

# MDTools® 760

## User Manual



# **MDTools<sup>®</sup> 760**

manifold design software

**Do more...**

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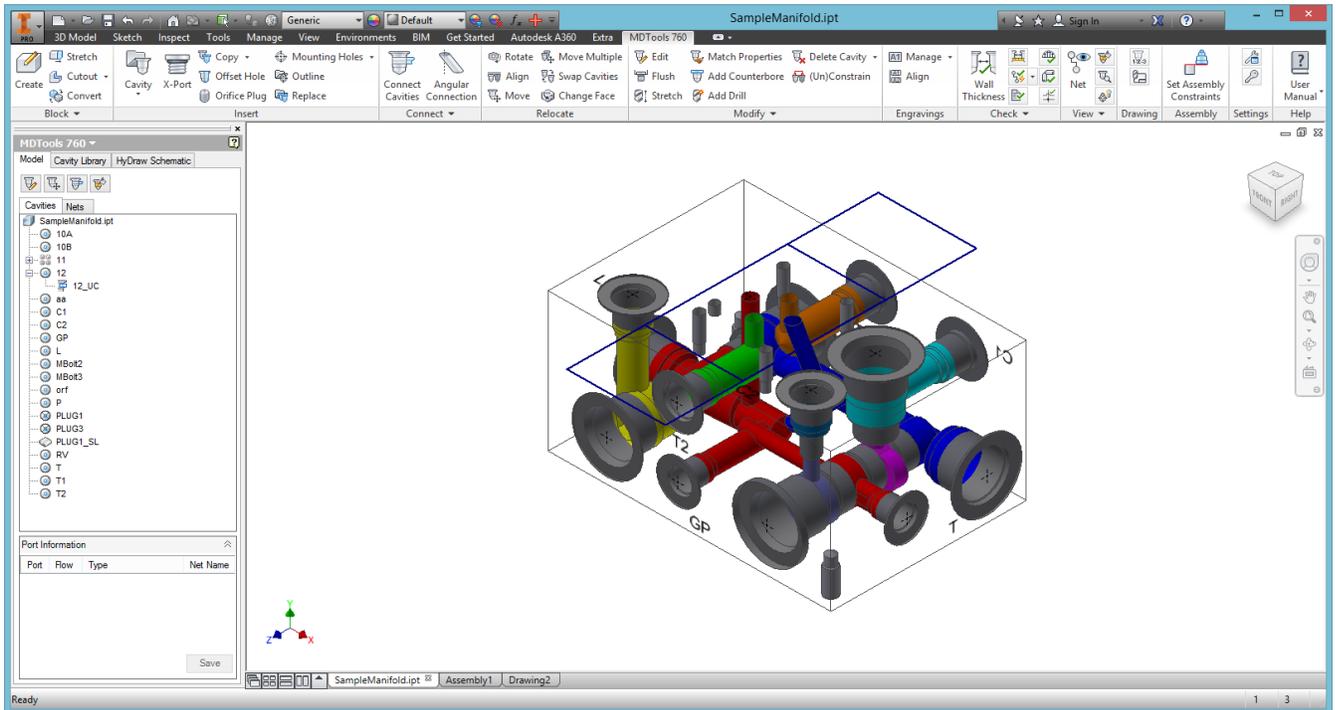
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# 1. Introduction



## VISUALIZES

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

## DESIGNS

- 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
- Holes cutting outside the port area of cartridge valve cavities
- Manufacturability
- 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
- MDTTools® 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® 760

**MDTools® 760**, the 3D manifold design software, provides power tools to automate the manifold design, checking, documentation, and modeling process within the **Autodesk Inventor** environment.

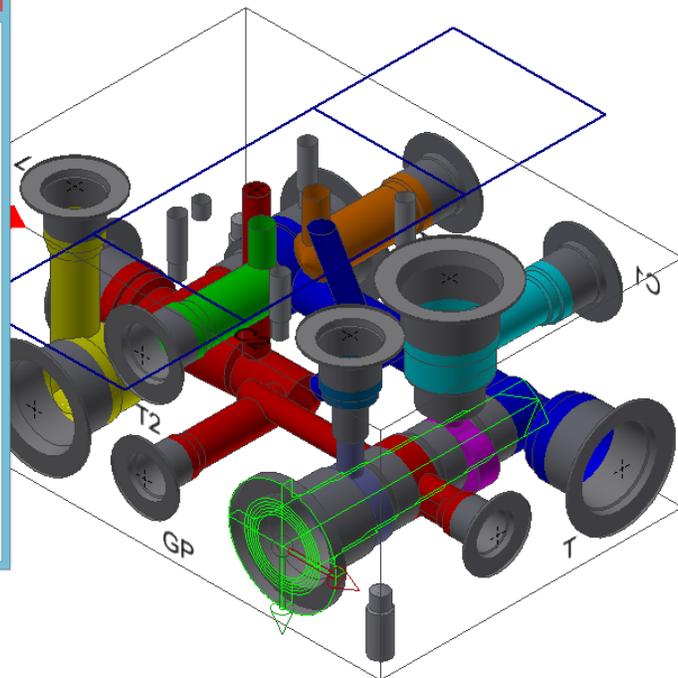
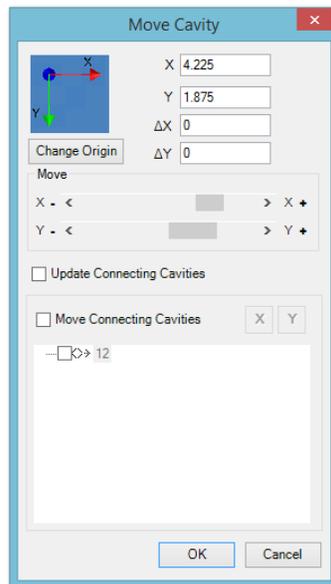
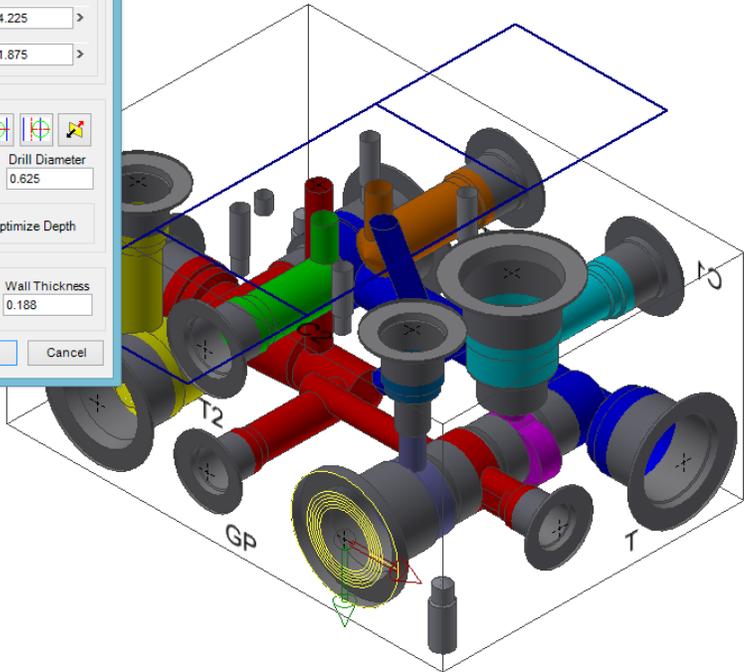
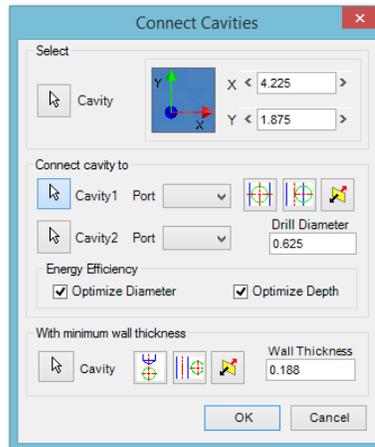
As a designer of hydraulic manifold blocks using both cartridge and interface valves, you will find MDTools 760 an invaluable tool enabling you to be more productive.

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

MDTools 760 provides efficient design tools to reduce your design time. Use the powerful Connect to Cavity 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

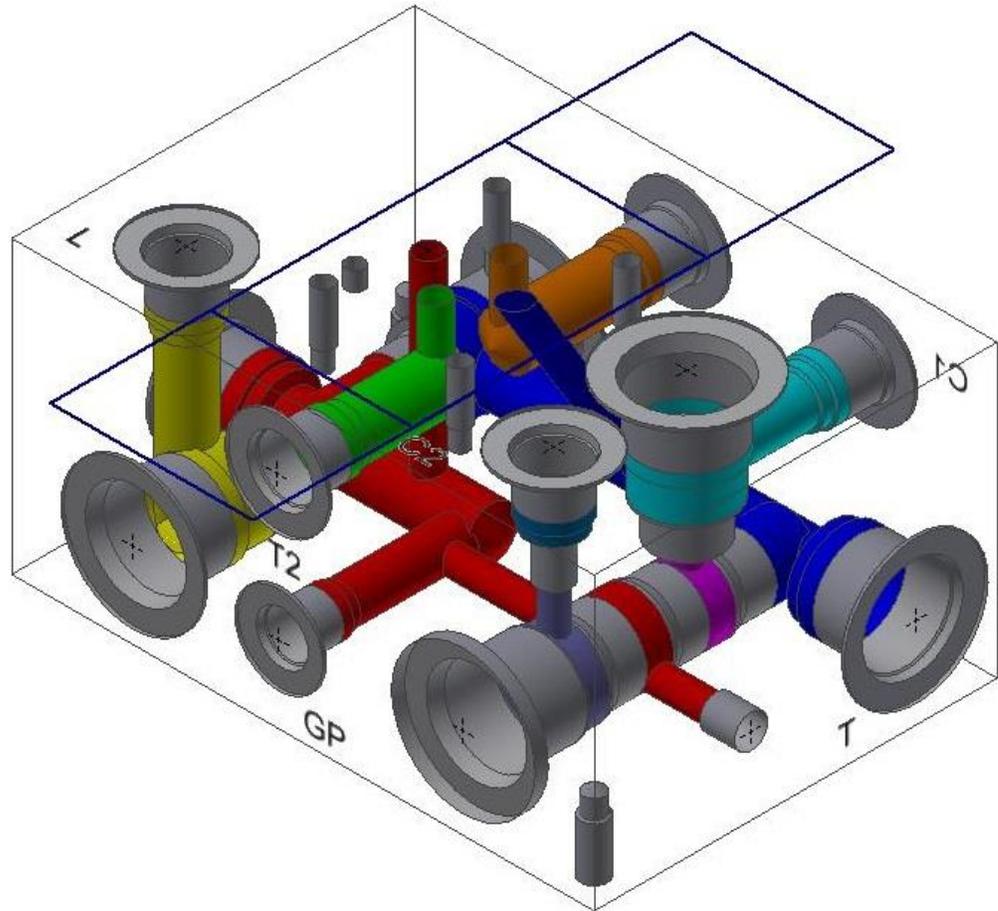
The **MDTools® 760 User Manual** provides comprehensive information on the features, commands, usage, processes, and design methodology of MDTools 760.

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 can be used as a comprehensive reference to the command set and usage of MDTools 760.

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 760, email us at [support@VESTusa.com](mailto:support@VESTusa.com).

Please include the following:

- Version Number of the software you are using

*To see the version of MDTools on your machine,*

> Click MDTools 760

> 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® 760 using its installation program. The installer creates all the required directories and installs MDTools 760 on your system.

### 2.1 System Requirements

- Intel Core i5 Processor 2.4 GHz.
- 8 GB RAM.
- Microsoft: Windows 7/Windows 8 (64 bit).
- Access Database Engine x64\*, automatically installed by MDTools Installation.
- Autodesk Inventor 2015/2016 (64 bit).
- Other system requirements, per Autodesk Inventor version used.

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

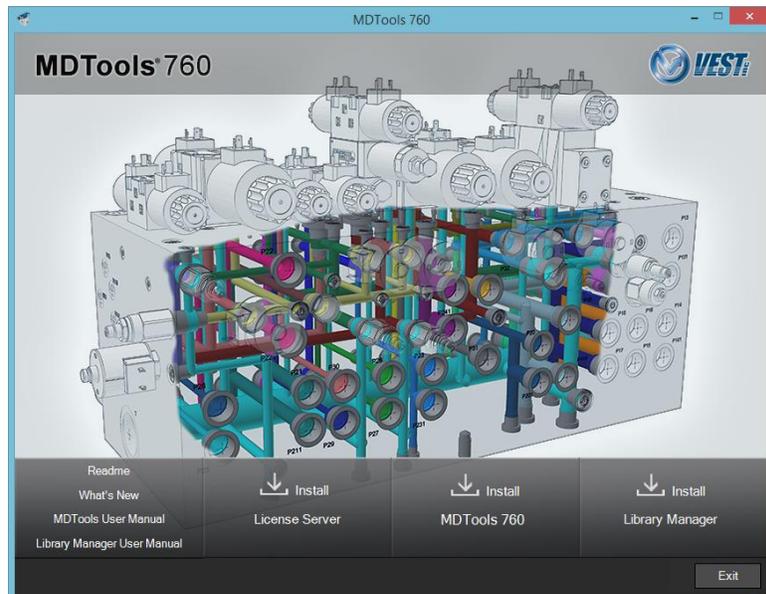
### 2.2 Software Installation

1. Insert the MDTools 760 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 760 startup screen displays.



MDTools 760 CD startup screen

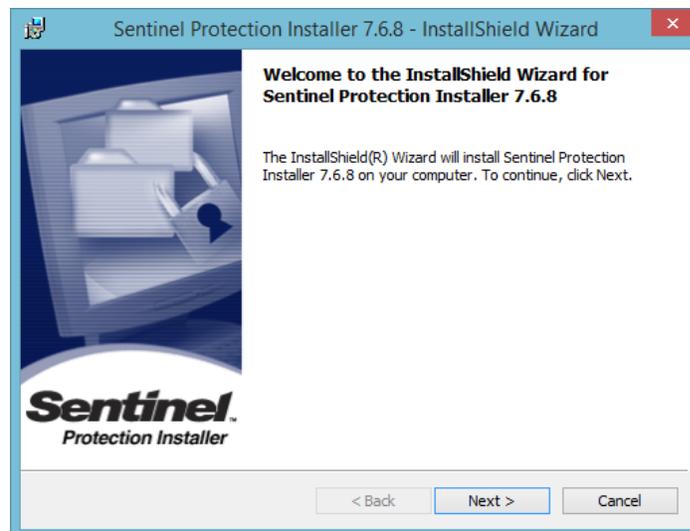
### 1 Install MDTools License Server Setup

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

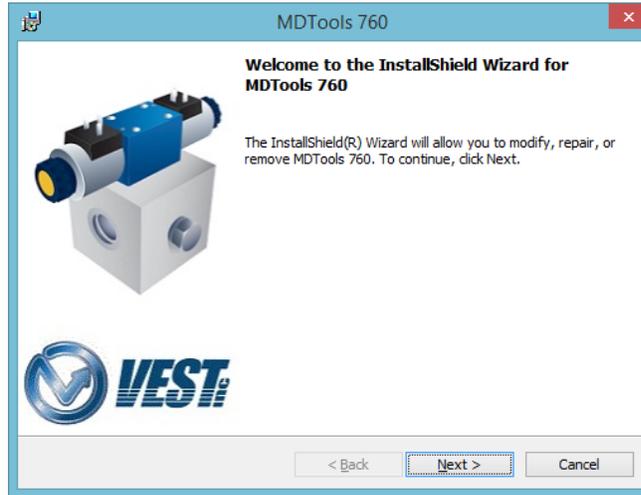
If you use the MDTools **Network License**, then install this program on the system with the hardware lock.



Hardware Lock Manager– InstallShield Wizard

## 2 Install MDTools 760

1. Click **Install MDTools 760**.  
*The MDTools® 760 InstallShield Wizard dialog box displays.*
2. Respond to all the setup program prompts.  
*MDTools 760 is installed on your system.*  
*The installation program automatically creates the required directories in the system.*



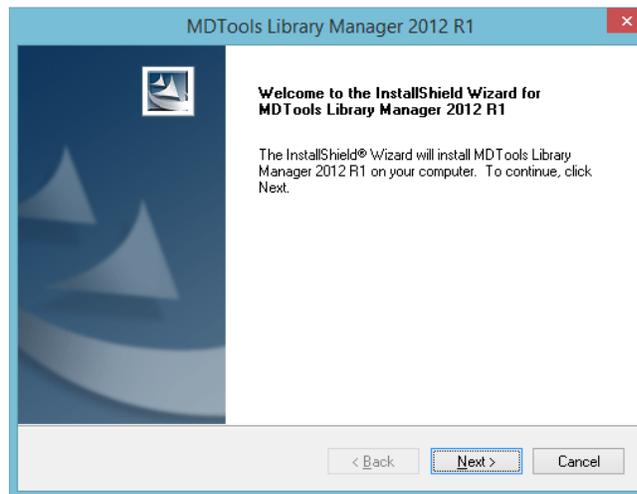
*MDTools 760 InstallShield Wizard*

## 3 Install MDTools Library Manager

1. Click **Install Library Manager**.  
*The MDTools Library Manager 2012 R1 – Install Shield Wizard dialog box displays.*
2. Respond to all the setup program prompts.  
*The MDTools Library Manager 2012 R1 program is installed on your system.*

### Note

- Install the MDTools Library Manager 2012 R1 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 2012 R1 (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® 760, 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.

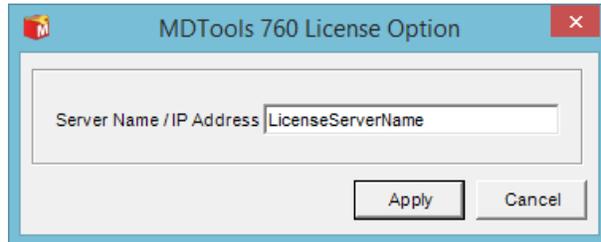
It will then work in the evaluation mode (cavity limit 10).

### License Option in Program Menu

Set the license server through the Program menu.

1. Start
  - > All Programs
  - > VEST
  - > MDTools 760
  - > **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 760 License Option dialog box

### Note

- This option is available only in the MDTools 760 Network License version.
- The MDTools 760 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 760 > **Settings** pane  
>**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 760 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.*

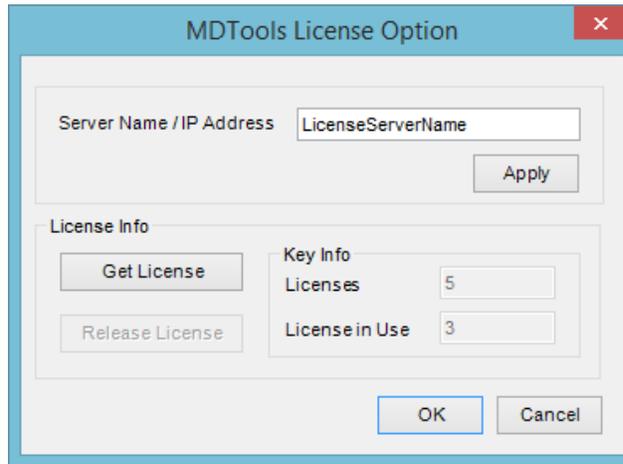
4. To release a license, click the **Release License** button.

*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*

# 3. Import and Export Settings

Export your MDTools® custom settings from MDTools 745/750/755/760 and import to MDTools 760 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 Programs
- > VEST
- > MDTools 760

> **Import and Export Settings**

The *Import and Export MDTools Settings* dialog box displays

## Export Settings

Export MDTools Settings to an XML file.

1. Select the **Export Settings** option from *Import and Export MDTools Settings* dialog box.
2. Click **Next**.  
*The MDTools 760 Export Settings dialog box displays.*
3. Select the required option from **Export from**.
4. Select the required option from, **Export Settings for**.

**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.

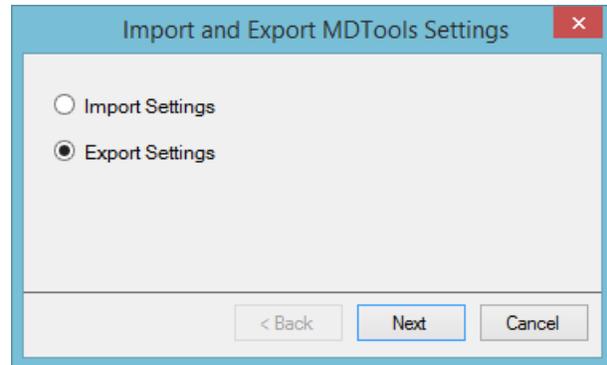
**Machining Callout:**

Exports Machining Callout settings.

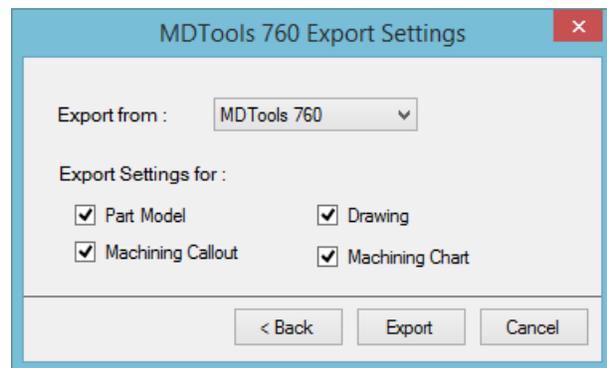
**Machining Chart:**

Exports Machining Chart settings.

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



*Import and Export MDTools Settings*

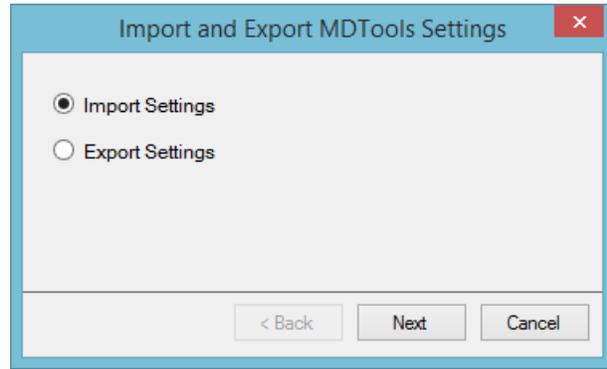


*MDTools 760 Export Settings*

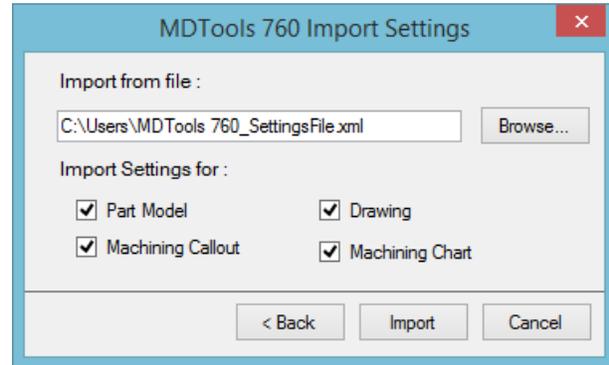
## Import Settings

Import MDTools® settings from an XML file.

1. Select **Import Settings**.
2. Click **Next**.  
*The MDTools 760 Import Settings dialog box displays.*
3. Click **Browse** and import the exported XML file.
4. Select the required options from **Import Settings for**.
  - Part Model
  - Machining Callout
  - Drawing
  - Machining Chart
5. Click **Import**.  
*MDTools updates the settings.*



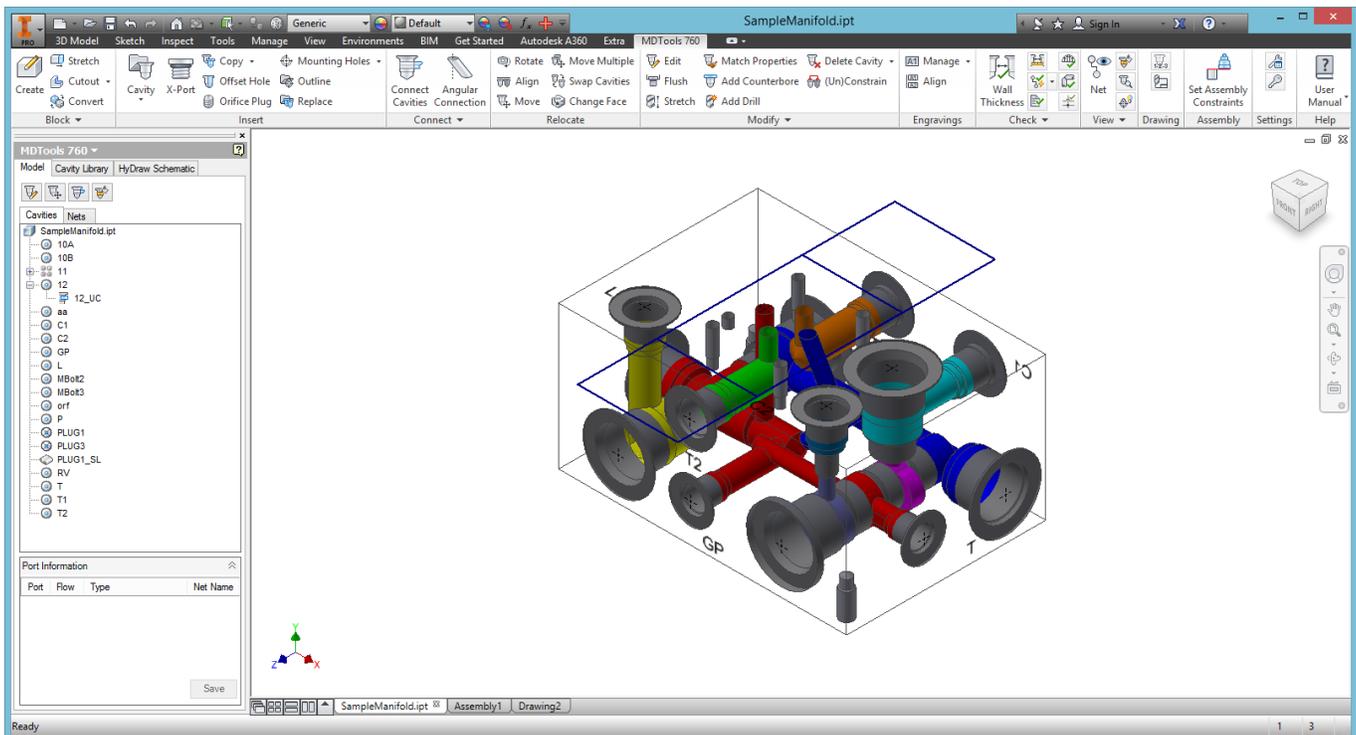
*Import and Export MDTools Settings*



*MDTools 760 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® 760 manifold design software enables you to design, check, draw, and model manifolds within the Autodesk Inventor environment.

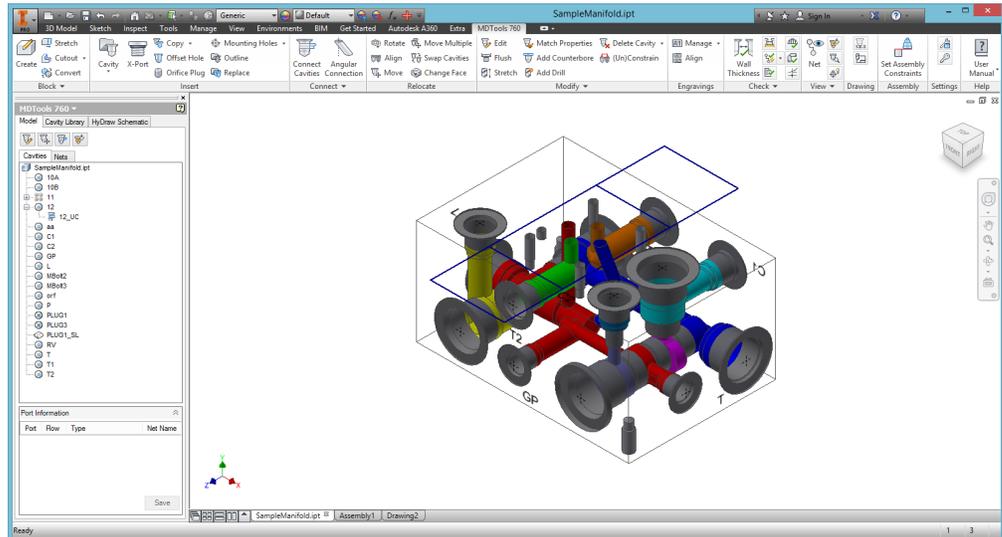
MDTools 760 ribbon menu toolbar, and panel bar gives you easy access to the commands.

There are three sets of commands in MDTools

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

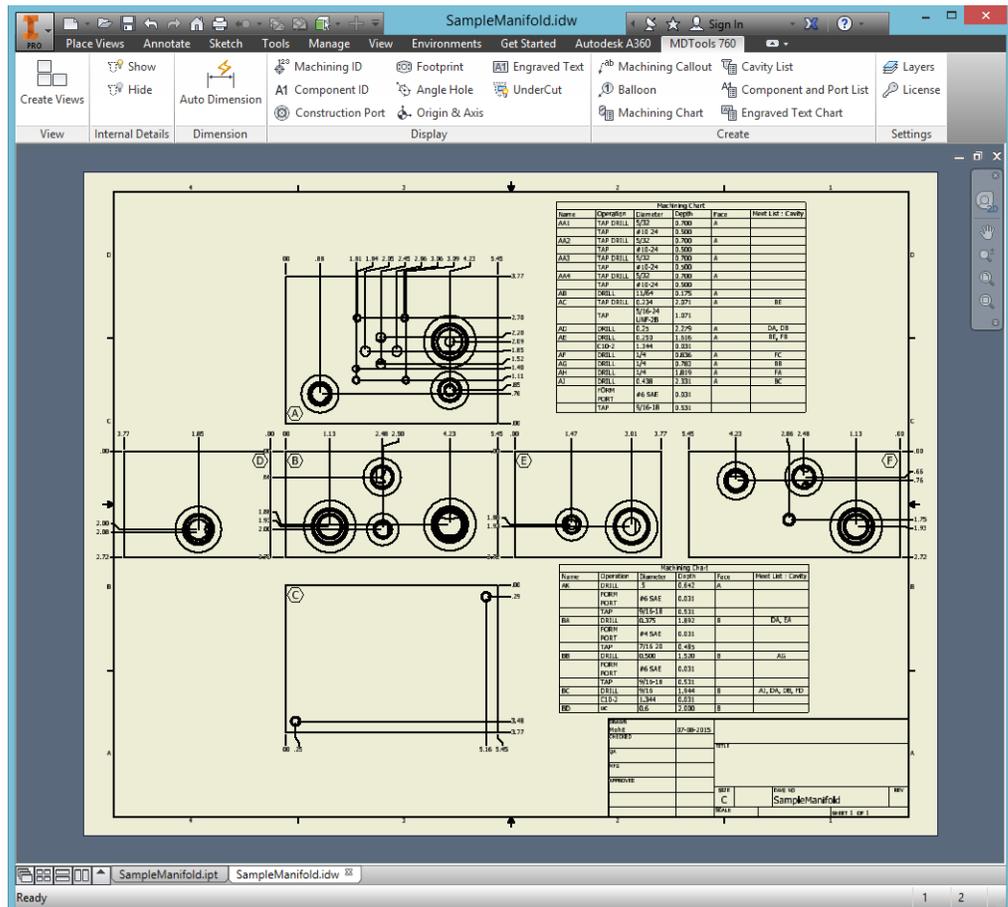
**Note**

- MDTools is loaded automatically in Inventor after installation.
- To modify the Load behavior:  
*Click Tools > Add-Ins > MDTools 760*



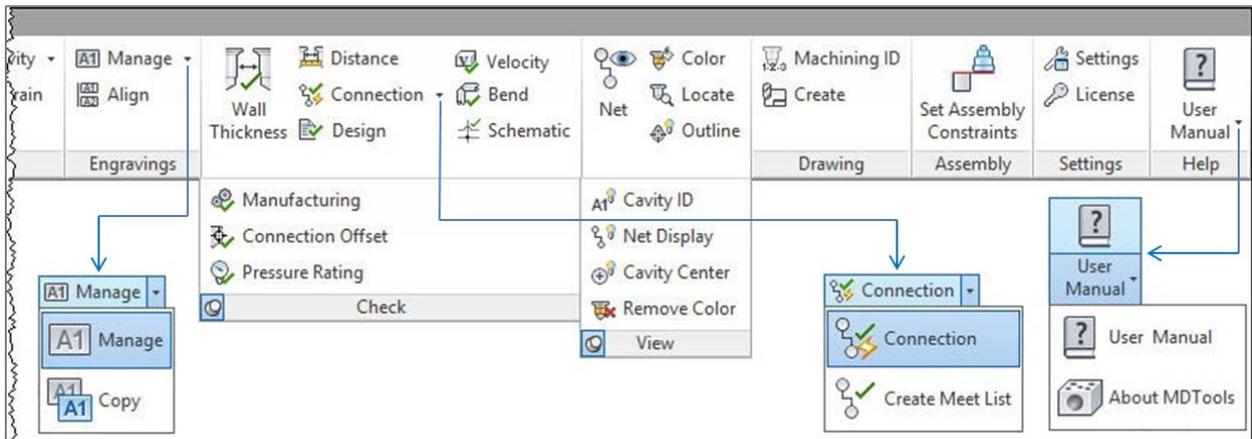
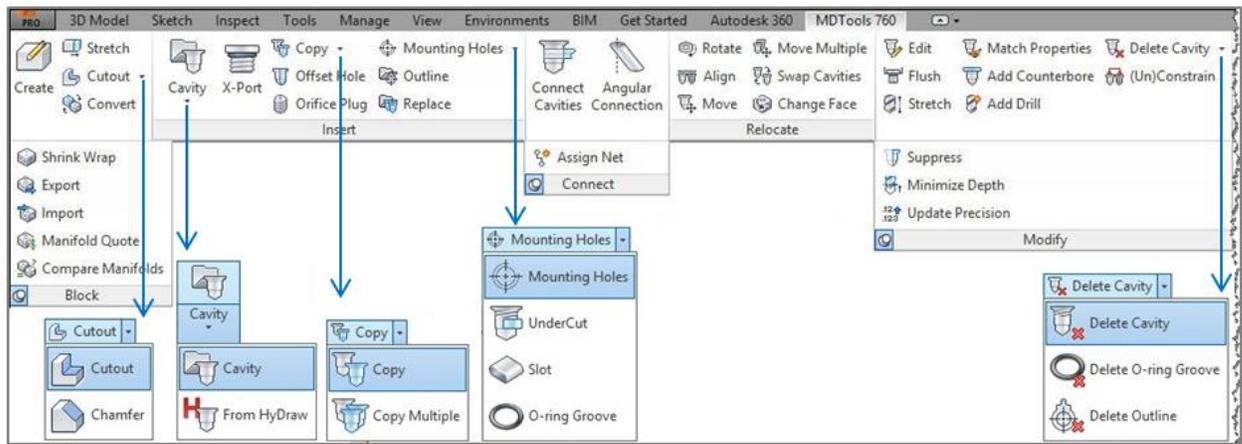
MDTools Part Model menu

- MDTools Part Model commands work only in the Part Model environment (.ipt file).
- 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 Assembly. This does not work from the Assembly file.

