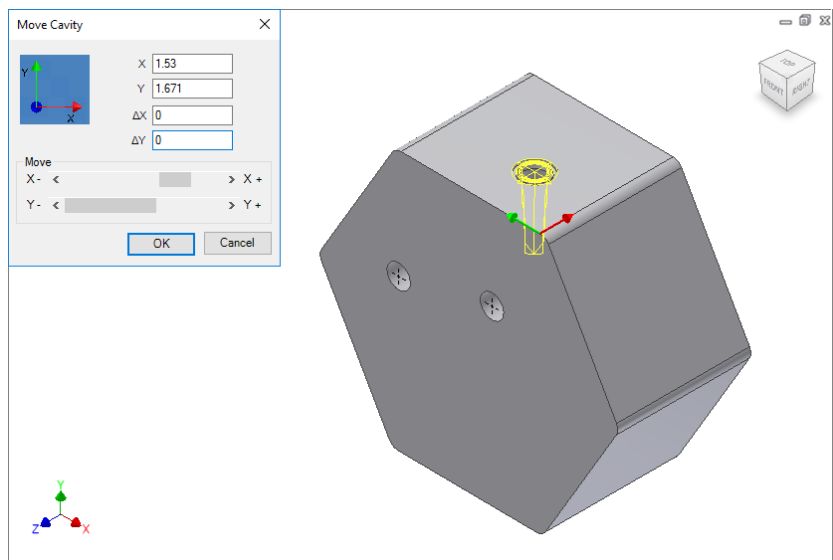
Moving by Increment

1. Move a cavity by an incremental distance (0.05 inches/1.00 mm).
2. Click the scroll bar button.
- After one click, MDTools moves the cavity by 0.05 inches/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.

Moving Cavities/Footprints Manually

Relocate the cavity manually by moving the cavity center point.

1. Drag the cavity center point to the new location.
2. Click **Update** on the Inventor Standard toolbar.
The cavity is relocated.



Move Cavity dialog box: Cavities on non-rectangular block

Note

Move a footprint with reference to the selected cavity in the footprint using the enhanced **Move Cavity** command.

Move a Slot inside the Cavity

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

1. MDTools 770 ribbon
>Relocate panel
>Move

The MDTools®: Select Cavity dialog box displays.

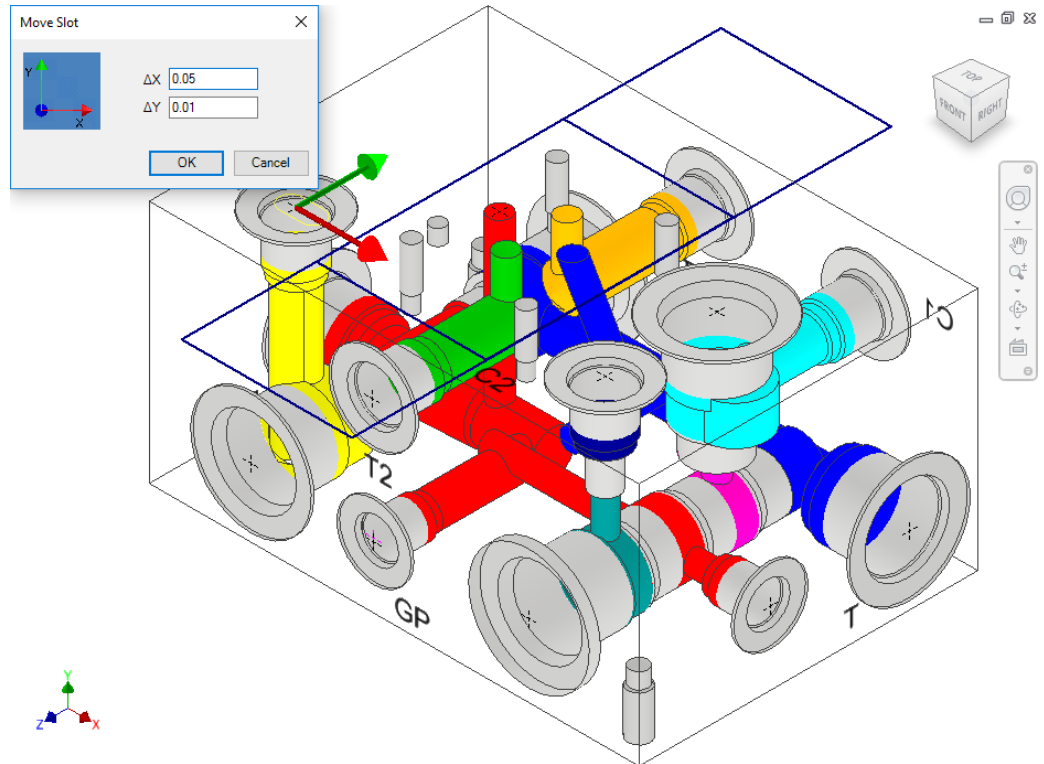
2. Select a slot on the manifold.

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**.

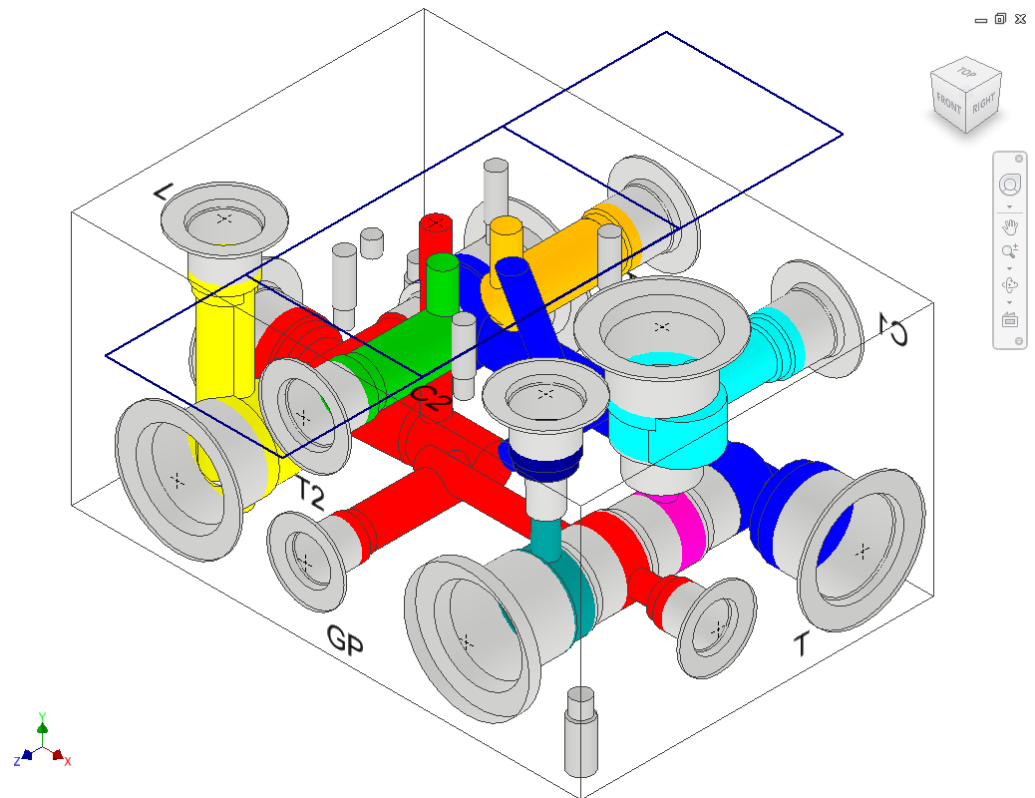
MDTools relocates the slot inside the parent cavity.



Move Slot dialog box

Note:

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



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 770 ribbon
>Relocate panel
>Move Multiple

The Move Cavities dialog box displays.

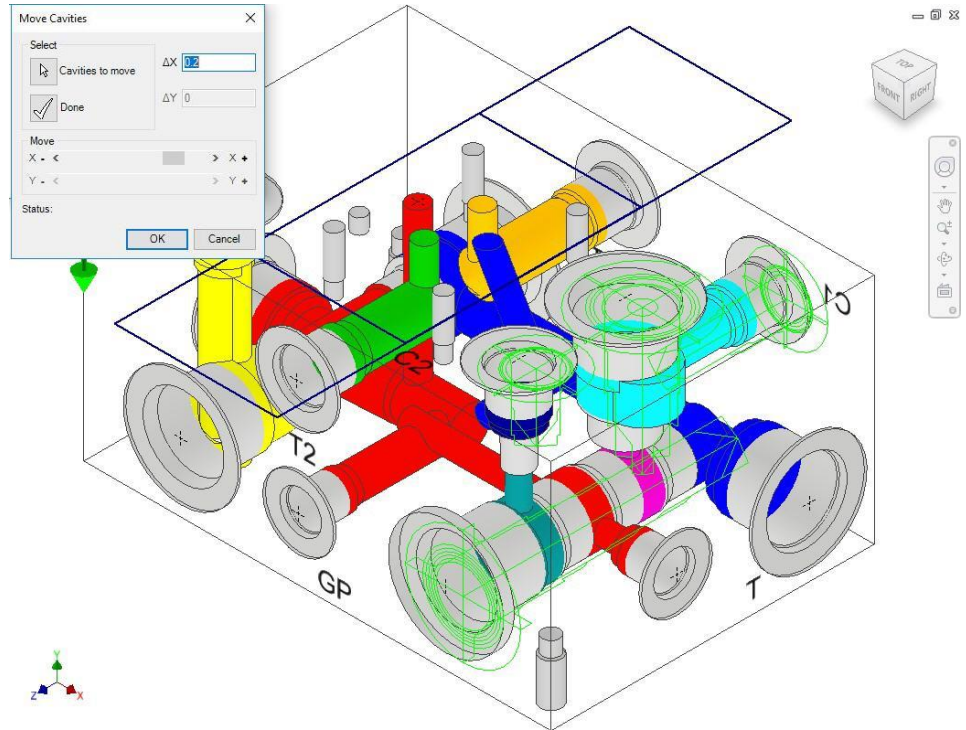
MDTools displays the coordinate symbol, indicating the direction of axis through the manifold origin.

2. Click the **Cavities to move** selection button.
3. Select the cavities you want to move.

Click the **Done** button when finished. Text fields to enter the change in location appear on the dialog box.

4. Enter the displacement along each coordinate.

When you select cavities on perpendicular faces, MDTools display only one field to enter displacement, as the cavities have only one common coordinate.



Move Cavities dialog box

Moving by Entering ΔX and ΔY

This option enables you to relocate the cavities by entering displacement values.

MDTools moves the cavities by the ΔX and ΔY values entered.

Moving by Increment

MDTools enables you to move cavities by an incremental distance (0.05 inches/1.00 mm)

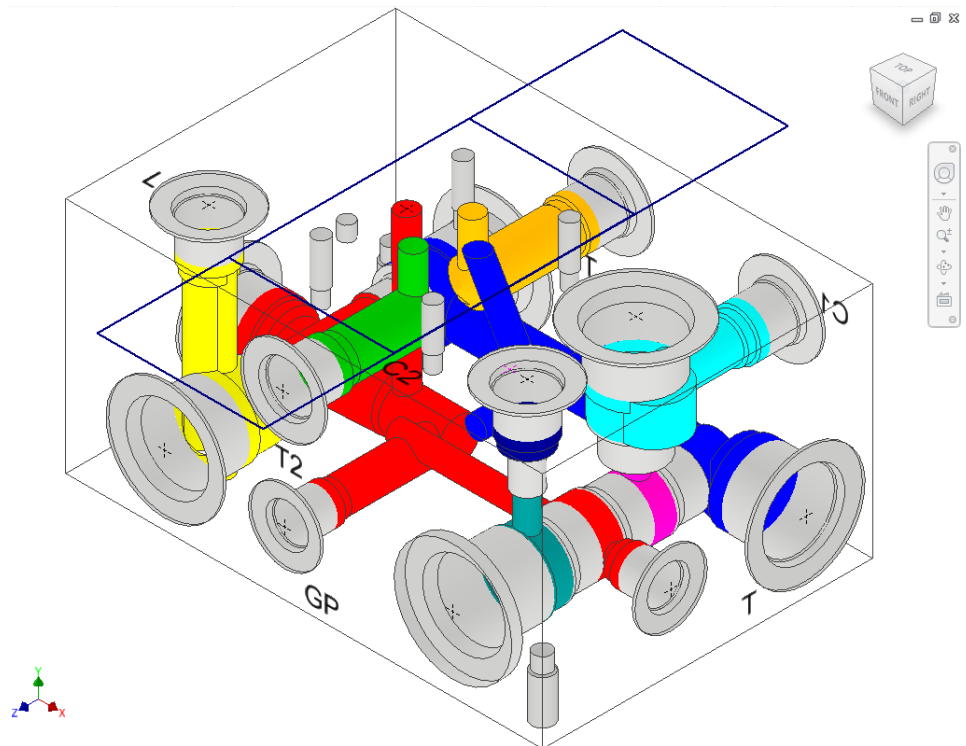
Click the scroll bar button.

After one click, MDTools moves the cavities by 0.05 inches/1 mm.

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

5. Click **OK**.

MDTools relocate the cavities by the specified distance and the coordinate symbol disappears.



Move Cavities dialog box: Data field to enter displacement

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.

43. Swap Cavities

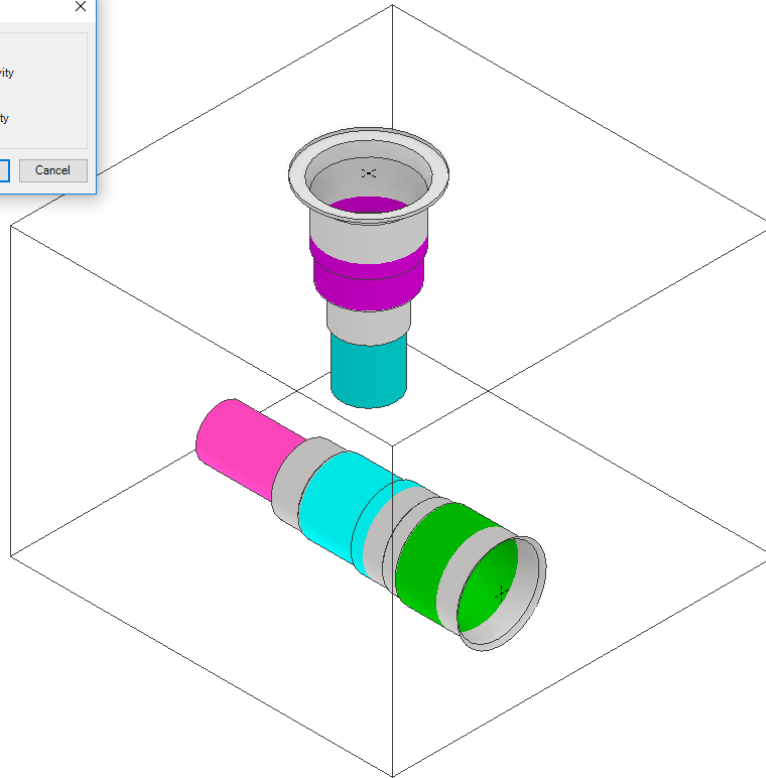
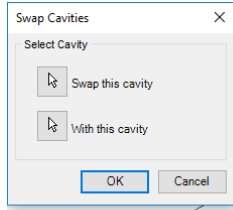
Interchange the location of two cavities on a manifold.

1. MDTools 770 ribbon
>Relocate panel
>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**.

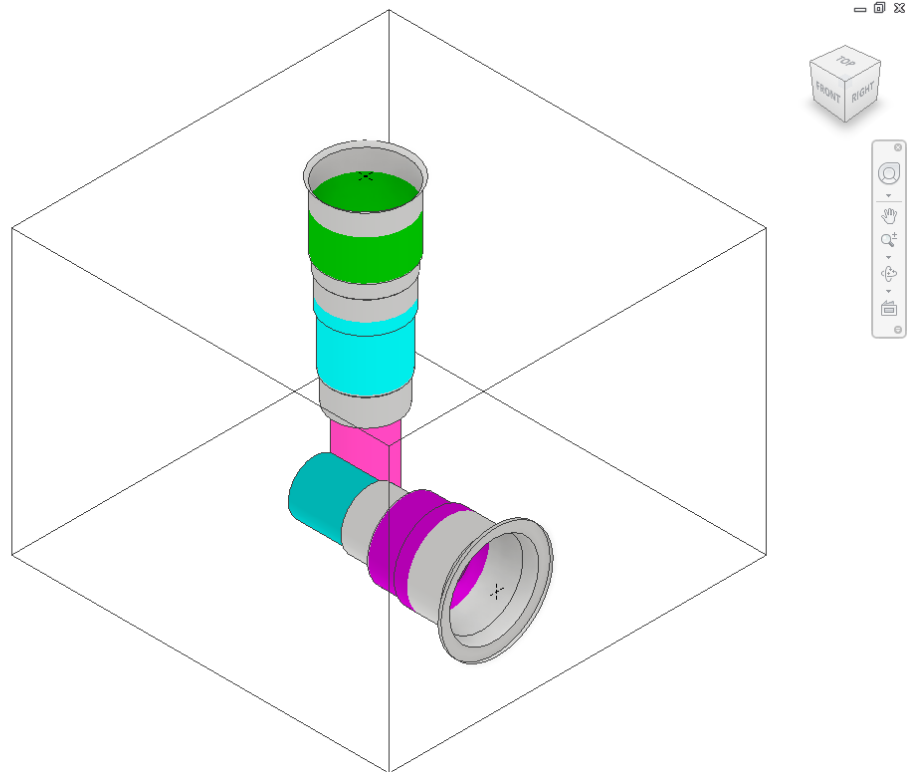
Location of two cavities are interchanged on the manifold.

NOTE

Constrained engravings do not move along with the cavity.



Swap Cavities dialog box



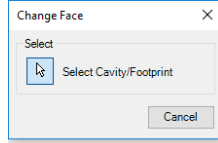
Cavities swapped

44. Change Face

Relocate a cavity/footprint from one face of a manifold to another manifold face.
 Connect the cavity with either one or two existing cavities on the block when relocating the cavity.

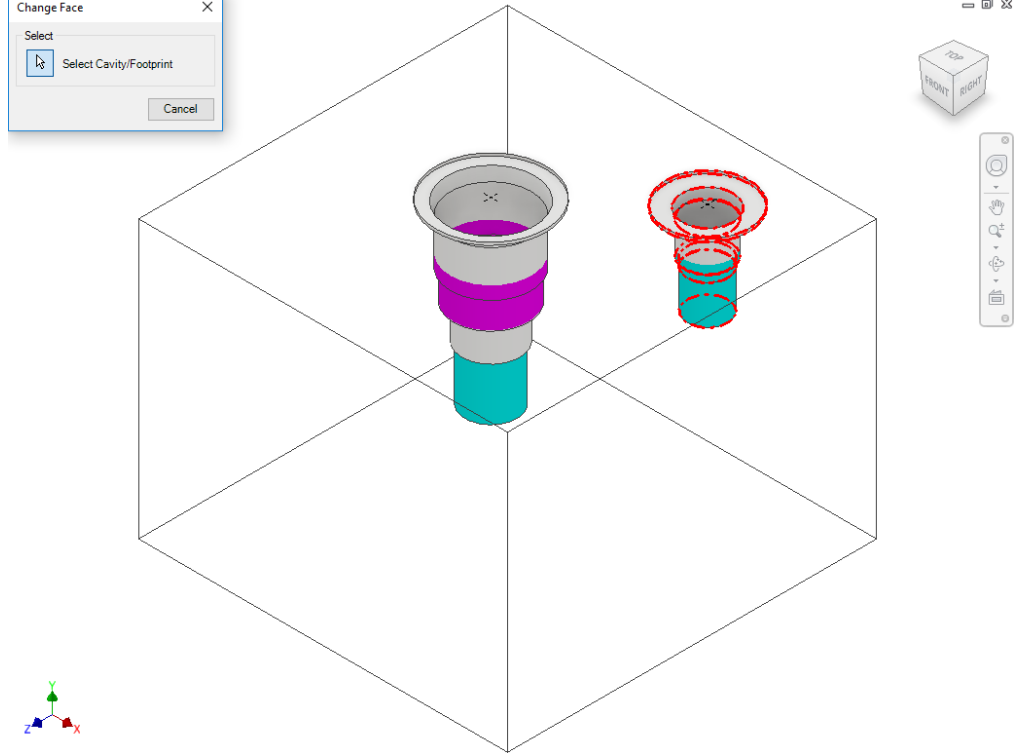
1. MDTools 770 ribbon
 >Relocate panel
 >Change Face

The Change Face dialog box displays.



2. Select the cavity/footprint you want to relocate.

The Specify Cavity Location dialog box displays.



Note

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

3. Select the point on the manifold face, where you want to move the cavity.

MDTools* display a preview with center point and X and Y axis arrow indicator of the selected cavity at the selected point on the manifold.



Change Face dialog box

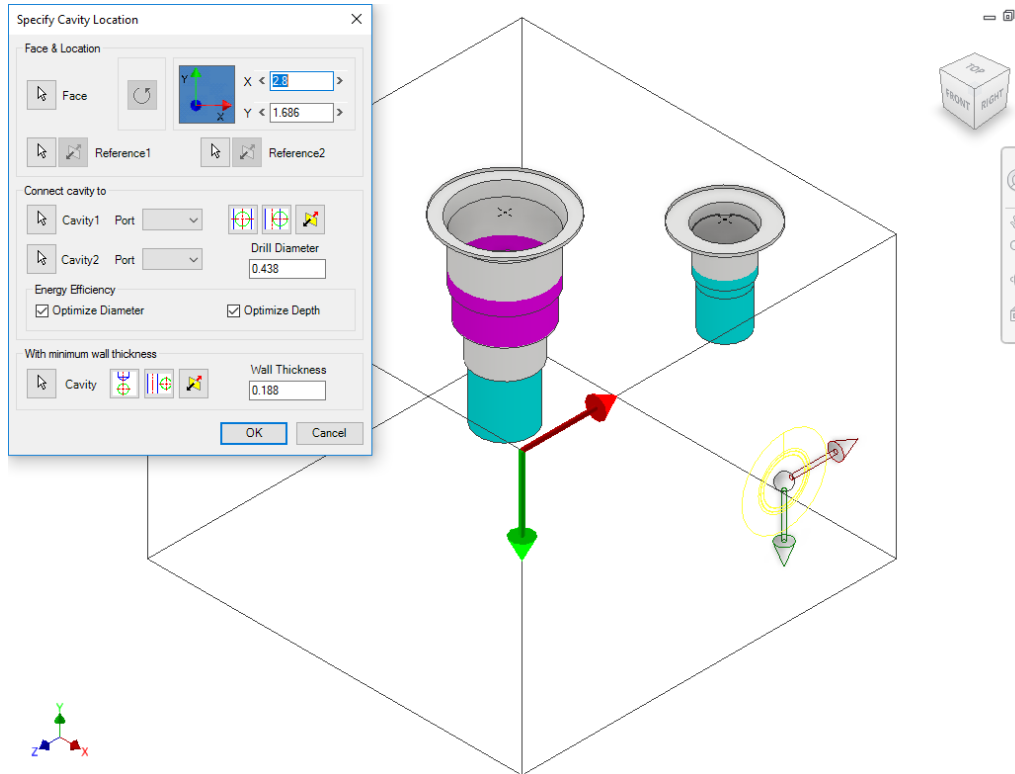
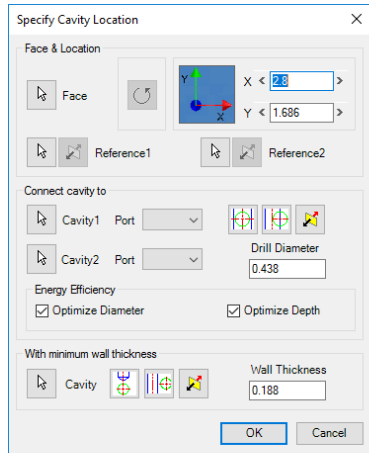
4. Enter the X and Y distance from the block origin, if required.

5. Drag the center point to move the cavity/footprint on any axis, if required.

6. Drag the X or Y axis arrow to move the cavity/footprint along a single axis, if required.

7. 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

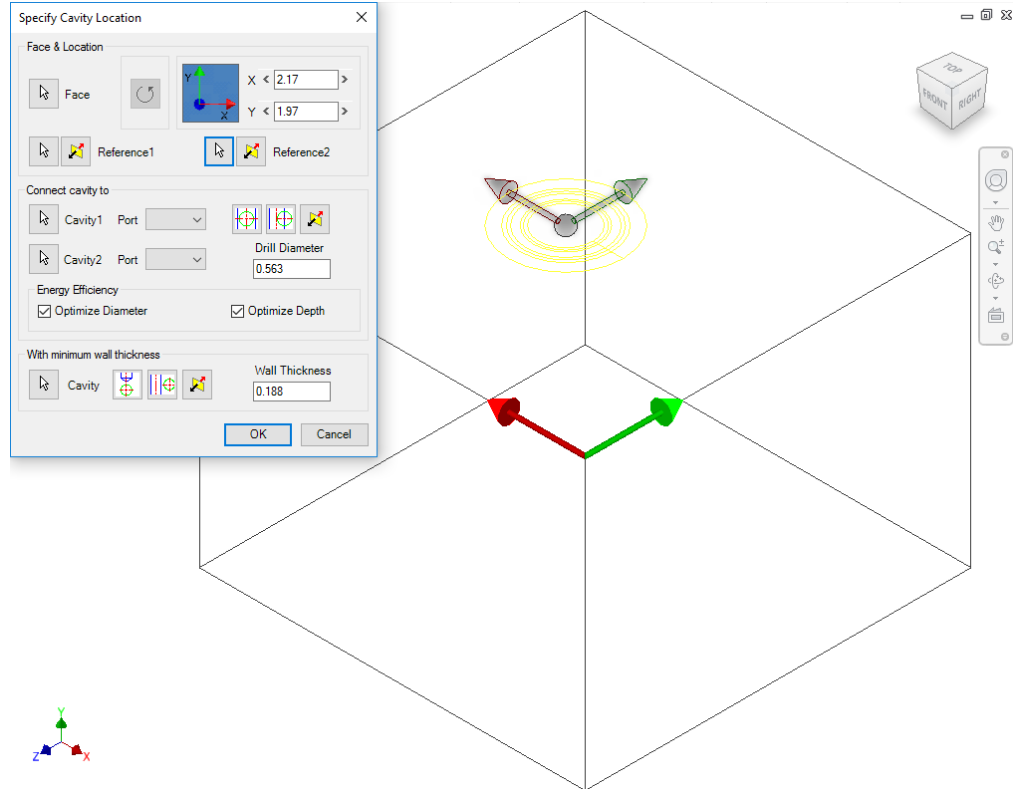
1 Position the cavity with reference to an edge or a cavity

1. Click the selection button for Reference1.
2. Select an edge or an existing cavity.

MDTools automatically relocates the origin symbol to the selected reference and updates the X and Y values as per the new origin.*

Note

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

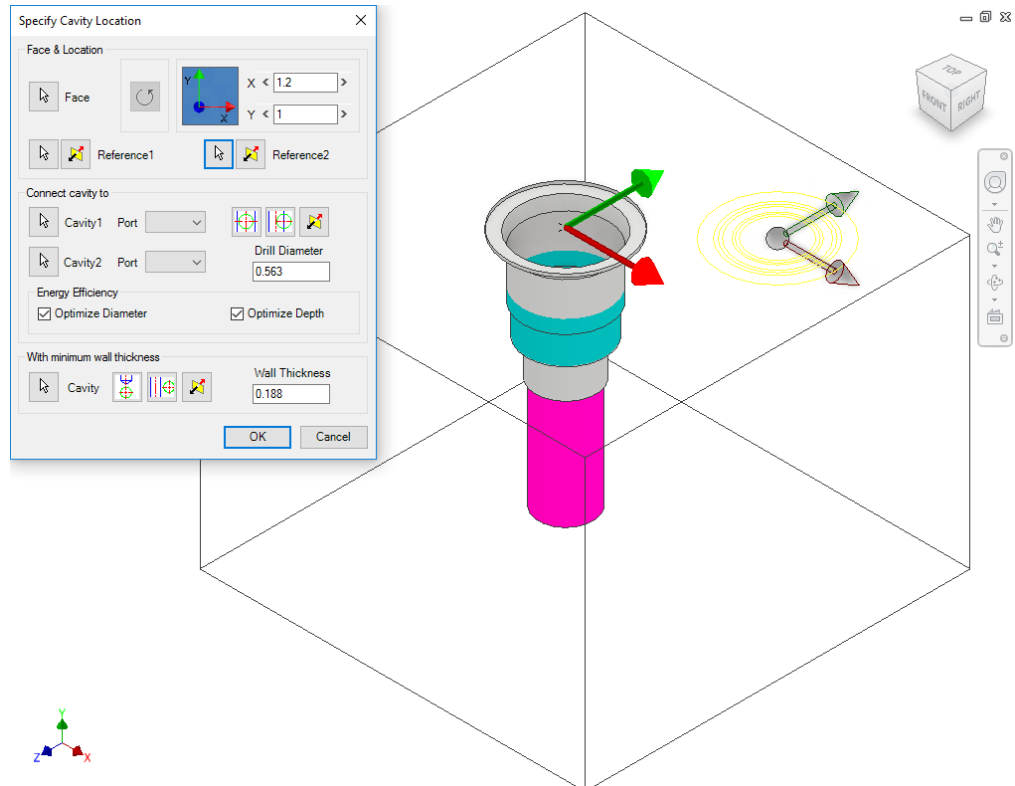


Position the new cavity with reference to an edge

3. Change the X and Y values to precisely position the new cavity.

MDTools automatically updates the preview of cavity/footprint upon changing the X and Y values.

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



Position the new cavity with reference to an existing cavity

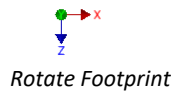
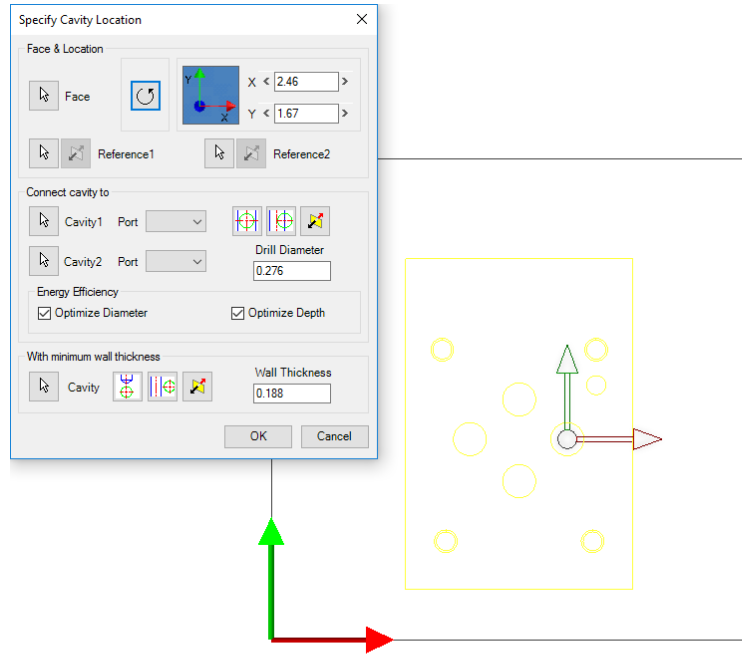
2 Rotate Footprint

The Rotate Footprint button on 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.



3 Connecting two existing cavities

Connect a 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.

Note

- Click the **Relocate to Side** button to relocate the cavity to the 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.

4. Click the selection button for Cavity2.
5. Select the connecting Cavity2.
6. Select the connecting port on the second cavity.

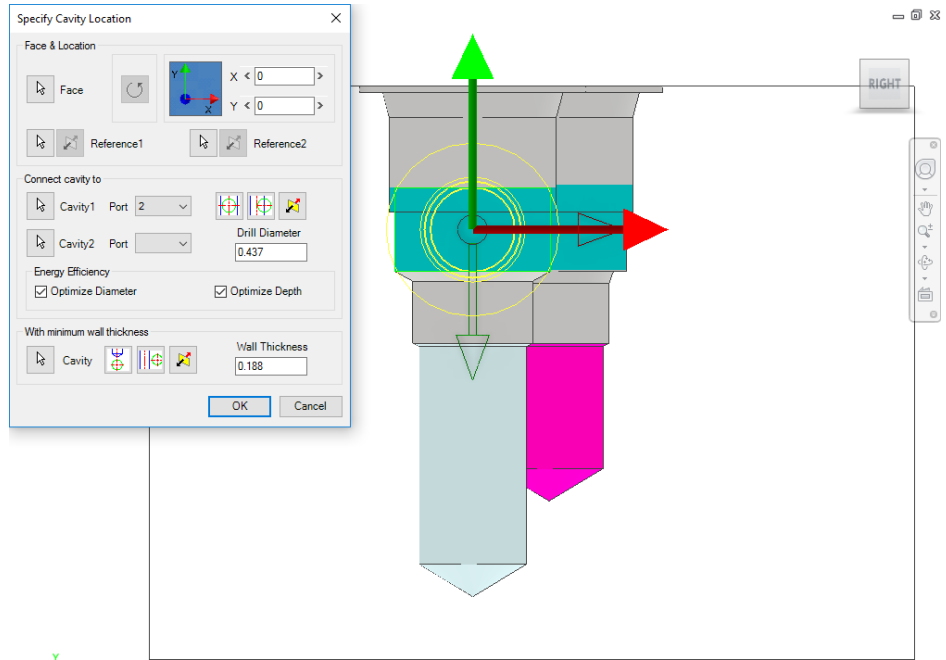
MDTools automatically relocates the cavity to the overlapping center of the two cavity ports.

7. Click **OK**.

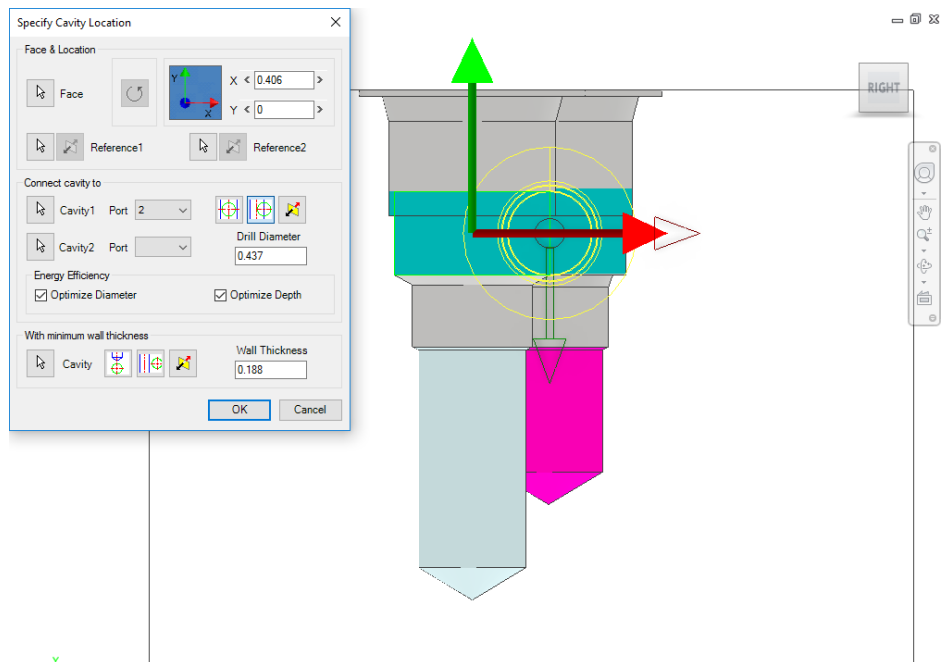
MDTools creates the new cavity at the specified location and connects the cavity to the selected connecting cavities.

Note

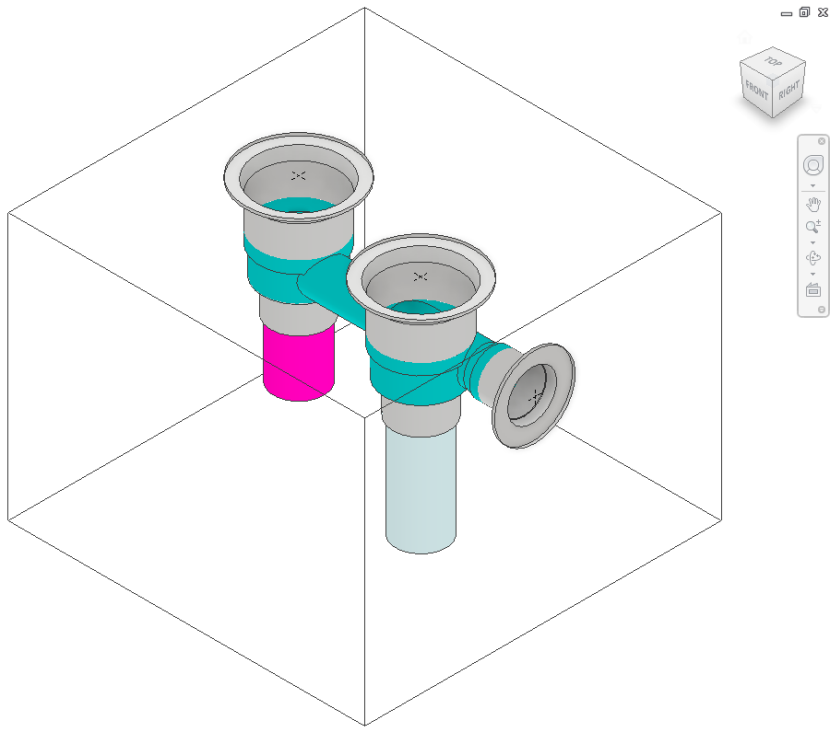
The Energy Efficient connectivity is applied, if either the Optimize Diameter or Optimize Depth option is selected.



Connecting Cavities



Positioning the cavity on the sides

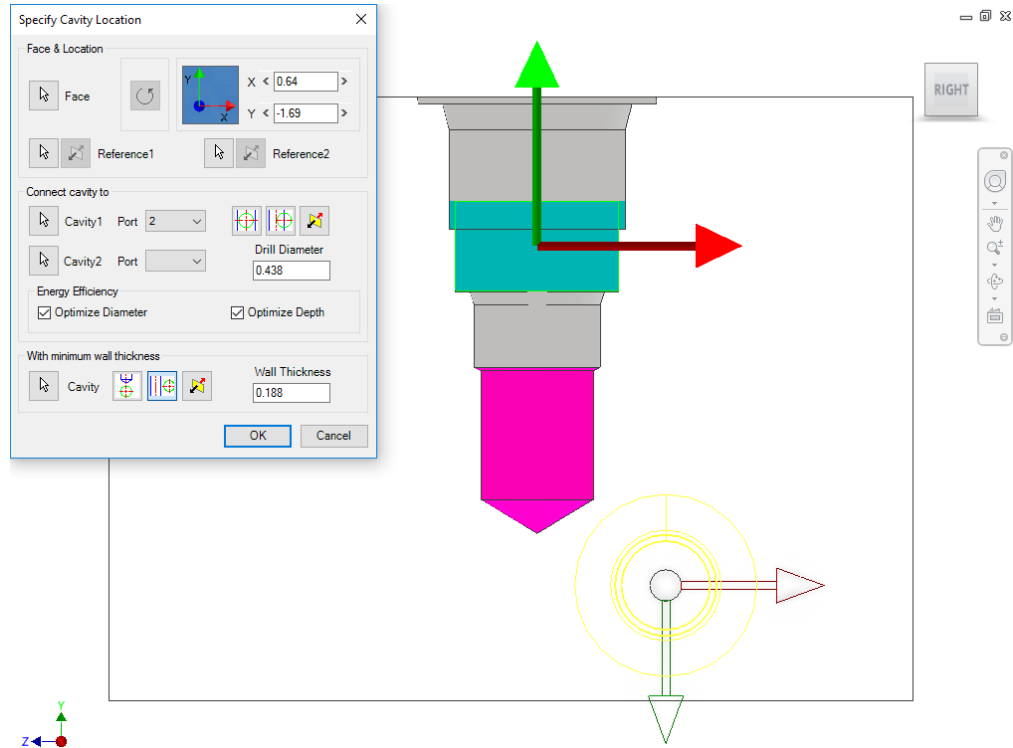


Cavities connected two existing cavities

4 Position with minimum wall thickness

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

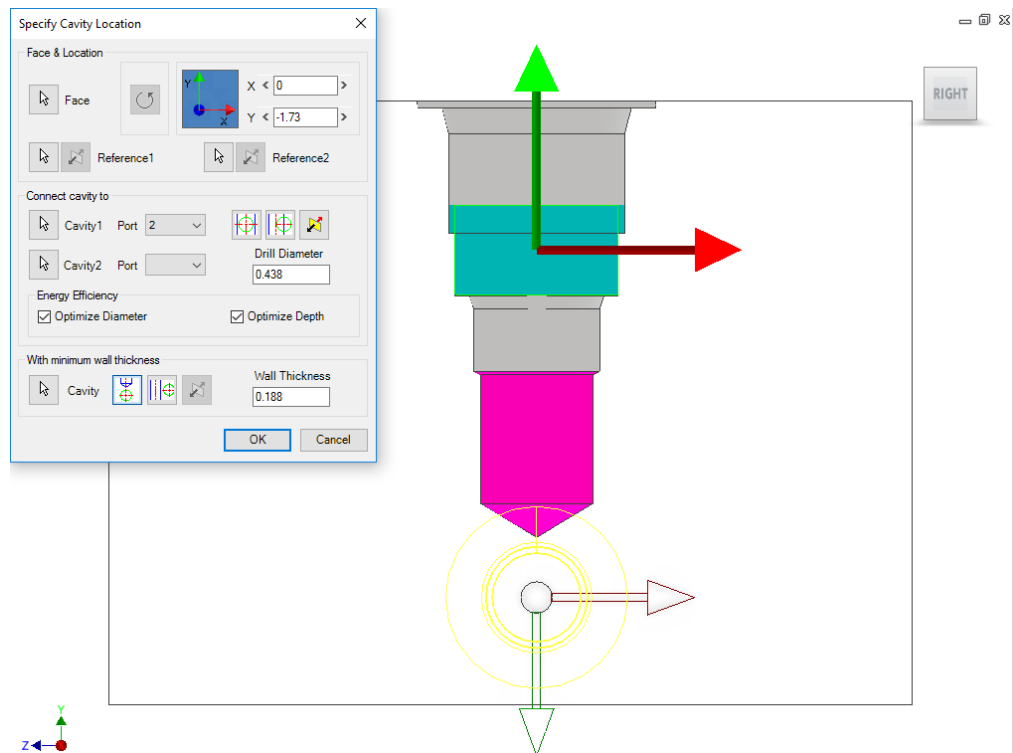
1. Click the select Cavity button.
2. Select an existing cavity on the manifold.
3. Click the **Move to Side** button to position the new cavity away from the selected cavity axis.
4. Click the **Flip Side** button to change the side, if required.
5. Repeat the above steps to position the cavity with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



Positioning the new cavity using the Move to side option

Note

Choose the **Locate below Cavity tip** option when you want to locate the new cavity with the minimum wall thickness from the tip of an existing cavity.



Positioning the new cavity below the cavity tip

5 Change Slot Face with Parent Cavity

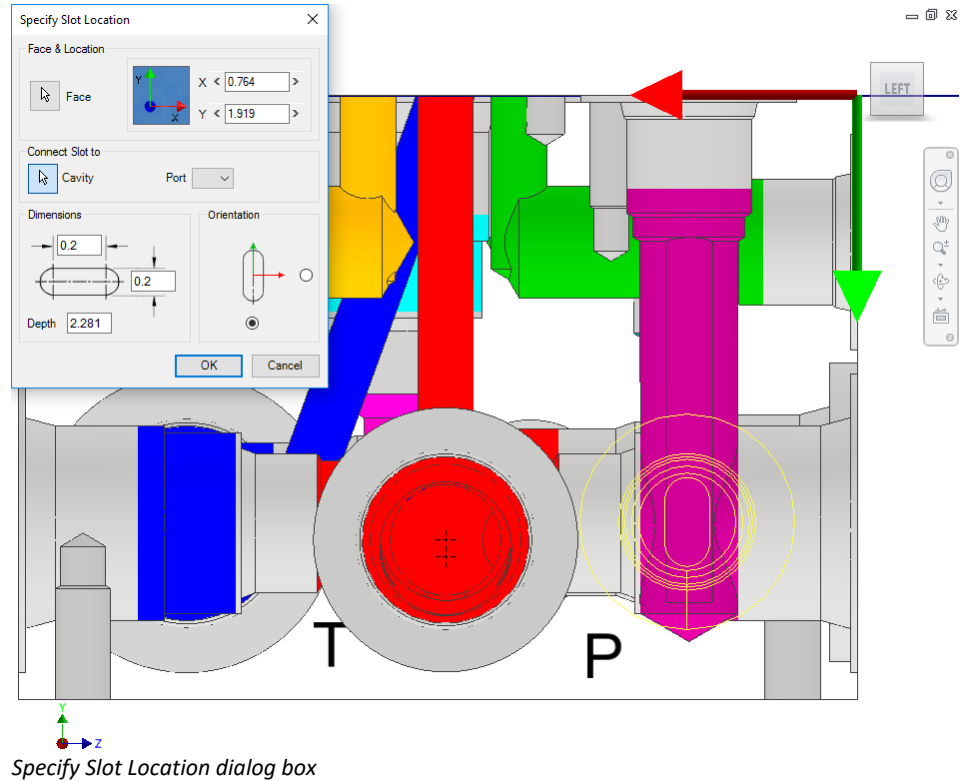
1. MDTools 770 ribbon
> **Relocate** panel
> Change Face
The Select Cavity/Footprint dialog box displays.

2. Select a slot or a slot with inserted cavity you want to relocate.
The Specify Slot Location dialog box displays.

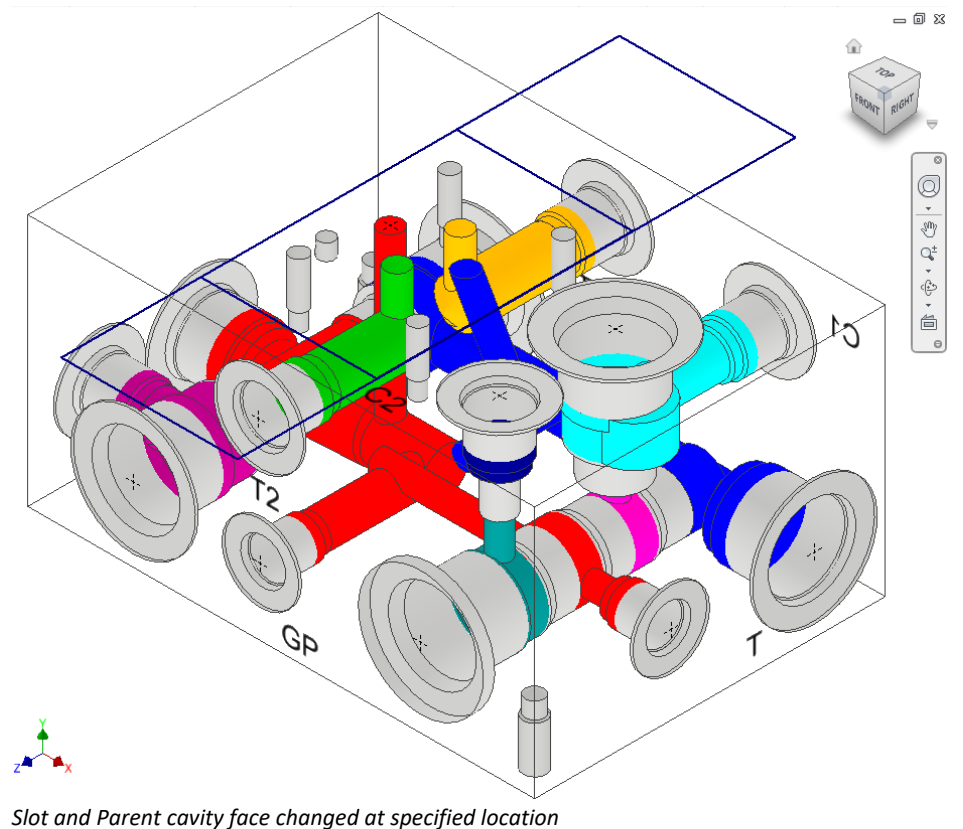
Note

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 display a top view with a center point and X and Y axis arrow indicator of the selected slot with 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 would be 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 would be parent cavity depth + 0.5 inches/12 mm.
7. Select the **orientation**.
Select the orientation of the slot from the axis or center of the selected cavity.
8. Click **OK**.
MDTools relocates the selected slot with the parent cavity at the specified location.



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.

6 Connect Slot to Existing Cavity

Connect the 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 cavity to the port center and displays the slot diameter, width and depth.

4. Modify slot **dimensions**.

Default value of the slot diameter would be 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 would be the center distance between the parent cavity and the connecting cavity.

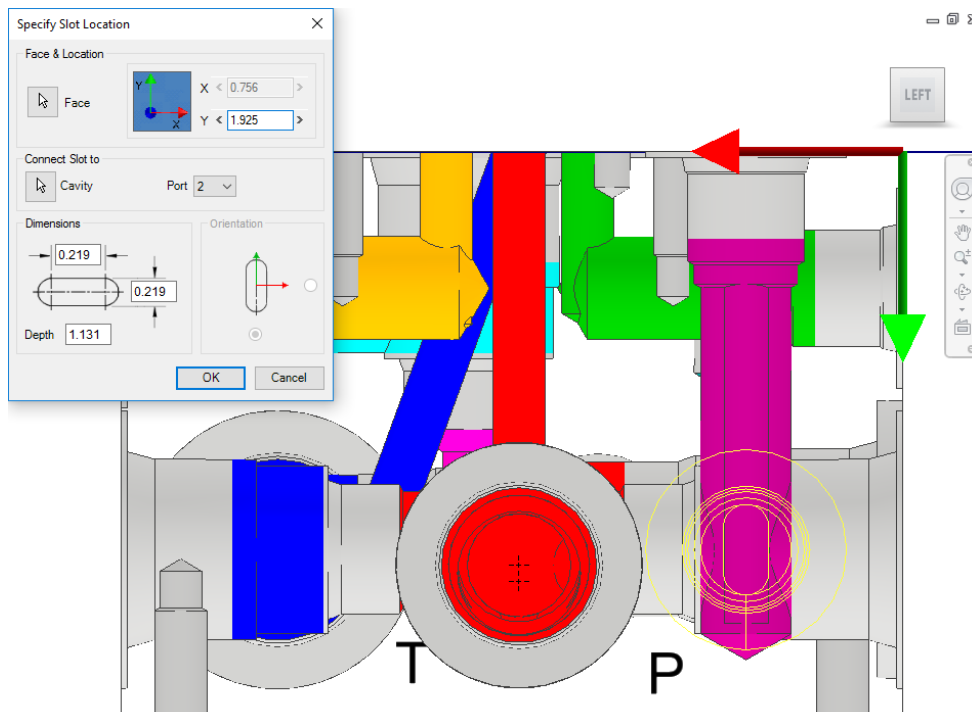
Slot depth should not be less than the center distance between the parent cavity and the connecting cavity.

6. Click **OK**.

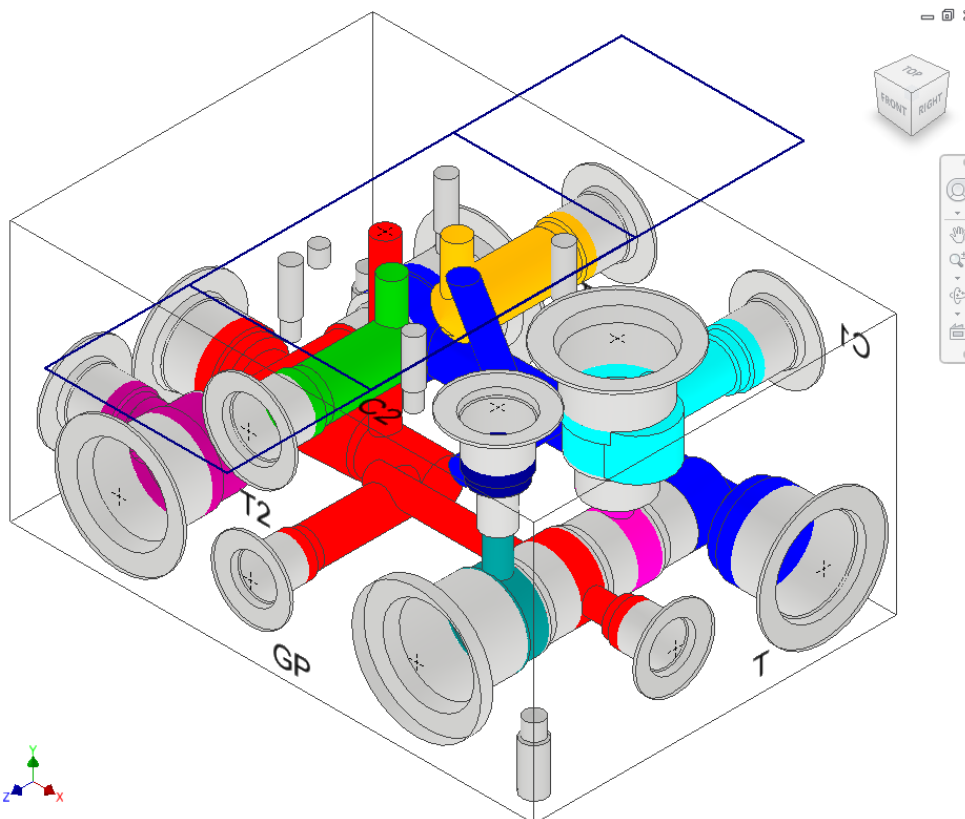
MDTools relocates the slot with the cavity at the specified location and connects the slot to the selected connecting cavity.

Note

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



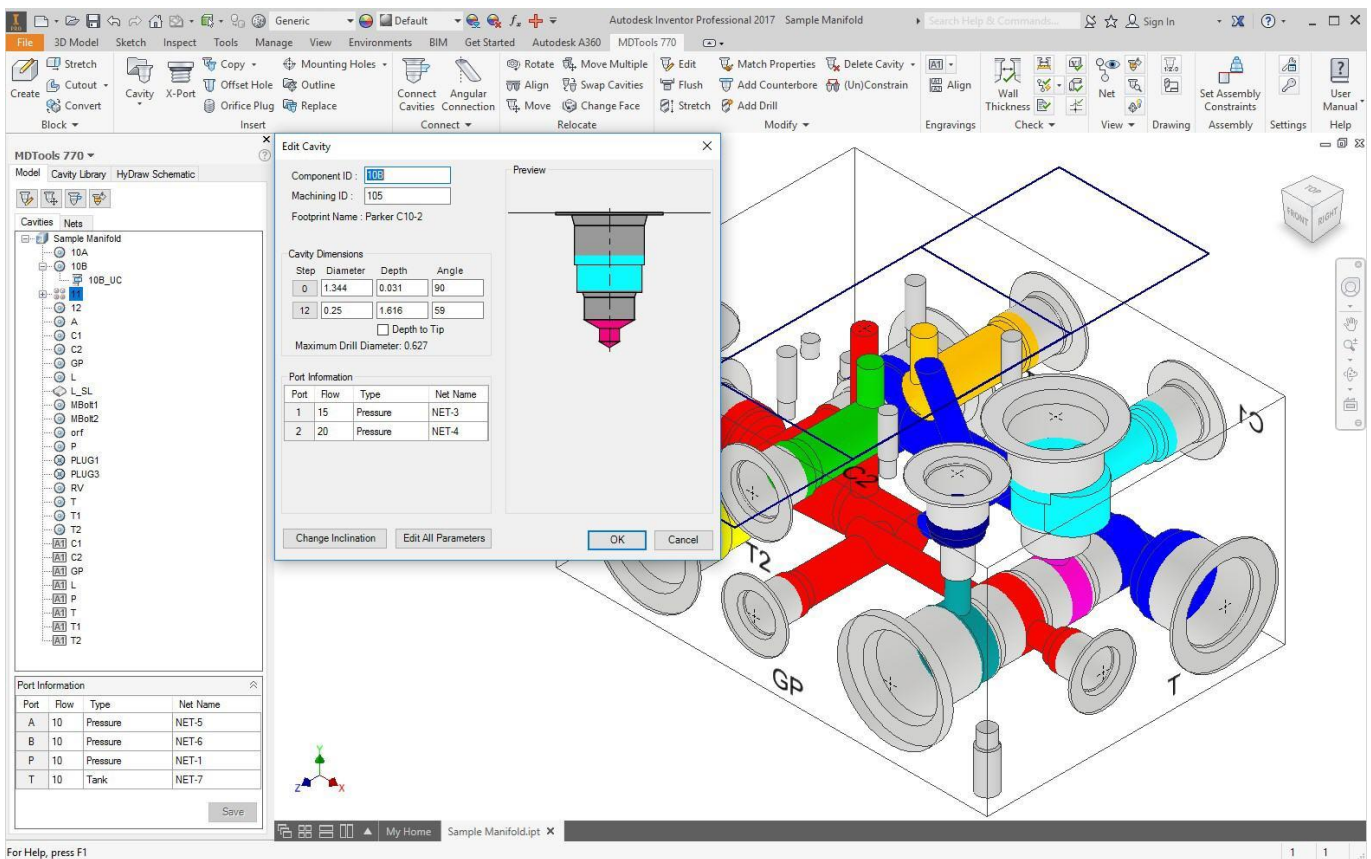
Positioning the Slot on the connecting cavity center



Slot face changed and connected with cavity

Modify

- 45 Edit
- 46 Flush X-drill Plugs
- 47 Stretch Drill
- 48 Match Properties
- 49 Add Counterbore
- 50 Add Drill
- 51 Delete Cavity
- 52 Delete O-ring Groove
- 53 Delete Outline
- 54 Constrain/Unconstrain Cavities
- 55 Suppress/Unsuppress Cavities
- 56 Minimize Depth
- 57 Update Precision



45. Edit

Modify the selected cavity, undercut, slot or O-ring groove.

1 Edit Cavity


Change the design-specific cavity dimensions inside Inventor, if you select a cavity. It also enables you to select a tool (Drill or Spot Face) from a tooling knowledge base. This helps avoid the use of non-standard drills and spot faces.

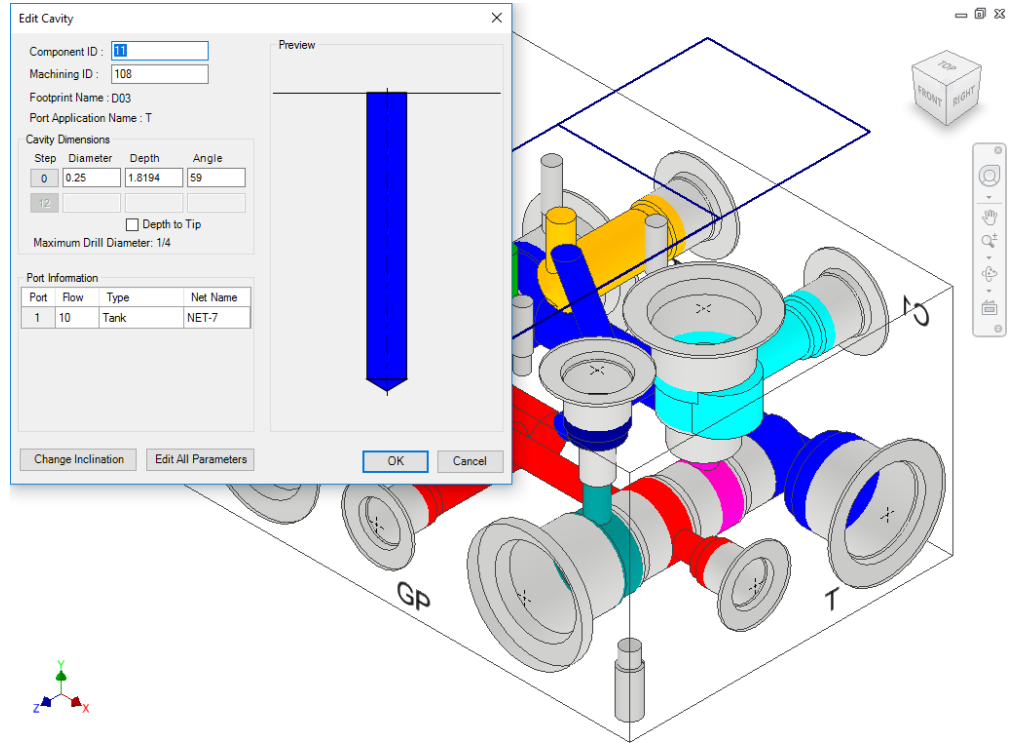
1. MDTools 770 ribbon
>**Modify** panel
>**Edit**
The MDTools® Select Cavity dialog box displays.

2. Select a cavity in the manifold.
When you move the cursor over the cavity, it gets highlighted.

3. Click to select the highlighted cavity.
The Edit Cavity dialog box displays.

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

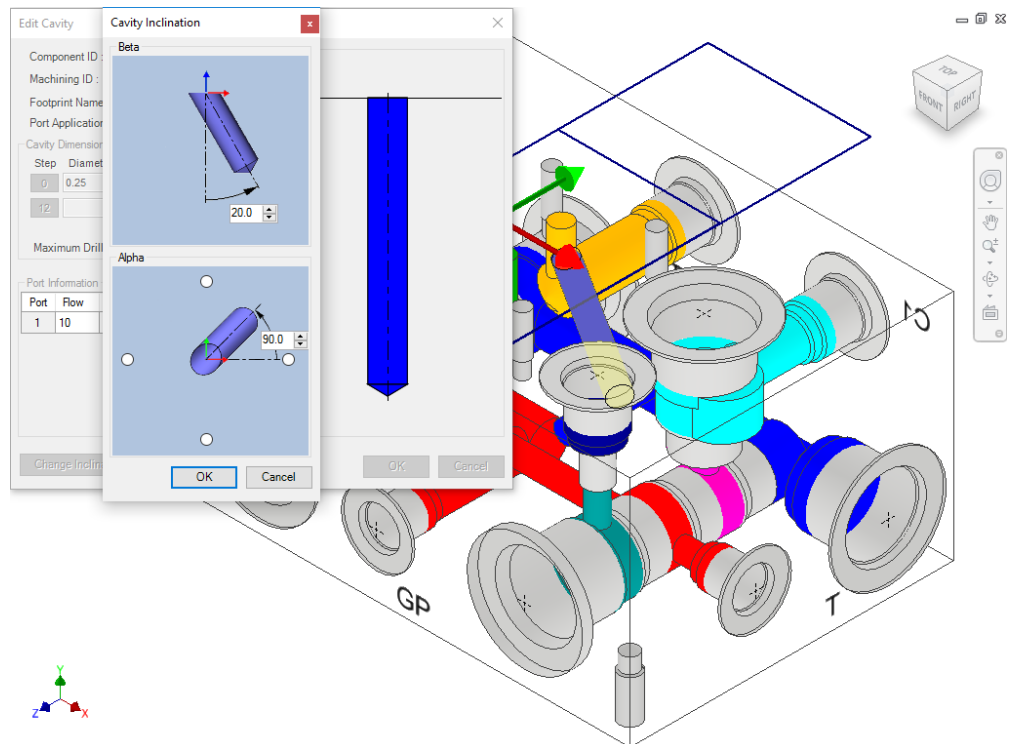
4. Click Edit All Parameters.

5. View or change all the cavity parameters.



Edit Cavity dialog box

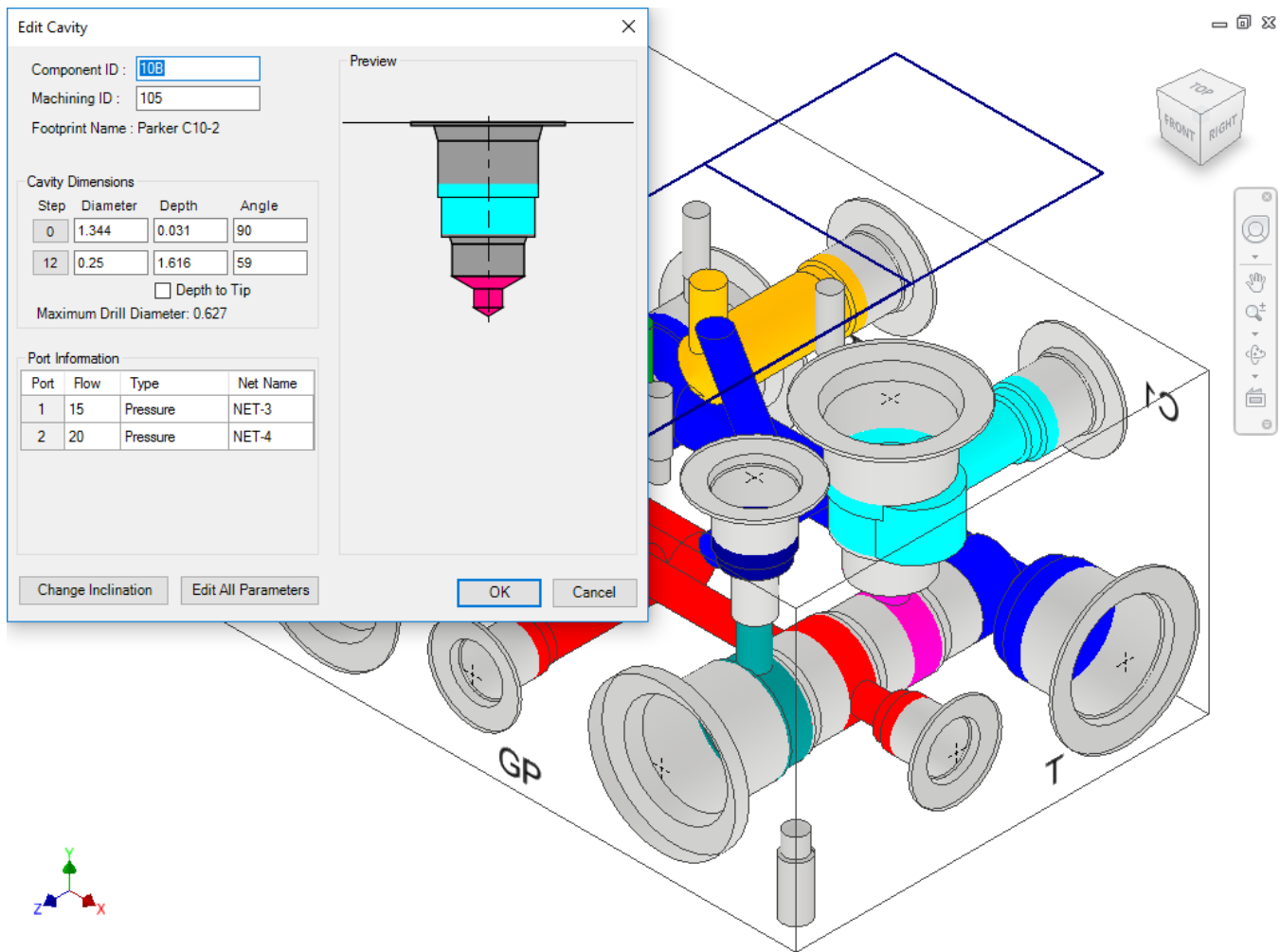
Note

- 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.



Cavity Inclination dialog box

Edit Cavity dialog box



Edit Cavity dialog box of a Cartridge valve cavity

The **Edit Cavity** dialog box displays:

- **Component ID**
The component ID for the cavity.
- **Machining ID**
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**
- **Maximum Drill Diameter**
This is a reference parameter, therefore not editable during design.
- **Port Information**
The Port Flow, Type, and Net Name can be edited.

- **Cavity Inclination angles**
(Alpha and Beta)
Inclination angle is only applicable to drill holes, ports, or cartridge valve cavities.
- **Net Name**
(Connectivity Information)
This is the net name entered in the cavity. When the net name is edited, the color of the cavity is updated according to the color assigned to the net.

Note

When you click in the Net Name column, the Net Name from the existing nets seem to get selected.

Selecting drill diameter

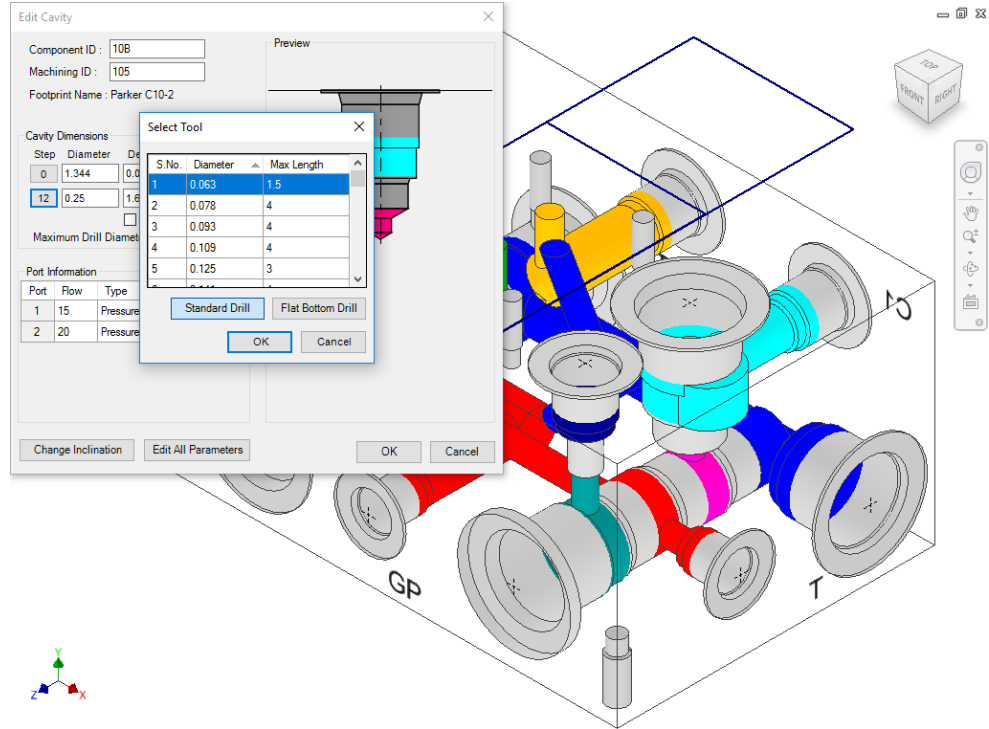
Select and use a drill from a standard drill list.

1. Click Step **12** button before entering the 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.



Select Tool dialog box

Note

- Click **Flat Bottom Drill** to view and select a flat bottom drill.
Only the drills with diameter less than or equal to the maximum allowable drill diameter of the cavity are listed.
- Option **Depth to Tip** is selected, if you have selected the Drill Depth Tip option in MDTools Settings.
*You can also override the **Depth to Tip** option locally.*

Selecting spot face diameter

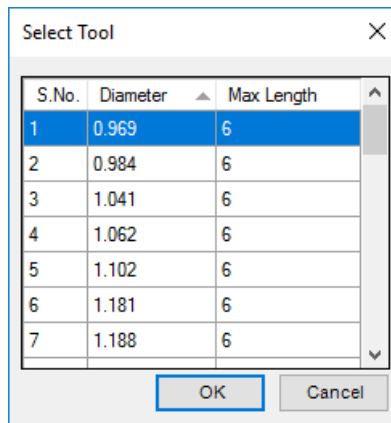
Select and use a spot face from a standard spot face tool list.

1. Click Step **0** button before clicking spot face dimensions on the Edit Cavity dialog box.

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.



Select Tool dialog box: Spot face tool list

2 Edit All Parameters

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

1. MDTools 770 ribbon
> **Modify** panel
> **Edit**

The *Edit Cavity* dialog box displays.