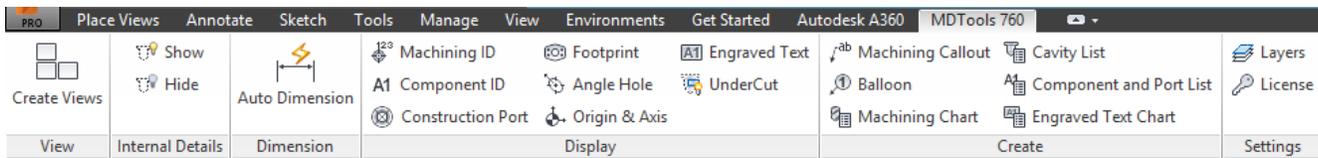


MDTools 2D Drawing menu

## 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:

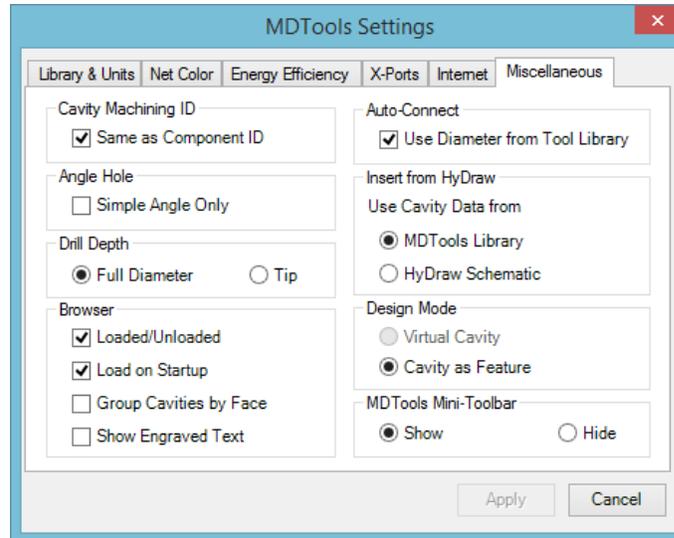
Lists the cavities by face name in the Model browser.

#### Show Engraved Text:

Shows or Hides engraved texts in the Model browser.

#### Note

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



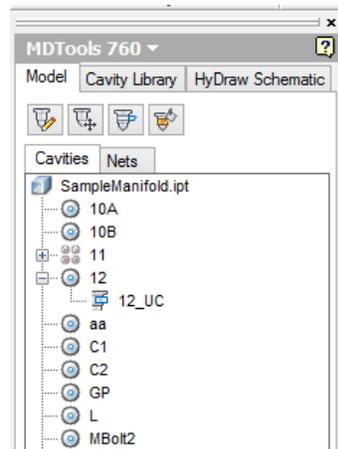
MDTools Settings dialog box: Miscellaneous

### MDTools Browser Bar in Browser Pane

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

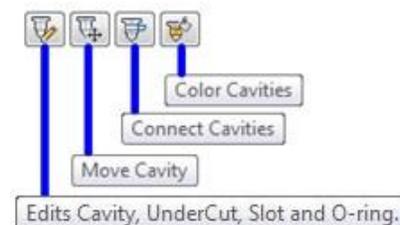
#### Note

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 panel.



MDTools Browser Toolbar

## 4.5 MDTools Cavity Browser

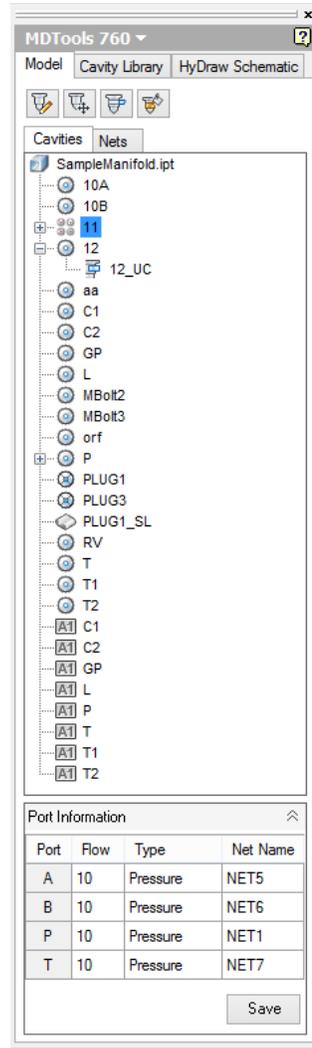
MDTools® Cavity Browser:

- 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.
- Engraving, O-ring, UnderCut, and Slot displays different icons.

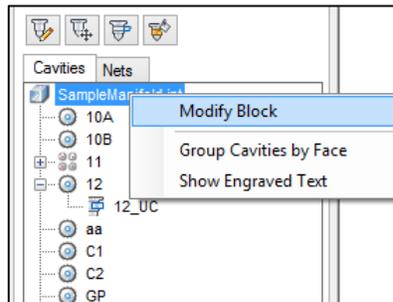


MDTools Cavity Browser

### 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

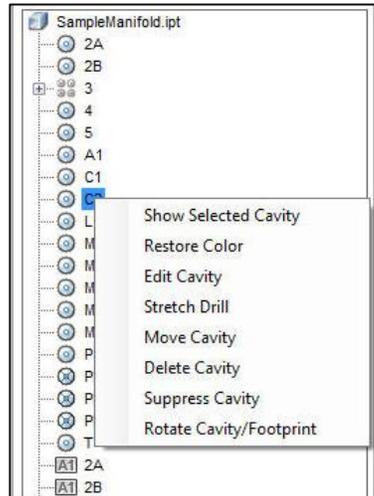
The context menu (right click) on the **selected cavity**:

#### Show Selected Cavity

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

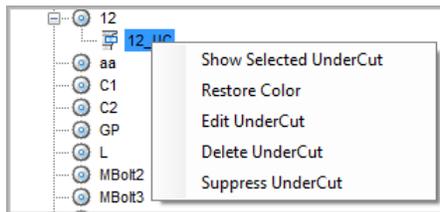
#### Restore Color

Restores the cavity shading.



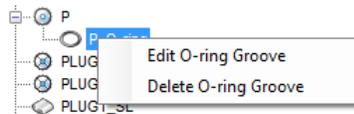
*Selected Cavity - Cavity Browser context menu (right click)*

### Selected UnderCut



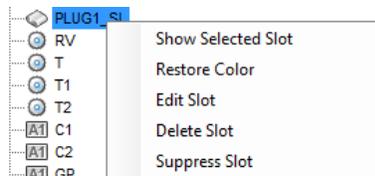
*Cavity Browser context menu (right click) Selected UnderCut*

### Selected O-ring Groove



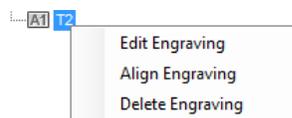
*Cavity Browser context menu (right click) Selected O-ring Groove*

### Selected Slot



*Cavity Browser context menu (right click) Selected Slot*

### Selected Engraving Text



*Cavity Browser context menu (right click) 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, and engraving.

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

Stretch block and modify block.



*Part Model Context Menu (left click)  
Face Selection*

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

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



*Part Model Context Menu (left click)  
Cavity Selection*

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

Edit, suppress and delete slot.



*Part Model Context Menu (left click)  
Slot Selection*

The context menu (left click) on the selected O-ring enables you to:

Edit and delete 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 Connectivity Browser

MDTools® Connectivity Browser in the Inventor browser pane displays:

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

### Connectivity Browser Context Menu

The context menu in the Connectivity Browser enables you to change the visibility and color of nets:

#### Show Selected Net

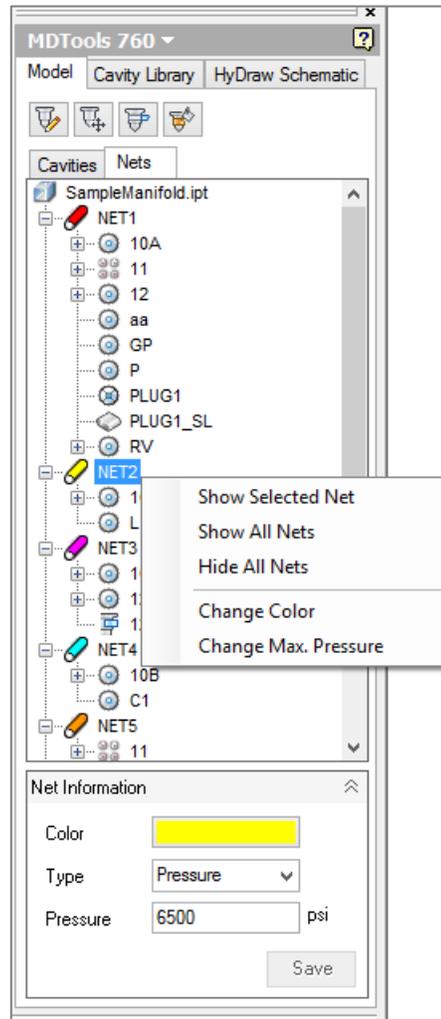
Displays the selected net with the net color and all other nets with the Dead Area color.

#### 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 Connectivity Browser

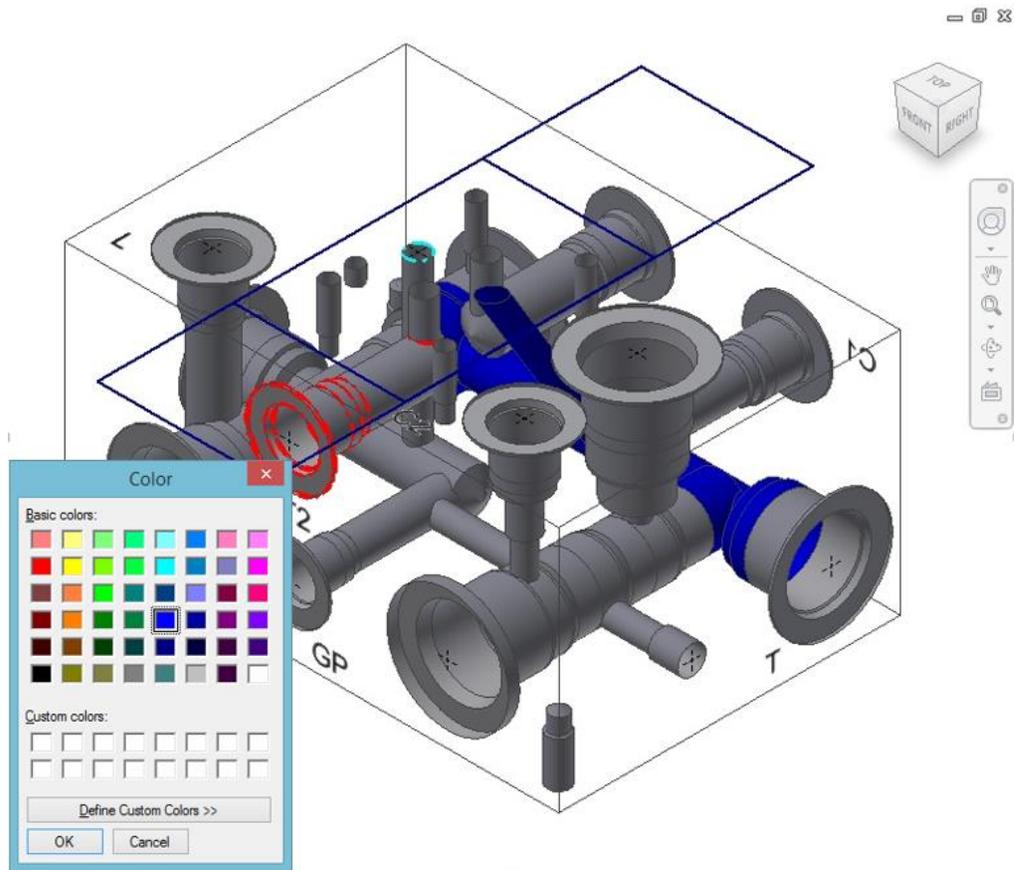
## Change Color

Changes the color of the selected net.

1. Select **Change Color** from the context menu.  
*The Color dialog box displays.*
2. Select the new color for the selected net.
3. 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

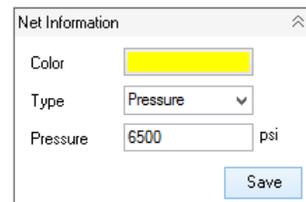
1. Select **Change Max. Pressure** from the context menu.  
*The Change Max. Pressure dialog box displays.*
2. Enter the new pressure for the selected net.
3. Click **OK**.  
*MDTools updates the selected net with the new pressure.*



Change maximum pressure

### Note

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



Net Information

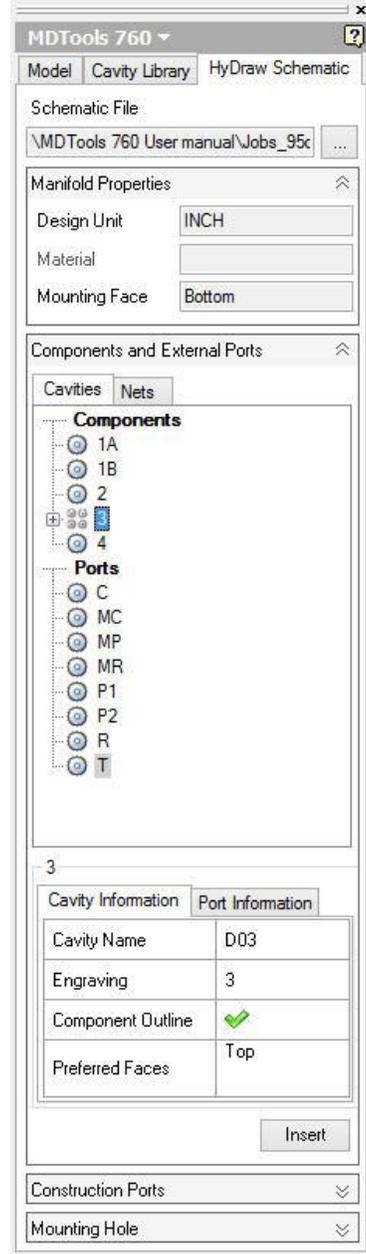
## 5. Schematic Interface

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

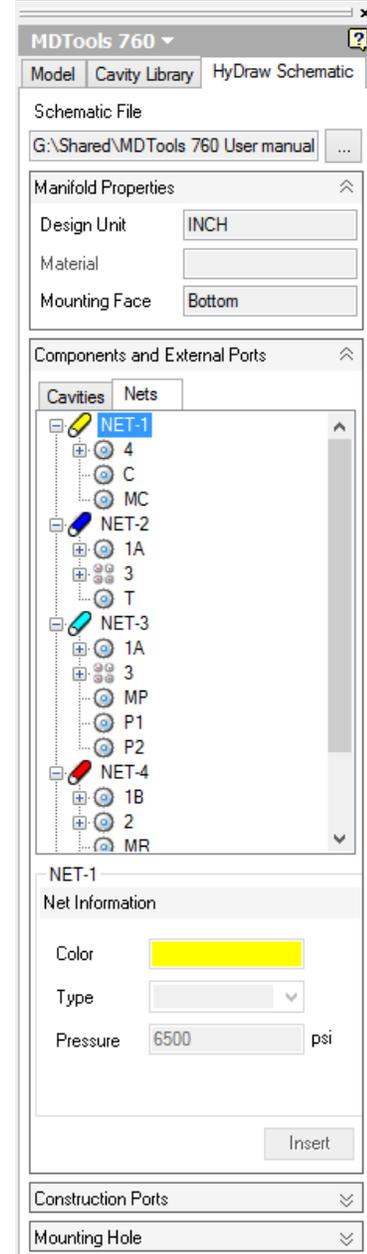
- MDTools 760 ribbon  
>Insert panel  
>From HyDraw  
*The MDTools HyDraw Schematic page displays in MDTools 760 browser.*
- Click .  
*The Select HyDraw File dialog box displays.*
- Select the required HyDraw XML/MBXML.
- Click **Open**.  
*MDTools automatically populates the Cavity Explorer with all the components from the schematic drawing.*

### Note

To insert cavities, click Insert cavity from HyDraw Schematic.



MDTools HyDraw Interface

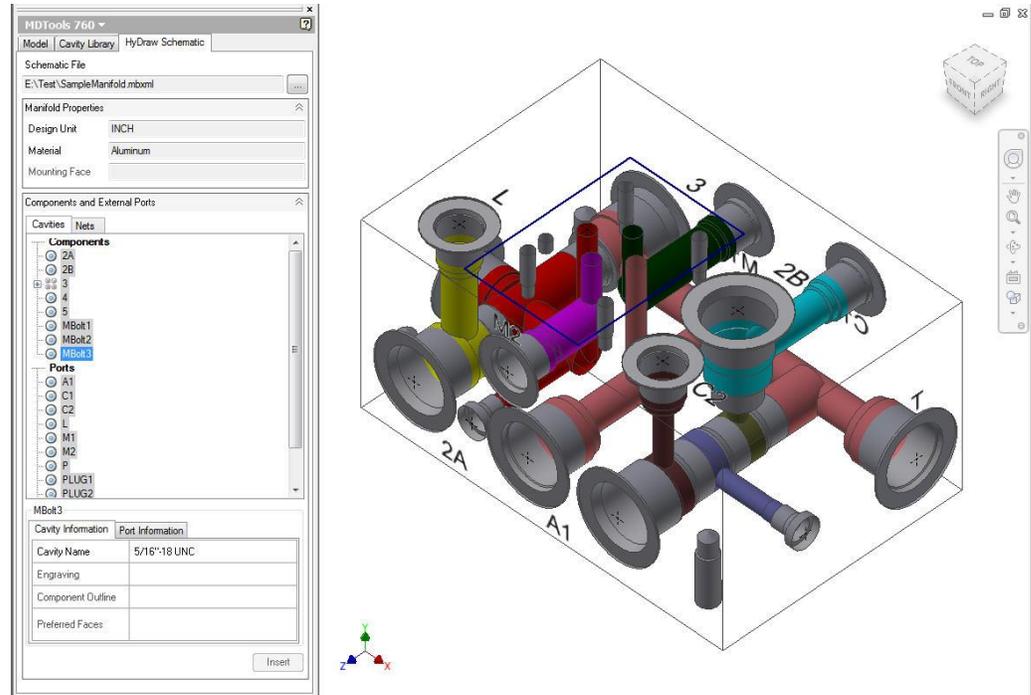


Components in Connectivity Explorer

## 5.1 Cavity Explorer

*Cavity Explorer 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 the cavity.

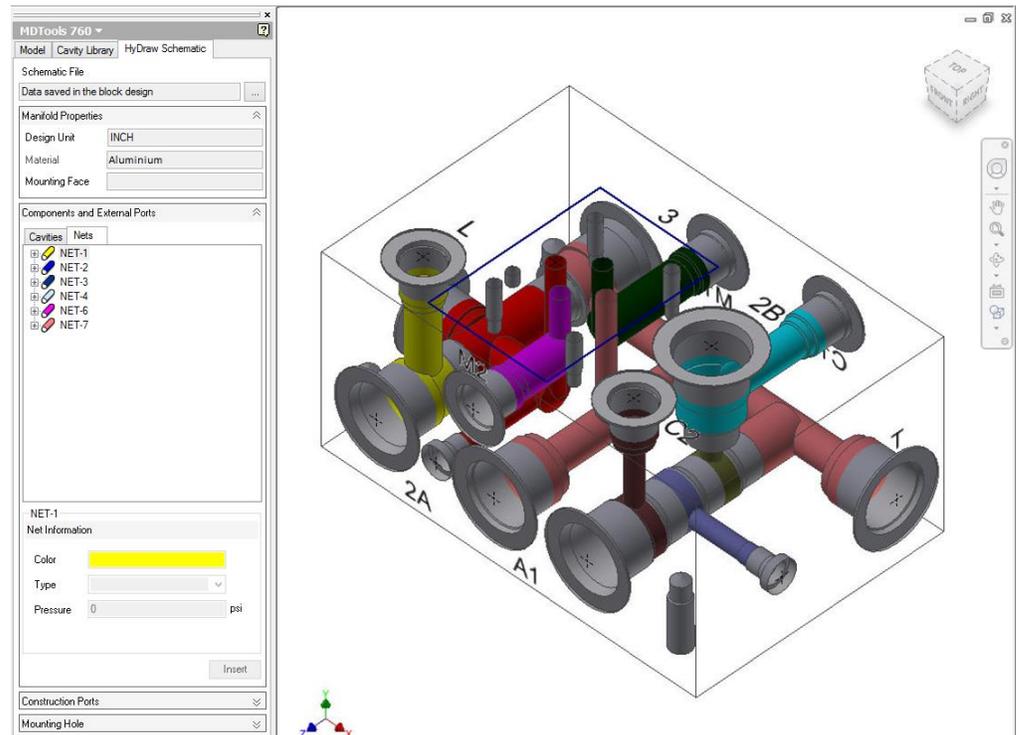


MDTools® HyDraw® Interface: Cavity Explorer

## 5.2 Connectivity Explorer

*Connectivity Explorer 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 the cavity.



MDTools HyDraw Interface: Connectivity Explorer

# 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

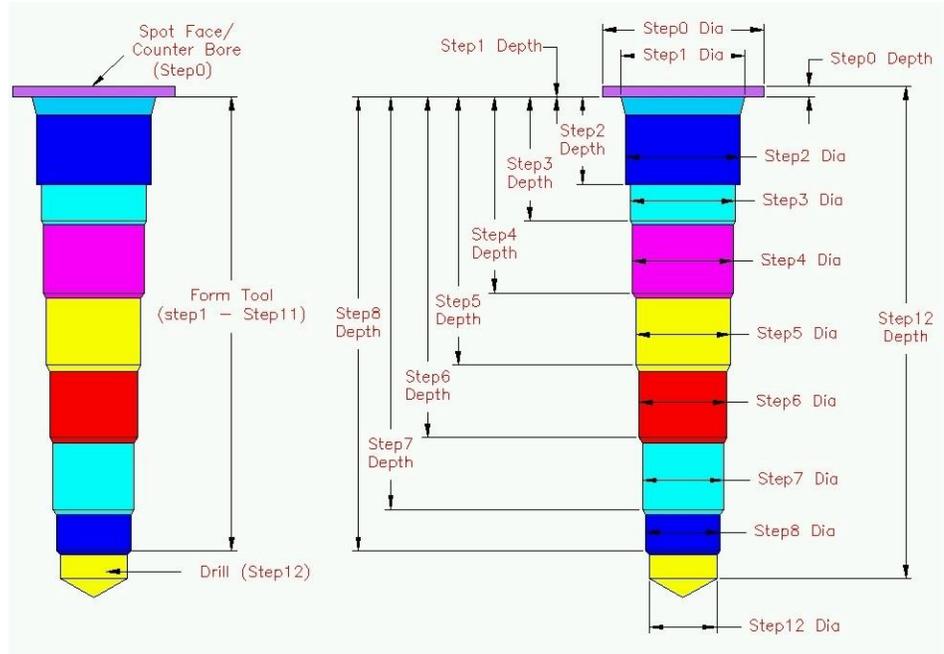
Geometry of a cavity is defined in terms of its dimensions and its relationship with the step number and step dimensions.

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.



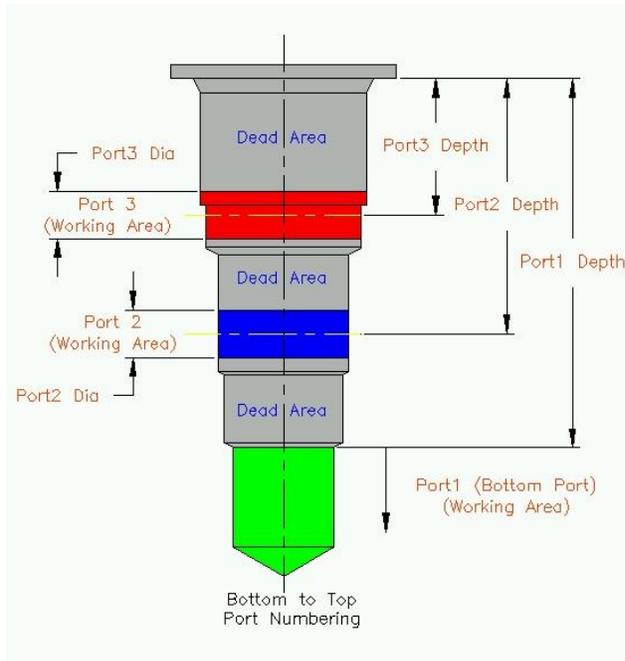
MDTools Cavity Geometry

## 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

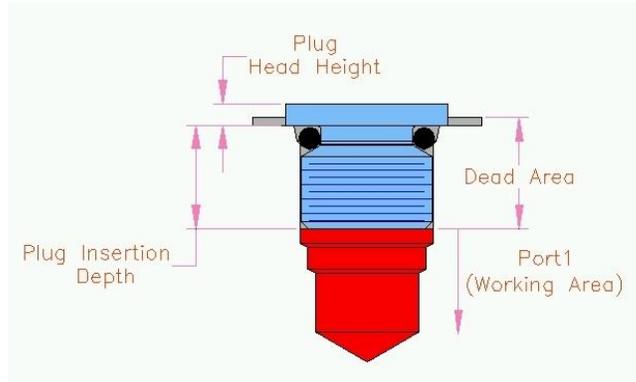
Cavities of ports are also divided into Working Areas and Dead Areas.

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.

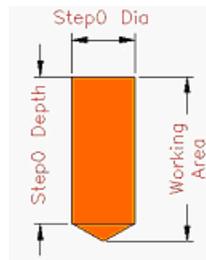


Plugs

## 3 Drill Holes

The complete cavity is considered as the Working Area.

Hole dimensions are entered in Step0 of the cavity.



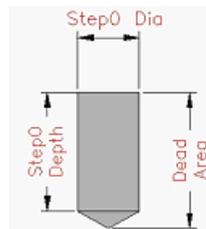
Drill Holes

## 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.



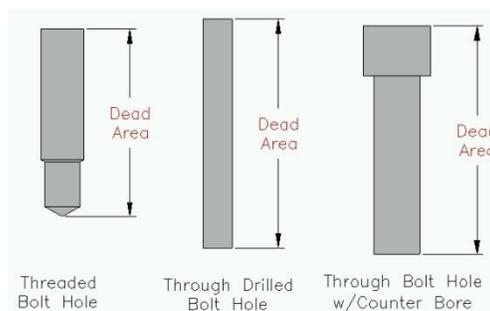
Locating Pin Holes

## 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)

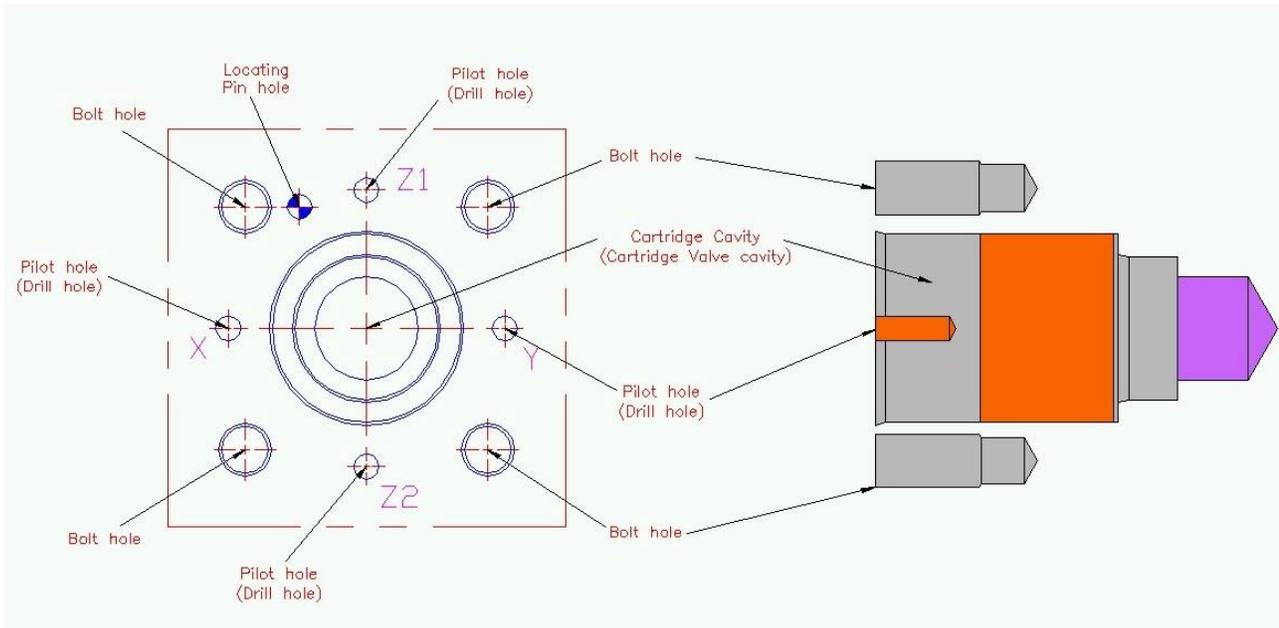


Bolt Holes

## 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.

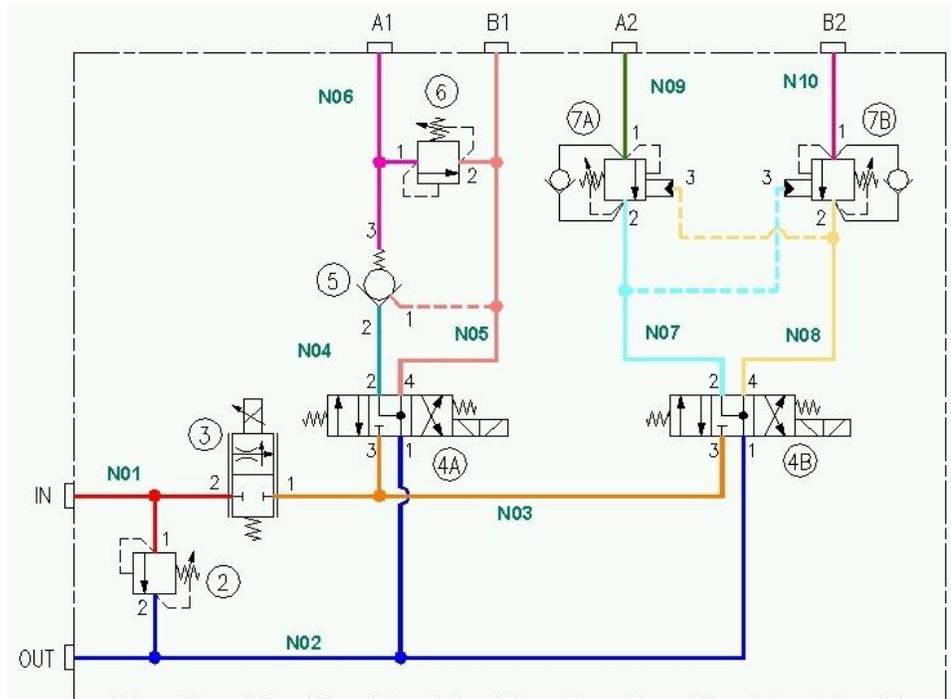
MDTools' consistent naming system between schematics and the manifold design encompasses:

- 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

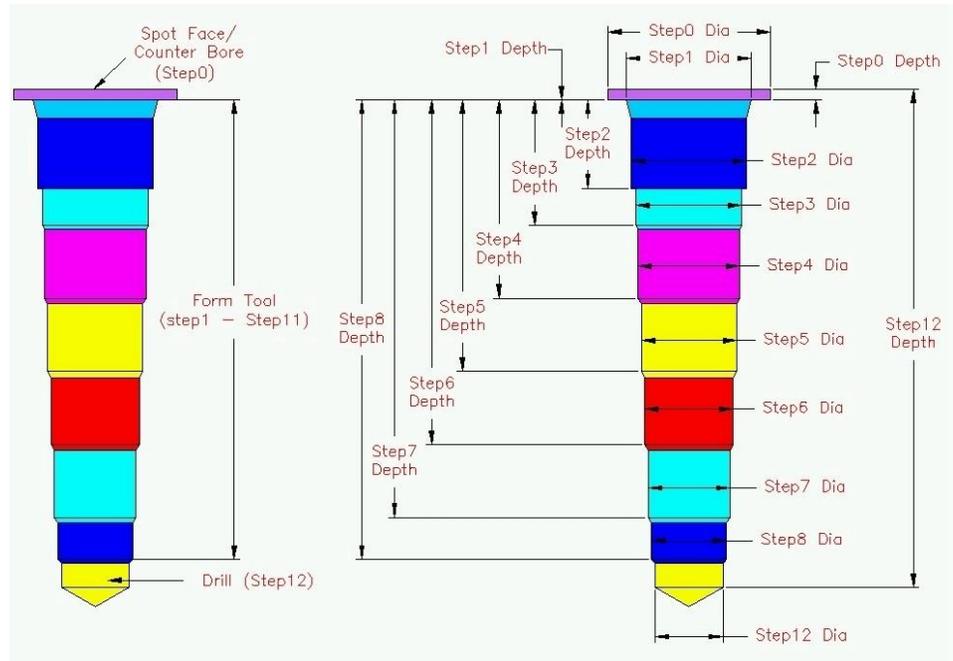
Geometry of a cavity is defined in terms of its dimensions and relationship with the step number and step dimensions.

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 Step 0.



Modeling MDTools cavities

## 1 Ports

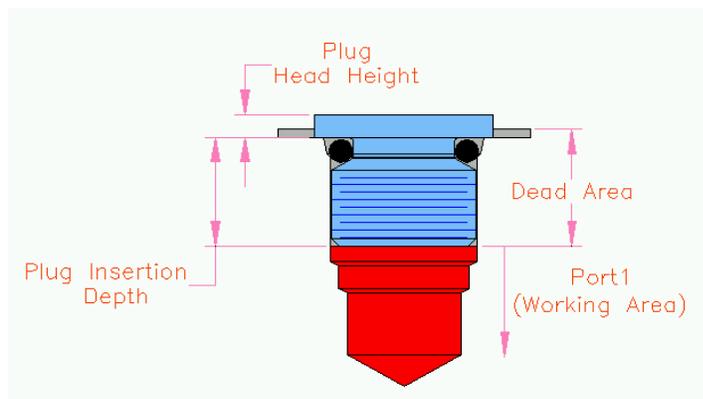
Cavities of ports are also divided into Working Areas and Dead Areas.

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.