2. Click Edit All Parameters.
3. View the associated parameters, and/or change associated values, if required.

The **Edit All Cavity Parameters** dialog displays:

Step	Diameter	Depth	Angle
0	1.344	0.031	90
1	0.947	0	15
2	0.875	0.625	90
3	0.814	0.97	90
4	0.672	0.97	20
5	0.627	1.312	60
6			
7			
8			
9			
10			
11			
12	0.25	1.616	59

Step#	Size	Pitch	Class
2	0.875	7/8-14 UN	2B

Operation	Diameter	Depth	Remarks
0	DRILL	\$STEP12	\$STEP12
1	C10-2	\$STEP0	\$STEP0
2			
3			
4			
5			
6			

Port	Dia	Depth	Flow	Type	Net Name	Connecting ...
1		1.312	8	Pressure	NET-3	
2	0.438	0.725	10	Pressure	NET-4	# 6 SAE

Edit All Cavity Parameters dialog box

- **Component ID**
The default Cavity ID is the same as the Component ID.
- **Cavity Machining ID**
Default ID is '?'.
The default Cavity ID is the same as the Component ID.
- **Cavity Dimensions**
Step0 through Step12 dimensions are editable.
- **Max. Pilot Drill Diameter**
- **Machining Sequence**
- **Cavity Inclination (Alpha and Beta)**
Alpha and Beta is editable only if the cavity is a drill hole or a port.
- **Thread Details**
- **Port Details**
Only available for Cartridge valve cavities.
- **Plug Detail**
Only available for Port type cavity.
- **Port & Connectivity Information**
- **Comments**
The Comments specified for each cavity in the MDTools® Cavity Library

Note

- You cannot remove a step in the cavity inside Inventor.
 - Use the **Add Drill** command to add a step in a cavity.
- Thread Details are not used in the design process.

Cartridge Valve Insert

Move a 2 or 3 port cartridge valve cavity step, containing the top port end, up or down without manually editing the data of all affected steps and ports.

1. MDTools 770 ribbon
> **Modify** panel
> **Edit**

The *Edit Cavity dialog box* displays.

2. Click the **Edit All Parameters** button.

The *Edit All Cavity Parameters dialog box* displays.

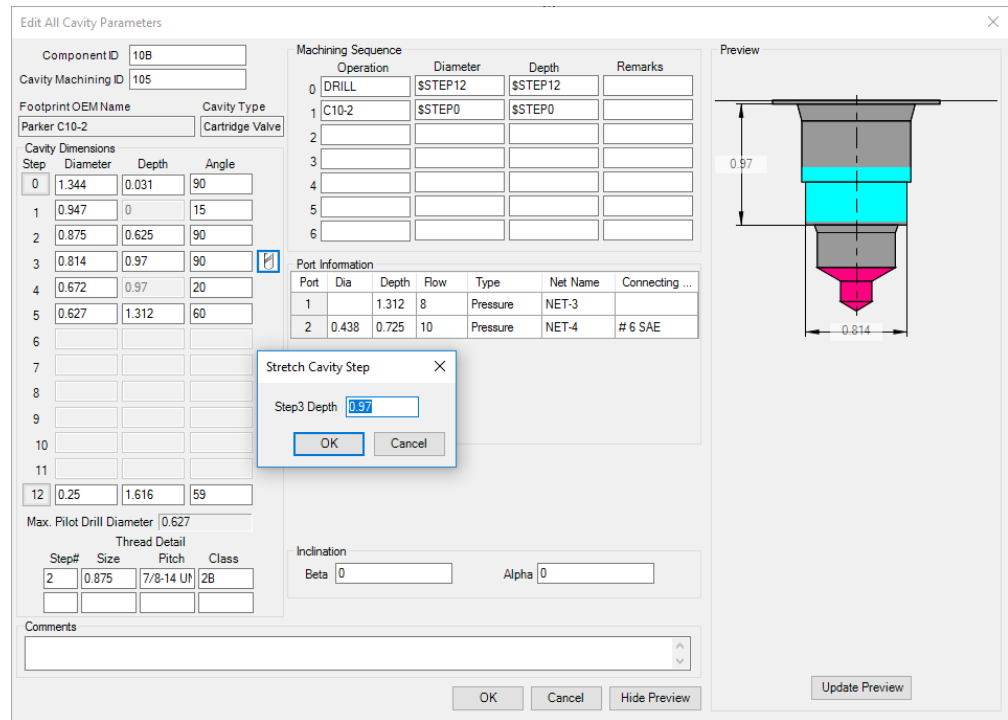
3. Click , the Stretch Cavity Step icon, displayed next to the Cavity Dimensions step, in which the top port of the cartridge valve cavity ends.

The *Stretch Cavity Step dialog box* displays.

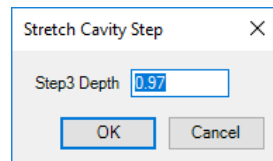
4. Enter the new step depth in the Stretch Cavity Step dialog box.

5. Click **OK**.
MDTools® automatically updates the data for all the affected steps and ports in the *Edit All Cavity Parameters dialog box*.

6. Click **OK** to save the changes.



Edit All Cavity Parameters dialog box



Stretch Cavity Step dialog box

Note

The Stretch Cavity Step icon is available, if there is a merged orifice plug in a cavity.

3 Sink Orifice Plug

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

1. MDTools 770 ribbon
>**Modify** panel
>**Edit**

The *Edit Cavity dialog box* displays.

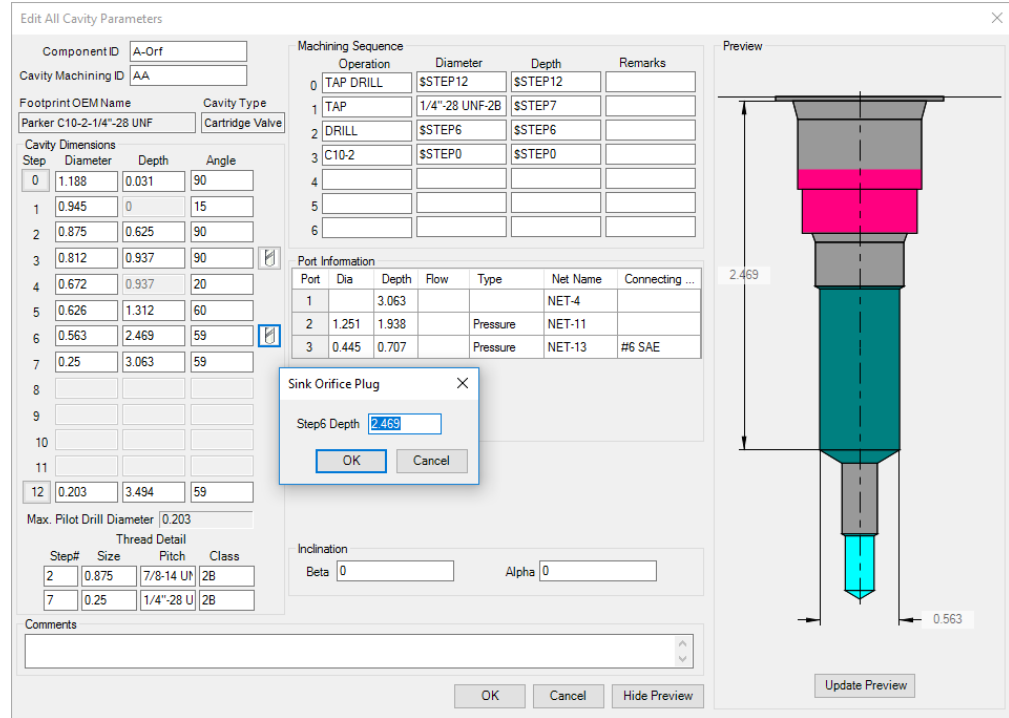
2. Click the **Edit All Parameters** button.

The *Edit All Cavity Parameters dialog box* displays.

3. Click , the **Sink Orifice Plug** icon, displayed next to the Cavity Dimensions step.

The *Sink Orifice Plug dialog box* displays.

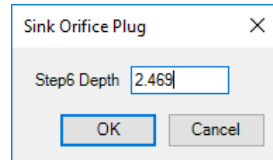
4. Enter the new step depth.



Edit All Cavity Parameters dialog box

5. Click **OK** in the Sink Orifice Plug dialog box.

MDTools[®] automatically updates the data for all the affected steps and ports in the *Edit All Cavity Parameters dialog box*.



Sink Orifice Plug dialog box

6. Click **OK** in the Edit All Cavity Parameters dialog box to save the changes.

Note

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

4 Edit Undercut

Change all the values of an undercut.

MDTools® modifies the existing undercut according to the new specifications.

- MDTools 770 ribbon
> **Modify** panel
> Edit

MDTools: Select Cavity dialog box displays.
- Select the undercut you want to modify.

The Edit Undercut dialog box displays.
- 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.
- 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.

- Modify the **undercut ID**.
- Change the **offset distance**, as required.

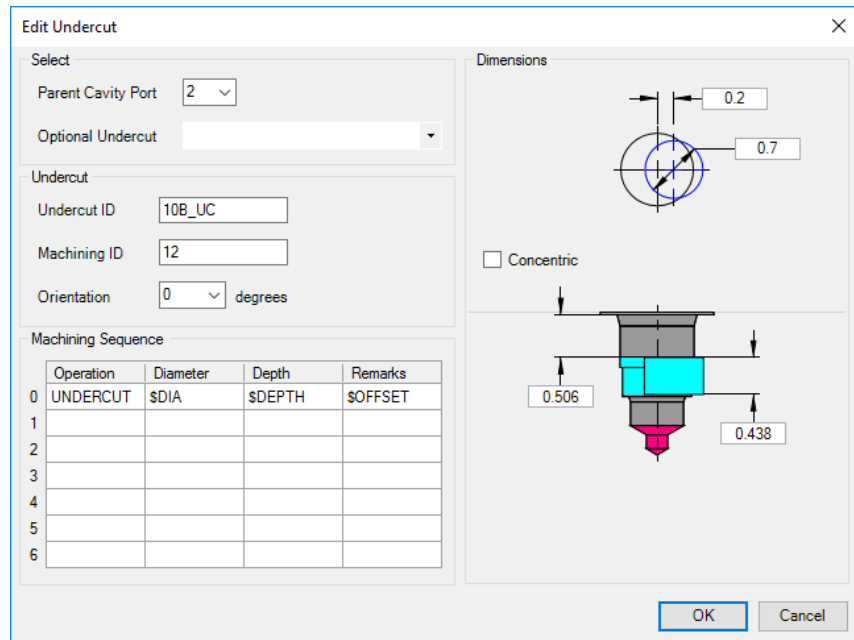
Change the desired distance between the center of the undercut and the selected cavity.
- Change the **undercut diameter**, as required.

Undercut diameter should be larger than the selected port diameter.
- Change the **undercut depth** from the spot face of the cavity, as required.
- Change the **undercut height**, as required.
- Modify the **orientation** from the drop down or enter the orientation angle.

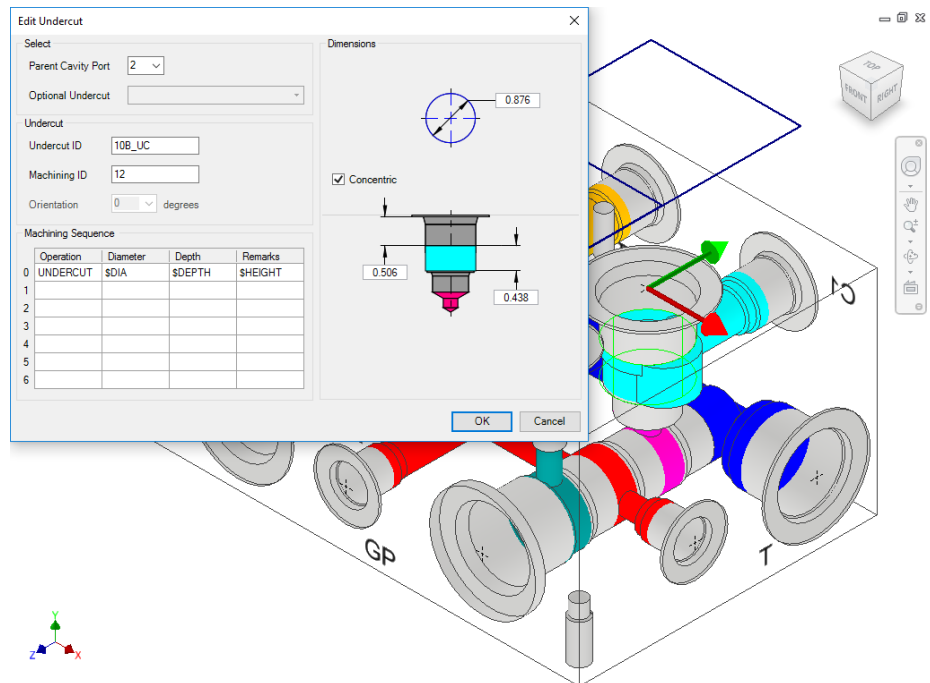
Enter the orientation angle between 0 to 360 degrees.

- Modify the **machining ID**.
- Click **OK**.

MDTools® automatically updates the selected undercut according to the changed dimensions.



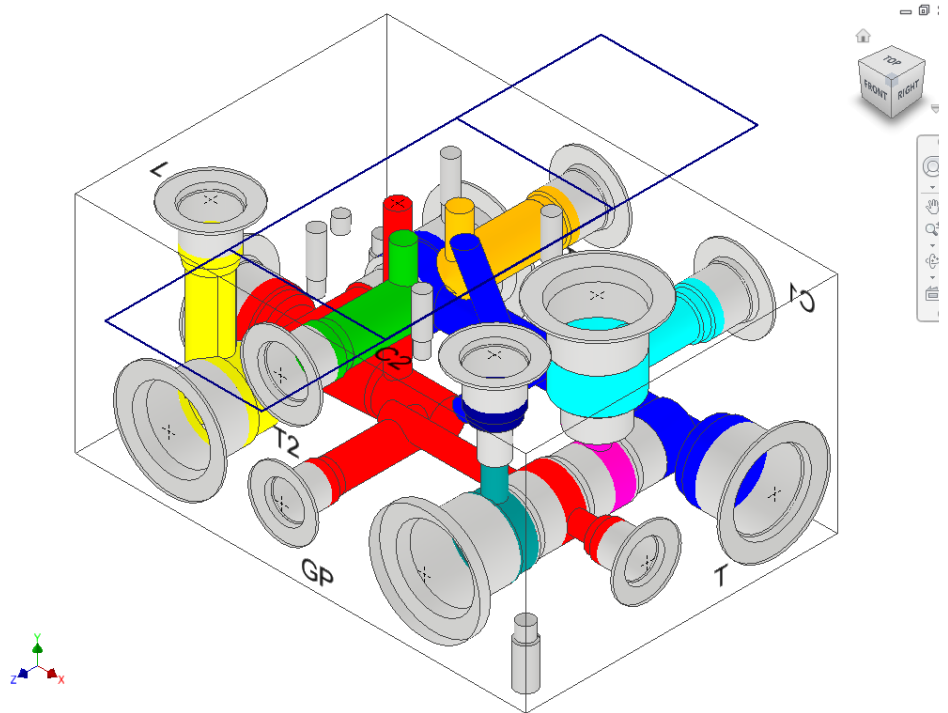
Edit Undercut dialog box



Modifying Offset Undercut to Concentric Undercut

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.



Offset Undercut changed to Concentric Undercut

5 Edit Slot

Edit or Change all the values entered when creating the slot, if you select a slot.

MDTools[®] modifies the existing slot according to the new specifications.

1. MDTools 770 ribbon
> **Modify** panel
> Edit
The MDTools: Select Cavity dialog box displays.
2. Select the slot you want to modify.
The Edit Slot dialog box displays.
3. Select any pre-defined slot, if required that exists for the cavity.
4. Change the slot ID, if required.
5. Change the slot **dimensions**, if required.

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

6. Change the slot depth, if required.

Slot depth should not be less than the parent cavity minimum drill depth.

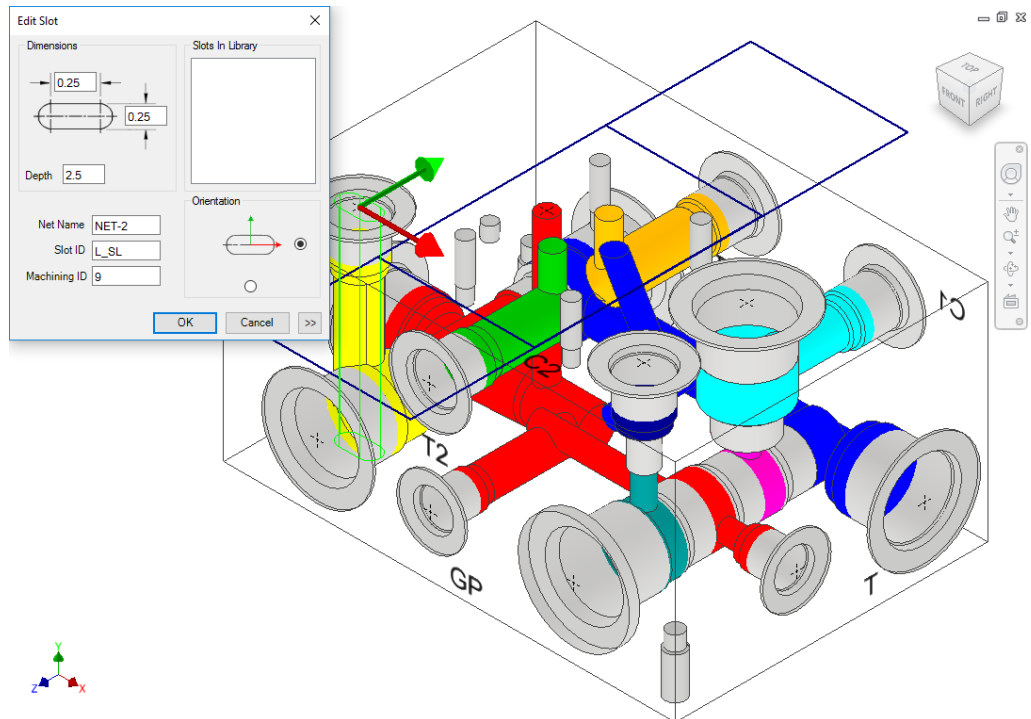
7. Change the orientation, if required.

Caution!

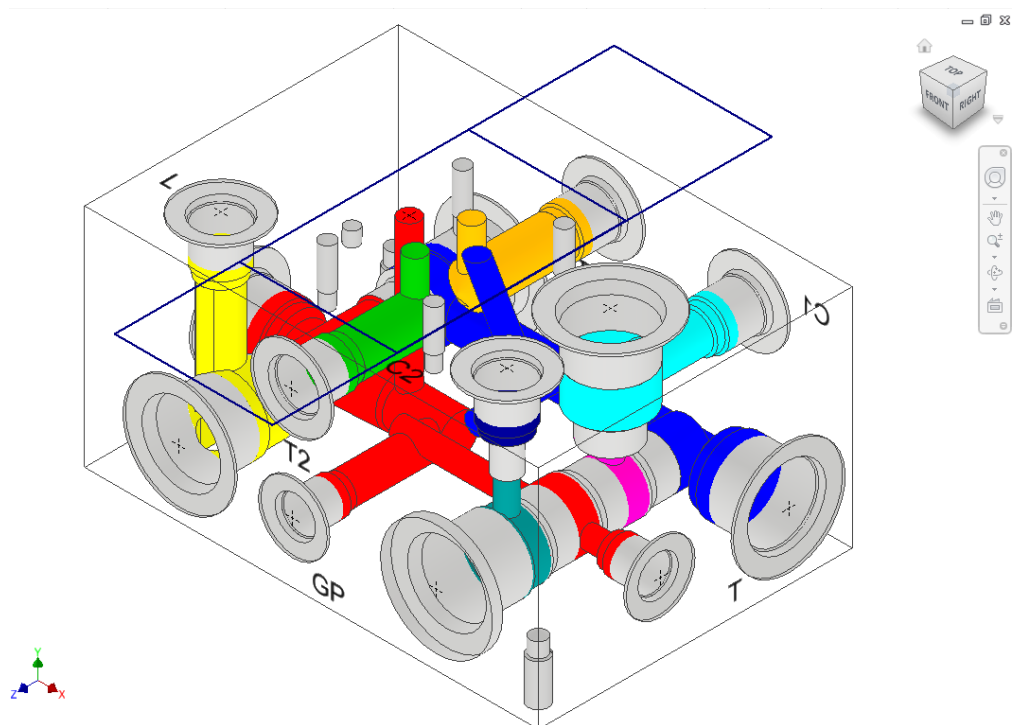
Changing connected slot orientation, intersects with the dead area of the connected cavity.

8. Change the machining sequence, if required.
9. Click **OK**.

MDTools automatically updates the selected slot according to the changed values.



Edit Slot dialog box



Slot: Orientation changed

6 Edit O-ring Groove

Edit an O-ring groove by selecting it.

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

1. MDTools 770 ribbon
>**Modify** panel
>**Edit**
>**O-ring Groove**

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. Modify **Component ID**.

4. Modify **Machining ID**.

5. Change the O-ring Groove dimensions either by selecting an O-ring or by manually modifying the dimensions.

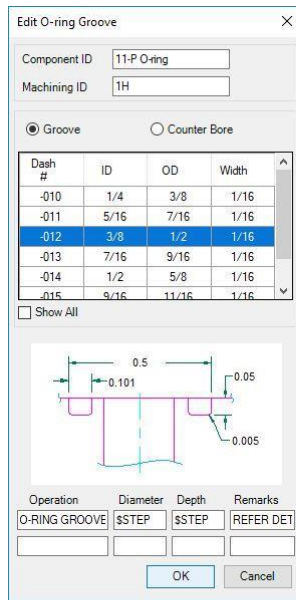
6. Change the machining sequence information, if required.

7. Click **OK**.

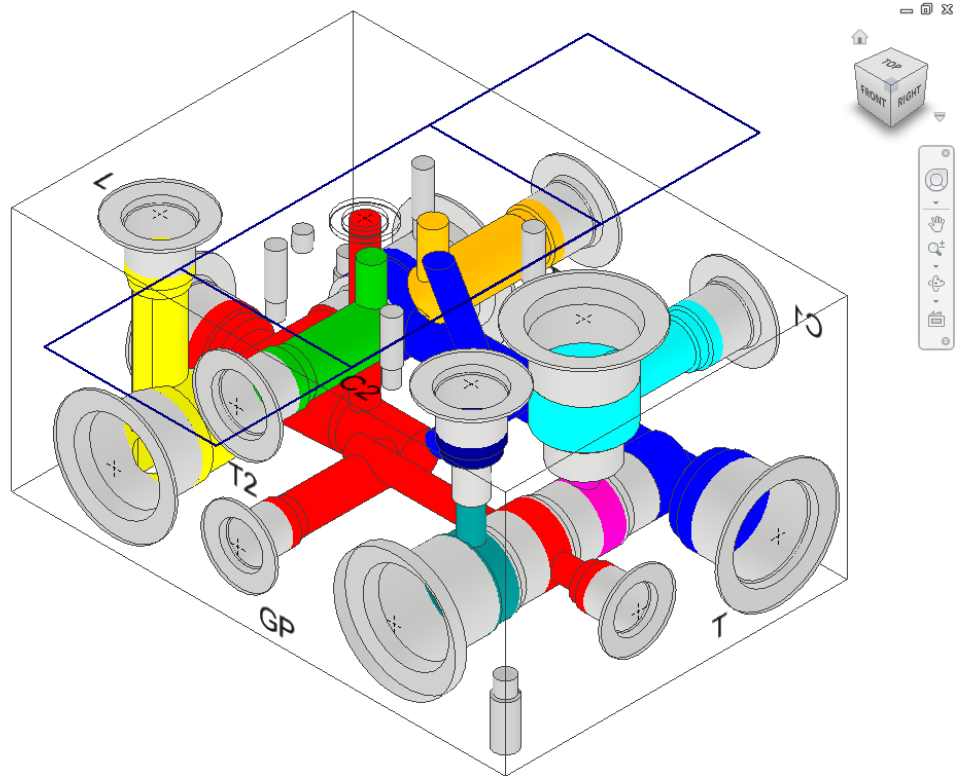
MDTools automatically modifies/creates a groove with the changed specification.

Note

- Use \$STEP for the Diameter and Depth field to easily maintain the machining chart information.
- \$STEP for depth is measured from the surface of the manifold in the Machining Chart.
- \$STEP takes the outer diameter as the diameter value in the machining chart.



Edit O-Ring Groove dialog box



MDTools automatically recreates the O-ring groove

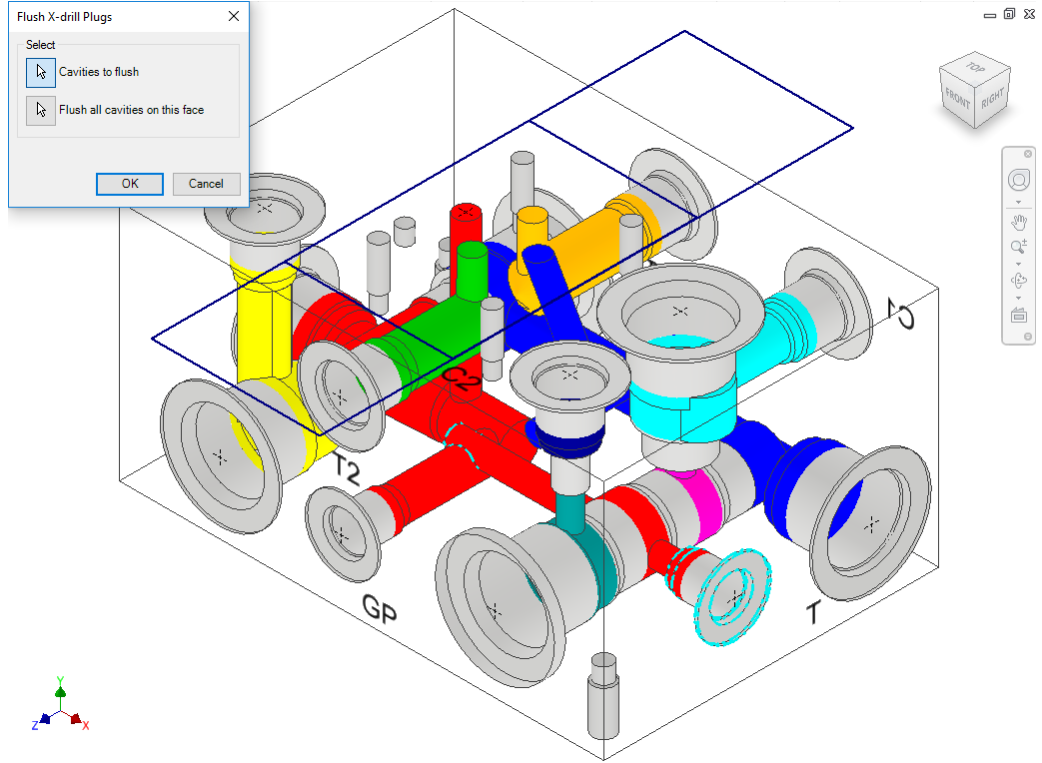
46. Flush X-drill Plugs

Automatically flush construction plugs below the manifold surface by increasing the spot face depth of the cavity.

Flush either the selected cavities or all the cavities on a selected face.

1. MDTools 770 ribbon >Modify panel >Flush

The Flush X-drill Plugs dialog box displays.



Flush selected X-drill Plugs

2. Click the Cavities to flush selection button and then select the cavities to flush the plugs.

The default option is Cavities to flush.

3. 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 X-drill Plugs dialog box

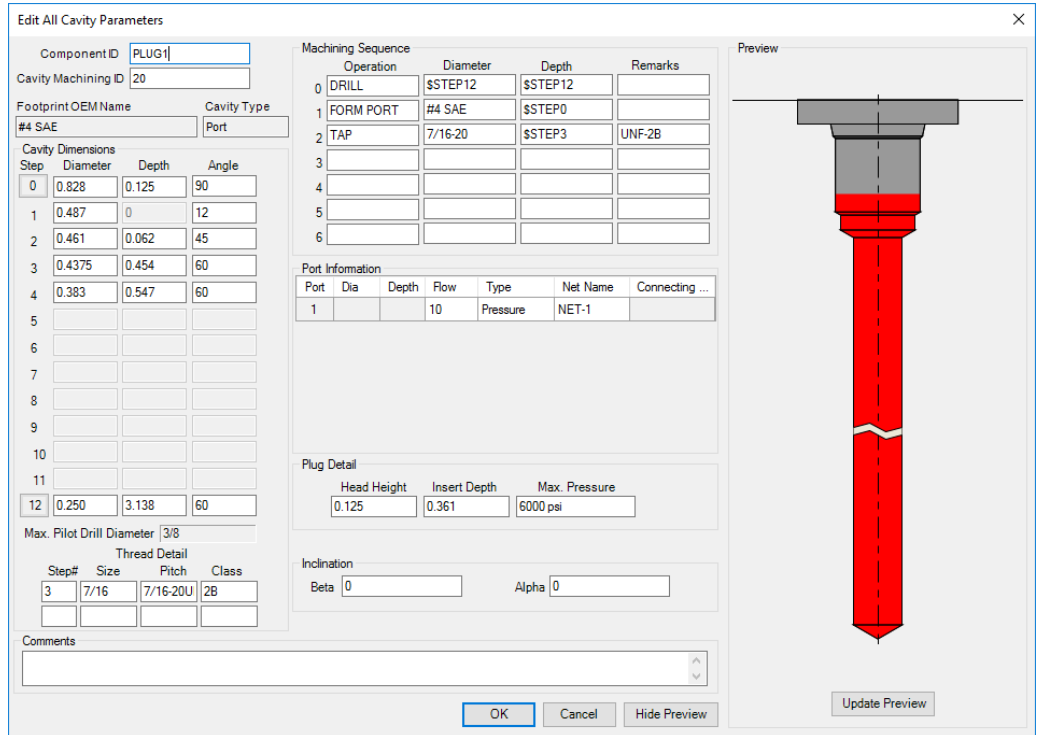
Flush X-drill Plugs on a selected face

4. Click  Flush all cavities on this face

Select the face.

5. Click OK.

MDTools flushes all the X-drill plugs on the selected face.



Edit All Cavity Parameters dialog box showing the updated spot face depth

47. Stretch Drill

Stretch the drill and change its depth by clicking and dragging the cavity to the required depth.

1. MDTools 770 ribbon
>**Modify** panel
>**Stretch**

The *Stretch Drill* dialog box displays.

2. Select a cavity in the manifold.

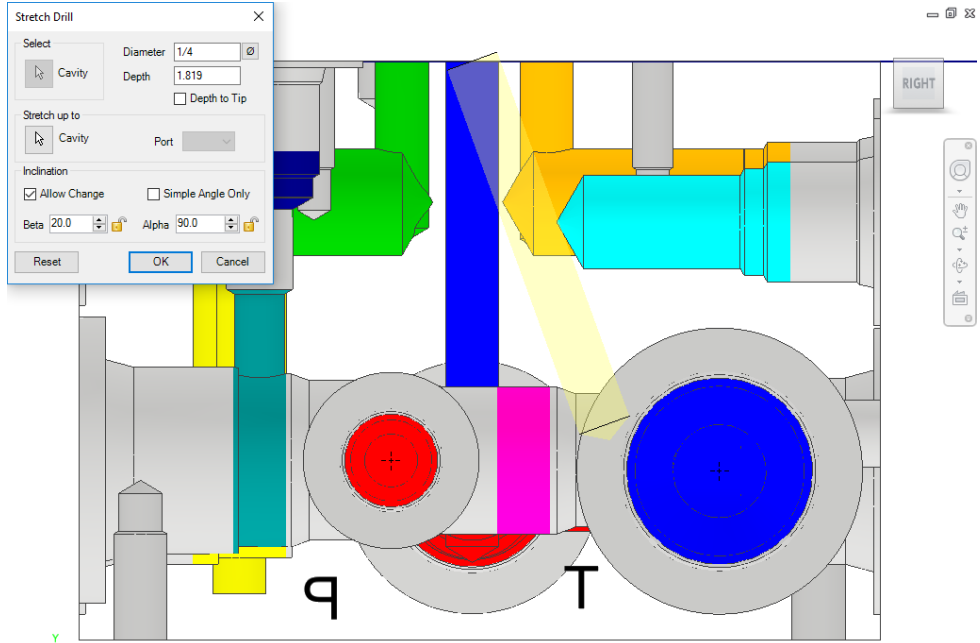
MDTools* displays the preview of the drill in the selected cavity.

The current drill depth and the diameter are displayed on the dialog box.

3. Change the drill depth, if required.
4. Click **OK**.

MDTools updates the drill depth and the diameter of the selected cavity.

5. Select **Depth to Tip**, if required.



Stretch Drill dialog box: Changing the drill depth by dragging

6. Click and drag the cavity to the required depth.

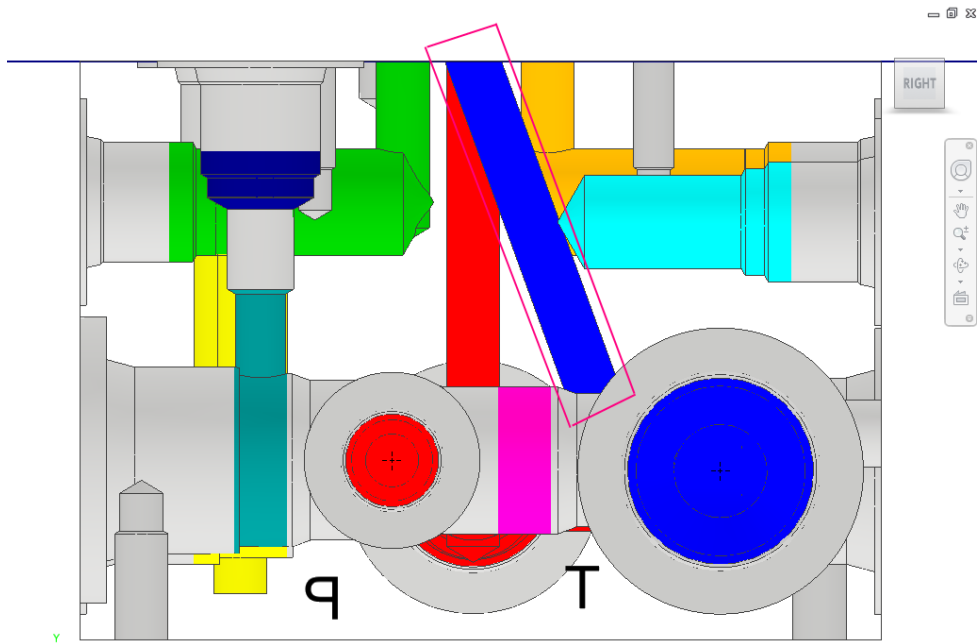
MDTools automatically updates the preview showing the new depth.

7. Release the mouse button, when you reach the required drill depth.

MDTools displays the new depth in the dialog box.

The **Stretch up to** function allows you to stretch the cavity to the selected cavity's port.

8. Select the cavity and port number.
9. Select the **Allow Change** option in the Inclination section, to interactively vary Beta and Alpha angle by entering the value in the Alpha or Beta text box or by dragging it manually.



Stretched Drill

Note

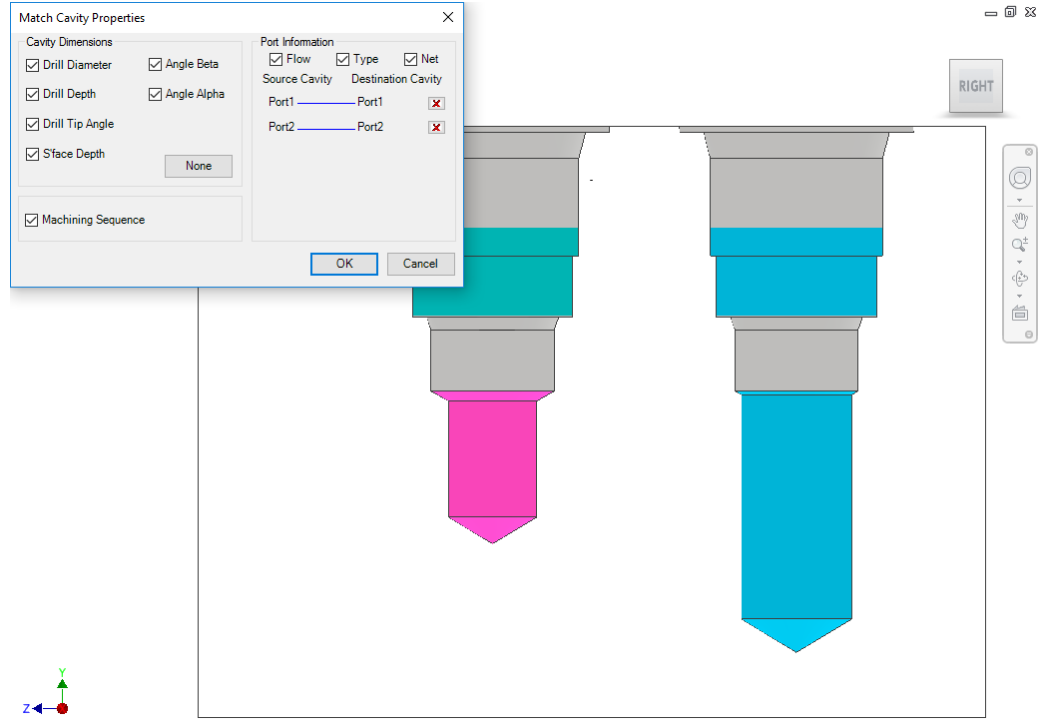
For better drag control, you may need to use either Beta or Alpha at a time.

1. Select **Simple Angle Only** to lock Alpha.
2. Click **OK**.

48. 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.

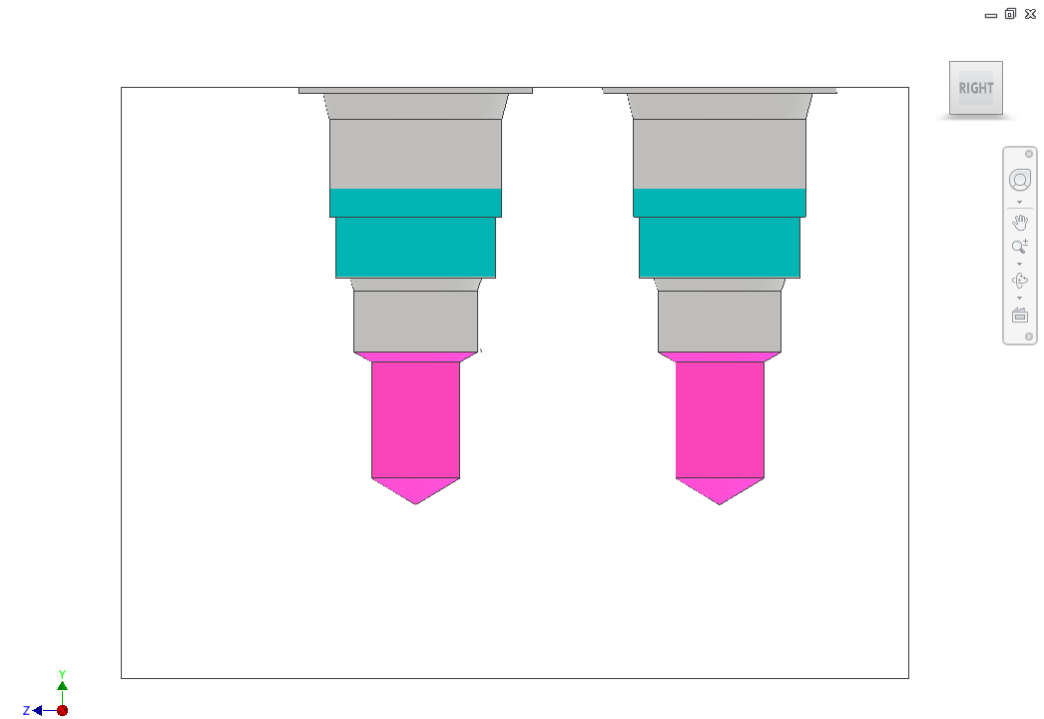
1. MDTools 770 ribbon
>**Modify** panel
>**Match Properties**
The Select Cavity dialog box displays.
2. Select the source cavity.
3. Select destination cavities.
4. Click **OK**.
The Match Cavity Properties dialog box displays.
5. Select properties you want to match.
6. Click **OK**.
MDTools updates the selected properties of destination cavities with that of the source cavity.*



Match Cavity Properties dialog box

Match Net Name

1. Click the source cavity port:
For example, Port1 Net.
2. Click the destination cavity port:
For example, Port2 Net.
MDTools displays a line connecting the selected ports to match the net names.
3. Click **X** to delete the selection.

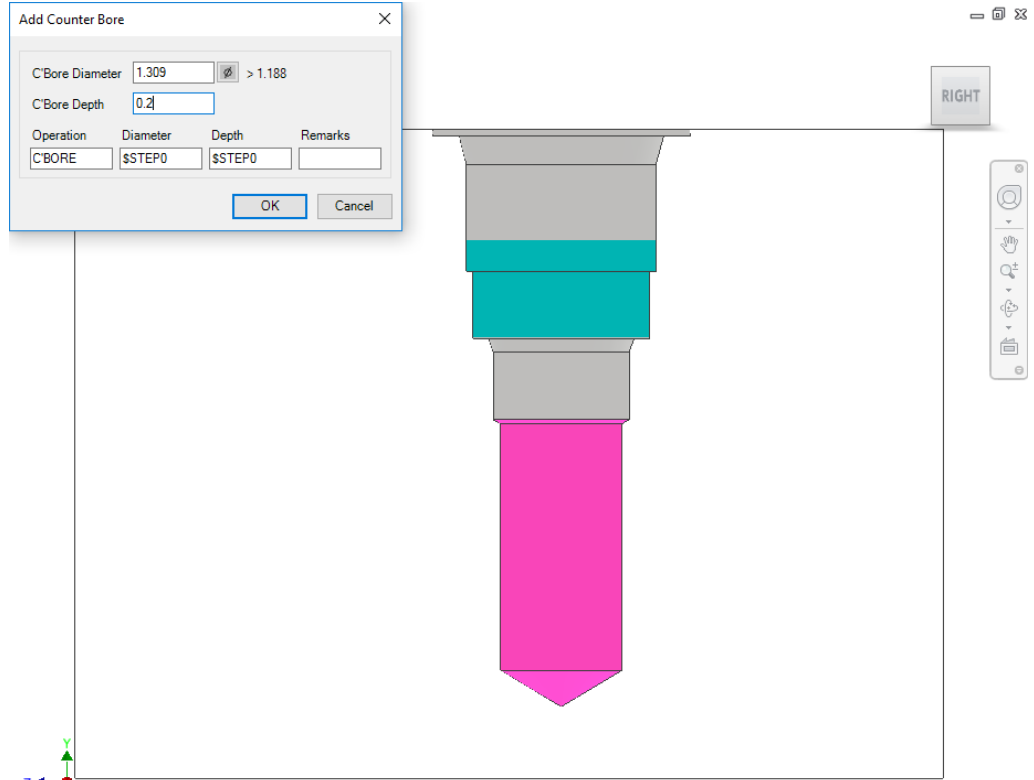


Cavity properties matched

49. Add Counter Bore

Automatically add a counter bore operation to an existing cavity.

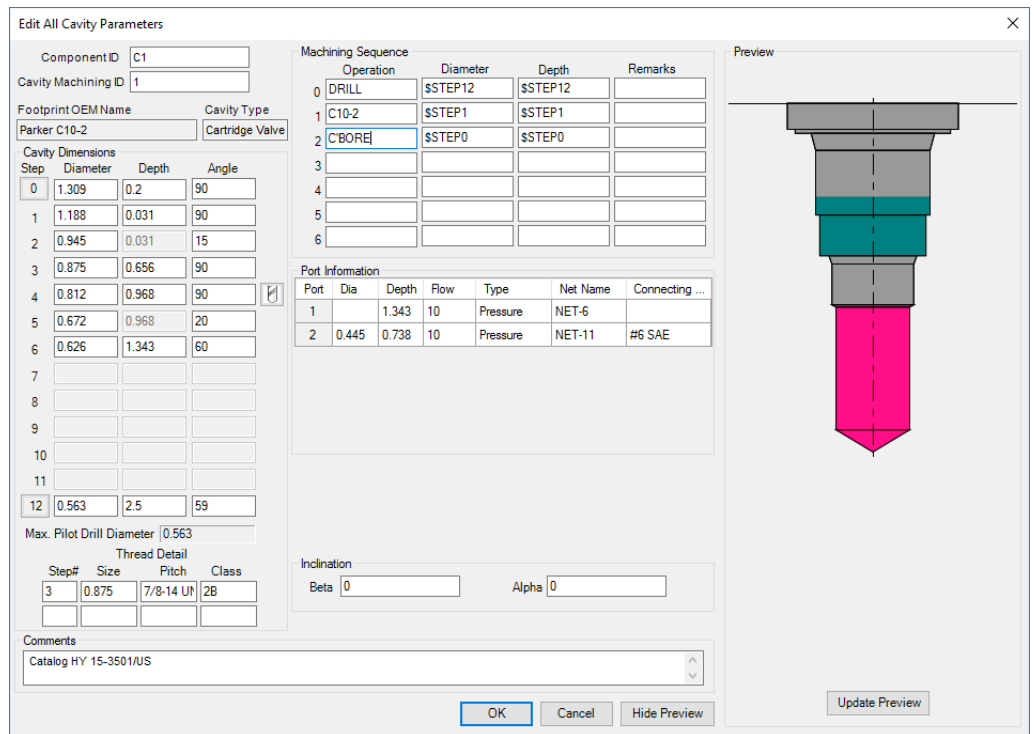
- MDTools 770 ribbon
>Modify panel
>Add Counter Bore
The Select Cavity dialog box displays.
- Select the cavity in which you want to add the counter bore.
The Add Counter Bore dialog box displays.
- Enter the counter bore diameter and depth.
- Change the machining details, if required.
- Click **OK** to add the counter bore to the selected cavity.



Add Counter Bore dialog box

Note

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



Cavity data after adding the counter bore

50. Add Drill

Automatically add a drill operation to an existing cavity.

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

1. MDTools 770 ribbon
>Modify panel
>Add Drill

The Select Cavity prompt displays.

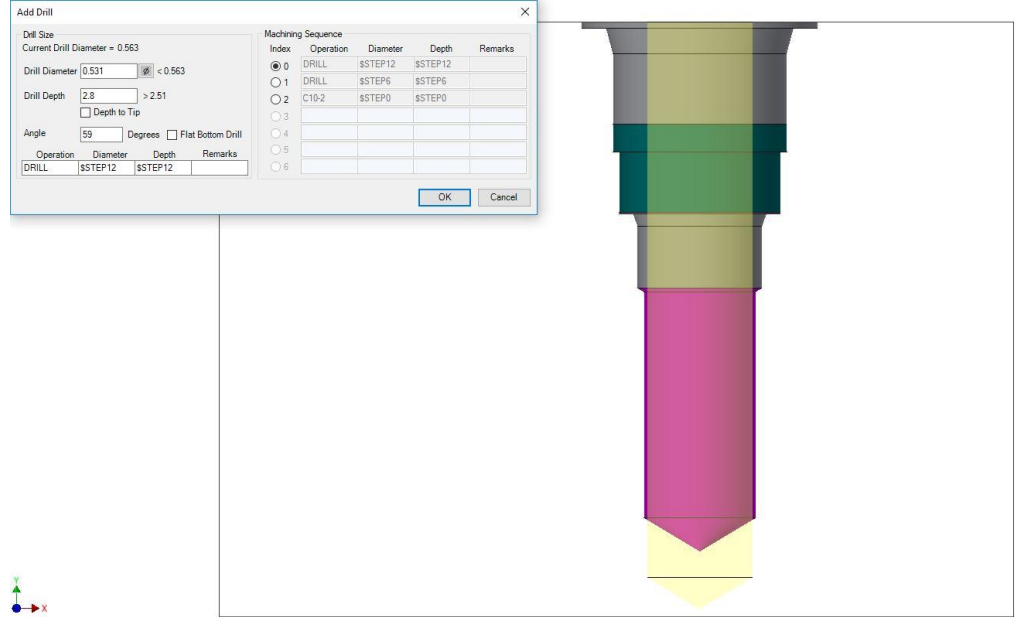
2. Select the cavity in which you want to add the drill.

The Add Drill dialog box displays.

3. Enter the drill diameter and depth.

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

When changing drill dimensions, MDTools automatically updates the drill preview.



Add Drill dialog box

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

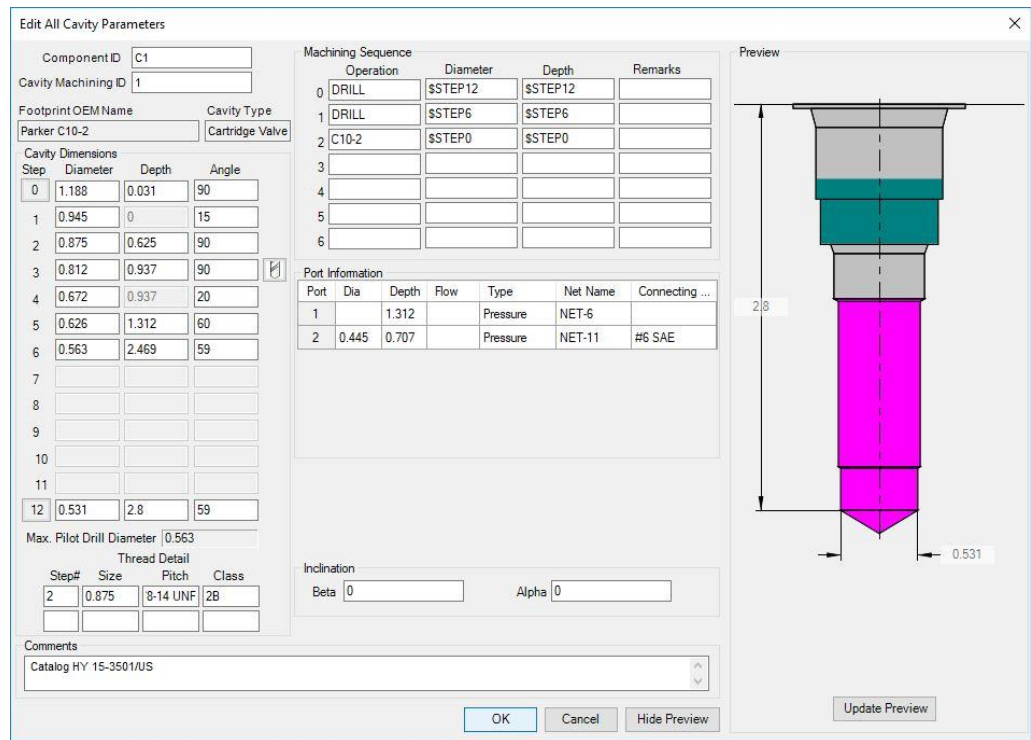
5. Select the location of a new machining operation in the cavity machining sequence.

The default location is the first row in the machining sequence.

6. Change the machining details, if required.

7. Select **Flat Bottom Drill**, if required.

8. Click **OK** to add the drill to the selected cavity.



Cavity data after adding the drill

51. Delete Cavity

The MDTools® cavity consists of multiple Inventor features; the **Delete Cavity** command enables you to automatically delete the complete cavity/footprint. All the features used to create the cavity/footprint are automatically deleted.

1. MDTools 770 ribbon
>**Modify** panel
>**Delete Cavity** dropdown
>**Delete Cavity**

The *Delete Cavity dialog box displays.*

2. Select cavities/footprints you want to delete.

When you move the cursor over a cavity, it gets highlighted. This indicates the selected cavities/footprints for deleting.

Note

Footprint engravings are deleted only when the **Delete Complete Footprint** option is selected.

3. Click **OK**.

MDTools deletes all the features used to create cavities/footprints in Inventor along with engravings, if selected.

Note

If you select a cavity in a footprint, then the complete footprint is deleted.

Deleting a single cavity from a footprint

To delete a single cavity from a footprint, use the Delete Cavity option on the MDTools Cavities browser context menu.

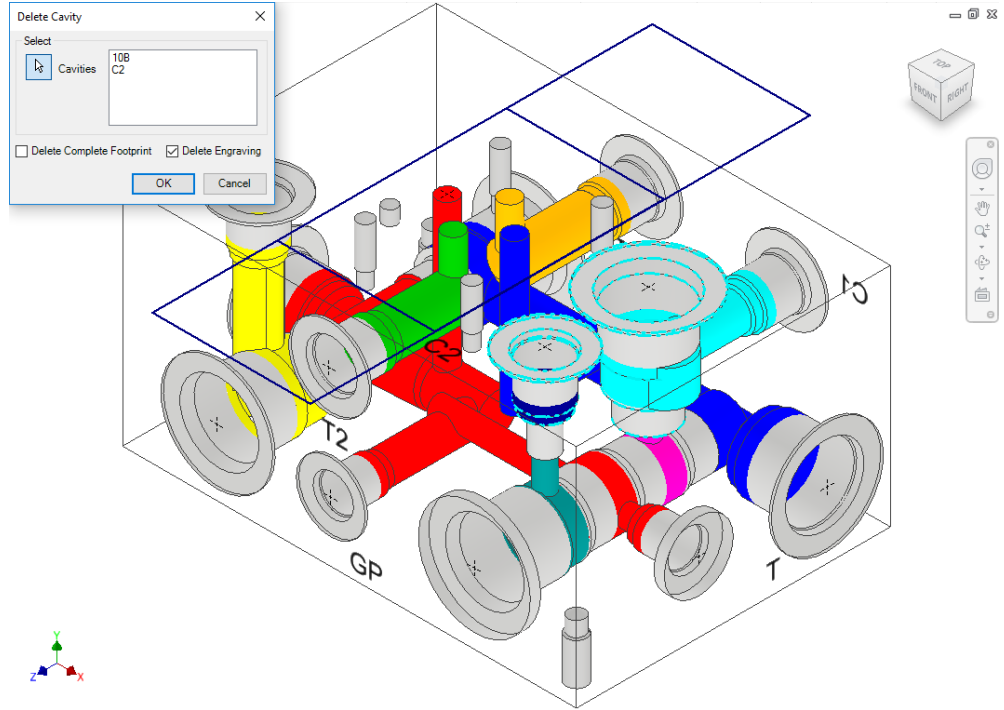
1. Select the cavity from the MDTools Cavities browser.
2. Right-click the selected cavity.

The context menu displays.

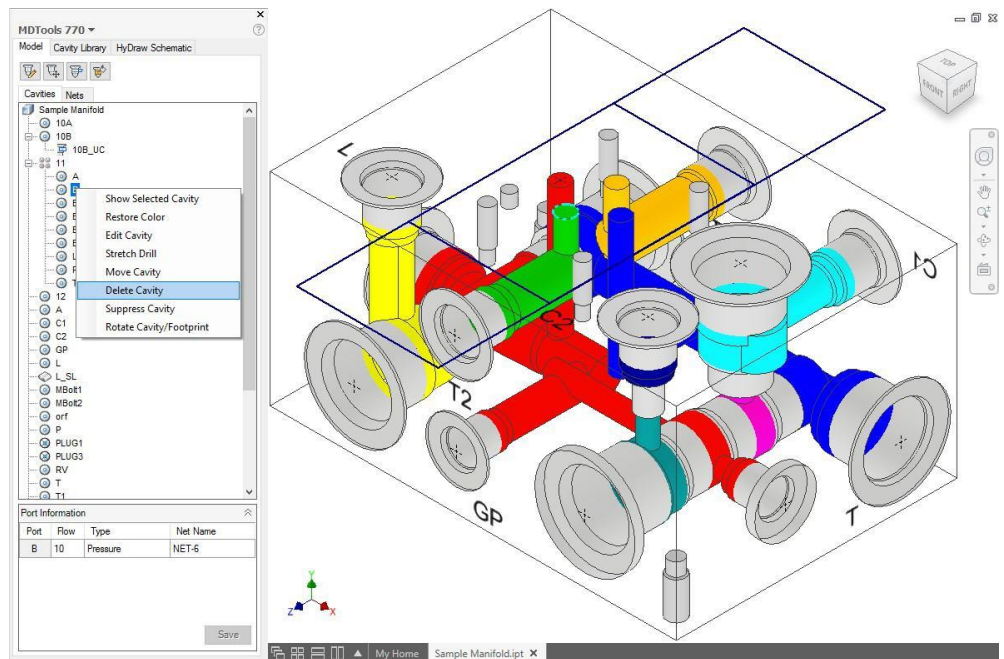
The context menu displays.

3. Click **Delete Cavity** from the context menu.

MDTools deletes the selected cavity from the footprint.



Delete Cavity dialog box: Cavity highlighted on moving cursor over the cavity



Delete single cavity from a footprint

52. Delete O-ring Groove

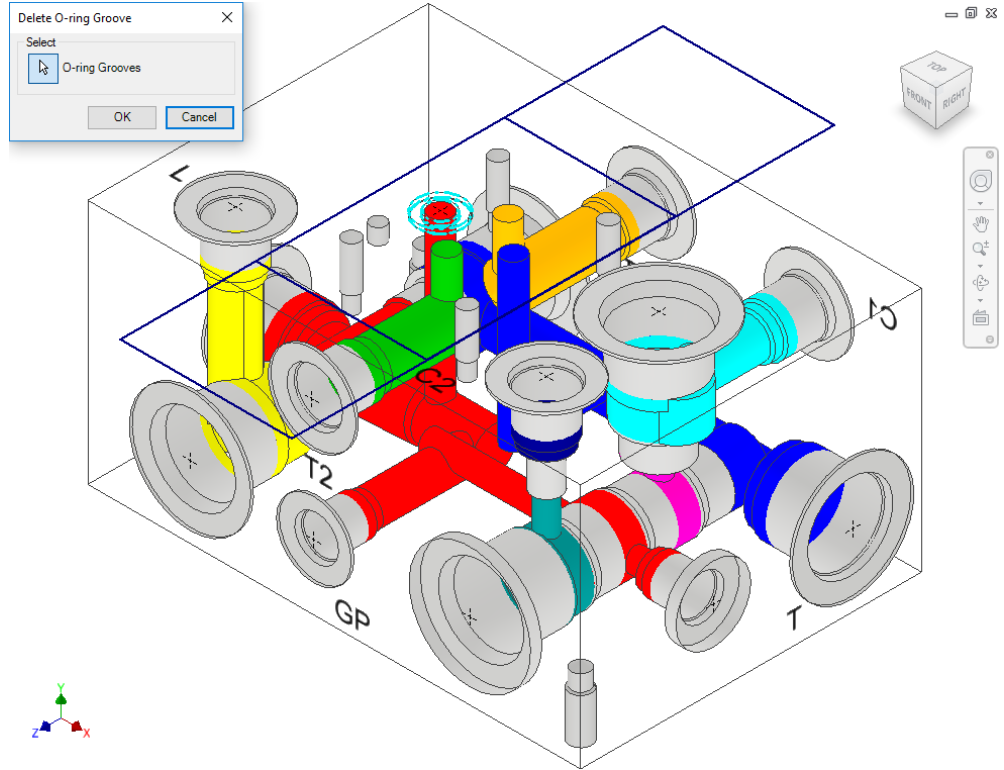
All features used to create an O-ring are automatically removed on deleting the O-ring groove.

1. MDTools 770 ribbon
>Modify panel
>Delete Cavity dropdown
>Delete O-ring Groove

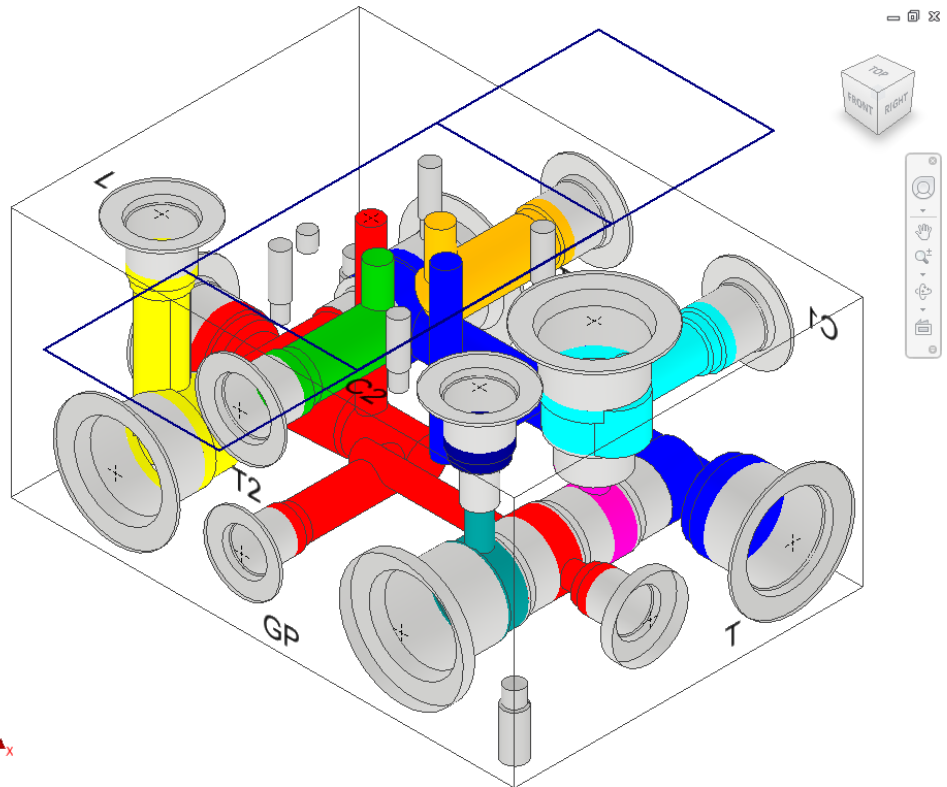
The Delete O-Ring Groove dialog box displays.

2. Select all O-ring grooves you want to delete.
When you move the cursor over an O-ring groove, it gets highlighted.

3. Click OK.
MDTools deletes all the selected O-ring grooves along with the features used to create the O-ring groove inside the Inventor.*



Delete O-Ring Groove dialog box



O-ring groove deleted

53. Delete Outline

Delete an assembly envelope around selected cavities/footprints that are created using the Insert Outline command.

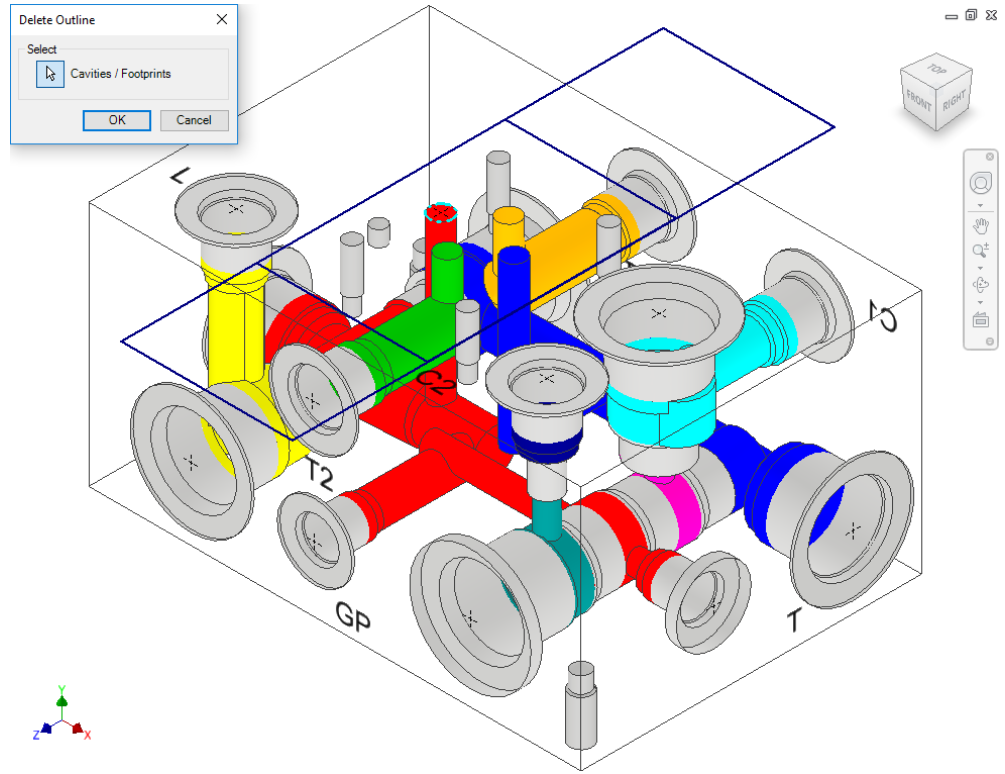
1. MDTools 770 ribbon
>Modify panel
>Delete Cavity dropdown
>Delete Outline

The Delete Outline dialog box displays.

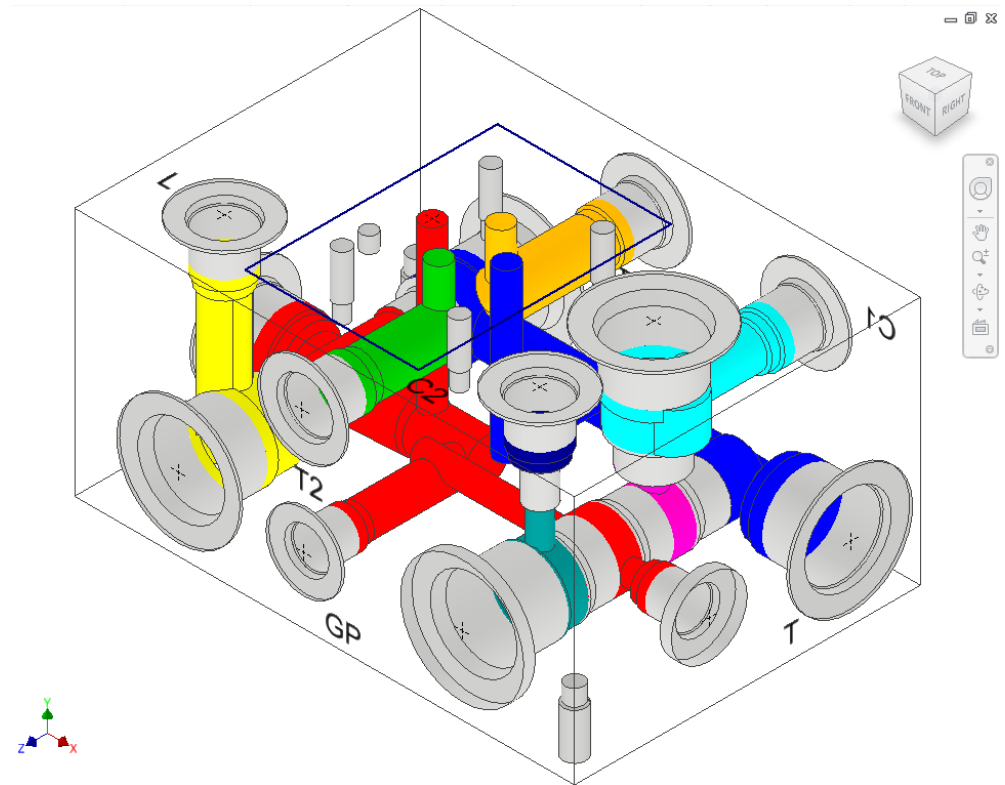
2. Select the cavities/footprints from which you want to delete the outline.

3. Click OK.

MDTools[®] automatically deletes the outlines around the selected cavities/footprints.



Delete Outline dialog box



Assembly envelope automatically deleted

54. Constrain/Unconstrain Cavities

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

The Constrain feature enables you to automatically update 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 770 ribbon

>Modify panel

>(Un)Constrain

The Constrain Cavities dialog box displays.

Constrain Cavities

1. Select the cavities you want to constrain.

'Cavities' is the default selection.

Note

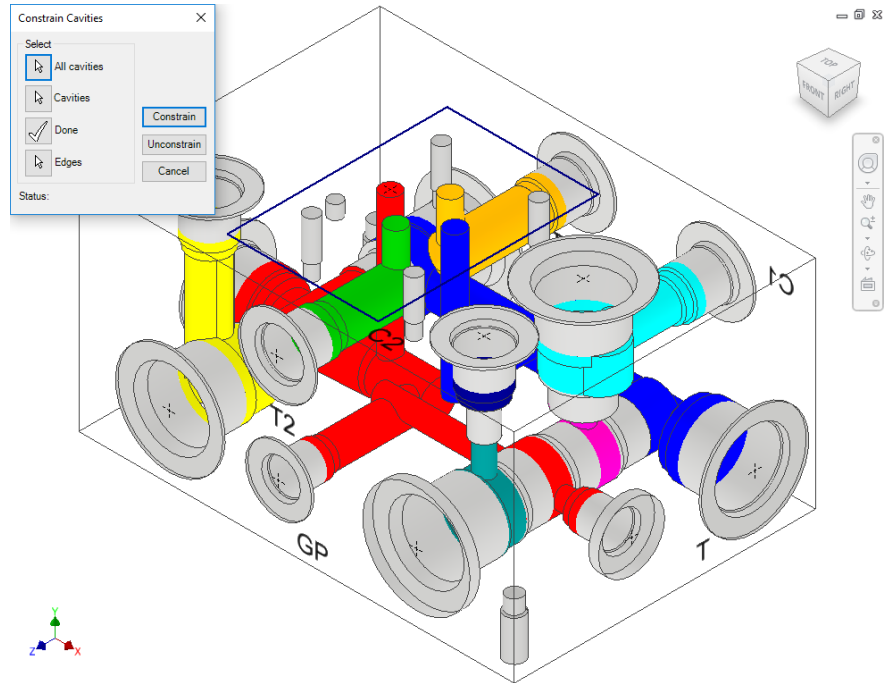
When you need to constrain the cavities to another cavity, first select the cavity to which you want to constrain.

2. Click **Done** to finish the cavity selection.

The Constrain and Unconstrain buttons are enabled.

3. Click Constrain.

All cavities selected after the selection of the first cavity are constrained to the first cavity.



Constrain Cavities dialog box

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.

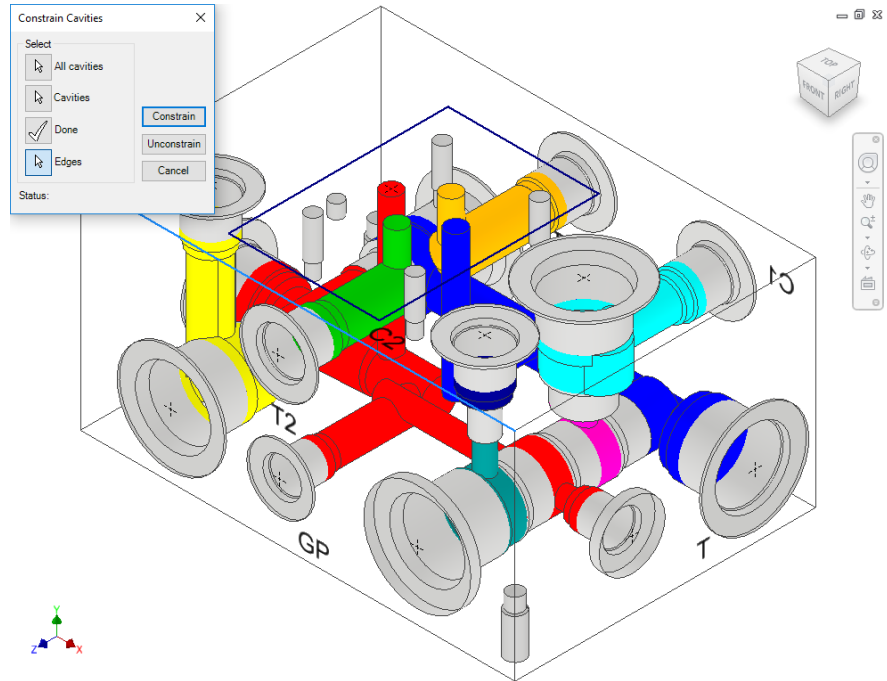
Constrain All Cavities

1. Click the **All cavities** selection.
2. Click Constrain.

All 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.