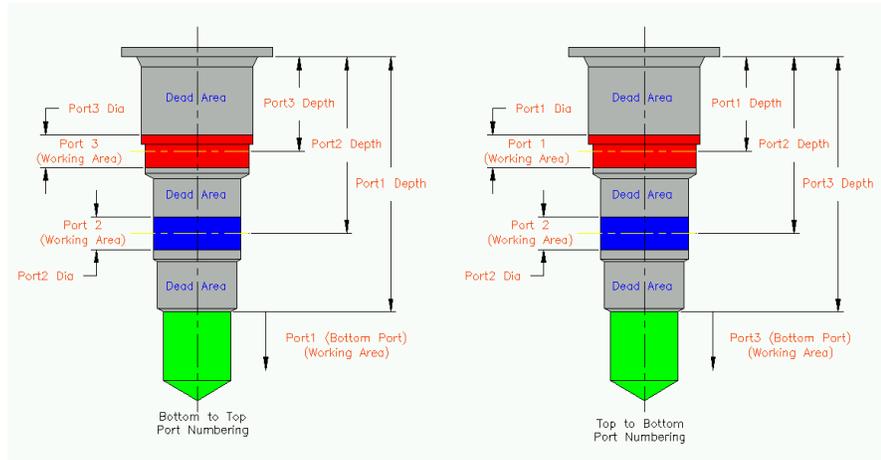
Plugs – Ports: Dead Area and Working Area

## 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.

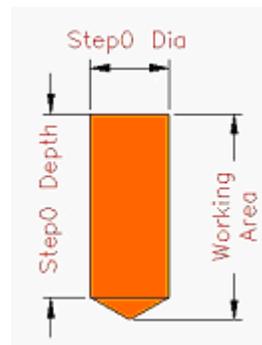


3 Port Cartridge Valve Cavity

## 3 Drill Holes

The complete cavity is considered the Working Area.

Hole dimensions are entered in Step0 of the cavity.



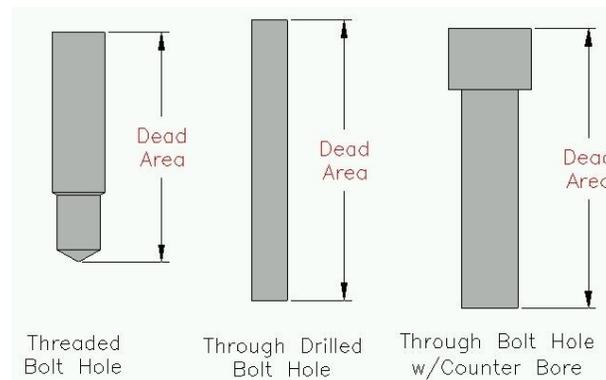
Drill Holes

## 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)



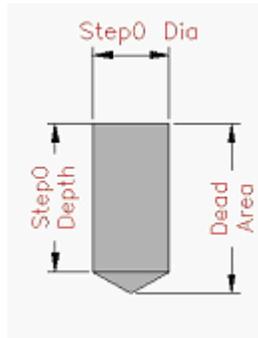
Types of Bolt Holes

## 5 Locating Pin Holes

The complete cavity is considered the Dead Area.

Hole dimensions are entered in Step0 of the cavity.

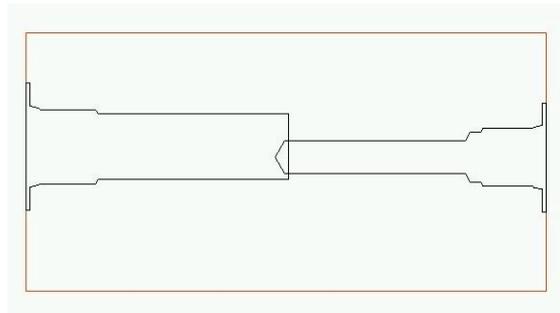
All the dimensions are fixed.



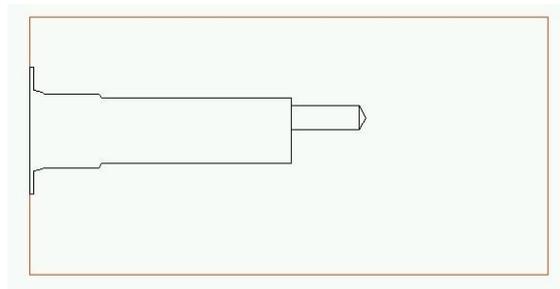
Locating Pin Holes

### 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.

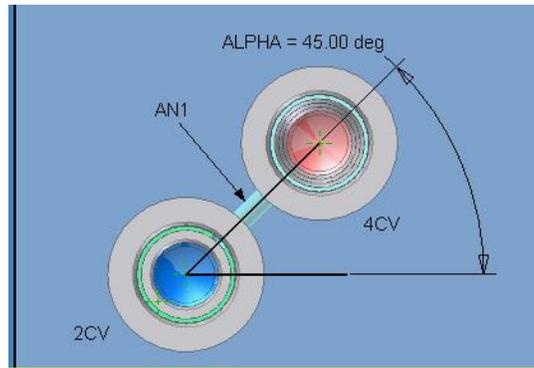
In MDTools, angle holes with Alpha angle of 0, 90, 180, or 270 are called **Simple Angle Holes** and angle holes with Alpha angle other than 0, 90, 180, or 270 are called **Compound Angle Holes**.

- 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.

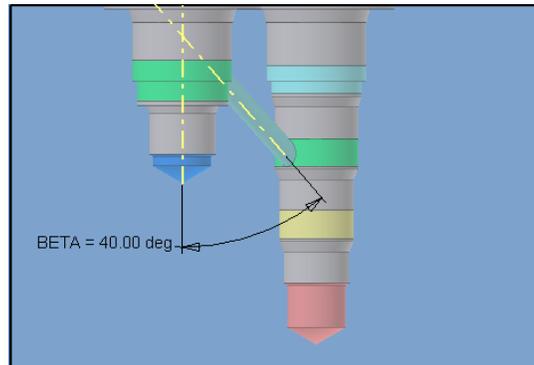
The figure on the right shows two cavities, 2CV and 4CV, which are connected using angle drill AN1, inside cavity 2CV.

- 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.

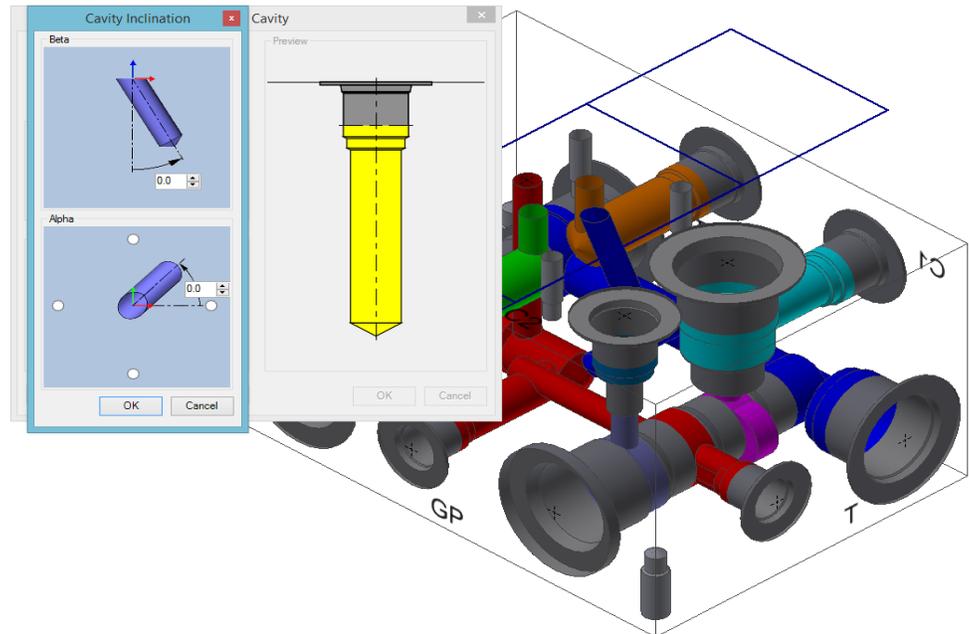
This connection is made using a compound angle drill AN1.



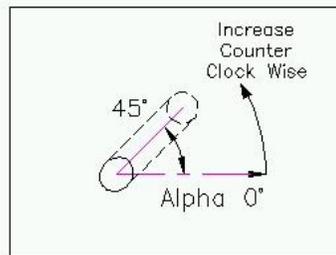
Alpha - rotation on the surface



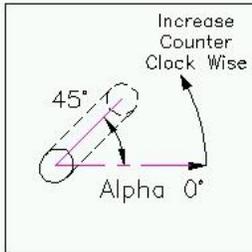
Beta - inclination from surface Normal



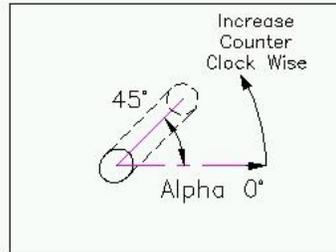
Edit Cavity dialog box: Alpha and Beta angles



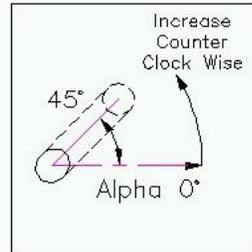
A Top



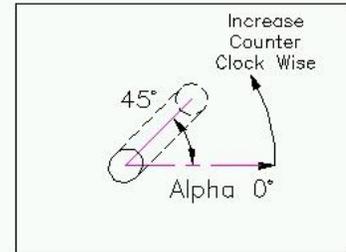
D Left



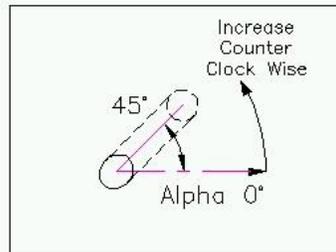
B Front



E Right



F Back



C Bottom

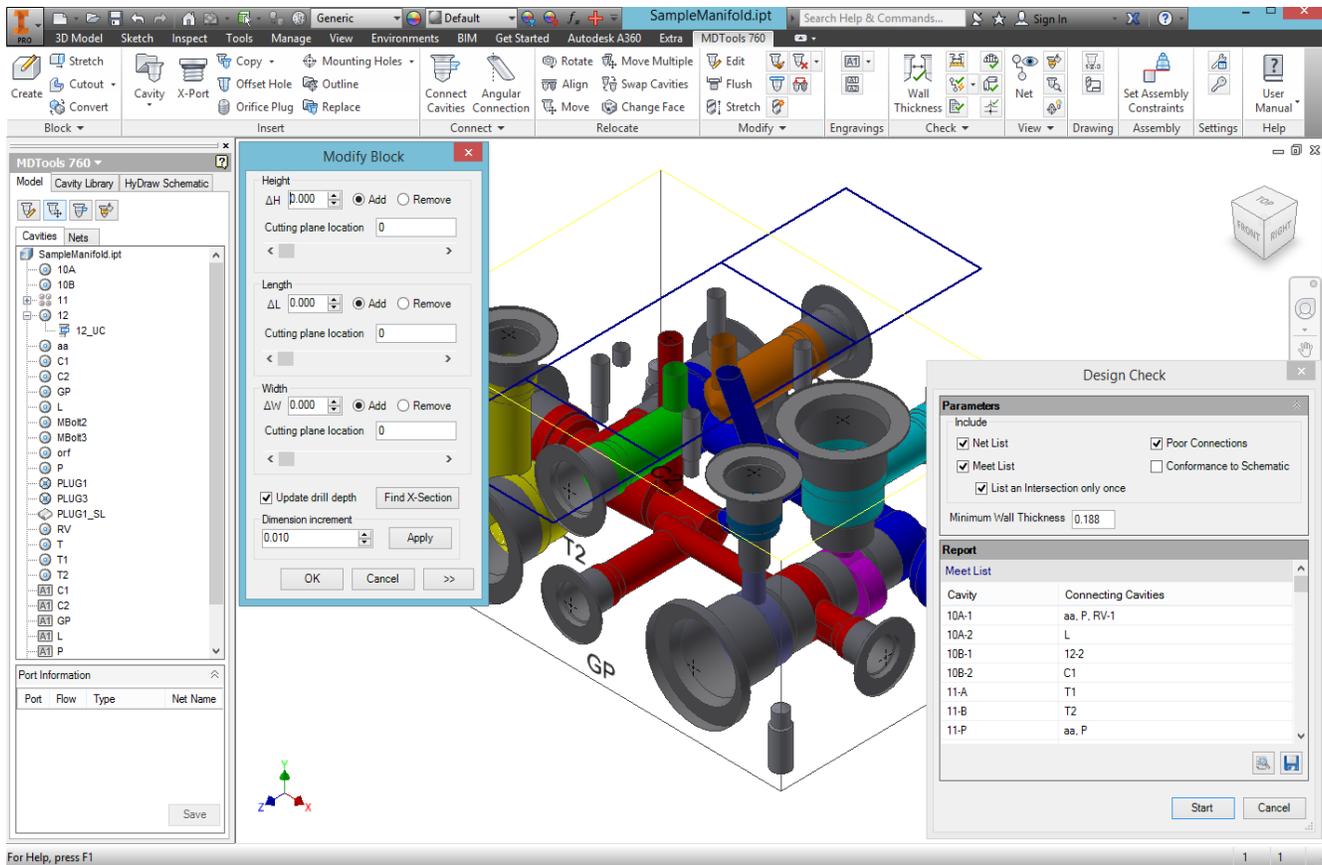
*Alpha angle convention used in MDTools*

#### 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.

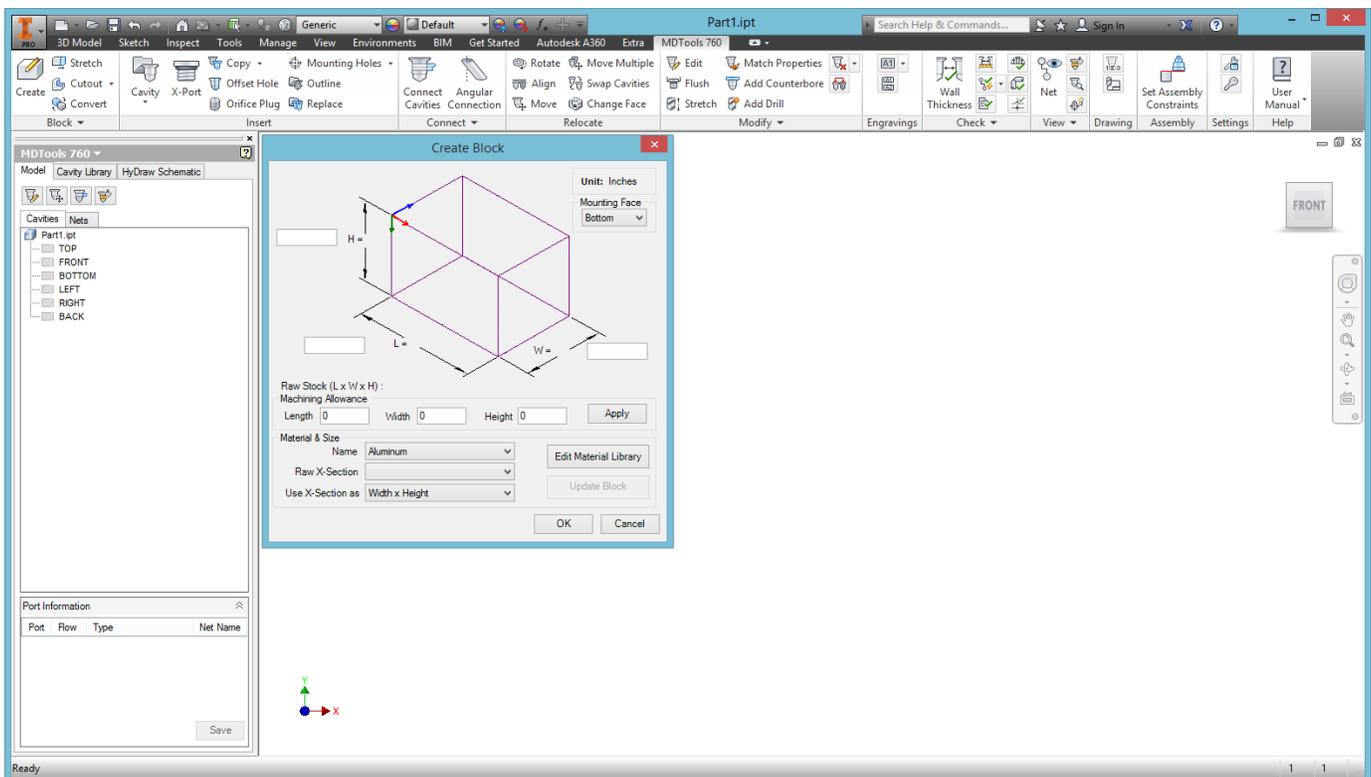
# DESIGN and CHECK COMMANDS

10 - 20	Block Commands
21 - 35	Insert
36 - 38	Make Connections
39 - 44	Relocate
45 - 57	Edit
58 - 60	Engravings
61 - 71	Design Check
72 - 79	Display Options
80 - 82	Part Model Drawing Commands
83 - 84	Settings



# 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 Manifold Quote
- 20 Compare Manifolds

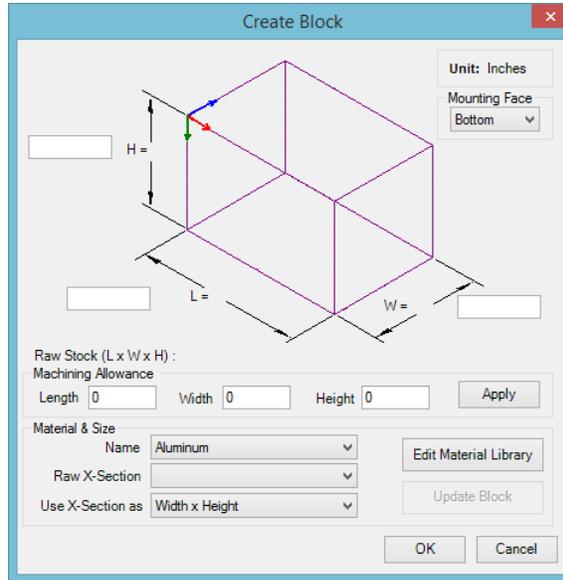


# 10. Create Block

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.



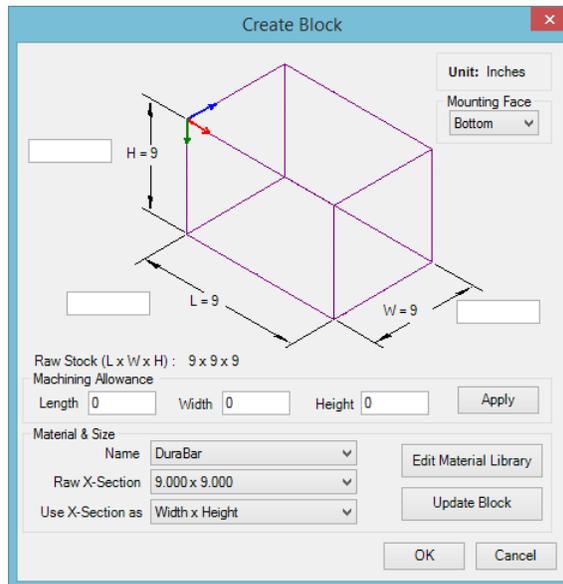
Create Block

## 1 Block - Dimensions entered manually

1. MDTools 760 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
  - $\Delta H$ (Manifold Height)
  - $\Delta L$ (Manifold Length)
  - $\Delta W$ (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.



Create Block 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.

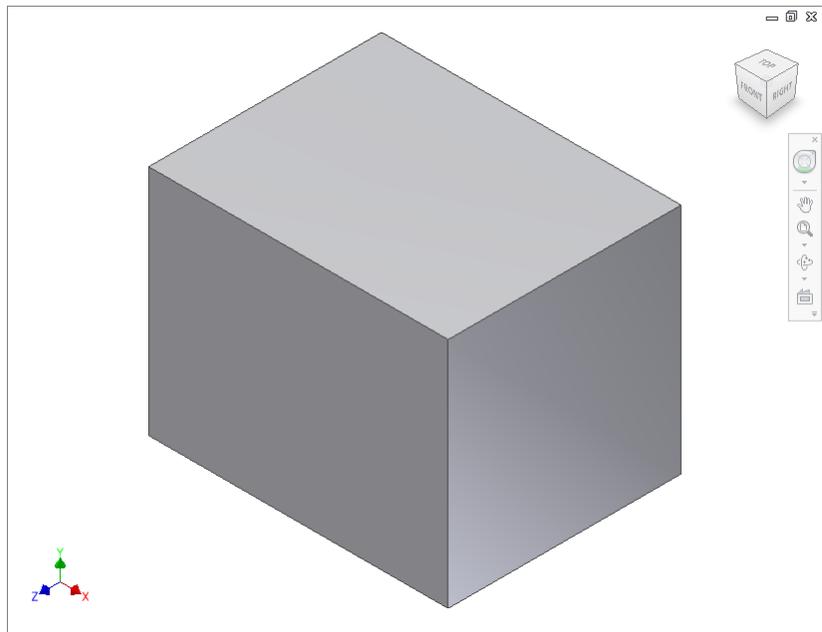
6. Click **OK** after the required data is entered.

MDTools® automatically creates the block inside Inventor.

## 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.

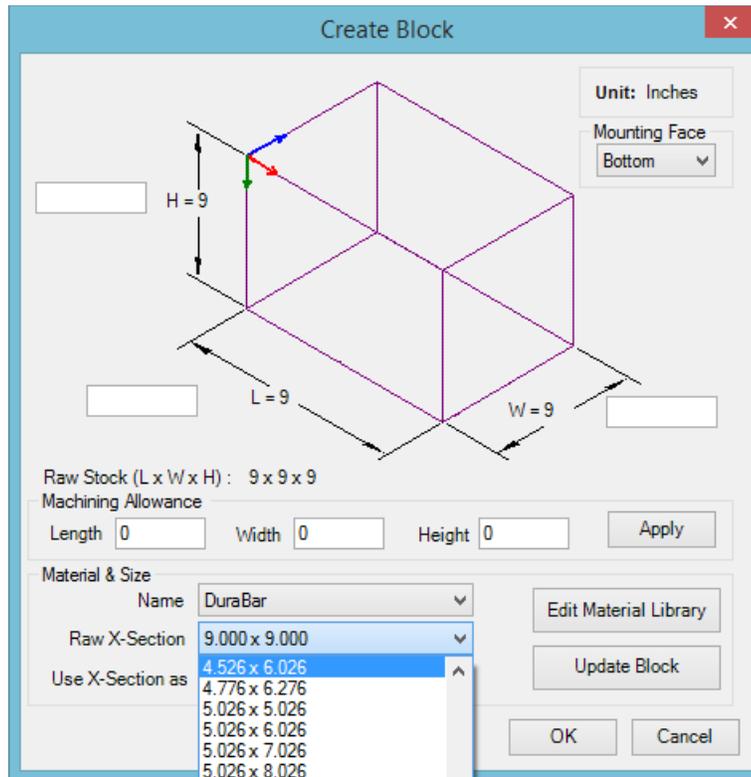
To create a block manually, which works with MDTools use the above names for the block model parameters.



*A Block drawn in Inventor*

## 2 Block - using Material X-Section Libraries

1. MDTools 760 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-Sections** 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.*



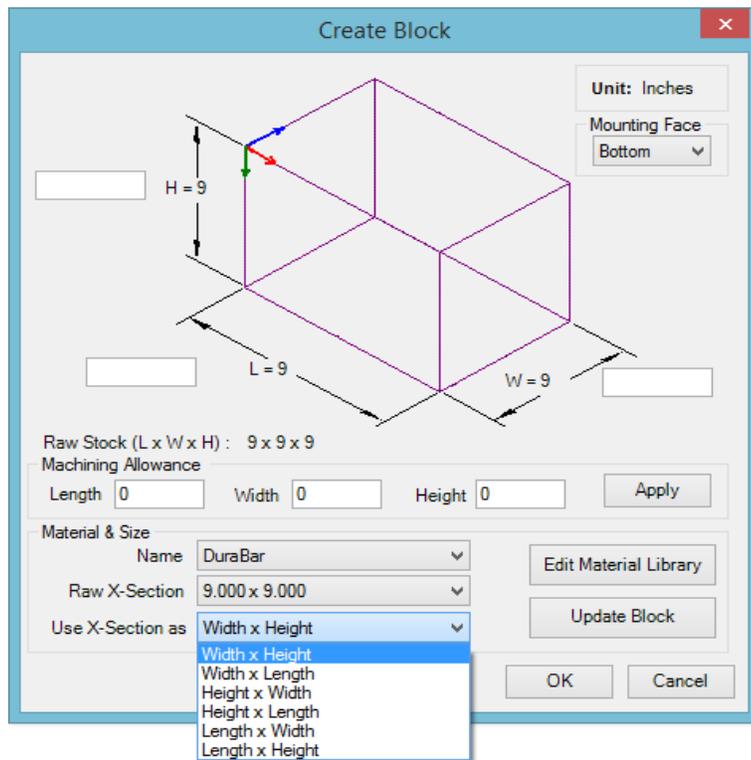
Create Block dialog box: Material X-section dimensions

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: 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.

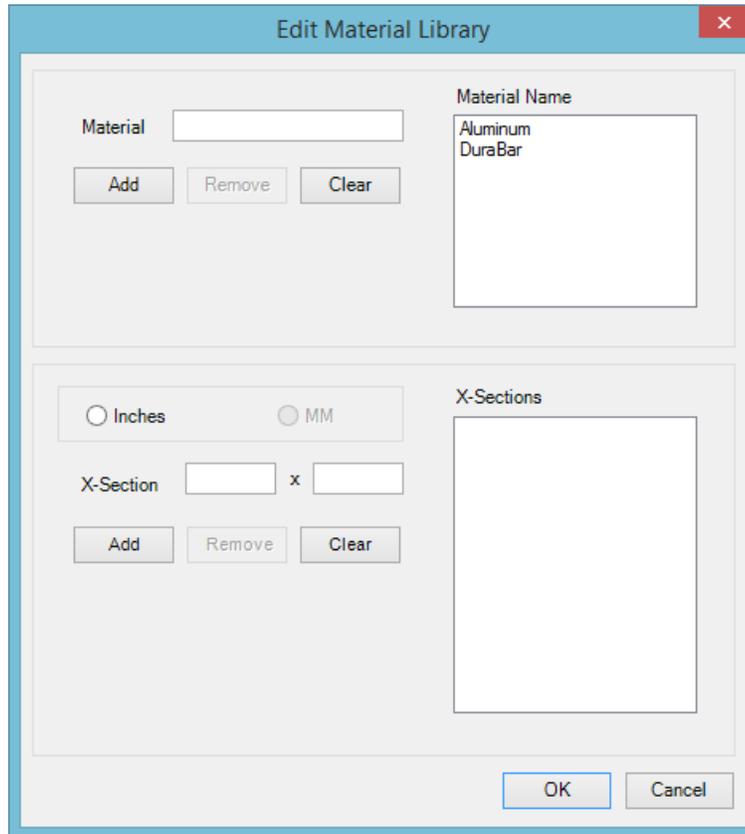
1. MDTools 760 ribbon  
>**Block** panel  
>**Block** (Create Block)  
The Create Block dialog box displays.
2. Click **Edit Material Library**.  
The Edit Material Library dialog box displays.

#### Add New Material

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

#### Change Material Name

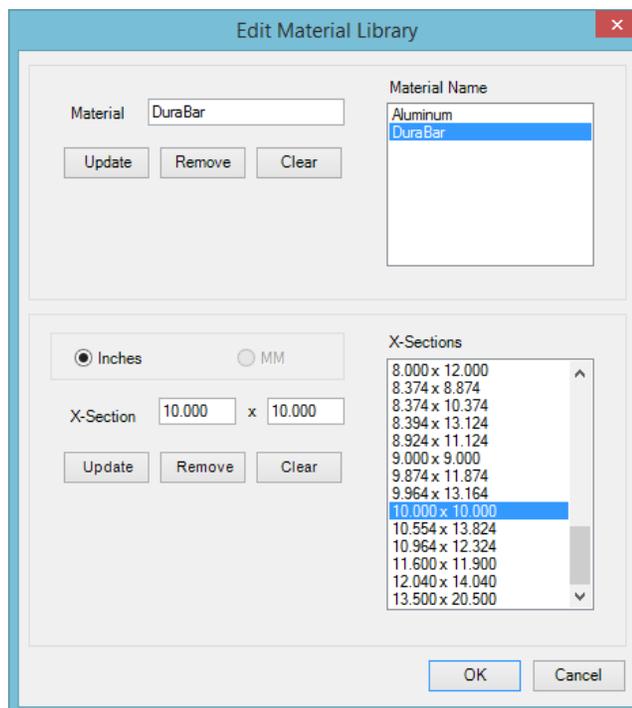
1. Select the material name you want to change from the **Material Name** list.  
The selected material name is displayed in the **Material** text box.
2. Enter the new material name in the **Material** text box.
3. Click **Update**.  
MDTools updates the material name with the new name.



Edit Material Library dialog box: Add new material

#### 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.



Edit Material Library dialog box: Update material name

## Add New X-Section

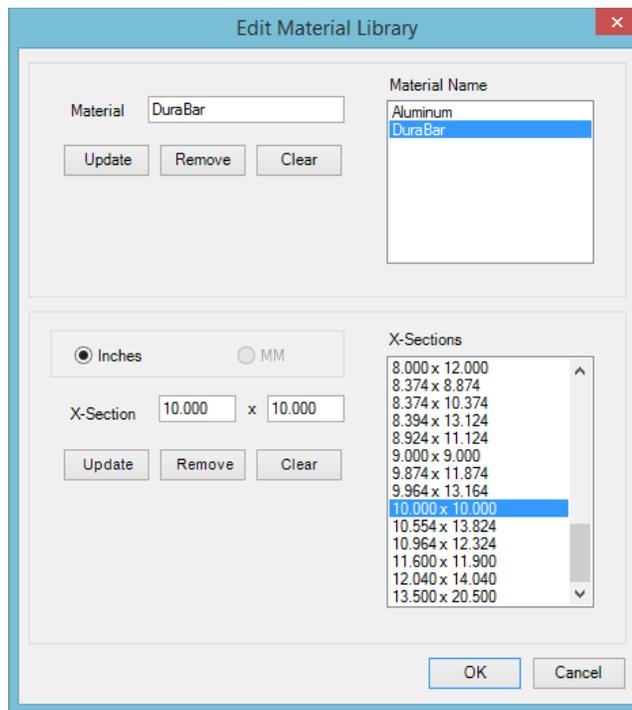
1. Select the material name from the **Material Name** list.  
*A list of cross sections displays in the X-Sections list.*
2. Select the unit: **Inches** or **MM**.
3. Enter the X-section dimensions in the **X-Section** text boxes.
4. Click **Add**.

## Change X-Section dimension

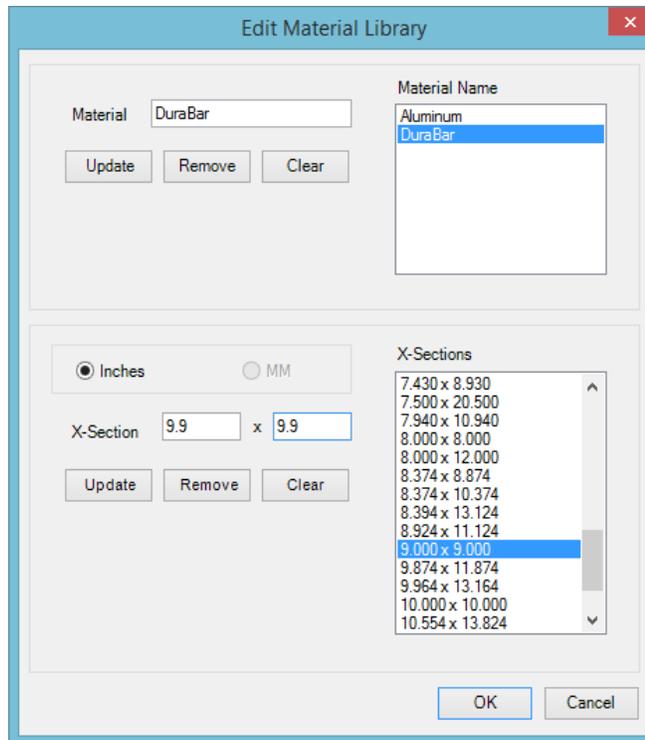
1. Select the cross section you want to change from the **X-Sections** list.  
*X-section dimensions are displayed in the X-Section text box.*
2. Select **X-Section** you want to change in the X-Section textbox.  
*Change the dimension, as required.*
3. Click **Update** to save the changes.

## Delete X-Section

1. Select the X-section you want to remove from the library.  
*The 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**.