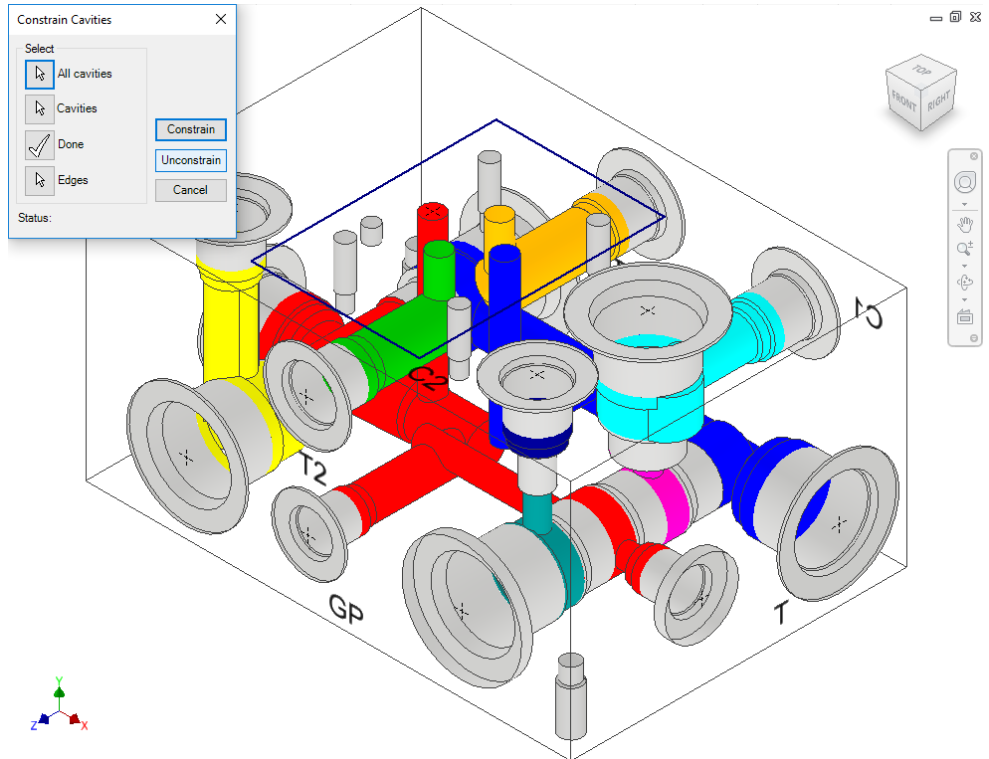


Constrain and Unconstrain buttons enabled

Unconstraining Cavities

1. Select the cavities you want to unconstrain.
2. Click **Done** to finish the selection.
3. Click Unconstrain.

MDTools unconstrains the selected cavities.*



Unconstraining All Cavities

1. Click the **All cavities** selection.
2. Click Unconstrain.

MDTools unconstrains all the selected cavities on the manifold.

Note

Shading of constrained cavities is not updated automatically.

Unconstraining the constrained cavities on the manifold

55. Suppress/Unsuppress Cavities

Suppress a cavity/footprint or unsuppress a suppressed cavity/footprint.

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

MDTools 770 ribbon

>Modify panel

>Suppress

The (Un)suppress Cavity dialog box displays.

The Cavities option is selected by default.

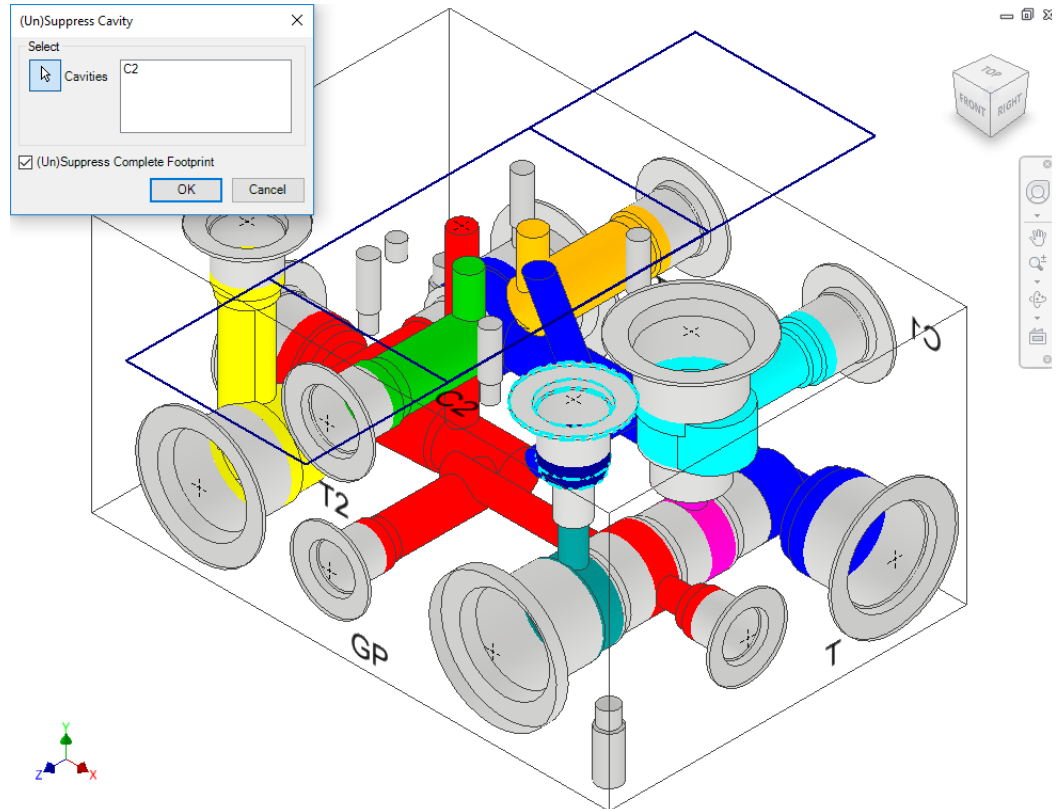
Suppressing cavities

1. Select the cavities/footprints you want to suppress.
2. Click **OK**.

MDTools suppresses all the selected cavities.

Note

If you select **UnSuppress Complete Footprint**, then the complete footprint is suppressed.



(Un)Suppress Cavity dialog box

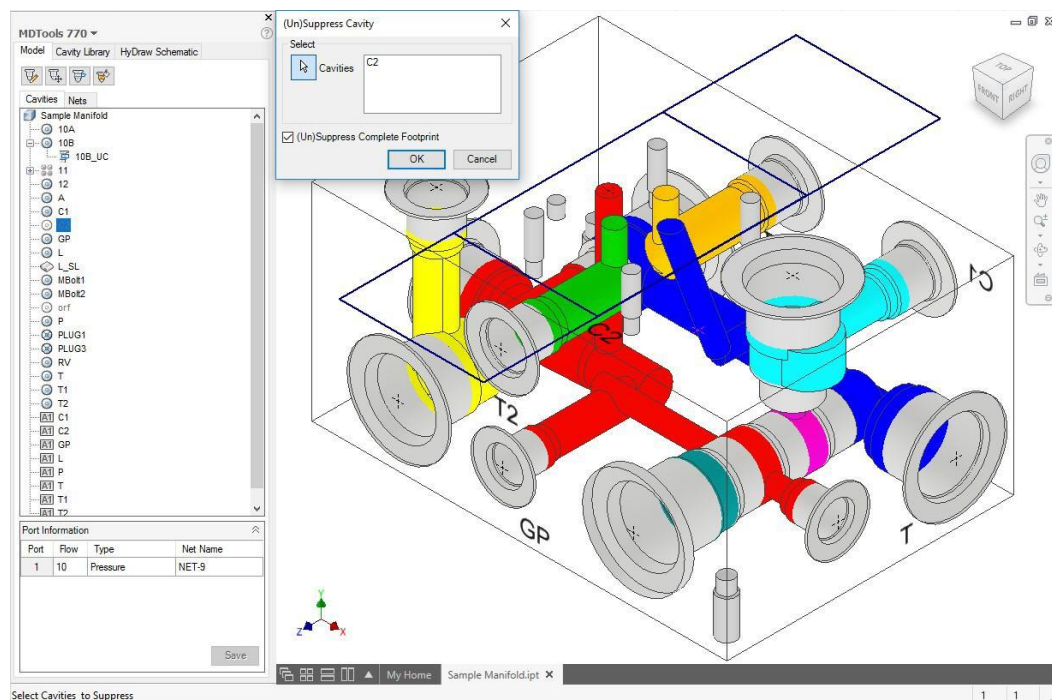
Unsuppressing Cavities

1. Select the cavity/footprint you want to unsuppress.

Select the cavity from the browser.

2. Click **OK**.

MDTools unsuppresses all the selected cavities; if a cavity belongs to a footprint, then the complete footprint is un-suppressed.



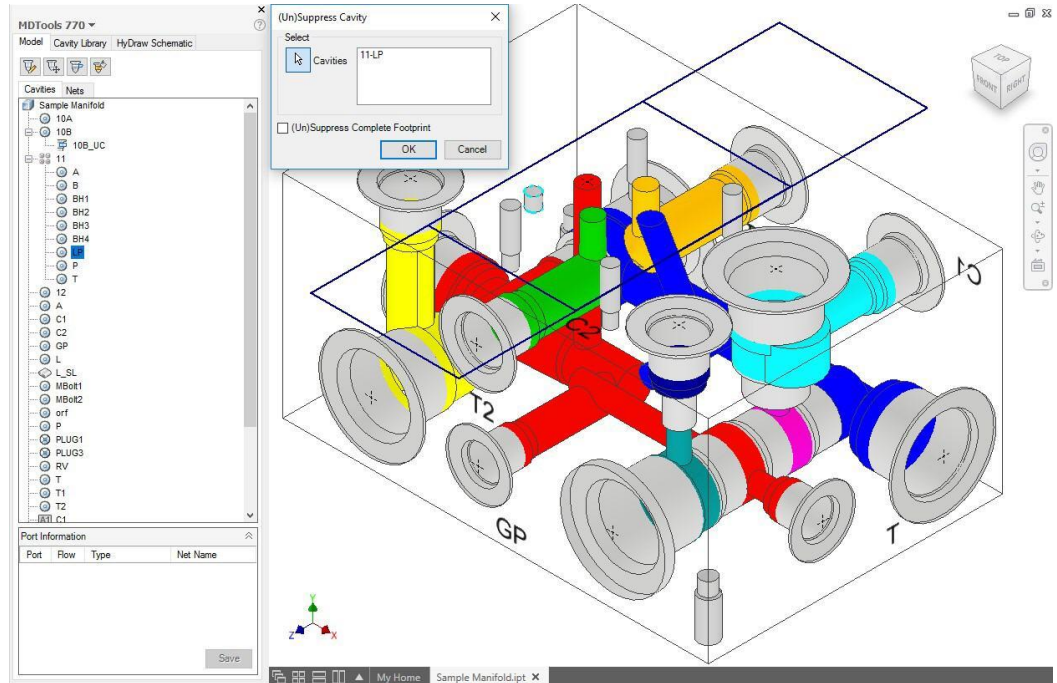
Select cavities from the browser

Suppressing a single cavity in a footprint

To suppress a single cavity in a footprint, click the Suppress Cavity option on the MDTools® Cavities browser context menu.

1. Select a cavity.
2. Right-click the selected cavity.
3. Select **Suppress Cavity** from the context menu.

MDTools suppresses the selected cavity in the footprint.



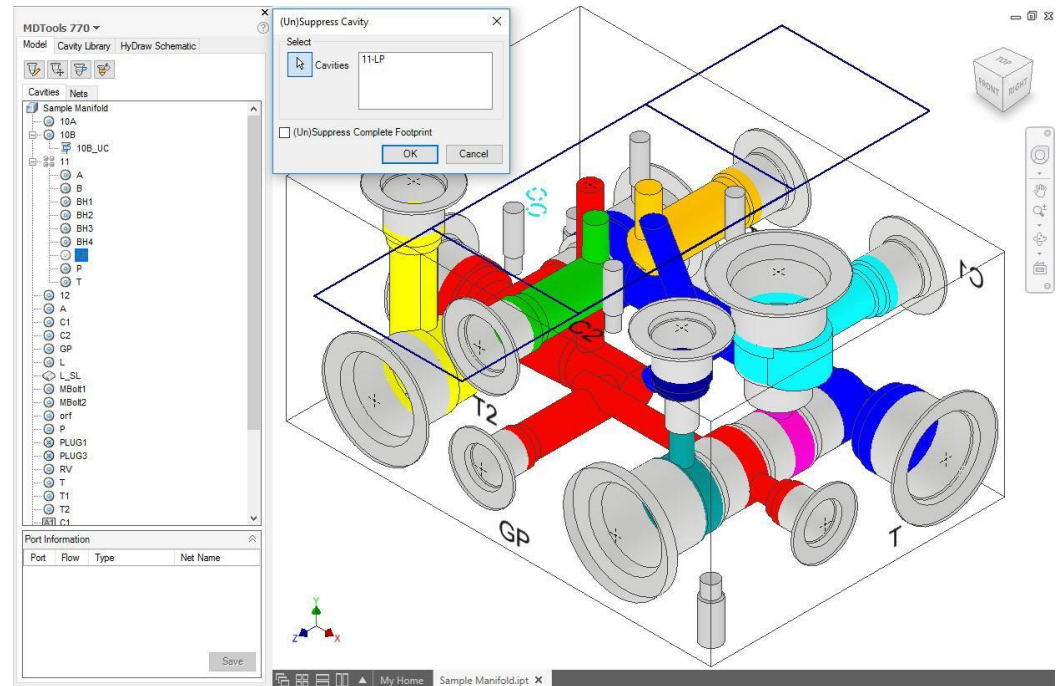
Suppress a single cavity in a footprint

Unsuppressing a single cavity in a footprint

To unsuppress a single cavity in a footprint, click the Unsuppress Cavity option on the MDTools Cavities browser context menu.

1. Select the cavity from the MDTools Cavity browser.
2. Right-click the selected cavity.
3. Select **Unsuppress Cavity** from the context menu.

MDTools unsuppresses the selected cavity in the footprint.



Unsuppress a single cavity in a footprint

56. Minimize Depth

Ensure minimum drill travel in an empty cavity space.

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

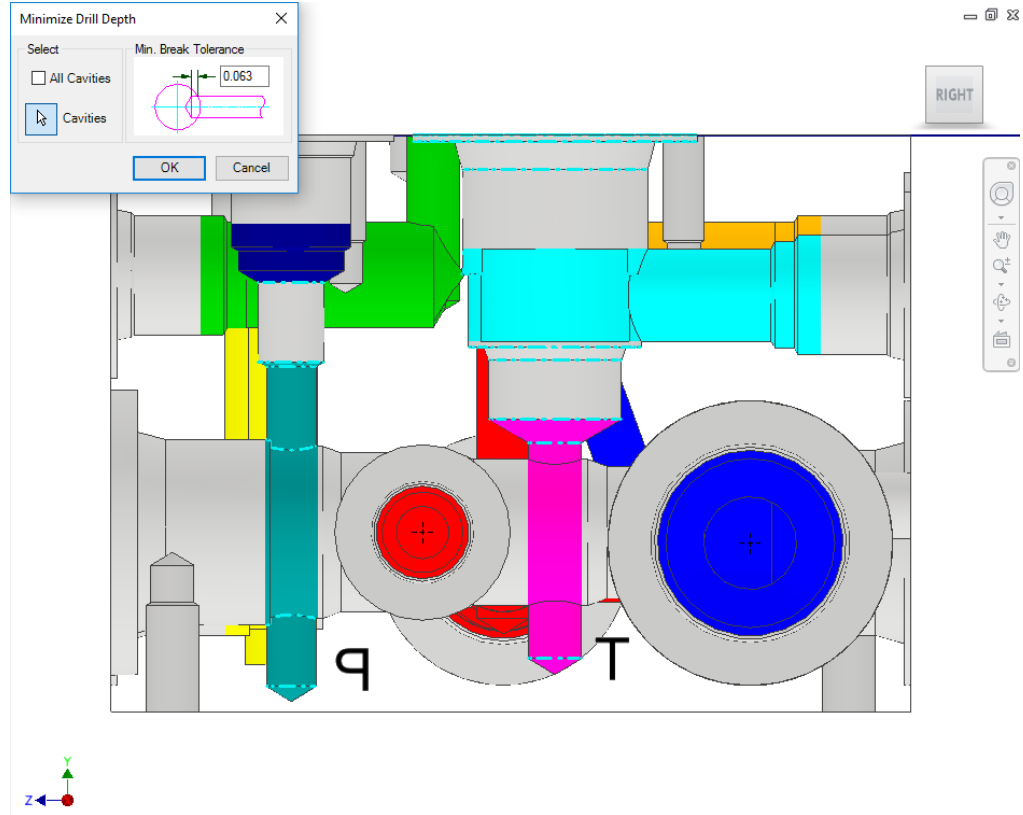
1. MDTools 770 ribbon
>**Modify Block** panel
>Slide out menu
>**Minimize Depth**

The *Minimize Drill Depth* dialog box displays.

The *All Cavities* selection option is selected by default.

2. Click the **Cavities** selection button and select the required cavities, if you don't want to minimize the depth of all the cavities.
3. Enter the minimum break tolerance in the pane.
4. Click **OK**.

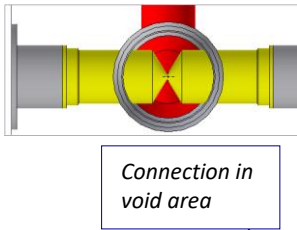
MDTools® updates the drill depth of all selected cavities to the minimum specified.



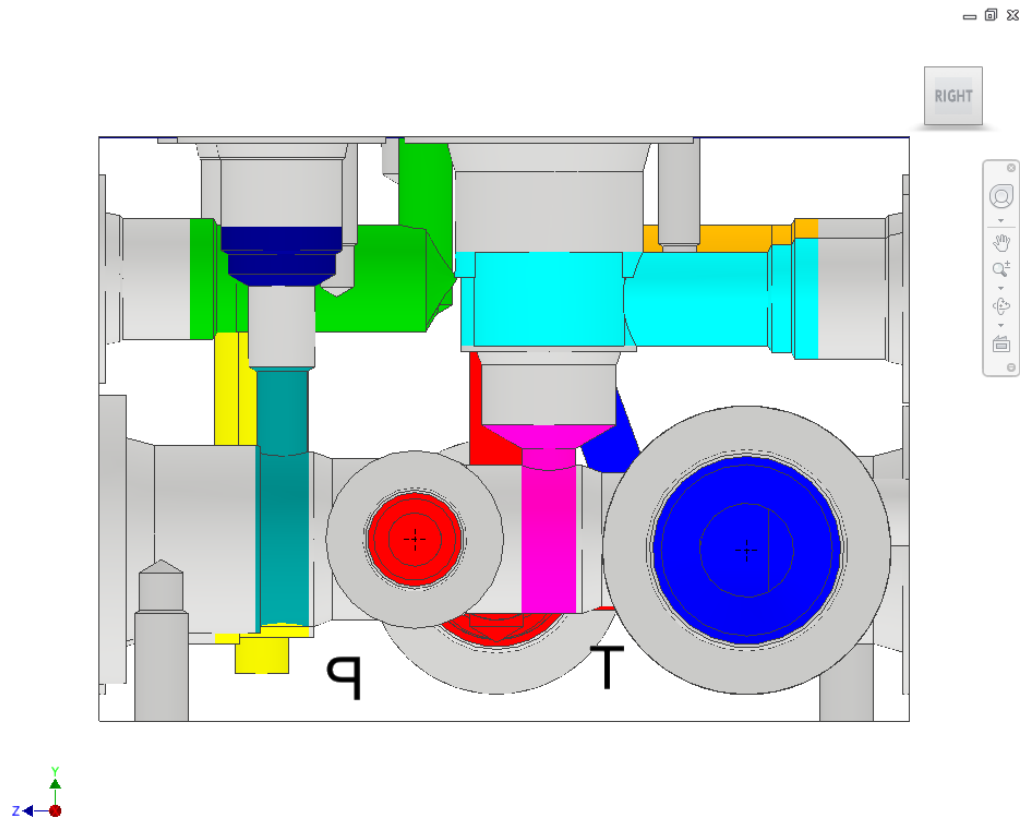
Minimize Drill Depth dialog box

Note:

If two cavities connecting another cavity intersect inside the empty cavity space (refer the figure below), then MDTools is unable to minimize the drill depth of the 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.



Drill depth reduced to the minimum

57. Update Precision

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

1. MDTools 770 ribbon
>Modify panel
>Update Precision

The Update Precision dialog box displays.

Location Precision

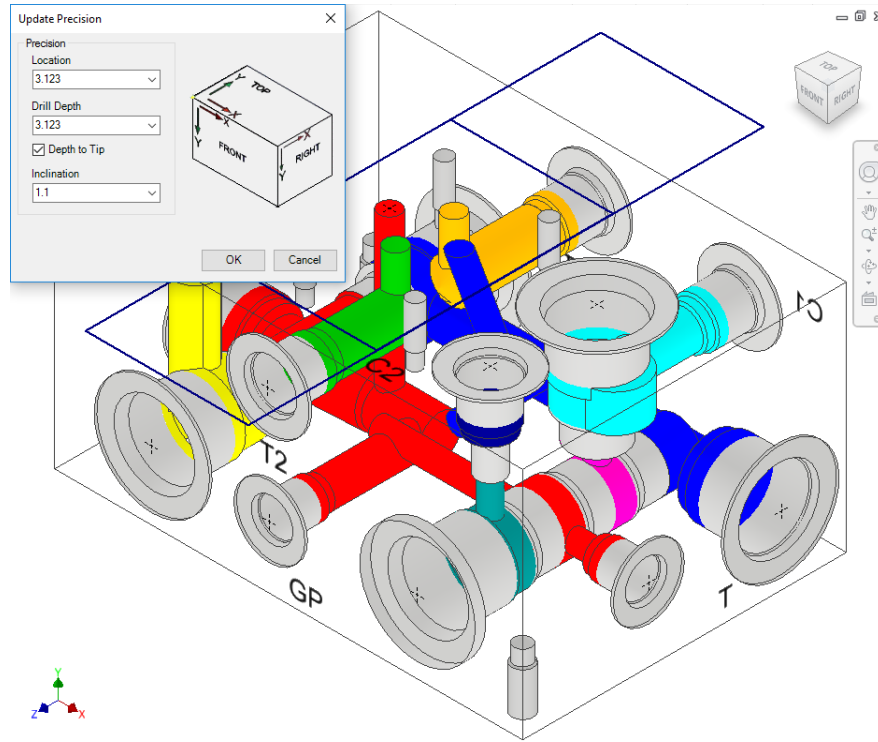
Select the desired location precision from the dropdown list.

Drill Depth Precision

Select the desired drill depth precision from the dropdown list.

Note

Select the Depth to Tip precision, as required.

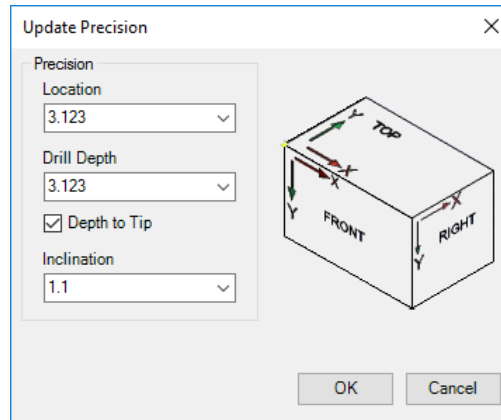


Update Precision dialog box

Inclination Precision

1. Select the desired angle precision from the dropdown list.
2. If you don't want to change any of the mentioned precision values, use the default Do Not Change option.
3. Click OK.

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



Update Precision dialog box

Note

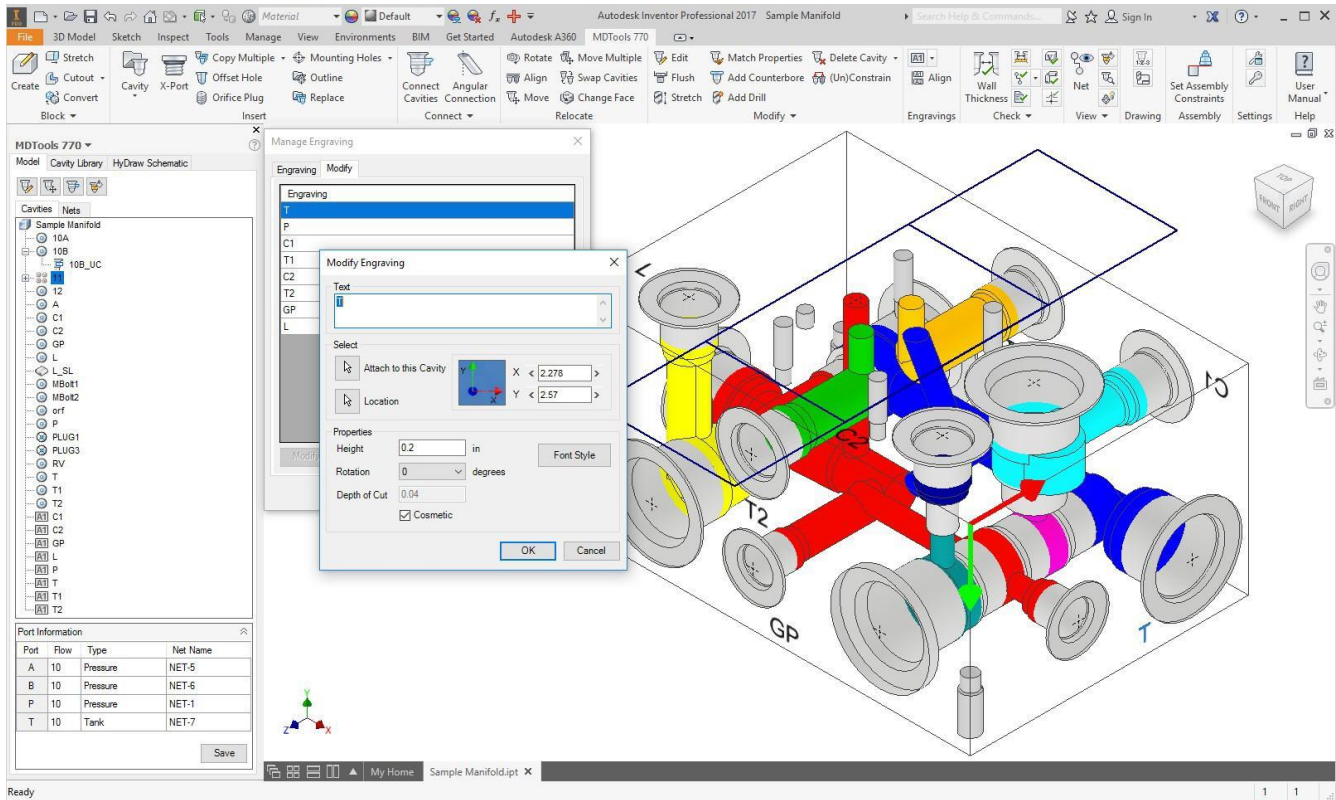
- When you apply Location precision, cavities are relocated with respect to the default coordinate system.
- In case of footprints, MDTools applies Location precision on the cavity marked as 'Dimension from This Cavity'.
- When updating the location, MDTools relocates the complete footprint, and the relative distance between the cavities in the footprint remains the same.
- Update Precision, also changes the default MDTools Settings Precision.

CAUTION!

If you use a cavity location precision value of less than 3.123, then the holes connecting the side ports of cartridge valve cavities may cut outside the port area.

Engravings

- 58 Manage Engravings
- 59 Copy Engravings
- 60 Align Engravings



58. Manage Engravings

Create planer sketch text, representing text engraving on the manifold.
Automatically convert client graphics text (if they exist) to planer sketch text.

1. MDTools 770 ribbon
>Engravings panel
>dropdown
>Manage

The Manage Engravings dialog box displays.

2. Select the cavity.
MDTools* display the component ID of the selected cavity as the default text.
Change the engravings, if required.

Engraving Tab

3. Select the **Location** button.
The engravings can be precisely relocated using the X and Y location scroll bars.

4. Select the text **rotation**.
The default text rotation is 0 degrees.

5. Enter the text **height**.
The default text height is 0.2 in inches and 5 in millimeters.

6. Enter Depth of Cut.
The default depth of the cut is 0.4 in inches and 1 in millimeters.

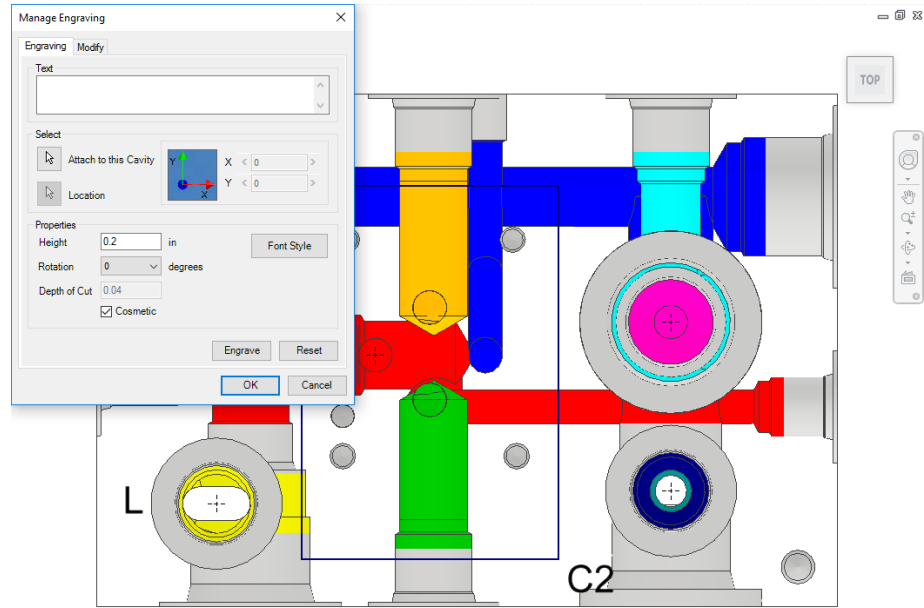
7. Select **Cosmetic** to create texts without depth on the manifold.
Otherwise, the text is engraved on the manifold face.

The Cosmetic option is selected by default.

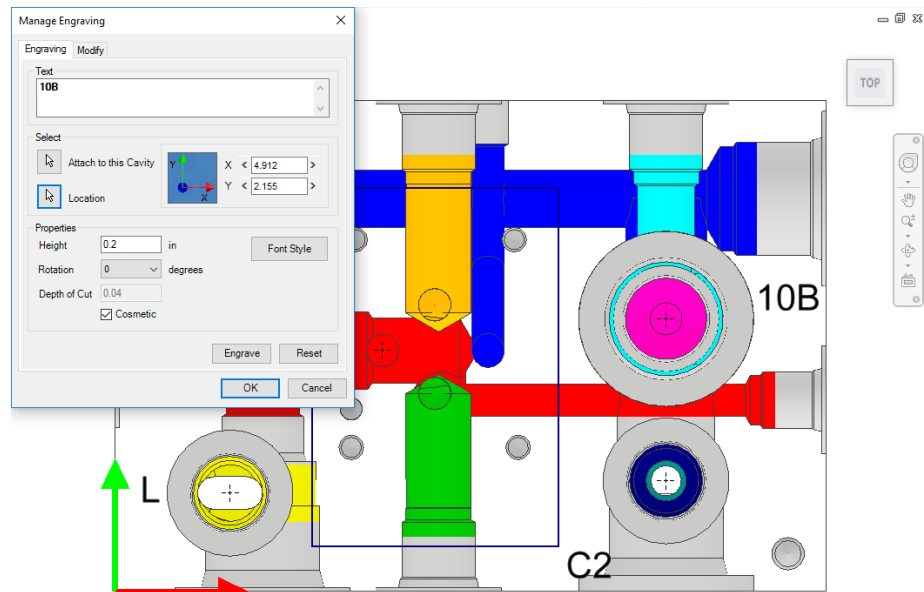
8. Click Font Style.
You can change the font type and font style (Regular/Italic/Bold/Bold Italic) for the engravings.

The Font dialog box with default styles is displayed.
Font Arial Style Regular
Size 8

9. Click **Engrave**.
MDTools creates and displays the planer sketch text or engraved text at the selected location.
10. Repeat the above steps to create all the text engraving on the manifold.



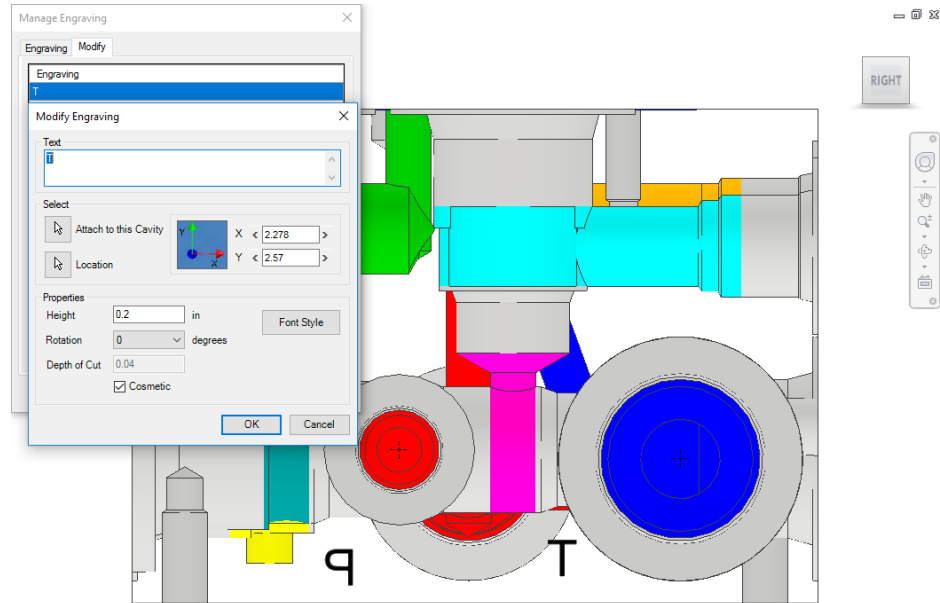
Manage Engravings dialog box



Planer Sketch text representing engraved text on manifold

1 Modify Engravings

1. Select the **Modify** tab on the Manage Engravings dialog box.
MDTools lists the engraved text on the manifold.*
2. Select the text you want to modify.
The selected text is highlighted on the manifold face.
3. Click **Modify**.
The Modify Engraving dialog box displays.
4. Change the text properties.
5. Click **OK** to save the modifications.
You can apply the engraved property on the planer sketch text.

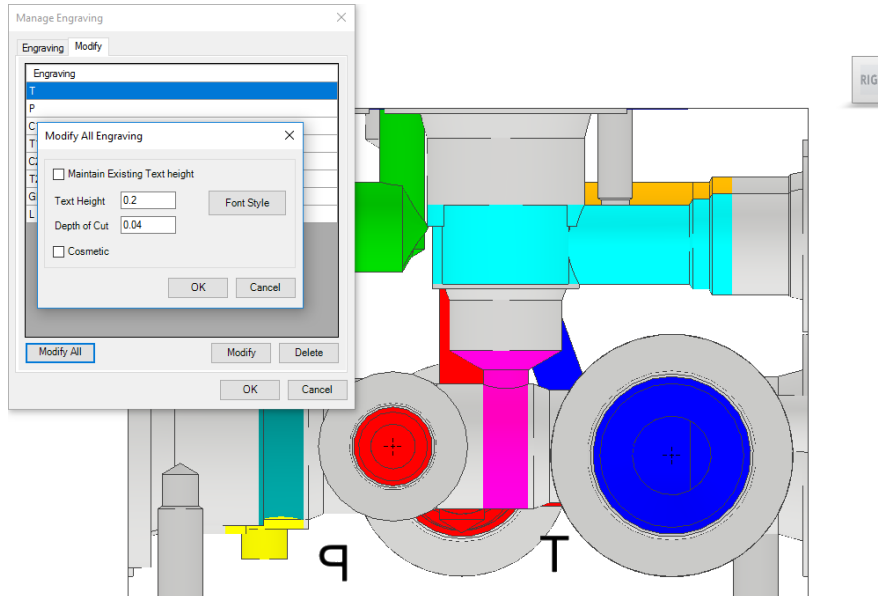


 **Modify Engraving dialog box**

By default, Engrave Text is unchecked for the planer text.
If the text is already engraved, then the Engrave Text checkbox is disabled and grayed.

2 Modify All Engravings

1. Click **Modify All**.
The Modify All Engraving dialog box displays.
2. Select the **Maintain Existing Text height** option to retain the text height.
Or
Change Text Height.
*If the **Maintain Existing Text Height** option is selected, then the Text Height option is disabled.*
3. Change Depth of Cut.
You can change the engraved text height.
4. Click **Font Style**.
You can change the font type and font style (Regular/Italic/Bold/Bold Italic) for all the engravings.
Select Cosmetic, if required.
5. Click **OK** to save the modifications.
You can apply the engraved property on all the planer sketch text and change the depth of the cut for engraved text.
Cosmetic is unchecked by default.

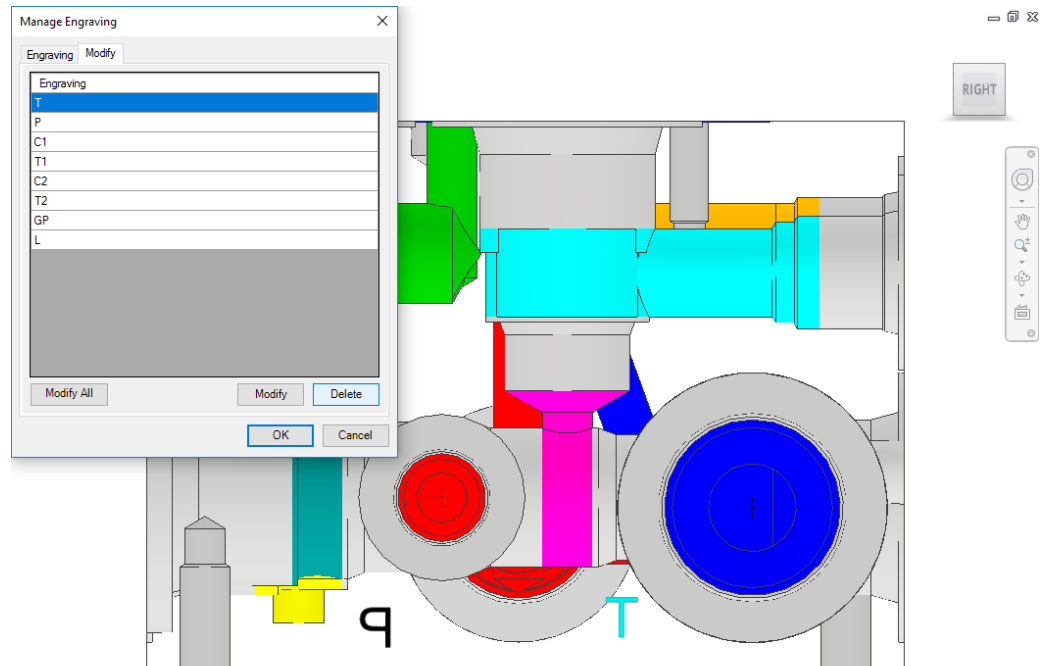



 **Modify All Engraving dialog box**

3 Delete Engravings

1. Select the text you want to delete.
2. Click **Delete**.

MDTools® deletes the selected text from the list and updates the text display.




Delete engravings

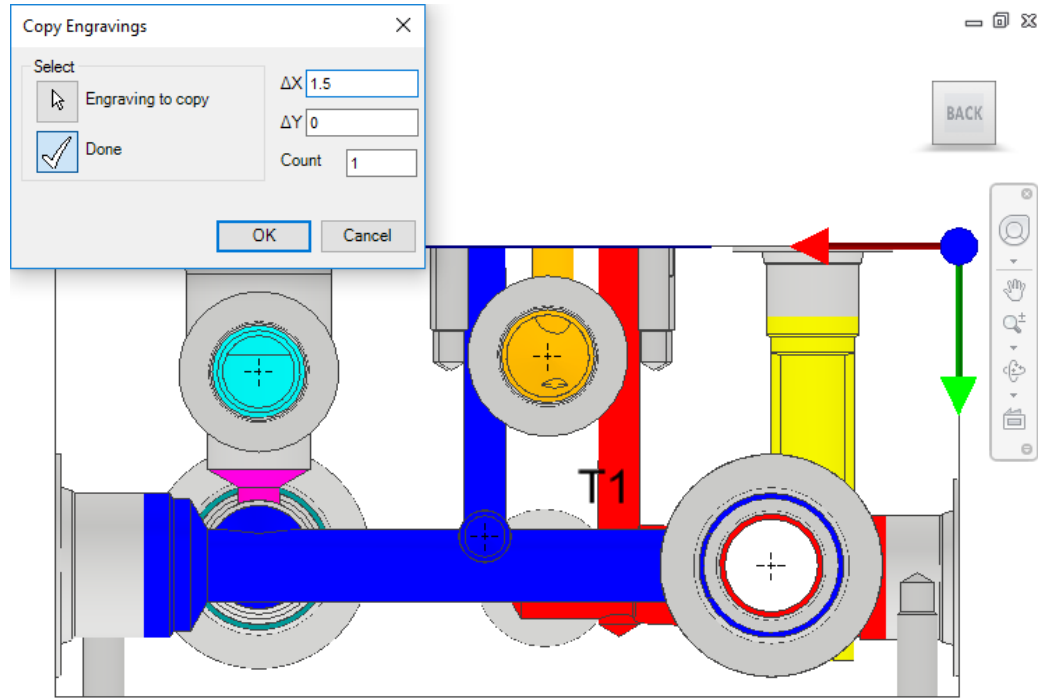
59. Copy Engravings

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

1. MDTools 770 ribbon
>Engravings panel
>dropdown
>Copy

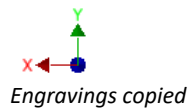
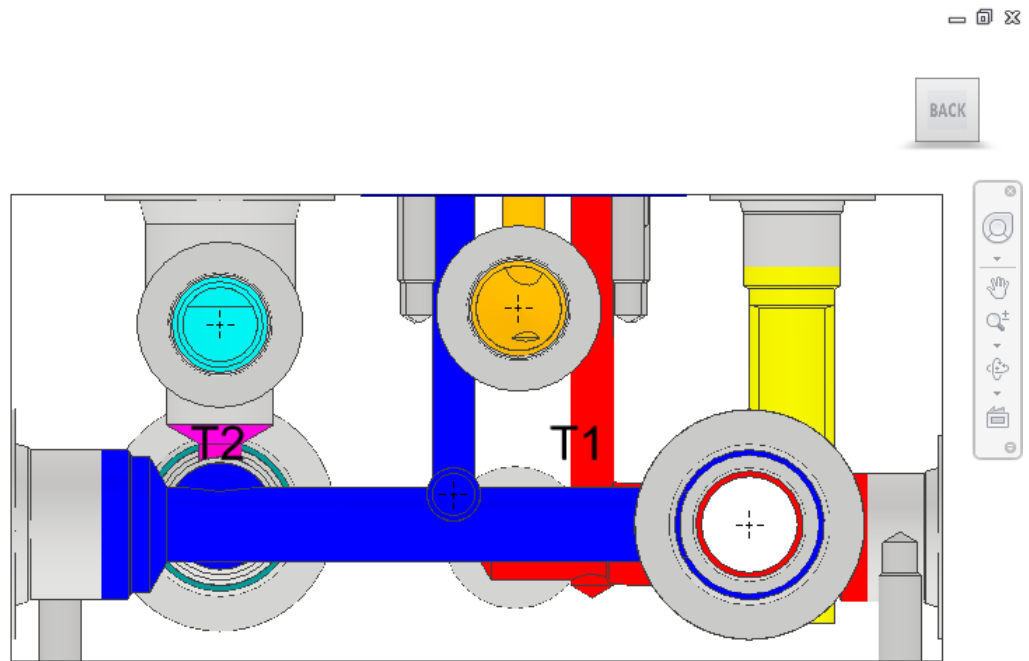
The Copy Engravings dialog box displays.
2. Select **Engraving to copy**, and then click the **Done** button.

After clicking Done, the ΔX , ΔY and count appears.
3. Enter values for ΔX and ΔY .
4. Enter **Count** to set the number of copies.
5. Click **OK** to create the copies of the selected engravings.



Note

- If the last character is a number, then the newly copied text automatically increments the count.
- If the last character is a letter or a special character, then MDTools* appends a number at the end, then increments that number by the count.



60. Align Engravings

Types of Alignment

The engraving is aligned in three ways:

- Same face – shortest distance alignment
- Perpendicular face – common axis alignment
- Opposite face – point to point alignment

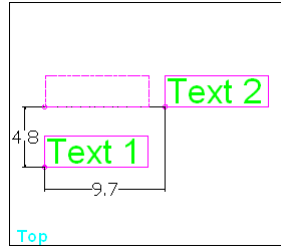
The left-bottom corner of the textbox is used as a reference point for all alignment calculations.

1 Same Face Alignment

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

- If the vertical distance is shorter than the horizontal distance, then the text is vertically aligned.
- If the horizontal distance is shorter than the vertical alignment, then the text is horizontally aligned.

The relocation of Text 2 is shown in dotted lines.

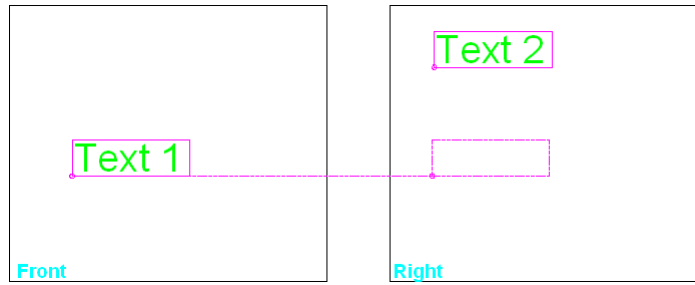


Same Face Alignment

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.

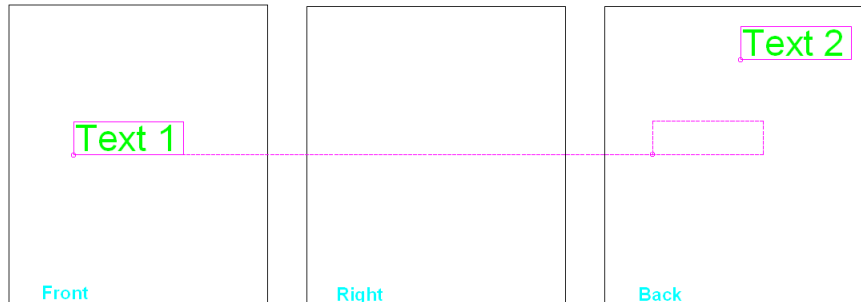


Perpendicular Face Alignment

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.

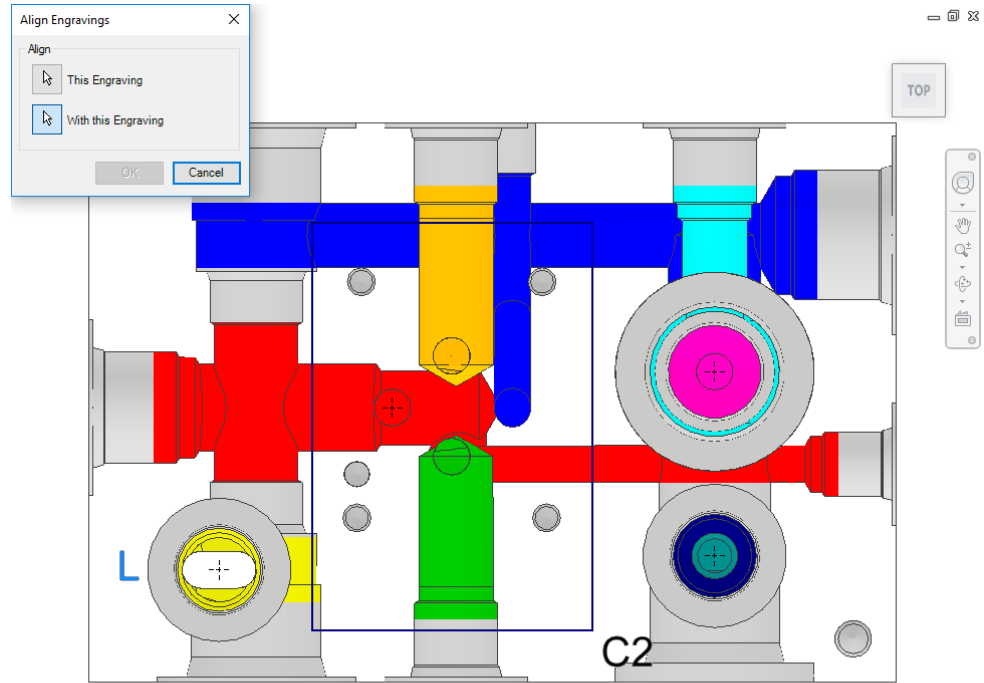


Opposite Face Alignment

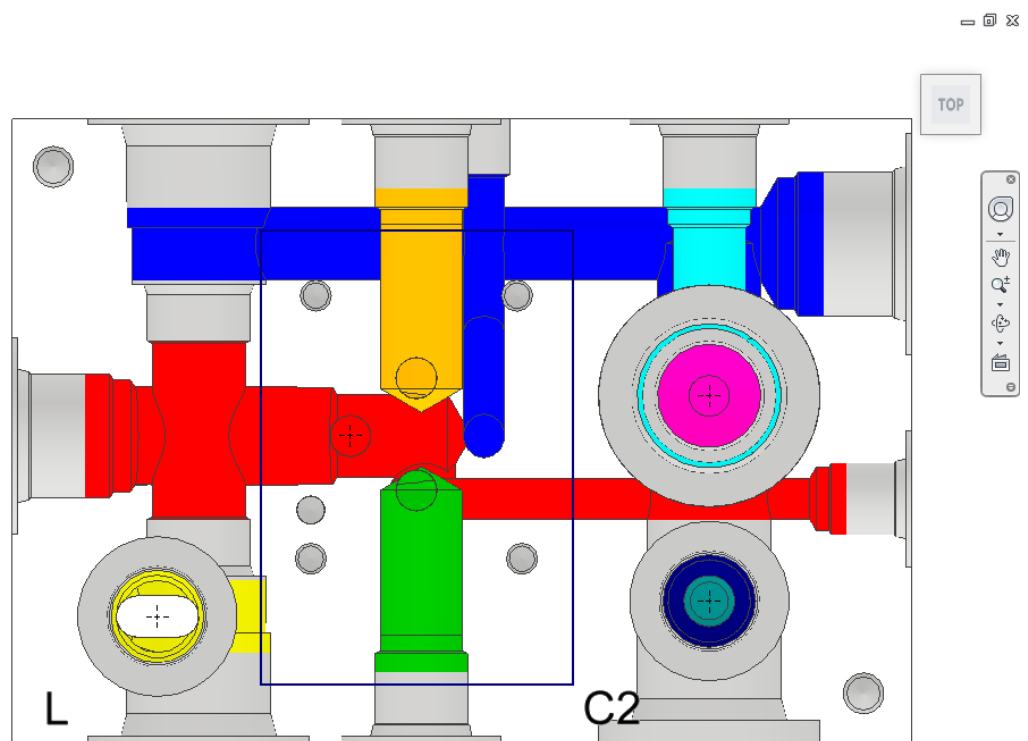
Align Engravings


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

1. MDTTools 770 ribbon
>Engravings panel
>Align
The Align Engravings dialog box displays.
2. Select **This Engraving**,
to align the selected engraving with other engravings.
3. Select **With this Engravings** to align with the previously selected engravings.
4. Click **OK** to align the two selected texts.
5. Click **Cancel** to close the dialog box.



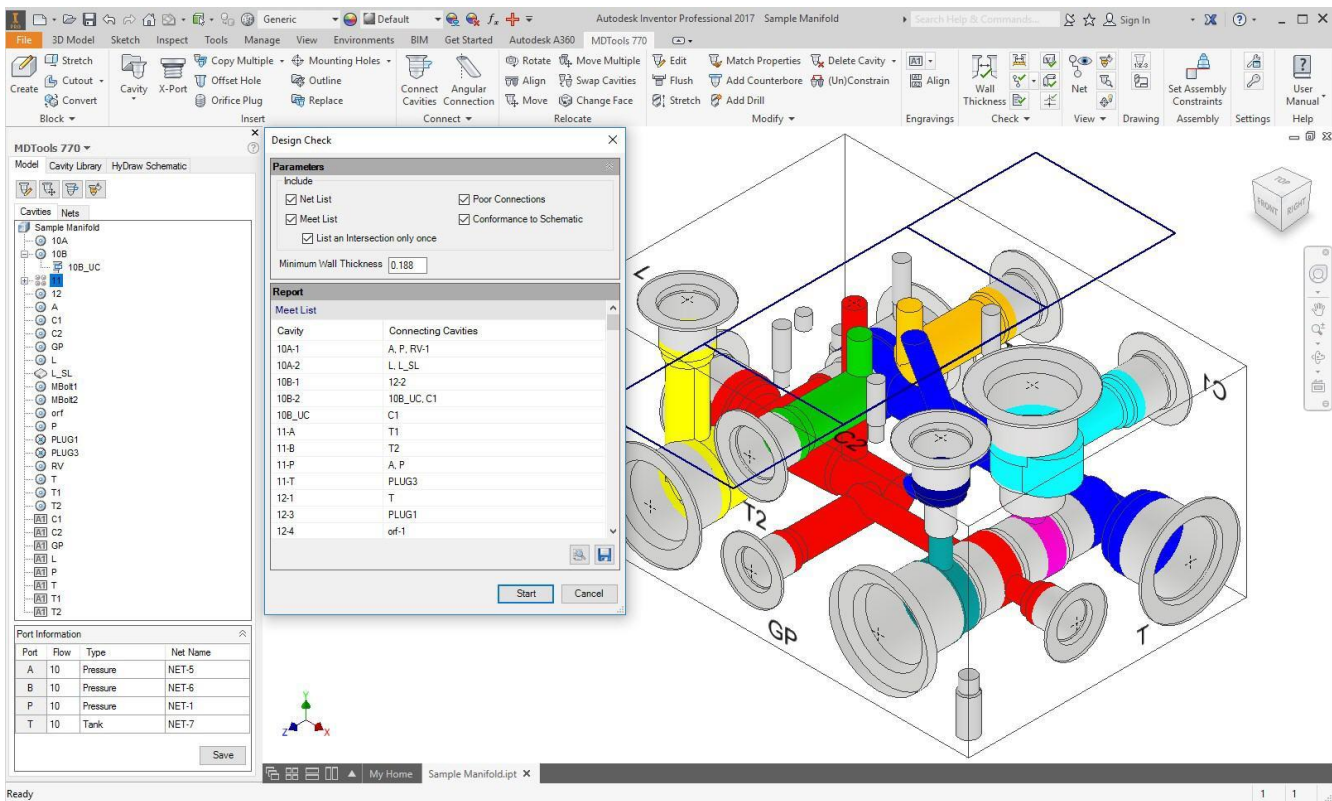

Align Engravings dialog box




Selected texts are aligned

Design Check

- 61 Wall Thickness Check
- 62 Measure Distance
- 63 Connection Check
- 64 Create Meet List
- 65 Design Check
- 66 Check Velocity in Block
- 67 Check Bend
- 68 Check Conformance to Schematic Check
- 69 Manufacturing & Tooling Check
- 70 Check Connection for Offset
- 71 Check Pressure Rating



61. Wall Thickness Check

Check the wall thickness around all cavities on the manifold.

If the wall thickness between the cavities is less than the minimum required value specified, then the Wall Thickness Check lists in parenthesis, the actual wall thickness between the cavities next to the cavity name.

Single click on a row in the report to locate any reported issue on the manifold.

Double click on a row in the report to zoom the problem area on the manifold.

Check the manifold for connection errors before performing the Wall Thickness check.

Select the appropriate Design Check option in MDTools Settings to locate any issue.

Highlight Selected Cavities is the default option in MDTools Settings.

- MDTools 770 ribbon
>Check panel
>Wall Thickness

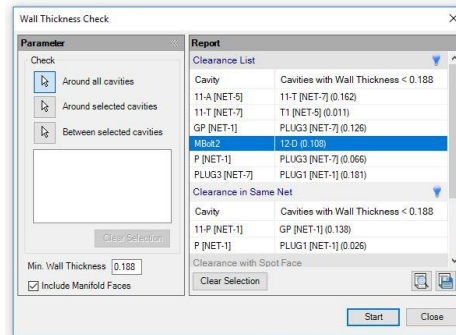
The Wall Thickness Check dialog box displays.



MDTools Settings option selected

- Click the required Check button.

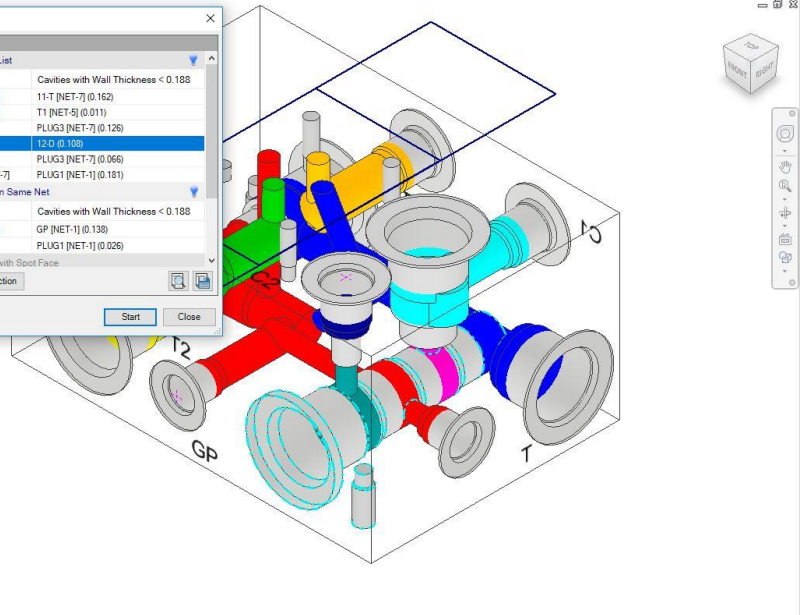
The Check section displays three options.



Around all cavities

To check the internal wall thickness between cavities.

MDTools* displays the list of cavities with wall thickness less than the specified value.



Wall Thickness Check dialog box

Around selected cavities

To check the internal wall thickness between the selected cavity and all other cavities.

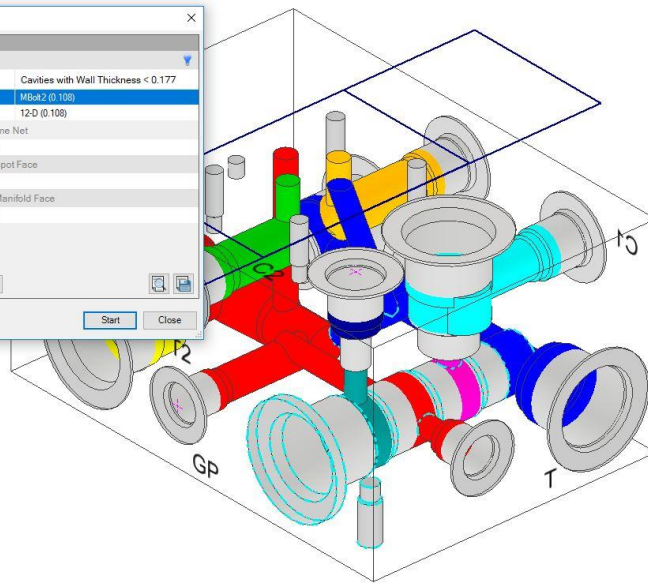
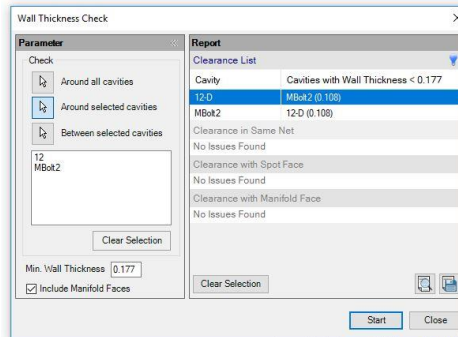
MDTools displays a list of cavities with the wall thickness less than the specified value.





Option Selected in MDTools Settings

Between selected cavities

MDTools displays the wall thickness between selected cavities.

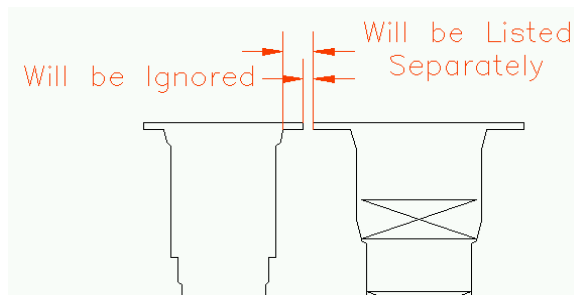


Wall Thickness Check dialog box: Selected cavities

- Enter the minimum wall thickness required.
The default minimum wall thickness is displayed according to the settings.
- Select **Include Manifold Faces** to check the wall thickness w.r.t faces.
- Click **Start**.
*MDTools displays the result as per the selection of the **Check** button.*
- Select a row.
MDTools highlights the specified issues.
- Click  to highlight specified section issues.
- Click  to hide specified section issues.
- Click **Clear Selection** to clear the highlighted issues.
- Click **Save** in a Text file to save the list.
The Save As dialog box displays.
- Enter an appropriate file name and save.

Note

- *The 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 issues between the spot face of one cavity and other cavities in the manifold are listed separately.*
- *MDTools® does not list the minimum wall thickness between locating pin and bolt hole, in case of a footprint.*
- *Double click on a reported issue row to zoom into the problem area/cavity.*



Spot Face to Spot Face clearance

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.*

62. Measure Distance

Measure the distance between two cavity surfaces or measure the distance between a cavity and a manifold surface.

1. MDTools 770 ribbon
>Check panel
>Measure

The Measure Distance dialog box displays.

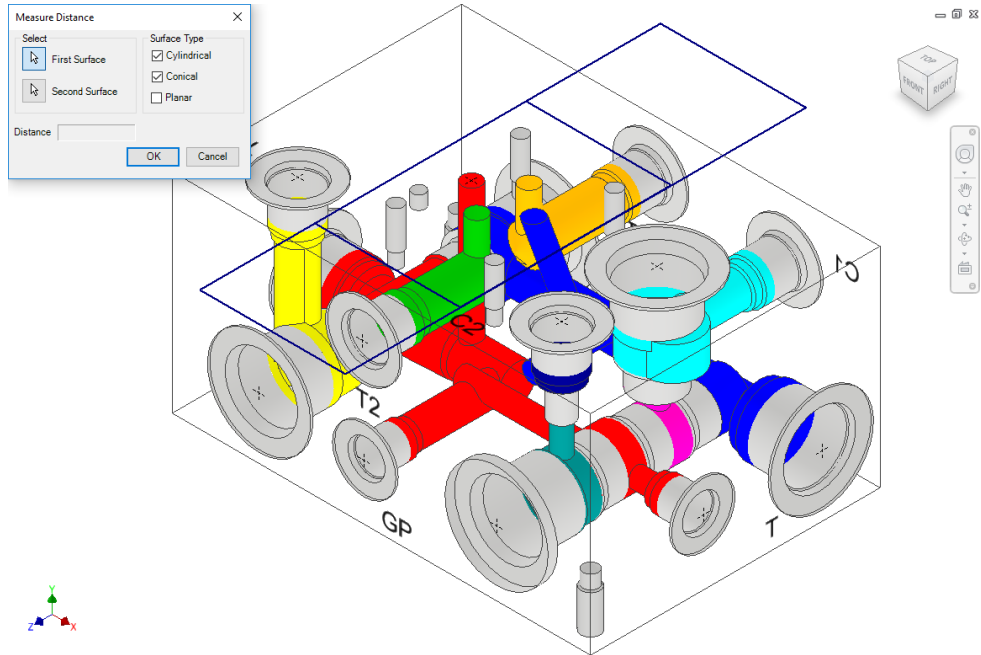
2. Click the **First Surface** selection button.

Select the required type of surface: Cylindrical/ Conical/ Planar

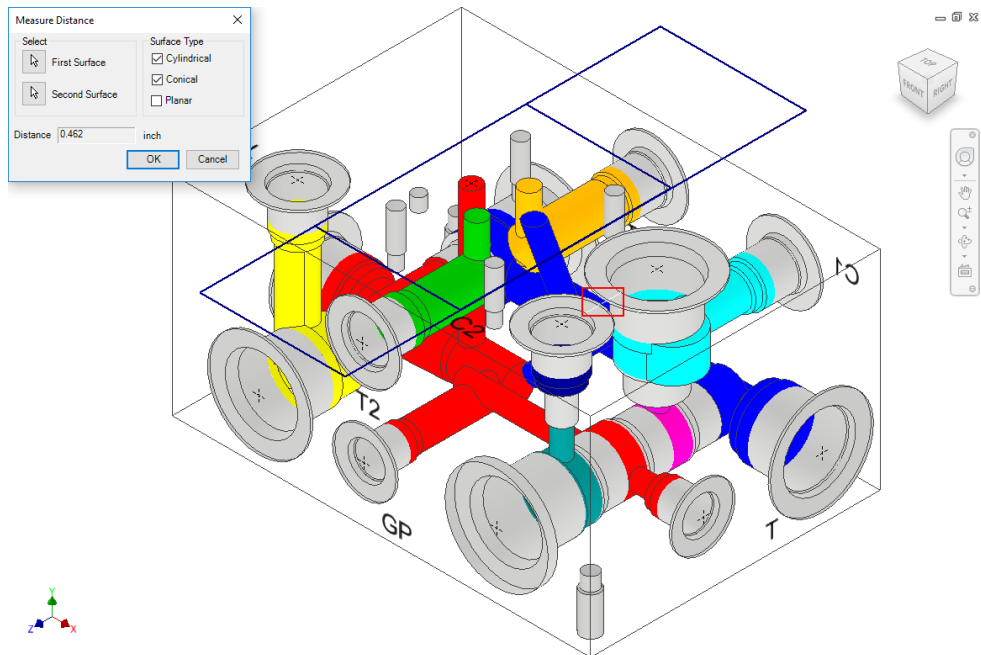
3. Select the Second Surface.

Select the required type of surface

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



Measure Distance dialog box



Display of the distance between the selected surfaces

63. Connection Check

The Connection 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 nets
- Wrong connection inside a manifold
- Poor Connection

If the design net names of two connected cavities or cavity ports are different, MDTools* lists the connection as a wrong connection, assuming net information in all the cavities is correct.

Single click a row in the report to locate any issue on the manifold.

Double click a row in the report to zoom the problem area on the manifold.

Select the appropriate Design Check option in MDTools Settings to locate any issue.

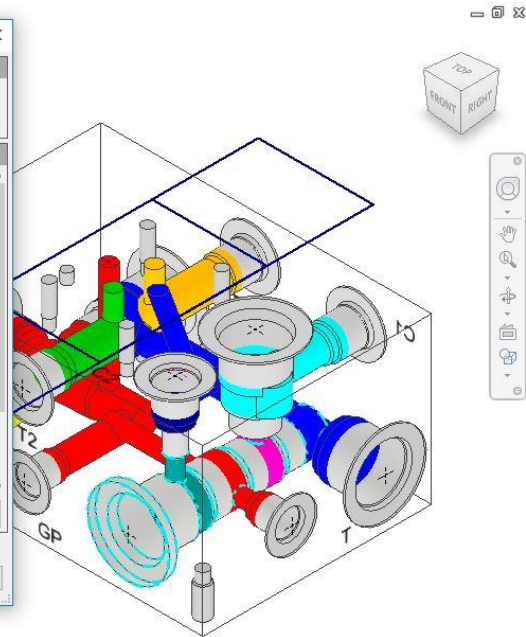
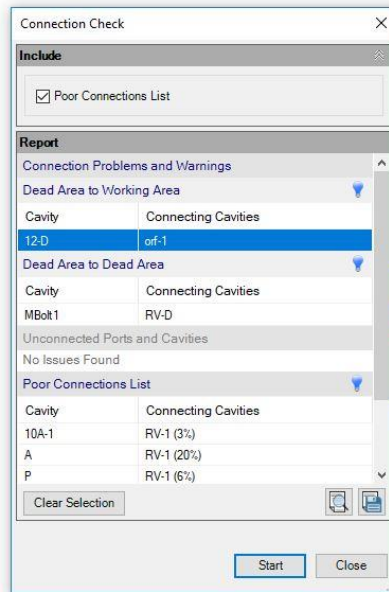
The Highlight Selected Cavities option is the default, selected in MDTools Settings.

1. MDTools 770 ribbon
 >Check panel
 >Connection
 dropdown
 >Connection

The Connectivity Check dialog box displays.

2. Select the **Include Poor Connection** option to add a new section, Poor Connection, 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 is listed in this section with approximate % of intersection area.





3. Click **Start**.



Connection Check dialog box

MDTools checks the manifold for the following design issues: Interference between Working Area or Dead Area in one or more cavities, unconnected cavities or ports of cavities, broken nets, or wrong connections inside a manifold.

4. Select a row. MDTools highlights the specified issues.
5. Click  to highlight specified section issues.
6. Click  to hide specified section issues.

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

8. Click  to save the list.

The Save As dialog box displays.

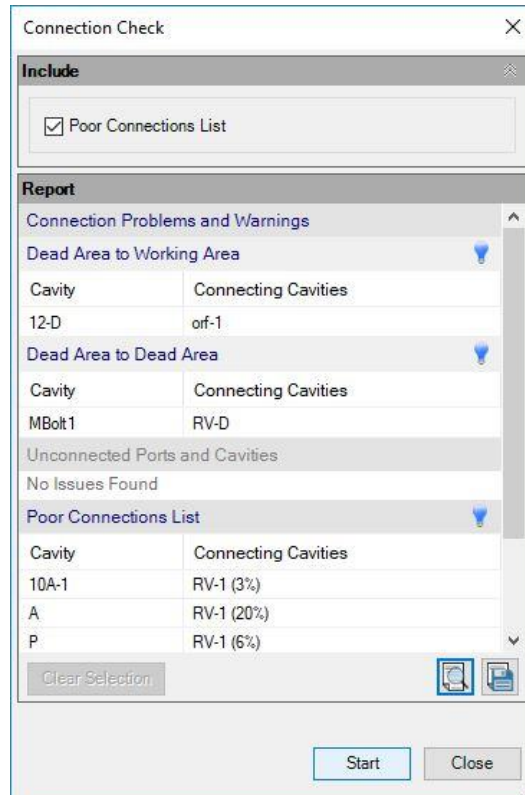
9. Enter an appropriate file name.

10. Click **Save**.

Note

- The **Wrong Connections** list of cavities 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 recheck the manifold.
- Repeat until the check confirms that all errors are resolved.
- Double click a reported issue row to zoom into the problem area/cavity.

Broken Nets list indicates that nets are assigned to one or more ports and the net is unconnected.



Connection Check List

64. Create Meet List

Check connectivity inside the manifold. You can 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.

Single click a row in report to locate any issue on the manifold.

Double click a row in report to zoom the problem area on manifold.

Select the appropriate Design Check option in MDTools Settings to locate any issue.

The Highlight Selected Cavities option is the default, selected in MDTools Settings.

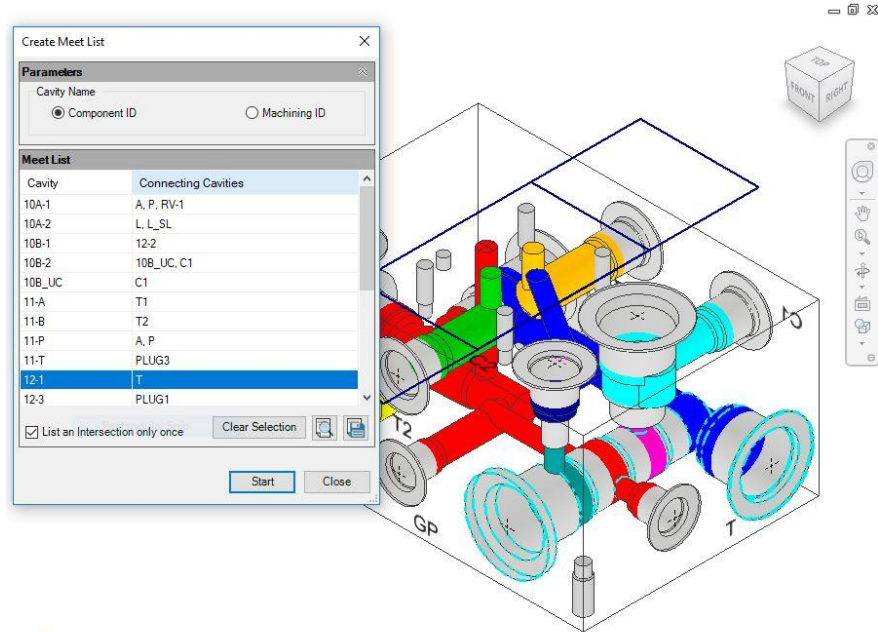
1. MDTools 770 ribbon
>Check panel
>Connection
dropdown
> Create Meet list

The Create Meet List dialog box displays.

2. Choose the preferred **Display ID** for the cavities.

Either the Machining ID or the Component ID can be used as the display ID for cavities.