Edit Material Library dialog box: Add new X-Section



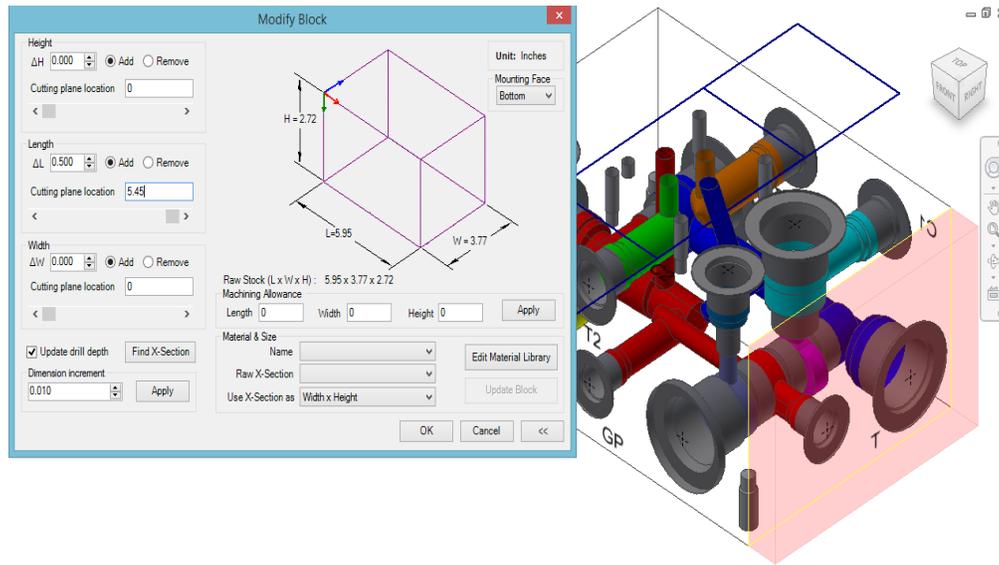
Edit Material Library dialog box: Change X-Section dimensions

# 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.



# 1 Modify Block Size

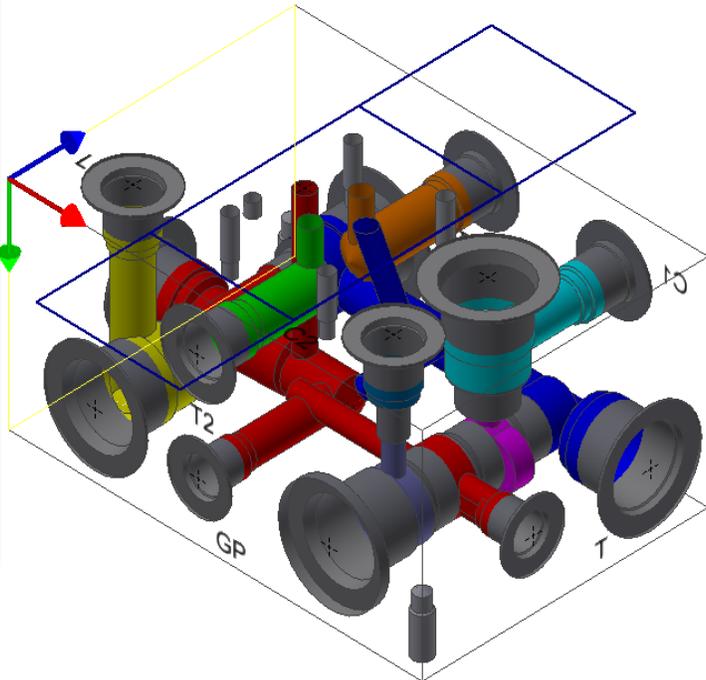
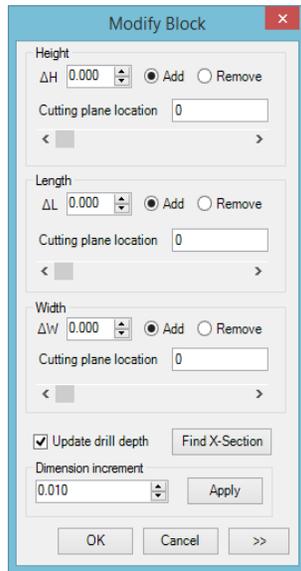
1. MDTools 760 ribbon >Block panel >Create(Modify Block)

*The Modify Block dialog box displays.*

2. Enter the change in dimensions in the data fields.

- $\Delta H$ (Manifold Height)
- $\Delta L$ (Manifold Length)
- $\Delta W$ (Manifold Width)

3. 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*

4. To reduce any of the block dimensions, select the **Remove** option with the value.
5. 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.*

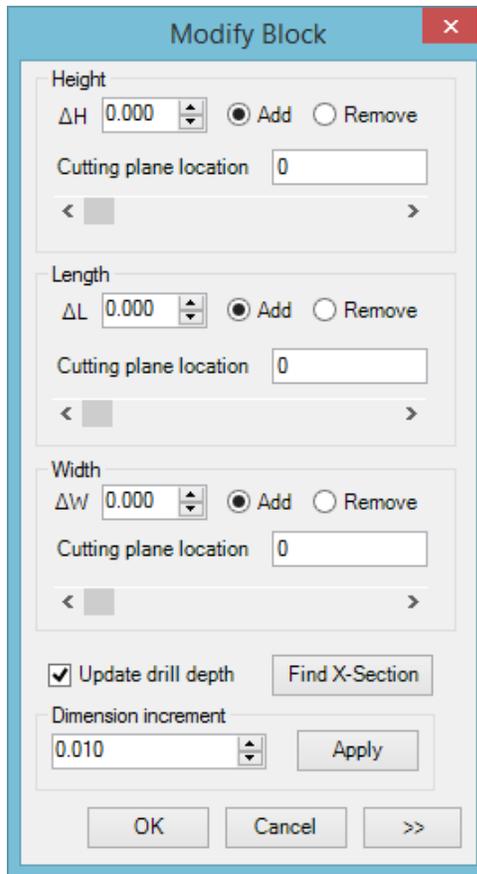
6. Select **Update drill depth** to update the drill depths of cavities according to the change in block dimensions.

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

7. You can set **Dimension increment** to define the default incremental value for changing the  $\Delta$  values using the up or down buttons.

8. Click **Apply** to save the changes.

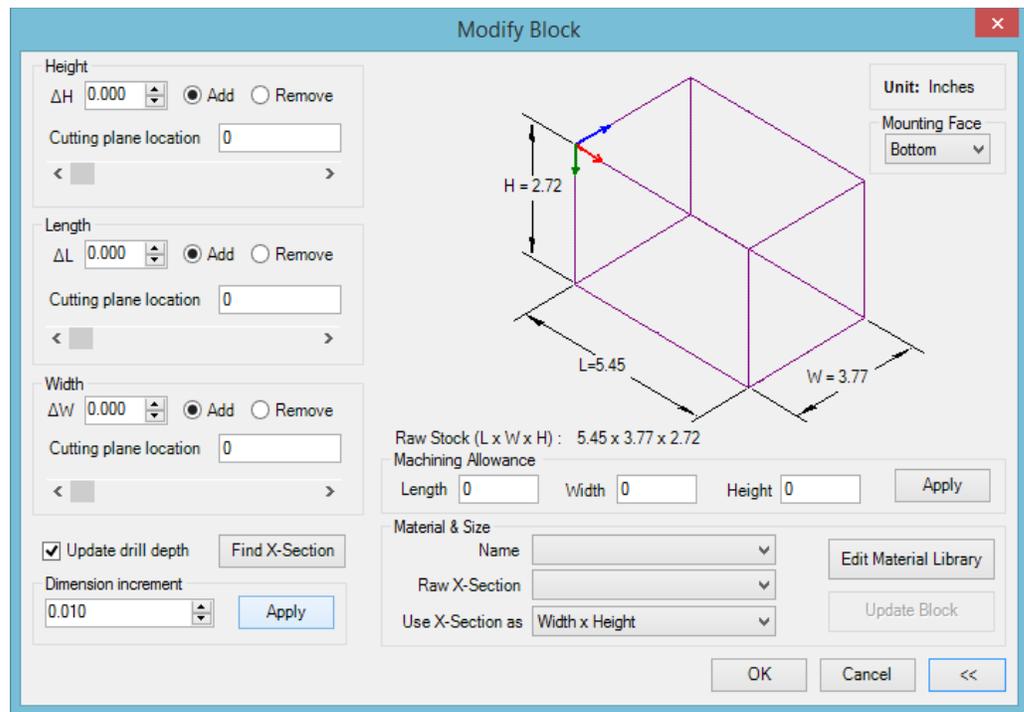
*The block dimension modifications are shown immediately in the dialog box for the corresponding dimensions' values.*



*Collapsed View: Modify Block*

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

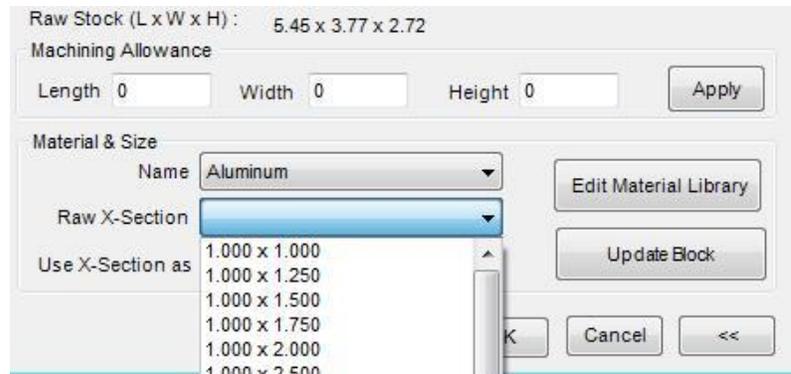
When you change the dimensions of the block, the block size changes will reflect in the Inventor model of the block.



Modify Block dialog box: Updating Block dimensions

OR

- 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

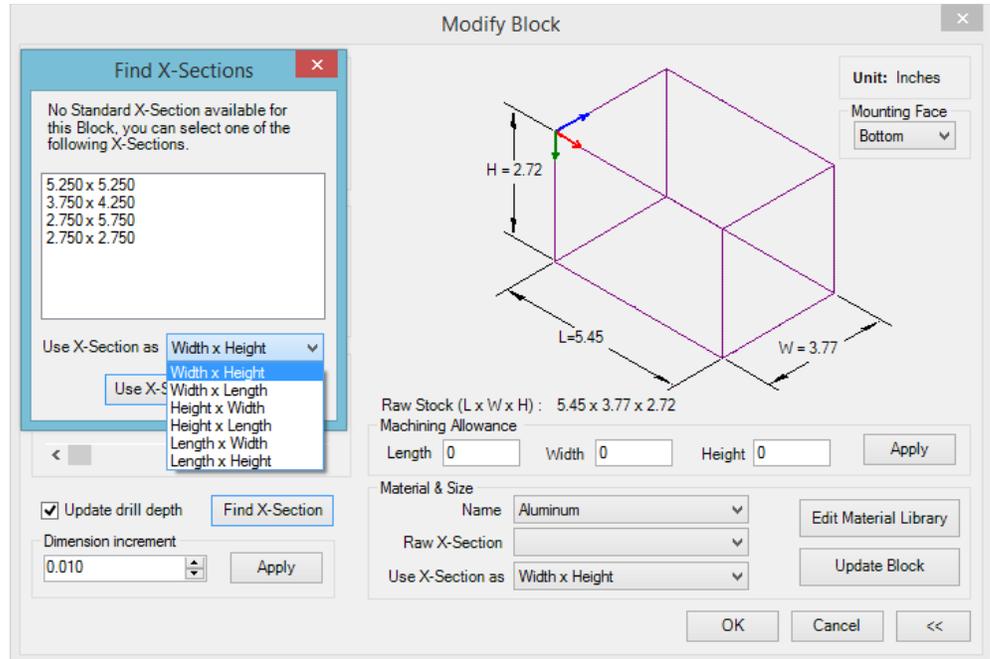
Check the availability of X-sections, when you enter the block dimensions manually, i.e. without selecting a standard X-section from the Material library.

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

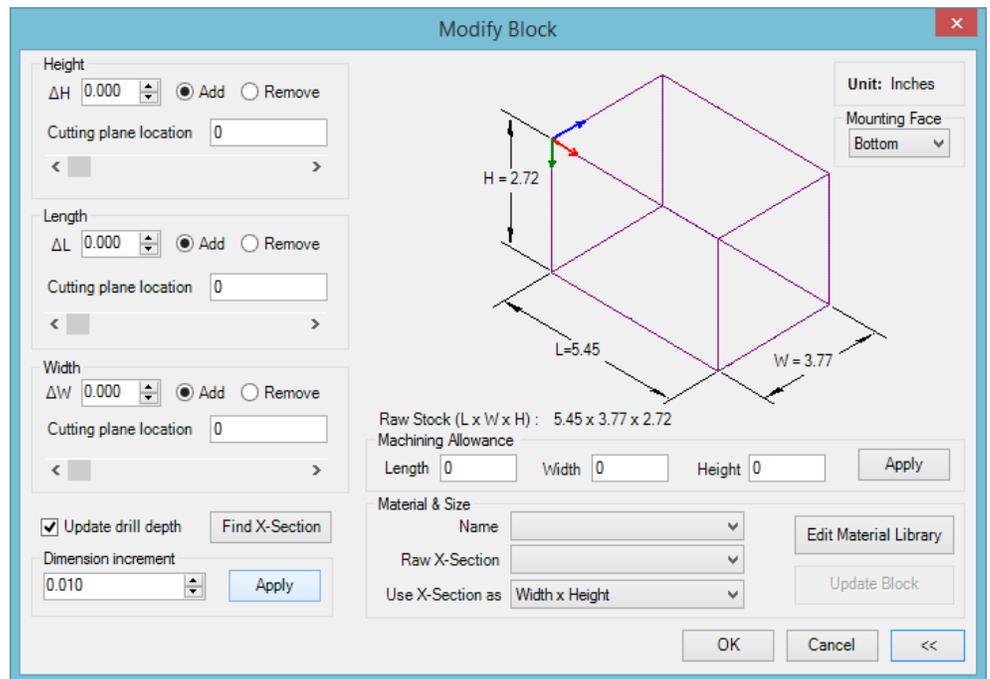
Use one of the X-sections listed in the Find X-Sections dialog box and update the block dimensions with the standard X-section.

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-Sections window.

*The selected X-section displays in the Raw X-Section list and the Use X-Section 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 glued to the selected face.

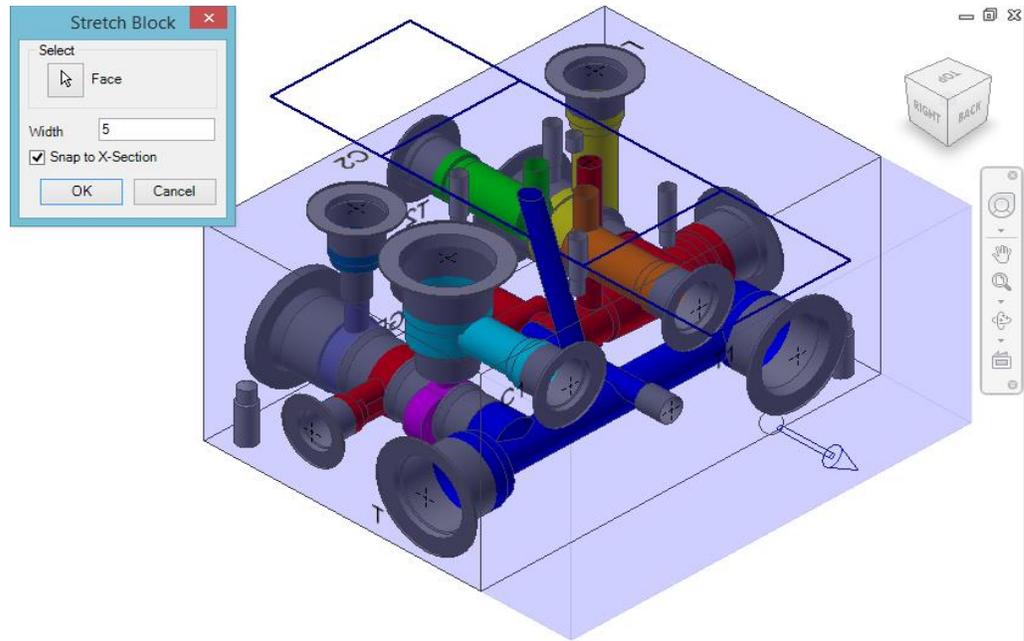
1. MDTools 760 ribbon  
>**Block** panel  
>**Stretch** (Block)

*The Stretch Block dialog box displays.*

2. Select a face.
3. Drag the arrow.  
Or,  
Enter the value.

### Note

The Snap to X-Section option enables you to use a material cross section available in the library.



*Stretch Block dialog box*

# 13. Create Cutout

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

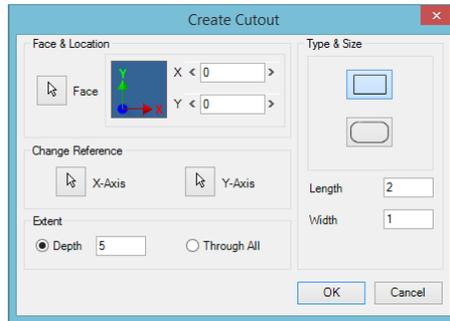
## 1. Create Cutout

1. MDTools 760 ribbon

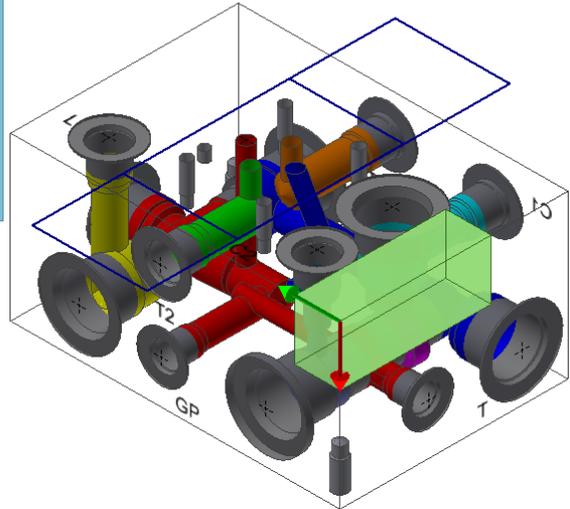
>**Block** panel  
>**Cutout**

*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 a type for the Cutout, i.e. rectangle or rounded rectangle.
6. Enter the **length** and **width**. Also enter the corner radius, if the rounded rectangle option is selected.

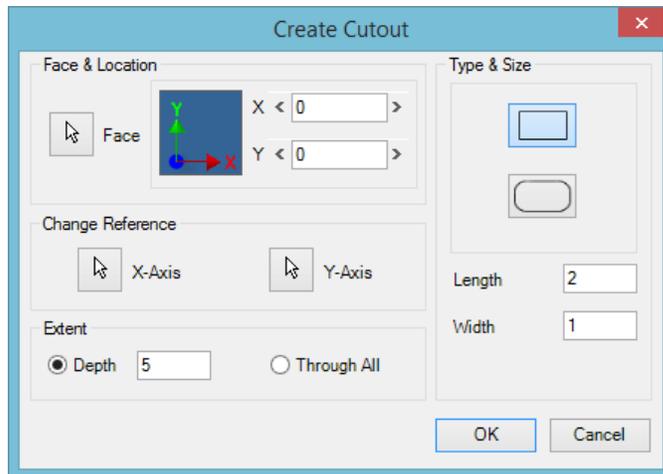


Create Cutout dialog box

*The preview of the Cutout displays.*

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

*The Cutout is created, per the specified dimensions or parameters.*



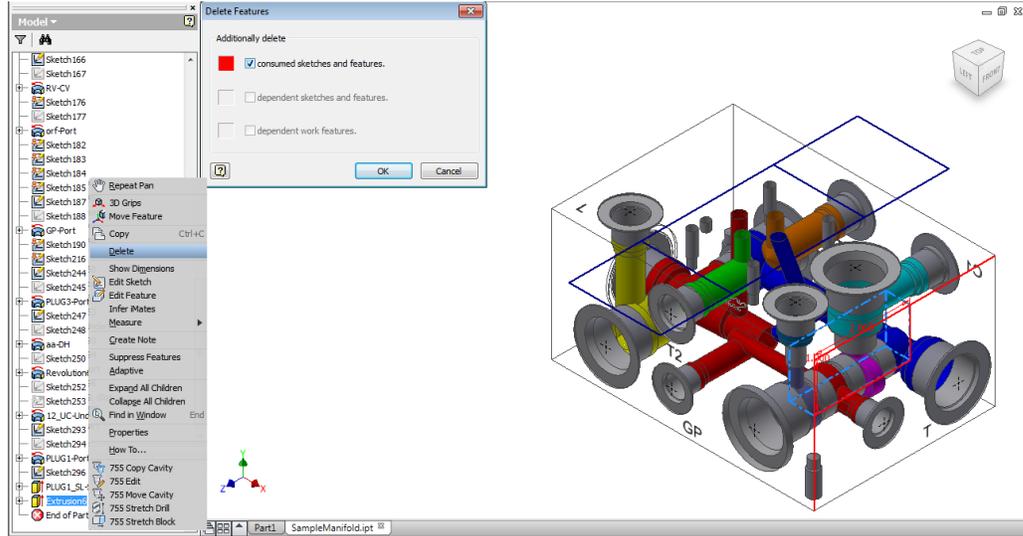
Create Cutout dialog box

## 2. Delete Cutout

1. Select the Inventor Model Feature Design tree in the browser pane.
1. Right-click the Extrude option of the Cutout feature and select **Delete**.  
*The Delete Features dialog box displays.*
2. Select the **consumed sketches and features** option and click **OK**.

**Note**

Similarly, you can edit the Cutout from the Inventor Feature Manager Design Tree.



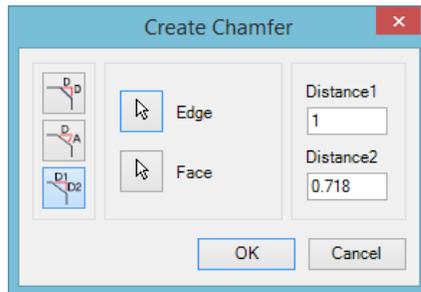
*Inventor Feature Manager Design Tree - Cutout*

# 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 760 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.

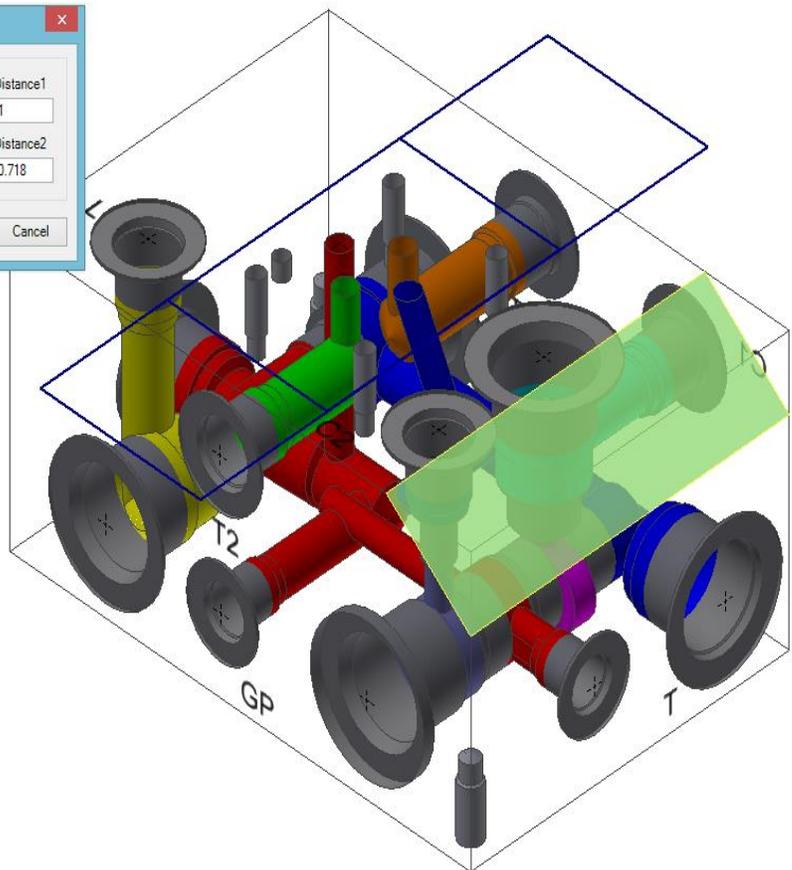
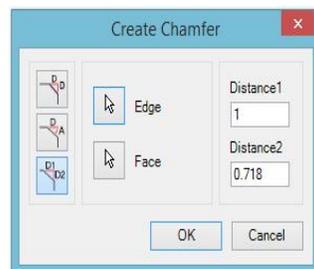
*Ensure that the Distance-Angle or Distance-Distance option is selected.*

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.*



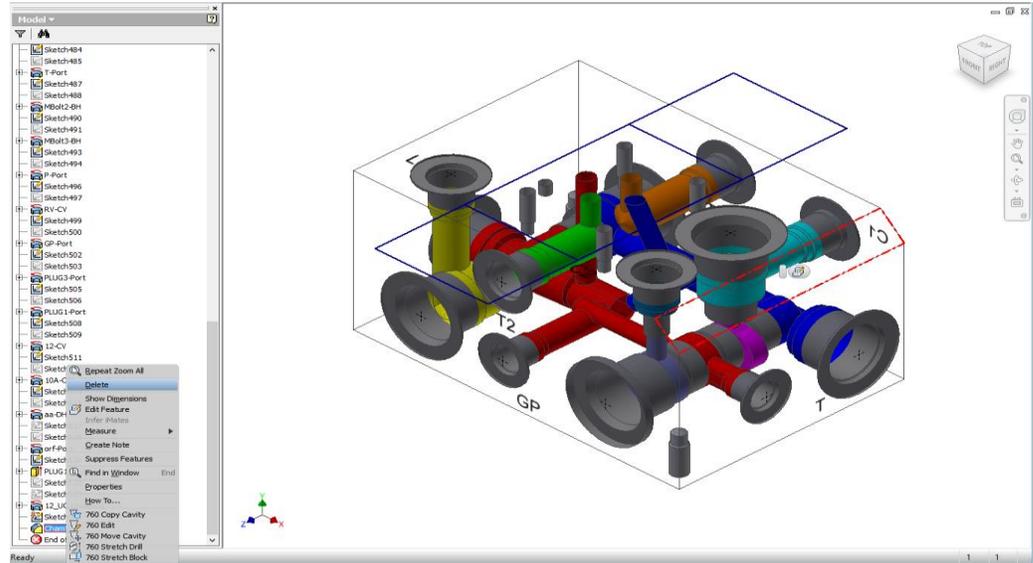
Create Chamfer dialog box

## 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 Bolt Holes
7. Connect to Cavity
8. Angular Connection
9. Stretch Drill
10. Velocity Check
11. Check Bend
12. Check Offset
13. Export Manifold
14. Import Manifold
15. Export to CAMit
16. 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 760 ribbon

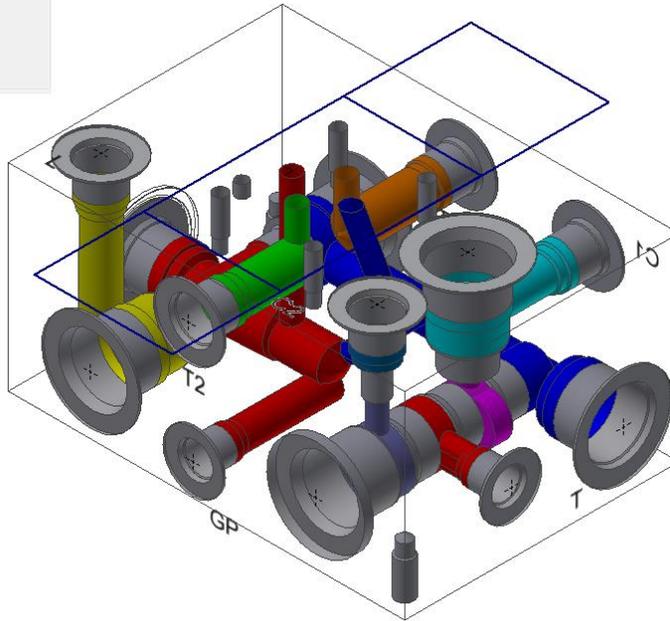
>Block panel  
>Convert

The *Converting manifold...* message displays.

MDTools® automatically converts:

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

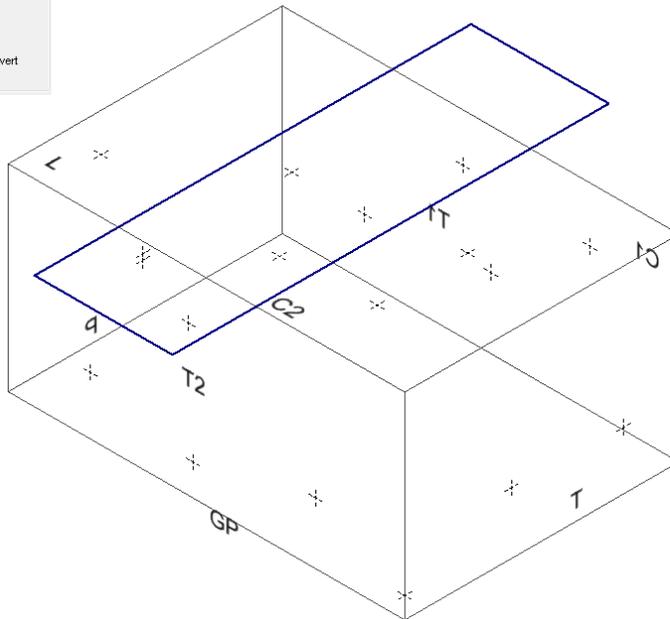
- A feature-based design into a virtual cavity design.



## Note

- Suppress all text engravings on the block before converting the manifold.
- Constrained cavities will be 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



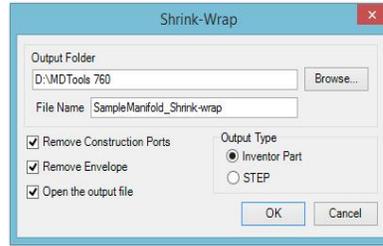
Converting manifold in process

# 16. Shrink Wrap

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

1. MDTools 760 ribbon  
>**Block** panel  
>Slide out menu  
>**Shrink Wrap**

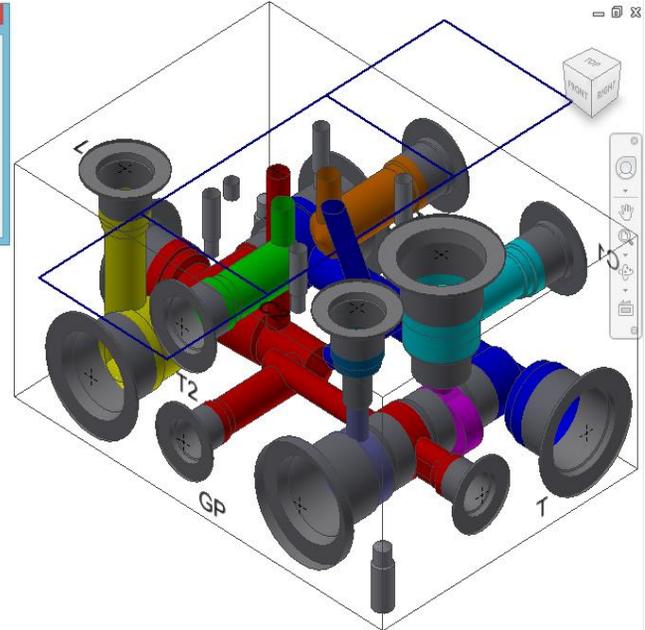
*The Shrink-Wrap dialog box displays.*



2. 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\_Shrink-Wrap".*



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



*Shrink-Wrap dialog box*

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

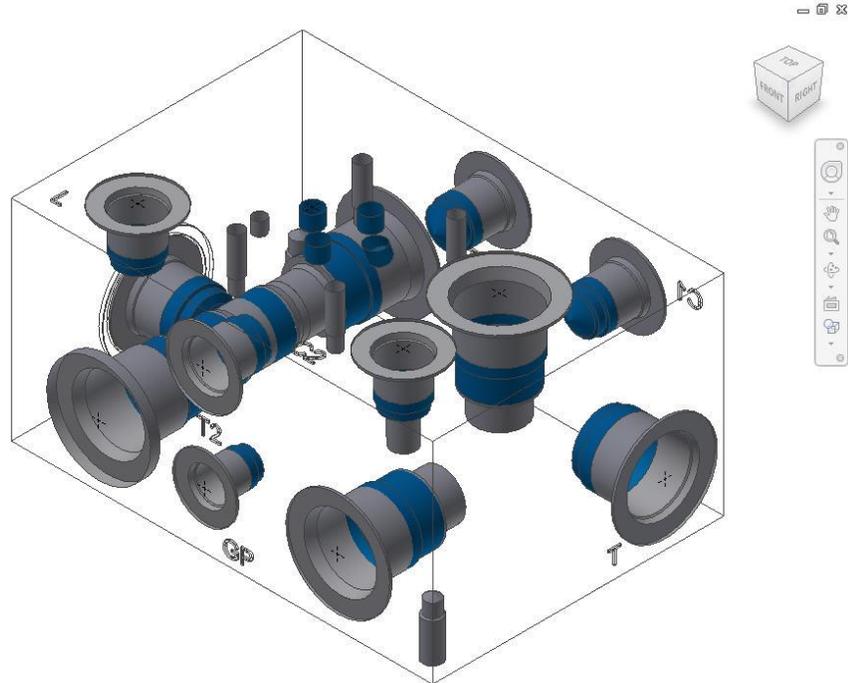
5. Select the type of output required.

6. Select **Open the output file**.

*The output file automatically opens in Inventor.*

7. Click **OK**.

*MDTools® automatically removes all the internal details.*



*Internal details removed automatically*

# 17. Export Block Design

The **Export** command enables you to export a manifold design and create an MDTools® manifold MBXML file.

1. MDTools 760 ribbon  
> **Block** panel  
> Slide out menu  
> **Export (Block Design)**

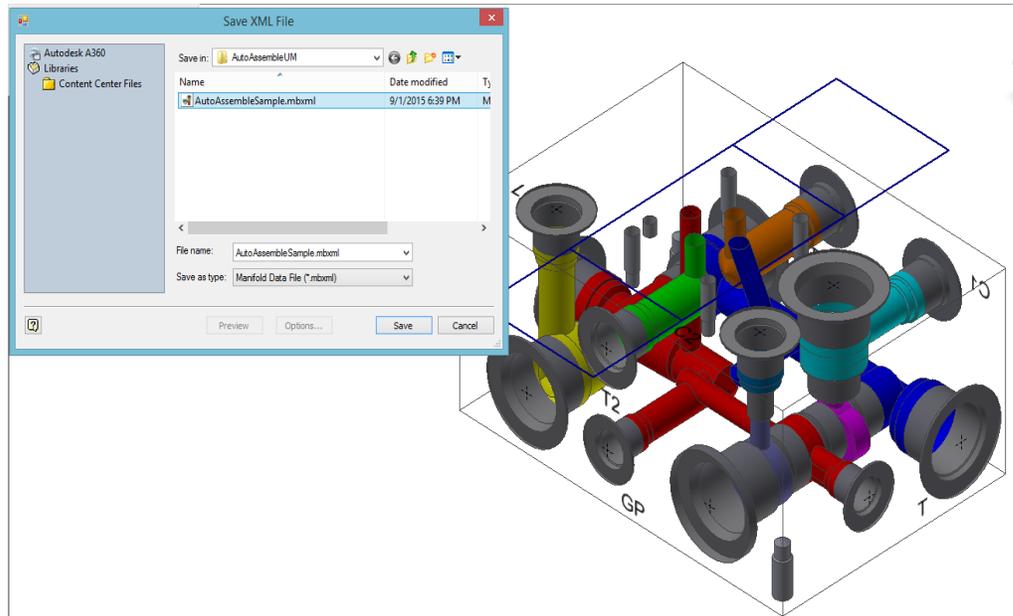
The *Save XML File* dialog box displays.

2. Enter the file name.
3. 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

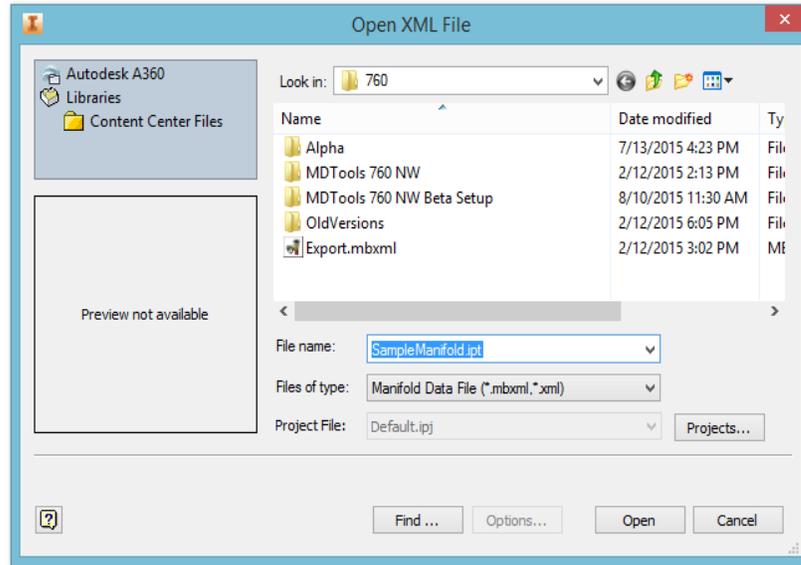
The **Import** command enables you to import an MDTTools® manifold XML/MBXML file and automatically create a new manifold in Inventor.

1. MDTTools 760 ribbon >**Block** panel > Slide out menu >**Import**

The *Open XML File dialog box displays.*

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

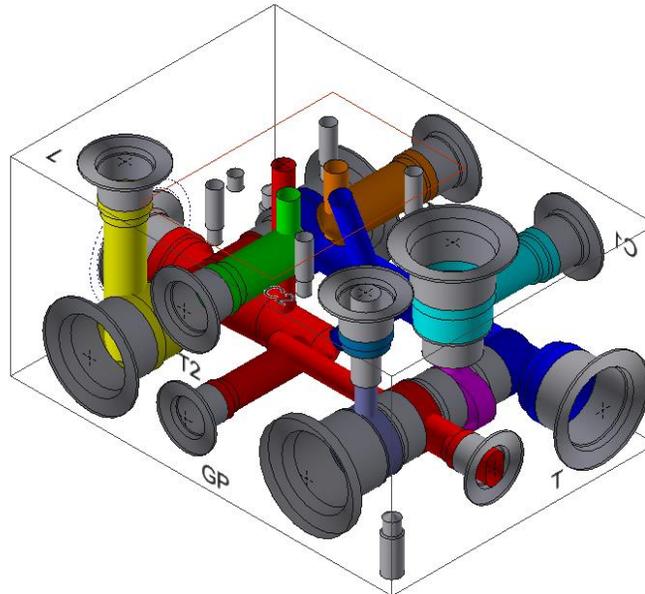
The program reads the input manifold data file and creates a new manifold in Inventor.



### Note

- When you import a manifold, MDTTools creates the manifold in the Virtual Cavity mode.
- Use the Convert Manifold command to convert the block design to a Feature-based cavity design.

Open XML File dialog box



Imported Manifold in Inventor

# 19. Manifold Quote

Submit a manifold quote request through the Internet for a manifold from a registered manifold manufacturer. The quote is generated automatically using VEST, Inc.'s **Manifold Quote System** and is received as a PDF file in the user mailbox within few minutes.

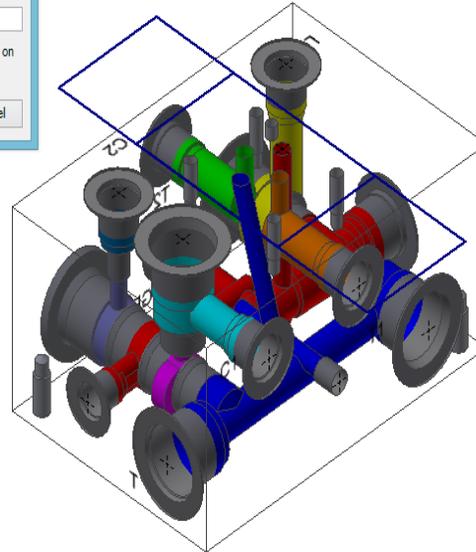
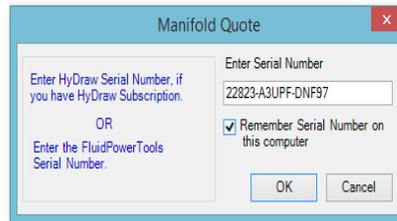
1. MDTools® 760 ribbon  
>**Block** panel  
>**Manifold Quote**

*The HyDraw – Serial Number dialog box displays.*

2. Enter the allotted serial number.
3. Select **Remember Serial Number on this computer**, if required.
4. Click **OK** to initiate the validation process of the serial number.

*This service will connect to the Internet for the validation process. On validation success, the MDTools manifold will be read from the drawing.*

*The Manifold Quote dialog box displays.*



Manifold Quote – Serial Number dialog box

**Manifold Manufacturers** from various regions around the world have already registered themselves with **VEST, Inc.** This enables the users to deliver accurate and quick quotes using this “Cutting Edge Technology” automatically through electronic medium, which aims to reduce the turnaround time to deliver a manifold.

5. Enter **Part Number** for the manifold.
6. Select a registered manifold manufacturer from the Manufacturer drop-down list to view the options on offer for requesting a quote request.

7. Select **Material, Plating, and Color** options, which are available as per the selected manifold manufacturer.

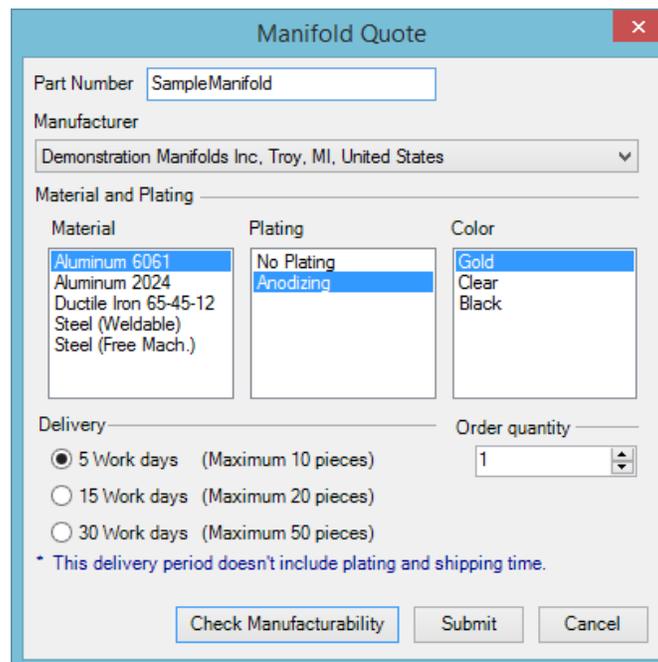
8. Select **Delivery** options along with your **Order quantity**, which is within the maximum limit.

*Each manifold manufacturer may have a different limit for a number of manifolds to manufacture, based on the number of delivery days.*

9. Click **Submit**.

*When the manifold quote request is submitted, a message box displays success.*

*The quotation will be mailed to the respective user mail ID.*



Manifold Quote –Submit Request

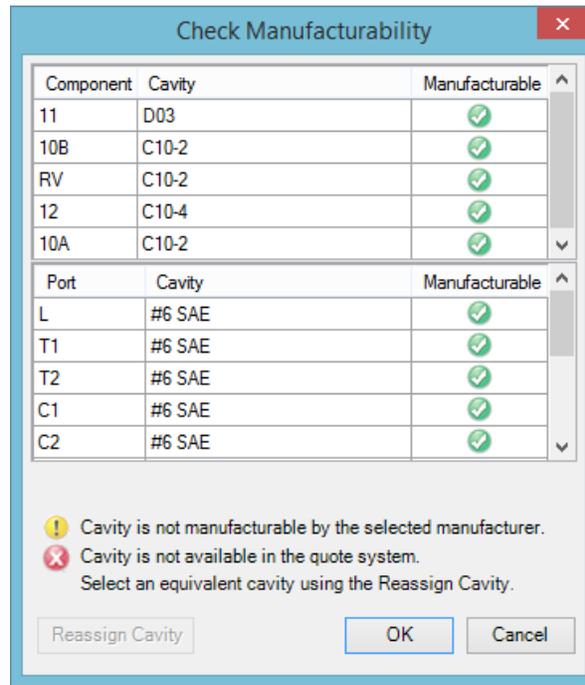
**Note**

- A quote can be requested from a manufacturer, only if all the cavities in the manifold are available in the quote system and are manufactured by the selected manufacturer.  
For example- any custom-named cavity may not be available.
- The Check Manufacturability dialog box displays if any of these validations fails or it can be checked manually before submitting a quote request.

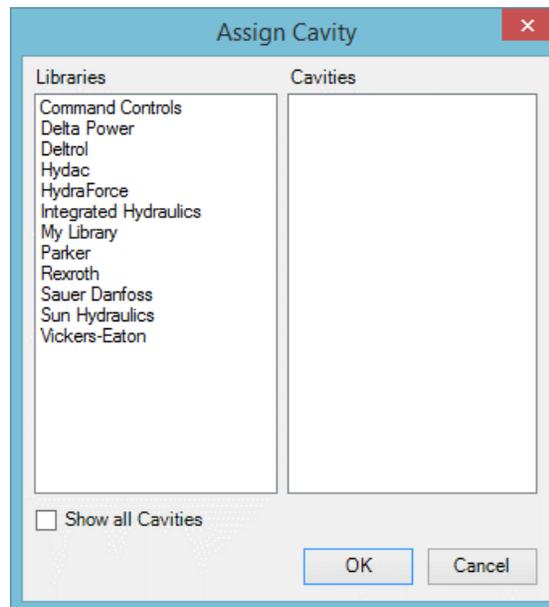
10. All the components and ports are grouped together separately. A cavity could be selected by selecting an item from the list of components or ports.
11. Click **OK** to close the dialog box if all the cavities meet the criteria stated above.
12. Click **Reassign Cavity** to select an equivalent cavity which is manufactured by the selected manufacturer for any cavity which fails the above criteria.  
*The Assign Cavity dialog box displays.*
13. Click an item from the **Libraries** list to view an equivalent cavity list containing similar number of ports, and is manufactured by the selected manufacturer.
14. You may select **Show all Cavities** to show all the cavities irrespective of the number of ports.
15. Click **OK** to assign an equivalent cavity selected from the Cavities list.
16. Repeat this process for all the components and ports which fail the criteria to submit a quote request.

**Note**

Check and configure the Internet Settings to connect to the Internet in order to use the Manifold Quote service.



Check Manufacturability dialog box



Assign Cavity dialog box

## 20. Compare Manifolds

Compare two selected manifolds.

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

1. MDTools 760 ribbon  
>**Block** panel  
>**Compare Manifolds**

The Compare manifolds dialog box displays.

2. Select two manifolds to be compared.

*Manifold A: By default, the current manifold displays.  
Select a different manifold, if required. .*

3. Parameters:

These are optional parameters.

These sections can be included in the report along with the fixed sections.

- **Cavity Geometry**

Compares all the cavity steps including Step0 and Step12 dimensions and port dimensions.

If unselected, then MDTools will compare only Step0 and Step12 dimensions.

- **Engravings**

Compares engravings also.

The section included in the report will be

1. New Engravings
2. Deleted Engravings
3. Modified Engravings
4. Renamed Engravings
5. Engravings Moved

- **Component ID**

Show all cavities name as the Component ID.

- **Machining ID**

Show all the cavities name as the Machining ID.

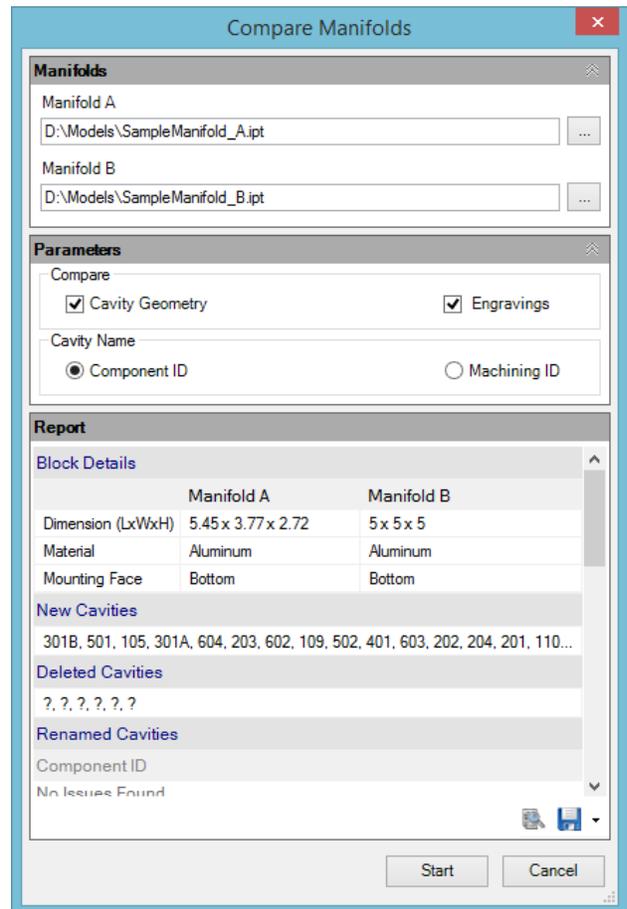
4. Click **Start**.

*Report is displayed in the Report section.*

4. Click , to save the list.

*The Save As dialog box displays.*

5. Enter an appropriate file name and click **Save**.



## Report

Report contains the following sections:

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

Lists all cavities/ports inserted in Manifold A.
  
- **Deleted Cavities:**

Lists all cavities/ports deleted from Manifold A that exists in Manifold B.
  
- **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 B, which are replaced by other cavities/ports in Manifold A.

**Spot Face Diameter Changed:**  
Lists all cavities/ports of Manifold B, where spot face diameter is changed in Manifold A.

**Spot Face Depth Changed:**  
Lists all cavities/ports of Manifold B, where spot face depth is changed in Manifold A.

**Drill Diameter Changed:**  
Lists all cavities/ports of Manifold B, where drill diameter is changed in Manifold A.

**Drill Depth Changed:**  
Lists all cavities/ports of Manifold B, where drill depth is changed in Manifold A.
  
- **Engravings:**

**New Engravings:**  
Lists the new engravings added in Manifold A.

**Deleted Engravings:**  
Lists the deleted engravings.

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

**Engravings Moved:**  
Lists the engravings moved on same face or moved to another face.

### **Drill Added:**

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

### **Counterbore Added:**

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

### **Step Dimension Changed:**

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

*Note: This is an optional section in the report.*

### **Machining Information Modified:**

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

### **Inclination Changed:**

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

### **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 A.

### **Footprints Rotated:**

Lists all footprints which have different rotation in original and Manifold A. The difference of rotation in original and Manifold A is listed in the Rotated By Angle field.

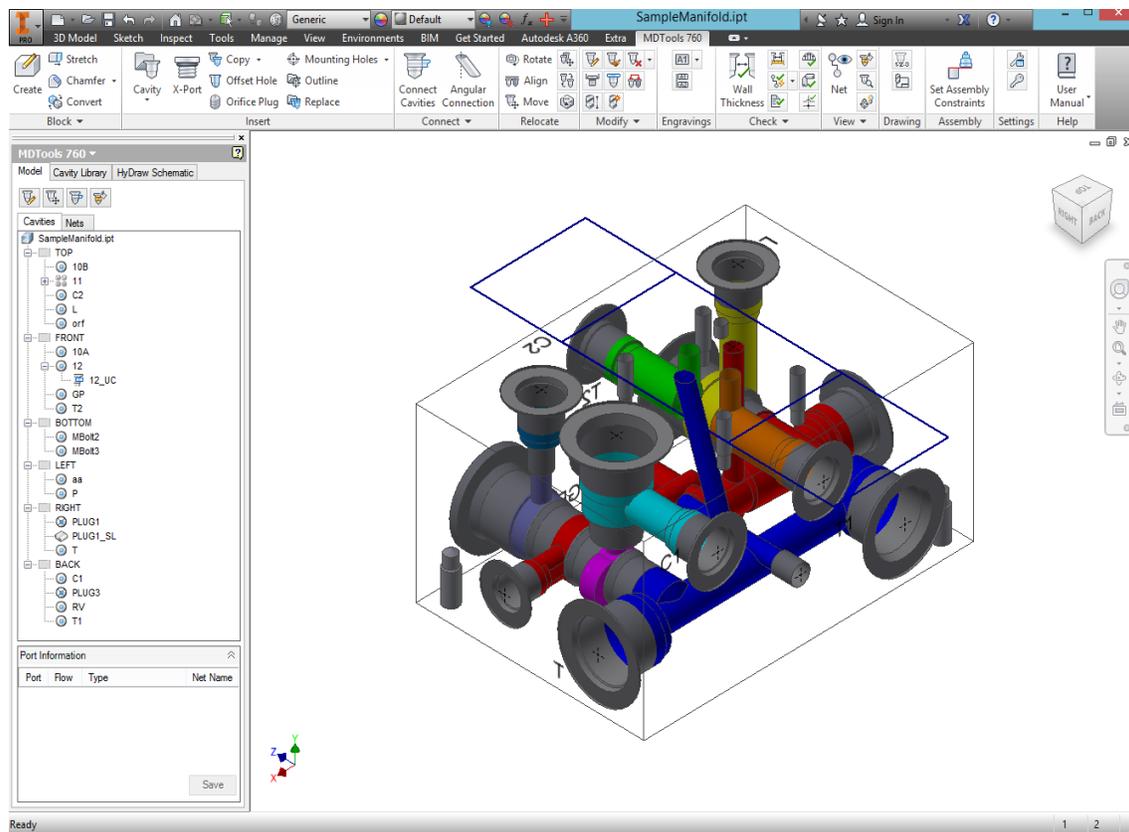
### **Note:**

Engravings section is optional.

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

# Insert

- 21 Insert Cavity (...from Library)
- 22 Insert Cavities (...from HyDraw Schematic)
- 23 Insert Cavities (Non-Rectangular Manifold Block)
- 24 Insert Construction Port (X-Port)
- 25 Copy Cavity
- 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



## 21. 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

- MDTools 760 ribbon  
>Insert panel  
>Cavity or dropdown  
>Cavity

The Cavity Library tab page displays in the MDTools® 760 browser.

- Select the required library name.

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

#### Note

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

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

#### Note

- When you insert cavity/footprint for a component in a 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.

- Click **OK**.

The Specify Cavity Location dialog box displays.

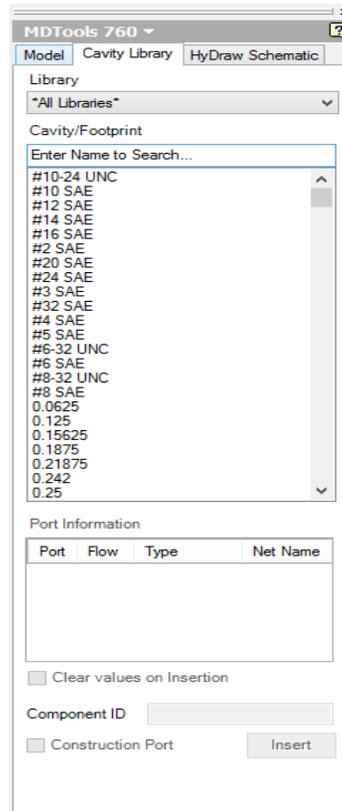
- Select the point on the manifold face where you want to insert the cavity.

MDTools displays a preview with center point and x and y axis arrows indicator of the selected cavity at the selected point on the manifold.

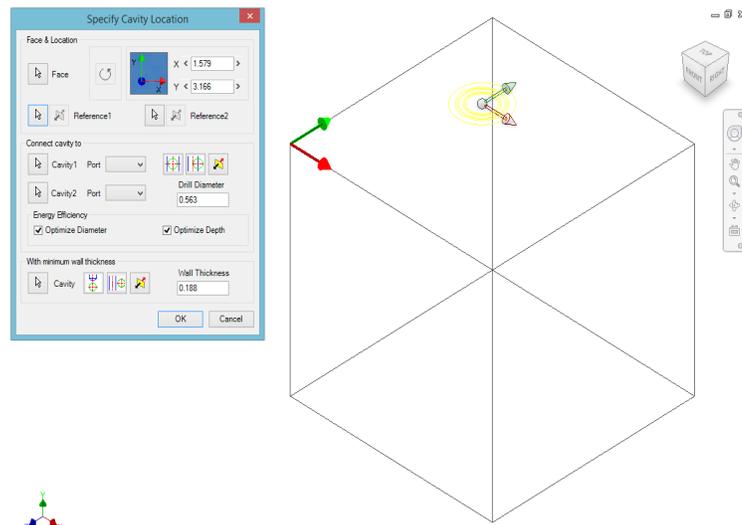
- Enter the X and Y distance from the block origin. Or  
Drag the center point to move cavity on any axis. Or  
Drag the X and Y axis arrow to move cavity along a single direction.

- Click **OK**.

The cavity is inserted at the specified location.



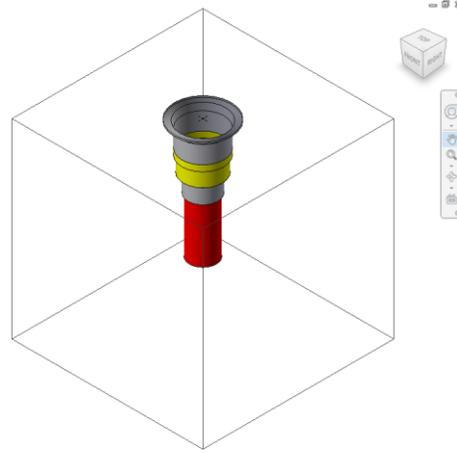
MDTools browser - Cavity Library tab



Specify Cavity Location dialog box

**Note**

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

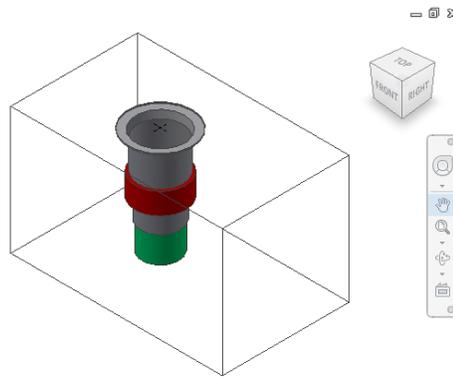


*Cavity inserted with connectivity information*

**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*

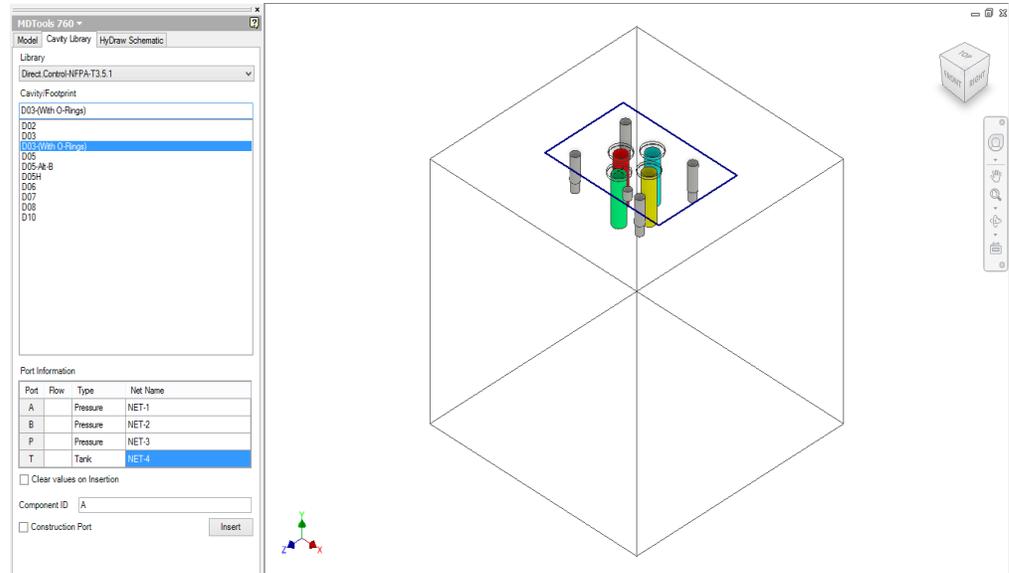
**O-ring in Cavity Profile**

*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 cavity library.

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.

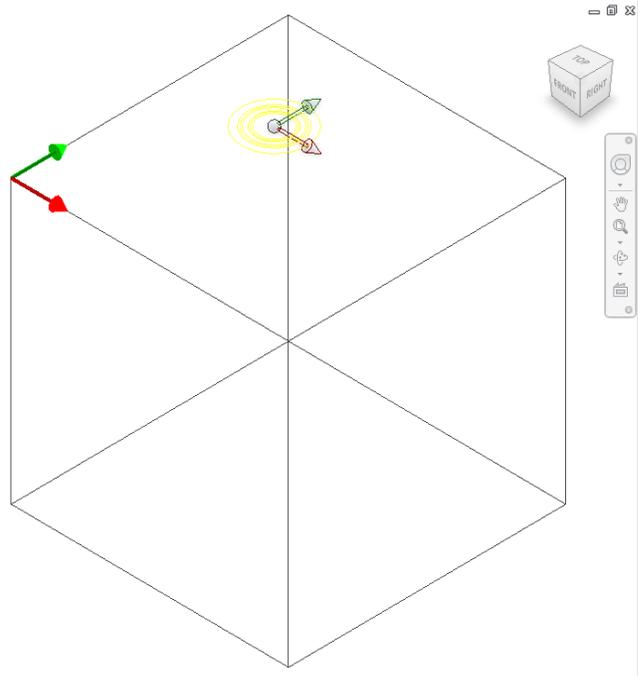
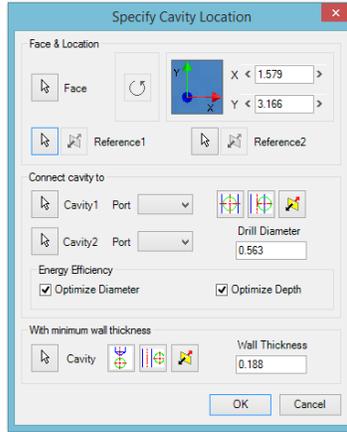


*O-ring automatically inserted with cavity*

# 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

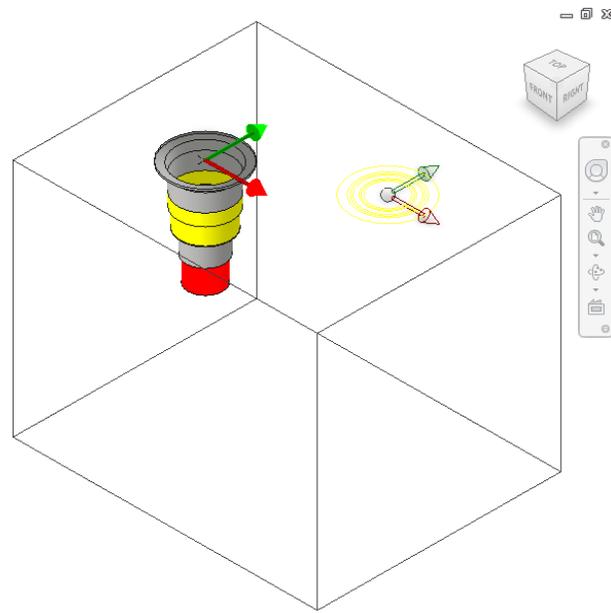
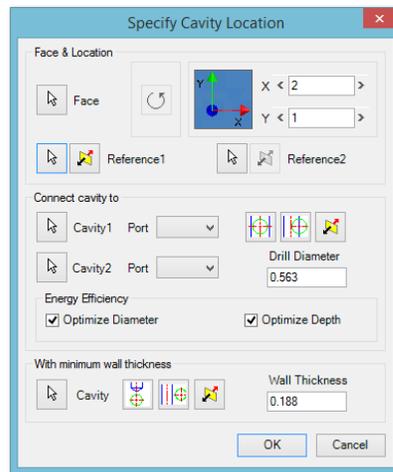
- Select Reference2 when you want to change the reference of both the X and Y axis.
- Click the Flip button to change the direction of axis. This flips the cavity location when a cavity is used as a reference.



*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.*



*Position the new cavity with reference to an existing cavity*

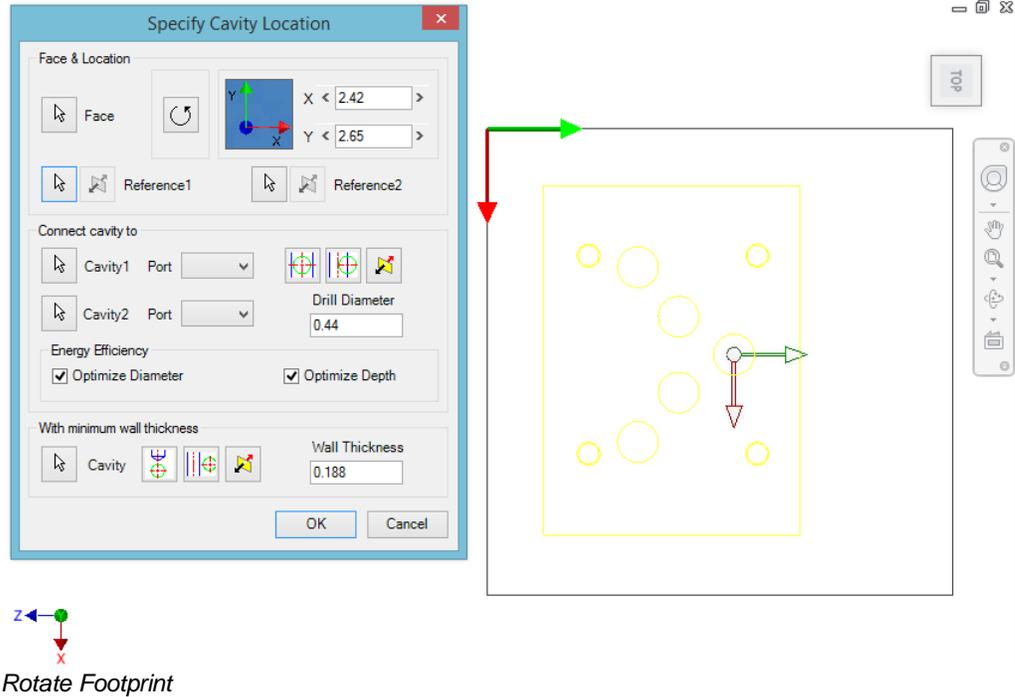
4. Click **OK** to create the cavity at the specified location.

## 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 to 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.

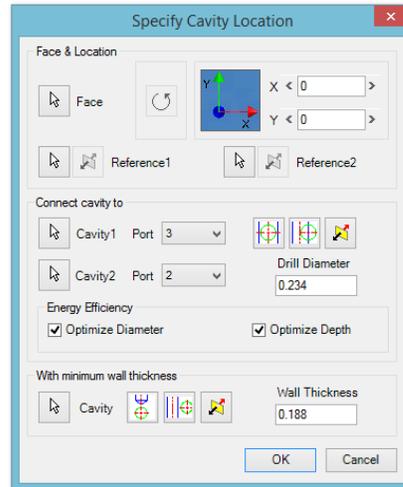
*MDTools automatically relocates the cavity to the overlapping center of the two cavity ports.*

4. Click **OK**.

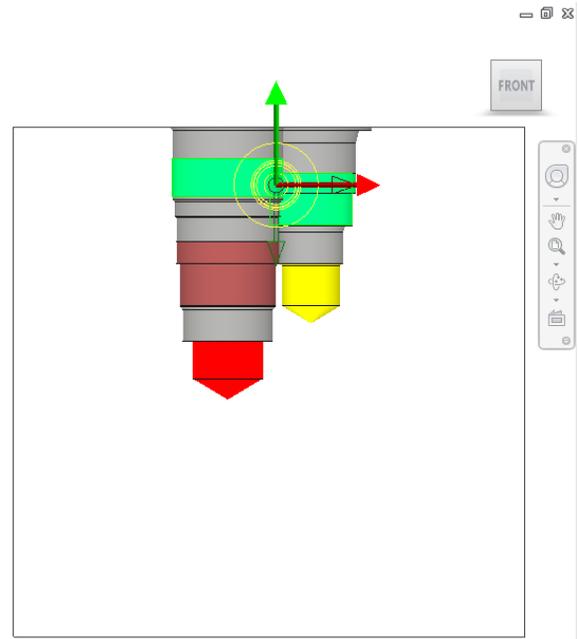
*MDTools creates the new cavity at the specified location and connects the cavity to the selected connecting cavities.*

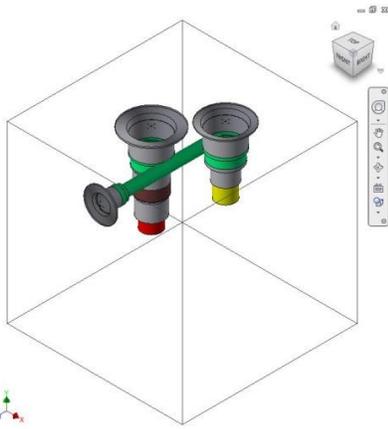
#### Note

- 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.