3. Select the **List an Intersection only once** option to remove the repetitive information from the report.



4. Click **Start**.

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



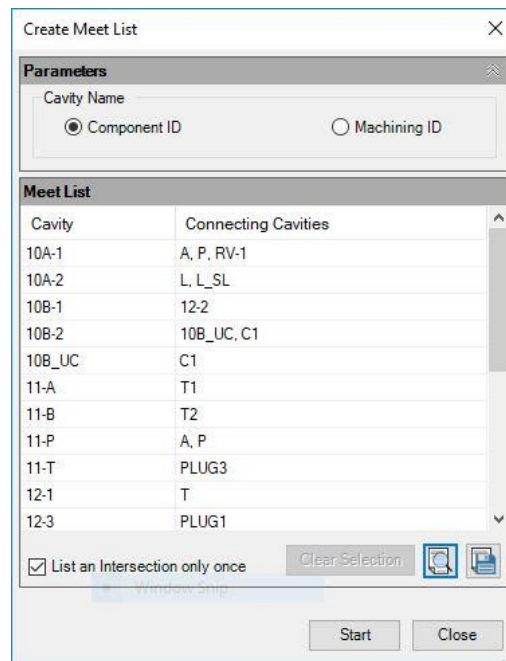
Create Meet List dialog box

5. Select a row.
MDTools highlights the specified issues.
6. Click **Clear Selection** to clear the highlighted issues.

7. Click  to save the list.

The Save As dialog box displays.

8. Enter an appropriate file name and click Save.



Meet List Check

Note

- The connectivity check showing cavities meeting 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 is considered the Dead Area.
- Double click a reported issue row to zoom into the problem area/cavity.
- Area below the spot face (Step0) is considered the Working Area, if the insertion depth for port cavity is not entered.
- Holes cutting outside the port area of cavity are listed in the Dead Area connection list.

1 Offset holes and angle drills

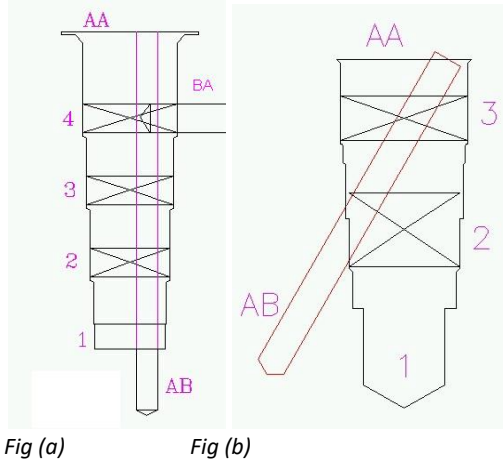
When an offset drill is used inside a cavity, the connection check will only list the bottom port of the cavity in the meet list.

None of the side ports will appear in the Meet List of the offset hole.

For example, the Meet List of offset hole AB in Fig (a) shows 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) shows only port 2 of cavity AA.



2 Cartridge valve side port connection

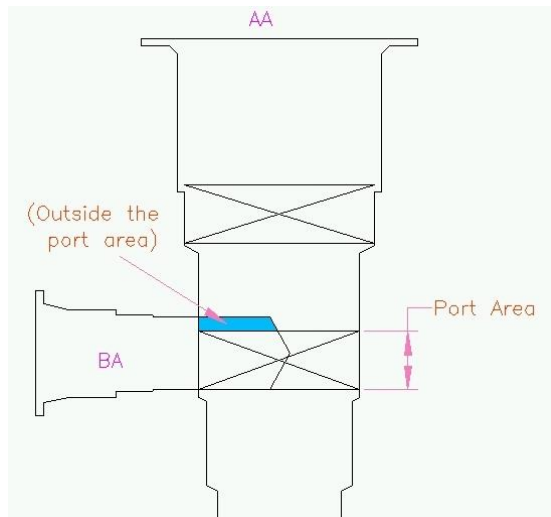
The Connection Check feature checks drill breakage outside the specified port area of a cartridge valve cavity.

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 the hole BA.

BA AA-2, AA-D

This helps you automatically locate holes cutting outside the port area.



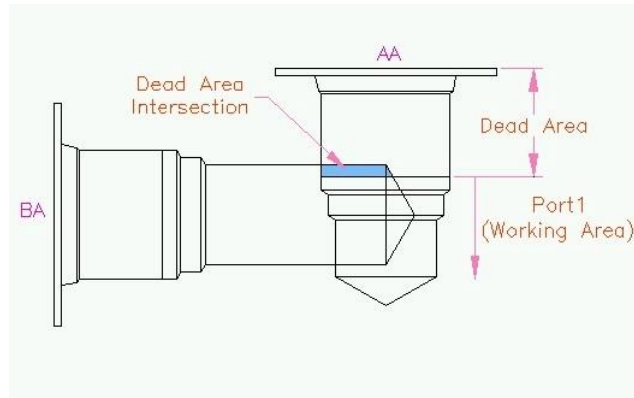
Cross-drill cutting outside the port area

3 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 the Dead Area Connection.
- If the plug insertion depth is not specified, the complete area below spot face is considered the 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

65. Design Check

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

The Design Check Report contains the following information.

- Meet list
- 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 check list
- Design net list
- Connectivity net list
- Net comparison list
- Broken nets
- Wrong connection inside manifold
- Poor connection
- Conformance to Schematic check list

Single click a row in report to locate any issue on the manifold.

Double click a row in report to zoom the problem area on manifold.

Select the appropriate Design Check option in MDTools Settings to locate any issue.

The Highlight Selected Cavities option is the default, selected in MDTools Settings.

1. MDTools 770 ribbon
>Check panel
>Design

The Design Check dialog box displays.

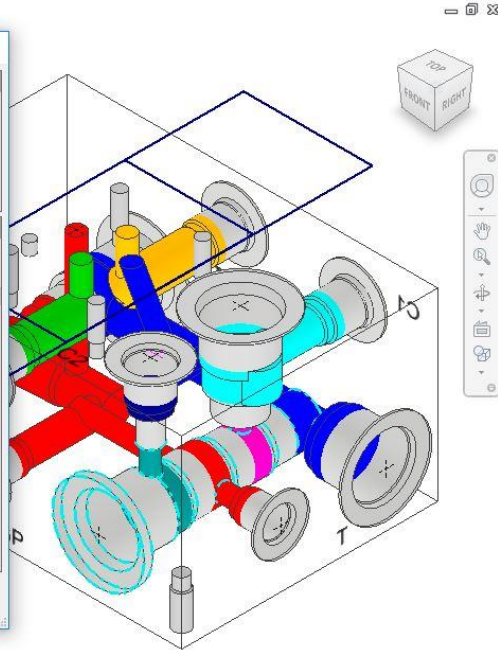
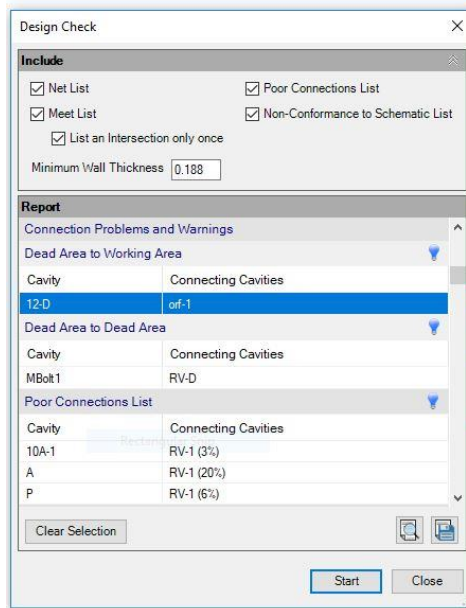
Select the parameters you want to check.

2. Click the Net list option to include three sections in the report.
 - Design Net list
 - Connectivity Net list
 - Net list comparison

3. Click 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. Click the **Poor Connections** option to include the Poor Connection section in the report.



Design Check dialog box

5. Click the Conformance to schematic option to include eight sections in the report.
 - a. Missing Component and ports.
 - b. Extra Component and ports.
 - c. Wrong cavities
 - d. Non-Preferred Construction ports.
 - e. Cavities on Non-Preferred face.
 - f. Wrong Net Name
 - g. Wrong Port Type
 - h. Wrong Flow.

6. Enter the minimum wall thickness required.


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


7. Click **Start**.

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

8. Select a row.

MDTools highlights the specified issues

9. Click  to highlight the specified section issues.

10. Click  to hide the specified section issues.

11. Click **Clear Selection** to clear the highlighted issues.

12. Click  to save the list.

The Save As dialog box displays.

13. Enter an appropriate file name.

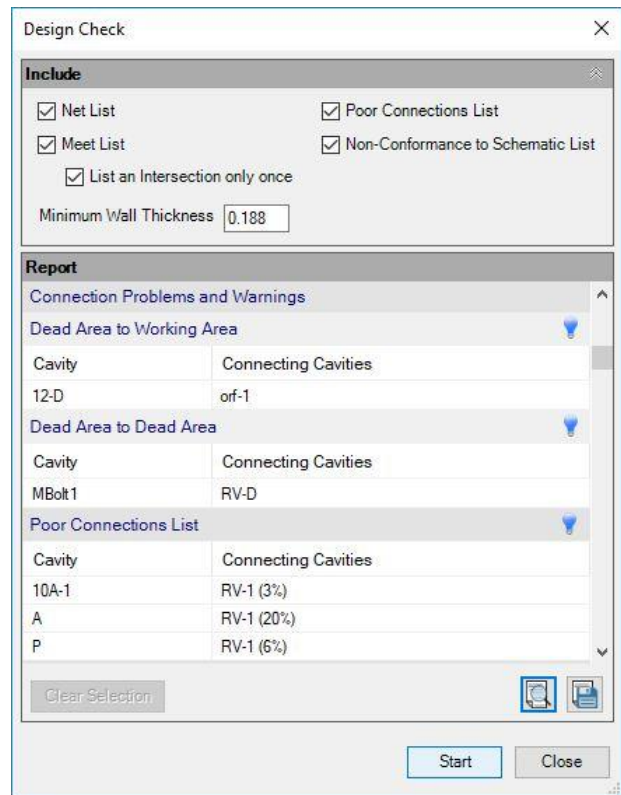
14. Click **Save**.

Note:

Double click the reported issue row to zoom into the problem area/cavity.

Caution!

Miscellaneous features such as Undercut, Slot and O-ring groove are not considered in any of the Design reports.



Design Check List

MDTools 700 Series Design Check Report

Drawing Name: Sample Manifold
Date/Time: 12/13/2017 3:12:07 PM
Revision:

Meet List

Cavity	Connecting Cavities
10A-1	A, P, RV-1
10A-2	L, L_SL
10B-1	12-2
10B-2	10B_UC, C1
10B_UC	C1
11-A	T1
11-B	T2
11-P	A, P
11-T	PLUG3
12-1	T
12-3	PLUG1
12-4	orf-1
A	P, RV-1
C2	orf-2
GP	P, PLUG1
L	L_SL
P	RV-1
PLUG3	T
RV-2	T

Connection Problems and Warnings

No Issues Found

Poor Connections

No Issues Found

Wall Thickness

Clearance List

Cavity	Cavities with Wall Thickness < 0.188
11-A [NET-5]	11-T [NET-7] (0.162)
11-T [NET-7]	T1 [NET-5] (0.011)
GP [NET-1]	PLUG3 [NET-7] (0.126)
P [NET-1]	PLUG3 [NET-7] (0.066)
PLUG3 [NET-7]	PLUG1 [NET-1] (0.183)

Clearance in Same Net

Cavity	Cavities with Wall Thickness < 0.188
11-P [NET-1]	GP [NET-1] (0.138)
P [NET-1]	PLUG1 [NET-1] (0.026)

Clearance with Spot face

Cavity	Cavities with Wall Thickness < 0.188
----- No Issues Found -----	

Clearance with Manifold face

Cavity	Faces with Wall Thickness < 0.188
--------	-----------------------------------

MBolt1-D	Left Face (0.125)
MBolt1-D	Back Face (0.165)
MBolt2-D	Right Face (0.165)
MBolt2-D	Front Face (0.165)

Net List

Design Net List

NET-1	10A-1, 11-P, 12-3, A, GP, P, PLUG1, RV-1
NET-2	10A-2, L, L_SL
NET-3	10B-1, 12-2
NET-4	10B-2, 10B_UC, C1
NET-5	11-A, T1
NET-6	11-B, T2
NET-7	11-T, 12-1, PLUG3, RV-2, T
NET-8	12-4, orf-1
NET-9	C2, orf-2

Connectivity Net List

Net-1	10A-1, 11-P, 12-3, A, GP, P, PLUG1, RV-1
Net-2	11-A, T1
Net-3	11-B, T2
Net-4	11-T, 12-1, PLUG3, RV-2, T
Net-5	10B-2, 10B_UC, C1
Net-6	10B-1, 12-2
Net-7	C2, orf-2
Net-8	12-4, orf-1
Net-9	10A-2, L, L_SL

Net List Comparison

Net Name :	NET-1
Design Net List :	10A-1, 11-P, 12-3, A, GP, P, PLUG1, RV-1
Connectivity Net List :	10A-1, 11-P, 12-3, A, GP, P, PLUG1, RV-1

Net Name :	NET-2
Design Net List :	10A-2, L, L_SL
Connectivity Net List :	10A-2, L, L_SL

Net Name :	NET-3
Design Net List :	10B-1, 12-2
Connectivity Net List :	10B-1, 12-2

Net Name :	NET-4
Design Net List :	10B-2, 10B_UC, C1
Connectivity Net List :	10B-2, 10B_UC, C1

Net Name :	NET-5
Design Net List :	11-A, T1
Connectivity Net List :	11-A, T1

Net Name :	NET-6
Design Net List :	11-B, T2
Connectivity Net List :	11-B, T2

Net Name :	NET-7
Design Net List :	11-T, 12-1, PLUG3, RV-2, T
Connectivity Net List :	11-T, 12-1, PLUG3, RV-2, T

Net Name :	NET-8
------------	-------

Design Net List : 12-4, orf-1
Connectivity Net List : 12-4, orf-1

Net Name : NET-9
Design Net List : C2, orf-2
Connectivity Net List : C2, orf-2

Wrong Connections

No Issues Found

Error in Nets

No Issues Found

Conformance to Schematic

Missing Components and Ports

Component ID Cavity Name

9-A D03
9-B D03
9-T D03

No Issues Found

Extra Components and Ports

Component ID Cavity Name

A
C1 #6 SAE
C2 #6 SAE
GP #4 SAE
orf 5/16"-24 UNF
RV C10-2

Wrong Cavity

Component ID Cavity Name in Design Cavity Name in Schematic

10A C10-2 T-9A
10B C10-2 C10-3
12 C10-4 VC10-3
L #6 SAE #5 SAE
P #8 SAE #5 SAE
T #10 SAE ISO 6149-1-M16
T1 #6 SAE NPT 1/4
T2 #6 SAE #2 SAE

Non-Preferred Construction Ports

Cavity ID Cavity Name

PLUG1 #4 SAE
PLUG3 MB-600-080

Cavities on Non-Preferred Face

Component ID Face Preferred Faces

10A Front Back

12	Front	Top
L	Top	Back
P	Left	Back
T1	Back	Left
T2	Front	Left

Wrong Net Name

Cavities/Ports	Net Name in Model	Net Name in Schematic
10A-1	NET-1	NET-5
10A-2	NET-2	NET-6
10A-3		NET-1
10B-2	NET-4	NET-7
10B-3		NET-2
11- P	NET-1	NET-6
11- A	NET-5	NET-8
11- B	NET-6	NET-7
11- T	NET-7	NET-1
12- 1	NET-7	NET-4
12- 2	NET-3	NET-8
12- 3	NET-1	NET-2
L	NET-2	NET-3
P	NET-1	NET-4
T	NET-7	NET-5
T1	NET-5	NET-2
T2	NET-6	NET-1

Wrong Flow

Cavities/Ports	Flow in Model	Flow in Schematic
10A-1	0	20
10A-2	0	20
10A-3		20
10B-1	15	20
10B-3		20
11- P	10	20
11- A	10	20
11- B	10	20
11- T	10	20
12- 1	10	20
12- 2	8	20
12- 3	8	20
T	0	20

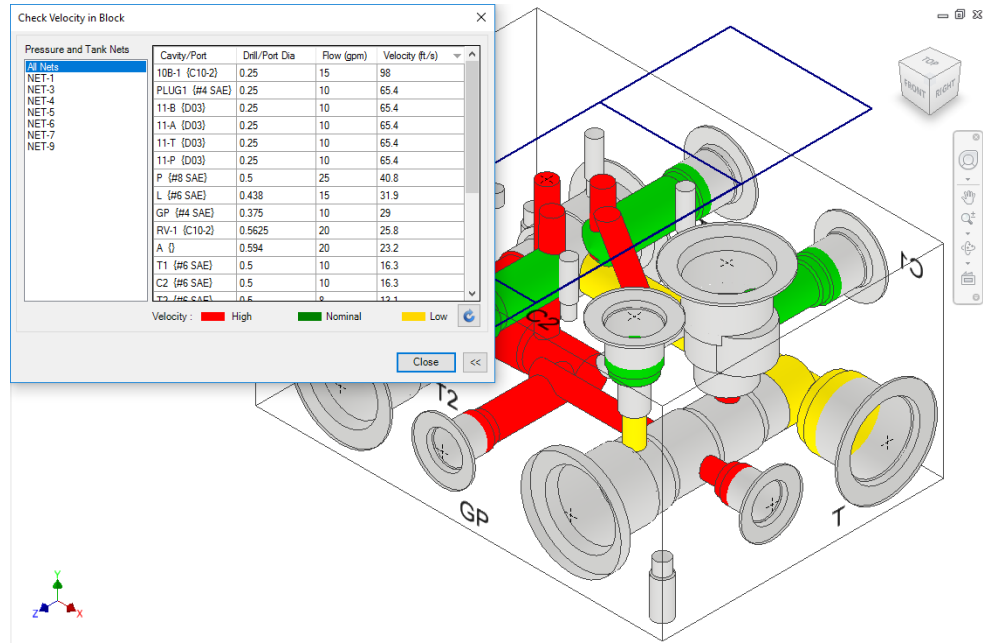
Wrong Port Type

Cavities/Ports	Port Type in Model	Port Type in Schematic
10A-1	Undefined	Pressure
10A-2	Undefined	Pressure
10A-3		Tank
10B-3		Pilot
12- 3	Tank	Pilot
L	Undefined	Pressure
P	Undefined	Pressure
T	Undefined	Pressure
T1	Undefined	Pilot
T2	Undefined	Tank

66. Check Velocity in Block

Check velocity in the block and quickly identify hotspots in the design.

- MDTools 770 ribbon
>Check panel
>Velocity
The Check Velocity in Block dialog box displays the pressure and tank nets.
- Select required net(s).
The Cavity/Port, Drill/Port Dia., Flow, and Velocity of each port is displayed in the grid.



The Legend indicates Velocity:

- Red – High
- Green – Nominal
- Yellow – Low

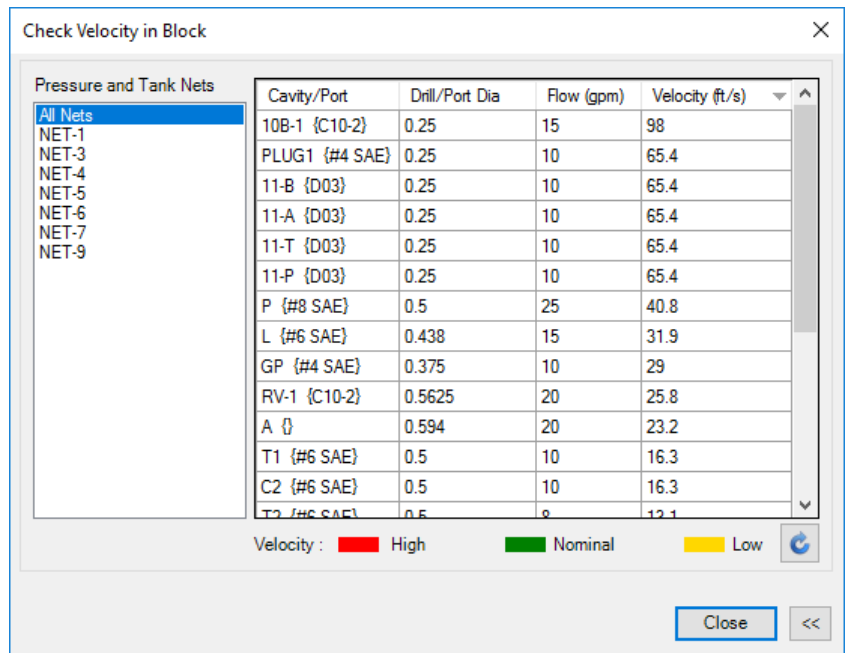
Check Velocity in Block dialog box

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.
- Double click a cavity/port to change its flow value, if required.
 - Click to recolor the cavities for the selected net.
 - Click **Close**.
Manifold is recolored.

Note

- If a pilot/drain or 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; also update the flow.
- If flow is merging in a connection, then the designer must manually update the flow.



67. 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.

Single click a row in the report to locate any issue on the manifold.

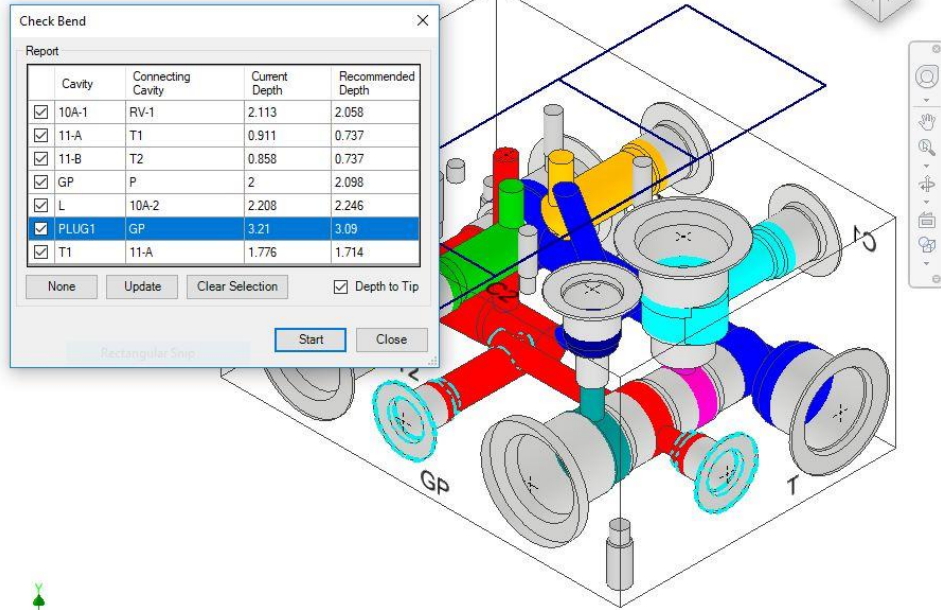
Double click a row in the report to zoom the problem area on the manifold.

Select the appropriate Design Check option in MDTools Settings to locate any issue.

The Highlight Selected Cavities option is the default, selected in MDTools Settings.

1. MDTools 770 ribbon
>Check panel
>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

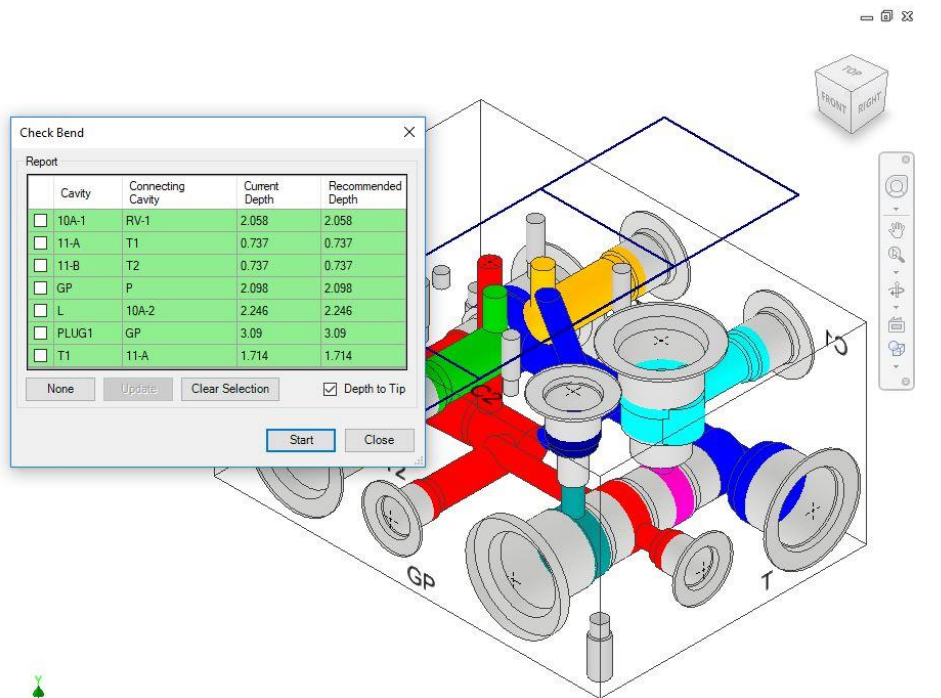
The All button turns None when all items are selected.



Check Bend dialog box

4. Select a row MDTools highlights specified issues.
5. Click Clear Selection to clear the highlighted issues.
6. Click Update.

The recommended depth is applied to the current depth and the affected rows turn green.



Note

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

Double click a reported issue row to zoom into the problem area/cavity.



Check Bend dialog box –Current and Recommended Depth equalized

68. 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

Single click a row in the report to locate any issue on the manifold.

Double click a row in the report to zoom into the problem area on manifold.

Select the appropriate Design Check option in MDTTools Settings to locate any issue.

The Highlight Selected Cavities option is the default, selected in MDTTools Settings.


1. MDTTools 770 ribbon
> Check panel
> **Check Conformance to Schematic**


The Check Conformance to Schematic dialog box displays.

2. Click **Start**.

MDTools® checks the manifold design against the HyDraw schematic.

3. Select a row
MDTools highlights the specified issues.

4. Click  to highlight specified section issues.

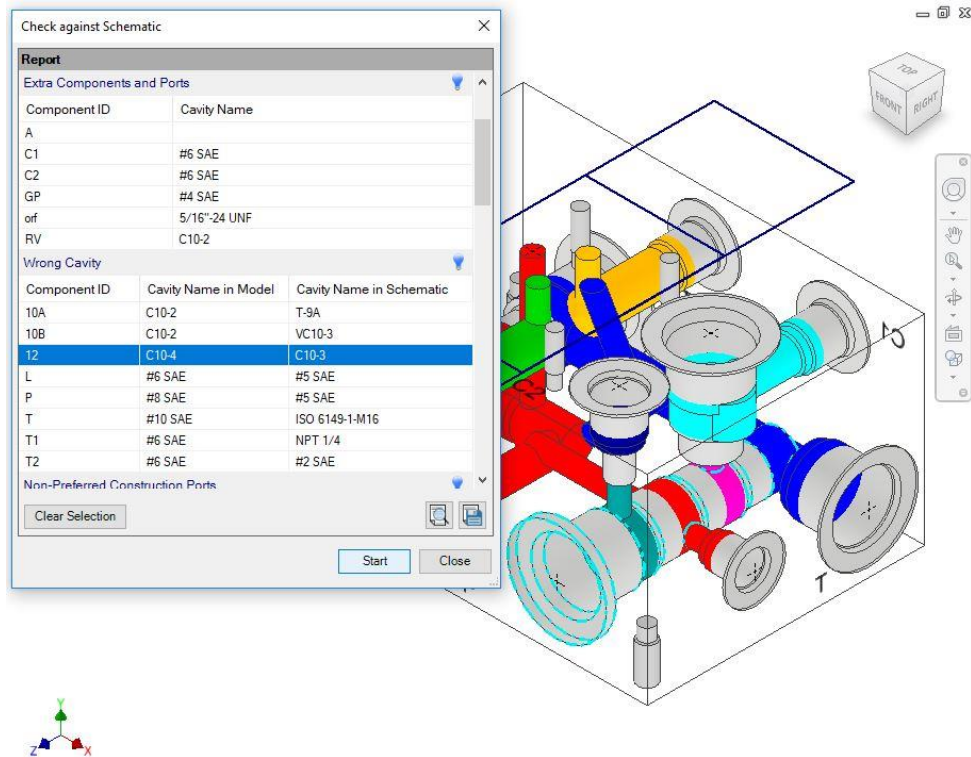
5. Click  to hide specified section issues.

6. Click **Clear Selection** to clear the highlighted issues.

7. Click **Save** in text file to save the list.

8. Enter an appropriate file name in the Save as dialog box.

9. Click **Save**.



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 the schematic interface.

Note

This command will not validate the mounting hole information.

Double click a row in the report to zoom into the problem area/cavity.

Non-Preferred Construction Ports section

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

Wrong Net Name section

Lists cavities and ports which have net name different than the one specified in the schematic.

Wrong Flow section

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

Wrong Port Type section

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

69. Manufacturing and Tooling Check

Check the design for manufacturing and tooling limitations.

This feature enables you to check the manifold for:

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

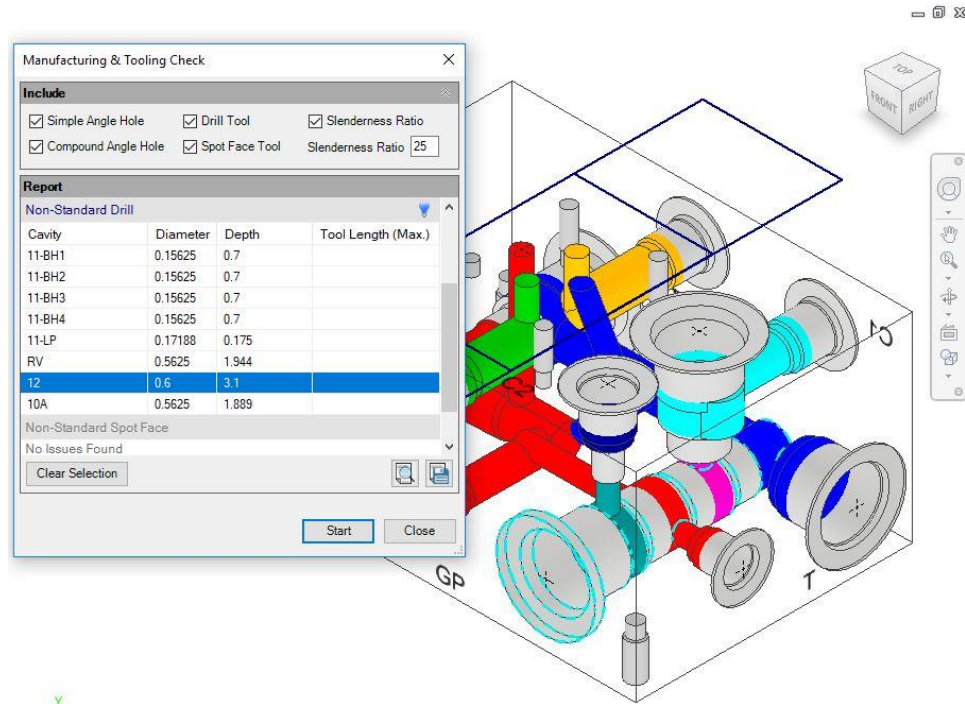
Single click a row in the report to locate any issue on the manifold.

Double click a row in the report to zoom into the problem area on manifold.



Select the appropriate Design Check option in MDTools Settings to locate any issue.

The Highlight Selected Cavities option is the default, selected in MDTools Settings.


1. MDTools 770 ribbon
>Check panel
>Manufacturing
The Manufacturing & Tooling Check dialog displays.
2. Select the parameters you want to check.
3. Modify the slenderness ratio.
The default slenderness ratio value is 25.



 Manufacturing & Tooling Check dialog box

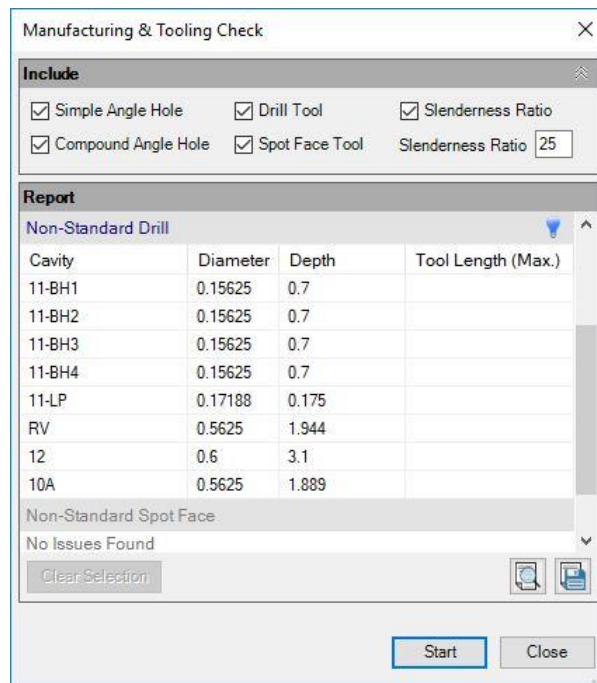
4. Click **Start**.
MDTools checks the manifold design for the selected parameters and lists the cavities deviating from the rule in the dialog box.*
5. Select a row
MDTools highlights the specified issues.
6. Click  to highlight specified section issues.
7. Click  to hide specified section issues.

8. Click **Clear Selection** to clear the highlighted issues.

9. Click Save  to save the list.

The Save As dialog box displays.

10. Enter an appropriate file name and click **Save**.



Manufacturing & Tooling Check List

Note

- If the drill diameter is not available in the Drill Tool database, then MDTools® considers the drill a non-standard drill.
- If the drill depth is greater than the maximum tool depth in the database, then MDTools considers the drill a non-standard drill.
- If only Step0 is present in the cavity, then Step0 is considered as the drill, else, Step12 in the cavity is considered a 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.
- Double click a row in the report to zoom into the problem area/cavity.
- Step0 of ports and cartridge valve cavities is considered a Spot Face.
- 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.
- If spot face diameter exists in the tool library and the 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.

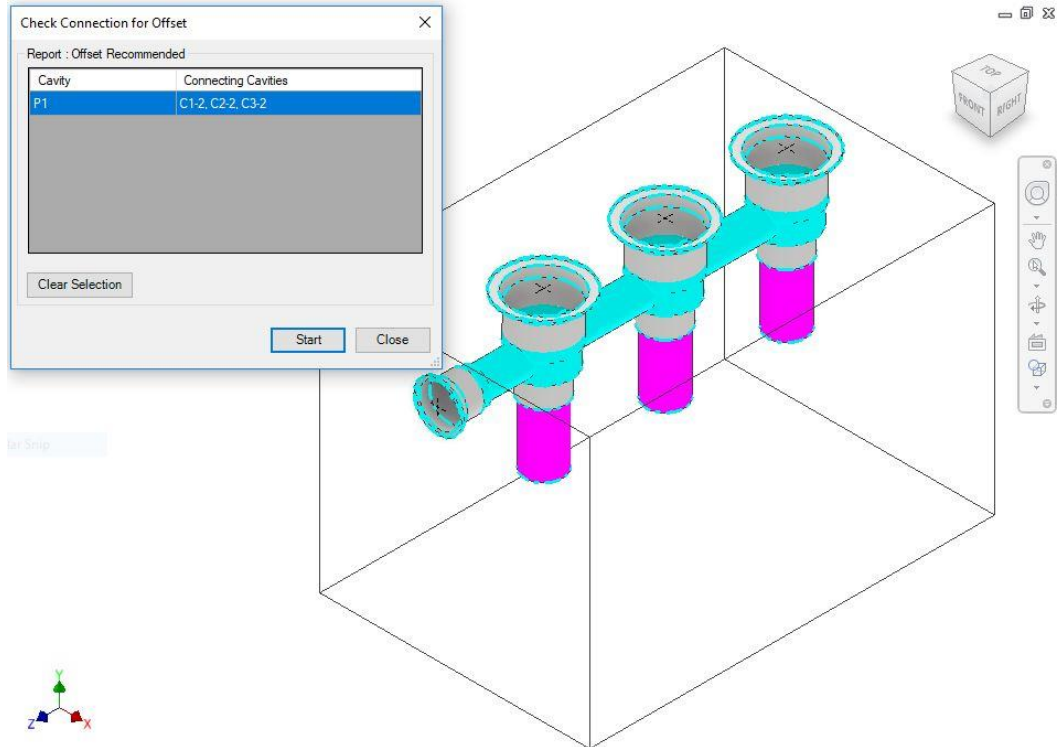
70. Check Connection for Offset

Check the design and recommend the Offset connection, when three or more cavities are connected inline.

1. MDTools 770 ribbon
> **Check** panel
> **Connection**
Offset

The *Check Connection for Offset* dialog box displays.

2. Click **Start**.
MDTools® checks the manifold design for offset and recommends the cavity and the connecting cavities.
3. Select a row.
MDTools highlights the specified cavities.
4. Click the **Clear Selection** option to clear the highlighted issues.



Check Connection for Offset dialog box

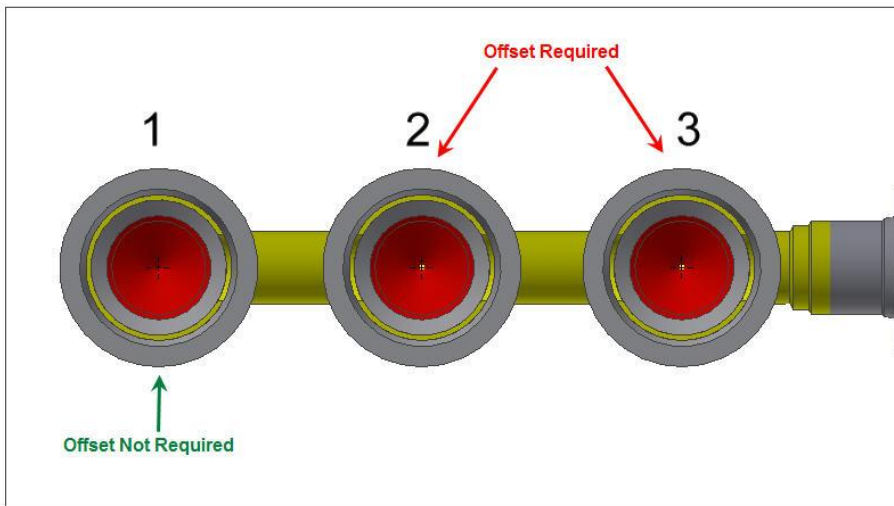
Note

Double click a row in the report to zoom into the problem cavities.

Offset Connection Rules

Case 1:

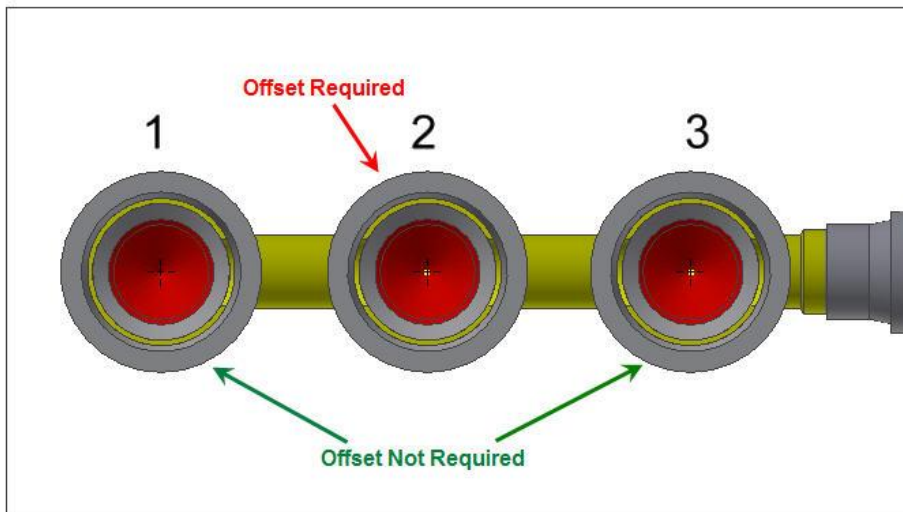
Work port/CV bottom port is connected to more than two cartridge valve side ports



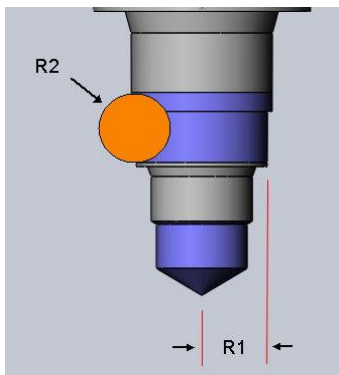
All CVs except the last one should be placed at an offset from the connecting cavity.

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.



71. Check Pressure Rating

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

Single click a row in the report to locate any issue on the manifold.

Double click a row in the report to zoom into the problem area on manifold.

Select the appropriate Design Check option in MDTools Settings to locate any issue.

The Highlight Selected Cavities option is the default, selected in MDTools Settings.

1. MDTools 770 ribbon

>Check panel

>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.

3. Select a row.

MDTools highlights specified issues.

4. Click  to highlight the specified section issues.

5. Click  to hide the specified section issues.

6. Click **Clear Selection** to clear the highlighted issues.

7. Click **Save**  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 which have lower Rated pressure than the Net operating pressure.

2. **Net without Operating Pressure specified:**

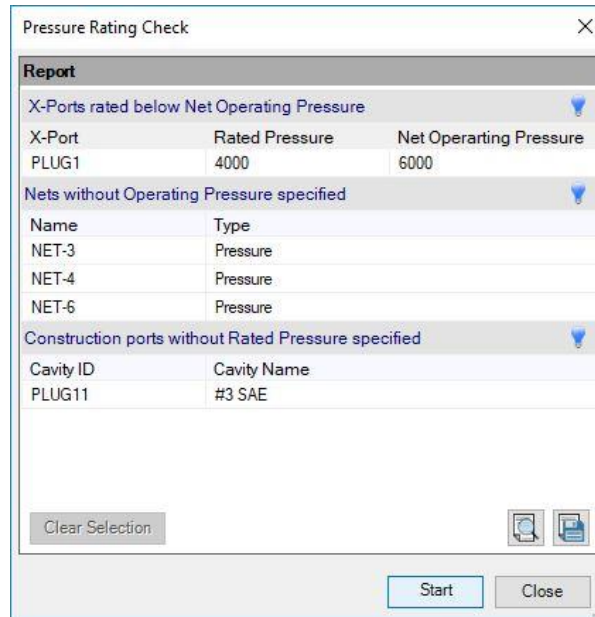
Lists all nets for unspecified pressure in the manifold or value is 0.

3. **Construction ports without Rated Pressure specified:**

Lists all Construction ports for unspecified pressure in the manifold or value is 0.

Note:

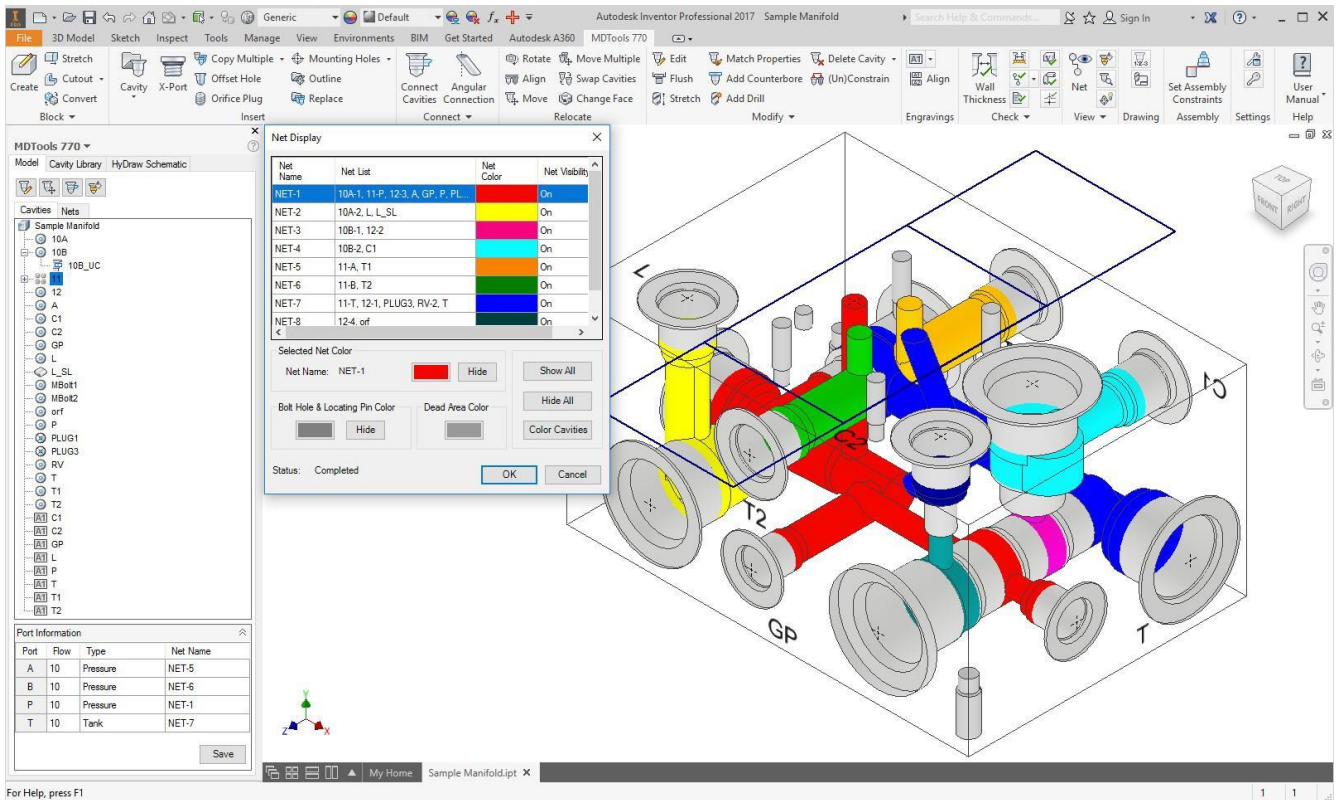
Double click a row in the report to zoom into the problem area/cavity.



Pressure Rating Check List

Display Options

- 72 View a Net
- 73 Color Cavities
- 74 Locate Cavity
- 75 Show/Hide Outline
- 76 Show/Hide Cavity ID
- 77 Net Display
- 78 Show/Hide Cavity Center
- 79 Remove Color



72. View a Net

Locate a position or an area on a selected manifold face, where a cavity can be placed to connect with the selected net.

MDTools displays cavities/ports in the selected net in green and all the other cavities/ports in the Dead Area color.

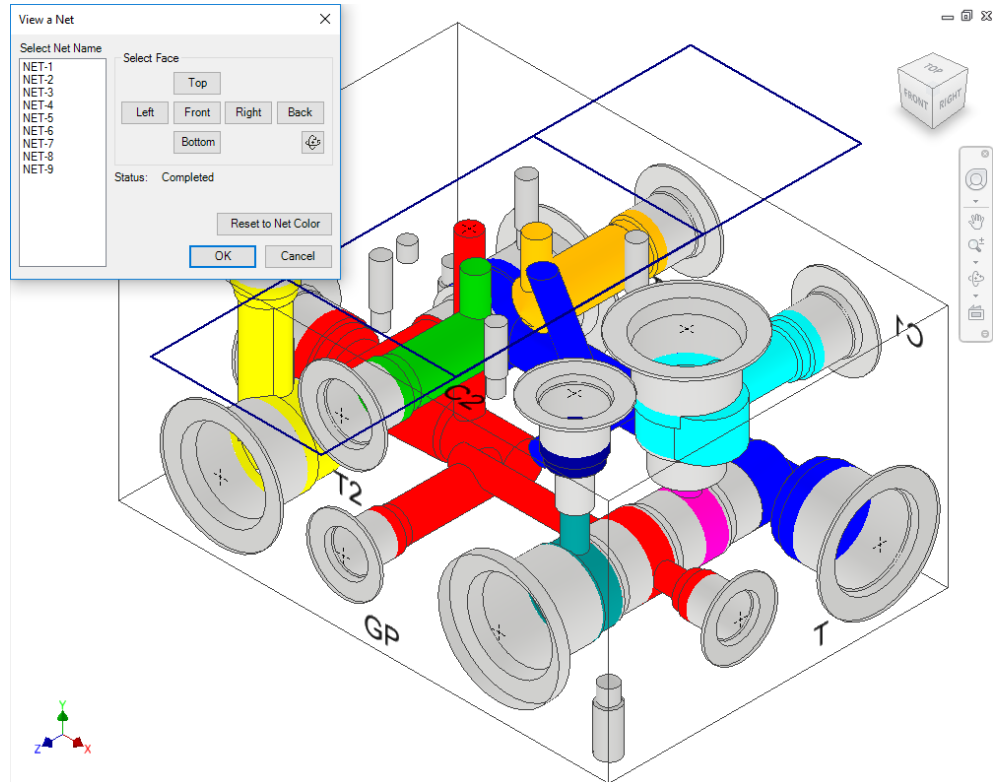
- MDTools 770 ribbon
>View panel
>Net

The View a Net dialog box displays with the list of nets in the manifold.
- Select the net from the Select 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.
- Select the face, where you want to place a cavity to connect to the selected net:
Top, Bottom, Left, Right, Front, or Back.

MDTools displays the selected manifold face parallel to the screen.



View a Net dialog box

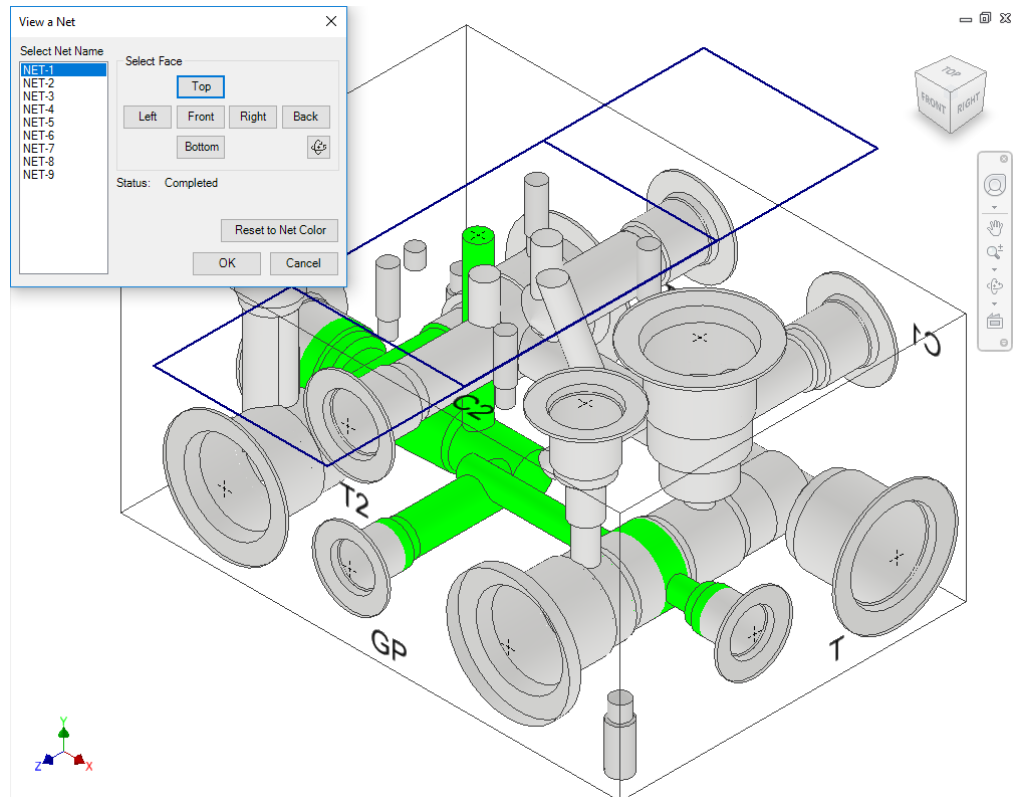
Reset to the Net Color

Click **Reset to Net Color** to revert to your default color settings for Nets.

Note

Use the **Rotate** button to rotate the block.

Default colors are the colors assigned to the nets in **MDTools Settings>Net Display**.



Areas in the selected net displayed in green

73. Color Cavities

Shade or update the shading of cavities on the manifold.

MDTools 770 ribbon

>View panel

>Color

The Coloring Cavities message box displays.

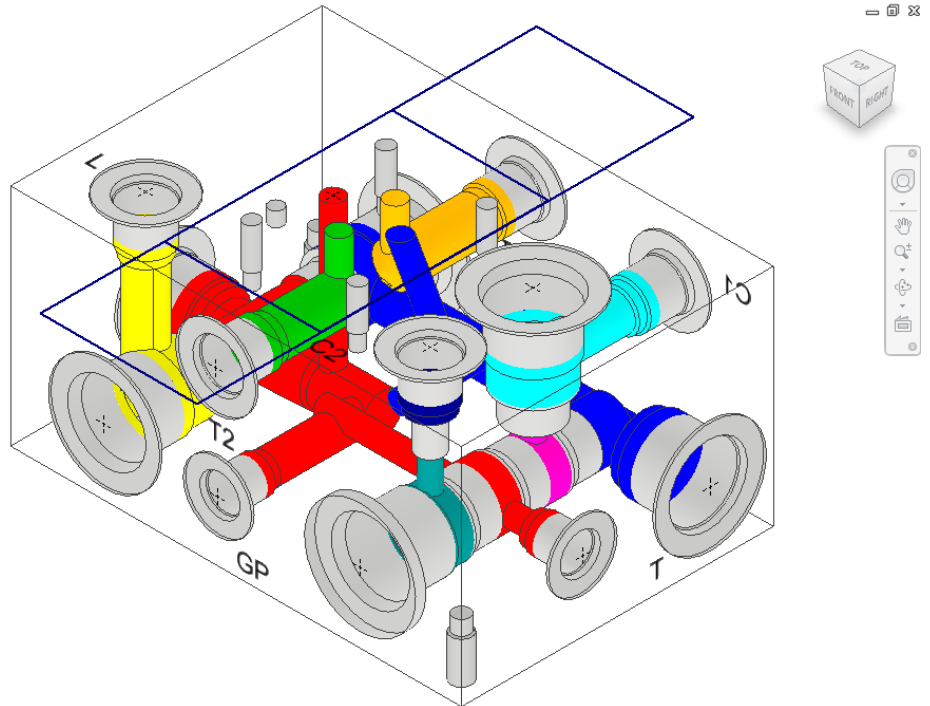
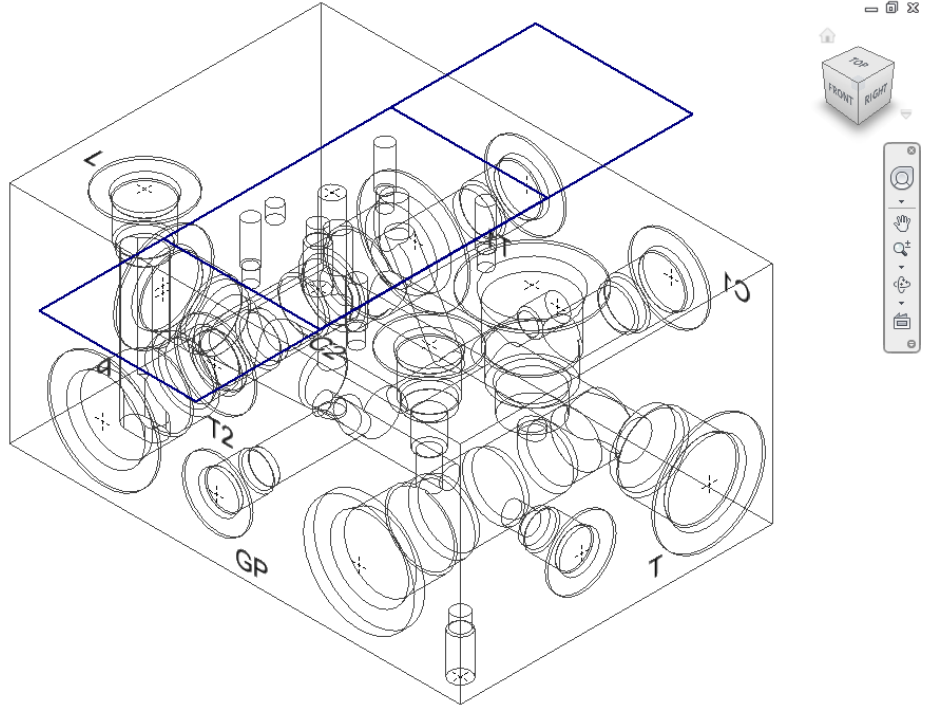
MDTools shades all the cavities on the manifold.

Note

- Terminate the command by pressing the Esc key.
- Run this command from the MDTools browser.
- Shading of cavities cannot be saved with the part model (limitation in Autodesk Inventor). Therefore, you must shade the cavities when you reopen the manifold, if the MDTools browser is not set to Load on Startup.



The Coloring Cavities message box



Cavities shaded automatically with their net colors

74. Locate Cavity

Easily locate cavities on a manifold.

1. MDTools 770 ribbon
> **View** panel
> **Locate**

The *Locate Cavity* dialog box displays the list of cavities on the manifold.

2. Select a cavity in the list.

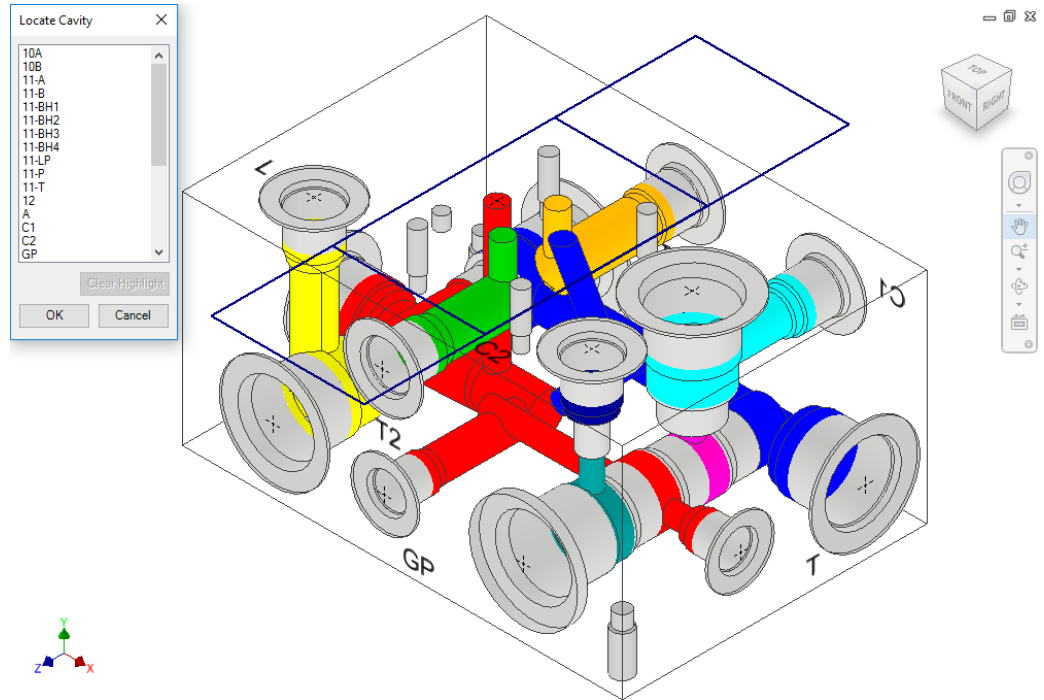
MDTools[®] highlights the selected cavity.

3. Select the next cavity you want to locate.

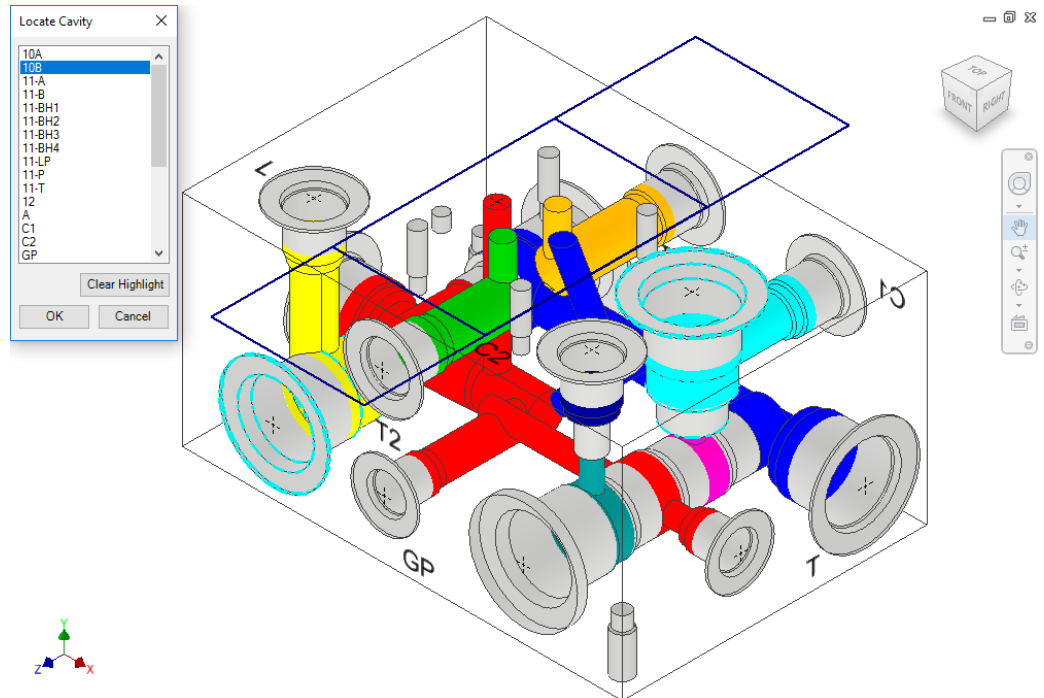
MDTools highlights the selected cavity.

4. Click **Clear Highlight** to clear the highlighted cavities.

5. Click **OK**.



Locate Cavity dialog box



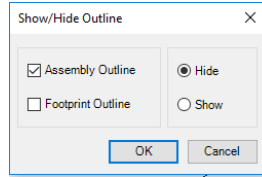
Cavity highlighted on selecting the cavity name

75. Show/Hide Outline

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

1. MDTools 770 ribbon
> **View** panel
> **Outline**

The Show/Hide Outline dialog box displays.



2. Select the type of outline required.

Both the Assembly Outline and Footprint Outline options are selected by default.

3. Select the display option.

To turn off the visibility, select the Hide option, else select the Show option.

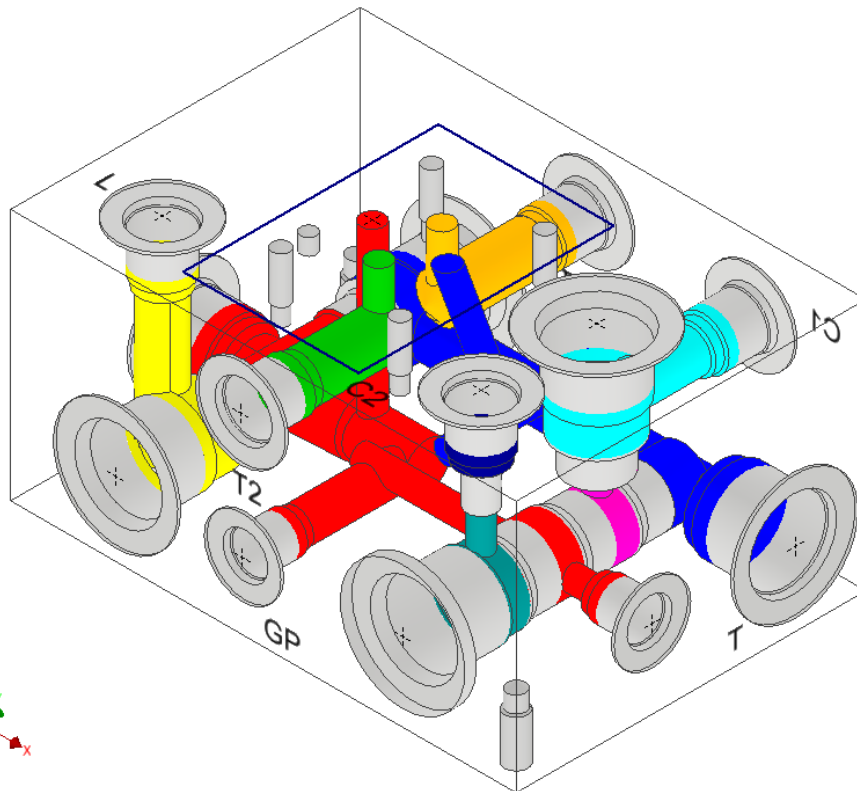
Show is the default state.



4. Click **OK**.

If the Hide option is selected, then MDTools turns off the visibility of the entire selected outline types on the manifold, else all the outlines are visible.

Show/Hide Outline dialog box



Visibility of outlines switched off

76. Show/Hide Cavity ID

The **Cavity ID** command displays the Cavity ID at the center of a cavity. Easily identify the cavity on the manifold. Show or hide cavity IDs on the selected faces or the selected cavity.

1. MDTools 770 ribbon
> **View** panel
> Slide out menu
> **Cavity ID**

The Show/Hide 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.

5. Click **Font Style** to change the font style.

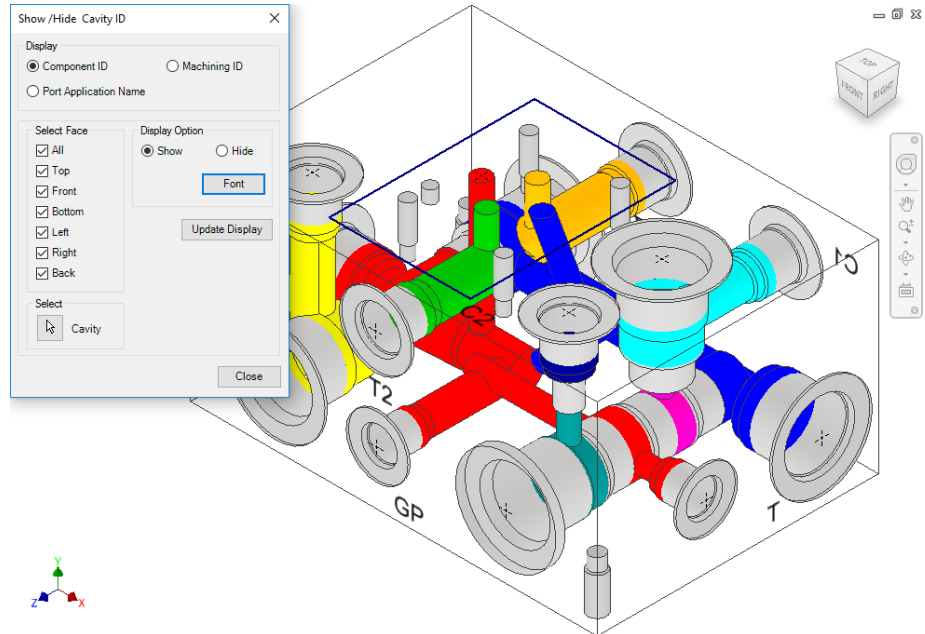
The Font dialog box displays with default styles.

Font Arial
Style Regular
Size 16
Color Black

Change the font properties, if required.

6. Click **Update Display**.

MDTools displays the cavity ID on the cavity center.

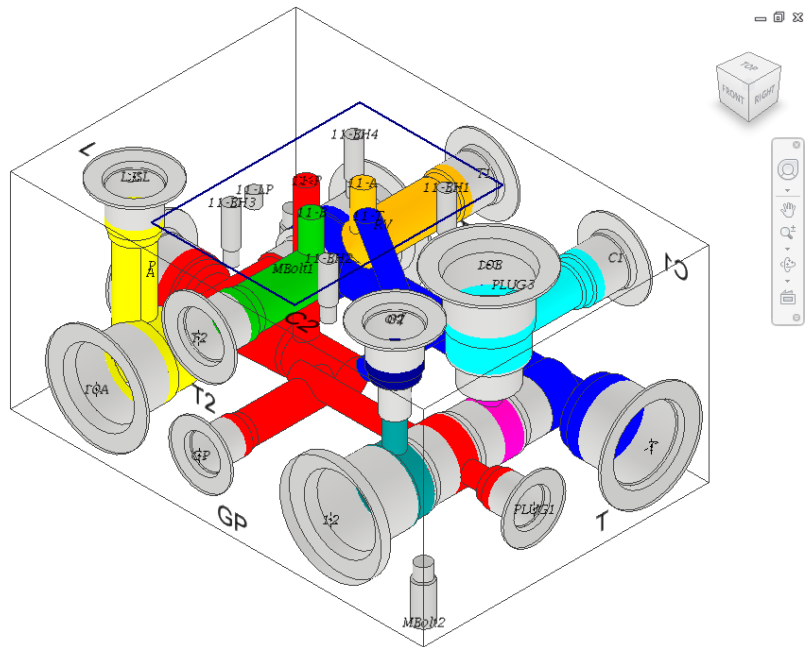


Show/Hide Cavity ID dialog box

Show/Hide Single Cavity ID

1. Click the **Cavity** selection button.
2. Select the cavity.

MDTools displays the cavity ID on the cavity center.



Cavity ID displayed on the center of cavities

Note

- The cavity ID is always displayed parallel to the screen. Cavity ID displays cannot be saved with the part model.
- Automatically display the port name in the model using the enhanced **Port Application Name** in the Show/Hide Cavity ID command.
- The Cavity ID displayed does not relocate on Manifold Resize.

77. Net Display

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

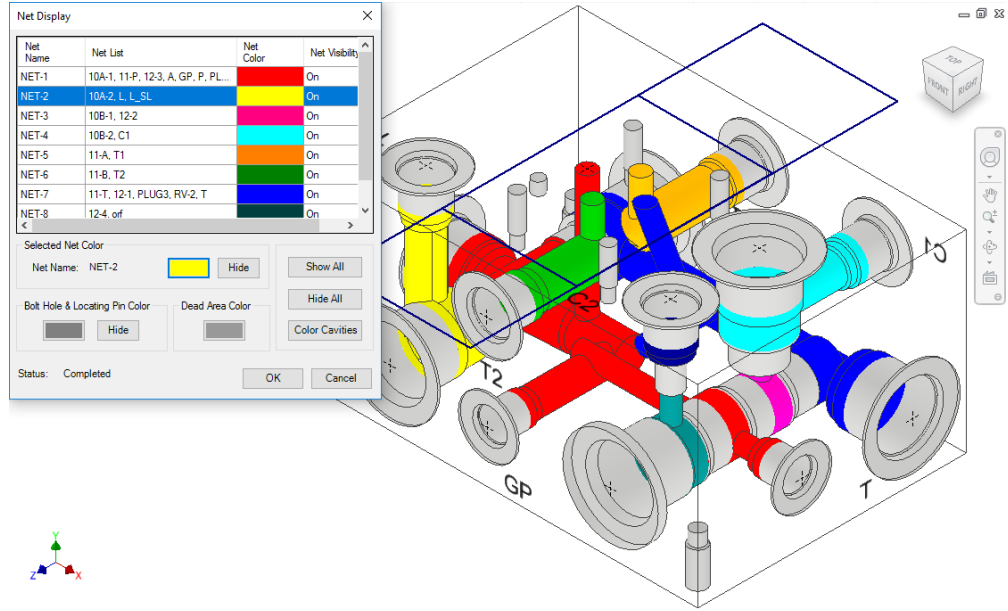
MDTools 770 ribbon

- > View panel
- > dropdown
- > Net Display

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

1. Show or hide a single net in the manifold.
You can select one net at a time.



2. Select the net from the list.

MDTools displays the net name and color in the dialog box.