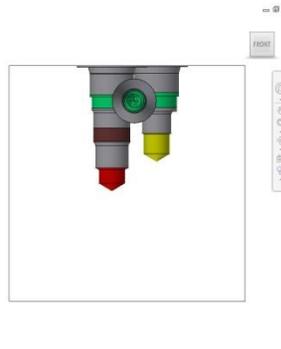


Positioning the cavity on the sides





The two cavities are connected

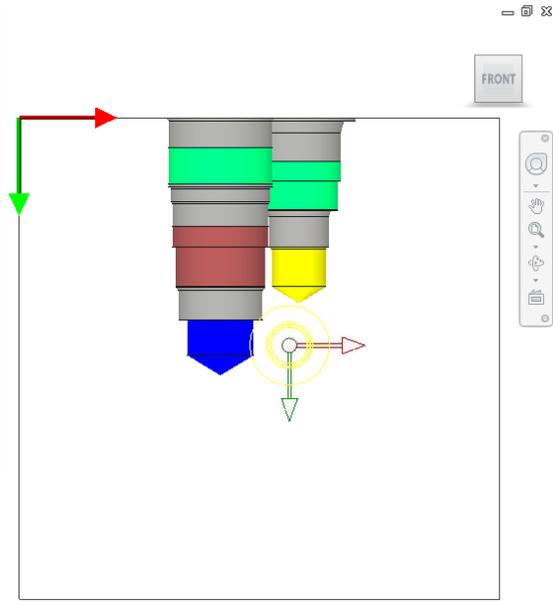
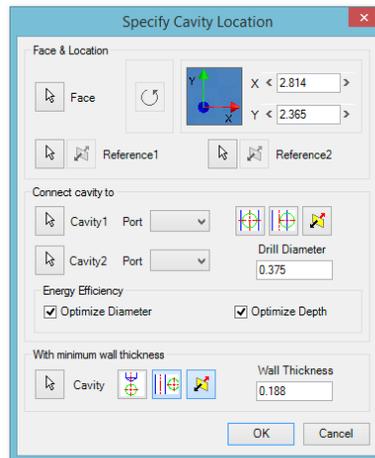


Connecting two existing cavities

#### 4 Position with minimum wall thickness

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

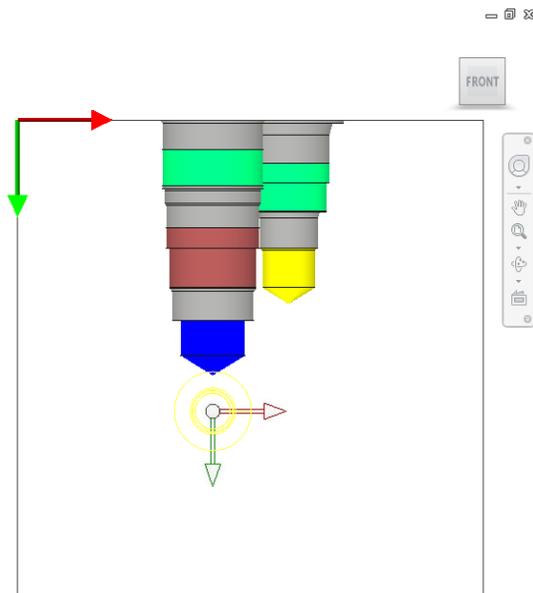
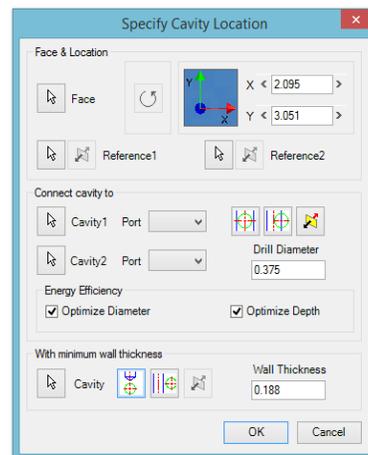
1. Click the selection button for cavity.
2. Select an existing cavity in the manifold.
3. Click the **Move to side** button to position the new cavity away from the selected cavity axis.
4. Click the **Flip side** button to change the side, if required.
5. Repeat the above steps to position the cavity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



Positioning 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.



Positioning the new cavity below the cavity tip

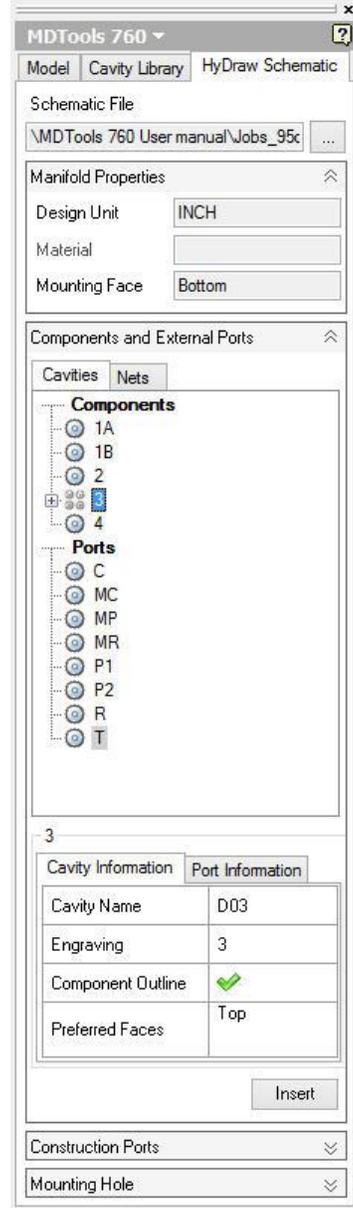
## 22. Insert Cavities (...from HyDraw Schematic)

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

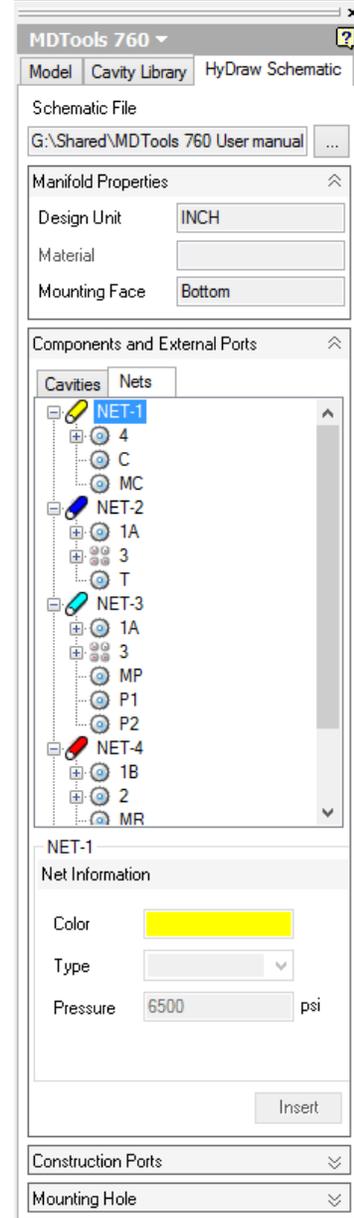
- MDTools 760 ribbon  
>**Insert** panel  
>**Cavity** dropdown  
>**From HyDraw**  
*The HyDraw Schematic tab page displays in the MDTools 760 browser.*
- Click the Schematic File **Browse** button and select the required HyDraw schematic xml/mbxml file.
- Click **Open**.  
*MDTools automatically populates the Cavity Explorer with all the components from the schematic drawing.*
- Select a component.

### Note

- The cavity and port information are displayed in the respective grid.
  - Cavity Browser displays the cavities by the cavity ID and Connectivity Browser displays by the net name.
  - The information on Engraving, Component Outline, and Preferred Faces is available only for MBXMLs imported from QuickManifolds.
- Click **Insert Cavity**.  
*The Specify Cavity Location dialog box displays.*



MDTools 760 Browser:  
HyDraw Schematic Page  
– Cavity Browser



MDTools 760 Browser:  
HyDraw Schematic Page  
– Connectivity Browser

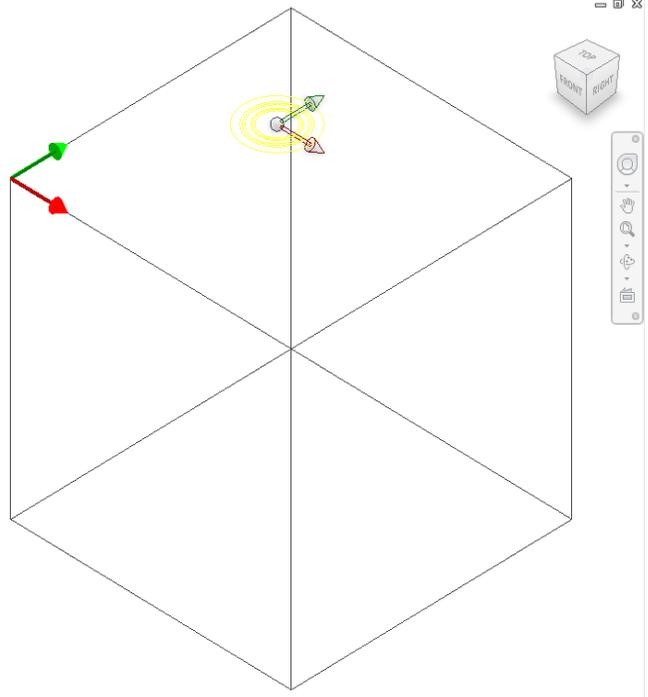
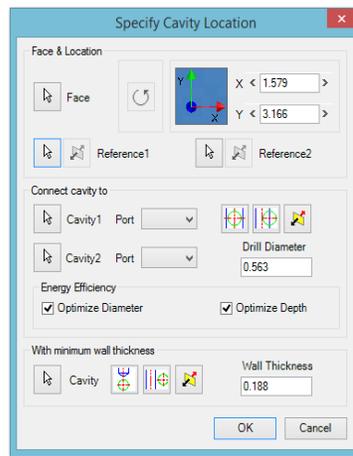
- Select the point on the manifold face, where you want to insert the cavity.

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

- Click **OK**.

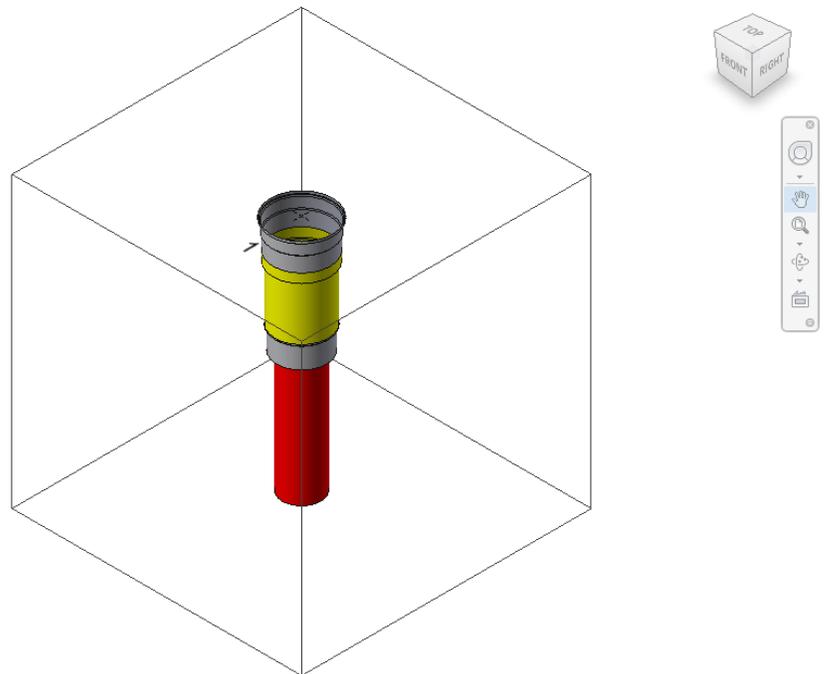
*The cavity is inserted at the specified location.*



Specify Cavity Location dialog box

#### Note

- Once a cavity is inserted into the manifold it is displayed in black against a shaded background in the Cavity Explorer and Connectivity Explorer.
- Refer HyDraw® Schematic Page.



Cavity inserted with Cavity and Port information

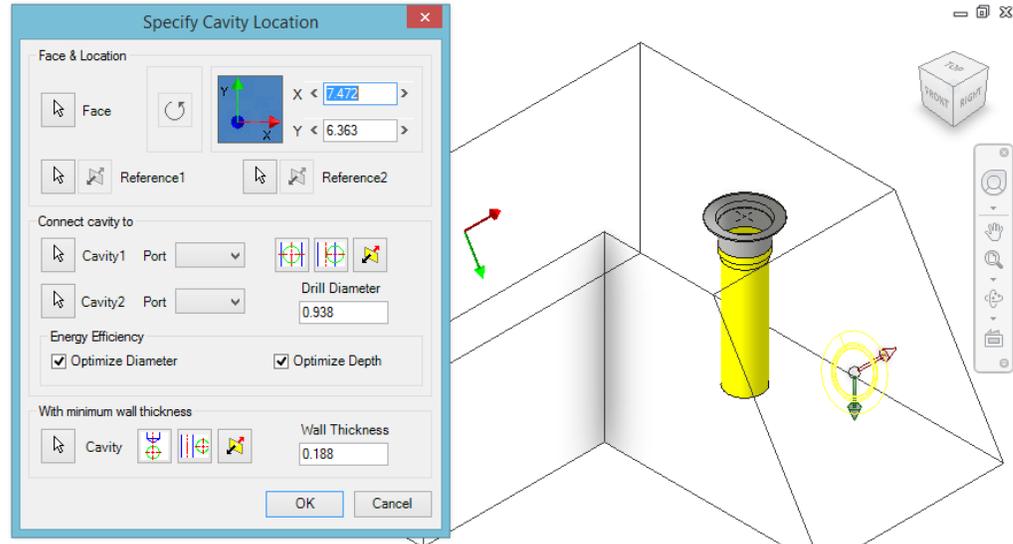
## 23. Insert Cavities (Non-Rectangular Manifold Block)

### Inserting Cavities

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

#### Note

- MDTTools 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.

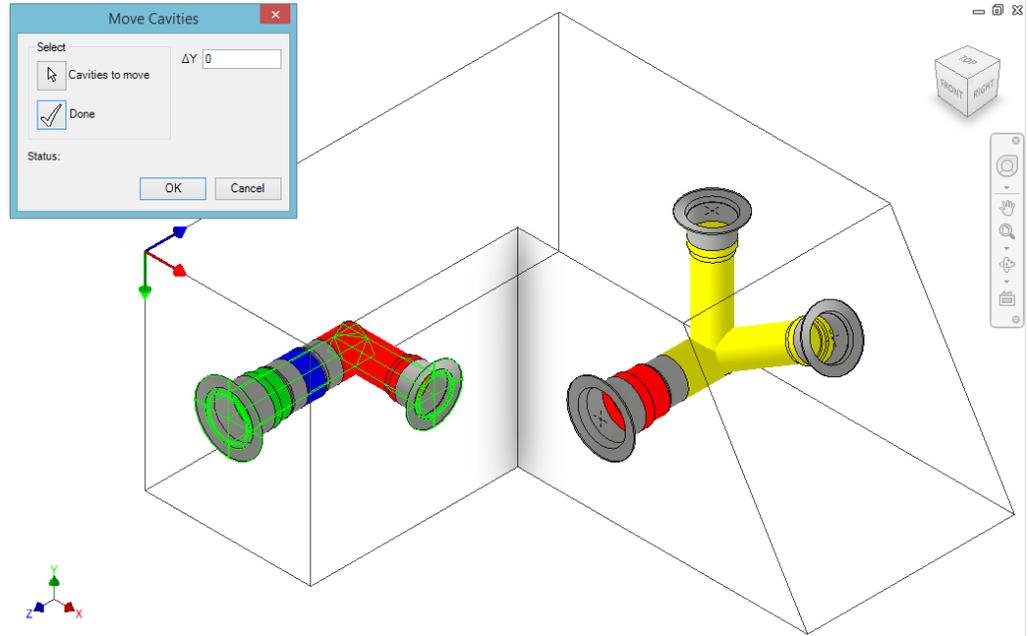


 Specify Cavity Location dialog box

## 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.



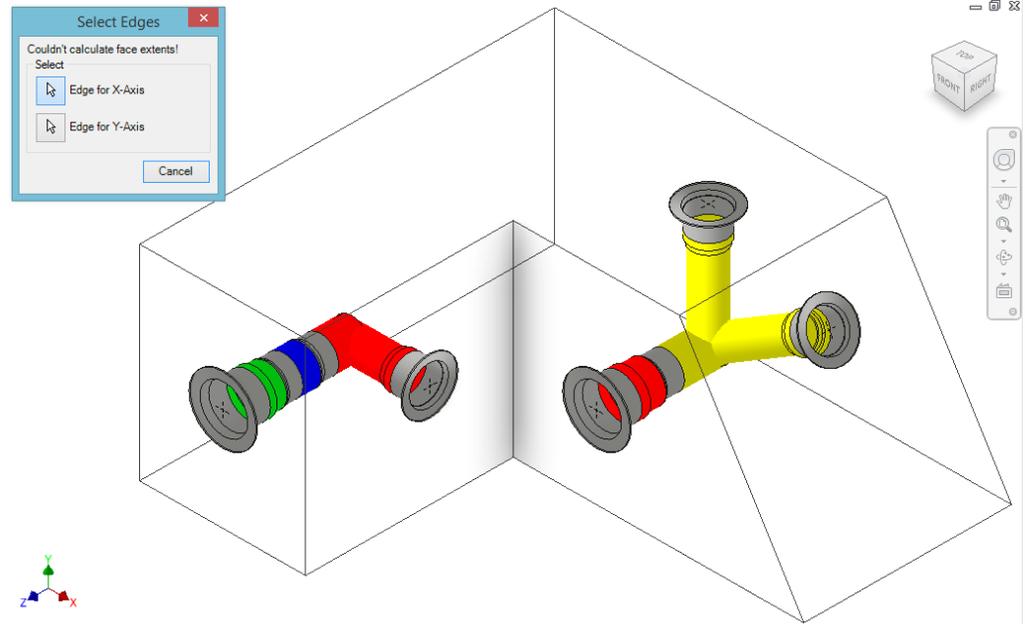
Move Cavities dialog box

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

*The Move Cavity dialog box displays.*

### Note

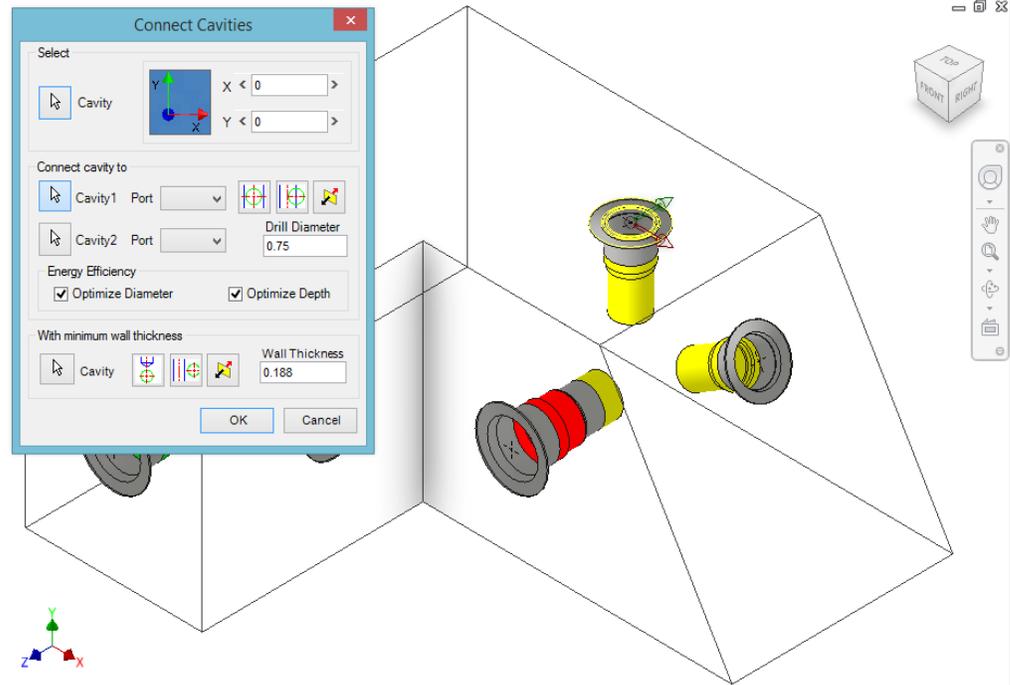
The Parametric Move command does not work with the non-rectangular manifold.



Select Edges dialog box: Specify the axes

## Creating Connections between Cavities

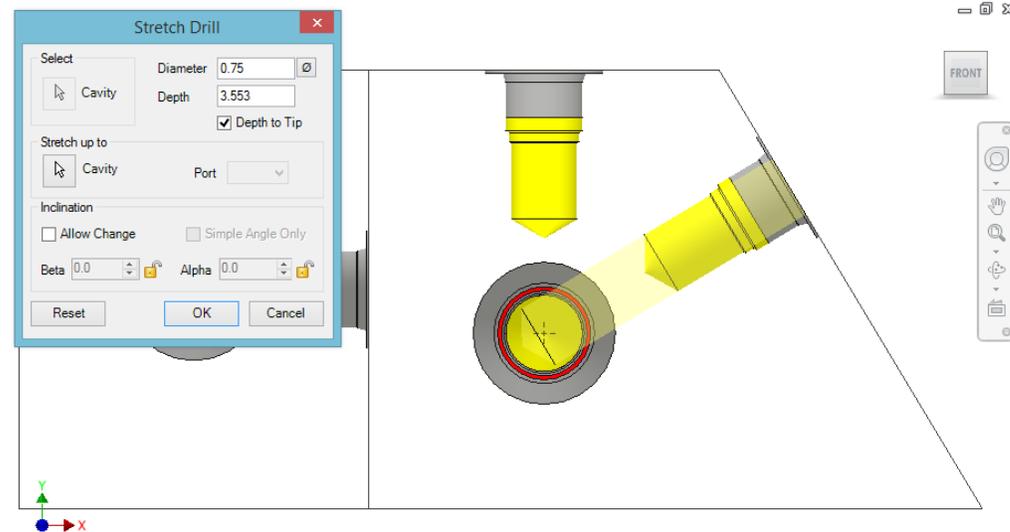
Use the MDTools® **Connect to Cavity** command to create connections between cavities on the non-inclined faces.



Connect Cavities dialog box

### Note

- The Connect to Cavity 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.



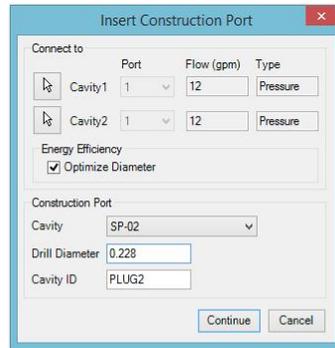
Stretch Drill dialog box: Cavity is stretched to create connection

## 24. Insert Construction Port (X-Port)

Automatically select a suitable construction port, per the connecting cavities. If energy efficient connection is active, then MDTools® will suggest drill diameter and a construction port to minimize bend losses.

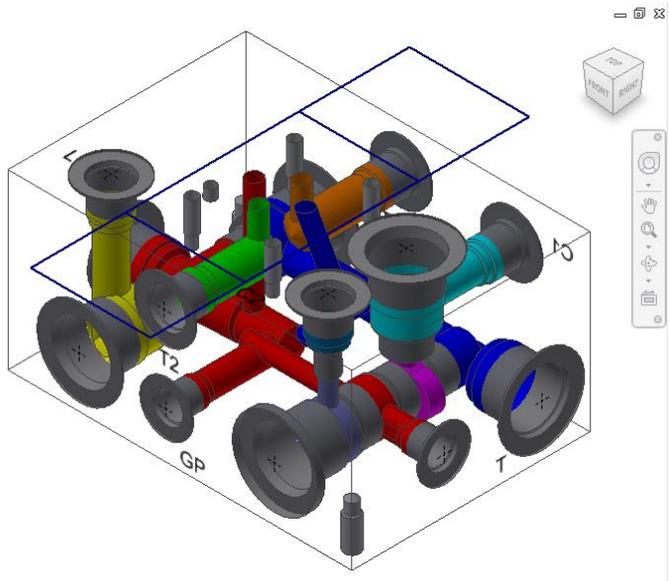
1. MDTools 760 ribbon >Insert panel >X-Port

The Insert Construction Port dialog box displays.



2. Select **Cavity1**.
3. Select the **port** for the first cavity.

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



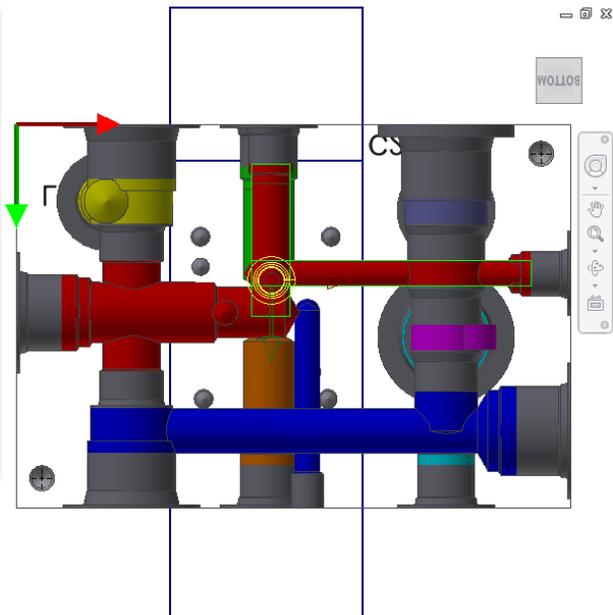
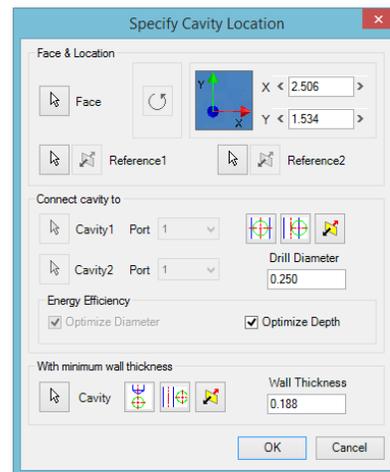
Insert Construction Port dialog box

### 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.



Specify Cavity Location dialog box

6. Click **Continue**.

The Specify Cavity Location dialog box displays.

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

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

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

9. 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.

# 25. 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.

- MDTools 760 ribbon  
>Insert panel  
>Copy dropdown  
>Copy

The Copy Cavity dialog box displays.

- Select the cavity you want to copy.
- Enter the **Component ID** for the new cavity/footprint.
- 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.

- Click **OK**.

The Specify Cavity Location dialog box displays.

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

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.

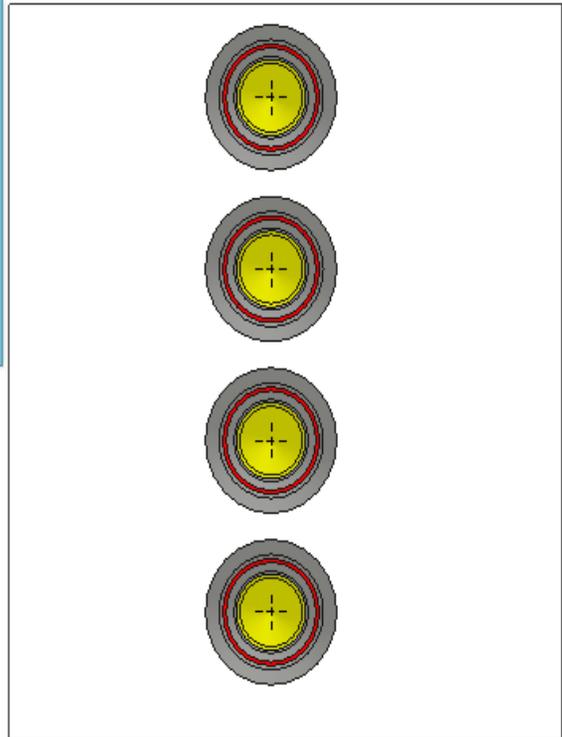
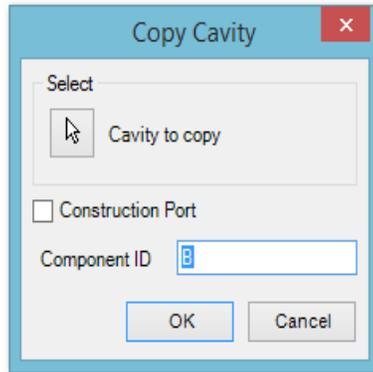
- Enter the X and Y distance from the block origin.  
Or  
Drag the center point to move cavity along any axis.  
Or  
Drag the X and Y axis arrow to move cavity along a single direction.

- Click **OK**.

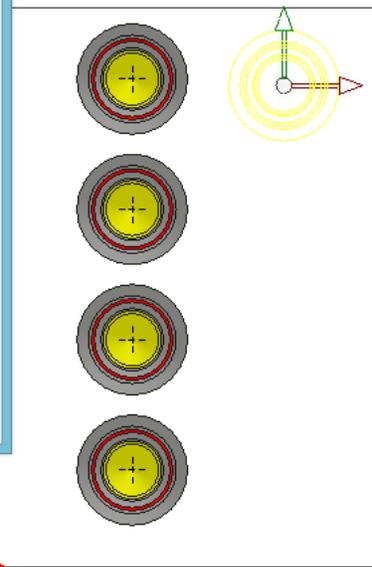
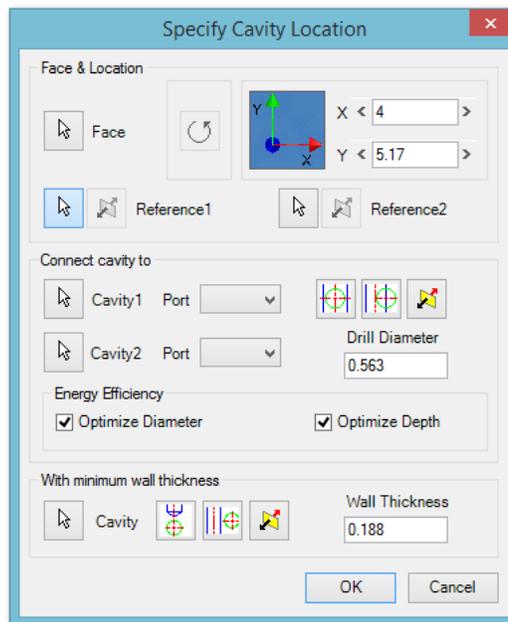
MDTools creates a copy of the selected cavity at the specified location.

### 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.



Copy Cavity dialog box

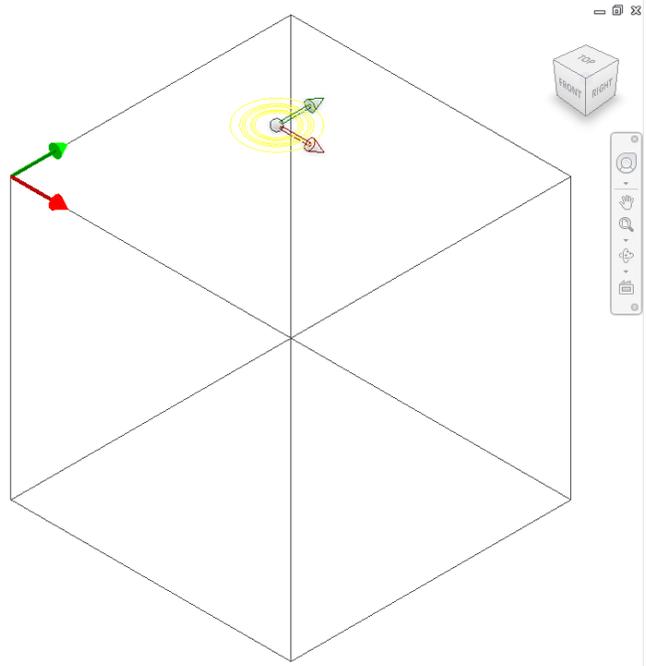
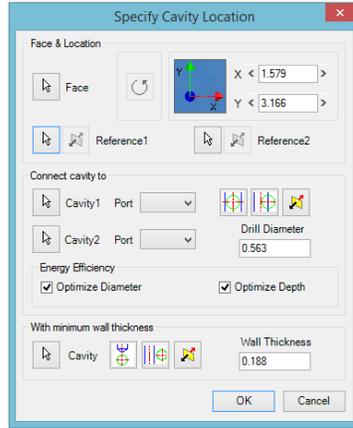


Specify Cavity Location dialog box

# 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, per the new origin.*



## Note

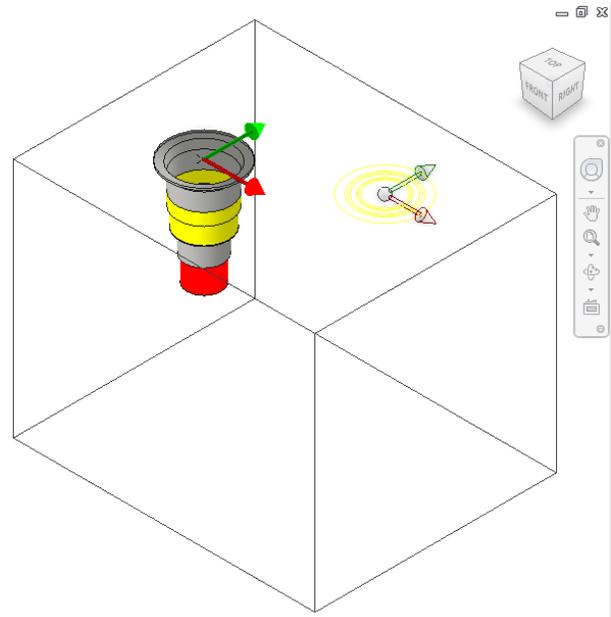
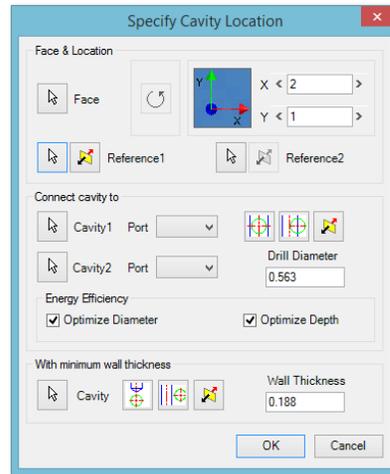
- Select Reference2 when you want to change the reference of both the X and Y axis.
- Click the Flip button to change the direction of axis. This flips the cavity location when a cavity is used as a reference.



*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.



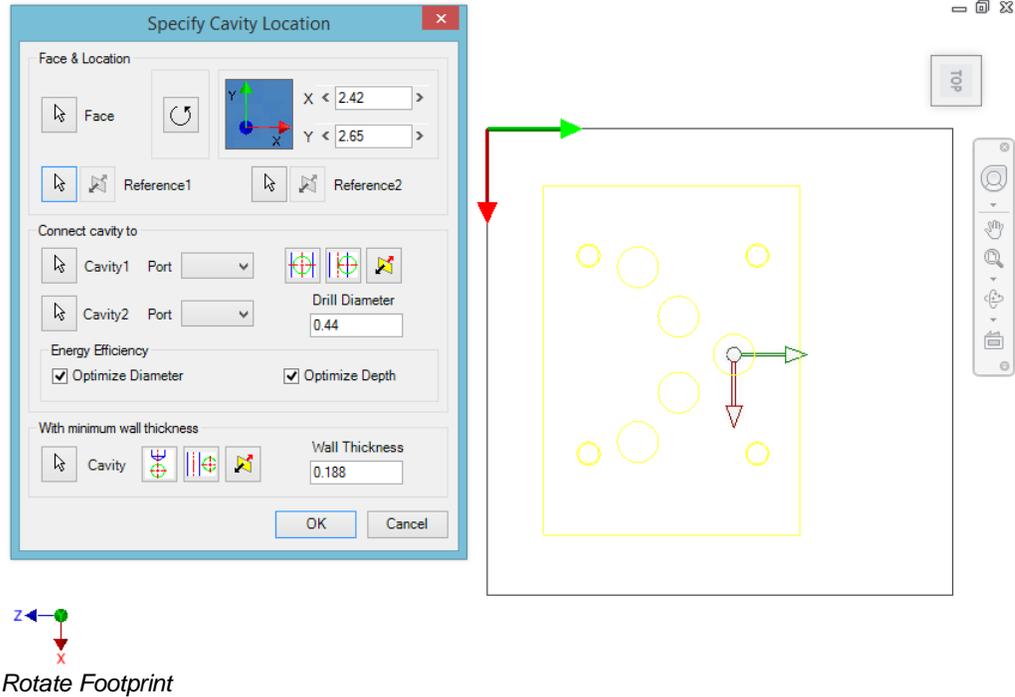
*Position the new cavity with reference to an existing cavity*

## 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.

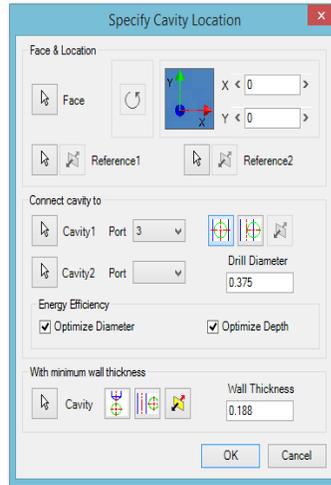
*MDTools automatically relocates the cavity to the overlapping center of the two cavity ports.*

4. Click **OK**.

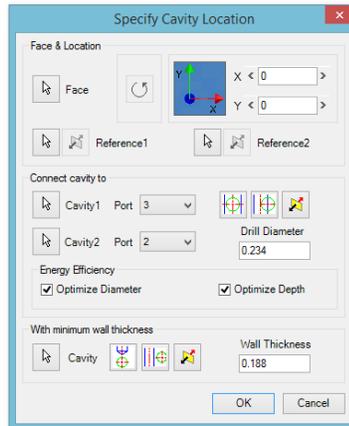
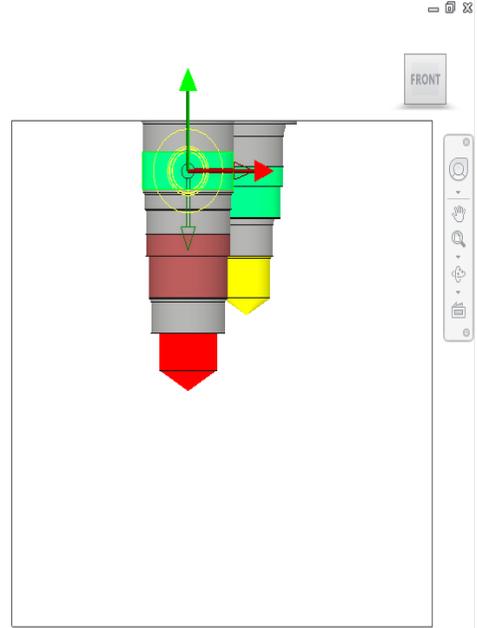
*MDTools creates the new cavity at the specified location and connects the cavity to the selected connecting cavities.*

#### Note

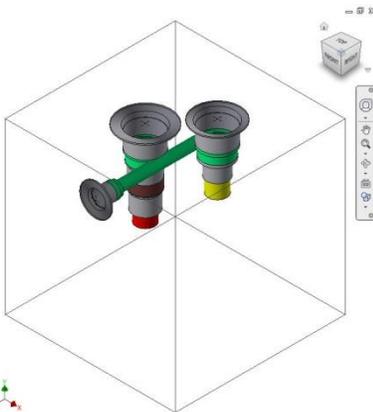
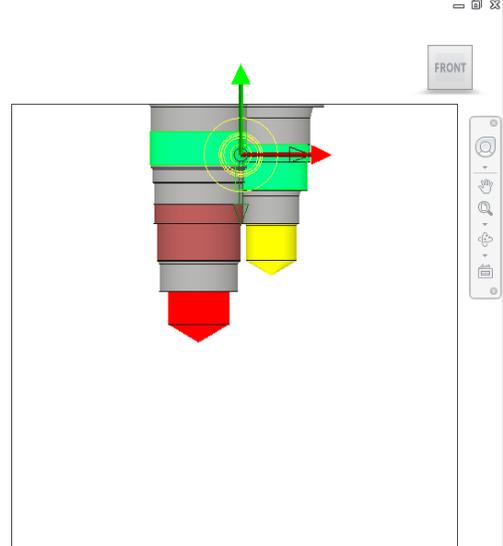
- The Energy Efficient connectivity is applied, if either Optimize Diameter or Optimize Depth is selected.
- Click the **Relocate to side** button to relocate the cavity to a side.
- Click the **Flip side** button to flip the sides.
- MDTools automatically selects the best drill diameter from the tooling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



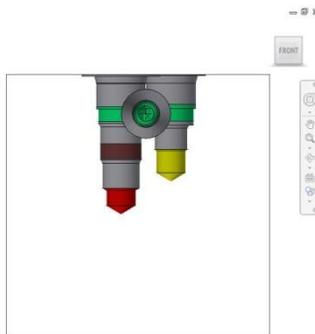
*Positioning the cavity on the center*



*Positioning the cavity on the side*



*The two cavities are connected*

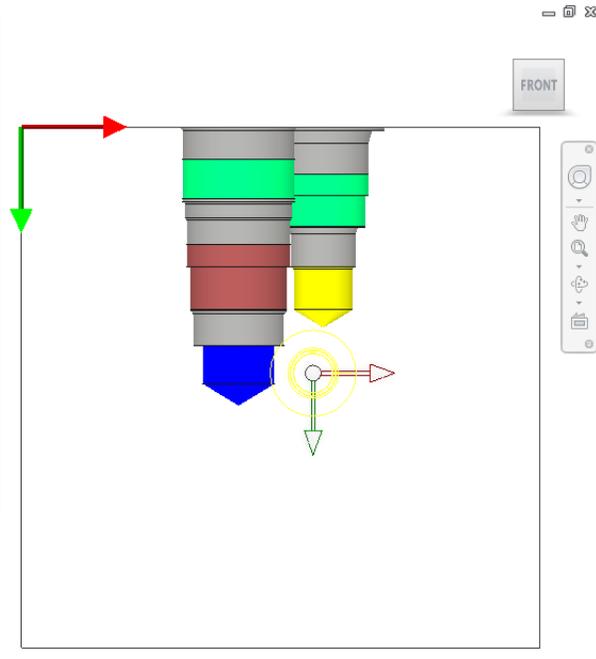
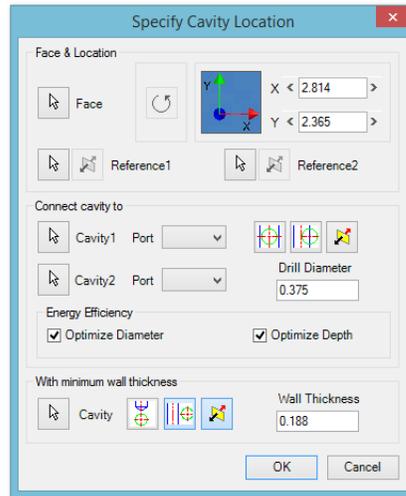


*Connecting two existing cavities*

## 4 Position with minimum wall thickness

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

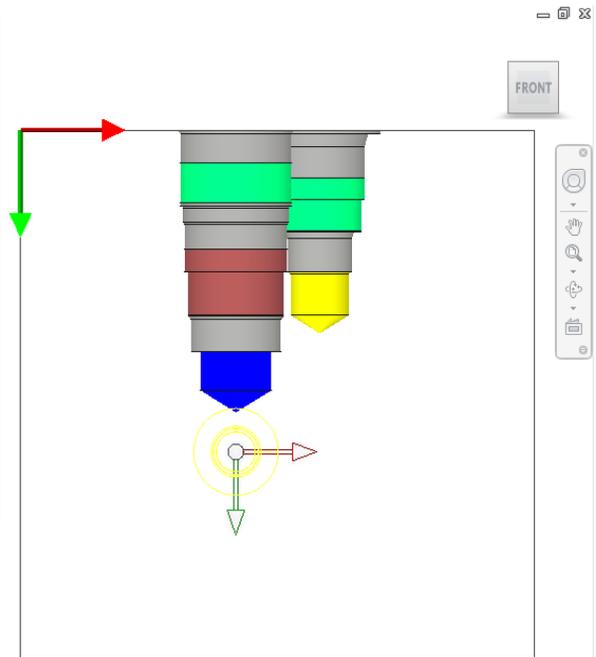
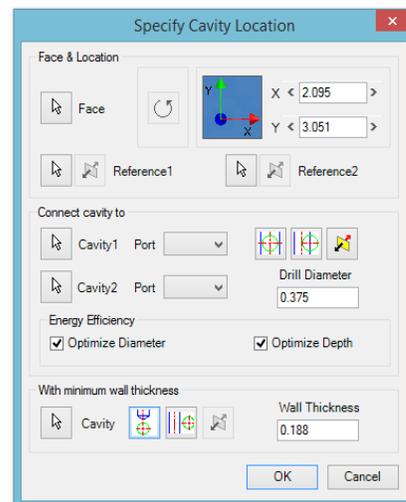
1. Click the selection button for Cavity.
2. Select an existing cavity in the manifold.
3. Click the **Move to side** button to position the new cavity away from the selected cavity axis.
4. Click the **Flip side** button to change the side, if required.
5. Repeat the above steps to position the cavity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



*Positioning 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.



*Positioning the new cavity below the cavity tip*

## 26. Copy Multiple

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

- MDTools 760 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 axes displays in the dialog box.

- Enter the required displacement along each axis.

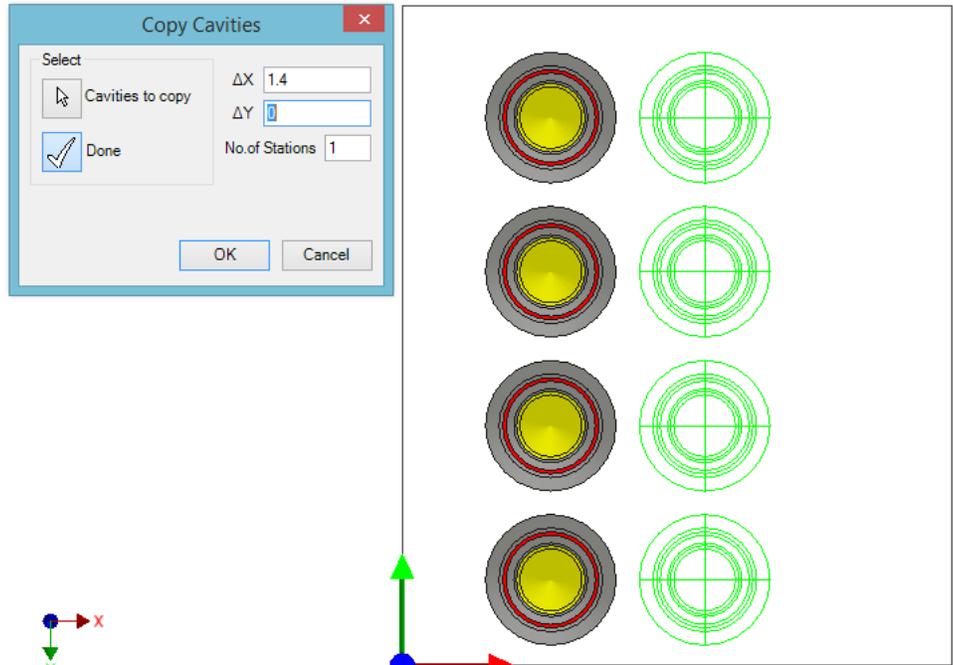
If you select cavities on perpendicular faces, MDTools display only one field to enter displacement, as the cavities have only one common axis.

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

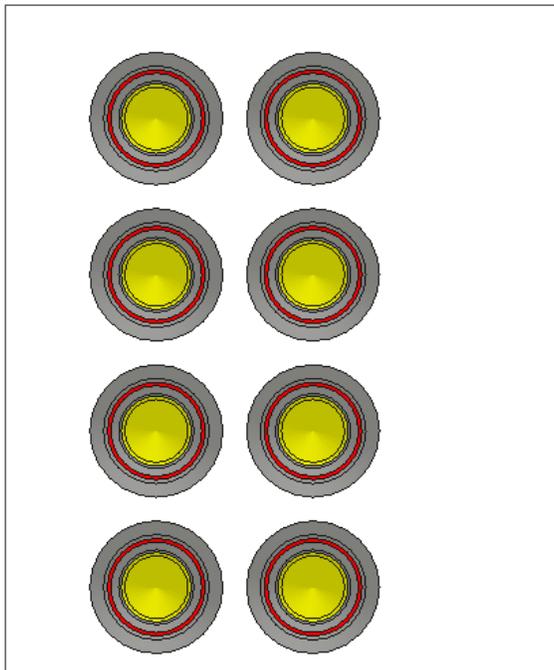
MDTools create copies of the selected cavities/footprints.

### 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.



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.

1. MDTools 760 ribbon  
>Insert panel  
>Offset Hole

The MDTools® Select Cavity dialog box displays.

2. Select a cavity to insert the offset hole.

The Insert Offset Hole dialog box displays.

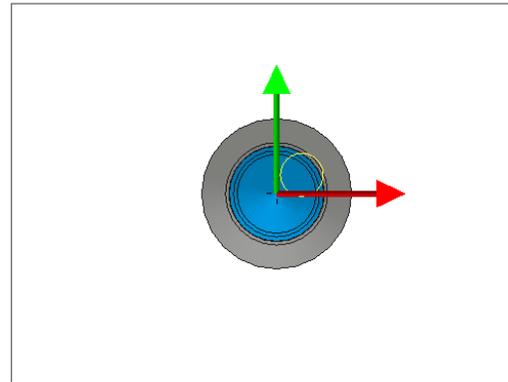
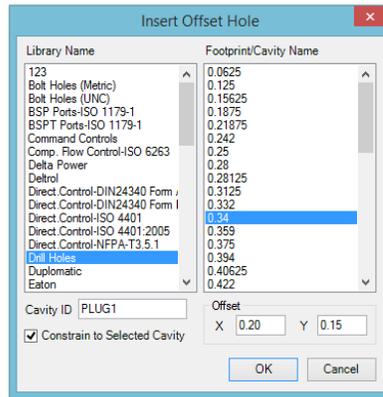
3. Select the offset hole from the library.

4. Enter X and Y distances from the parent cavity center.

MDTools displays a preview of the drill hole at the specified location.

5. Click **OK**.

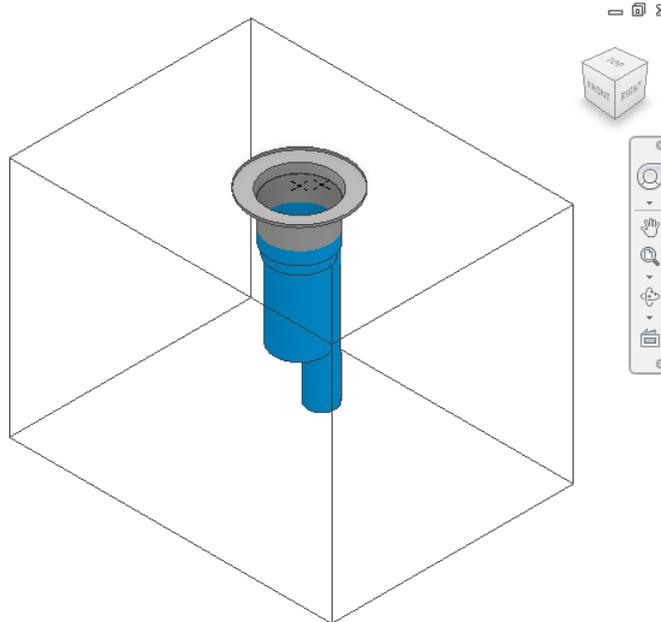
MDTools inserts the offset hole into the selected cavity with the specified X and Y offset distances.



Insert Offset Hole dialog box

### Note

- The depth of the offset hole is 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, X, and Y distances to create a concentric hole.



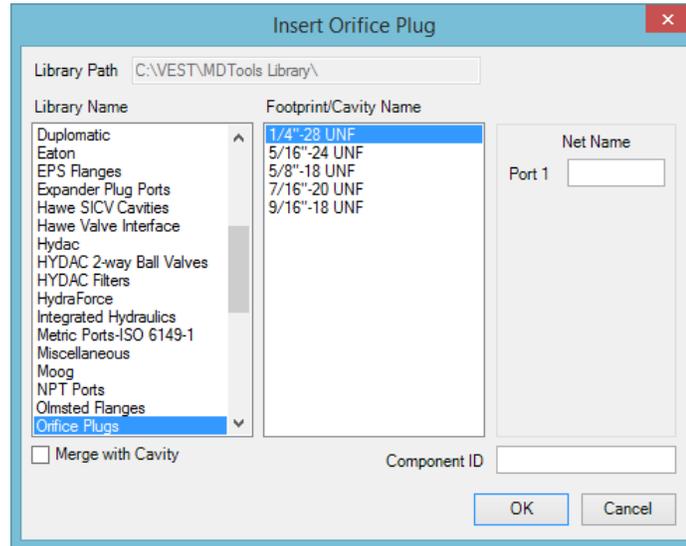
Offset hole inserted into the cavity

## 28. Insert Orifice Plug

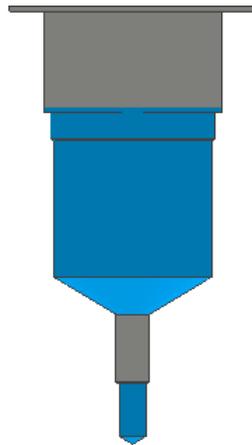
Insert a cavity for an orifice plug at the bottom port of the selected cavity.

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

1. MDTools 760 ribbon  
>Insert panel  
>Orifice Plug  
The MDTools Select Cavity dialog box displays.
2. 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.
3. Select the cavity for the orifice plug from the library.
4. Enter port net name for orifice plug.  
Or  
Click the **Net Name** textbox to select a net from the existing net names.
5. Enter **Component ID** for the orifice plug cavity.
6. 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



1/4\" -28 UNF orifice plug in side BSP G 1-11 port

### 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 will be 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.

# 29. Merge with Cavity

Delete the original cavity and create a merged cavity at the same location.  
Merge the orifice plug with the existing cavity.

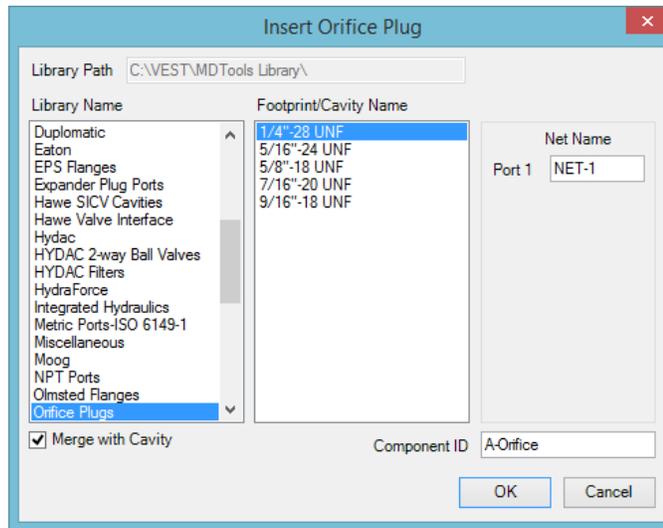
- MDTools 760 ribbon  
>Insert panel  
>Orifice Plug  
*The MDTools® Select Cavity dialog box displays.*
- Select a cavity to insert into the orifice plug.  
*The orifice plug cavity is inserted into the center of this cavity.*  
*The Insert Orifice Plug dialog box displays.*
- Select the cavity for orifice plug from the library.
- Enter 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**

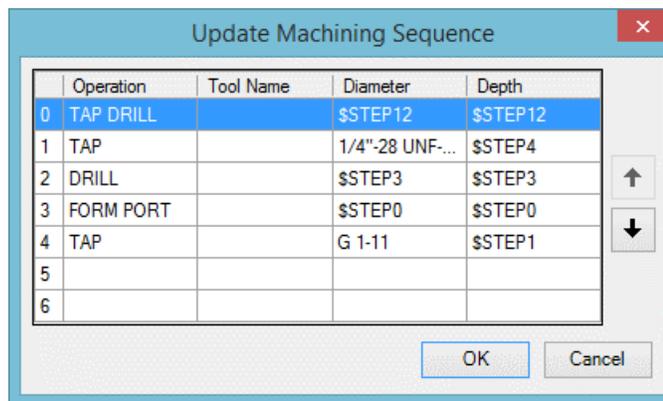
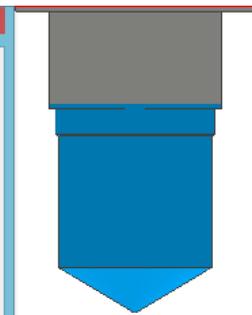
The dialog box shows the machining sequence extracted from both the cavities.

You can reorder the processes as required.

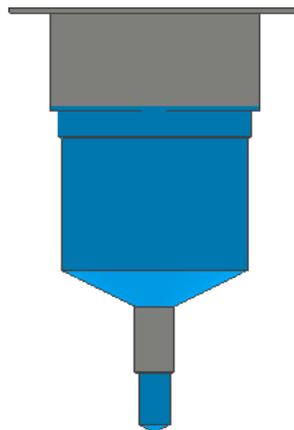
- Click **OK**.
- Note**  
1. The Merge with Cavity option converts all the cavity types to the Cartridge Valve (CV) cavity types.  
2. The area from the bottom port plug to the drill end is considered the Working Area.  
Thus, the merged cavity has a side port in this area.  
3. The machining parameters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



Insert Orifice Plug dialog box



Update Machining Sequence dialog box



Orifice Plug : Merge with Cavity option

# 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.

1. MDTools 760 ribbon  
>Insert panel dropdown  
>Mounting Holes  
  
*The Insert Mounting Holes dialog box displays.*
2. 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.
3. Select **Through Hole**, if required.

4. Enter the **Cavity ID**.  
*Mbolt is the default Cavity ID.*

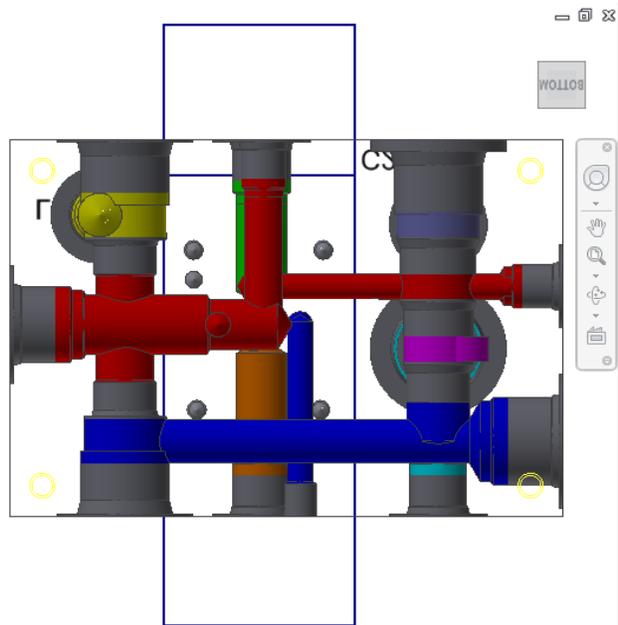
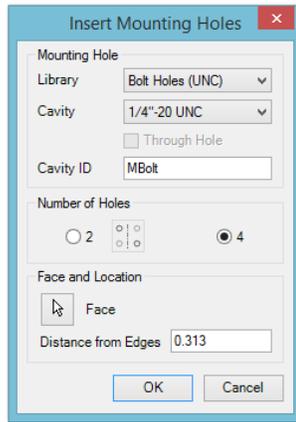
5. Select **Number of Holes** 2 or 4.
6. Select the **face**.

7. Enter **Distance from Edges**.  
*Enter the desired distance between the center of the bolt hole and the manifold edge.*

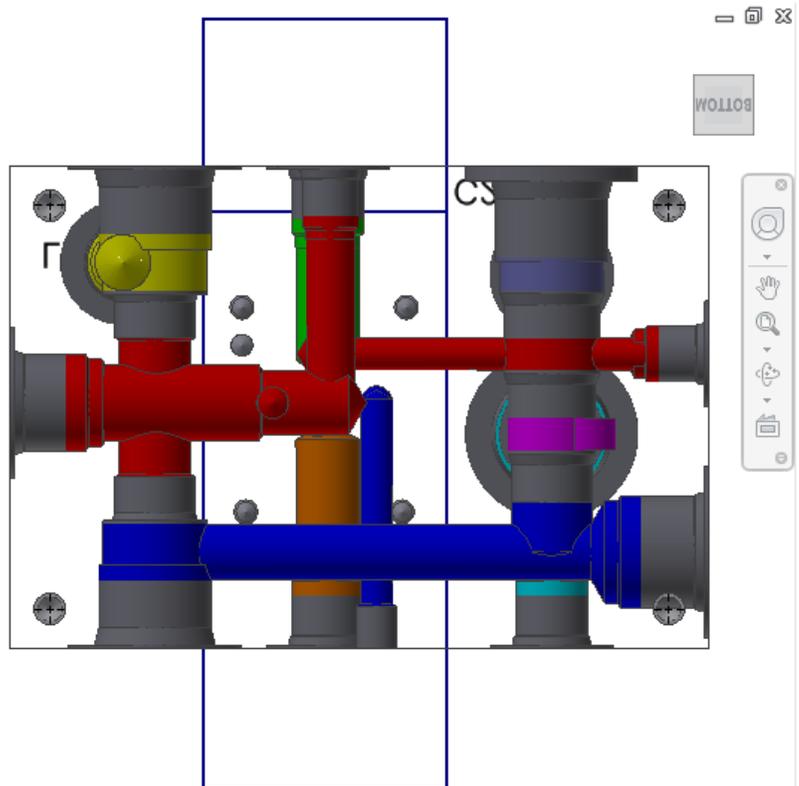
8. Click **OK**.
9. Select the manifold face to insert bolt holes.  
*MDTools automatically inserts four bolt holes on the selected face.*

### Note

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



Insert Mounting Holes dialog box



MDTools automatically inserts four mounting holes

# 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.*

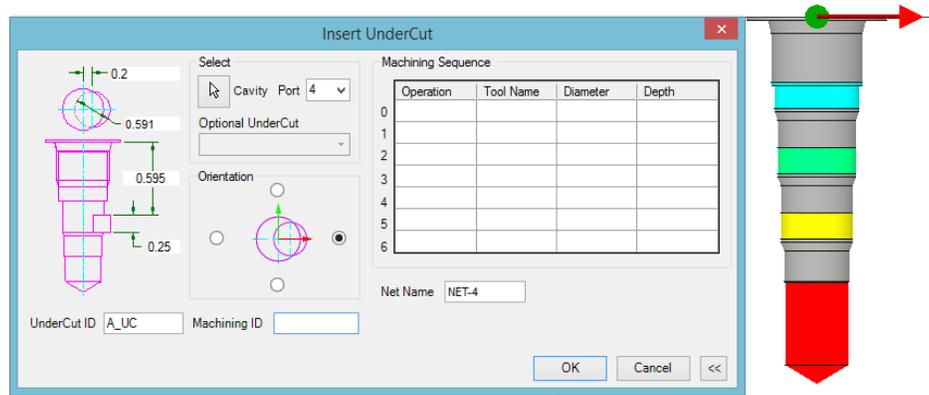
*Insert an undercut in a selected cavity on a manifold.*

*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 760 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.



*Insert UnderCut dialog box*

3. Select any optional undercut, if defined for the cavity, from the list.

Or

Select the **port** of the cavity.

*Default values for the undercut as per the selected port/optional undercut are displayed.*

*You can enter the Net Name for the selected port.*

4. 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.*

5. Modify the **offset distance**, as required.

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

6. Modify the **undercut diameter**, as required.

7. Modify the **undercut depth** from the spot face of the cavity, as desired.

8. Modify the **undercut height**, as required.

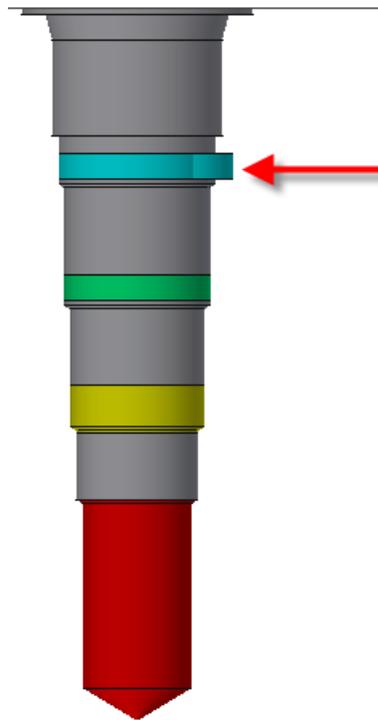
*Default value would be the selected port diameter.*

9. Select the **orientation** from the axis or center of the selected cavity.

10. Enter the **Net Name** and **Machining ID**.

11. Click **OK**.

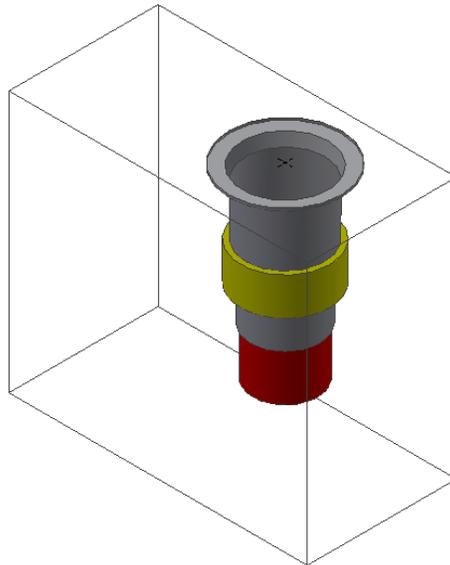
*MDTools creates an undercut in the selected cavity.*



*Undercut created in the selected cavity*

**Note**

- You can enter the machining operations in the *Machining Sequence* section.
- Optional undercuts linked to the cavity inside the Library Manager will be displayed in the *Optional UnderCuts* drop down.
- Mandatory undercuts can be defined inside the Library Manager for a cavity and the same undercut will be created automatically when that cavity is inserted.



*Mandatory undercut created in an inserted cavity*

## 32. Insert Slot

Increased flow requirements often require the use of slots within the cavities.  
This section shows how such cavities are modeled using MDTTools® 760.

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

- MDTools 760 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**, if defined for the cavity, from the Slot list.

*Values as per the selected pre-defined slot are 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.*
- Enter the **Machining ID**.
- Select the **Constrain to cavity** option to constrain the slot with the selected cavity, if required.

- Modify the slot **Dimensions**.
- Modify the **Depth** of the slot.

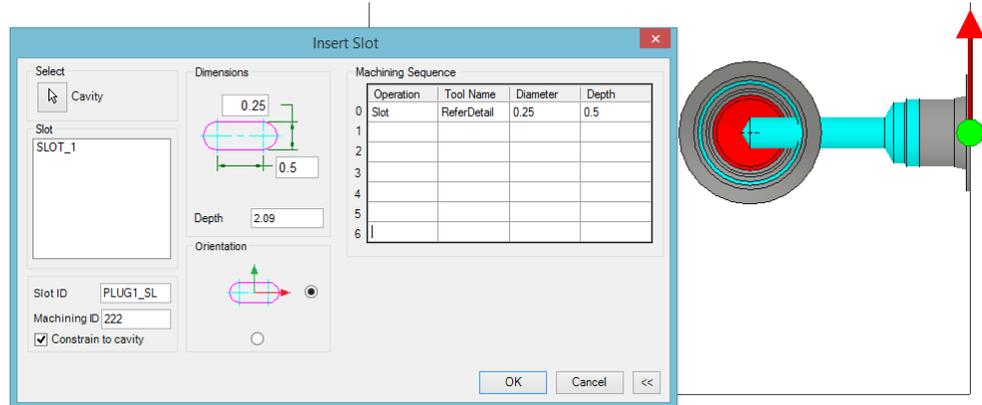
*Modify the desired depth of the slot from the manifold surface.*

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

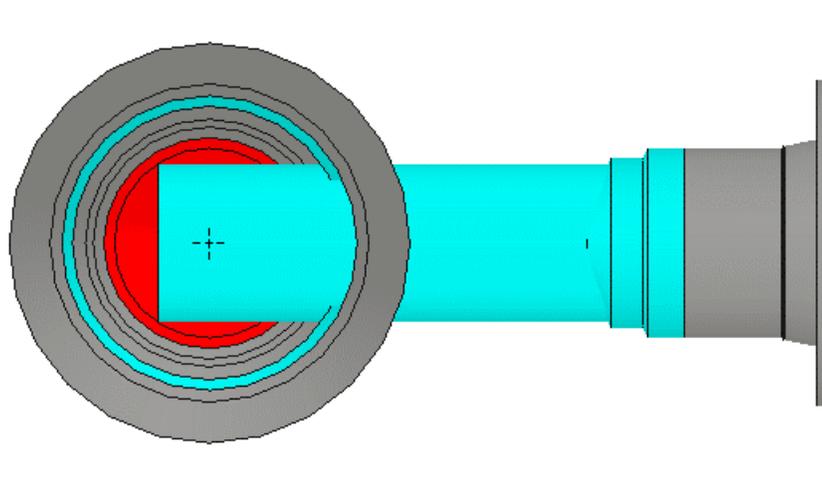
- Click **OK**.  
*MDTools automatically creates a slot in the selected cavity.*

### Note

You can enter the machining operations in the *Machining Sequence* section.