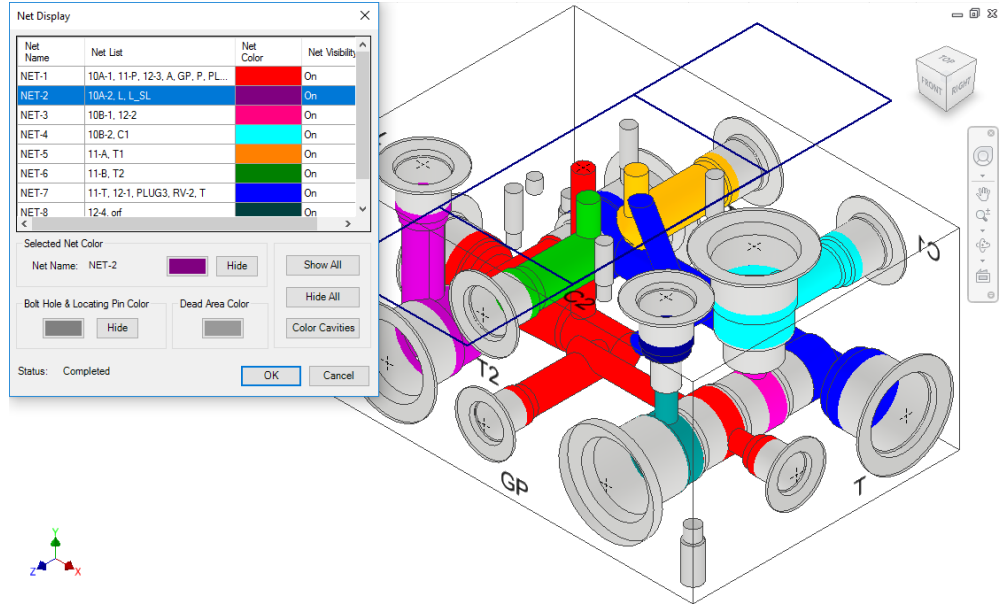
Net Display dialog box

3. Click **Show** to display the selected net.

MDTools displays the selected net with the selected net color.

4. Click **Hide** to hide the selected net.

MDTools hides the selected net.



Nets displayed with different colors

Show/Hide All Nets

1. Show or hide all the nets in the manifold.
2. Click **Show All**.

MDTools shows each net in the manifold with a different color.



Show/Hide Bolt Holes and Locating Pins

3. Show or hide bolt holes and locating pins color in the manifold.
4. Click the **Show** button in the Bolt Holes & Locating Pin Color section.

MDTools displays the bolt holes and locating pins on the manifold.

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.

1. Click the **Color** button.

The Color dialog box displays.

2. Select the required color from the Color dialog box.

Note

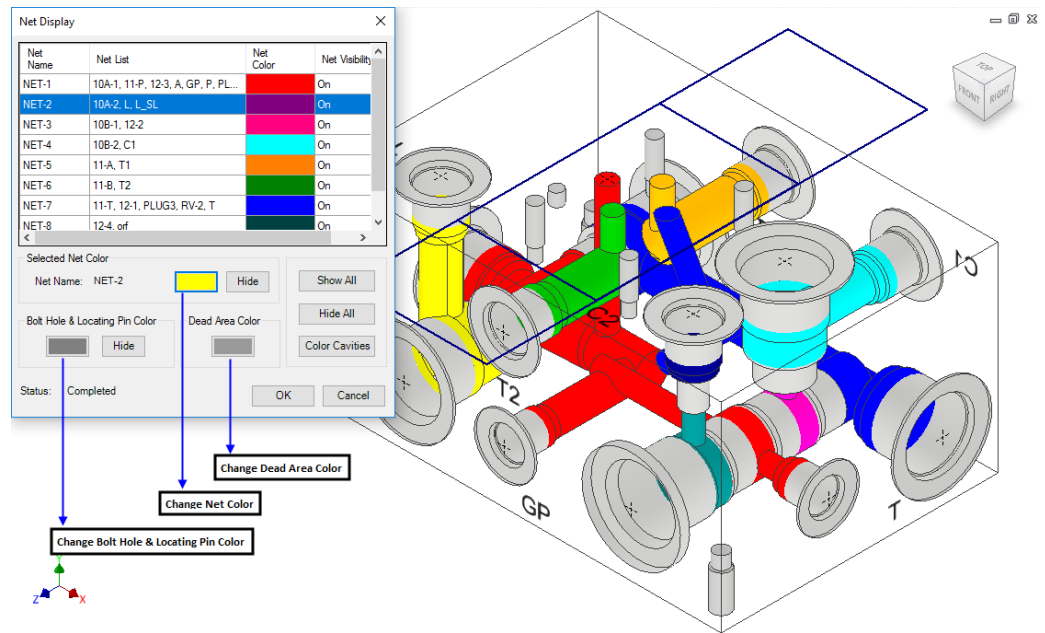
- Click the color button for a selected net to change the selected net color.
- Click the Bolt Hole & Locating Pins Color button to change the color of bolt holes and locating pins.
- Click the Dead Area Color button to change the color of Dead Areas in cavities.

3. Click **OK**.

MDTools automatically updates the color and the net display.*

Note

If needed, change the default Net colors in the MDTools Settings dialog box.



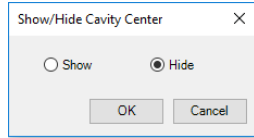
Net Display: Change color

78. Show/Hide Cavity Center

Change the visibility of the cavity center points.

1. **MDTools 770 ribbon**
> **View panel**
> Slide out menu
> **Cavity Center**

The Show/Hide Cavity Center dialog box displays.



2. Select **Show/Hide**.
3. Click **OK**.

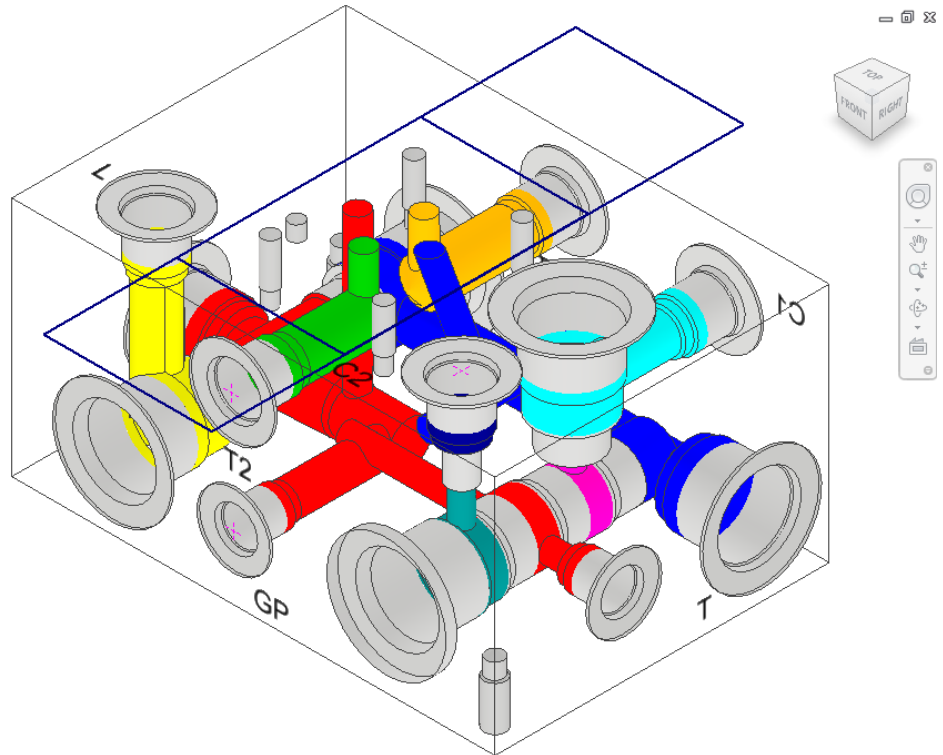
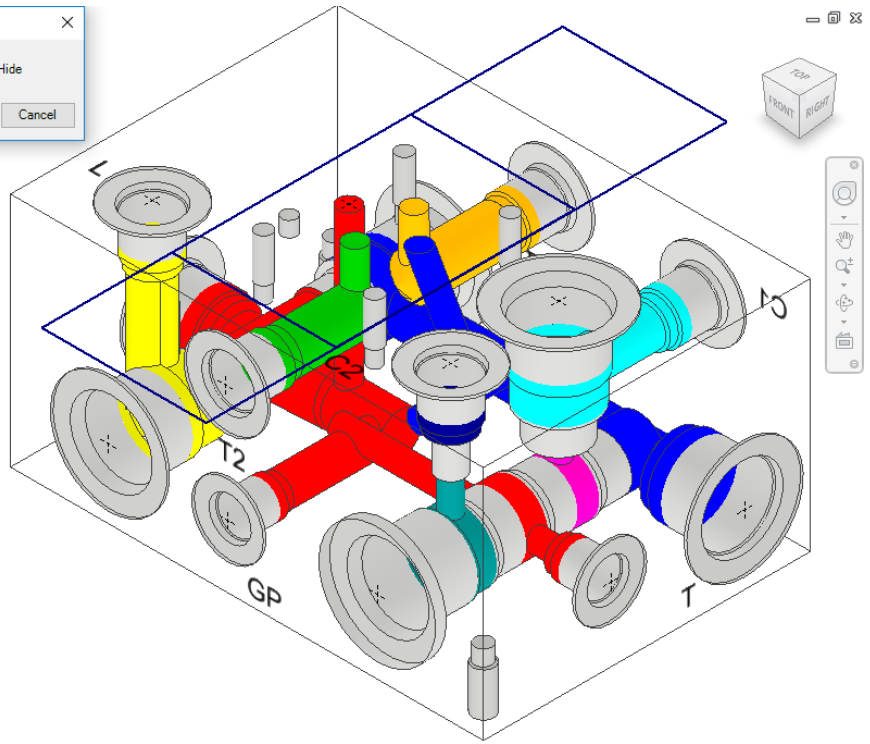
MDTools* makes the cavity center points visible or invisible, as required.

Note

- When you hide or show the cavity center points, MDTools hides or shows all the cavity center points.
- Hiding or showing the center point is done manually.



Show/Hide Cavity Center dialog box



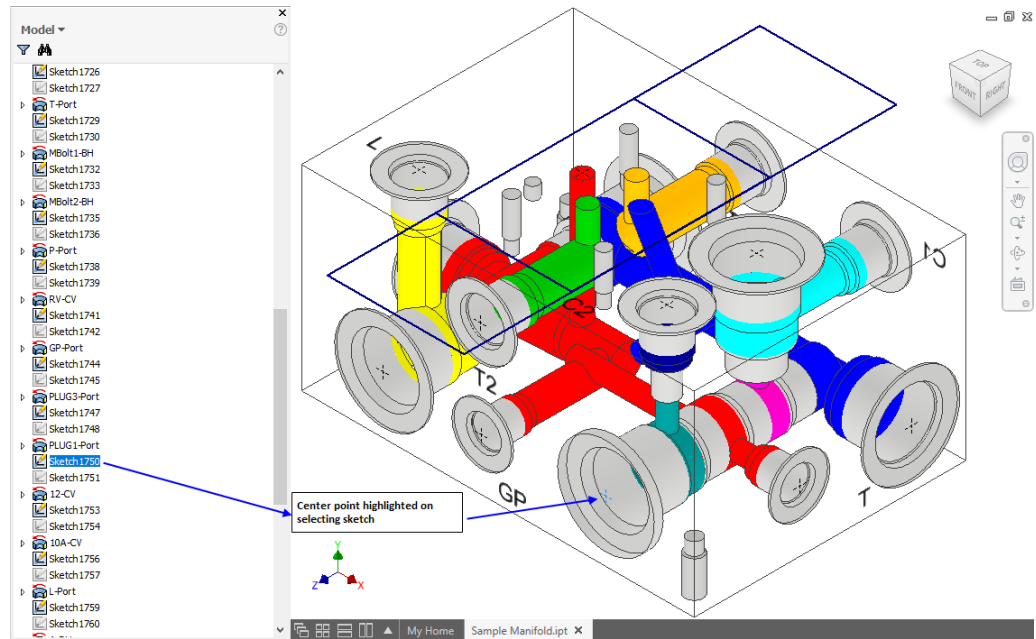
Cavity Center - Hidden.

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 Inventor browser.

When you select the sketch, the center point gets highlighted.



Controlling the visibility manually

2. Right-click the selected sketch.

The context menu displays.

3. Select **Visibility** from the context menu.

If the center point is visible, then it becomes invisible and 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 specified cavity.

79. Remove Color

Remove the shading of cavities on the manifold.

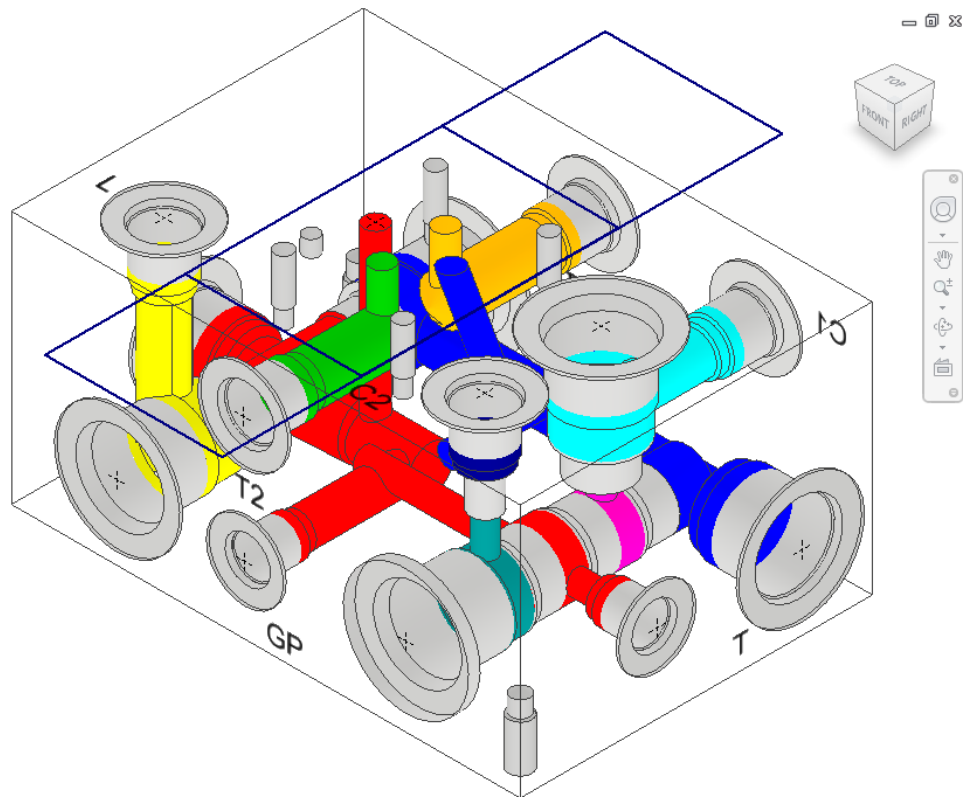
Removing Cavity Shading

- > View panel
- > Slide out menu
- > Remove Color

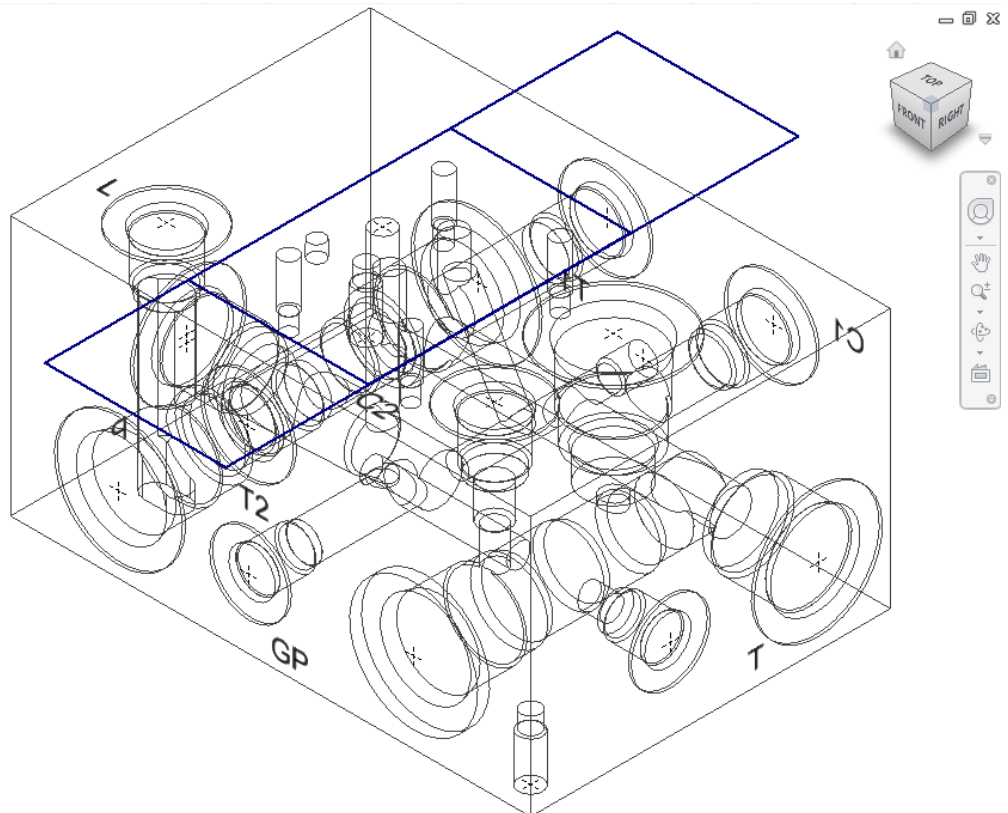
MDTools[®] removes the shading of all the cavities on the manifold.

Note

You can terminate the command by pressing the Esc key.



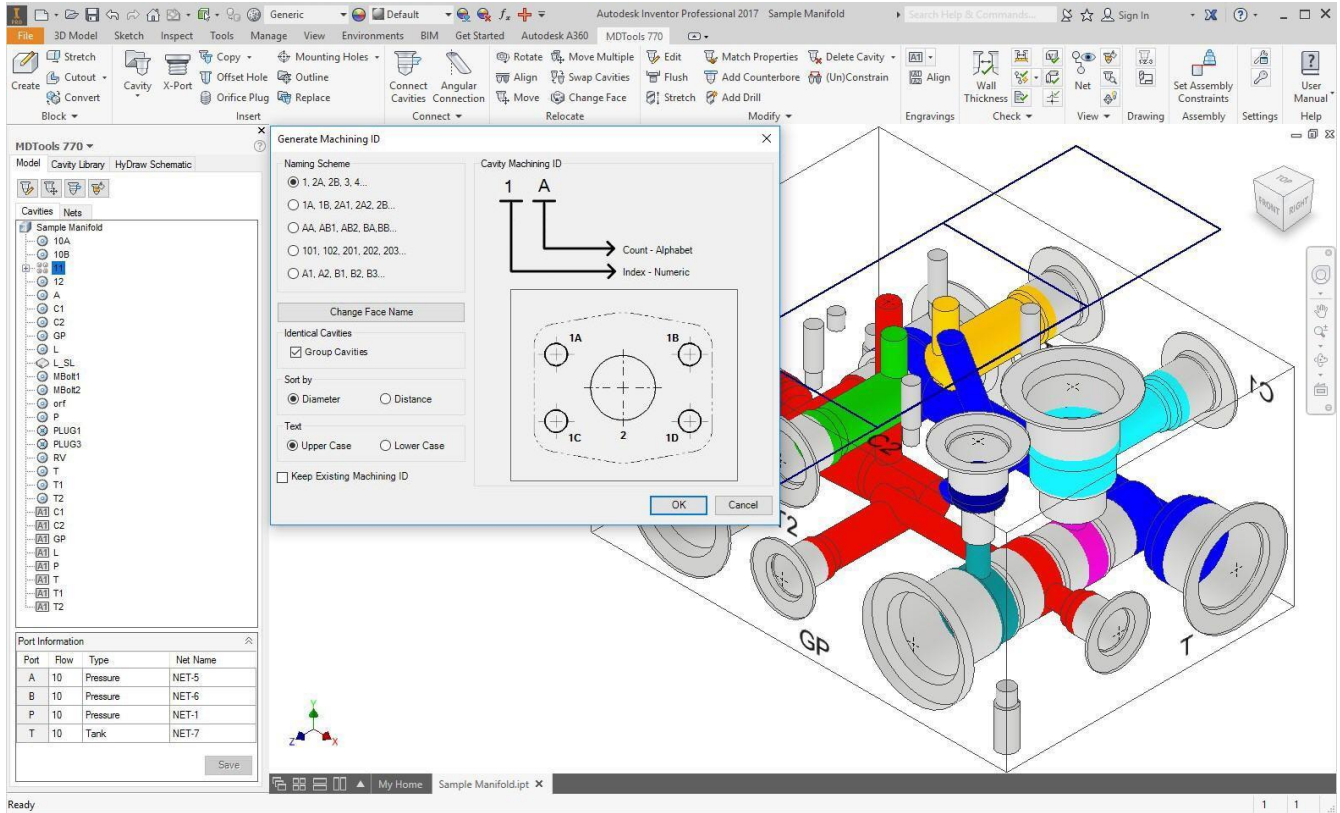
Cavities shaded with their net colors



Cavities shading removed using Remove Color

Part Model Drawing Commands

- 80 Generate Machining ID
- 81 Create Machining Drawing
- 82 Set Assembly Constraints



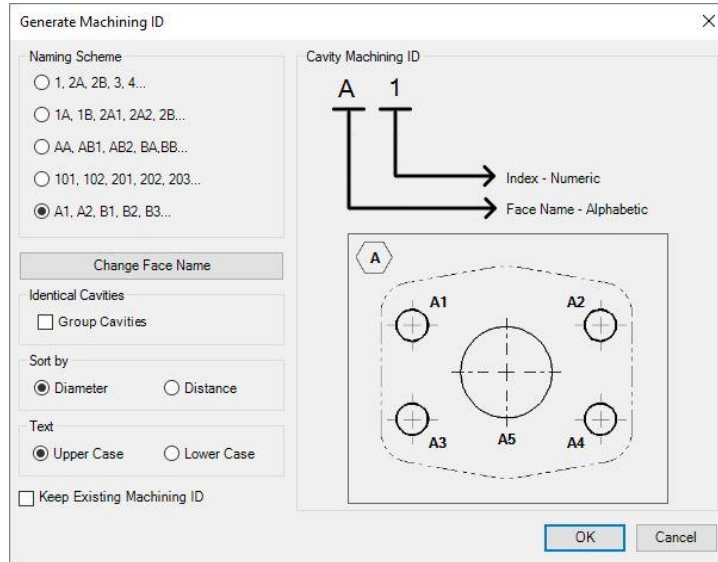
80. Generate Machining ID

Automatically generate machining IDs for all the cavities on the manifold. It is based on the diameter or the distance naming options and one of the four alternative numbering options.

The Machining ID command depends on the following.

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

1. MDTools 770 ribbon
> **Drawing** panel
> **Machining ID**
The Generate Machining ID dialog box displays.



Generate Machining ID dialog box

Select Cavity Naming Scheme

2. Select Naming Scheme.
 - 1, 2A, 2B, 2, 4...
 - 1A, 1B, 2A1, 2A2, 2B...
 - AA, AB1, AB2, BA, BB...
 - 101, 102, 201, 202, 203...
 - A1, A2, B1, B2, B3
3. Use the **Change Face Name** option to configure the face name.

You can have Alphabetic or Numeric Face name.

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.
4. Select the Group Cavities option for Identical Cavities, if required.

4. Select the **Sort by** option

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

5. 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 is 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.

6. Click **OK**.

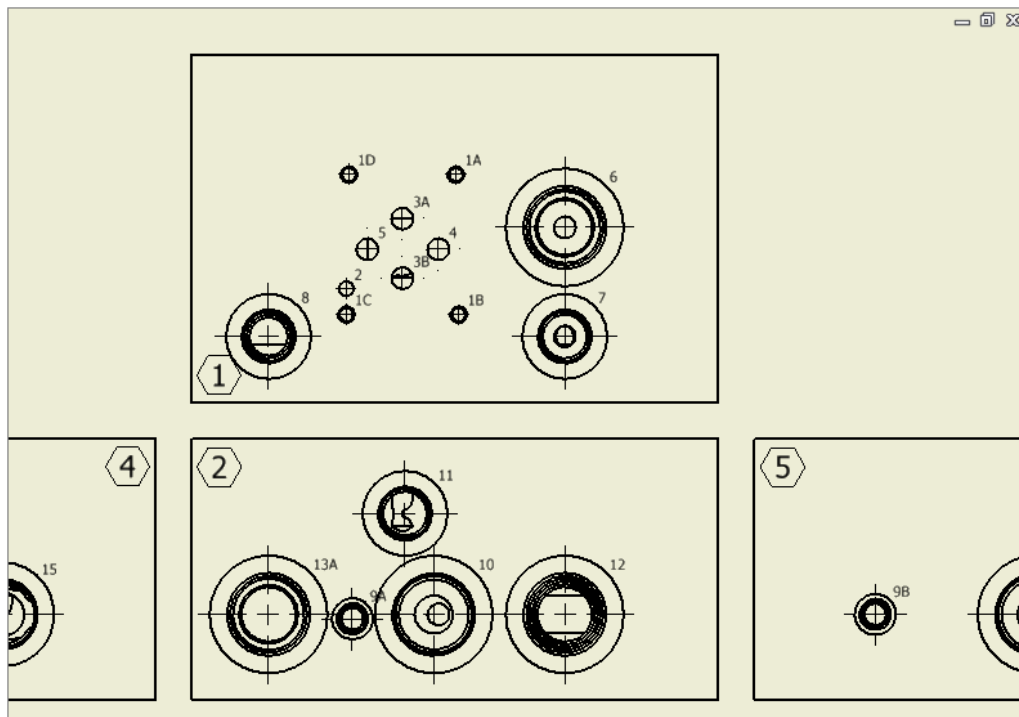
1. Naming Scheme

The Machining IDs of cavities is assigned using four different naming schemes. Refer images on the right.

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

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

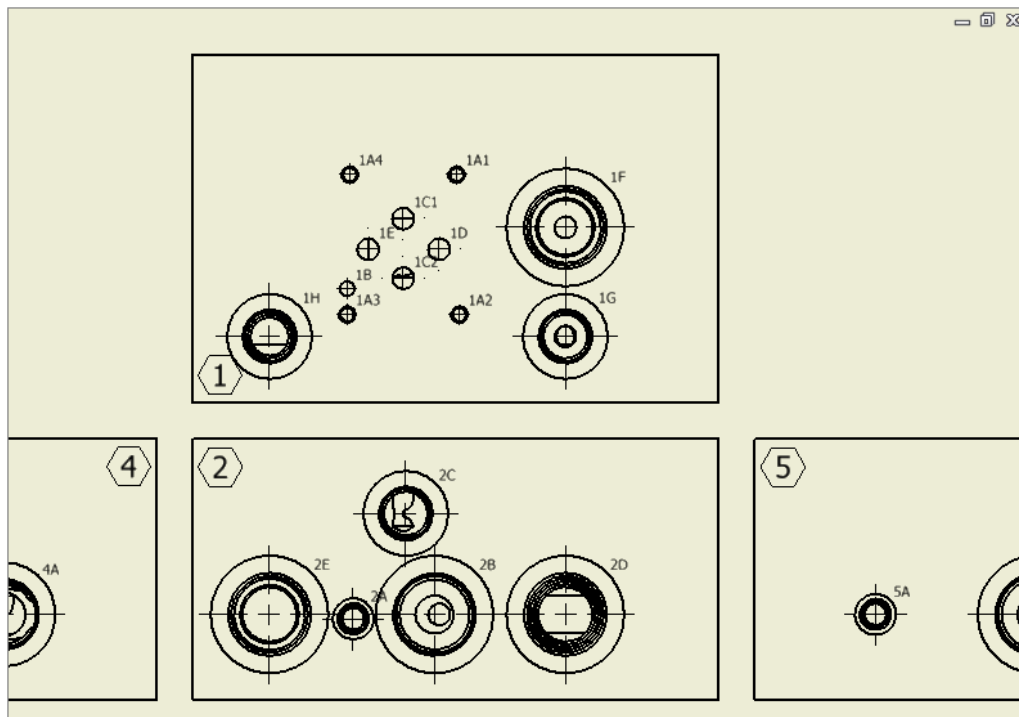
The number is incremented with each non-identical cavity found on the face starting with the cavity found with the smaller diameter on the first face.



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

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

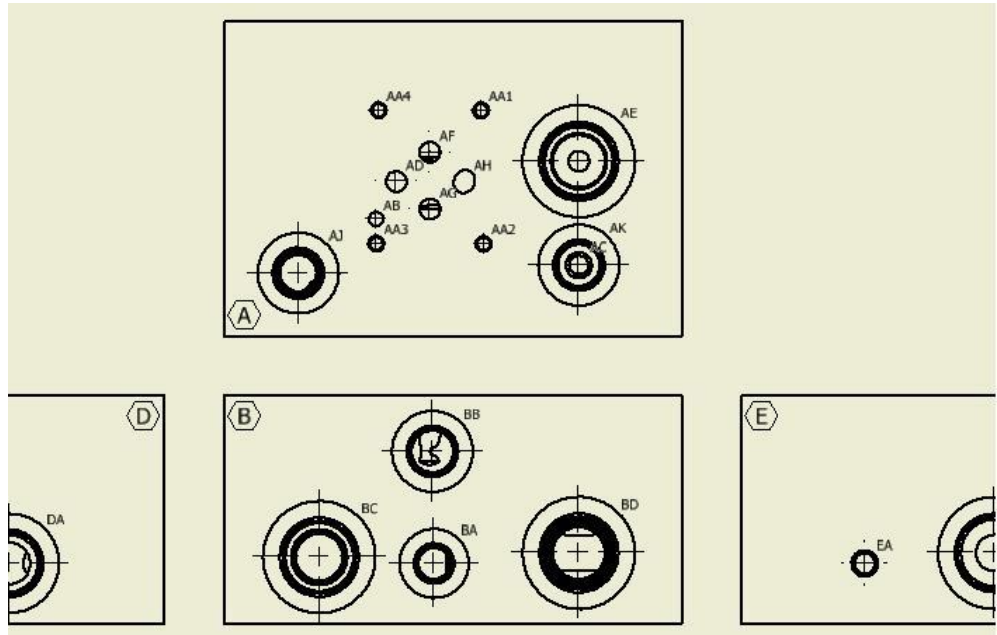
- Name of the cavity is a Numerical Face Name + Alphabetical Cavity Index
- Count is an alphabet and Naming option: Distance



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

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

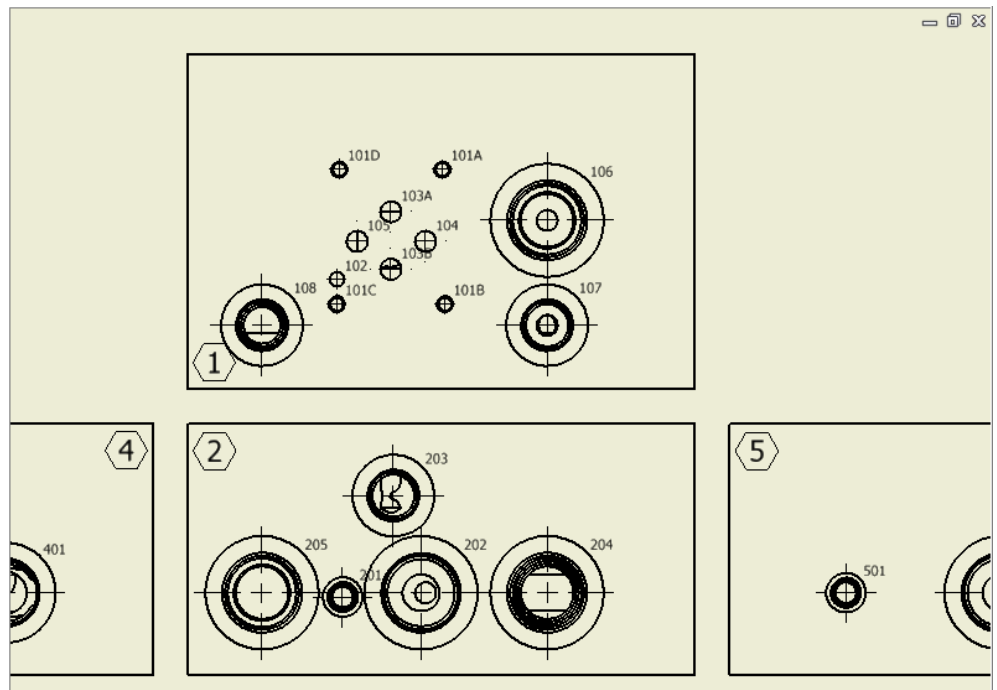
- Name of the cavity is an Alphabetical Face Name + Alphabetical Cavity Index
- Count is an alphabet and Naming option: Diameter



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

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

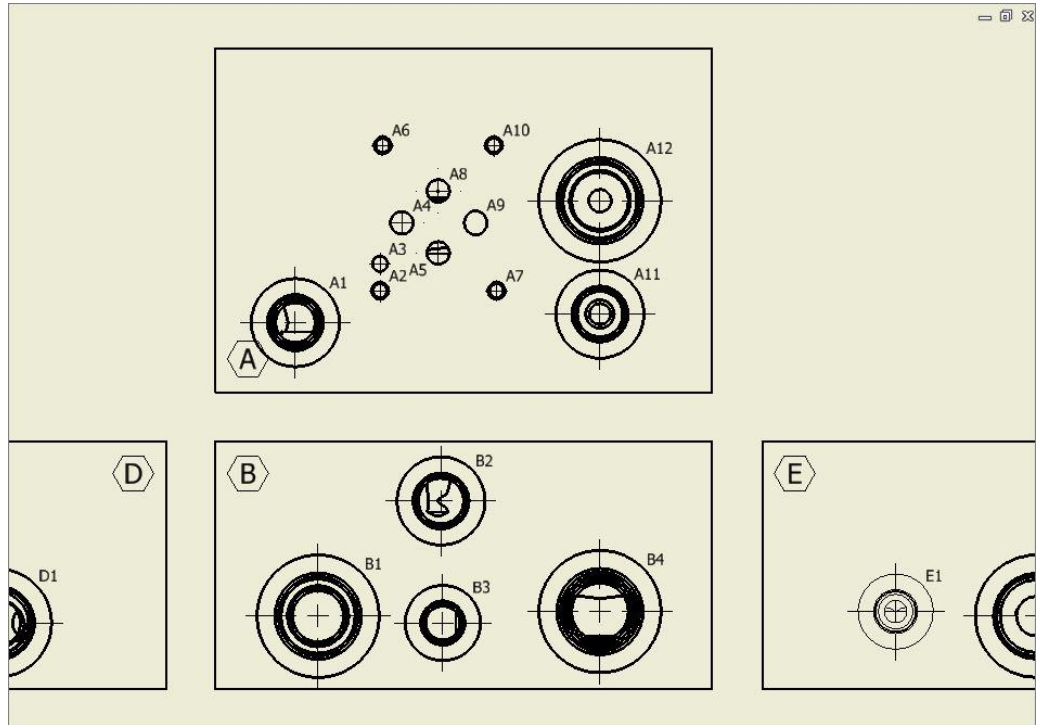
- Name of the cavity is a Face Name + Numerical Cavity Index
- Naming option: Diameter



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

Naming scheme: A1, A2, B1, B2, B3

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



Naming Scheme: A1, A2, B1, B2, B3

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.

2. 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.

Else

- 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 is removed from 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

Else

- 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 counter bore/Match properties/Flush Plugs/Replace etc.

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

Else

If a cavity belongs to a group of identical cavities,

1. If same change is applied to all, then no change is required.

Else

2. Split the group and retain ID of cavities in the sub group with majority.
Consider others as new cavities and assign new IDs 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) where dimensions are not changed.

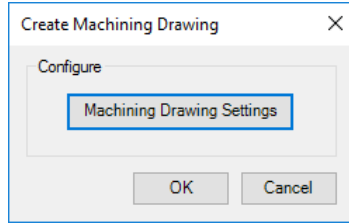
81. Create Machining Drawing

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

Save the Part document before using this command.

1. MDTools 770 ribbon
> **Drawing** panel
> **Create**

The Create Machining Drawing dialog box displays.



2. Click **Machining Drawing Settings** to change the preset configurations.

The Machining Drawing Settings dialog box displays.

Machining Drawing dialog box

3. Click **OK** to initiate the automatic creation of the machining drawing.

Machining Drawing Settings

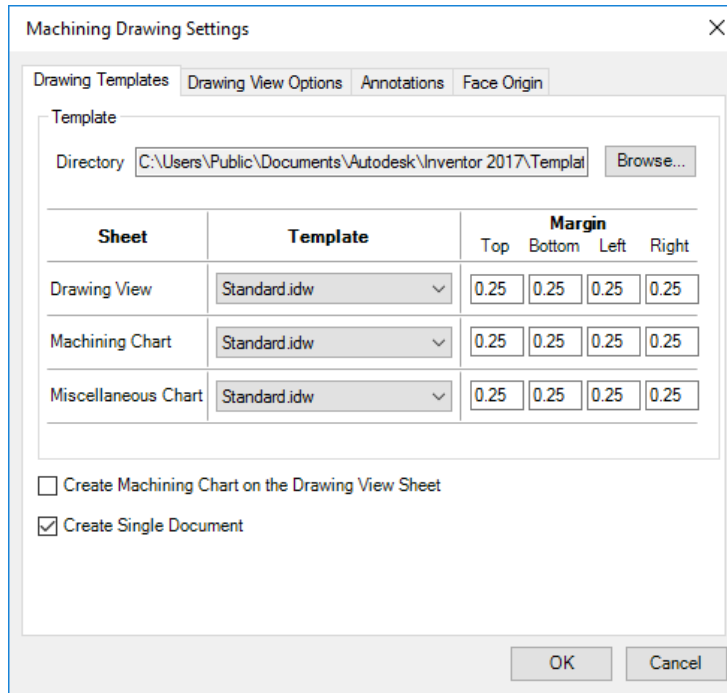
The Machining Drawing Settings dialog box enables you to configure the various options and automatically create the machining drawing for the manifold block.

1 Drawing Templates

1. Click the **Browse** button and select the template folder.

All templates (.idw/dwg) in the selected folder is displayed in combo boxes in the Template for group.

2. Select the template from the combo box for the Drawing View.
 - To create a Machining Chart on a separate sheet, specify template for a machining chart.
 - Select template for Miscellaneous Charts, i.e. Cavity table, X-Drill plugs chart, or Engravings chart.
 - Select the Create Machining Chart on the Drawing View Sheet option to draw the machining chart on the main sheet with drawing views, outside the title block.
3. Enter the Margin value, if you want to have clearance from the sheet border for each template. This will disallow overlapping between views/tables and sheet border or any supplementary items (notes, revision tables etc.) on the sheet.



Machining Drawing Settings dialog box:
Drawing Templates

Working of Margin feature

1. **Drawing View:** Views are 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

2. **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

3. **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

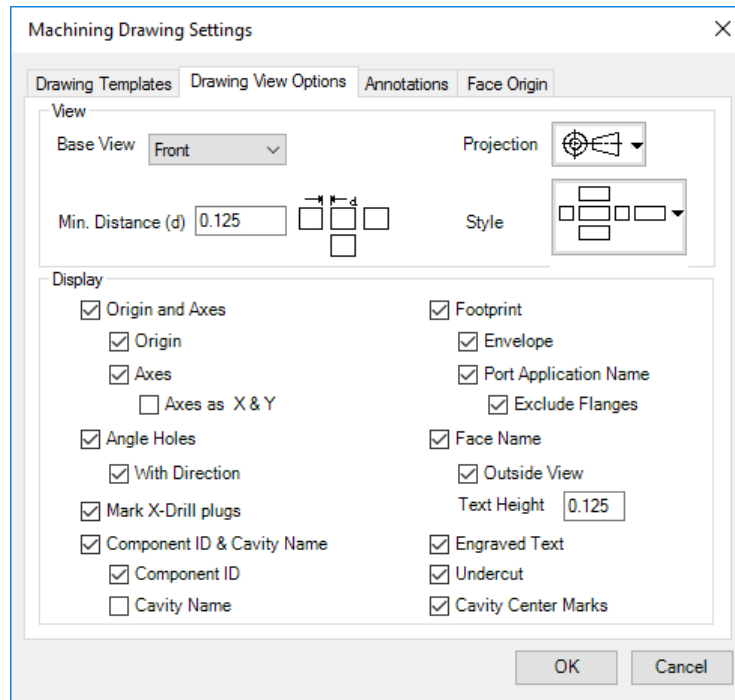
Distance between left end of the chart and sheet inner border

Right

Distance between right end of the chart and sheet inner border

2 Drawing View Options

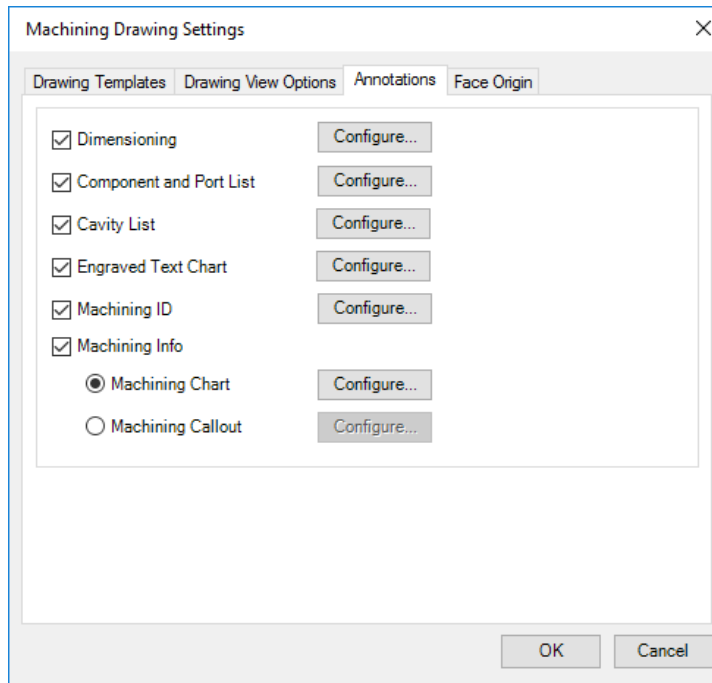
- Specify **Base** view or reference view. Other views are placed based on the selected base view.
- Specify the **projection** type for the drawing views by selecting the required button.
- Specify the **Min. Distance (d)** value between the views. MDTools* maintains this minimum clearance between the views when placing the views on the sheet.
- Select placement style of drawing views.
- Select **Origin and Axis** to display the origin and axes.
 - Select **Axis as X & Y** to display the axis as X and Y for each face, otherwise the block axis is displayed for the faces.
- Select **Footprint** to display the footprints inside the machining drawings.
 - Select **Envelope** and **Port Application Name** to display them.
 - Select **Exclude Flanges** to hide the port application name for the flanges.
- Select **Angle Holes** to display the angle holes.
- Select **Face Name** and specify the value for the text height in the **Text Height** text box to display the face name with each drawing view.
 - Select Outside view option if you want to display face name outside the view boundary.
- Select **With Direction** to display direction of the angle holes.
- Select **Mark X-Drill plugs** to mark the X-Drill plugs in drawing views.
- Select **Component ID & Cavity Name** and then select the required options.
- Select **Engraved Text** to display the engravings inside the drawing views.
- Select **Undercut** to display undercuts as circles in the drawing views.
- Select **Cavity Center Marks** to display center marks of cavities inside the drawing.



Machine Drawing Settings dialog box: Drawing View Options

3 Annotations

- Select the cavity **Dimensioning** option to dimension the cavities in the drawing views and then click Configure.
- Select **Components and Ports List** to create the Components and Ports List chart and then click Configure.
- Select **Cavity List** to create cavity table and then click Configure.
- Select **Engraved Text Chart** to create the Engravings chart and then click Configure.
- Select **Machining ID** to display the machining ID of the cavities. Click the **Configure** button to configure the machining ID display options.
- Select **Machining Chart** to create the machining chart and then click Configure.
- Select **Machining Callout** to create the machining callout and then click Configure.



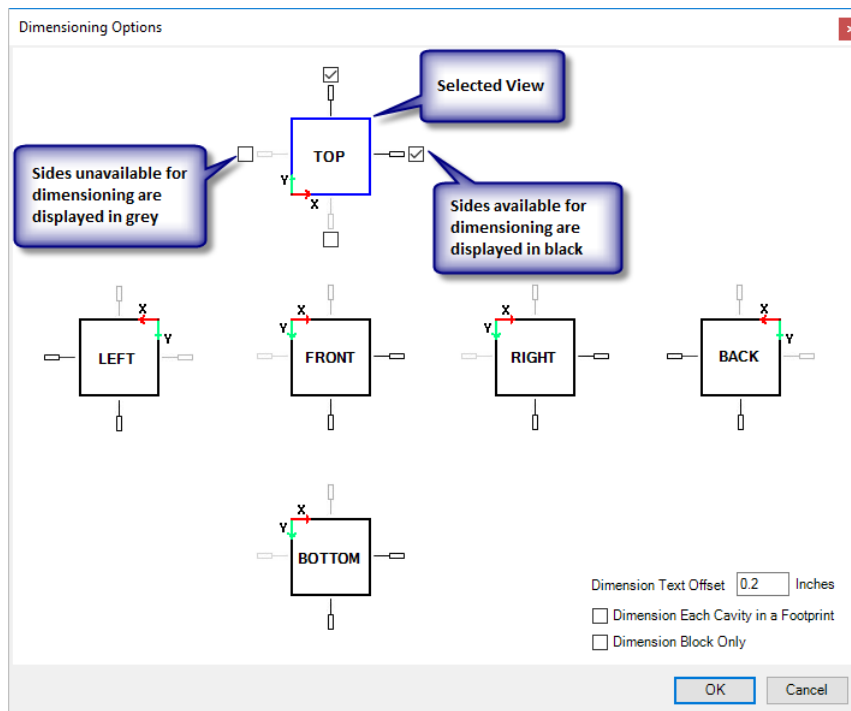
Machining Drawing Settings dialog box: Annotations

1 Dimensioning Options

1. Select a view.
2. Specify the side available for dimensioning.
3. Specify the value for **Dimension Text Offset** from views.
4. Select **Dimension Block Only** to only dimension the block.
5. Select **Dimension All Cavities** to dimension all the cavities in footprints. Otherwise, only the cavity marked 'dimension from this cavity' is dimensioned.
6. Set the orientation of X and Y dimensions on all the faces.
7. Click **OK** to save the settings.

Note:

The views in the dialog box displays the same placement and orientation as the base view selected in the **Drawing View Options** tab.



Dimensioning Options dialog box

2 Configure Cavity List

Select the items to be included when inserting the Cavity list.

For example: If you want to exclude Mounting Bolt Hole, deselect that option.

1. Select/Deselect the **Cavity Type** option to display or hide a type of cavity.
2. You may change the **column** headers for the customized column headings.
 - Select/Deselect the Serial Number option to display or hide the serial numbers in the table.
3. Select the **Sort List by** option.
4. Change the **title**, if required.
5. Enter the **Text Height** for the Cavity List table.
6. Click **OK** to save the settings.

Configure Cavity List

Cavity Type

Footprint X-Drill Plug Port

Cartridge Valve Mounting Bolt Hole Drill Hole

Slot Undercut O-Ring Groove

Columns

Serial Number S.N.

Cavity/Footprint Name Cavity/Footprint Name

Cavity Type Cavity Type

Quantity Quantity

Sort List by

Cavity/Footprint Name Cavity Type

Title Text Height

Cavity List 0.125 in

OK Cancel

Configure Cavity List dialog box

3 Configure Machining ID

1. Select **Same as Component ID** to display the machining ID same as the component ID.
2. Enter **Text Height** for machining ID.
3. Select **Display Within Balloons** to display the machining ID within balloons.
 - Select the balloon start position, i.e. from the center of the cavity or the edge of the cavity.
4. Select **Display Cavity Location** to display the machining ID with the cavity location within balloons.
5. Click **OK**.

Configure Machining ID

Same as Component ID Text Height 0.125

Display Within Balloons

Start balloon from

Center of Cavity Edge of the Cavity

Display Cavity Location

OK Cancel

Configure Machining ID dialog box

4 Configure Machining Chart

Create or update the format used for the machining chart.

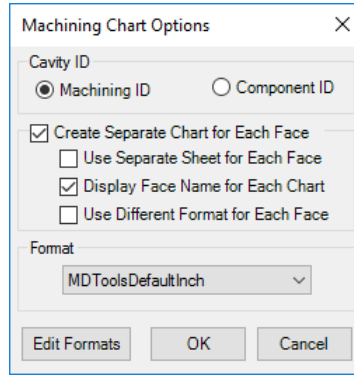
1. Select **Machining ID** or **Component ID** to use as the Cavity ID in the machining chart.
2. Select **Create Separate Chart for Each Face** to create separate machining charts for all the faces. Otherwise, a combined machining chart is created.
3. Select **Use Separate Sheet for Each Face** to create a machining chart on a separate sheet for each face.
4. Select **Display Face Name for Each Chart** option to display the face name on top of the machining chart for each face
5. Select **Use Different Format for Each Face** to use a different machining chart format for each face.
6. Select **Format**.
7. Click **Edit Formats**, if you want to edit the Machining Chart formats.

The Edit Machining Chart Formats dialog box displays.

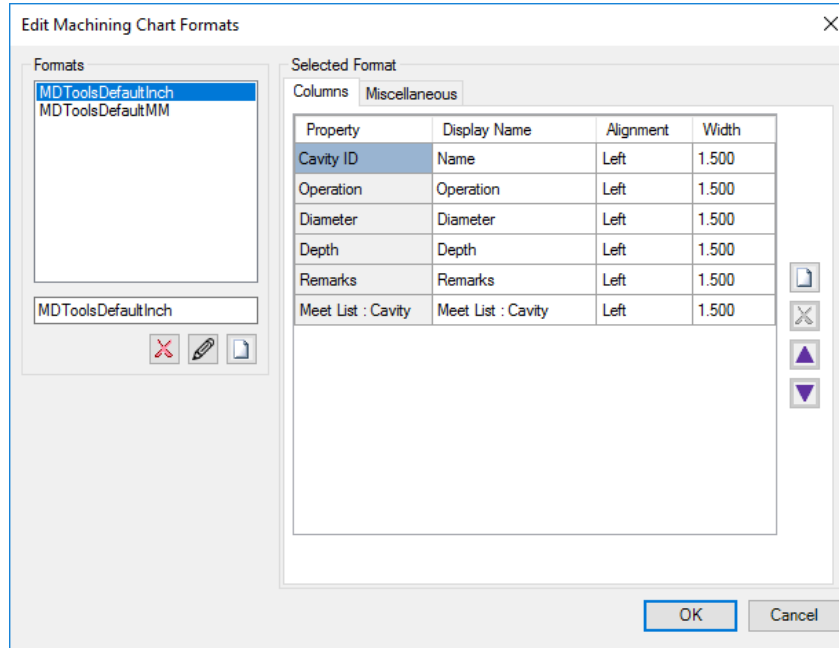
8. Click **OK** to save the settings.

Note

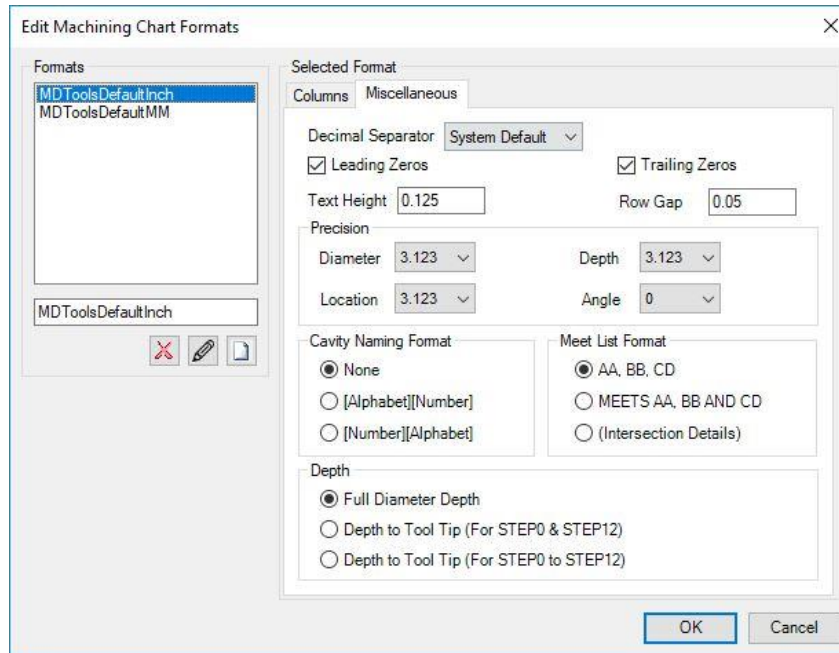
For detailed information, refer to Chapter 101, Create Machining Chart.



Configure Machining Chart dialog box



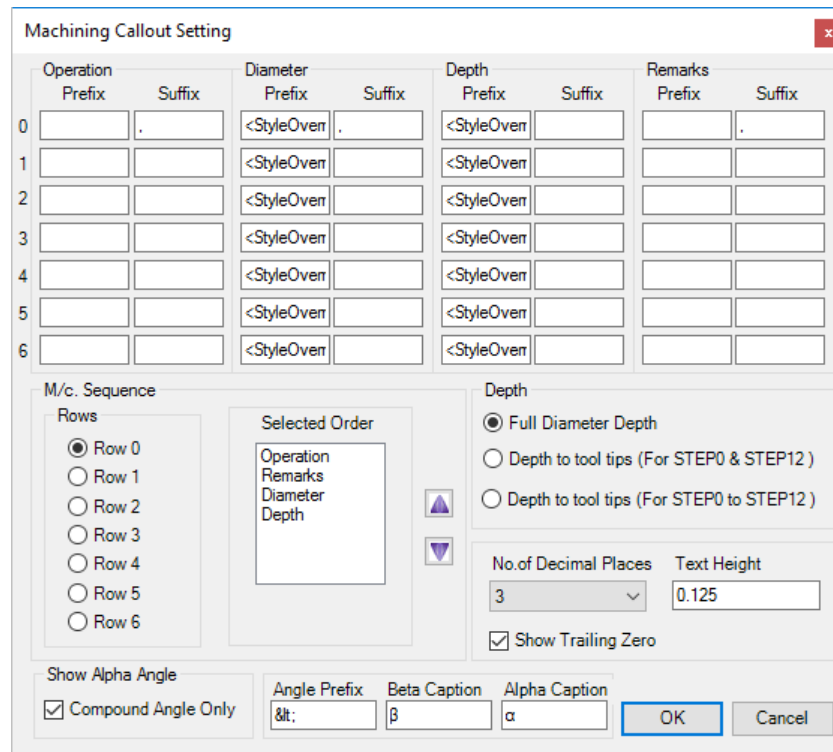
Configure Machining Chart dialog box: Columns tab page



Configure Machining Chart dialog box: Miscellaneous tab page

5 Machining Callout Setting

1. Specify prefixes and suffixes for the machining rows.
2. Configure the sequence of columns from the **M/C Sequence** group.
3. Specify the **Depth** option.
4. Specify the number of decimal places and text height for the callout text.
5. Select **Show Trailing Zero** to display the trailing zero for the operation diameter and depth.
6. Select **Show Alpha Angle** to display the Alpha angle for the compound angle holes.
7. Specify the prefix for the angle and the captions for the Beta and Alpha angles.
8. Click **OK**.



The dialog box is titled "Machining Callout Setting" and contains several sections:

- Table:** A table with 7 rows (0-6) and 8 columns: Operation Prefix, Operation Suffix, Diameter Prefix, Diameter Suffix, Depth Prefix, Depth Suffix, Remarks Prefix, and Remarks Suffix. Each cell contains a text input field with a placeholder "<StyleOver".
- M/c. Sequence:** A section with "Rows" (radio buttons for Row 0-6, Row 0 is selected) and "Selected Order" (a list box containing "Operation", "Remarks", "Diameter", "Depth").
- Depth:** A section with three radio button options: "Full Diameter Depth" (selected), "Depth to tool tips (For STEP0 & STEP12)", and "Depth to tool tips (For STEP0 to STEP12)".
- Text Settings:** "No. of Decimal Places" (dropdown set to 3) and "Text Height" (input field set to 0.125).
- Show Trailing Zero:** A checked checkbox.
- Show Alpha Angle:** A checked checkbox labeled "Compound Angle Only".
- Angle Prefix:** Input field containing "&t".
- Beta Caption:** Input field containing "β".
- Alpha Caption:** Input field containing "α".
- Buttons:** "OK" and "Cancel" buttons.

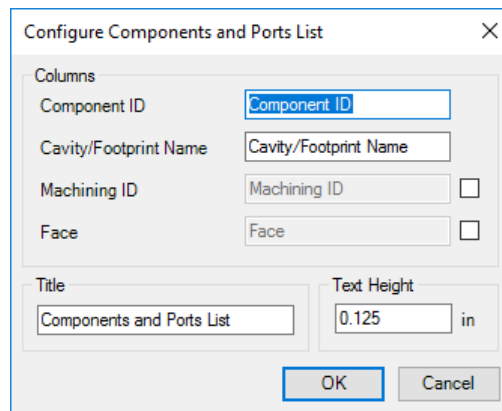
Machining Callout Setting dialog box

Note

For detailed information, refer to Chapter 99 Create Machining Callout

6 Configure Components and Ports List

1. Select the items to be included when inserting the Component and Port list.
2. Select/Deselect the **Machining ID** option to display/hide the machining ID in the table.
3. Select/Deselect the **Face** option to display/hide the face in the table.
4. Change the title, if required.
5. Enter the **Text Height** for the Component and Port List table.
6. Click **OK** to save the settings.



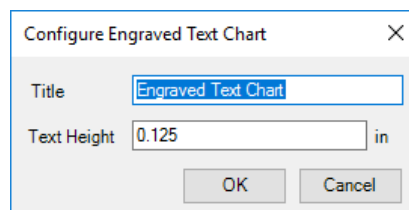
The dialog box is titled "Configure Components and Ports List" and contains the following fields:

- Columns:** A list of items to include: "Component ID" (selected), "Cavity/Footprint Name", "Machining ID" (checkbox), and "Face" (checkbox).
- Title:** Input field containing "Components and Ports List".
- Text Height:** Input field containing "0.125 in".
- Buttons:** "OK" and "Cancel" buttons.

Configure Components and Ports List dialog box

7 Configure Engraved Text Chart

1. Change the title, if required.
2. Enter the **Text Height** for the Engraved Text chart.
3. Click **OK** to save the settings.



The dialog box is titled "Configure Engraved Text Chart" and contains the following fields:

- Title:** Input field containing "Engraved Text Chart".
- Text Height:** Input field containing "0.125 in".
- Buttons:** "OK" and "Cancel" buttons.

Configure Engraved Text Chart dialog box

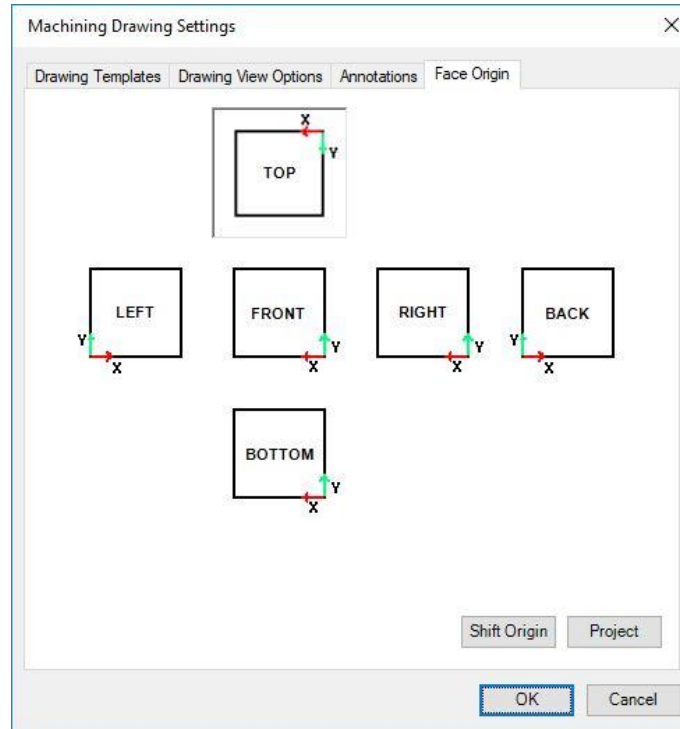
4 Face Origin

The **Face Origin** command enables you to set the origin for each face in the 2D drawing.

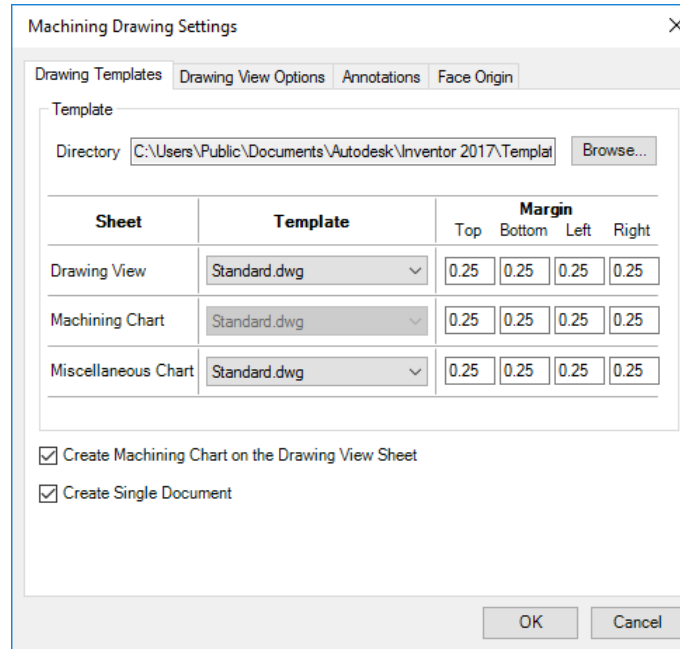
The updated Auto Dimensioning and Create Machining Chart features will use the newly set origins.

*The views in the dialog box displays the same placement and orientation as the base view selected in the **Drawing View Options** tab.*

1. Select a face to set the origin.
2. Click **Shift Origin** to change the origin.
3. Click **Project** to project the origin of the selected face to other faces.
4. Click **OK**.



Machining Drawing Settings dialog box: Face Origin



Include Machining Chart with Views

Note:

Create Machining Chart on the Drawing View sheet.

- If you select **Create Machining Chart on the Drawing View Sheet** option, then the machining chart is drawn on the main sheet with drawing views, outside the sheet.
- This option will override some of the machining chart configurations, such as 'Use Separate Sheet for Each Face'.
- On selecting this option, the template for machining chart would not be used or available for selection.

The screenshot displays a CAD environment with a technical drawing of a mechanical part. A machining chart is integrated into the drawing, showing various views and associated data tables.

Component List Table:

S.No	Part No	Part Name	Quantity	Unit
1	001	Frontplate	1	
2	#1 SAE	nut	5	
3	C10-2	Cartridge	3	
4	#10 SAE	nut	1	
5	1/8"-20 UNF	Hex Head	2	
6	#8 SAE	nut	1	
7	#4 SAE	nut	2	
8	M8-0.0080	nut	1	
9	C10-4	Cartridge	1	
10	Tap 1/8"	Drill Hole	1	
11	5/16"-24 UNF	nut	1	
12	5/16" DIA x 1/2"	nut	1	
13	Undercut Shank P	Undercut	1	

Feature List Table:

Name	Orientation	Diameter	Depth	Sheet List
00A	DRILL	1/16	1.944	L
	C10-2	1.344	0.031	A-S
				B
				BY
00B	DRILL	0.310	1.616	UNF UC
	C10-2	1.344	0.031	C1
				C2
				UNF UC
				UNF
				C1
11-A	DRILL	1/4	0.636	T1
11-B	DRILL	1/4	0.781	T2
11-0B1	TAP DRILL	5/32	0.700	
	TAP	#10-24	0.500	
11-0B2	TAP DRILL	5/32	0.700	
	TAP	#10-24	0.500	
11-0B3	TAP DRILL	5/32	0.700	
	TAP	#10-24	0.500	
11-0B4	TAP DRILL	5/32	0.700	
	TAP	#10-24	0.500	
11-LP	DRILL	1.004	0.175	

Component and Part List Table:

Component ID	Part Name	Part Name	Face
00A	003	C10-2	2
00B	005	C10-2	1
11	104	001	1
12	005	C10-2	2
C1	002	#1 SAE	6
C2	110	#1 SAE	1
GP	001	#1 SAE	2
L	000	#1 SAE	1
P	001	#1 SAE	4
UP	103	5/16"-24 UNF	1
T	001	#10 SAE	6
Y	001	#10 SAE	6
T1	001	#10 SAE	6
T2	002	#10 SAE	2

Engraved Text Chart Table:

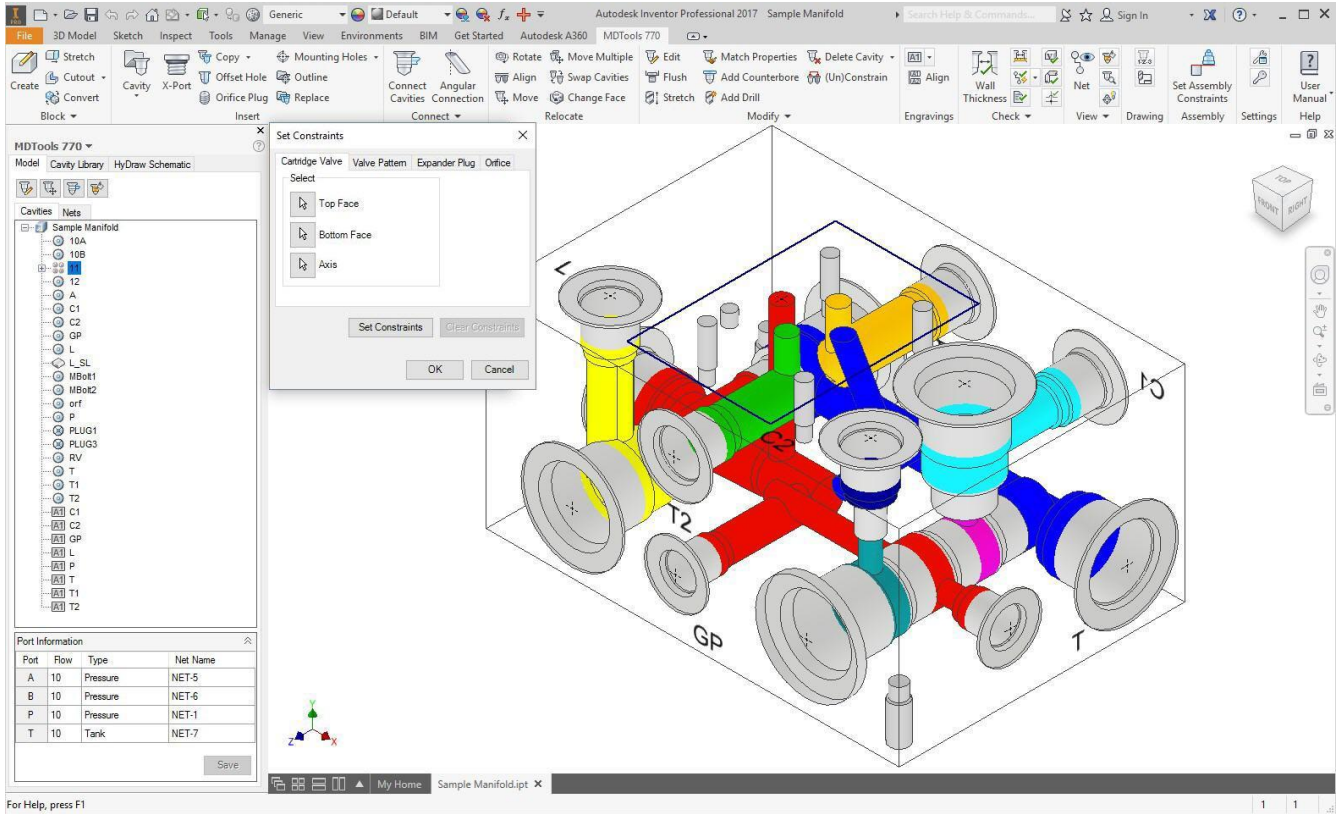
TEXT	FACE	X	Y	ROTATION	FONT	TEXT HEIGHT
C1	1	1.497	0.101		Arial	0.2
L	1	0.161	0.664		Arial	0.2
GP	2	2.271	1.406		Arial	0.2
T2	2	2.386	1.406		Arial	0.2
P	4	1.229	1.621		Arial	0.2
T	1	2.538	2.87		Arial	0.2
C1	1	1.497	0.101		Arial	0.2
T1	6	2.3	1.568		Arial	0.2

The drawing includes several views: a top view, a front view, and a side view. The machining chart is positioned around these views, with callouts linking specific features to the data tables. A 'Sample Placeholder' box is visible in the bottom right corner of the drawing area.

Machining Chart on main sheet with views.

Assembly

82 Set Assembly Constraints



82. Set Assembly Constraints

Set Assembly Constraints on all the part models to make them work with the Assembly Interface.
Parts with the assembly constraints get assembled on the manifold.
Open the part/assembly model of valve in Inventor.

MDTools 770 ribbon

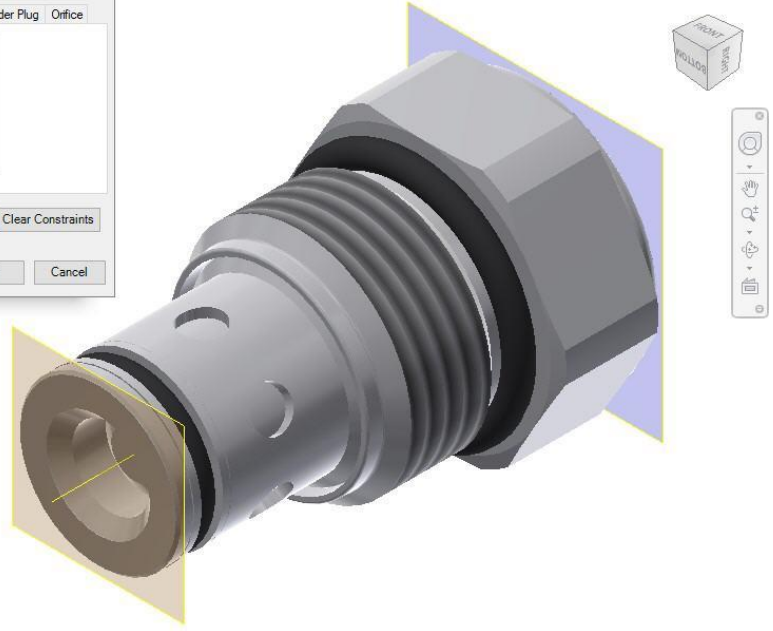
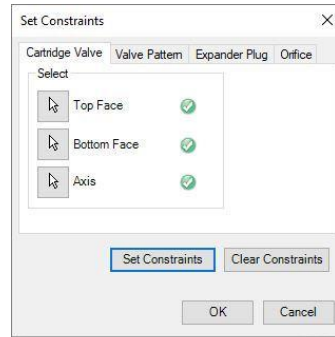
> Assembly panel

> **Set Assembly Constraints**

The Set Constraints dialog box displays.

The Set Constraints dialog box contains the following tabs.

- Cartridge Valve
- Valve Pattern
- Expander Plug
- Orifice



Set Constraints dialog box: Cartridge Valve tab

1 Cartridge Valve tab

Set the assembly constraints for cartridge valves, port fittings, and plugs. For these components, you need to specify the three parameters, Top Face, Bottom Face, and Axis.

1. Create work planes for top and bottom face.

Note

Work planes should be used to define the top and bottom face. Bottom work plane will mate with the spot face of the 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. 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 **Axis** button.
7. Select an axis passing through the valve body.
8. Click **Set Constraints** to set assembly constraints.

MDTools sets all the assembly constraints and the dialog box closes.*

Now, this part is ready for use with the Assembly Interface.

9. Save the model.

Note

Use this option to set the assembly constraints for solenoid coils and lock nut/manual overrides on the screw-in cartridge solenoid valves.

2 Valve Pattern tab

Set assembly constraints for the surface mounted valves, slip-in-cartridge valves, or flanges.

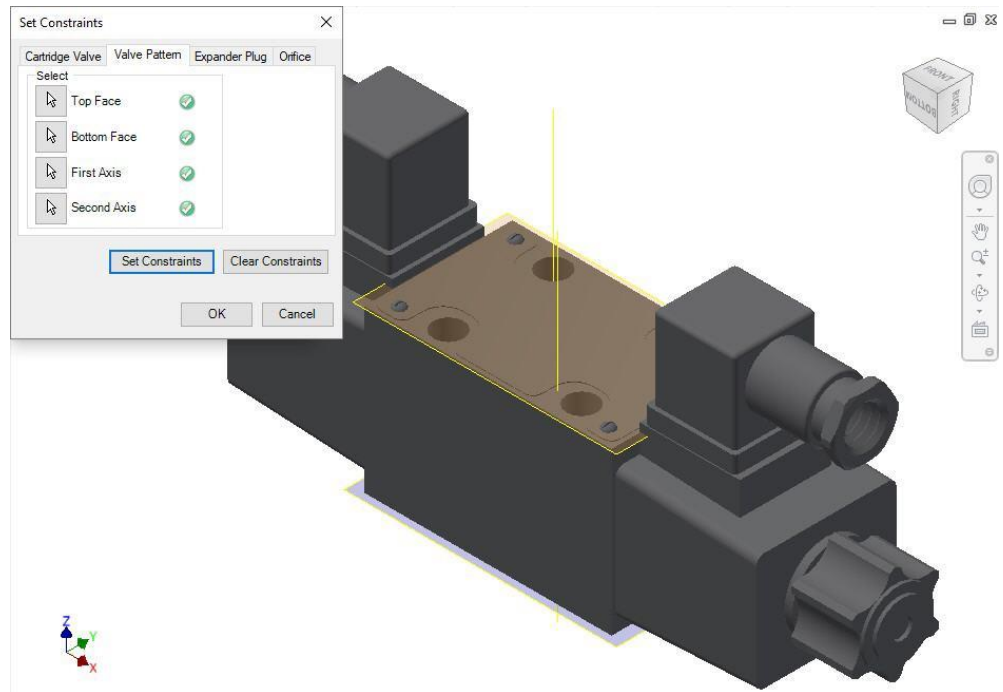
For these components, you need to specify the four parameters: Top Face, Bottom Face, First Axis, and Second Axis.

1. Create work planes for the top and bottom face.
2. Create the first axis. Create a work axis that passes through LP/LP1/BH1.
3. Create the second axis. Create a work axis that passes through LP2/BH2.
4. Select the **Top Face** button.
5. Select the top face work plane.
6. Select the **Bottom Face** button.
7. Select the bottom face work plane.
8. Select the **First Axis** button.
9. Select the axis passing through LP/LP1/BH1.
10. Select the **Second Axis** button.
11. Select the axis passing through LP2/BH2.
12. 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 the Assembly Interface.

13. Save the Part Model.
14. Click **OK**.



Set Constraints dialog box: Valve Pattern tab

Note

First Axis

- Create an axis that passes through the locating pin for valves with one locating pin.
- Create an axis that passes through the locating pin LP1 for valves with two locating pins.
- Create an axis that passes through the bolt hole BH1 for valves with no locating pin.

Second Axis

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

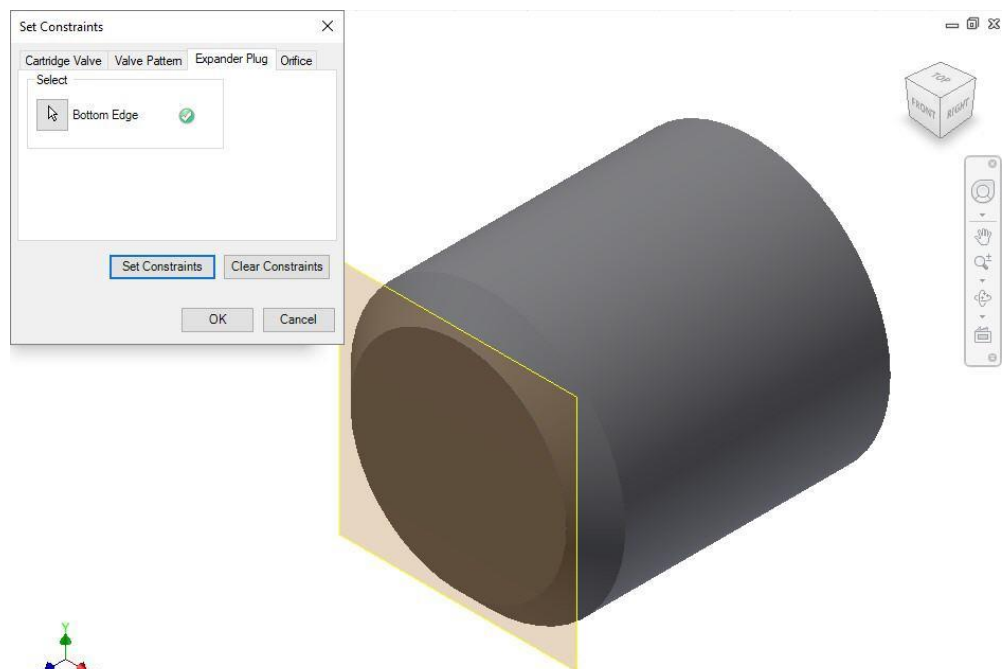
LP1 is a locating pinhole with the port application name LP1, and LP2 is a locating pinhole with the port application name LP2 on the footprint.

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

3 Expander Plug tab

If there is no spot face in the cavity (Step0 angle is not equal to 90), for example, in expander & NPT plug ports, then you must use the Expander Plug tab to set the assembly constraints. 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 Step0 of the cavity.
3. Click **Set Constraints** to set the assembly constraints.
4. Save the part model.



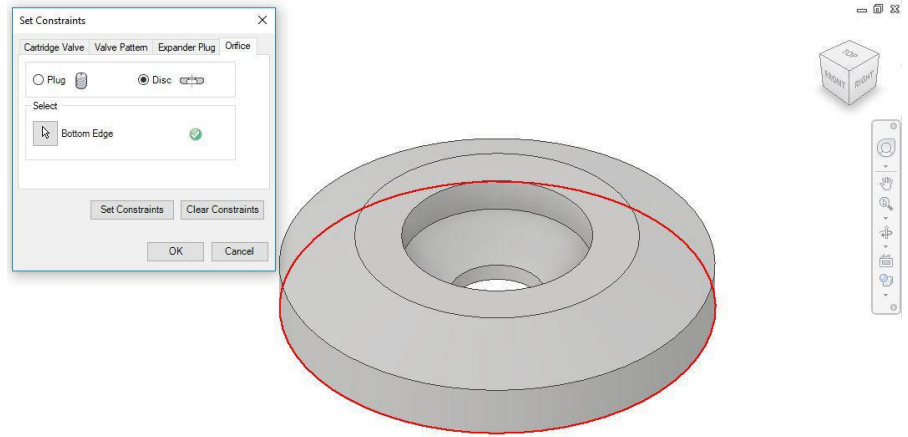
Set Constraints dialog box: Expander Plug tab

4 Orifice Tab

For Orifice Plug/Disc, 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. Click **Set Constraints** to set the assembly constraints.
4. Save the part model.



Set Constraints dialog box: Orifice tab

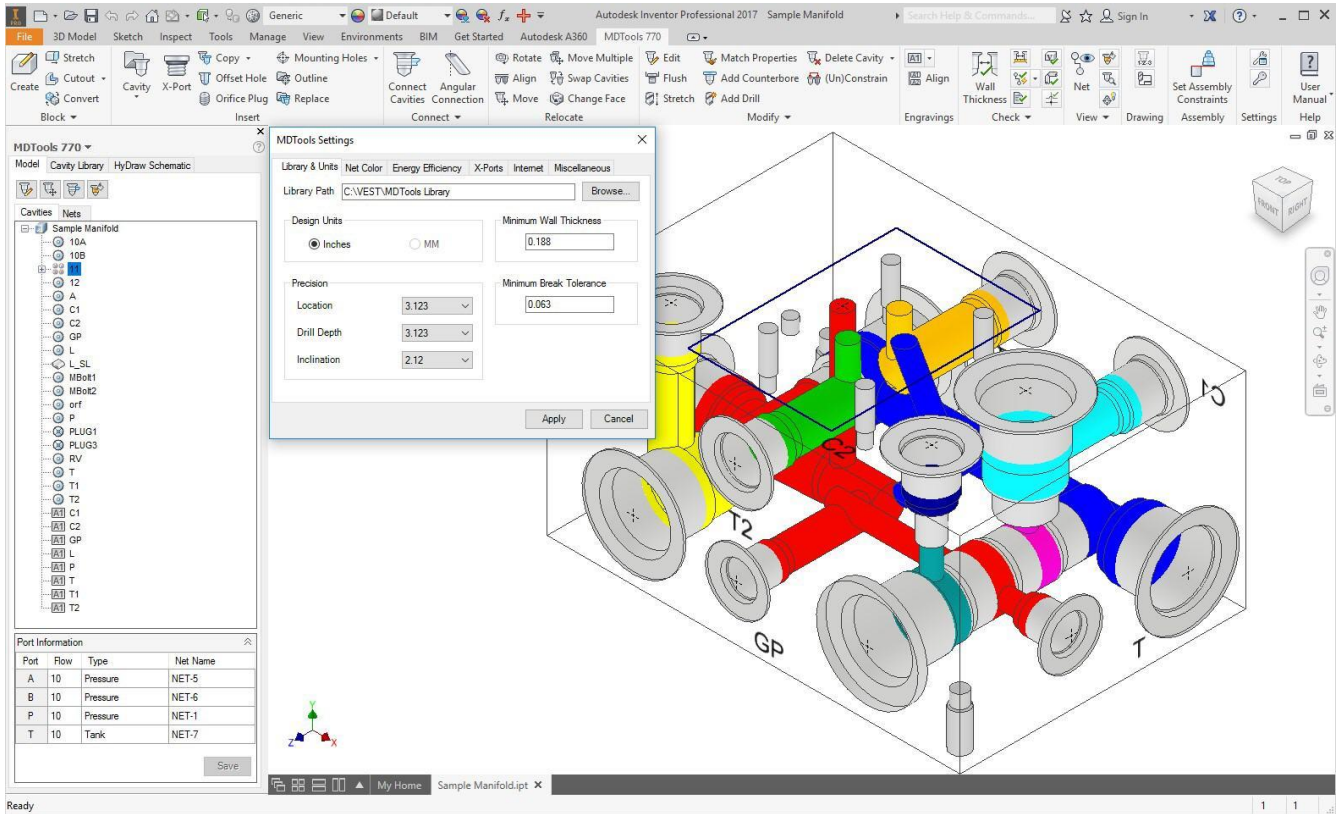
Clear Constraints

Click **Clear Constraints** to automatically delete the assembly constraints from the selected Part model.

Settings

83 MDTools Settings

84 MDTools License Option in Inventor



83. MDTools Settings

Set library and units, net color, energy efficiency defaults, cross ports, Internet settings, and miscellaneous settings.

MDTools[®] enables you to share the library with all designers in your organization so that all use the same data. Easily manage changes in standards or libraries within your organization.

1 Library & Units

MDTools 770 ribbon

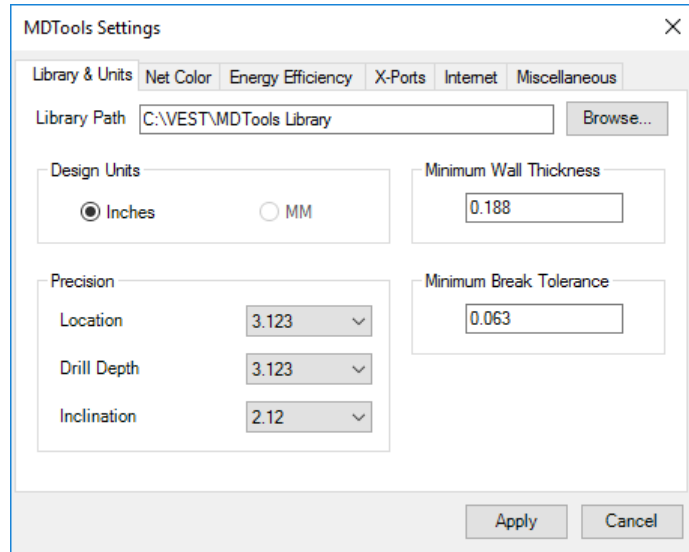
> Settings panel

> Settings

The MDTools Settings dialog box displays.

Units

Design Units	Sets the design unit to Inches or MM
Minimum Wall Thickness	Sets the default minimum wall thickness
Minimum Break Tolerance	Sets the default minimum break tolerance
Precision	Sets the location, drill depth, and inclination precision for the manifold design



MDTools Settings dialog box: Library & Units

CAUTION!

- Set the design unit before inserting the first cavity.
- You cannot change the units in the middle of the design process.

Library Path

1. Sets the location of the MDTools library.
2. Click **Browse** and select the folder containing the MDTools library.

Note

- You can change the library path by typing the new library path in the Library Path text box.

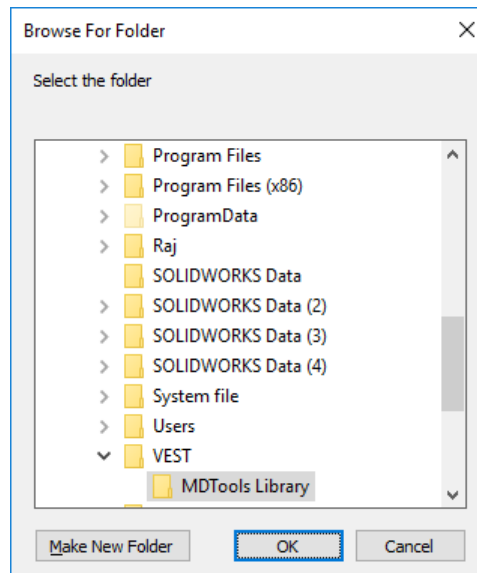
3. Click **OK** to confirm the selection.
4. Click **Apply**.

MDTools saves the change in the library path and unit settings.

5. Click **OK**.

Note

Set the library path on all systems independently.



Browse for Folder dialog box

2 Net Color

Net Color Display

Automatic Automatically updates the color of all the cavities in the manifold

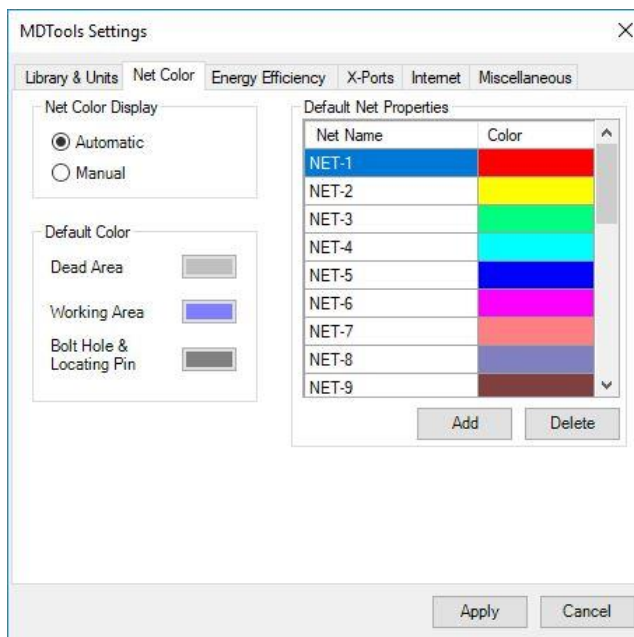
Manual Only updates the color of the modified cavity

Default Color

Dead Area Sets the color for the dead areas in the cavity

Working Area Sets the default color of the working areas in the cavity

Bolt Hole & Locating Pin Sets the color for locating pin holes and bolt holes



MDTools Settings dialog box: Net Color

Default Net Properties

Default Nets View the default name and color for a number of defined nets (flow paths)

Add a Net Click Add.

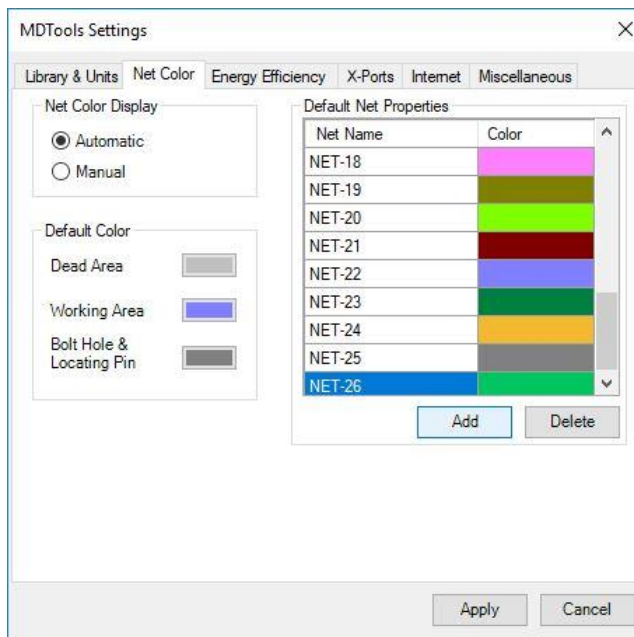
Change the default net name assigned by clicking the newly added net name

Delete a Net Click Delete.

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.



MDTools Settings dialog box: Add Net Name

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 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 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

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.

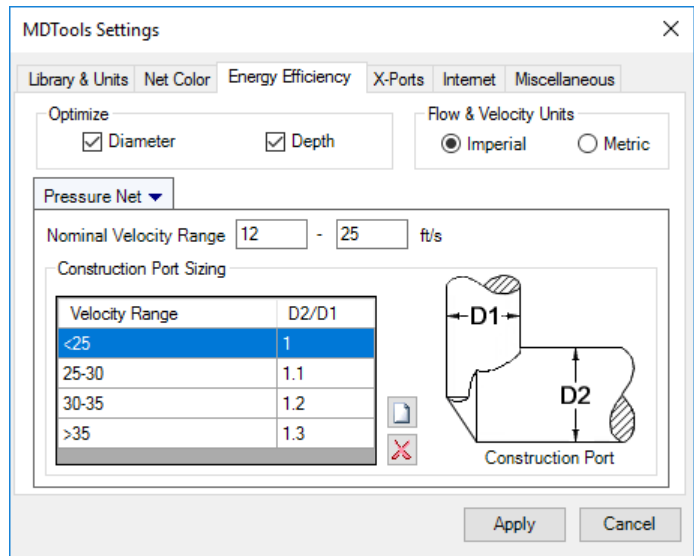
In the Check Velocity command; it is used to check if the velocity range is high, low, or nominal.

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

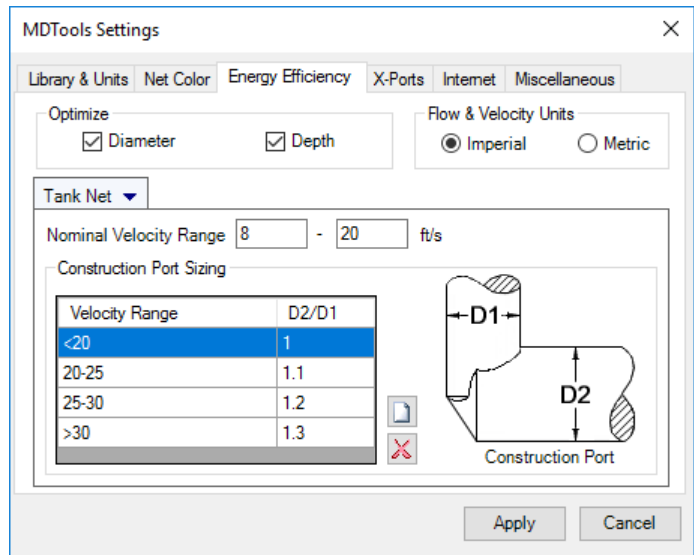
Note:

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.



MDTools Settings dialog box: Energy Efficiency- Pressure Net




MDTools Settings dialog box: Energy Efficiency- Tank Net

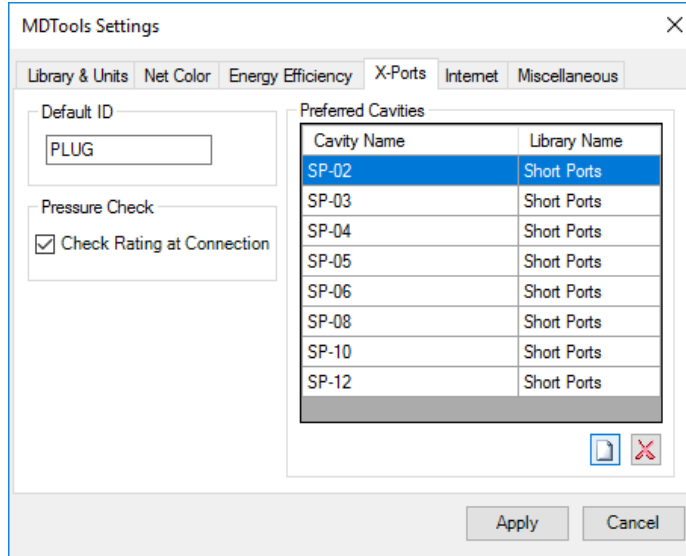
4 X-Ports

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.

Preferred Cavities


Add Preferred Cavities

- Click  to add construction plug.
The Select Preferred Cavities dialog box displays the libraries that contain ports.
- Select the required library.
The cavity is listed on the right panel.
- Select cavities to add or click **All** to select all the cavities.
- Click **Add**.
The selected cavities are added to the library.
- Click **Cancel** to close the dialog box.



MDTools Settings dialog box: X-Ports

Delete Preferred Cavity

- Select the cavity to delete.
- Click  to delete the cavity.

Default ID

Sets the component ID for the construction holes in the manifold.

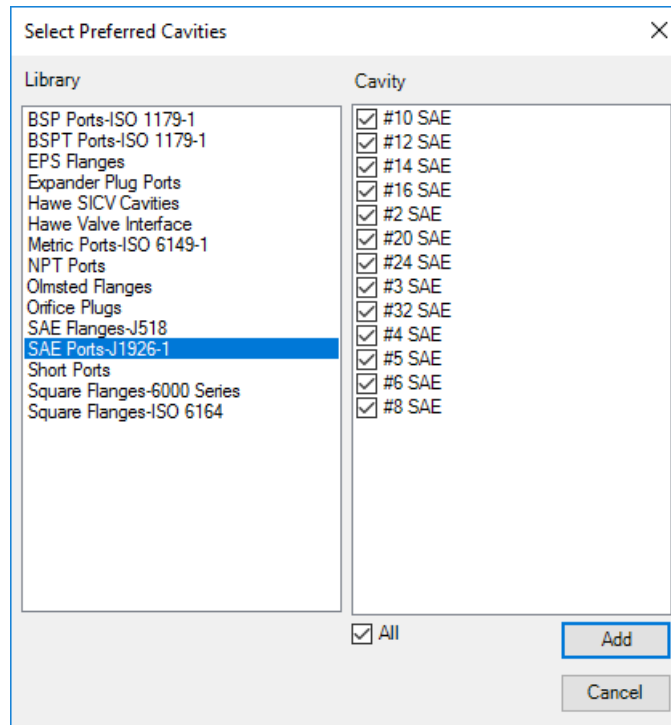
Pressure Check

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

MDTools checks pressure ratings automatically when inserting a construction plug and brings up a warning dialog if a plug is not rated for the Net pressure which it will connect to.

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

- Insert construction port from MDTools browser.
- Insert construction port from MDTools ribbon.
- Edit cavity
- Connect cavities



Select Preferred Cavities dialog box

5 Internet

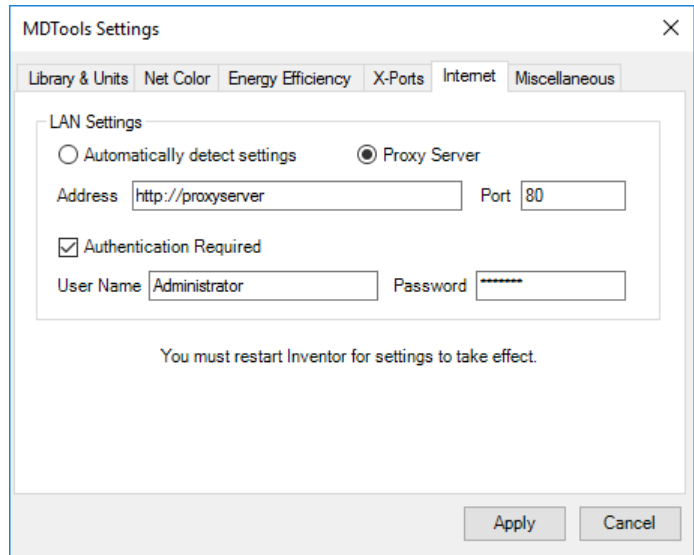
Define the Internet connection settings to enable MDTools* to access the Internet for services delivered through the Internet.

Automatically Detect Settings Default settings to connect to the Internet for all users other than the users of Proxy Servers

Proxy Settings Define Host address and Port number for the Proxy Server

Enable proxy authentication Provide User Name and Password, if your proxy requires authentication.
Click Apply to save the settings

Contact your IT/System Administrator in case you do not have this information.



The screenshot shows the 'MDTools Settings' dialog box with the 'Internet' tab selected. The 'LAN Settings' section is visible, containing two radio buttons: 'Automatically detect settings' (unselected) and 'Proxy Server' (selected). Below the radio buttons are two text input fields: 'Address' with the value 'http://proxyserver' and 'Port' with the value '80'. There is a checked checkbox for 'Authentication Required'. Below this are two more text input fields: 'User Name' with the value 'Administrator' and 'Password' with a masked password '*****'. At the bottom of the dialog, there are 'Apply' and 'Cancel' buttons. A message at the bottom of the dialog reads: 'You must restart Inventor for settings to take effect.'

MDTools Settings dialog box: Internet Setting

6 Miscellaneous

Cavity Machining ID

Switches between having or not having the Cavity Machining ID the same as the Component ID

Angle Hole

Selects Simple Angle Hole only or Compound Angle Hole

Drill Depth

Select the **Full Diameter** option to use drill depth value without adding the drill tip value.

The Depth to Tip option is unchecked for applicable commands.

Select the **Tip** option to use the drill depth value including the drill tip value.

The Depth to Tip option is checked for applicable commands.

Browser Behavior

Loaded/Unloaded

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

Lists the cavities by the face name in the Model browser. This option is also available in the MDTools Cavity browser when you right-click the manifold node.

Show Engraved Test

Show or Hide engravings in the Model browser. This option is also available in the MDTools Cavity browser when you right-click the manifold node.

Assembly

Select the **Update on Startup** option, MDTools automatically updates/resolves the assembly model.

MDTools updates only if there is some modification in the part model.

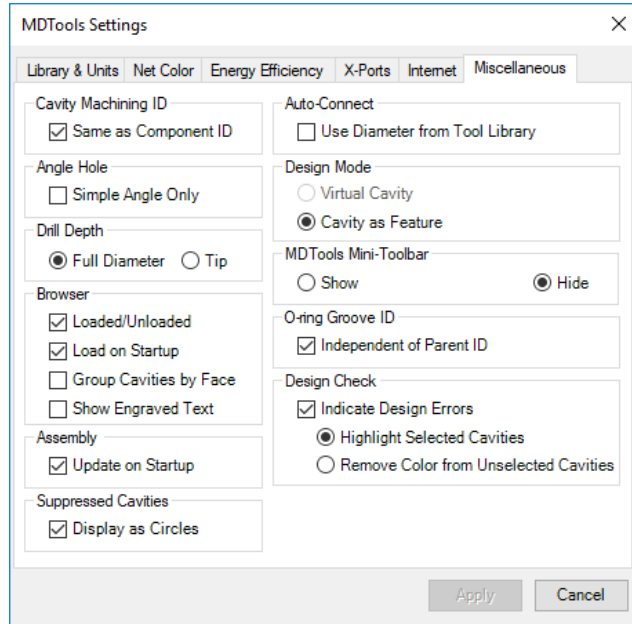
(For example, change face of cavities, swap cavities, delete cavities, suppress-unsuppress cavities etc.)

Suppressed Cavities

Select the **Display as Circles** option, While Inserting the footprints MDTools automatically Suppressed and display the circles for blocked port in a Footprint defined in HyDraw Schematic.

Auto-Connect

Use Diameter from Tool Library to use the drill tools that are listed in your MDTools Library Manager – Tools library.



MDTools Settings dialog box: Miscellaneous

Design Mode

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

Virtual Cavity

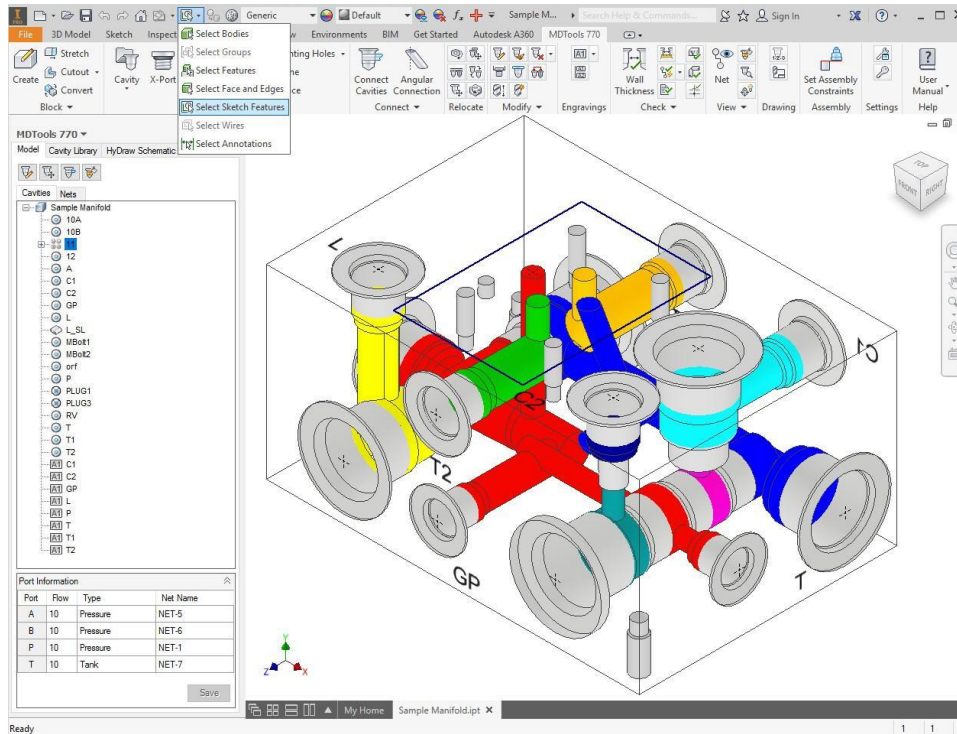
Quickly design the manifold and then switch to the feature-based manifold design mode using the new Convert Manifold command. No Inventor feature is created for cavities in the Virtual Cavity design mode.

Cavity as Feature

Cavities are created as revolve features in Inventor.

Selecting a Virtual Cavity

Set the selection option to the **Select Sketch Features** option in the **Select Sketch Features** option in Inventor part model.



Setting Select Sketch Features

MDTools Mini-Toolbars

Show/Hide

Show or hide MDTools mini-toolbars when you click cavity, footprint, O-ring, undercut and manifold.

O-ring Groove ID

Select **Independent of Parent ID**.

Assign independent O-ring Groove ID.

MDTools lists O-ring Groove machining sequence as a separate row in the Machining chart.

Design Check

Select **Indicate Design Errors**.

MDTools locates the selected issues on a single click in all the Design Check command.

Highlight Selected Cavities

MDTools locates the issue by highlighting the cavities containing issues in all the Design Check command.

Remove Color from Unselected Cavities

MDTools locates the issue by coloring the cavities in Net color containing issue in all the Design Check command. By default, whole manifold is greyed out when you start the Design Check.

84. MDTools License Option in Inventor

Set the license path through the Inventor, MDTools* 770 ribbon menu.

1. MDTools 770 ribbon
>**Settings** panel
>**License Option**
The MDTools License Option dialog box displays.
2. Enter the server name or the IP address of the system where the MDTools hardware lock is located.

This option is available only in the MDTools 770 Network license version.

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.

The screenshot shows the 'MDTools License Option' dialog box. It features a title bar with a close button. The main area is divided into two sections. The top section is for entering the server information, with a text box labeled 'Server Name / IP Address' containing 'LicenseServerName' and an 'Apply' button. The bottom section is titled 'License Info' and contains two buttons: 'Get License' and 'Release License'. To the right of these buttons is a 'Key Info' section with two text boxes: 'Licenses' and 'License in Use', both containing the number '5'. At the bottom right of the dialog are 'OK' and 'Cancel' buttons.

MDTools License Option dialog box

Help

85 User Manual

86 About MDTools

Autodesk Inventor Professional 2017 Sample Manifold

MDTools 770

Model Cavity Library HyDraw Schematic

MDTools 770

Sample Manifold

TOP

10B

10B_UC

C2

L

L_SL

orf

C2

L

FRONT

10A

T2

GP

T2

GP

T2

BOTTOM

MBot1

MBot2

LEFT

A

P

P

RIGHT

PLUG1

T

T

BACK

Port Information

Port	Flow	Type	Net Name
A	B	Pressure	NET-5
B	B	Pressure	NET-6
P	B	Pressure	NET-1
T	B	Tank	NET-7

Save

My Home Sample Manifold.ipt X

Ready

1 1

MDTools 770

Product Information

Release 770

Build 770.0.0.5

Release Date 19/12/2017

License Type Stand Alone

Service Pack 0

MDTools 770

© 2002 - 2018 VEST, Inc. All rights reserved.

Warning : This software is protected by copyright law. Unauthorized reproduction and distribution of this program or any portion of it, may result in criminal penalties, and will be prosecuted to the maximum extent possible under the law.

License Agreement

OK

85. User Manual

Open the MDTools® 770 user manual in the PDF format.

MDTools 770 ribbon

- > **Help** panel
- > **User Manual**

The MDTools User Manual opens in the PDF format.

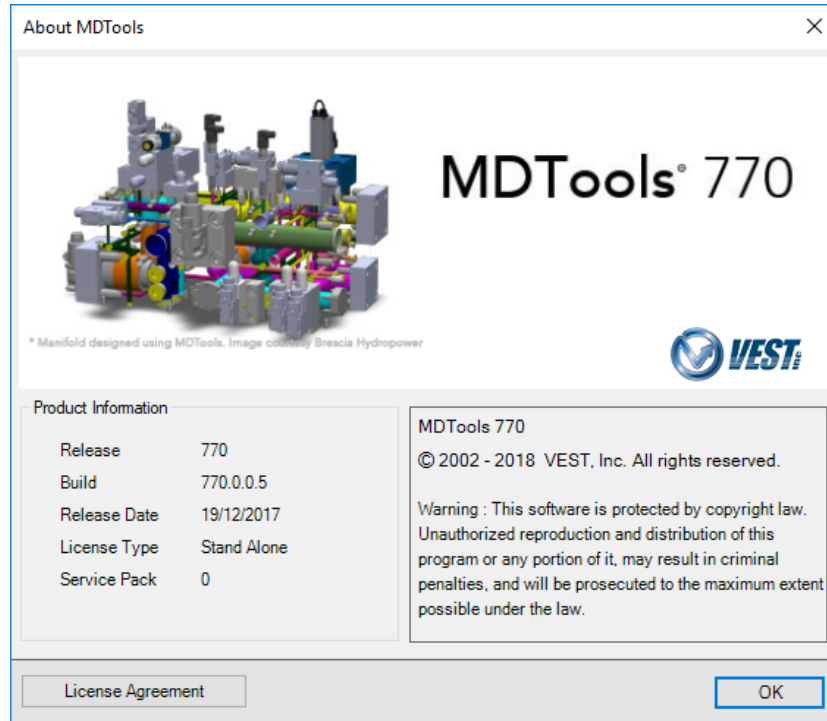


86. About MDTools

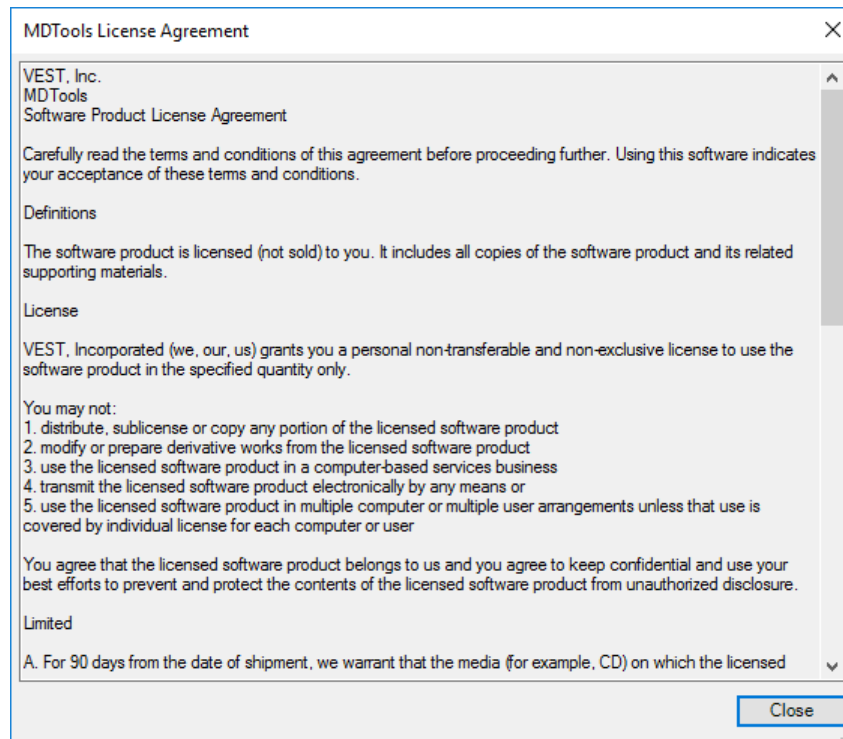
View the MDTools® version and build number.

MDTools 770 ribbon
> **Help** panel
> **About MDTools**

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



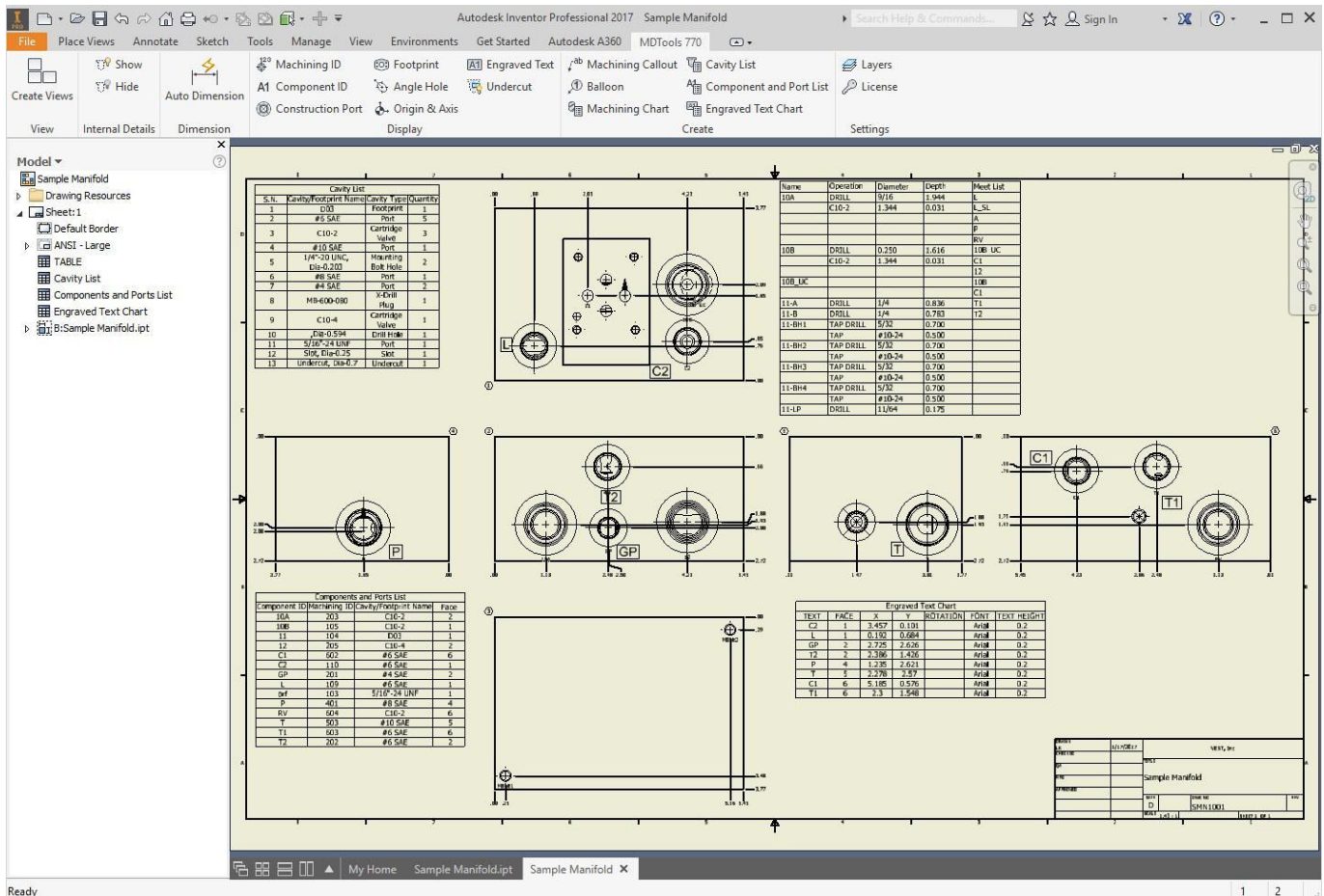
About MDTools dialog box



About MDTools License Agreement dialog box

DRAWING COMMANDS

- 87 Create Views
- 88 Show Internal Details
- 89 Hide Internal Details
- 90 Auto Dimension
- 91 Show Machining ID
- 92 Show Component ID
- 93 Construction Port
- 94 Footprint
- 95 Show Angle Hole
- 96 Show Origin & Axes
- 97 Show Engraved Text
- 98 Show Undercut
- 99 Create Machining Callout
- 100 Create Balloon
- 101 Create Machining Chart
- 102 Create Cavity List
- 103 Create Component and Port List
- 104 Create Engraved Text Chart
- 105 Drawing Layers
- 106 MDTools License option



87. Create Views

Automatically create 2D views of a manifold.

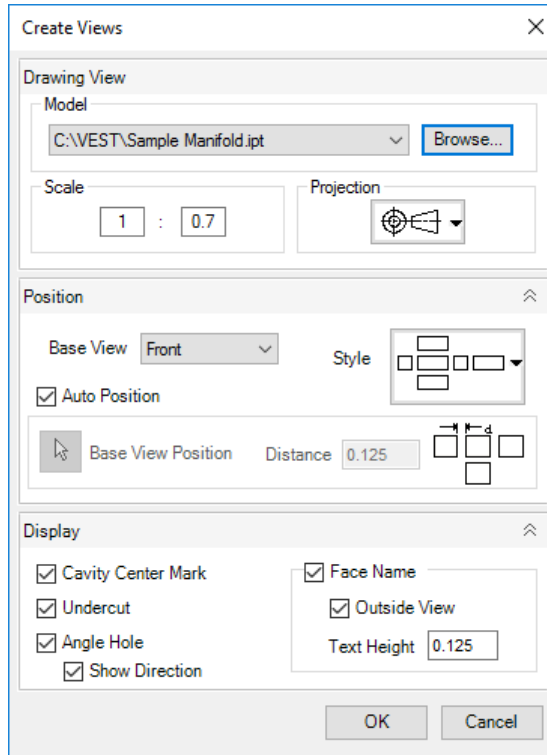
- MDTools 770 ribbon
 >View panel
 >Create Views

The Create Views dialog box displays.

- Click **Browse**.
 The Open File dialog box displays.
- Select the block part model or the assembly model.
- Click **Open**.

Note

- Names of the part models or assembly models, which are open in Inventor, are listed in the File Name drop-down list.
 - Part model or assembly model can also be selected from the list.
- Define the scaling between the views dimensions and part model dimensions.
 - Select the current projection type.
 The Third Angle projection is selected by default.



Create Views dialog box

- Specify the Base view or reference view.
- Select placement style of views.

Auto Position

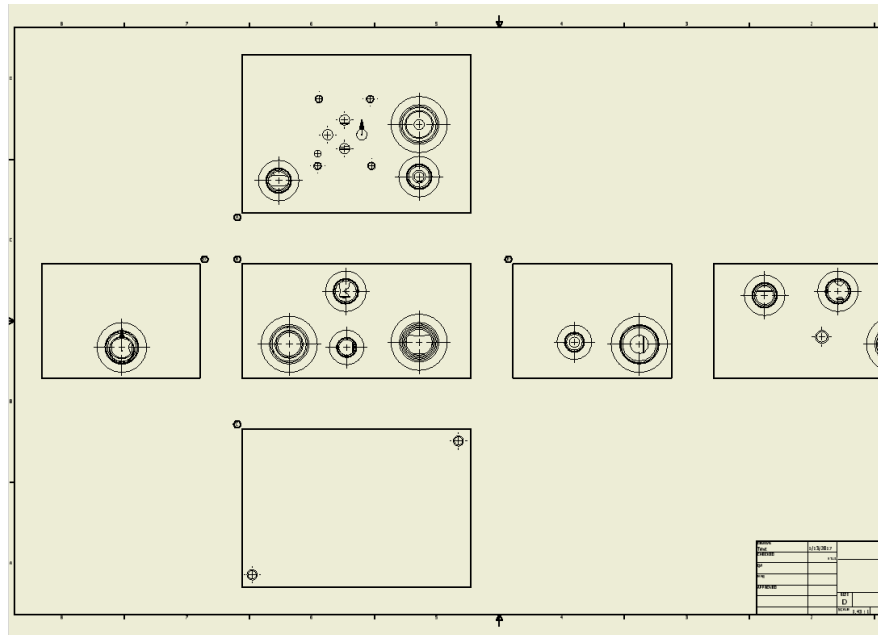
Select this option for MDTools* to position all the views automatically.

Otherwise, manually select the base view position and distance between views.

MDTools calculates the distance between the views based on the sheet and the block size.

Display

- Select the **Cavity Center Mark** option.
 MDTools displays cavity center mark in drawing views.
- Select the **Undercut** option.
 MDTools displays Undercuts as circles in drawing views.
- Select the **Angle Hole** option.
 MDTools displays angle holes with direction in drawing views.
- Select the **Show Direction** Option.
 MDTools displays angle holes with direction in drawing views.
- Select the **Face Name** option.
- Select the **Outside view** option.



Six views of the manifold created automatically

MDTools displays face name outside the view boundary.

Enter the text height for the face name text

16. Click **OK**.

MDTools automatically creates six views of the selected manifold block. MDTools automatically names the views according to the MDTools 2D view naming convention.*

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

Note

- The Enhanced Create View command enables you to select the assembly model of the manifold and create six views with all the details in the 2D drawing.
- All 2D drawing commands of MDTools support redefined faces in the Part Model.

88. Show Internal Details

Process all the drawing views in the active sheet and display the internal details for the drawing views.

If the drawing is opened and the part is modified, then the part file is to be saved and closed, before running this command.

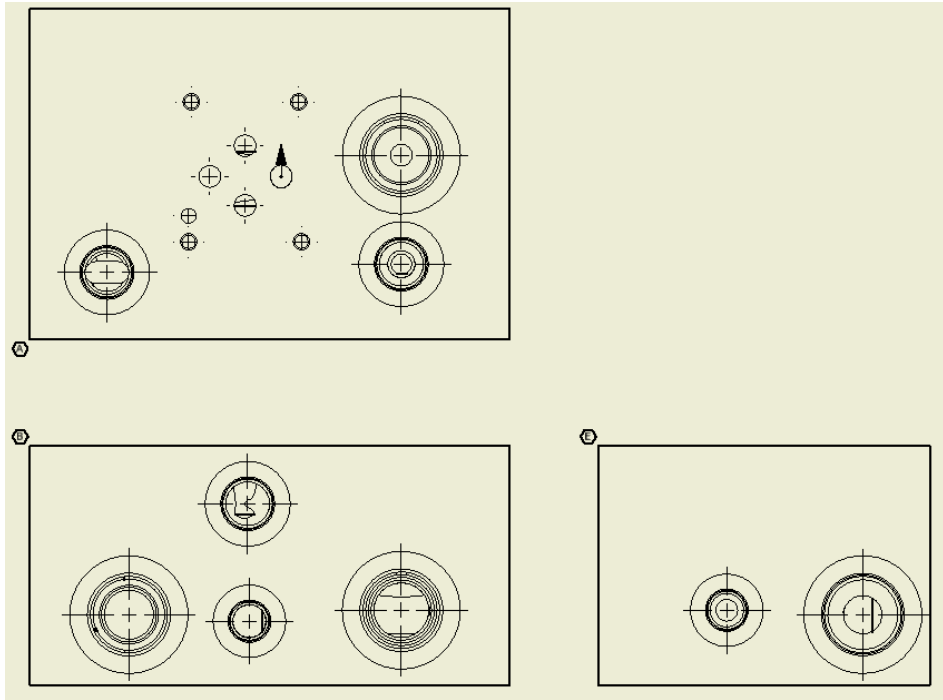
Ensure that you always save the Part file before running the Show Internal Details command.

MDTools 770 ribbon

>Internal Details panel

>Show

The MDTools® program processes all the drawing views in the active sheet and displays the internal view details in the drawing views.



MDTools 770: 2D Drawing Views

Limitations: Show Internal Details

- After using the Show Internal Details command some of the MDTools 770 commands will not work properly for the processed sheet.

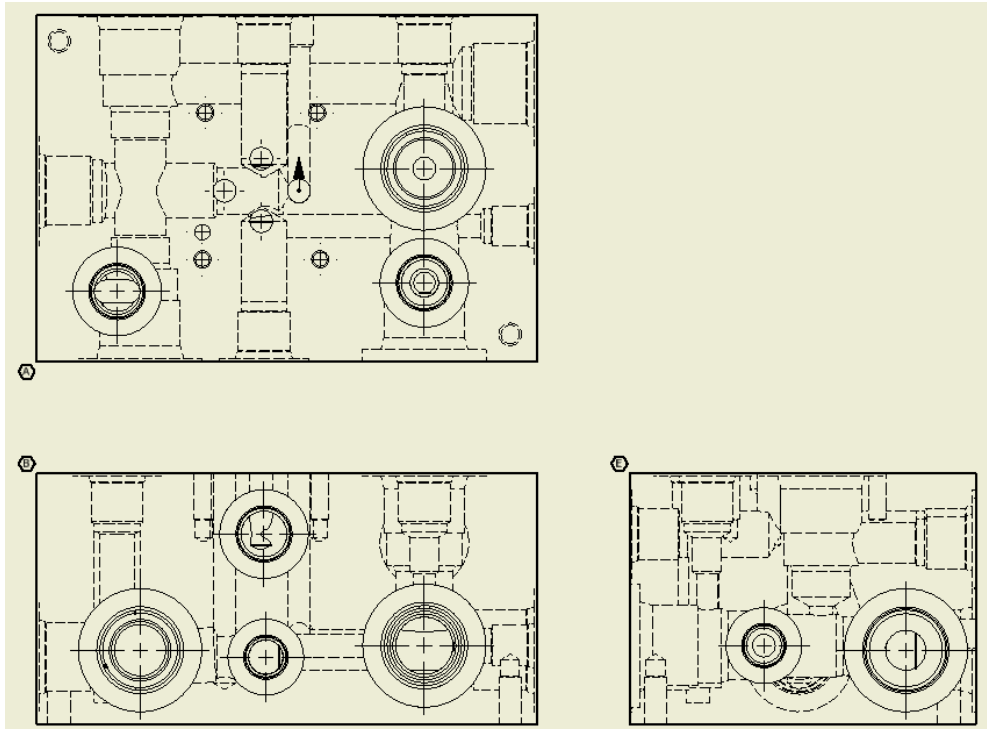
To avoid this, use the command after completion of the all machining drawing process.

- 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 is created with the same name as the part document name suffixed with “_Internal”.

Do not delete this file.



MDTools 770: 2D Drawing Views with Internal Details

89. Hide Internal Details

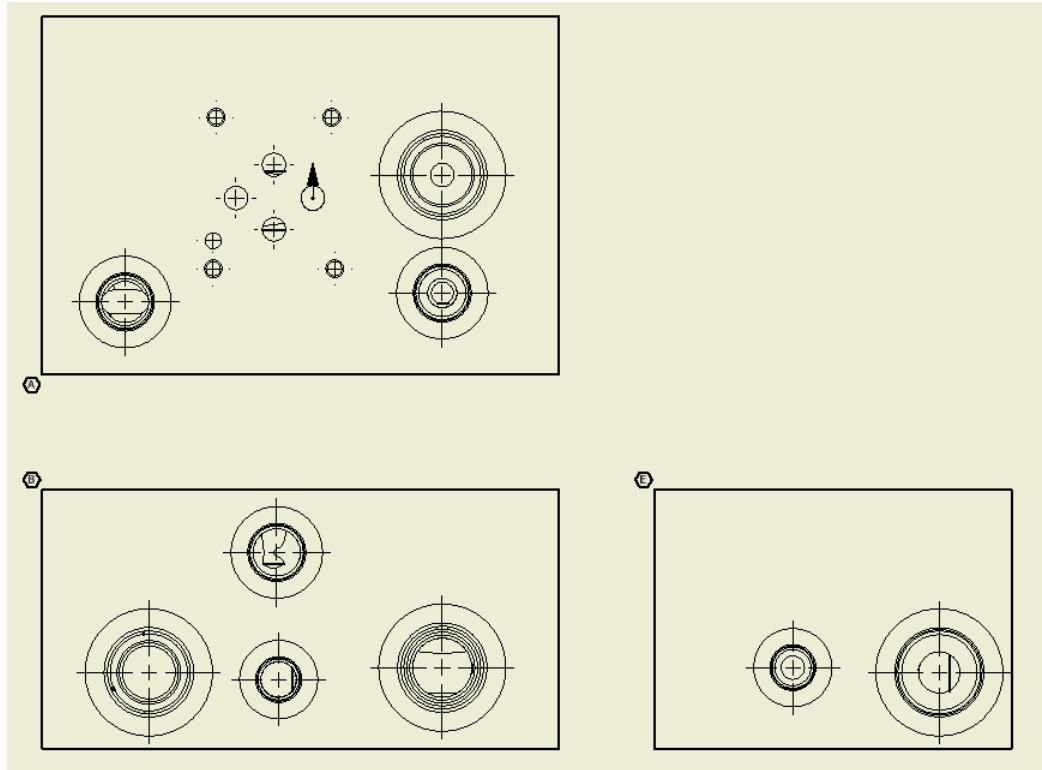
Hide the internal details in all the views of the 2D drawing in the active sheet.

MDTools 770 ribbon
>Internal Details panel
>Hide

Removes the internal details from all the drawing views.

CAUTION!

Use this command before updating the drawing or using any MDTools® 770 command.



MDTools 770: 2D Drawing Views

90. Auto Dimension

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

- MDTools 770 ribbon
 > **Dimension** panel
 > **Auto dimension**

Auto Dimension dialog box displays.

Sides available for dimensioning are displayed in black.

Sides unavailable for dimensioning are displayed in gray.

The views in the dialog box display exactly with the same placement and orientation as in the drawing space.

- Select a view to set face origin and sides available for dimensioning (i.e. Front view is selected in image).

The default option is Both sides.

- Click **Reset** to restore the face origins to their default positions.
- Click **Shift Origin** to set the origin position as per the requirement.
- Enter **Dimension Text Offset**, i.e., the distance between the dimension text and the block.

- Click **Project** to project current face origin to other face and update origin of other faces.

- Select **Dimension Each Cavity in a Footprint** to dimension all the cavities in footprints. Otherwise, only the cavity marked 'dimension from this cavity' is dimensioned.

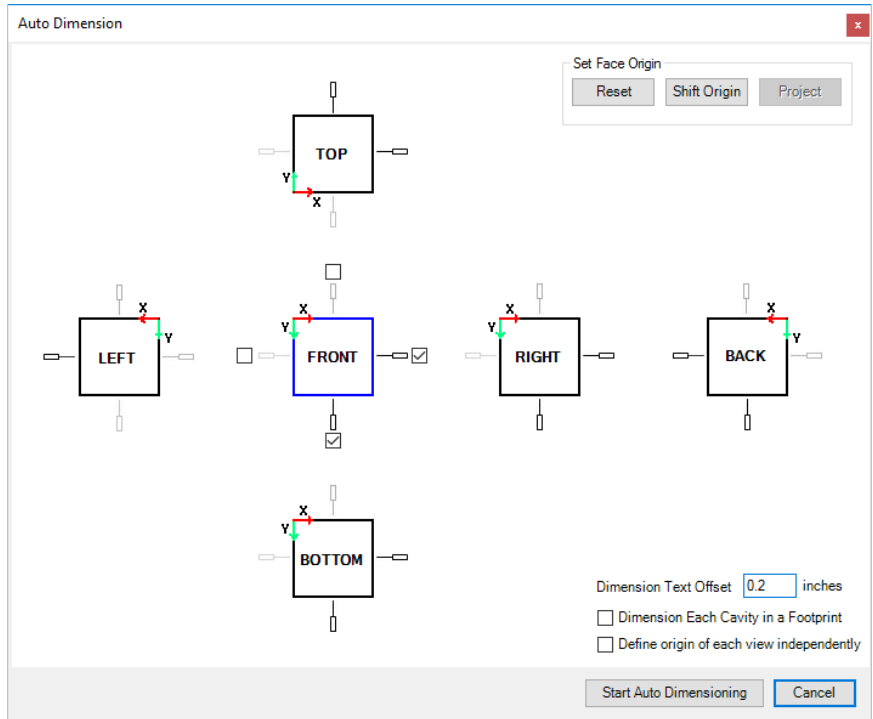
- Select **Define origin of each view independently** to define each view origin independently.

If unselected, the Shift option will shift current face origin and project other face origin according to the current face origin.

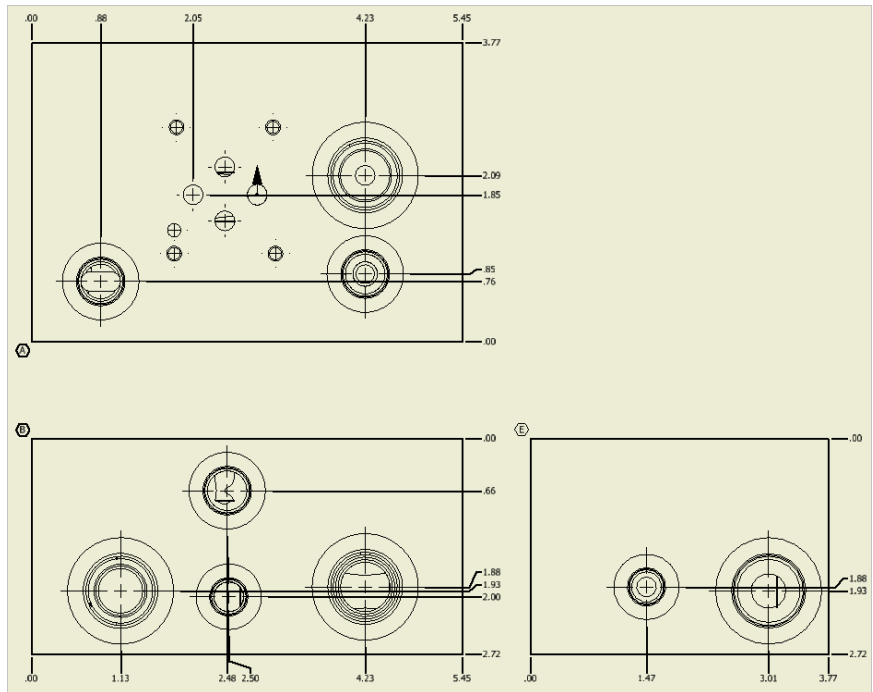
The default option is Both sides.

- Click **Start Auto Dimensioning** after selecting all the required options to dimension the manifold.

All dimensions are created in ordinate dimensions, per the properties set in the current dimension style.



Auto Dimension dialog box



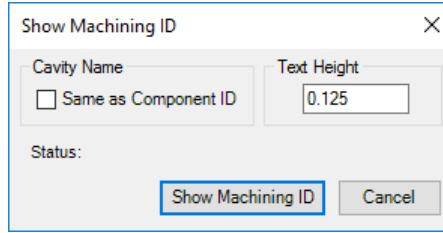
Cavities dimensioned automatically

91. Show Machining ID

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

- MDTools 770 ribbon
>Display panel
>Machining ID

The Show Machining ID dialog box displays.



Show Machining ID dialog box

- Select **Same as Component ID** option if you want to use the component ID same as the cavity machining ID.

Set the default option from the MDTools Settings dialog box.

- Enter **Text Height** for machining IDs.
- Click **Show Machining ID**.

MDTools[®] displays the cavity machining ID near the outermost circle at 45 degrees from the center of each cavity. This enables no overlapping of cavities, other cavity machining ID and stamping text in that view.

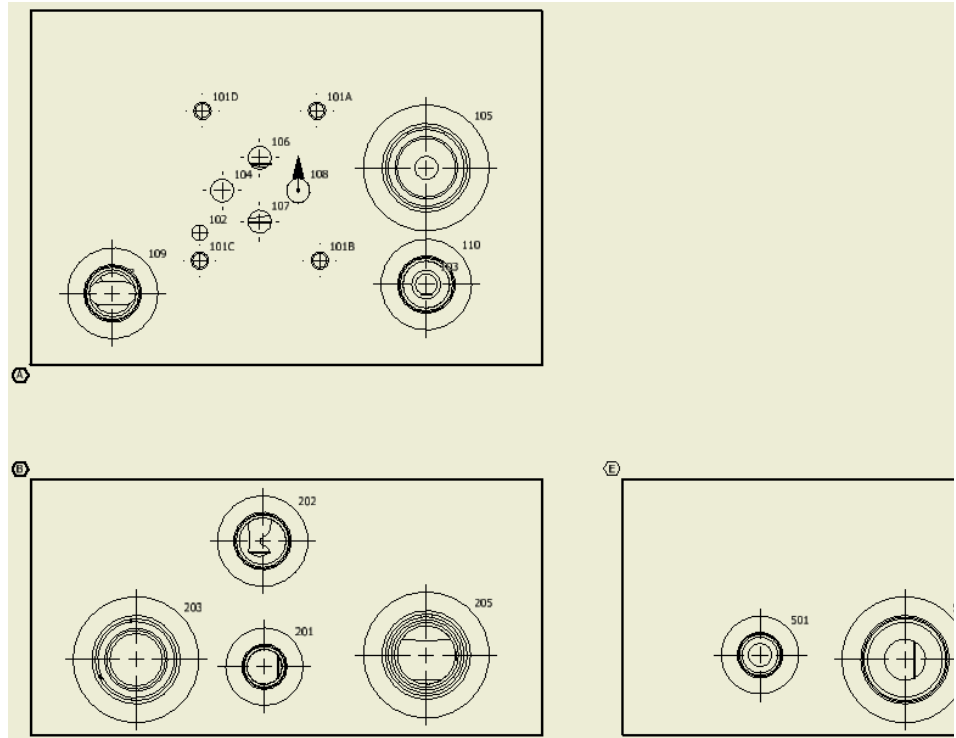
In case of overlapping, Machining ID will rotate around the cavity circle.

The cavity ID for all the cavities in a view is created inside a single sketch.

All cavity IDs in a view move together when you drag the cavity ID text.

To move a single cavity machining ID, double click one of the IDs to open the sketch containing machining IDs.

Drag the cavity machining ID to the desired location.



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
- Machining ID will not cross View border.
- Undercut and slot machining ID are always located at an angle of 45 degrees.
- Non-rectangular block machining ID may overlap manifold edges.
- The Machining ID command will not work, if you do not use the view names, per naming conventions.

92. Show Component ID

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

- MDTools 770 ribbon
>Display panel
>Component ID

The Show Component ID & Cavity Name dialog box displays.

- Select the required display option.

Select **Component ID** option to display the component ID.
The Component ID option is selected by default.

Select **Component ID & Cavity/Footprint Name** option to display the cavity/footprint name with the component ID.

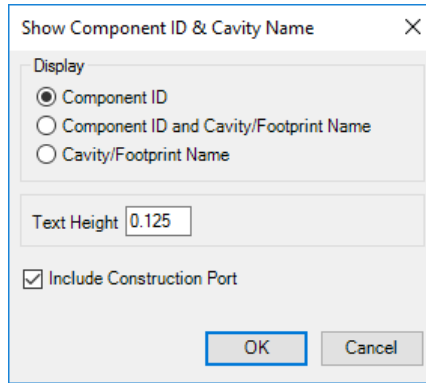
Select **Cavity/Footprint Name** option to display the cavity/footprint name.

- Enter **Text Height** for component IDs.
- Select the **Include Construction Port** option to display the ID for all cavities including construction holes.
- Click **OK**.

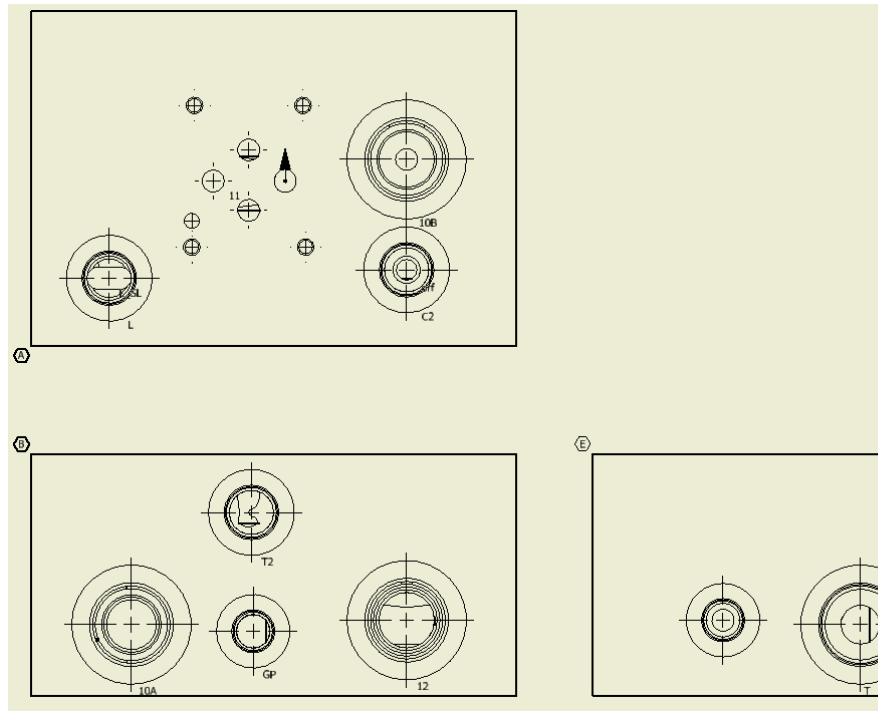
MDTools* displays the component ID near the outermost circle at the bottom of the cavity.

The component ID for all the cavities in a view is created inside a single sketch. All component IDs in a view move together when you drag the component ID text.

To move a single component ID, double click one of the IDs to open the sketch containing the component IDs. Drag the cavity component ID to the desired location.



Show Component ID & Cavity Name dialog box



Component ID with cavity name in 2D drawing

Note

- 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 Component ID command will not work, if you do not use the view names, per naming conventions.

93. Mark Construction Port

Automatically mark construction ports on each view in 2D drawing views.

MDTools 770 ribbon
>Display panel
>Construction Port

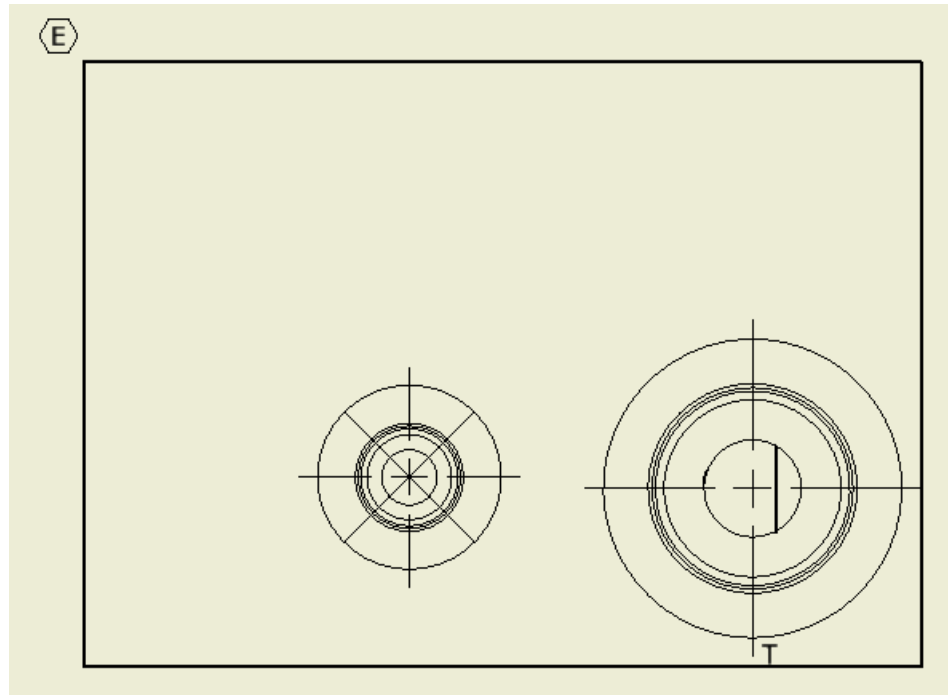
MDTools marks construction holes in each drawing view of the 2D drawing.*

In "X" view, mark of the construction hole is created in a separate layer named "X-Drill".

Note

- 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 Construction Holes command will not work if you do not use the view names, per naming conventions.
- The "X" mark will not be deleted automatically from the 2D drawing when you delete a construction port in the part model.



Marked Construction Holes displayed in the 2D drawing

94. Footprint

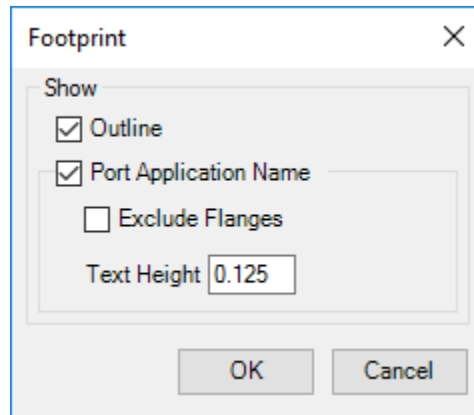
Automatically display the port application name for footprint cavities near the cavities and footprint envelopes in 2D drawing views.

MDTools 770 ribbon
>Display panel
>Footprint

MDTools* displays the port name and draws the outline around the footprint.

Exclude **Port Application Name** for flanges, if required.

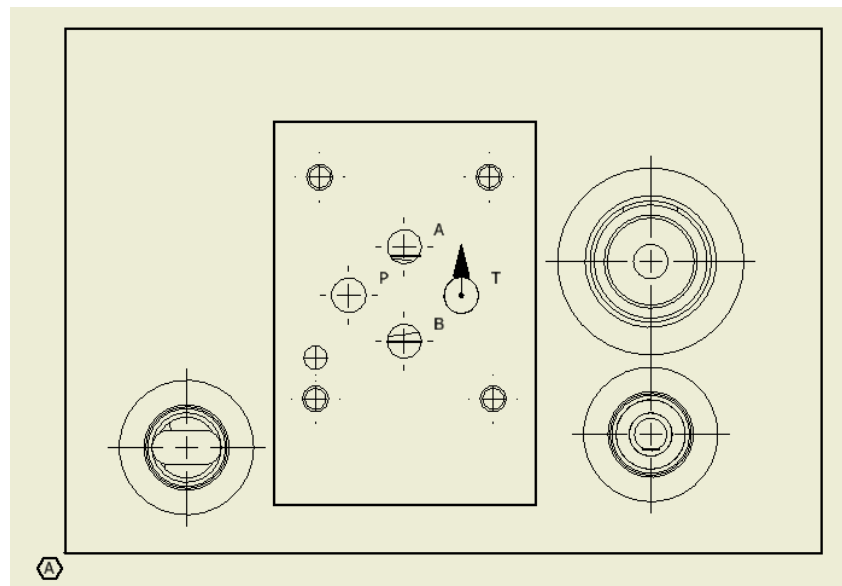
Enter **Text Height** for the Port Application name.



Footprint dialog box

The port name and footprint outline are created inside a single sketch in a view.

The port name and footprint outline in a view moves together when you drag the view position.



Port Application name and Footprint outline displayed in the 2D drawing

Note

- 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 Footprint command will not work if you do not use the view names, per naming conventions.
- After you delete the footprint from the part model, the port name and footprint envelope will not be automatically deleted from the 2D drawing.
- The dash dot line type in Inventor is used to draw the footprint envelope.

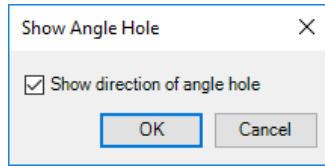
95. Show Angle Hole

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 an angle hole.

1. MDTools 770 ribbon
>Display panel
>Angle Hole

The Show Angle Hole dialog box displays.



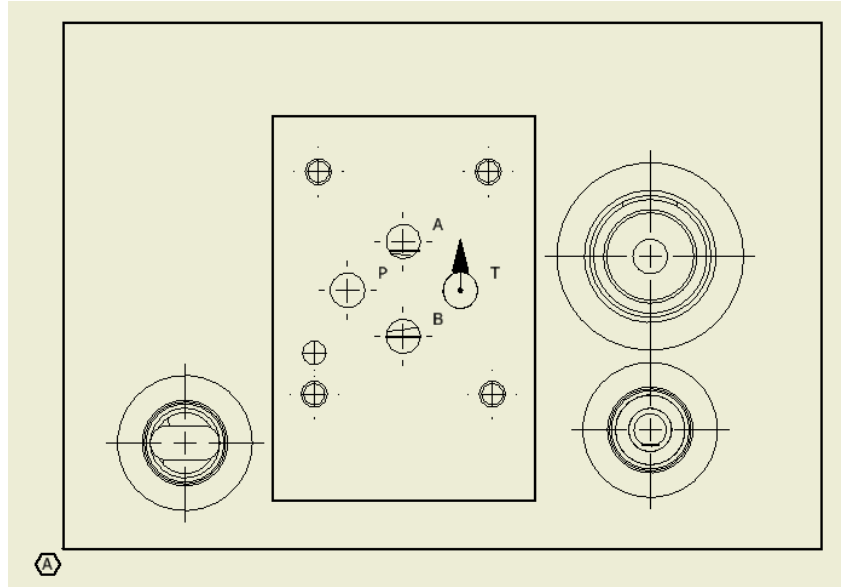
Show Angle Hole dialog box

2. Select the **Show direction of angle hole** option to display the direction of an angle hole.

This option is selected by default.

3. Click **OK**.

MDTools® displays the top view of the angle holes in the 2D drawing views.



Angle hole displayed in 2D drawing

96. Show Origin & Axes

Automatically display the face origin and X/Y direction of each face in the 2D drawing.

MDTools 770 ribbon
>Display panel
>Origin & Axes

MDTools[®] displays the face origin & axis direction in each drawing view according to the drawing projection angle.

The face origin is marked by a half-filled circle and the axis direction is indicated by an arrow and X, Y, Z axis notation. This is created inside a single sketch in a view.

The face origin and axis direction in a view moves together when you drag the view position.

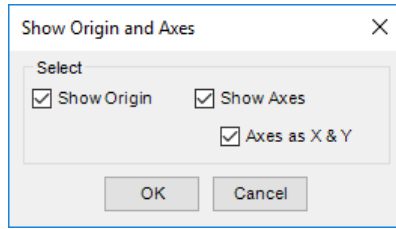
To move an origin & axis, drag the origin and axis to the desired location.

Note

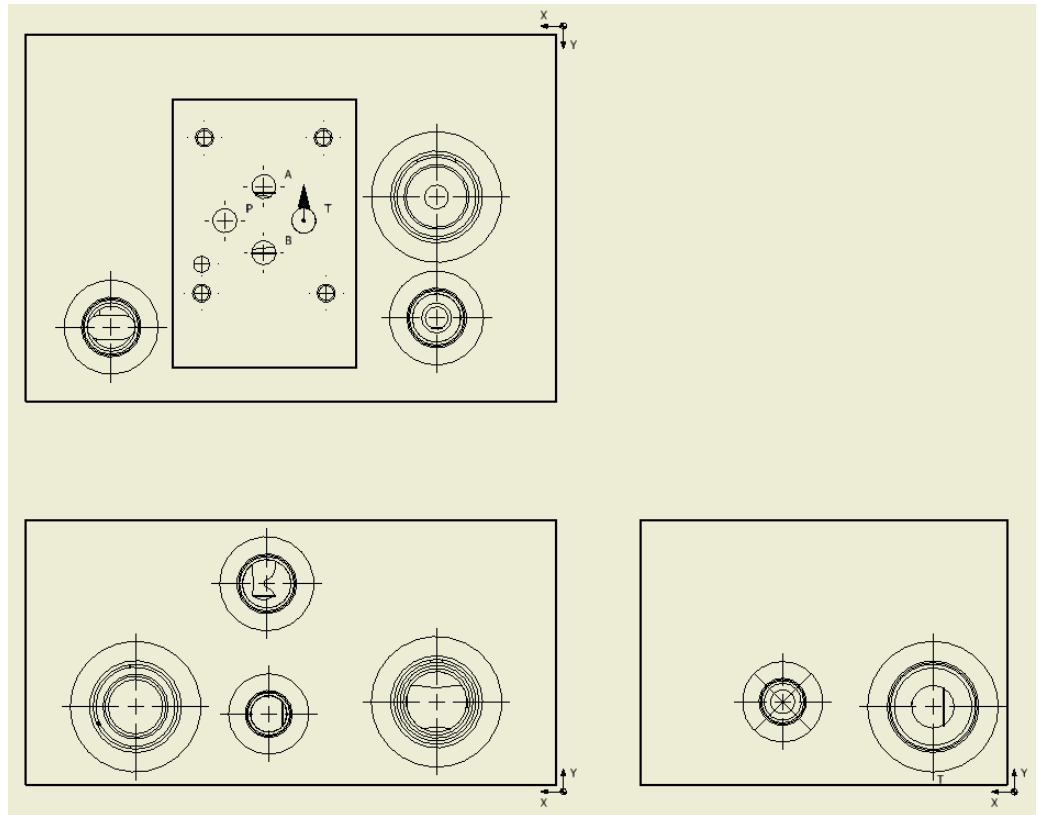
- If 2D views are created manually, then use the following naming convention for the manifold views.

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

- The Show Origin & Axes command will not work if you do not use the view names, per naming conventions.



Show Origin & Axes dialog box



Origin & Axes displayed in the 2D drawing

97. Show Engraved Text

Automatically display the engravings near cavities in the 2D drawing views.

Engraved text is displayed at specified locations when you create the engraved text in the Part model.

MDTools 770 ribbon

>Display panel

>Engraved Text

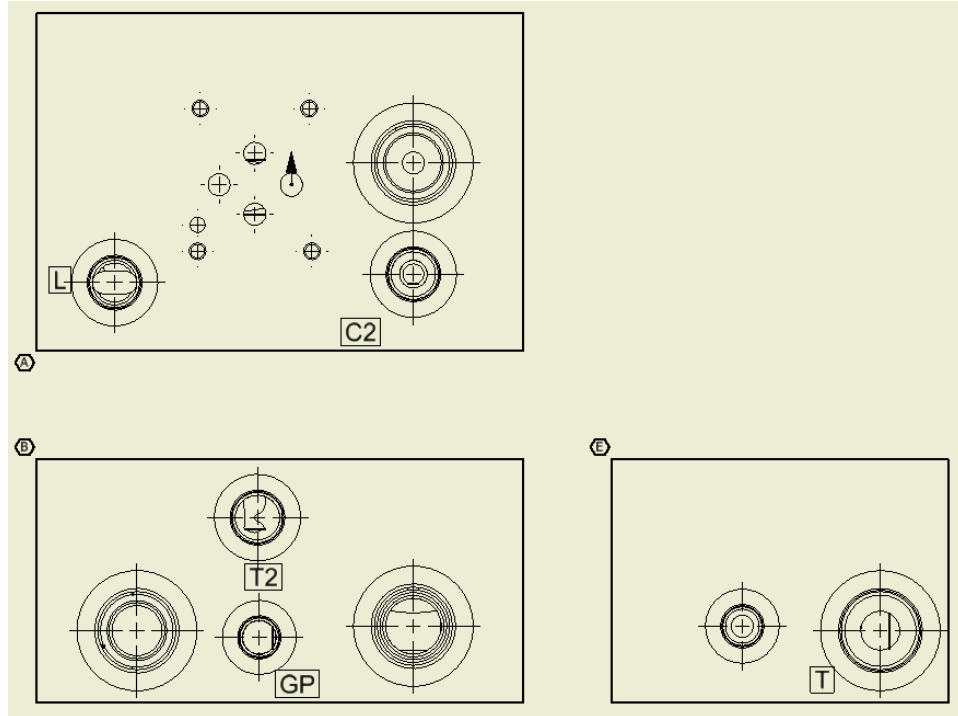
MDTools[®] displays the engraved texts with the enclosed box near the cavity.

All the engravings and enclosed boxes except the engraved text in a view is created inside a single sketch.

All the engravings and enclosed boxes in a view move together when you drag the view position.

Drag the engraving to the desired location.

You cannot move the engraved text.



Engraved text with enclosed box displayed in the 2D drawing

Note

- 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 Engravings command will not work, if you do not use the view names, per naming conventions.

98. Show Undercut

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

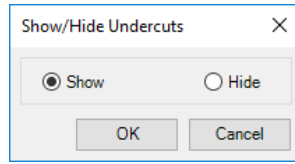
MDTools 770 ribbon
 >Display panel
 >Undercut

Show

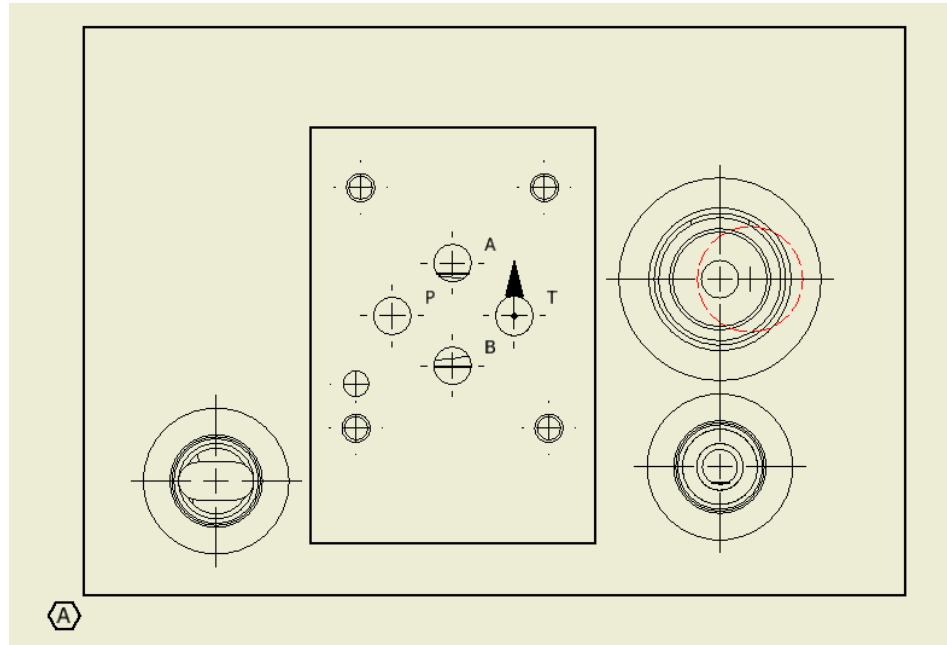
MDTools® displays the top view of undercuts as circles in the 2D drawing.

Hide

MDTools removes the top view of undercut as circles in the 2D drawing.



Show/Hide Undercut Dialog box.

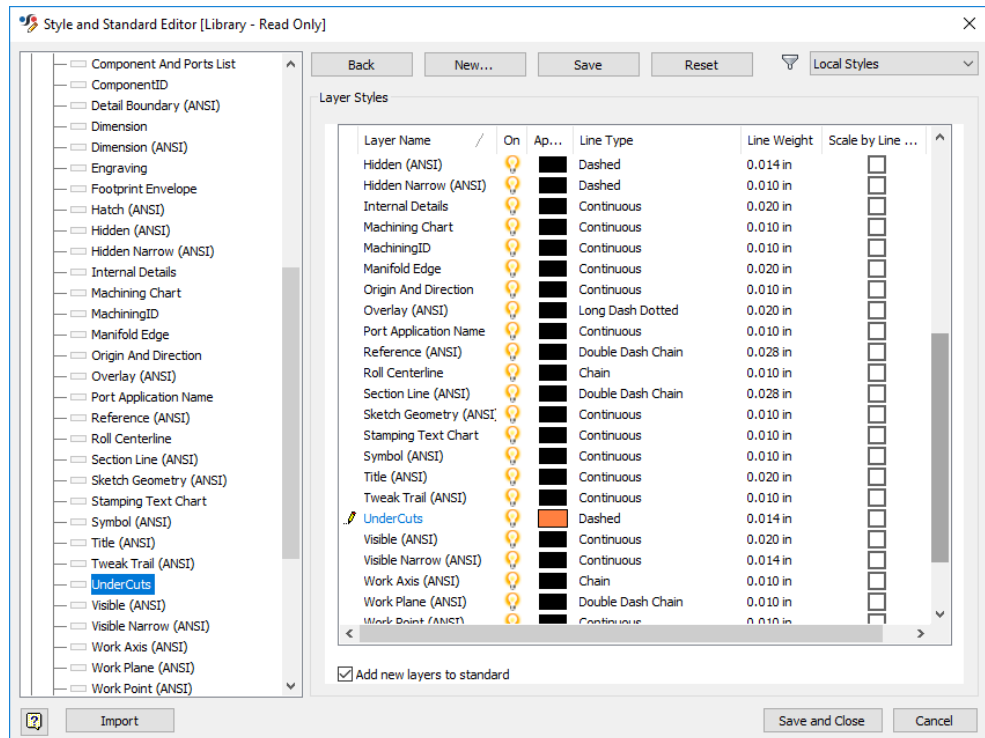


Undercut display in 2D Drawing views.

Note

Undercuts are placed on a separate layer.

Change the layer using the MDTools layer command.



Undercut layer setting

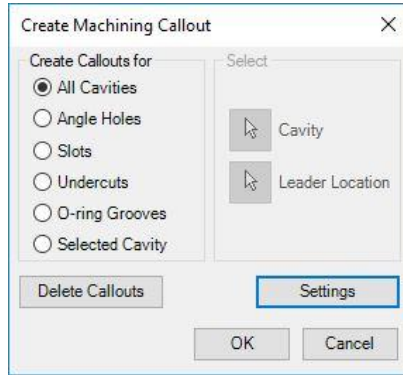
99. Create Machining Callout

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 the leader on the cavities. Position of existing machining callout is retained.

1. MDTools 770 ribbon
>**Create** panel
>**Machining Callout**

The Create Machining Callout dialog box displays.



Create Machining Callout dialog box

2. Click **Settings**.

The Machining Callout Setting dialog box displays.

3. Set the machining sequence, per required format.

4. Click **OK**.

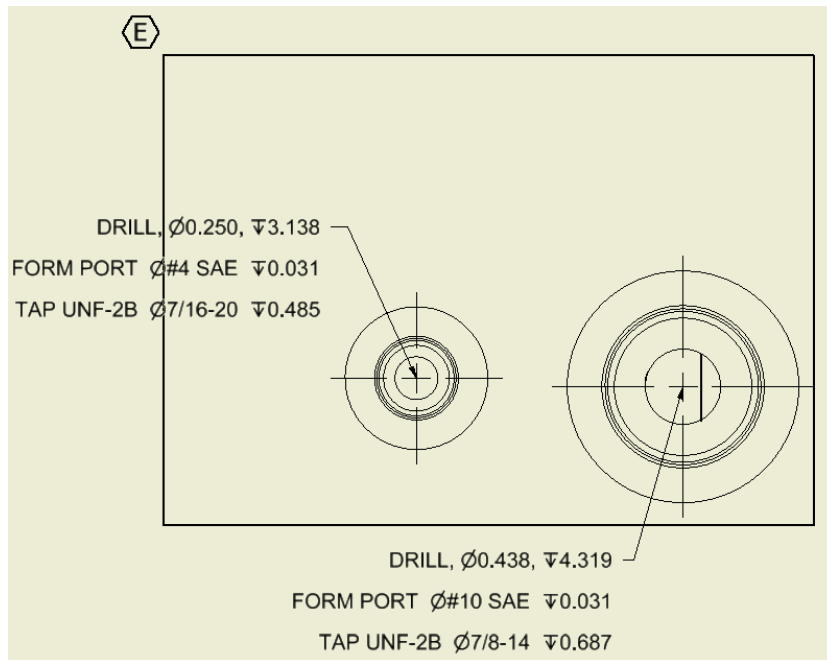
The machining callout settings are saved in the XML file. The Machining Callout Setting dialog box closes.

All Cavities

To create the machining callout for all cavities,

5. Select the **All cavities** option on the Create Machining Callout dialog box and click **OK**.

MDTools* inserts the leader on all the cavities with the machining detail and places the leader from the cavity's center at an angle of 45 degrees. If machining callout already exists position of machining callout will be retained.



Machining Callout displayed for all the cavities in the 2D drawing

Angle Holes

To create the machining callout for only the angle holes in the block, use the **Angle Holes** option.

Slots

To create the machining callout for only the slots in the block, use the **Slots** option.

Undercuts

To create the machining callout for only the undercuts in the block, use the **Undercuts** option.

O-ring Grooves

To create the machining callout for only the O-ring Groove in the block, use the **O-ring Grooves** option.

Note:

This option is enabled only if the **Independent of Parent ID** option is selected in the MDTools Settings, Miscellaneous tab.

Selected Cavity

To create the machining callout for a **cavity**

1. Select the **Selected Cavity** button.
The Cavity button automatically becomes active.
2. Select the cavity.
*The **Leader Location** button automatically becomes active.*
3. Select the point where you want to place the leader.
4. Click **Cancel** to close the dialog box.
5. To move a machining detail, drag the leader endpoint to the desired location.
The text moves automatically.

Note

- The active text style in Inventor is used to create the machining callout.
- Leader always starts from the cavity center.

Machining Callout Setting

The Machining Callout Setting dialog box has options to enable output of the machining detail, as per the user requirements.

Machining Callout Setting dialog box with selected output fields and their order

Prefix and Suffix for Operation Column

Specify the prefix and suffix for machining operation from Step0 through 6 in the Operation column.

Prefix and Suffix for Tool Name Column

Specify the prefix and suffix for tool name from Step0 through 6 in the Tool Name column.

Prefix and Suffix for Diameter Column

Specify the prefix and suffix for diameter from Step0 through 6 in the Diameter column.

Prefix and Suffix for Depth Column

Specify the prefix and suffix for depth from Step0 through 6 in the Depth column.

Selected Order

The Selected Order list shows the order in which the machining operation sequence are created for a specified row.

There are 6 row options available.

The order list is easily built by selecting the machining sequence and clicking the up or down arrow button, in the desired order.

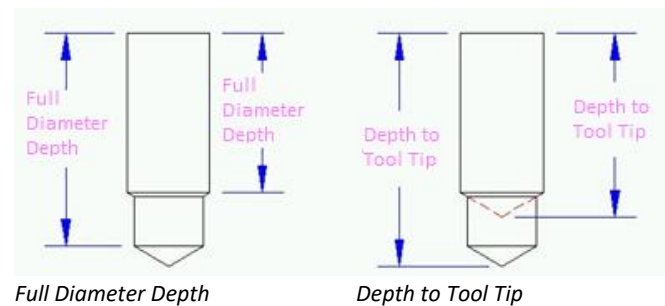
Changing the Column Name (Heading)

Depth

The machining depth in the Machining Chart can be as follows:

- Full Diameter 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.



Number of Decimal Places

Select the number of decimal places for the Depth and Diameter entries in the bore chart.

0 to 4 decimal place accuracy for the depth and diameter, possible.

Text Height

Specifies the Machining Chart text height.

For an Inches unit design, the default text height is 0.125 inches.

For a MM unit design, the default text height is 3.00 millimeter.

Show Trailing Zero

Shows the trailing zero in the cavity diameter and depth.

Show Alpha Angle

- Select the Compound Angle Only option to show the Alpha angle for angle holes in the machining callout.
- The Alpha angle of compound angle holes is always displayed in the callout.
- The default option is last used.
- If the Compound Angle Only option is deselected, the Alpha angle of compound angle hole will not be displayed in the machining callout.

Angle Prefix

Specify **Angle Prefix** for the Alpha and Beta angle to display in the machining callout. For example, \angle :

Beta Caption

Specify **Beta Caption** for the Beta angle in the machining callout. For example, $\beta =$

Alpha Caption

Specify **Alpha Caption** for the Alpha angle in the machining callout. For example, $\alpha =$

100. Create Balloon

Automatically create balloons around the cavity machining ID for all cavities in the 2D drawing.

1. MDTools 770 ribbon
>Create panel
>Balloon

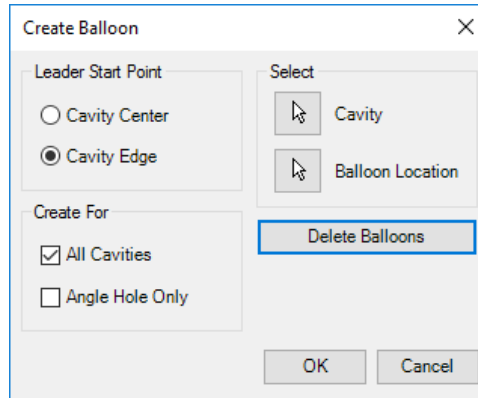
The Create Balloon dialog box displays.

2. 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

Create Balloon for All Cavities

To create balloons for all cavities, select the **All Cavities** option in the Create For group box.

MDTools[®] inserts balloons on all the cavities with machining ID. The leader is placed at an angle of 45 degrees from the cavity's edge or center as per the selected Leader option in the Create Balloon dialog box.

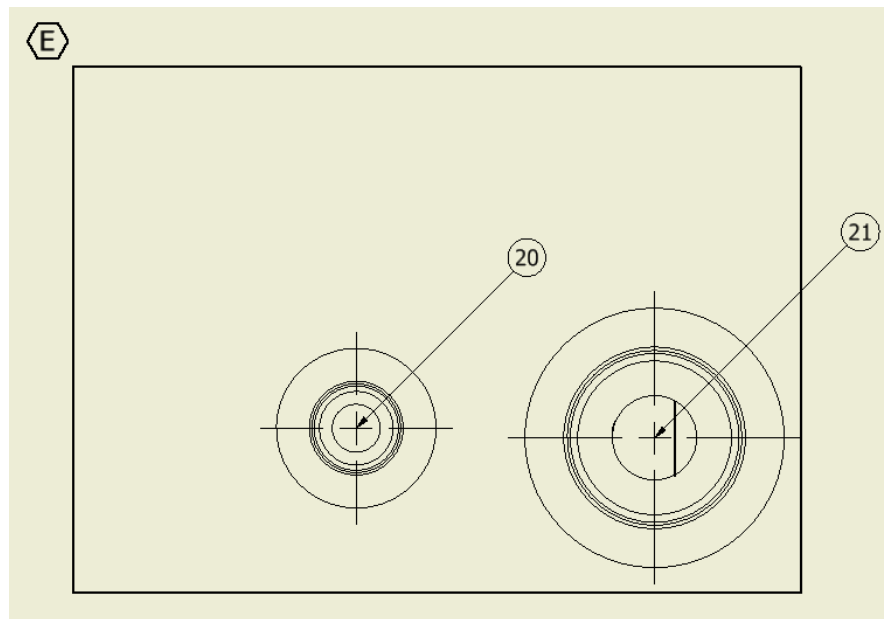
Create Balloon for Angle Hole Only

To create a balloon for only an angle hole, click the **Angle Hole Only** button.

Create Balloon for a Single Cavity

To create a balloon for a single cavity

1. Click the **Cavity** select button.
2. Select the cavity in the drawing view.
The Balloon Location button automatically becomes active.
3. Select the point where you want to place the balloon.
4. Click **Cancel** to close the dialog box.



Balloons displayed for the selected cavity

Move a Balloon

To move a balloon, drag the balloon to the desired location.

The text automatically moves with the balloon.

Delete Balloons

To delete all balloons, click **Delete Balloons**.

Note

- The Sketch Symbol in Inventor is used to create the balloons.
- All the Sketched Symbol Editing options in Inventor are available for the balloons created by this command.

101. Create 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.

Automatically extract the machining data from all the cavities and create the machining chart. Machining Chart is created as Inventor table object for easily modification.

- MDTools 770 ribbon
 >Create panel
 >Machining Chart

The Loading Cavities List message box displays and is followed by the Create Machining Chart dialog box.

- Select the required options.
- Click Insert into Drawing.

The Select Top Left Corner (Point1) message displays.

- Click **OK**.
- Select the top-left corner to define a rectangular window for the machining chart.

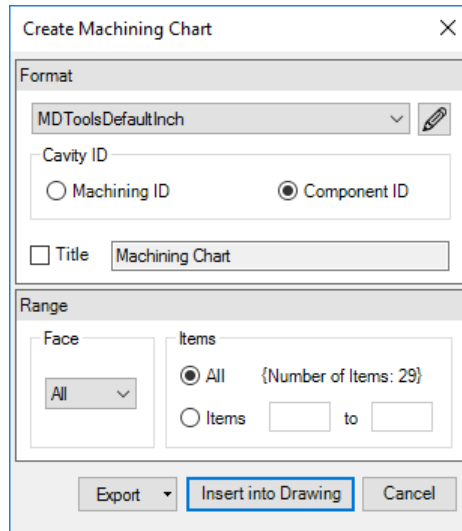
The Select Bottom Right Corner (Point2) message displays.

- Click **OK**.
- Select the bottom-right corner to define a rectangular window for the machining chart.

MDTools* creates the machining chart in the selected window according to the selected machining chart format.

If the selected window is insufficient to create the complete machining chart, the Select Top Left Corner (Point1) message reappears.

- Repeat the above steps until the complete machining chart is created in the drawing.



Create Machining Chart dialog box

Name	Operation	Diameter	Depth	Remarks
10A	DRILL	9/16	1.944	
	C10-2	1.344	0.031	
12	DRILL	0.625	3.014	
	C10-4	1.344	0.125	
GP	DRILL	0.375	1.892	
	FORM PORT	#4 SAE	0.031	
	TAP	7/16-20	0.485	UNF-2B
T2	DRILL	0.500	1.520	
	FORM PORT	#6 SAE	0.031	
	TAP	9/16-18	0.531	UNF-2B

Machining Chart inserted into Inventor

Note

- The active text style in Inventor is used to create the machining chart.
- Use the word 'AND' instead of '&' in the cavity machining information. Using '&' will result in bad data in the machining chart. (Limitation in Inventor API)
- For Sun Cavities, the steps above the block surface are ignored in the Machining Operation information.





Edit Machining Chart dialog box

The Edit Machining Chart dialog box has options to enable output of the machining chart, per the user requirements.

1. Select a format from the **Formats** section.

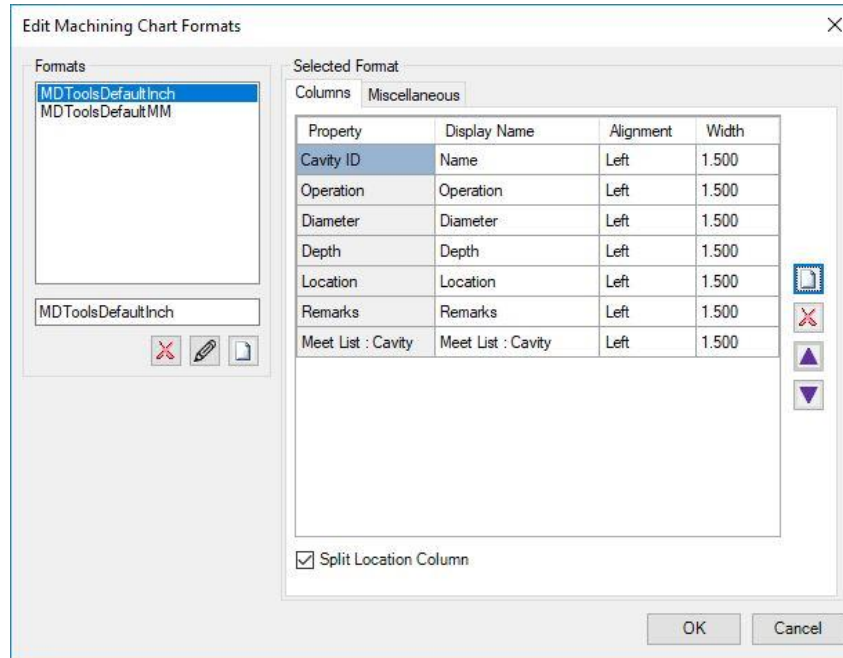
Columns of selected formats are displayed in the Columns tab page.

Other settings of the machining chart are displayed in the Miscellaneous tab page.

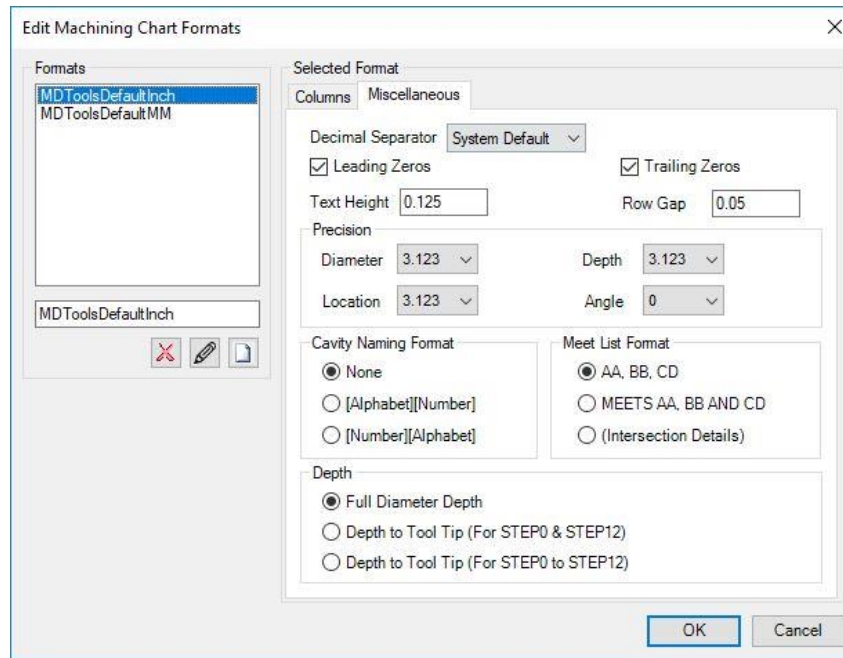
2. Click  to add columns.
3. Select a machining chart column or cell and click  to remove a column.
4. Select a row or cell and click  or  to change order of a column.
5. Select the **Split Location Column** option.

Location column splits X and Y coordinates in two different columns.

This option is visible only if the Machining Chart format contains the Location column.



Edit Machining Chart Formats: Columns tab page



Edit Machining Chart Formats: Miscellaneous tab page

Selected Order

You can change the column order by selecting a column and clicking the up and down arrows.

The Machining chart selected columns order is shown in the Selected Order of columns page.

For the Selected Order, the machining chart is created as shown in the table below.

Machining Chart					
Name	Operation	Diameter	Depth	Face	Meet List : Cavity
201	DRILL	0.375	1.892	B	401, 501

Changing the Column name (Heading)

Change the default column headings to the names that you would like to display in the bore chart.

1. Select a format from the Formats section.
Default columns name displays in the Columns sections.
2. Change the display name of columns.

The new name displays in the Selected Order list.

Column names are saved with the bore chart format.

Column Alignment

Select the horizontal text alignment for each column in the machining chart.

MDTools® aligns the text in the machining chart as per the selection.

Column Width

Specify the column width of machining chart.

Decimal Separator

MDTools uses the selected decimal separator instead of system's decimal separator to display numeric values in Machining chart.

Following three options are available in the dropdown:

System Default

,(Comma)

.(Period)

Leading Zeros

Add leading Zeros to numeric values.

Trailing Zeros

Add trailing Zeros to numeric values.

Text Height

Specifies the machining chart text height.

For an Inches unit design, the default text height is 0.125 inches.

For a MM unit design, the default text height is 3.00 millimeters.

Row Gap

Specifies the row gap.

Row Gap is the distance between the row top line and the text.

Precision

Diameter: Select the number of decimal places for diameter entries in the bore chart.

You can have an accuracy of 1 to 4 decimal places for the diameter.

Depth: Select the number of decimal places for depth entries in the bore chart.

You can have an accuracy of 0 to 4 decimal places for the depth.

Location Precision: List the cavity center coordinates (X and Y) and set the precision of these values.

Accuracy of 1 to 4 decimal places for the diameter, possible.

Angle: Set the precision of cavity Alpha angle and Beta angle values.

Accuracy of 0 to 4 decimal places for the depth, possible.

Note:

- If you select the naming format option 1 (No cavity numbering system), MDTools® will list all the cavities separately, i.e. MDTools will not total the quantities of identical holes.

- If you total the quantity of identical holes in the bore chart, Select the cavity naming format (Option 2 or 3) according to the cavity naming option, Refer the Cavity Naming Format given below for details.

- If you select **Intersection Details** in the Meet List Format, and then select Meet List from Select Columns, all the other Meet List columns (Start Dia, End Dia, Start Depth, End Depth, Edge Offset & Center Offset) are displayed.
- The Split Location column is visible only when the Location column is selected in the Chart format.
- MDTools totals the quantity in a machining chart only if the cavity geometry dimensions of identically named cavities are the same, else, the cavities are listed separately in the machining chart.

Cavity Naming Format

Select the naming format to be used:

Option 1 - None

Use this option, if you have not named the cavities using the MDTools® Generate Machining ID command.

None:

RV1, SV2-1, SV2-2...

Option 2 - [Alphabet][Number]

Use this option to total the quantity of identical holes in the machining chart, if the cavity name is 'Alphabets Or Number + Alphabets' and count is a number.

[Alphabet][Number]

AA, AB1, AB2 AC...

2A, 2B1, 2B2, 2C...

Option 3 - [Number][Alphabet]

Use this option to total the quantity of identical holes in the machining, if you have used Scheme 1 in the Generate Machining ID command.

[Number][Alphabet]

1,2A, 2B, 3...

Meet List Format

Select the Meet List format option:

AA, BB, CD

MDTools lists the meeting cavities in the Meet List for a cavity, separated by a comma (,).

Cavity ID	Operation	Remarks	Diameter	Depth	Meet List : Cavity
2A	DRILL		0.375	1.892	4A, 5A
	FORM PORT		#4 SAE	0.031	
	TAP	UNF-2B	7/16-20	0.485	
2B	DRILL		0.500	1.520	1G
	FORM PORT		#6 SAE	0.031	
	TAP	UNF-2B	9/16-18	0.531	
2C	DRILL		9/16	1.944	1J, 1K, 4A, 4B, 6D
	C10-2		1.344	0.031	
2D	DRILL		0.625	3.014	1C, 1E, 5A, 5B
	C10-4		1.344	0.125	

Meet List option AA, BB, CD

Meets AA, BB and CD

MDTools lists the meeting cavities in the Meet List for a cavity.

For clarity, it prefixes the list with the word, MEETS.

Cavity ID	Operation	Remarks	Diameter	Depth	Meet List : Cavity
2A	DRILL		0.375	1.892	MEETS 4A AND 5A
	FORM PORT		#4 SAE	0.031	
	TAP	UNF-2B	7/16-20	0.485	
2B	DRILL		0.500	1.520	MEETS 1G
	FORM PORT		#6 SAE	0.031	
	TAP	UNF-2B	9/16-18	0.531	
2C	DRILL		9/16	1.944	MEETS 1J, 1K, 4A, 4B AND 6D
	C10-2		1.344	0.031	
2D	DRILL		0.625	3.014	MEETS 1C, 1E, 5A AND 5B
	C10-4		1.344	0.125	

Meet List option Meets AA, BB, CD

(Intersection Details)

MDTools lists the meeting cavities in the Meet List for a cavity with Intersection details.

You can add Meet List columns by clicking Add options in Columns page.

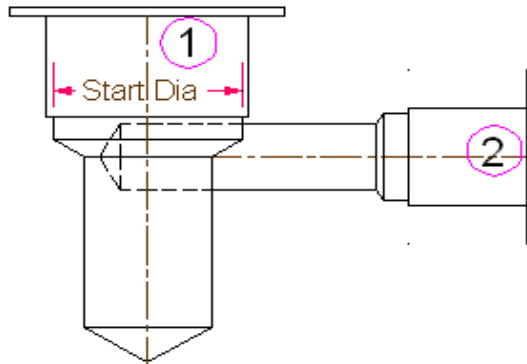
Cavity ID	Meet List	Meet List : Start Dia	Meet List : End Dia	Meet List : Start Depth	Meet List : End Depth	Meet List : Edge Offset	Meet List : Center Offset
2A	5A	0.375	0.25	1.344	1.594	0.125	
	4A	0.375	0.5	1.600			
2B	1G	0.5	1/4	1.395	1.645	0.030	-0.095
	1K	0.875	0.438	0.537	0.975	0.250	0.031
2C	1J	0.875	0.25	0.631	0.881	0.250	0.125
	4B	9/16	0.594	1.553	2.023	0.092	-0.205
	4A	9/16	0.5	1.600	2.093	0.075	-0.175
2D	6D	9/16	9/16	1.826			
	1C	0.875	0.234	0.733	0.967		
	5A	0.751	0.25	1.344	1.594		
	1E	0.689	0.25	1.968	2.218		
	5B	0.625	0.438	2.795	3.118	0.050	-0.169

Meet List intersection details inserted in the 2D Machining Drawing

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.

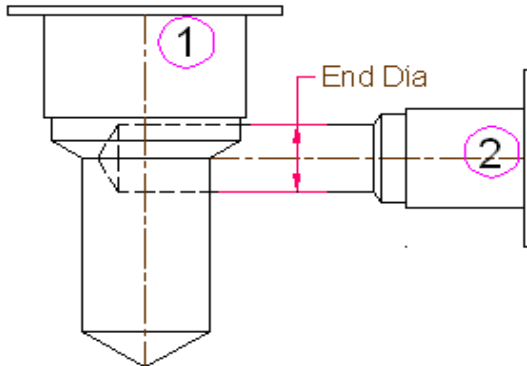
Larger step diameter of the first cavity in the intersecting area is considered the **Start Dia**.



End Dia

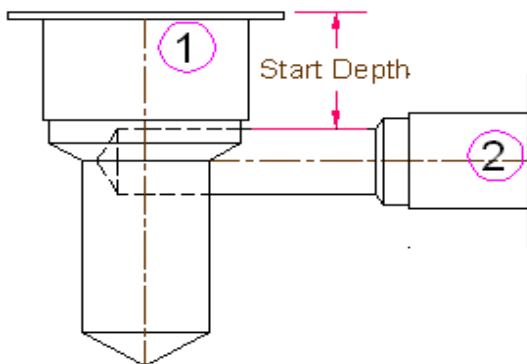
The End Dia in the Machining Chart defines the Step diameter of the second cavity at the meet point of the first cavity.

Larger step diameter of the second cavity in the intersecting area is considered the **End Dia**.



Start Depth

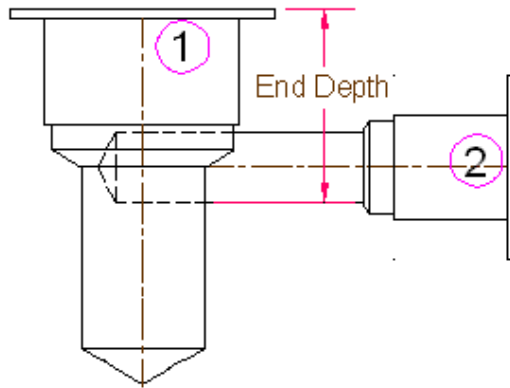
Start Depth is the distance from the spot face of the first cavity to the nearest connecting edge of the second cavity.



End Depth

End Depth is the distance from the spot face of the first cavity to the end connecting edge of the second cavity.

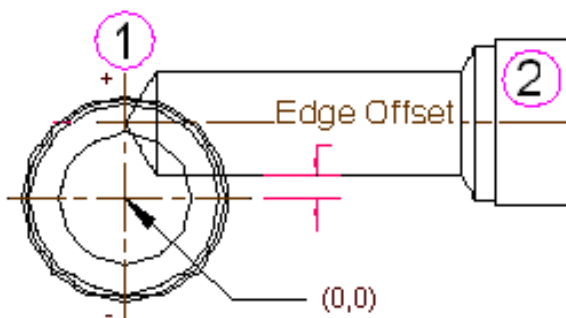
If the first cavity terminates before the second cavity center axis, then the End Depth is considered the null value.



Edge Offset

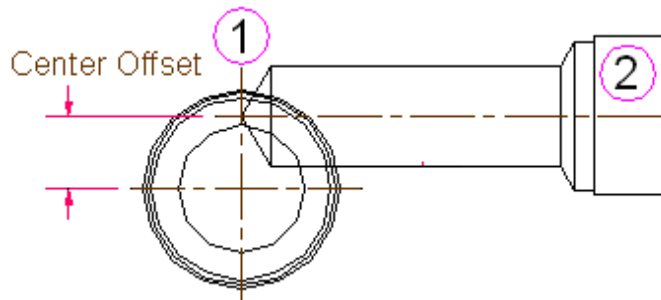
The Edge Offset is the distance between the center of the first connecting cavity to the nearest connecting edge of the second connecting cavity.

It may be a +ve or a -ve value with respect to the origin.



Center Offset

Center Offset is the center-axis offset distance between two connected cavities.

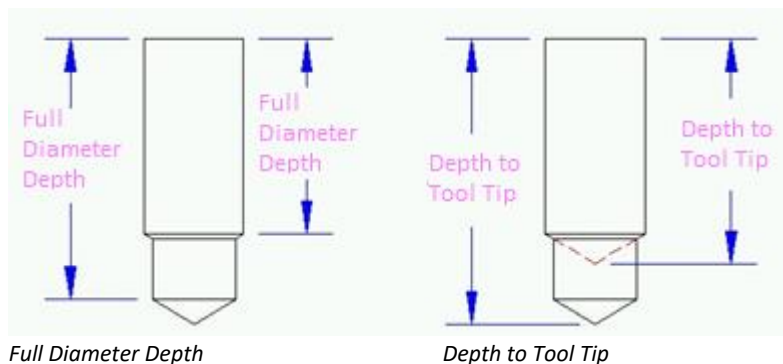


Depth

The machining depth in the Machining Chart can be as follows.

- Full Diameter Depth
- Depth to Tool Tip for Step0 and Step12
- Depth to Tool Tip for Step0 through Step12

The machining depth is calculated according to the selected option.




New Name Format

Create and save custom machining chart formats for subsequent use.

To save the format:


Enter the name of the format.

Click  to save the format after selecting all the required options.


Rename Format

To rename the format:

Enter the name of the format.

Click  to rename the format.

Delete Format

Click  to delete the selected format.

Stored Formats

Select the format from the saved format drop-down list.

Face

Create the complete machining chart in one step, or create it face wise.

The default option is All.

To create the machining chart of cavities on one face:

Select all the required format options.

Select the face name.

Click **Insert into Drawing**.

Item Range

Create the complete machining chart of all the selected cavities, or a part of the selected cavities.

The default option is All.

To create specific number of items:

Enter the item range.

Click **Insert into Drawing**.

Total No. of Items

Total number of items in the selected face option is displayed under Total No. of Items.

This option helps calculate and select the approximate area required to create the machining chart.

Export

Click the **Export** button to export the Machining Chart format.

1. Click the Export button to configure export options.

Popup displays with Save and Cancel options.

- Specify the column delimiter to be used when exporting the machining chart into a text file.

Each of the columns in the machining chart can either be:

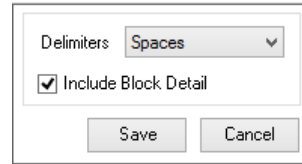
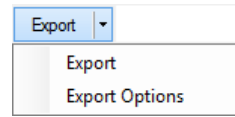
Space Delimited ...separated by spaces

Semi Colon (;) Delimited ...separated by semi colons

Tab Delimited ...separated by tabs

Comma (,) Delimited ...separated by commas

2. Include block details, such as Block dimensions or Block material, when exporting the machining chart into a text file.
3. Click **Save**.

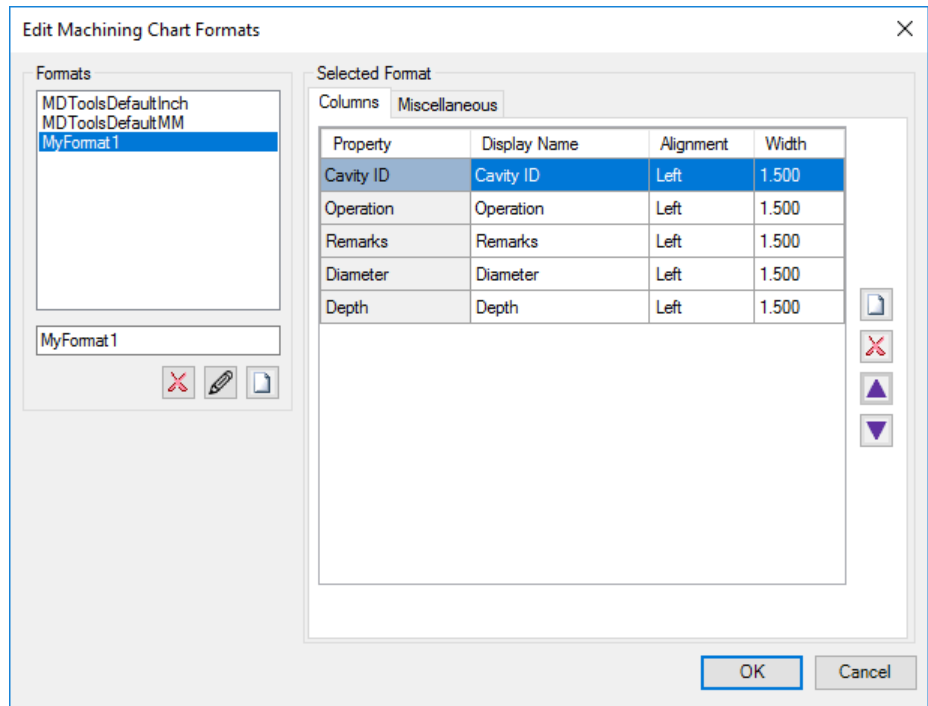


Saving Machining Chart Formats

Your organization may have its own standard Machining Chart output formats.

These formats can be saved for easy use during Machining Chart creation as follows:

1. Make appropriate selections for various options in the **Edit Machining Chart** dialog box.
2. Save this format with a name, **MyFormat1**, in the New Format Name edit box.
3. Click **OK** to save the format.



Saving a Machining Chart format


Create another Bore Chart format as shown in the figure, and save it with the name, **MyFormat1** in the Machining Chart format.

Using Saved Formats

1. Click the **Formats** drop-down option.

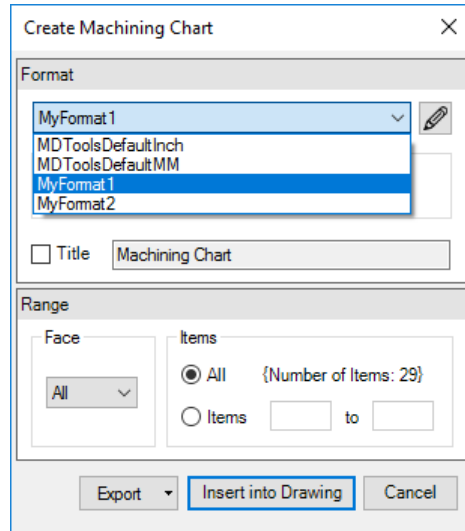
The existing formats are displayed.

2. Select the desired format.

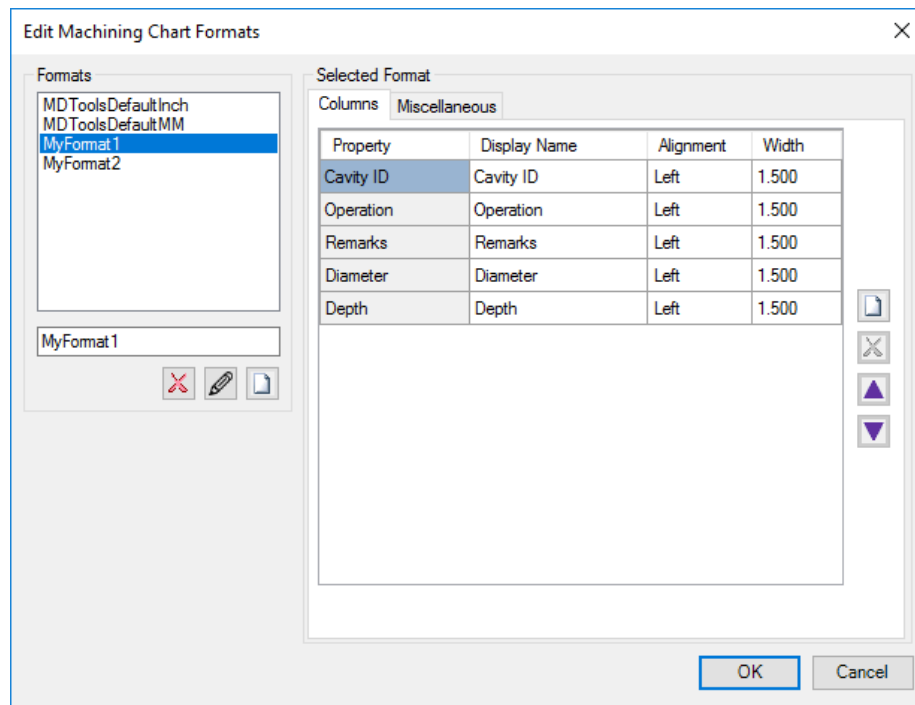
3. Click , the Edit option.

The Edit Machining Chart Formats dialog box displays.

Selected format is loaded by default in the Edit Machining Chart Formats dialog box.



Machining Chart Stored Formats displayed



Edit Machining Chart dialog box options updated

102. Create Cavity List

Insert a cavity table consisting of the serial number, cavity/footprint name, cavity type, and quantity in the 2D drawing.

- MDTools 770 ribbon
 - > **Create** panel
 - > **Cavity List**

The *Create Cavity List* dialog box displays.
- Click **Configure** to configure the Cavity List optional fields, column headers and title of the list.

The *Configure Cavity List* dialog box displays.
- Select/Deselect the items to be included when the cavity list is inserted. For example: If you want to exclude Mounting Bolt Hole, deselect that option.
- Select/Deselect the **Cavity Type** checkbox to display/hide the cavity type.
- Select/Deselect the **Serial Number** checkbox to display/hide the serial numbers in the table.
- Change the Title of the table, if required.
- Enter **Text Height** for the Cavity List table.
- Change the column headers for the customized column headings.
- Select the **delimiter** for the text file in the Export Format option.
- Click **OK** in the Configure Cavity List dialog box to save the customized settings.

Note

Cavity/Footprint Name and Quantity are always visible in the Cavity List.

- To export the Cavity list as a text file, click **Export**.

The *delimiter configured is used when creating the text file*.
- Click **Insert into Drawing**.

The *Select Top Left Corner* message displays.
- Click **OK**.

The *Select Bottom Right Corner* message displays.
- Select the top-left corner to define a rectangular window for the Cavity list.

The *Select Bottom Right Corner* message displays.
- Click **OK**.
- Select the bottom-right corner to define a rectangular window for the Cavity list.

MDTools* creates the cavity table in the selected window.

If the selected window is insufficient in size to create the complete cavity table, the *Select Top Left Corner* message displays.
- Repeat the above steps, till the complete cavity table is created in the drawing.

Note

The active text style in Inventor is used to create the Cavity List table.

S.N.	Cavity/Footprint Name	Cavity Type	Quantity
1	D03	Footprint	1
2	#6 SAE	Port	5
3	C10-2	Cartridge Valve	3
4	#10 SAE	Port	1
5	1/4"-20 UNC, Dia-0.203	Mounting Bolt H...	2
6	#8 SAE	Port	1
7	#4 SAE	Port	2
8	MB-600-080	X-Drill Plug	1
9	C10-4	Cartridge Valve	1
10	,Dia-0.594	Drill Hole	1
11	5/16"-24 UNF	Port	1
12	Slot, Dia-0.25	Slot	1
13	Undercut, Dia-0.7	Undercut	1

Create Cavity List dialog box

Configure Cavity List dialog box

Cavity List			
S.N.	Cavity/Footprint Name	Cavity Type	Quantity
1	D03	Footprint	1
2	#6 SAE	Port	5
3	C10-2	Cartridge Valve	3
4	#10 SAE	Port	1
5	1/4"-20 UNC, Dia-0.203	Mounting Bolt Hole	2
6	#8 SAE	Port	1
7	#4 SAE	Port	2
8	MB-600-080	X-Drill Plug	1
9	C10-4	Cartridge Valve	1
10	,Dia-0.594	Drill Hole	1
11	5/16"-24 UNF	Port	1
12	Slot, Dia-0.25	Slot	1
13	Undercut, Dia-0.7	Undercut	1

Cavity List inserted in the drawing

103. Create Component and Port List

Insert a cavity table consisting of the component ID, machining ID, cavity/footprint name, and face name in the 2D drawing.

- MDTools 770 ribbon
>Create panel
>**Components and Ports List**
The Create Component and Ports List dialog box displays.
- Select the cavities you want to include in the table.
- Click **Configure** to configure components and ports list optional fields, column headers, and title of the list.
The Configure Component and Ports List dialog box displays.
- Select/Deselect the **Face** checkbox to display/hide the face names.
- Select/Deselect the **Machining ID** checkbox to display/hide the Machining ID in the table.
- Change the **Title** of the table, if required.
- Enter **Text Height** for the Components and Ports List table.
- You may change the column headers for customized column headings.
- Click **OK** to save the customized settings.
The Select Top Left Corner message displays.
- Click Insert into Drawing.
- Click **OK**.
- Select the top-left corner to define a rectangular window for the machining chart.
The Select Bottom Right Corner message displays.
- Click **OK**.
- Select the top-left corner to define a rectangular window for the Components and Ports List.
MDTools creates the cavity table in the selected window.*
If the selected window is insufficient to create the complete Components and Ports List, the Select Top Left Corner message displays.
- Repeat the above steps until the complete Components and Ports List is created in the drawing.

Note

The active text style in Inventor is used to create the Components and Ports list.

Component ID	Machining ID	Cavity/Footprint Name	Face
<input checked="" type="checkbox"/> 10A	2C	C10-2	2
<input checked="" type="checkbox"/> 10B	1E	C10-2	1
<input checked="" type="checkbox"/> 11	1D	D03	1
<input checked="" type="checkbox"/> 12	2D	C10-4	2
<input checked="" type="checkbox"/> C1	6B	#6 SAE	6
<input checked="" type="checkbox"/> C2	1L	#6 SAE	1
<input checked="" type="checkbox"/> GP	2A	#4 SAE	2
<input checked="" type="checkbox"/> L	1K	#6 SAE	1
<input checked="" type="checkbox"/> orf	1C	5/16"-24 UNF	1
<input checked="" type="checkbox"/> P	4A	#8 SAE	4
<input checked="" type="checkbox"/> RV	6D	C10-2	6
<input checked="" type="checkbox"/> T	5B	#10 SAE	5
<input checked="" type="checkbox"/> T1	6C	#6 SAE	6
<input checked="" type="checkbox"/> T2	2B	#6 SAE	2

Create Component and Port List dialog box

Components and Ports List			
Component ID	Machining ID	Cavity/Footprint Name	Face
10A	2C	C10-2	2
10B	1E	C10-2	1
11	1D	D03	1
12	2D	C10-4	2
C1	6B	#6 SAE	6
C2	1L	#6 SAE	1
GP	2A	#4 SAE	2
L	1K	#6 SAE	1
orf	1C	5/16"-24 UNF	1
P	4A	#8 SAE	4
RV	6D	C10-2	6
T	5B	#10 SAE	5
T1	6C	#6 SAE	6
T2	2B	#6 SAE	2

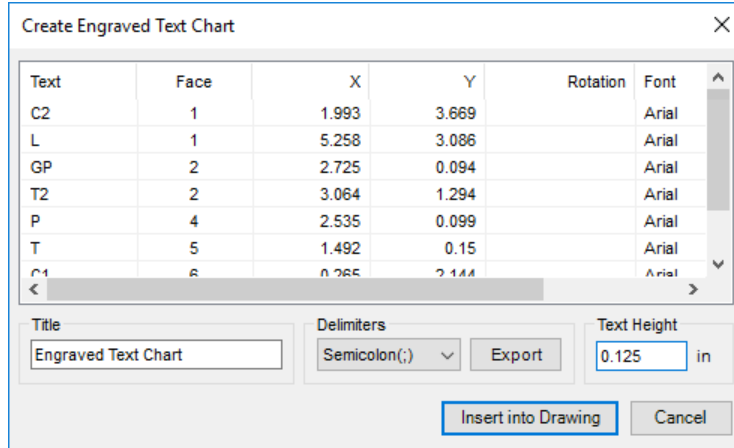
Component and Port table inserted into a 2D drawing

104. Create Engraved Text Chart

Insert an engraving text chart consisting of texts, face, X and Y co-ordinates of the location of the texts rotation, font, and text size in the 2D drawing.

- MDTools 770 ribbon
 > Create panel
 > **Engraved Text Chart**

The Create Engraved Text Chart dialog box displays.



- Change the table title, if required.

- Enter **Text Height** for the Engraved Text Chart.

- 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 Engraved Text Chart.

The Select Bottom Right Corner message displays.

- Click **OK**.

- Select the top-left corner to define a rectangular window for the Engraved Text Chart.

MDTools* creates the Engraved Text Chart in the selected window.

ENGRAVED TEXT CHART						
TEXT	FACE	X	Y	ROTATION	FONT	TEXT HEIGHT
C2	A	1.993	3.669		Arial	0.2
L	A	5.258	3.086		Arial	0.2
GP	B	2.725	0.094		Arial	0.2
T2	B	3.064	1.294		Arial	0.2
P	D	2.535	0.099		Arial	0.2
T	E	1.492	0.15		Arial	0.2
C1	F	0.265	2.144		Arial	0.2
T1	F	3.15	1.172		Arial	0.2

Engraved Text Chart inserted into the 2D drawing

If the selected window is insufficient in size to create the complete Engraved Text Chart, the Select Top Left Corner message displays.

- Repeat the above steps till the complete engraved text chart is created in the drawing.

Note

The X-axis is taken as the reference point for the rotation angle of the text.

105. Drawing Layers

Define the Inventor style layers for MDTools® objects like cavity, center marks, dimensions, machining ID, bore chart etc. in the 2D drawing views.

1. MDTools 770 ribbon
>Settings panel
>Layers

The Drawing Layers dialog box displays.

Various MDTools objects are set for the layers.

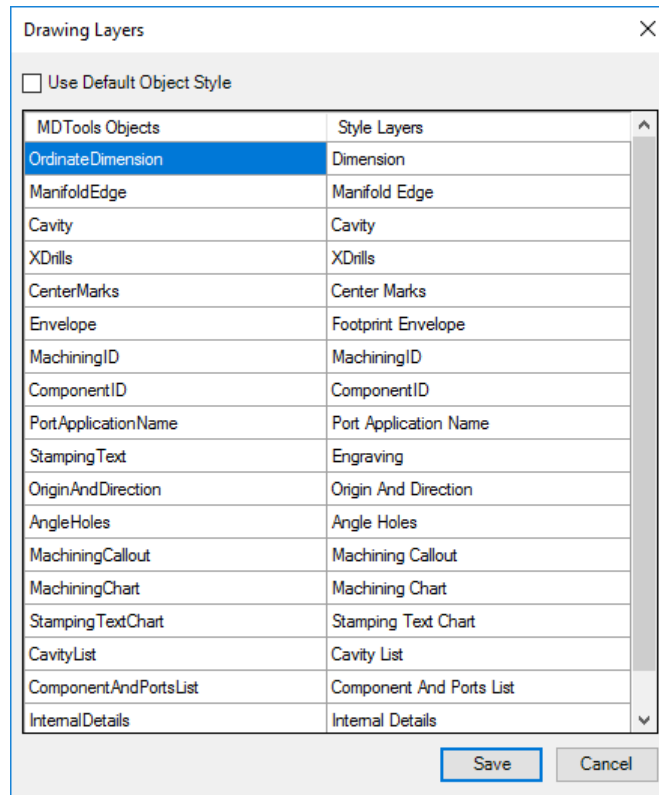
Select **Use Default Object Style**, if you need Inventor style.

2. Select an MDTools object and set an inbuilt or custom-defined Inventor style layer for the selected entity to be used by the drawing commands.
3. Click **Save** to save the layer settings.

For example, Click Show Machining ID.

MDTools displays the cavity machining ID with the type, size, color etc. according to the layer, which is set for the Machining ID text.

Modifying a layer characteristic or showing/hiding them would reflect on the MDTools objects using that layer.



Drawing Layers dialog box

Note

- Drawing Layers should ideally be set before creating automatic machining drawing or before running the Drawing commands.
- If the Style layer set for an MDTools object does not exist, a copy of the default layer type is saved in that name.

106. MDTools License option

Set the MDTools® license path through the MDTools 2D Drawing ribbon.

1. MDTools 770 ribbon
>**Settings** panel
>License.

The MDTools License Option dialog box displays.

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

This option is available only in the MDTools 770 Network license version.

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.

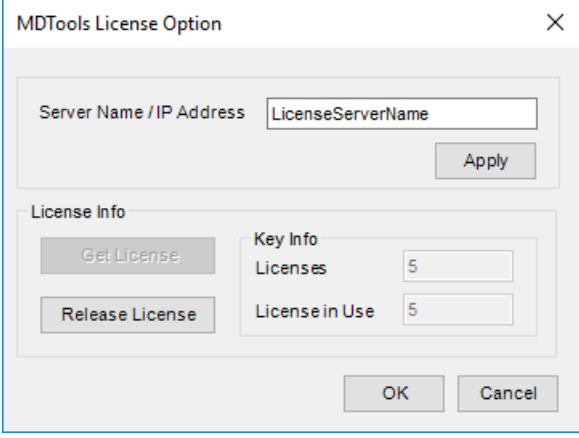
4. To release a license, click the **Release License** button.

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.

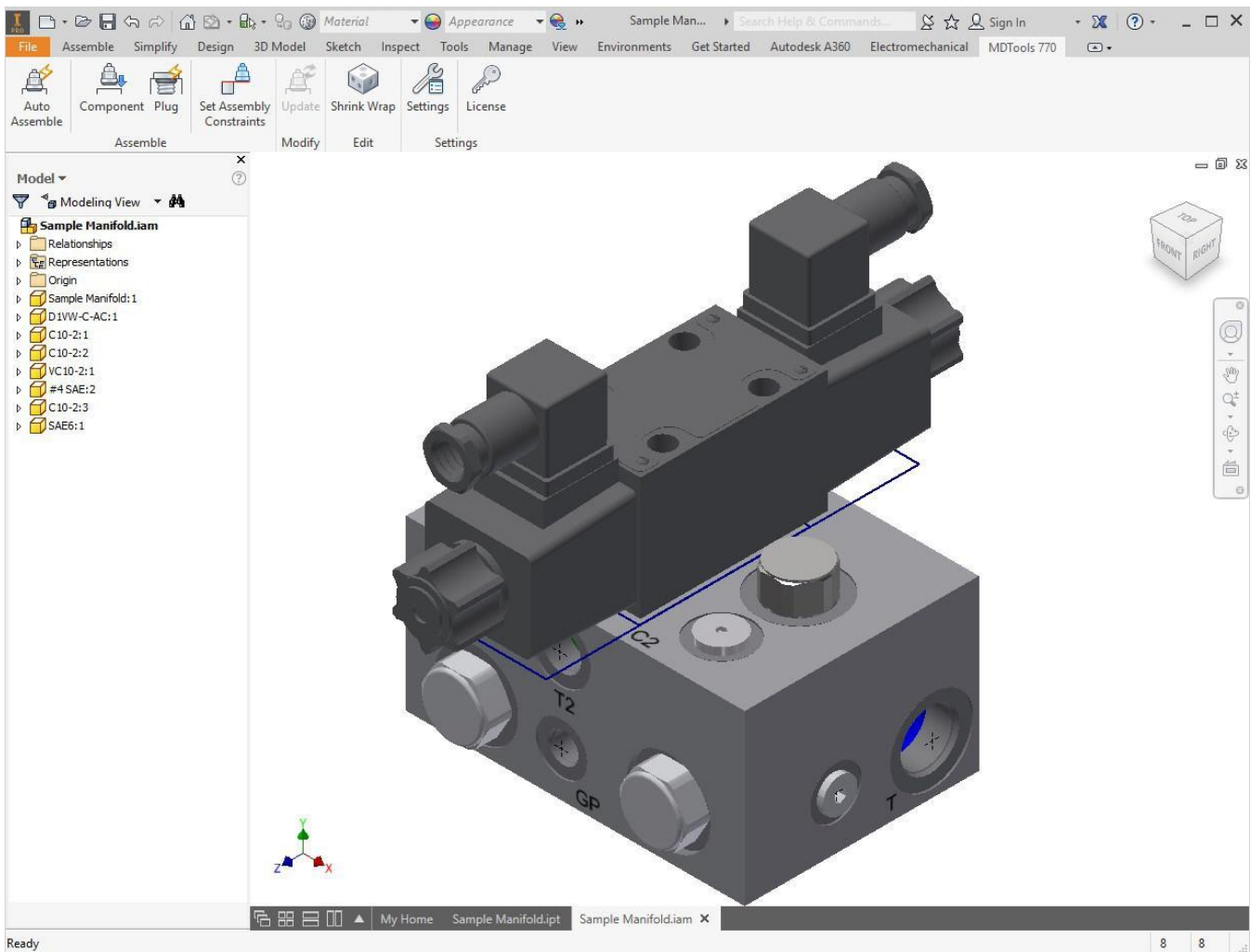


The screenshot shows the 'MDTools License Option' dialog box. It features a title bar with a close button. The main area is divided into sections: 'Server Name / IP Address' with a text input field containing 'LicenseServerName' and an 'Apply' button; 'License Info' with a 'Get License' button, a 'Release License' button, and a 'Key Info' section containing 'Licenses' and 'License in Use' fields, both with the value '5'. At the bottom are 'OK' and 'Cancel' buttons.

MDTools License Option dialog box

ASSEMBLY COMMANDS

- 107 Auto Assemble
- 108 Assemble Component
- 109 Assemble Plugs
- 110 Set Assembly Constraints
- 111 Update Assembly
- 112 Shrink Wrap
- 113 MDTools Assembly Settings
- 114 MDTools License option



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.

1. Create a new assembly drawing (.iam) and place the manifold into the assembly drawing using the Place Component command in Inventor.

MDTools 770 ribbon
>Assemble panel
>**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.

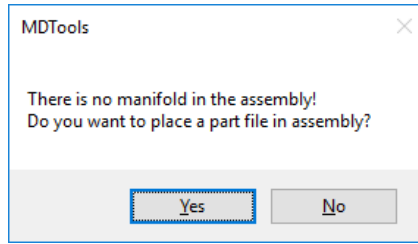
3. Select a component.

MDTools automatically places the selected component in the assembly drawing.

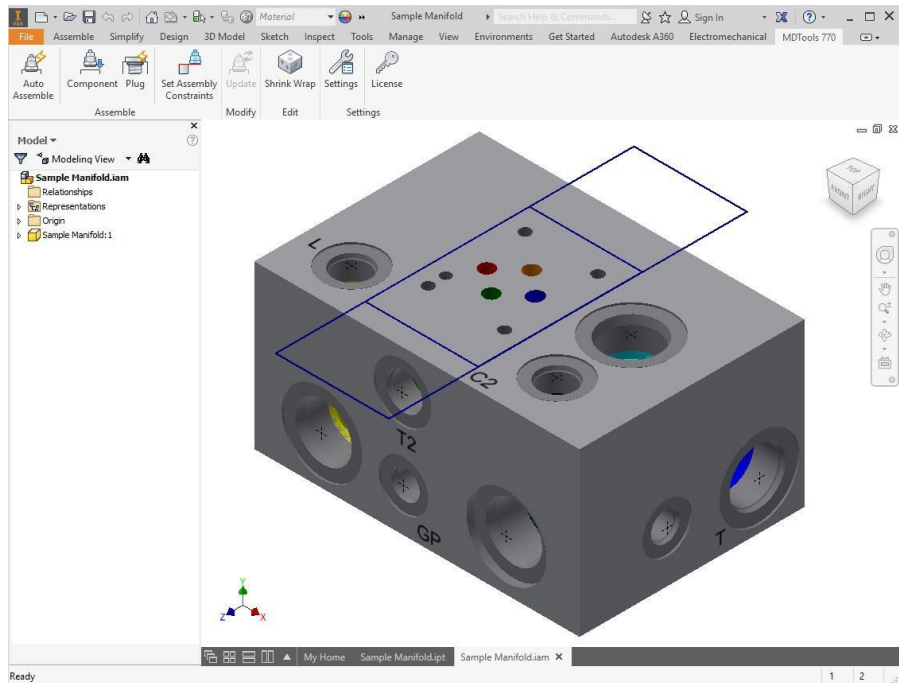
The component models assigned in the HyDraw® Schematic are automatically assembled to the manifold.

Note

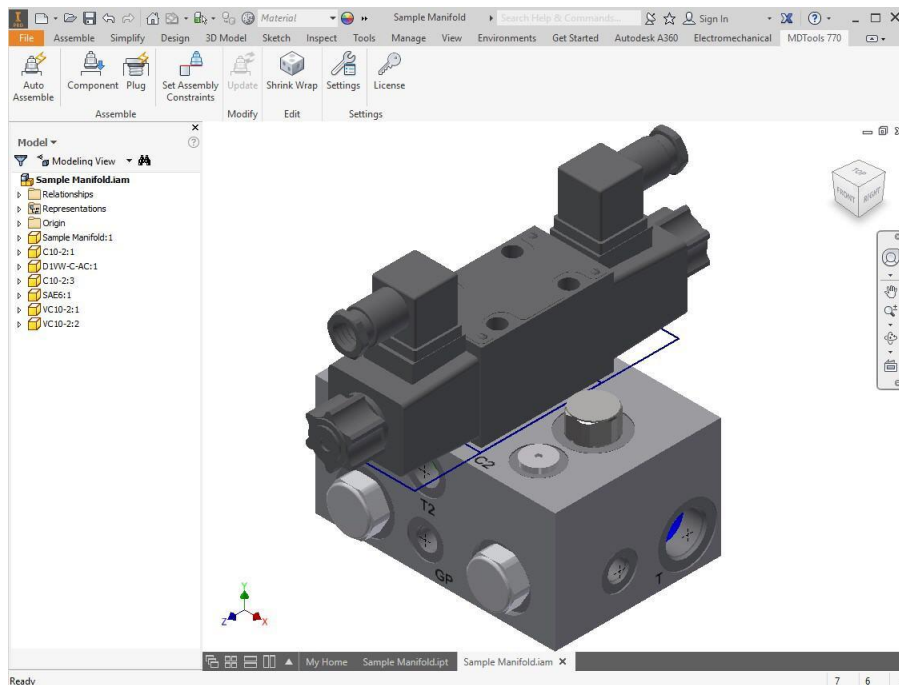
If the CAD Model Location option is selected as Vault Server in the MDTools Assembly Settings. Then, assign plugs using CAD Models location in Vault Server, MDTools Library Manager 2018.



Assembly Drawing



Manifold inserted to the Assembly Interface



Component Models auto assembled to the Manifold

108. Assemble Component

Automatically assemble all the components on a manifold.

MDTools® automatically creates all the required constraints and assembles the components at the correct location. MDTools automatically resolves/updates the existing assembled CAD models (e.g. Cavity face changed, cavity deleted, moved, suppressed etc.)

1. Create a new assembly drawing (.iam) and place the manifold into the assembly drawing using the Place Component command in Inventor.
2. MDTools 770 ribbon >Assemble panel >Component

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.

3. Click **Yes**.
4. Select a component.

The Place Component dialog box displays.



MDTools automatically places the selected component in the assembly drawing.

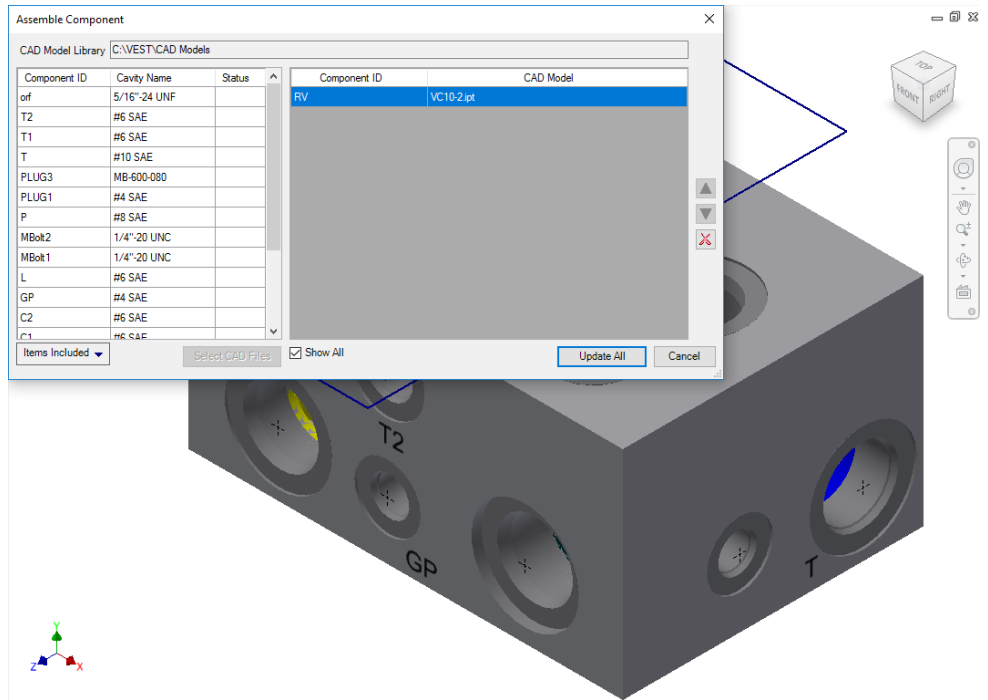
The Assembly Interface dialog box displays.

MDTools displays the component IDs of all the cavities in the dialog box.

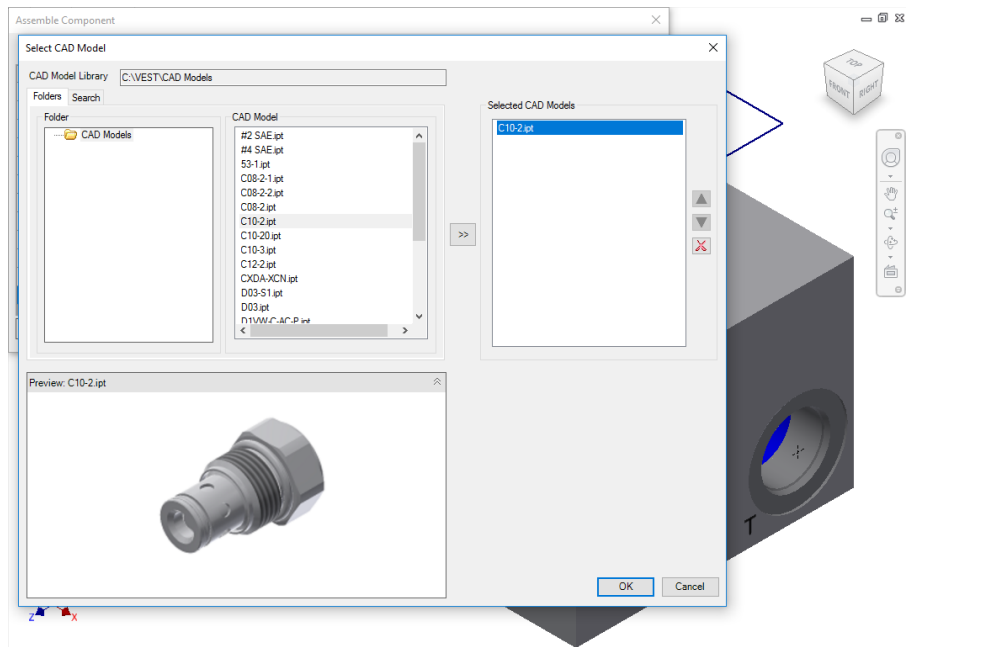
The Status column shows the status of component assembled for that cavity.

Selecting Valves

1. Select the Component ID to choose a cavity.
You can also select multiple cavities.
2. Click **Select CAD Files**.
The Select CAD Model dialog box displays.
3. Select the required model from the CAD Model list.
You can also see the preview of model by clicking this  option.
4. Click  to add selected model to the Selected CAD Models list.




Assemble Component dialog box



Select CAD Model dialog box


Note

If more than one model assembled with a single cavity/footprint is required, then select another model from the CAD Model list and click .

5. Click OK.

The Select CAD Model dialog box closes.

The Assemble Component dialog box displays.

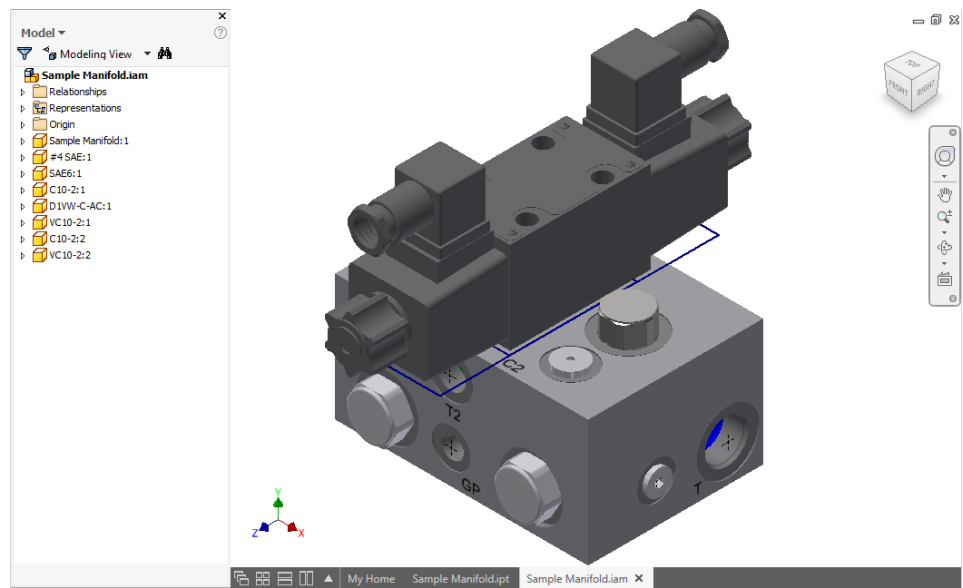
The Status of the selected cavity changes to .

Note

If the selected cavity is a solenoid valve cavity, then select the solenoid coil and manual override/lock nut before adding the cavity into the assembly list.

6. Similarly, select part files for all the cavities on the manifold.
7. Click **Assemble**.

MDTools[®] automatically assembles or resolves/updates all the selected components at their locations on the manifold.



Assembly created using MDTools


Same Component for Multiple Cavities

When multiple cavities use the same component, you can select the component for all the cavities together.

1. Select the cavities from the list, one by one.

Note

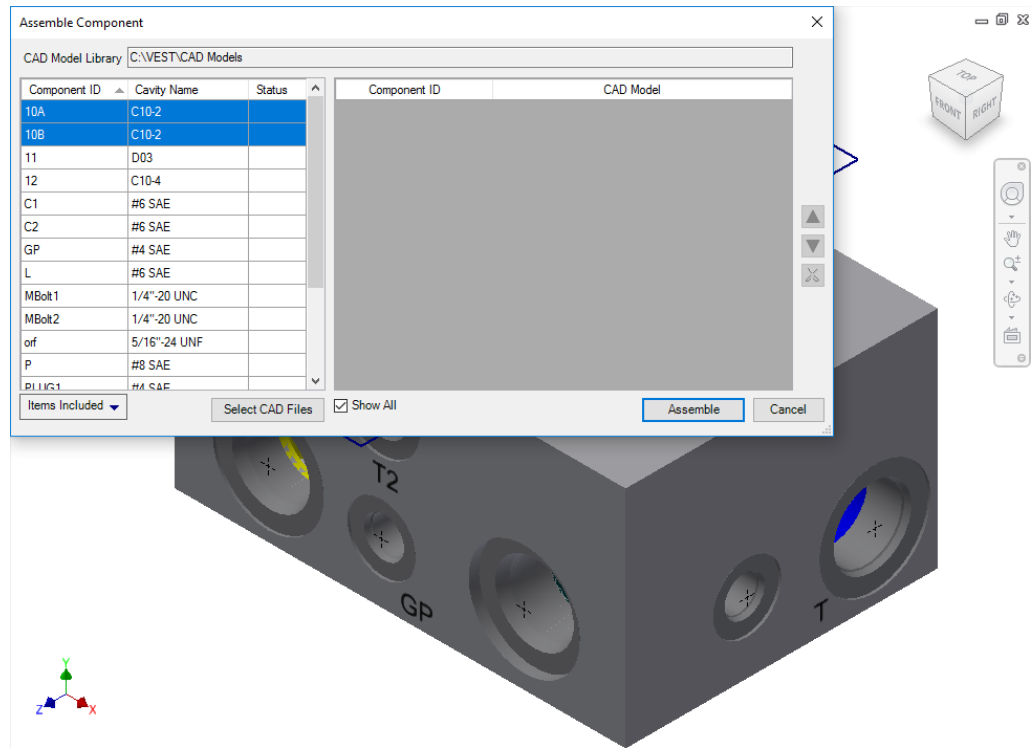
*Hold the **Ctrl** key to enable multiple cavity selection.*

2. Select the component using the **Select CAD File** feature.
3. Status of selected cavities changes to .

Note




- Set assembly constraints on all the part models using the MDTools' Set Assembly Constraints feature to make it work with the Assembly interface.
- Parts without the assembly constraints will not get assembled on the manifold.

Refer to Chapter 104 Set Assembly Constraints for details.



Multiple Cavity selection

Status Description

1.  - Component already assembled, no action required.
2.  - Component was assembled previously, but having some error, needs to be resolved (e.g. change face, swap cavity, suppress cavity etc.)
3.  - Updating required for that component. (For example, Component deleted, new component added, component assembly order changed, if multiple components and one or more component deleted etc.)

Note

You can also see the assembled model by selecting a model from the CAD Model column.

If Orifice plug is merged with footprint child cavities, MDTools lists footprint child cavity as a separate item.

For two Port Orifice Plug models, MDTools assembles it at the thread step index of a cavity.

If the thread step information does not exist in the cavity, then MDTools displays a warning message.

109. 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.

Specify the cavity and plug file path locations using the Plug in the MDTools Library Manager.

1. Open the assembly model in Inventor.
2. MDTools 770 ribbon >Assemble panel >Plug

Automatically assembles the plugs onto all the construction (X- Drill) ports, which are assigned in the MDTools Library Manager, in a manifold.

Note

If there is no manifold placed in the assembly, a message box displays.

3. Click **Yes** to place a manifold in the assembly.

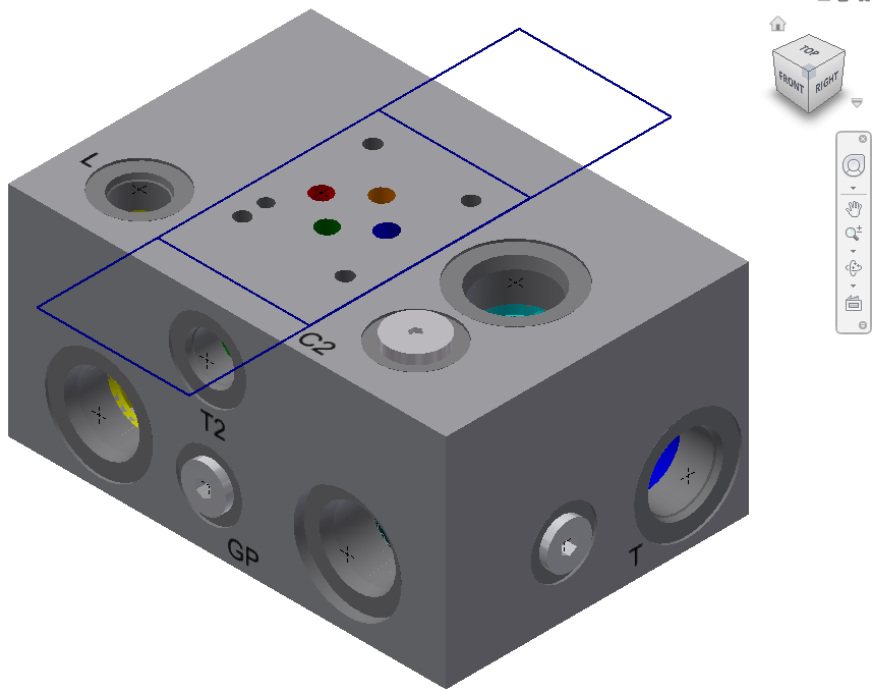
The Place Component dialog box displays.

4. 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 Library Manager, in a manifold.

Note

If the CAD Model Location option is selected as Vault Server in MDTools Assembly Settings, then assign plugs using CAD Models location in the Vault Server, MDTools Library Manager 2018.

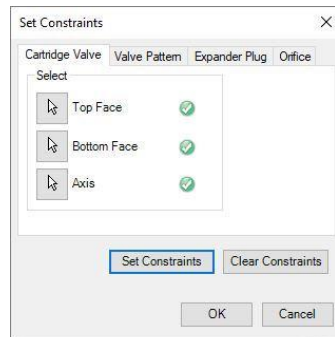


Assemble the plugs on the construction ports in a manifold

110. Set Assembly Constraints

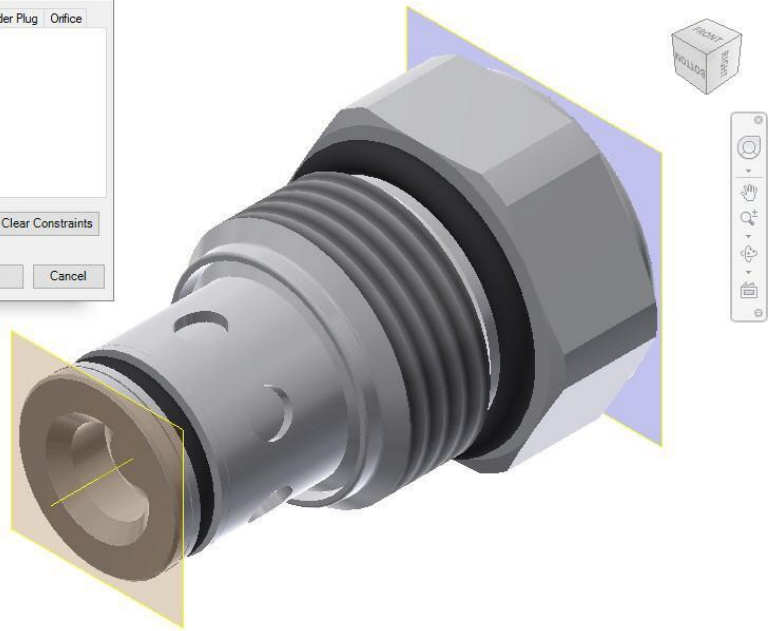
Set Assembly Constraints on all the part models to make them work with the Assembly Interface.
Parts with the assembly constraints get assembled on the manifold.
Open the part/assembly model of valve in Inventor.

MDTools 770 ribbon
> Assembly panel
> **Set Assembly Constraints**
The Set Constraints dialog box displays.



The Set Constraints dialog box contains the following tabs.

- Cartridge Valve
- Valve Pattern
- Expander Plug
- Orifice



Set Constraints dialog box: Cartridge Valve tab

1 Cartridge Valve tab

Set the assembly constraints for cartridge valves, port fittings, and plugs. For these components, you need to specify the three parameters, Top Face, Bottom Face, and Axis.

1. Create work planes for the top and bottom face.

Note

Work planes should be used to define the top and bottom face. Bottom work plane will mate with the spot face of the 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. 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 **Axis** button.
7. Select an axis passing through the valve body.
8. Click **Set Constraints** to set assembly constraints.

MDTools® sets all the assembly constraints and the dialog box closes.

Now, this part is ready for use with the Assembly Interface.

9. Save the model.

Note

Use this option to set the assembly constraints for solenoid coils and the lock nut/manual overrides on the screw-in cartridge solenoid valves.

2 Valve Pattern tab

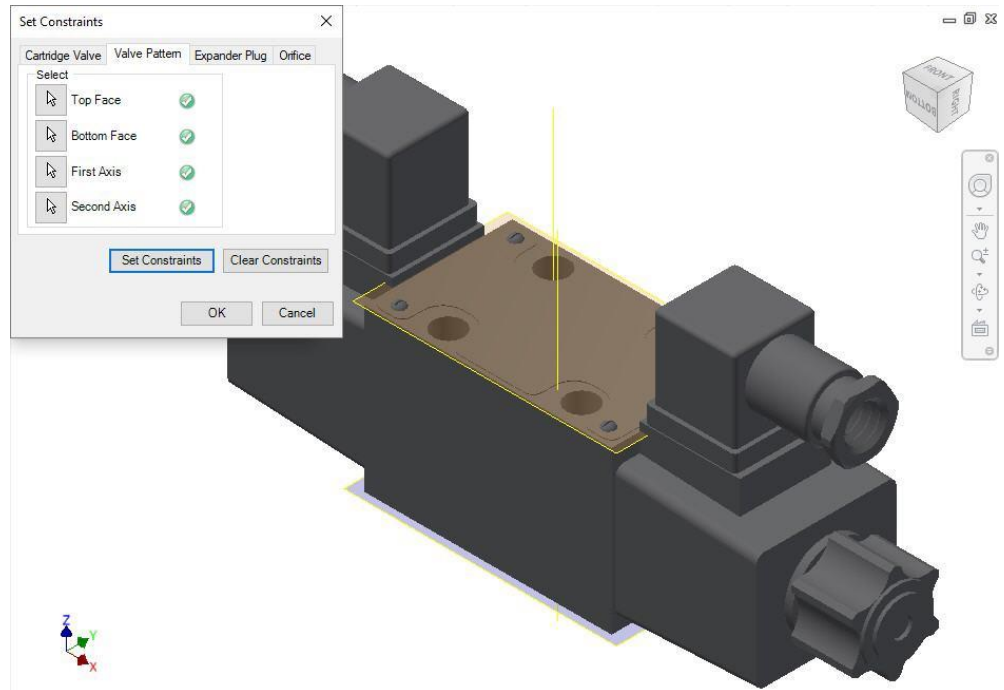
Set assembly constraints for surface mounted valves, slip-in-cartridge valves, or flanges. For these components, you need to specify the four parameters: Top Face, Bottom Face, First Axis, and Second Axis.

1. Create work planes for the top and bottom face.
2. Create the first axis. Create a work axis that passes through LP/LP1/BH1.
3. Create the second axis. Create a work axis that passes through LP2/BH2.
4. Select the **Top Face** button.
5. Select the top face work plane.
6. Select the **Bottom Face** button.
7. Select the bottom face work plane.
8. Select the **First Axis** button.
9. Select the axis passing through LP/LP1/BH1.
10. Select the **Second Axis** button.
11. Select the axis passing through LP2/BH2.
12. 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 the Assembly Interface.

13. Save the Part Model.
14. Click **OK**.



Set Constraints dialog box: Valve Pattern tab

Note

First Axis

- Create an axis that passes through the locating pin for valves with one locating pin.
- Create an axis that passes through the locating pin LP1 for valves with two locating pins.
- Create an axis that passes through the bolt hole BH1 for valves with no locating pin.

Second Axis

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

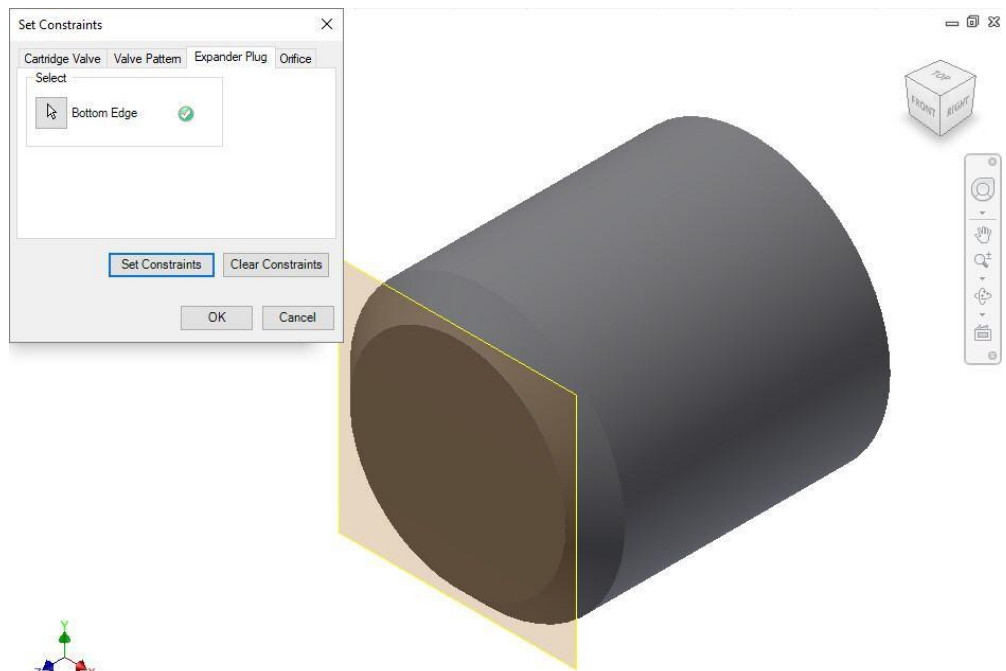
LP1 is a locating pinhole with the port application name LP1, and LP2 is a locating pinhole with the port application name LP2 on the footprint.

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

3 Expander Plug tab

If there is no spot face in the cavity (Step0 angle is not equal to 90), for example, in expander & NPT plug ports, then you must use the Expander Plug tab to set the assembly constraints. 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 Step0 of the cavity.
3. Click **Set Constraints** to set the assembly constraints.
4. Save the part model.



Set Constraints dialog box: Expander Plug tab

Clear Constraints

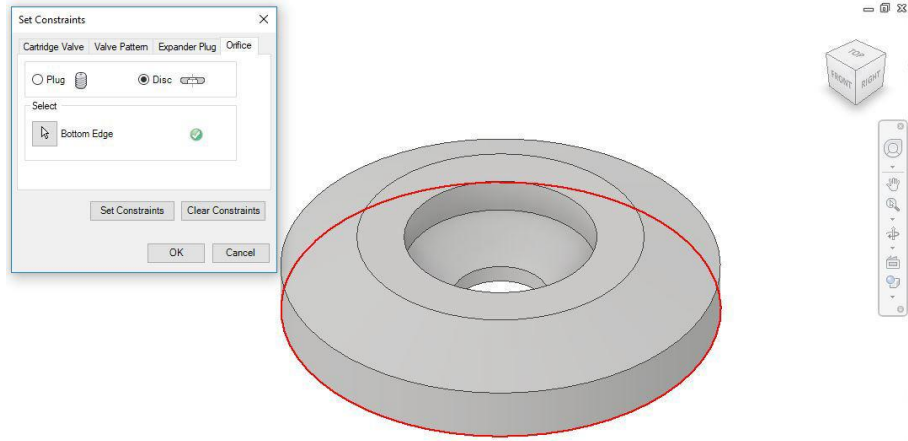
Click **Clear Constraints** to automatically delete the assembly constraints from the selected Part model.

4 Orifice tab

For Orifice Plug/Disc, 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. Click **Set Constraints** to set the assembly constraints.
4. Save the Part model.



Set Constraints dialog box: Orifice tab

Clear Constraints

Click **Clear Constraints** to automatically delete the assembly constraints from the selected Part model.

111. Update Assembly

MDTools automatically updates the assembly if the reference manifold of that assembly is modified.*

1. Click Local/Global update in the Inventor Part menu.

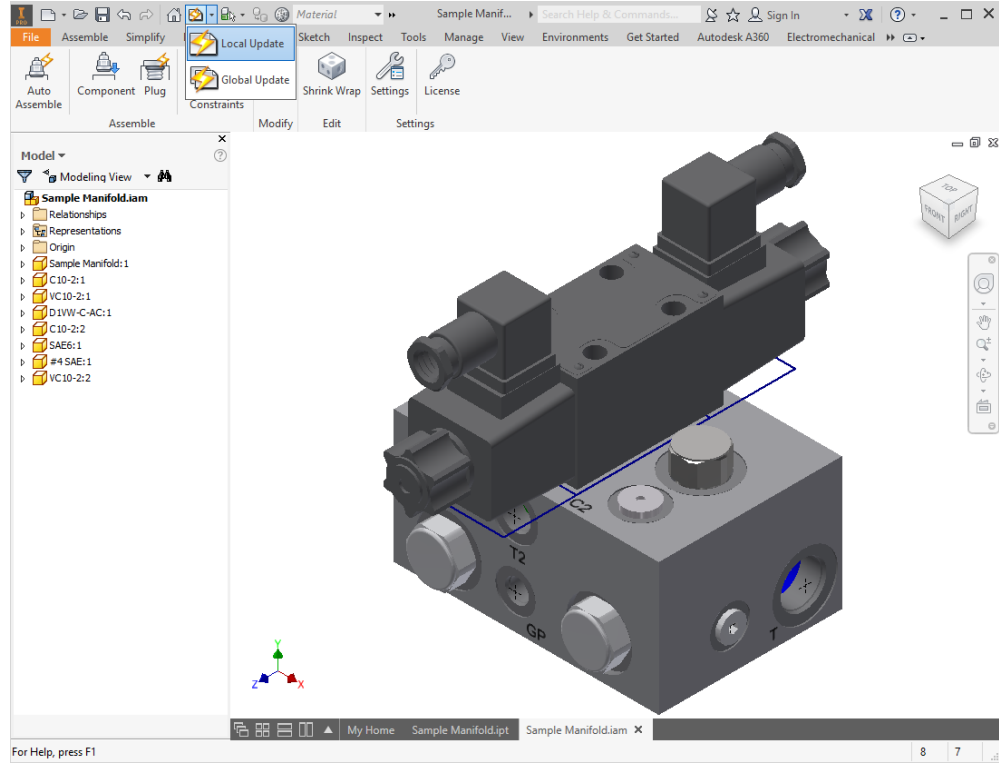
The Inventor Update Component dialog box displays.

2. Click **Accept**.
3. MDTools 770 ribbon > **Modify** panel > **Update**

MDTools automatically updates/resolves the assembly model.

Note

The Update option is enabled only if there is some modification in the part model. (For example, change face of cavities, swap cavities, delete cavities, suppress-unsuppressed cavities etc.)

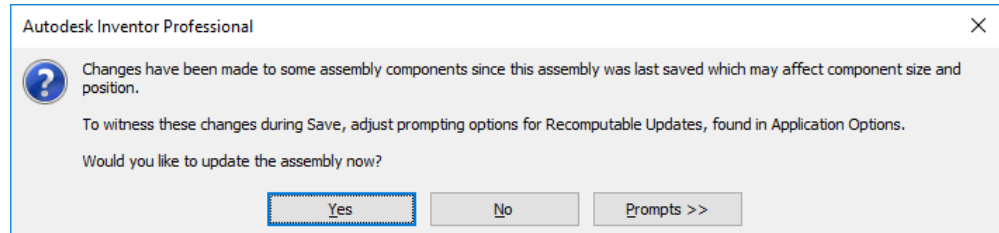


Local/Global Update options

Updated Existing Assembly

1. Open an existing assembly, where the reference manifold is modified.

Autodesk Inventor Professional message displays.

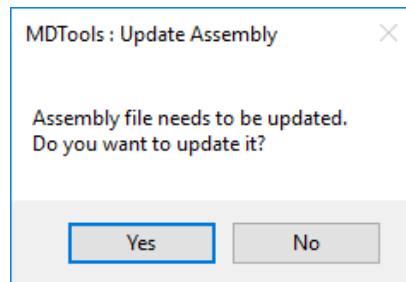


Message box

2. Click **Yes**.

The MDTools: Update Assembly dialog box displays.

3. Click **Yes** to update. *MDTools automatically updates/resolves the assembly model.*



MDTools: Update Assembly dialog box

112. Shrink Wrap

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

MDTools® preserves constraints of assembly.

1. MDTools 770 ribbon
>Edit panel
>Shrink Wrap
2. Click **Browse** and select the output path.

The Shrink-Wrap dialog box displays.

The default path is the assembly model path.

The output file is saved to the specified path.

3. Enter the file name of the shrink-wrapped model.

The Default file name is model name “_Shrink-Wrap”

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.

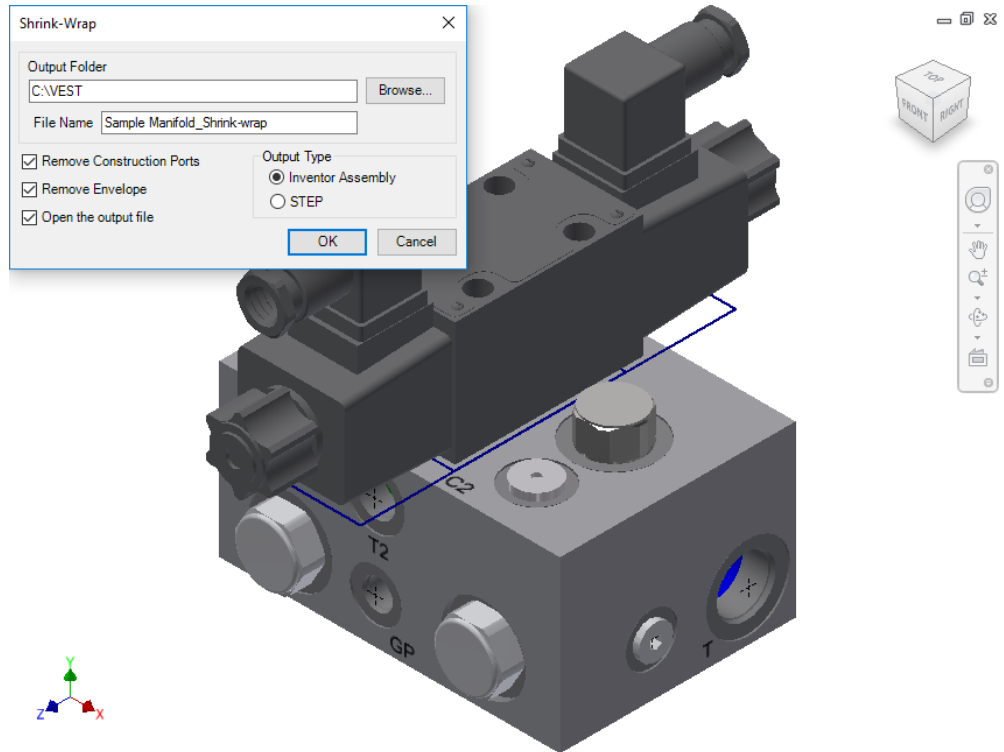
6. Select the Output type format you want to shrink-wrap the model.

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

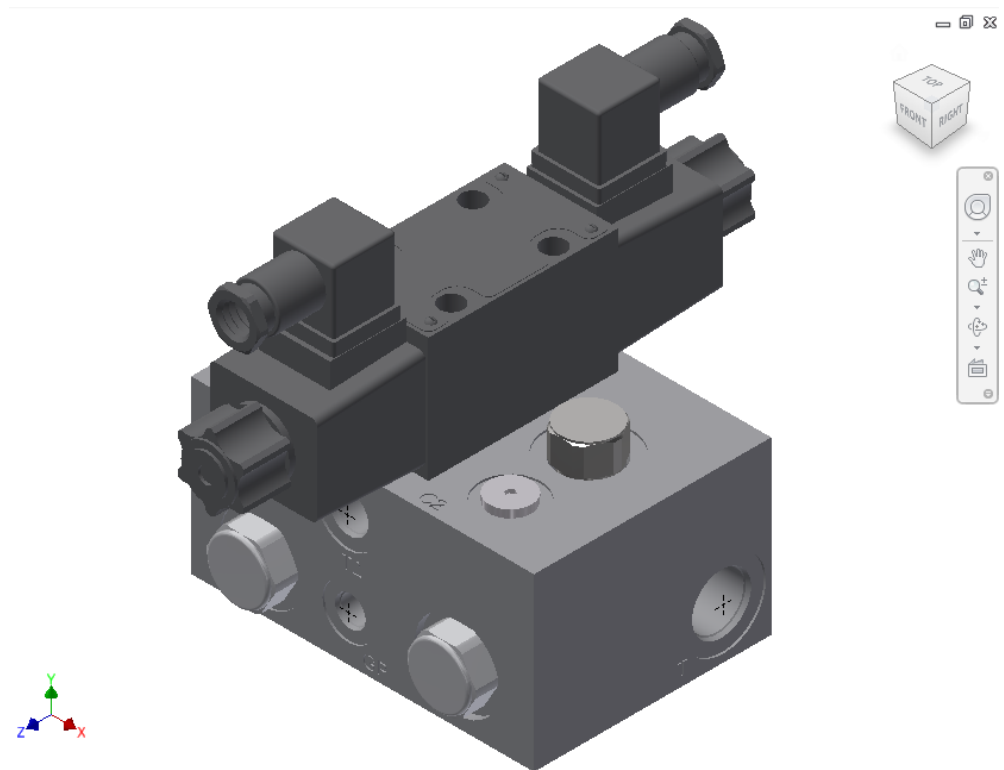
7. Select Open the output file.

8. Click **OK**.

MDTools automatically removes all the internal details.



Shrink-Wrap dialog box



Internal details removed automatically

113. MDTools Assembly Settings

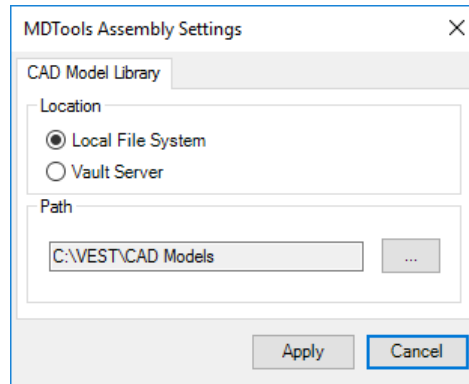
Use CAD Models stored in the Autodesk vault server while assembling MDTools designed manifolds. Configure assembly settings in the MDTools Assembly Settings dialog box.

MDTools 770 is compatible with Autodesk Vault 2018.

1. MDTools 770 ribbon
>Settings panel
>Settings

The MDTools Assembly Settings dialog box displays.

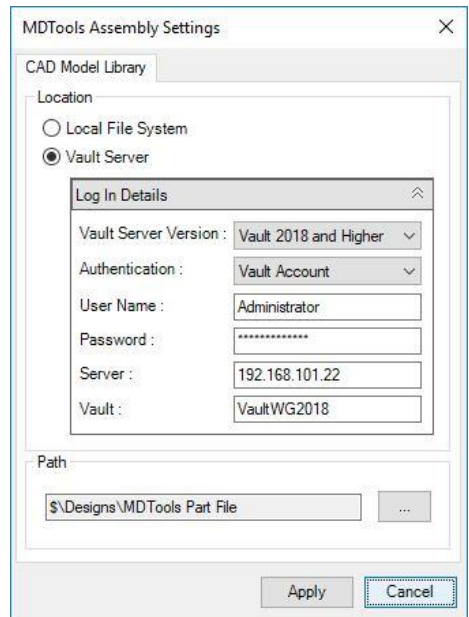
2. Select **Location** of the CAD Models folder.
 - **Local File System**
To use CAD files from the local system.
 - **Vault Server**
To use CAD files from the Vault Server, fill the vault log in detail in the Vault Server, Log In Details section.




MDTools Assembly Settings dialog box

Vault Server Log In Details:

3. Specify the **Vault Server Version** and login details in the Vault Server, Log In Details section.
 - Select **Vault Server Version** Vault 2018 and Higher for Autodesk Vault 2018 and higher version.
 - Select **Vault Server Version** Vault 2017 and lower for Autodesk Vault 2017, Autodesk Vault 2016 and Autodesk 2015.
MDTools remembers the login details for the current and the future Inventor sessions.
 - Change the Vault login details later, if required.



MDTools Assembly Settings: Vault Server – Log In Details

4. Click  to browse.
The Browse option, lists folders on the local machine or on the Vault server, based on the option selected in the Location section.
5. Select the CAD Models folder.
6. Click **Apply** to save the settings.

The selected CAD Model Library path in MDTools Settings will work as the CAD Model Library path for MDTools Assembly commands.

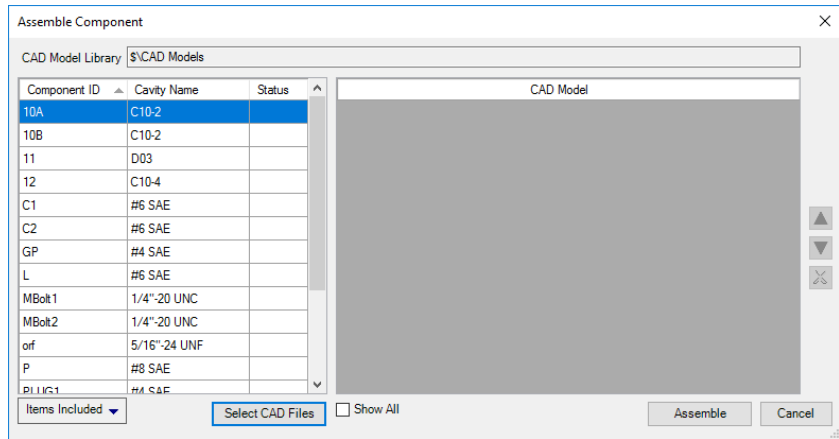
Note

The Apply option will not login to Vault Server.

MDTools logs into Vault Server, when you use any Assembly command (Auto Assemble, Assemble Plugs, Assemble Component and Browse option for CAD Model library path (In MDTools Assembly settings)) for the first time.

This connection terminates at the end of the Inventor session.

If CAD Model location option is selected as the Vault Server. Then, assign Plugs using the CAD Models location in the Vault Server, MDTools Library Manager.



Select CAD Model from Vault Server

114. MDTools License Option

Set the MDTools® license path from the MDTools Assembly ribbon.

1. MDTools 770 ribbon
> **Settings** panel
> **License Option**.

The MDTools License Option dialog box displays.

2. Enter the server name or the IP address of the system where the MDTools hardware lock is located.

This option is available only in the MDTools 770 Network license version.

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.

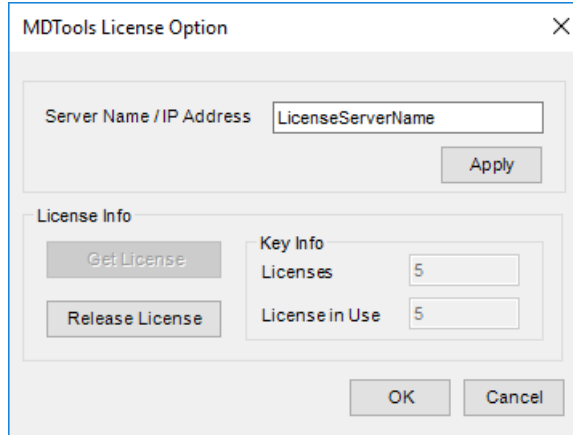
4. To release a license, click the **Release License** button.

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 License Option dialog box

APPENDIX

- 115 Energy Loss Considerations
- 116 Command Overview

115. Energy Loss Considerations

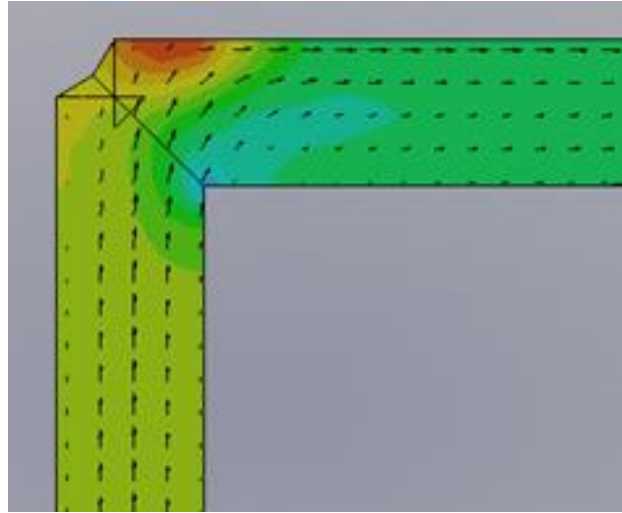
1 Bends in Drilled Circular Passages

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:

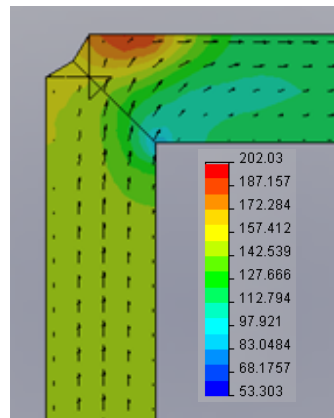


Fig 1a

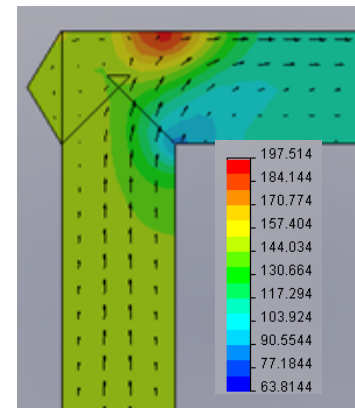


Fig 1b

Energy Drop
(psi)

a	MDTools* - "Connect to Cavity"	35
b	Outlet Extended	35
c	Inlet Extended	44
d	Both Extended	48

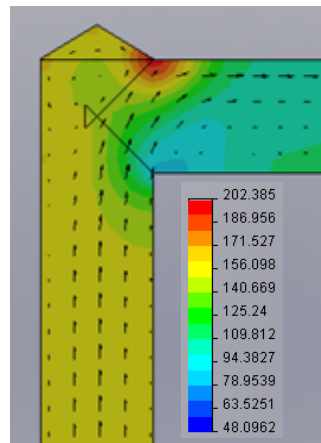


Fig 1c

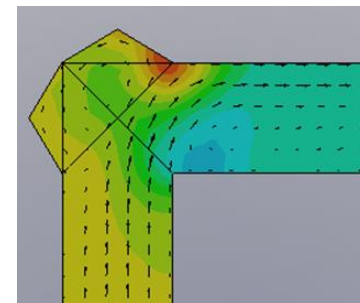


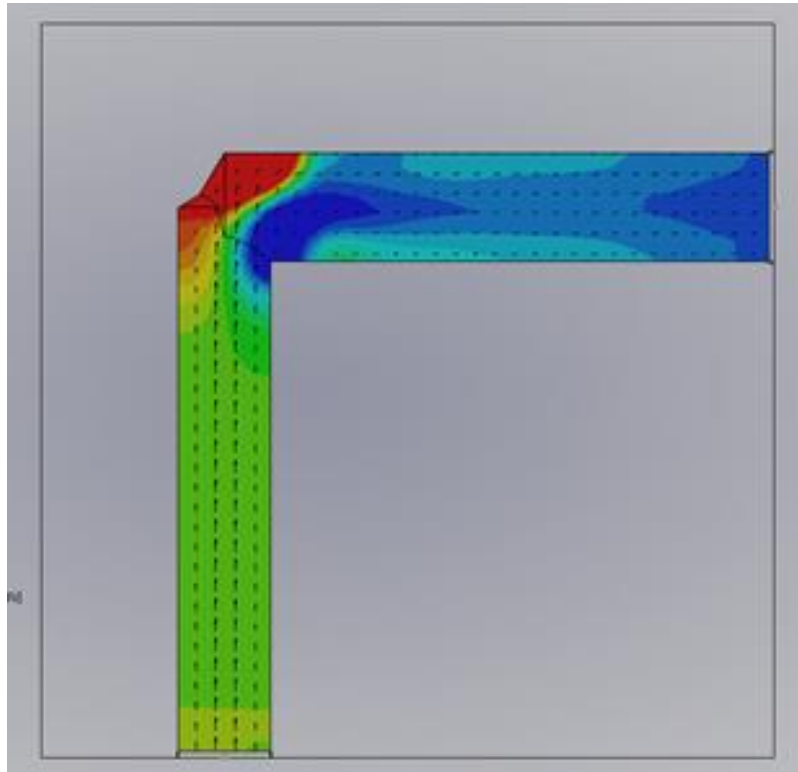
Fig 1d

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

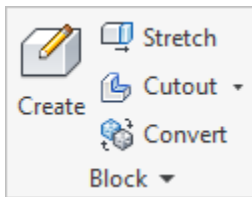
Pilot and Signal lines do not carry power and energy efficiency is of no concern. Diameters can be chosen based on geometry, stress, and manufacturability.

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.













116. Command Overview

Part Model Commands

Command Name	Function	Ch
--------------	----------	----




















1. Block Panel

 Create	Automatically draw the manifold block in Inventor based on: <ul style="list-style-type: none"> • Required manifold length, width, and height • Required material cross section from an existing material, a cross section database, and the corresponding length 	10 11
 Stretch	Stretch the block in the specified direction	12
 Cutout ▾		
 Cutout	Create a rectangular cutout on the block	13
 Chamfer	Create a chamfer on the block	14
 Convert	Convert a virtual cavity design into a feature-based manifold design and vice versa.	15
<div style="border: 1px solid blue; padding: 2px; display: inline-block;">Block ▾</div>		
 Shrink Wrap	Remove all the internal manifold design details and create a new “Shrink Wrap” block model without any internal connection detail.	16
 Export	Create the manifold data file in the XML format.	17
 Import	Read the input manifold data file in the XML format and create a new manifold in Inventor.	18
 Compare Manifolds	Compares two selected manifolds.	19

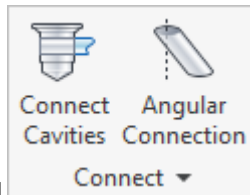




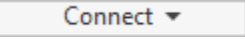

2. Insert Panel

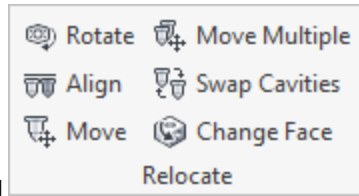
 Cavity ▾		
 Cavity	Insert a selected cavity/footprint from the standard cavity/footprint library. Precisely position the cavity with reference to either an edge of the block or an existing cavity maintaining minimum wall thickness with an existing cavity.	20
 From HyDraw	Read a HyDraw® created schematic drawing and insert all the required cavities with the connectivity information.	21
 X-Port	Insert construction port for Energy Efficient connections	23

Command Name	Function	Ch
 Copy ▾	▼	
 Copy	Create a copy of an existing cavity/footprint on the manifold. Connect the new cavity to either one or two existing cavities on the block. All the parameters including the connectivity information are copied to the new cavity.	24
 Copy Multiple	Copy multiple cavities/footprints simultaneously by specifying the displacement along their common axes.	26
 Offset Hole	Insert an offset drill hole into a cavity on the manifold.	27
 Orifice Plug	Insert an orifice plug cavity 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.	28
 Mounting Holes ▾	▼	
 Mounting Holes	Insert four mounting holes on a selected manifold face at a specified distance from the edges.	30
 Undercut	Insert an undercut into a cavity on the manifold.	31
 Slot	Create a slot in a cavity at the specified depth from the manifold surface. Increased flow requirements often require the use of slots within the cavities.	32
 O-ring Groove	Create an O-ring groove around a bore hole on a manifold surface. MDTools inserts an O-ring groove in a cavity according to the specification provided.	33
 Outline	Create the outline of a valve assembly around the selected cavities/footprints.	34
 Replace	Replace a cavity located on the manifold with any other cavity from the MDTools library. The new cavity is inserted at the location of the existing cavity.	35







3. Connect Panel

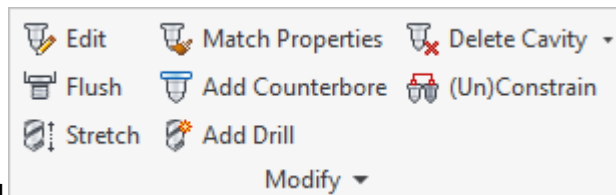


 Connect Cavities	Interactively create connections between cavities. If a connection is not possible without relocating the cavity, then MDTools automatically relocates the connecting cavity to the port center. In case of a bottom port, MDTools relocates the connecting cavity to the full diameter depth of the second cavity.	36
 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.	37
 Connect ▾	▼	
 Assign Net	Display the nets (flow paths) with different colors inside the manifold.	38


















4. Relocate Panel

 Rotate	Rotate the inserted footprint on the manifold surface. The footprint is rotated by the angle specified, about the center of the main cavity of the footprint.	39
 Align	Align Multiple cavities on the manifold. <ul style="list-style-type: none"> • Cavities on the same face are aligned on the coordinate with shortest distance. • Cavities on two perpendicular faces are aligned with reference to the common coordinate. 	40
 Move	Precisely move or relocate a cavity. Specify the X and Y values from the face origin. Enter the displacement values, which is ΔX and ΔY .	41
 Move Multiple	Move multiple cavities on the manifold simultaneously, by entering the displacement along their common coordinate. <ul style="list-style-type: none"> • Cavities on the same or opposite faces can be moved along two coordinates. • Cavities on perpendicular faces can be moved along a single coordinate. 	42
 Swap Cavities	Interchange the location of two cavities on a manifold. The two cavities replace each other.	43
 Change Face	Relocate the cavity/footprint from one face of a manifold to another manifold face. Connect the cavity with either one or two existing cavities on the block, when relocating the cavity.	44

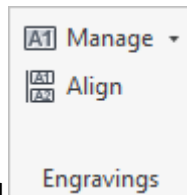







5. Modify Panel

 Edit	Edits cavity, undercut, slot and O-ring groove	45
 Flush	Flush the construction plugs below the manifold surface by increasing the spot face depth of the cavity. Flush a single selected cavity or all the cavities on a selected face.	46
 Stretch	Stretch the drill and change its depth by clicking and dragging the cavity to the required depth.	47
 Match Properties	Match the properties of two or more cavities. Match drill diameter, drill depth, drill tip angle, spot face/LS depth, cavity inclination (Alpha and Beta), net name, and cavity machining information.	48
 Add Counterbore	Add the counter bore to an existing cavity.	49
 Add Drill	Add a drill to an existing cavity. MDTools® adds the machining operation in a user-specified row in the machining sequence.	50
 Delete Cavity ▾	▼	

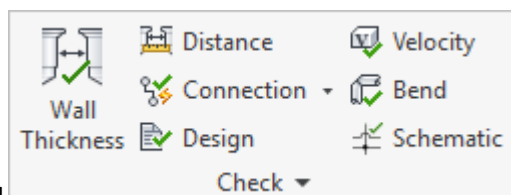
Command Name	Function	Ch
 Delete Cavity	Delete the complete cavity/footprint. All the features used to create the cavity/footprint in Inventor are automatically deleted.	51
 Delete O-ring Groove	Delete the selected O-ring grooves.	52
 Delete Outline	Delete the assembly outline around the selected cavities/footprints created using this command.	53
 (Un)Constrain	Constrain a cavity either to another cavity on a manifold or to a selected manifold edge. MDTools updates the location of a connecting hole when you relocate the main cavity. Unconstrain a cavity and relocate it independently.	54
		
 Suppress	Suppress a cavity/footprint or unsuppress a suppressed cavity/footprint. MDTools suppresses all the features used to create the cavity when you suppress a cavity.	55
 Minimize Depth	Ensure minimum drill travel in empty cavity space. Reduce the drill depth to a minimum and remove any extra drilling created during the layout process.	56
 Update Precision	Change the precision for cavity location, drill depth, and the angle value of angle holes.	57


6. Engravings Panel















 Manage		
 Manage		Create planer sketch text representing engraved text on the manifold surface. Automatically convert client graphics text (if they exist) to planer sketch text.
 Copy		Create multiple copies of existing engravings on the manifold at specified distance from the location of selected texts. Various properties of the selected texts also get copied.
 Align		Align two engravings on the manifold. <ul style="list-style-type: none"> Two engravings on the same face are aligned on the coordinate with shortest distance. Engravings on two perpendicular faces are aligned with reference to the common coordinate.

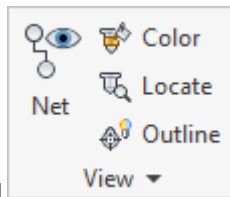
7. Check Panel












 Wall Thickness	Measure the wall thickness between two cavities. Measure the wall thickness between a cavity and a manifold surface.	61
--	---	----

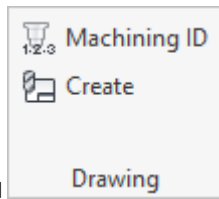
Command Name	Function	Ch
 Distance	Measure distance between two surfaces.	62
 Connection ▾	▼	
 Connection	Check connection errors in the block.	63
 Create Meet List	Create Meet List for manifold.	64
 Design	Perform connection and wall thickness checks and create a detailed design report.	65
 Velocity	Check velocity in connections in the block.	66
 Bend	Check quality of intersections for energy efficient bends.	67
 Schematic	Check Conformance of design to the HyDraw® schematic.	68
		
 Manufacturing	Check the manifold design for manufacturing and tooling limitations. Check the manifold for angle holes, compound angle holes, non-standard drills, non-standard spot faces, and drills with slenderness ratio more than a specified value.	69
 Connection Offset	Check the design to recommend offset connections.	70
 Pressure Rating	Check pressure ratings of construction ports	71

8. View Panel





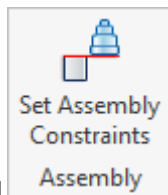
 Net	Locate a position or an area on a selected manifold face, where a cavity can be placed to connect with a selected net. MDTools® displays the cavities/ports in the selected net in green and all other cavities/ports in the dead area color.	72
 Color	Shade or update the shading of cavities on the manifold.	73
 Locate	Locate cavities on the manifold.	74
 Outline	Toggle the visibility of component assembly outlines and footprint outlines on the manifold.	75
		
 Cavity ID	Display the cavity ID at the center of the cavity. Easily identify the cavity on the manifold. Display or hide cavity IDs of cavities on selected faces or the cavity ID of a selected cavity.	76
 Net Display	Display the nets (flow paths) with different colors. Visually check the connections inside the manifold. Change the color and the visibility of nets inside the manifold.	77
 Cavity Center	Change the visibility of cavity center points. MDTools hides or shows all the cavity center points. The visibility of a cavity center point is controlled by the visibility of the sketch containing the cavity center point	78

Command Name	Function	Ch
 Remove Color	Remove the shading of cavities on the manifold.	79




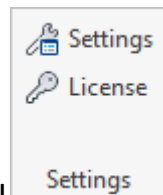
9. Drawing Panel

 Machining ID	Generate Machining ID for all cavities in the specified format.	80
 Create	Create 2D Machining drawing of the block.	81





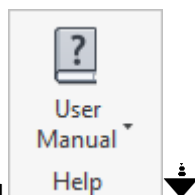
10. Assembly Panel

 Set Assembly Constraints	Set assembly constraints to a component model.	82
--	--	----




11. Settings Panel

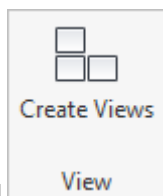
 Settings	Define various settings for MDTools® such as net color, units, and library path. Share the library with all designers in your organization so that all use the same data. Easily manage changes in standards or libraries within your organization.	83
 License	Set the license server path for MDTools770. Check for the license and select license from the specified license path.	84
























12. Help Panel



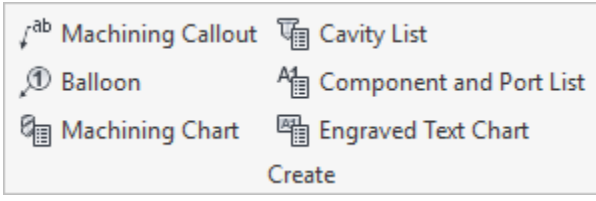






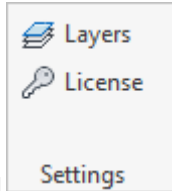


 User Manual	MDTools User Manual.	85
 About MDTools	About MDTools.	86

Drawing Commands

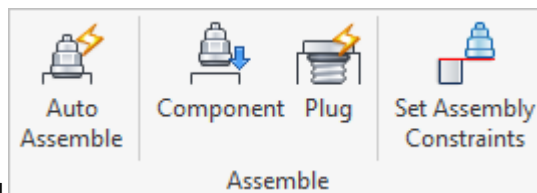



1. View panel






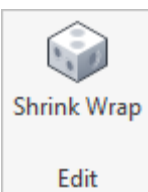

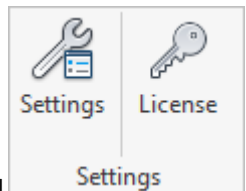


Command Name	Function	Ch
 Create Views	Create 2D views of the manifold.	87
<div style="border: 1px solid gray; padding: 5px; width: fit-content; margin: 10px auto;">  Show  Hide Internal Details </div>		
2. Internal Details panel		
 Show	Show internal details of the manifold.	88
 Hide	Hide internal details of the manifold.	89
<div style="border: 1px solid gray; padding: 5px; width: fit-content; margin: 10px auto;">  Auto Dimension Dimension </div>		
3. Dimension panel		
 Auto Dimension	Dimension all the cavity locations on all six views of the manifold in the 2D machining drawing.	90
<div style="border: 1px solid gray; padding: 5px; width: fit-content; margin: 10px auto;">  Machining ID  Footprint  Engraved Text  Component ID  Angle Hole  Undercut  Construction Port  Origin & Axis Display </div>		
4. Display panel		
 Machining ID	Display the cavity machining ID near cavities in the 2D drawing views.	91
 Component ID	Display the component ID near cavities in the 2D drawing views.	92
 Construction Port	Mark construction ports on each view in the 2D drawing views.	93
 Footprint	Display the port names and footprint outlines in the 2D drawing views.	94
 Angle Hole	Display angular holes with an option to show direction.	95
 Origin & Axis	Display the face origin and X/Y direction of each face in the 2D drawing.	96

Command Name	Function	Ch
 Engraved Text	Display the engravings near the cavities in the 2D drawing views. Engraving is displayed at the specified locations, when you create the engraved text in the part model using this command.	97
 UnderCut	Display the top view of undercuts as circle in 2D drawing.	98
<div style="border: 1px solid gray; padding: 5px; margin: 10px 0;">  <p>5. Create panel</p> </div>		
 Machining Callout	Extract the machining data from all the manifold cavities and create the machining chart.	99
 Balloon	Create leader-type cavity machining callout for all cavities in the 2D drawing. Extract the cavity machining detail from all cavities and insert with the leader on the cavities.	100
 Machining Chart	Create balloons around the cavity machining ID for all cavities in the 2D drawing.	101
 Cavity List	Insert a Cavity table consisting of cavity/footprint name and quantity into the 2D drawing.	102
 Component and Port List	Insert a components and ports table consisting of the component ID, cavity name, and face name into the 2D drawing.	103
 Engraved Text Chart	Insert an engravings chart consisting of text, text location, font style, and text height.	104
<div style="border: 1px solid gray; padding: 5px; margin: 10px 0;">  <p>6. Setting panel</p> </div>		
 Layers	Set drawing layers for MDTools® objects.	105
 License	Set the license server path for MDTools770. Check the license and select license from the specified license path.	106

Assembly Commands

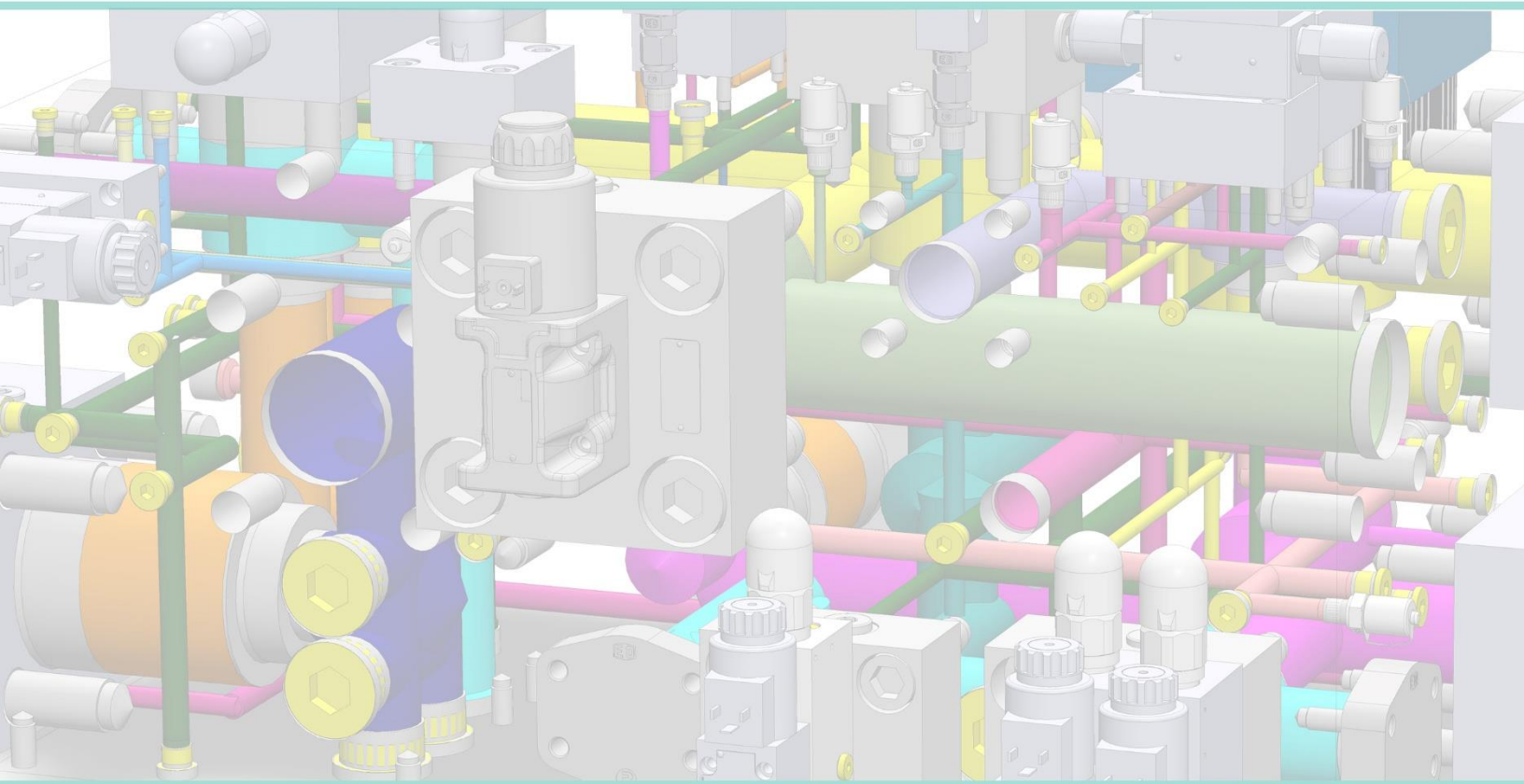


Command Name	Function	Ch
 Auto Assemble	Automatically assembles components and construction plugs.	107

Command Name	Function	Ch
 Component	Assemble all the components on the manifold. MDTools® creates all the required constraints and assembles the components at the correct location.	108
 Plug	Assemble plugs onto all the construction (X-drill) ports on the manifold. Create all the required constraints and assemble the plugs at the correct location. Specify cavity and plug file path location using MDTools Library Manager.	109
 Set Assembly Constraints	Set assembly constraints for a component model.	110
<div style="text-align: center;">  <p>2. Modify panel</p> </div>		
 Update	MDTools® automatically updates the assembly, if the reference manifold of that assembly is modified.	111
<div style="text-align: center;">  <p>3. Edit panel</p> </div>		
 Shrink Wrap	Remove all the internal design details of manifold and create a new “Shrink Wrap” block model without any internal connection details.	112
<div style="text-align: center;">  <p>4. Settings panel</p> </div>		
 Settings	Displays MDTools Assembly settings dialog box to configure Assembly settings.	113
 License	Set the license server path for MDTools770. Check the license and select license from the specified license path.	114

- About MDTools, 214
- Add Counter Bore, 133
- Add Drill, 134
- Add New Material, 36
- Add New X-Section, 37
- Align Cavity, 101
- Align Engravings, 149, 150
- Angle Holes, 29
- Angular Connection, 96
- Annotations, 193
- Assemble Component, 251
- Assemble panel, 272
- Assembly Commands, 12, 272
- Assembly Plugs, 254
- Assign Net, 98
- Auto Assembly, 250
- Auto Dimension, 220
- Block Commands, 32
- Bolt Holes, 22, 27
- Cartridge Valve Cavities, 21
- Cartridge Valve Cavity, 27
- Cartridge Valve Insert, 124
- Cartridge valve side port connection, 158
- Cartridge Valve tab, 200
- Cartridge Valve tab), 255
- Cavities Browser, 20
- Cavity Browser Context Menu, 14, 15
- Cavity Naming Format, 237
- Center Offset, 239
- Change Color, 181
- Change Face, 111
- Change Material Name, 36
- Change Slot Face with Parent Cavity, 117
- Change X-Section Dimensions, 37
- Check Bend, 167
- Check Conformance to Schematic, 168
- Check Connection for Offset, 171
- Check Pressure Rating, 173
- Check Velocity in Block, 166
- Color Cavities, 176
- Column Alignment, 236
- Command Overview, 265
- Compare Manifold, 53
- Configure Cavity List, 194
- Configure Components and Ports List, 196
- Configure Engraved Text Chart, 196
- Configure Machining Chart, 195
- Configure Machining ID, 194
- Connect Cavities, 93
- Connect Slot to existing cavity, 78, 118
- Connecting to existing cavities, 61, 74
- Connecting two existing cavities), 114
- Connection Check, 155
- Connectivity Net List, 24
- Constrain/Unconstrain Cavities, 138
- Constraining Cavities to a Manifold Edge, 138
- Convert Block, 47
- Copy Cavity, 71
- Copy Engravings, 148
- Copy Multiple, 79
- Copy Slot, 76
- Create Balloon, 233
- Create Block, 33
- Create Cavity List, 244
- Create Chamfer, 45
- Create Components and Ports List, 245
- Create Cutout, 43
- Create Engraved Text Chart, 246
- Create Machining Callout, 229
- Create Machining Chart, 234
- Create Machining Drawing, 190
- Create Machining Settings, 190
- Create Meet List, 157
- Create Views, 216
- Creating a Net List from a Schematic, 25
- Creating Connections between Cavities, 68
- Creating Material X-Section Library, 36
- Default Color, 205
- Default Net Properties, 205, 206
- Delete Cavity, 135
- Delete Chamfer, 46
- Delete Cutout, 44
- Delete Engravings, 147
- Delete Material, 36
- Delete O-ring Groove, 136
- Delete Outline, 137
- Delete X-Section, 37
- Depth, 239
- Design Check, 160
- Design Check Basics, 26
- Design Net List, 24
- Dimensioning Options, 193
- Draw Block - Dimensions entered manually, 33
- Draw Block - using Material X-Section Libraries, 35
- Drawing Commands, 12
- Drawing Layers, 247
- Drawing View Options, 192
- Drill holes, 22
- Drill Holes, 27
- Edge Offset, 239
- Edit, 120
- Edit All Parameters, 123
- Edit Cavity, 120
- Edit Cavity dialog box, 121
- Edit Machining Chart, 235
- Edit O-ring Groove, 129
- Edit Slot, 128
- Edit UnderCut, 126
- End Depth, 239
- End Dia, 238
- Energy Efficiency, 206
- Energy Loss Considerations, 263
- Expander Plug tab, 202, 257
- Export Block Design, 49
- Export Settings, 8
- Face, 240
- Face Alignment - Opposite, 149
- Face Alignment - Perpendicular, 149
- Face Alignment - Same, 149
- Face Origin, 197
- Find X-Sections, 41
- Flush X-drill Plugs, 130
- Footprints, 23
- Generate Cavity Machining ID, 186
- Hide Internal Details, 219
- Import and Export Settings, 8
- Import Block Design, 50
- Import Settings, 9
- Insert Cavities (...from HyDraw Schematic), 64
- Insert Cavities in Non-Rectangular Manifold Block, 66
- Insert Cavity (...from Library), 56
- Insert Cavity/Footprint, 56
- Insert Construction Port, 69
- Insert Mounting Holes, 84

- Insert Offset Hole, 80
- Insert Orifice Plug, 81
- Insert O-ringGroove, 89
- Insert Undercut, 85
- Inserting Cavities, 66
- InsertOutline, 90
- InsertSlot, 87
- Install MDTools 770, 5
- Install MDTools Library Manager, 5
- Install MDTools Network License Setup, 4
- Installation, 4
- Internal Details panel, 271, 272
- Internet Settings, 208
- Introduction, 1
- Item Range, 240
- Keep Existing Machining ID, 189
- Library & Units, 204
- License Option in Inventor MDTools Ribbon Menu, 7
- License Option in Inventor Part Model Menu, 211
- License Option in Program Menu, 6
- Locate Cavity, 177
- Locating Pin Holes, 22, 28
- Location Precision, 236
- Machining Callout Setting, 196, 231
- Manage Engravings, 145
- Manifold Quote, 51, 53
- Manufacturing and Tooling Check, 169
- Match Properties, 132
- MDTools Assembly Settings, 260
- MDTools Browser Bar, 13
- MDTools Browser Bar in Browser Pane, 13
- MDTools Cavities, 21
- MDTools Cavity, 26
- MDTools Cavity Browser, 14
- MDTools License Option, 261
- MDTools License Options, 248
- MDTools Nets Browser, 17
- MDTools Part Model Context Menu, 16
- MDTools Settings, 204
- MDTools Workspace, 11
- Meet List, 24
- Meet List Format, 237
- Merge with Cavity, 82
- Minimize Depth, 142
- Miscellaneous, 209
- Modeling Cavities, 21, 26
- Modify All Engravings, 146
- Modify Block, 38
- Modify Block Size, 39
- Modify Engravings, 146
- Move a Cavity by Dragging Move Handle, 106
- Move a Cavity on a Non-Rectangular Manifold, 107
- Move a Slot inside the cavity, 108
- Move Cavity, 102
- Move Connecting Cavities, 105
- Move Multiple, 109
- Net Color, 205
- Net Color Display, 205
- Net Display, 180
- Net List, 24
- Nets (Flow Paths), 24
- Nets Browser, 20
- Nets Browser Context Menu, 17
- Number of Decimal Places, 232
- Offset holes and angle drills, 158
- O-ring in Cavity Profile, 58
- Part Model Commands, 12
- Ports, 22, 26
- Position the Cavity, 94
- Position the cavity with reference to an edge or a cavity, 59, 72
- Position with minimum wall thickness, 62, 75, 116
- Position with minimum wall thickness), 95
- Preferred Cavities, 207
- Remove Color, 184
- Replace and Replace All Cavity, 91
- Repositioning of Cavities, 67
- Rotate Footprint, 60, 73, 113
- Rotate Footprint/Cavity, 100
- Rotating Outline, 90
- Same component for multiple cavities, 253
- Saving Machining Chart Formats, 242
- Schematic Interface, 19
- Select Cavity Naming Scheme, 186
- Selected Order, 231, 235
- Selecting drill diameter, 122
- Selecting spot face diameter, 122
- Set Assembly Constraints, 200, 255
- Set License Server Path, 6
- Show Angle Holes, 225
- Show Component ID, 222
- Show Construction Port, 223
- Show Engraved Text, 227
- Show Footprint, 224
- Show Internal Details, 218
- Show Machining ID, 221
- Show Origin & Axes, 226
- Show Undercuts, 228
- Show/Hide Cavity Center, 182
- Show/Hide Cavity ID, 179
- Show/Hide Center Point Manually, 183
- Show/Hide Outline, 178
- Shrink Wrap, 259
- Shrink-wrap manifold, 48
- Sink Orifice Plug, 125
- Software Installation, 4
- Start Depth, 238
- Start Dia, 238
- Stored Formats, 240
- Stretch Block, 42
- Stretch Drill, 131
- Study Guidelines, 3
- support, 3
- Suppress a single cavity in a footprint, 141
- Suppress/Unsuppress Cavities, 140
- Swap Cavities, 110
- System Requirements, 4
- Text Height, 232, 236
- Thread eating of ports, 159
- Unconstraining Cavities, 139
- UnderCut in Cavity Profile, 58
- Unsuppress a single cavity in a footprint, 141
- Update Assembly, 258
- Update Connecting Cavities, 104
- Update Precision, 143
- Updating Block Dimensions, 41
- User Manual, 213
- Using Saved Format, 243
- Valve Pattern tab, 201, 256
- View a Net, 175
- View panel, 271
- Virtual Cavity Selection, 210
- Wall Thickness - Measure Distance, 154
- Wall Thickness Check, 152
- Welcome to MDTools 770, 2
- X-Ports, 207



cover image courtesy of Brescia Hydropower



VEST, Inc.
3250 W Big Beaver Rd #440
Troy, MI 48084 USA

 01 (248) 649 9550

 sales@VESTusa.com

 VESTusa.com

© 2018, VEST, Inc. All rights reserved.