Create Slot dialog box



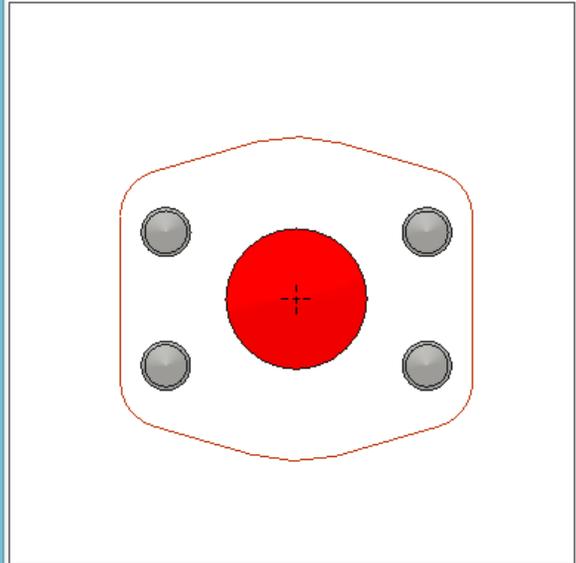
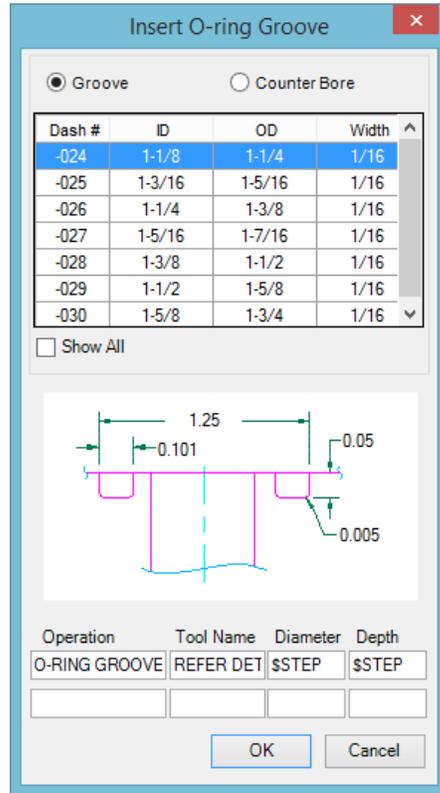
Slot created in the selected cavity

### 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® 760.

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

- MDTools 760 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.*
- Select the O-ring size to automatically specify the groove dimensions.  
*MDTools creates a groove to the specification.*
- Click **OK**.  
*MDTools creates a groove to the specification.*



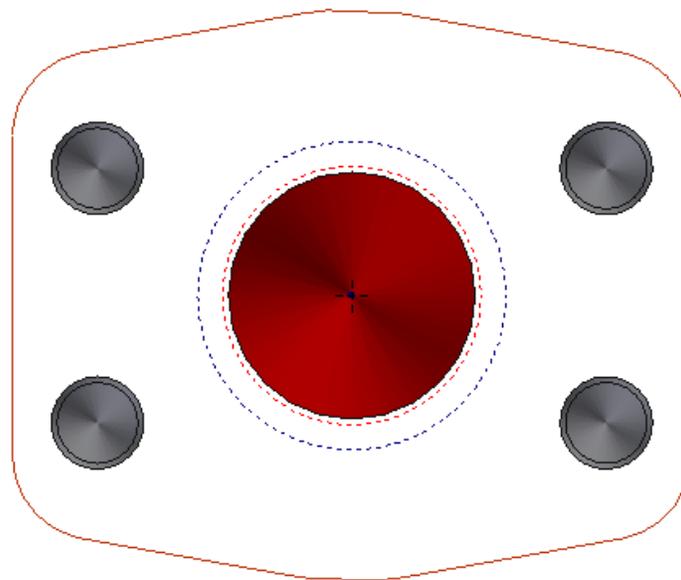
Insert O-ringGroove dialog box

- 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.*

**Note:** You can use \$Step for diameter and Depth field for easily maintaining of machining Chart information.

\$Step takes Outer Diameter as Diameter value in Machining Chart.

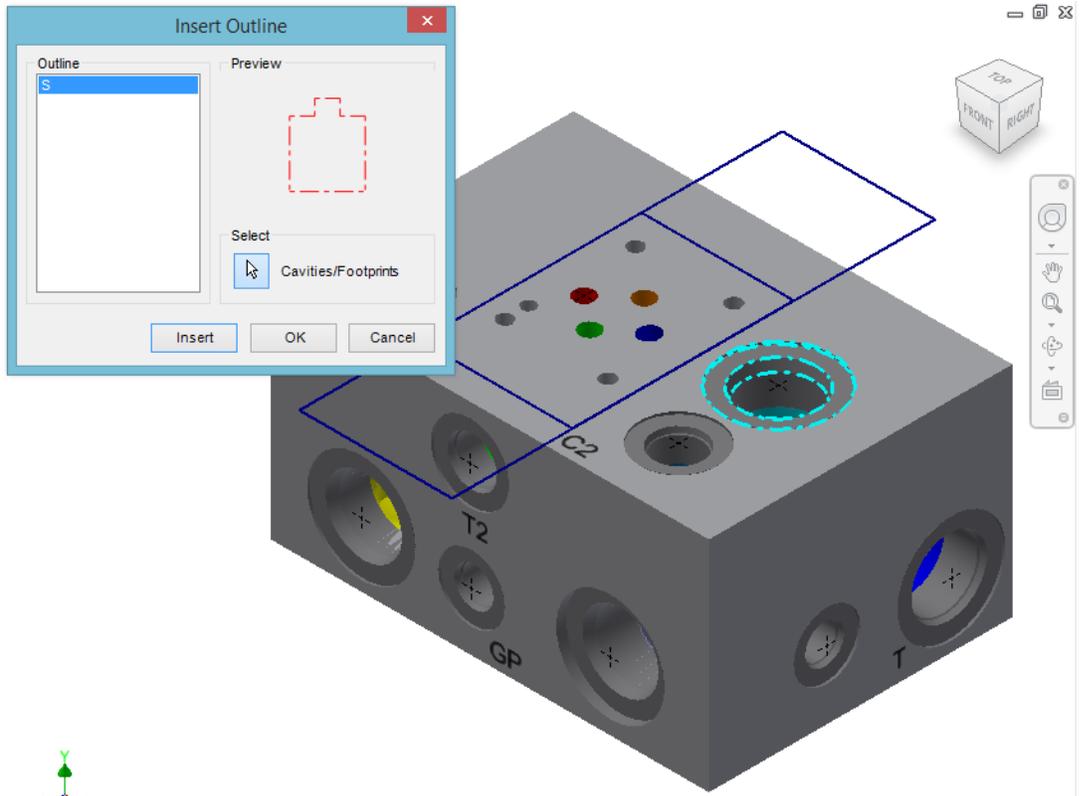


O-ring groove created

# 34. Insert Outline

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

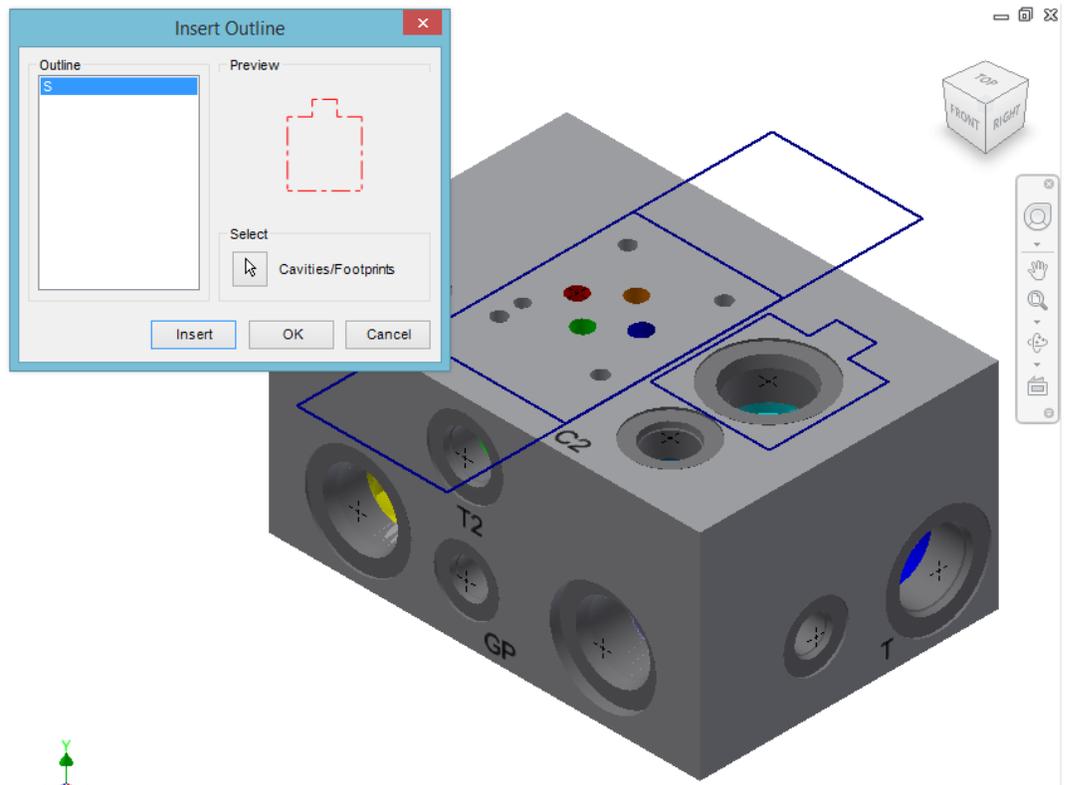
1. MDTools 760 ribbon  
>**Insert** panel  
>**Outline**  
*The Insert Outline dialog box displays.*
2. Select the Outline from the assembly envelope list.  
*MDTools® display a preview of the selected assembly envelope (Outline).*
3. Click the **Cavities/Footprints** selection button.  
*When you move the cursor over a cavity, it gets highlighted*
4. Click **Insert**.  
*MDTools automatically creates an assembly envelope around the selected cavities.*
5. Click **OK**.



 Create Outline dialog box

**Note**  
Use the MDTools Envelope Library program to create the Outline (Assembly Envelope) 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.



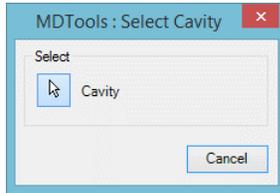
 Assembly envelope created on selected cavities

# 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 760 ribbon >Insert panel >Replace

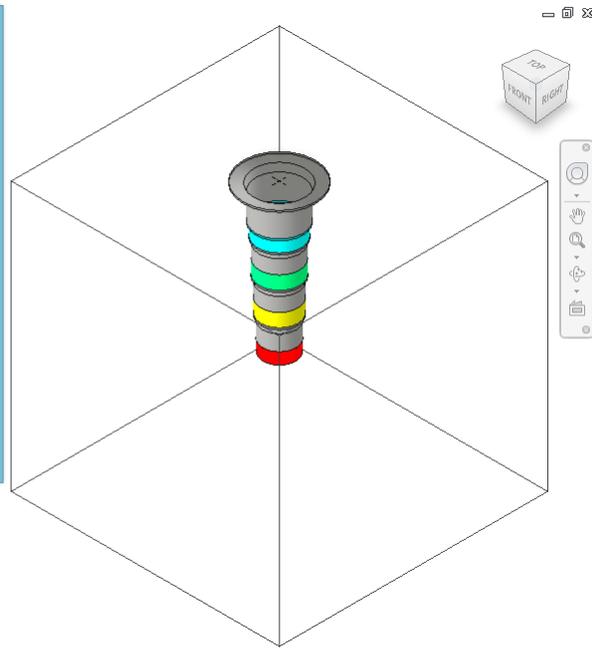
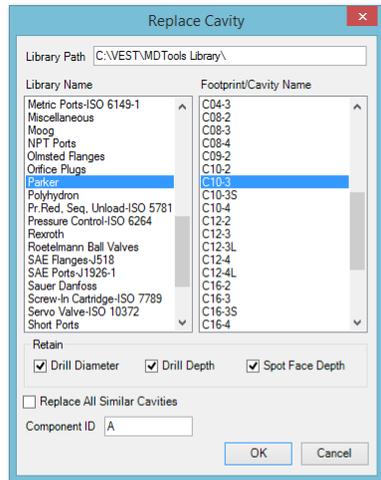
The MDTools: Select Cavity dialog box displays.



Select Cavity dialog box

2. Select the cavity to replace.

The Replace Cavity dialog box displays the MDTools library.



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

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

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

5. Click **OK**.

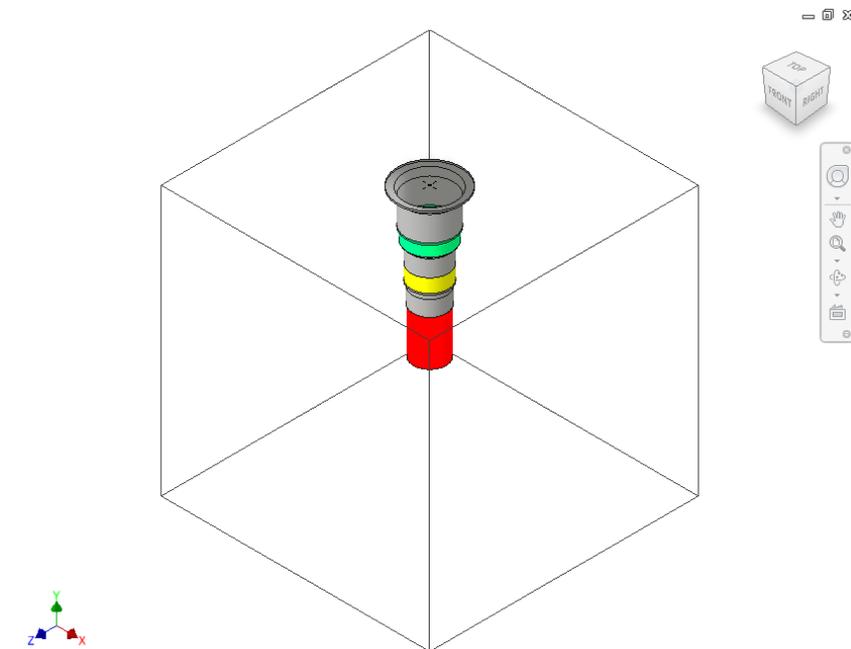
MDTools replace the selected cavity in the manifold with the new cavity from the library.



Replace Cavity dialog box

## Note

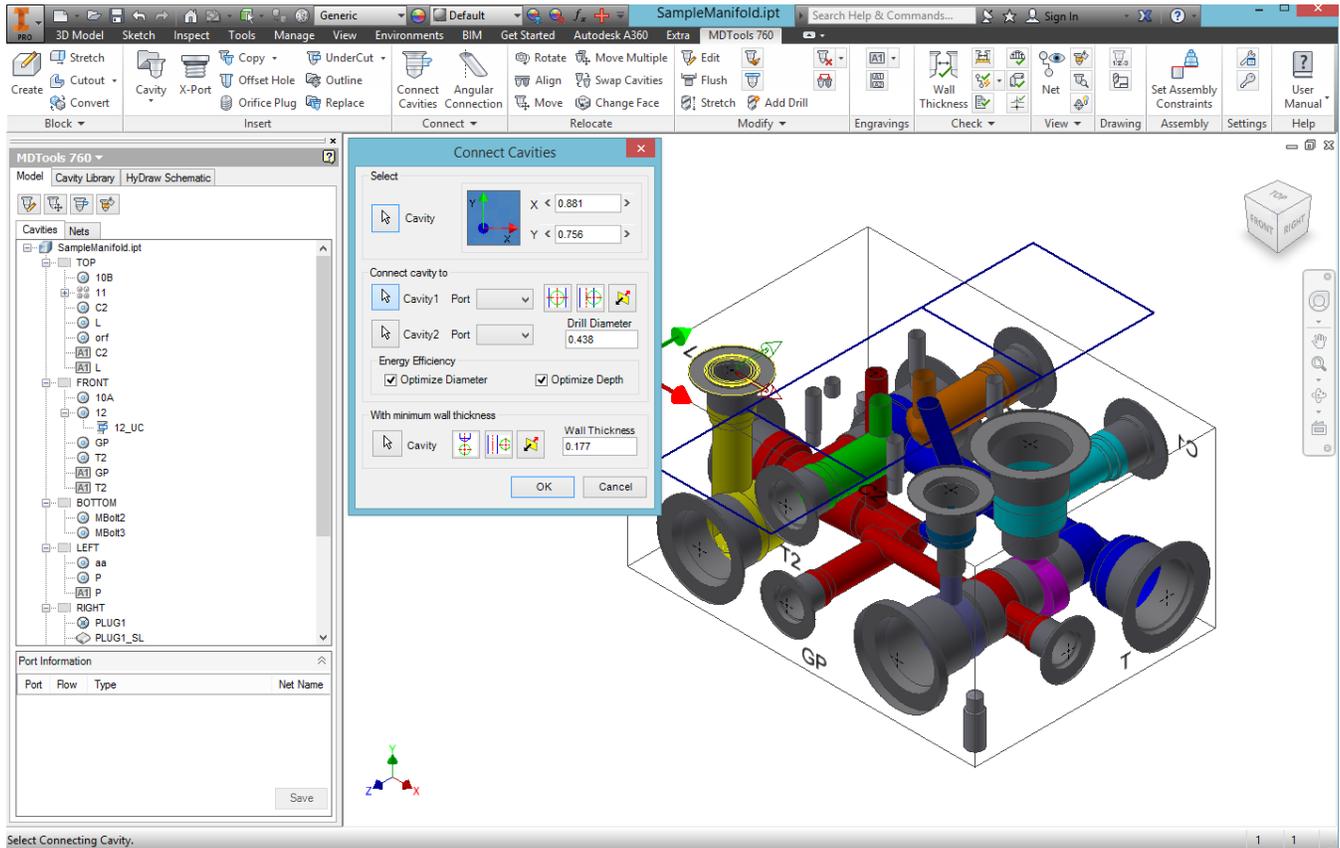
- **Replace All Similar Cavities** option enables you to replace all similar type of cavities with the selected cavity.
- If a footprint is selected for replacement, by default the whole footprint is replaced with the specified cavity. The replaced item could be another footprint or a cartridge cavity.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

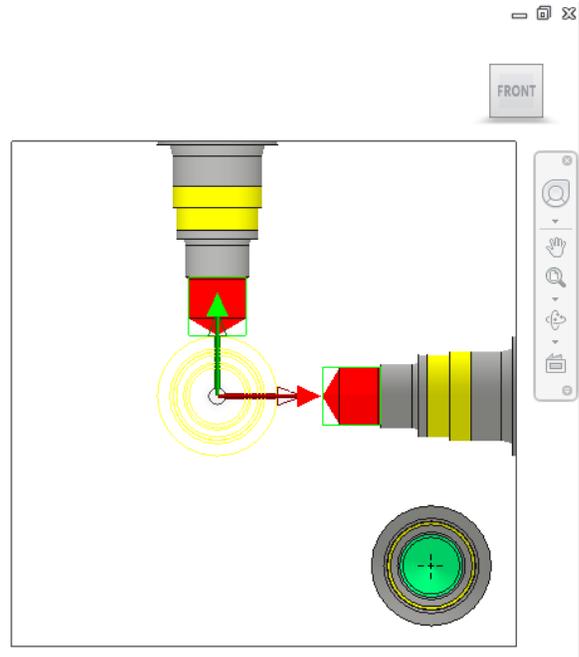
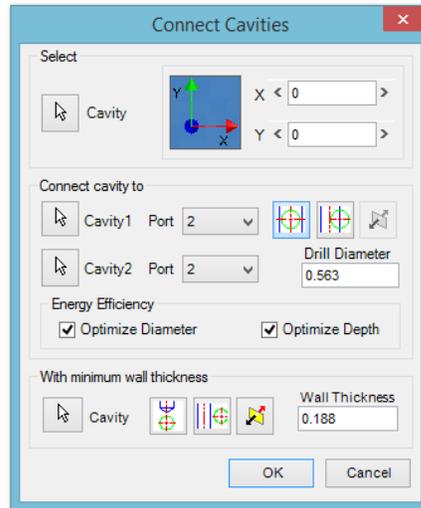
If a connection is not possible without relocating the cavity, then MDTools® automatically relocates the connecting cavity to the port center.

In case of a bottom port, MDTools relocate the connecting cavity to the full diameter depth of the second cavity.

1. MDTools 760 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.



5. Click the selection button for Cavity2.
6. Select the connecting Cavity2.
7. Select the connecting port on Cavity2.



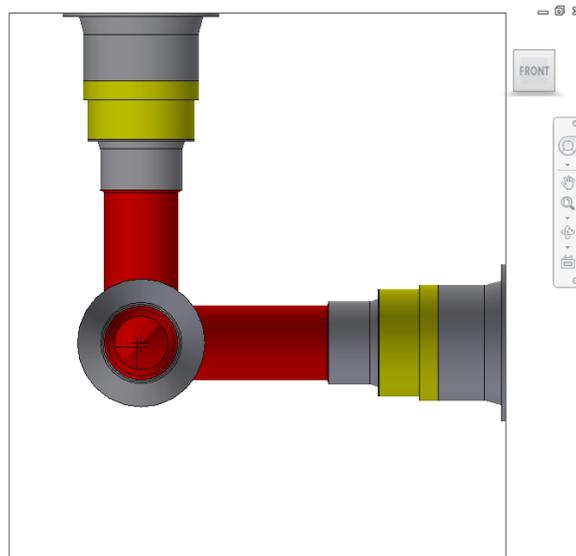
Connect Cavities dialog box

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

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

**Note**

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



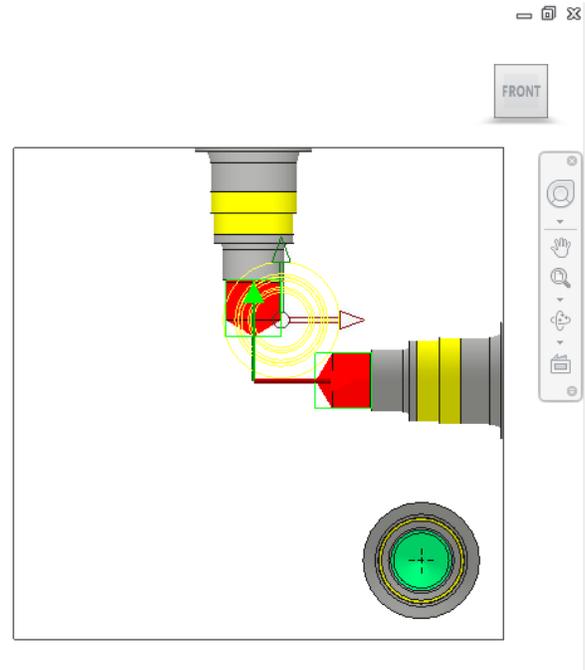
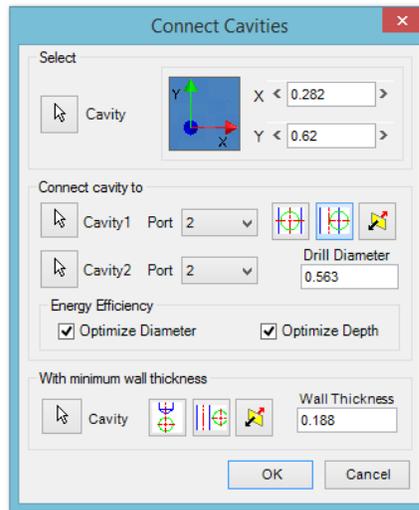
Cavities connected using the Connect to Cavity command

## 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 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*

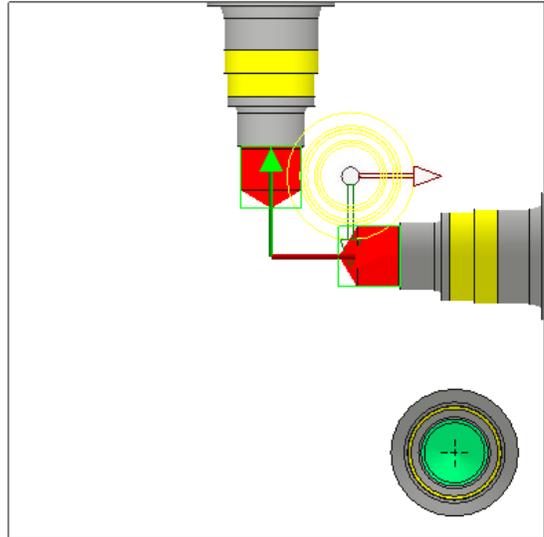
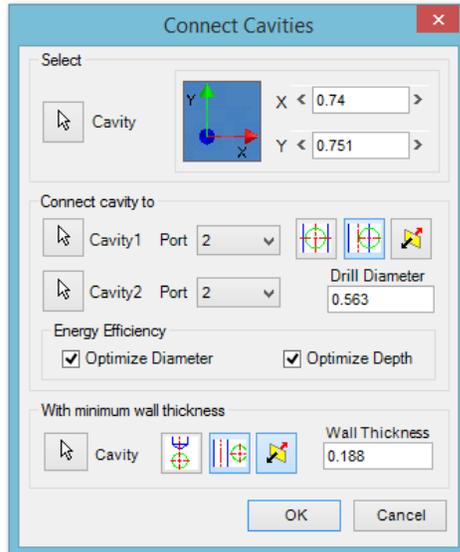
## Position with minimum wall thickness

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

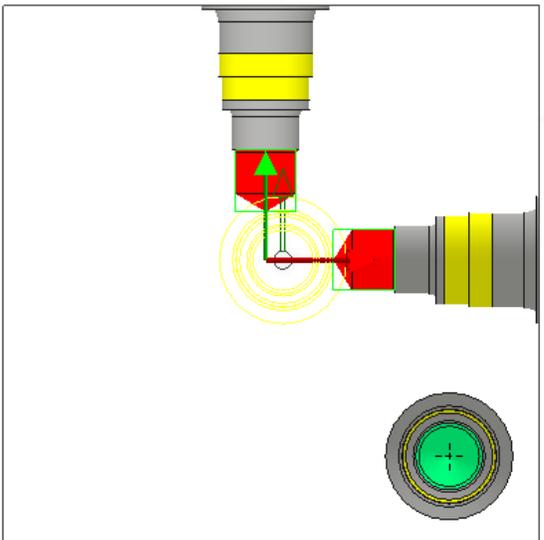
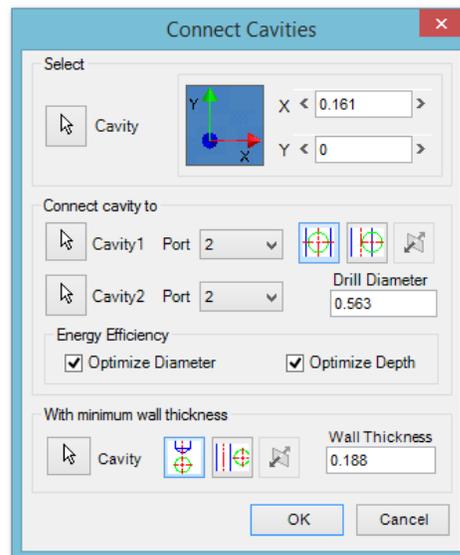
1. Click the selection button for Cavity.
2. Select an existing cavity on the manifold.
3. Click the **Move to side** button to position the new cavity away from the selected cavity axis.
4. Click the **Flip side** button to change the side, if required.
5. Repeat the above steps to position the cavity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

### 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 using the Move to side option*

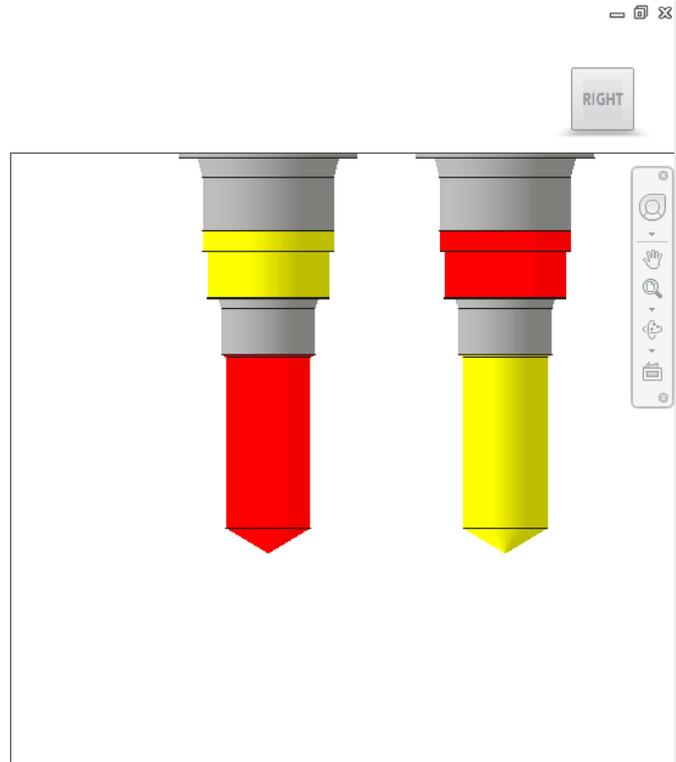
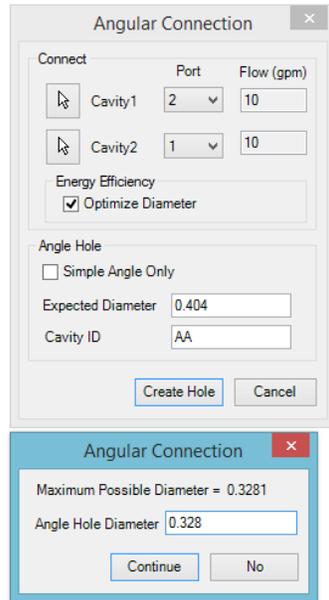


*Positioning the cavity below the cavity tip*

# 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.

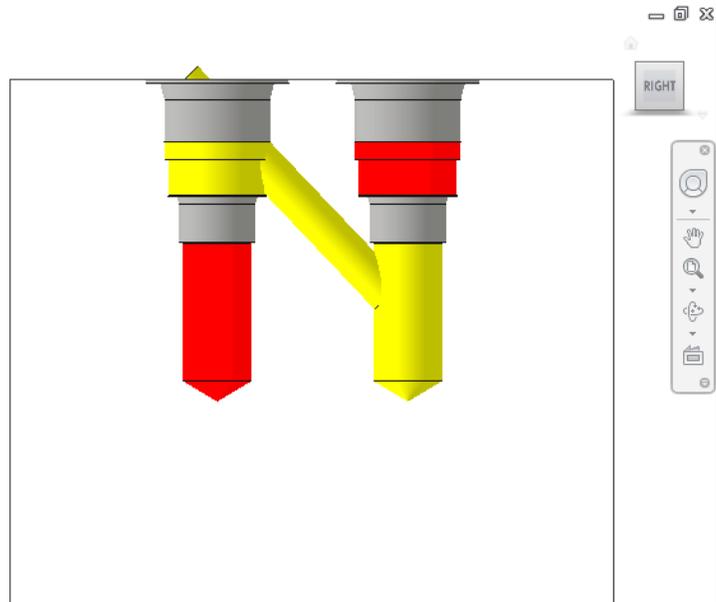
1. MDTools 760 ribbon >Connect panel >Angular Connection  
The Angular Connection dialog box displays.
2. Select **Cavity1**.  
Select the cavity from which you want to make an angle drill.
3. Select the **Port** of Cavity1.  
Select the port of Cavity1, which you want to connect with Cavity2.
4. Select the **Cavity2** button.  
Select Cavity2 to which Cavity1 is to be connected by an angle drill.



5. Select the **Port** of Cavity2.  
Select the port of Cavity2, which you want to connect to the selected port of Cavity1.
6. Select the Energy Efficiency option, **Optimize Diameter**, if required.
7. Select **Simple Angle Hole only**, if required.
8. Enter **Expected Diameter**.  
If possible, MDTools create the angle hole with the specified diameter. Otherwise, it displays the maximum possible diameter.
9. Enter **Cavity ID**.
10. 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'



Angular Connection between two ports of the selected cavities



11. 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 760 ribbon  
>Connect panel  
>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.

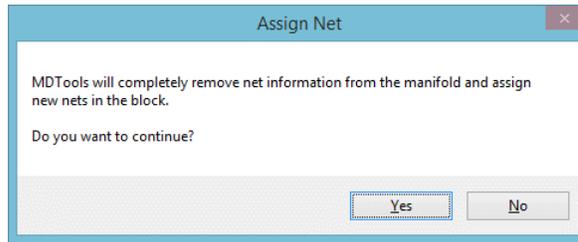
The Connectivity Browser shows all the assigned net names.

### Caution!

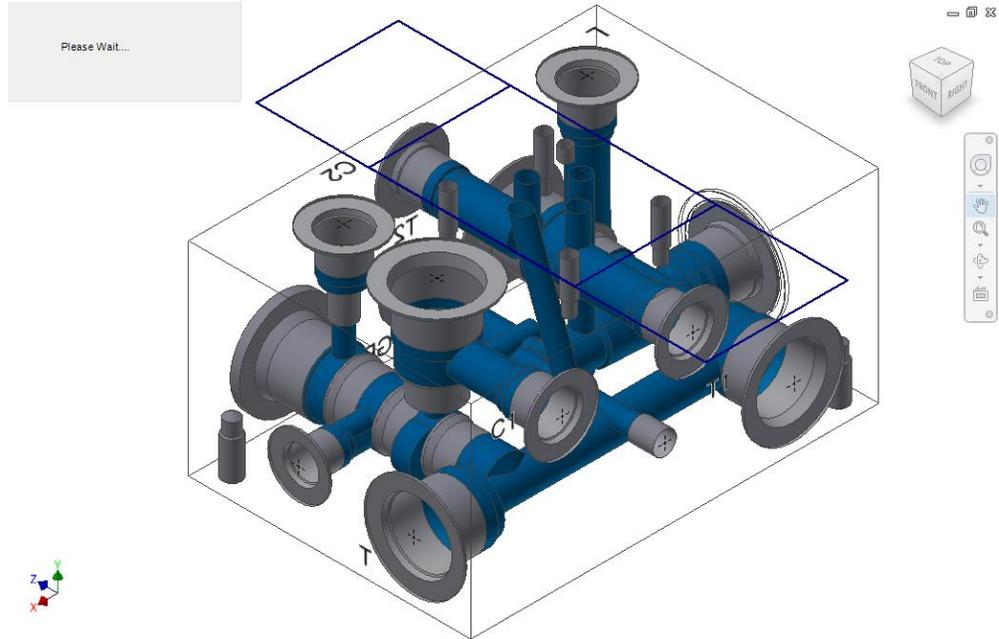
MDTools will completely remove net information from the manifold and assign new nets in the block.

### Note

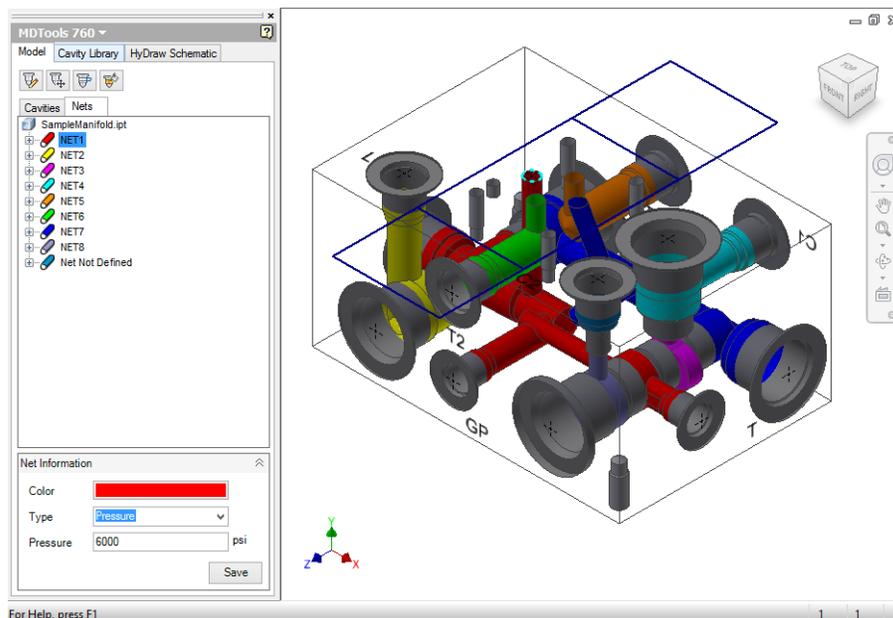
Change the default Net colors in the MDTools Settings dialog box.



Assign Net - Warning Message



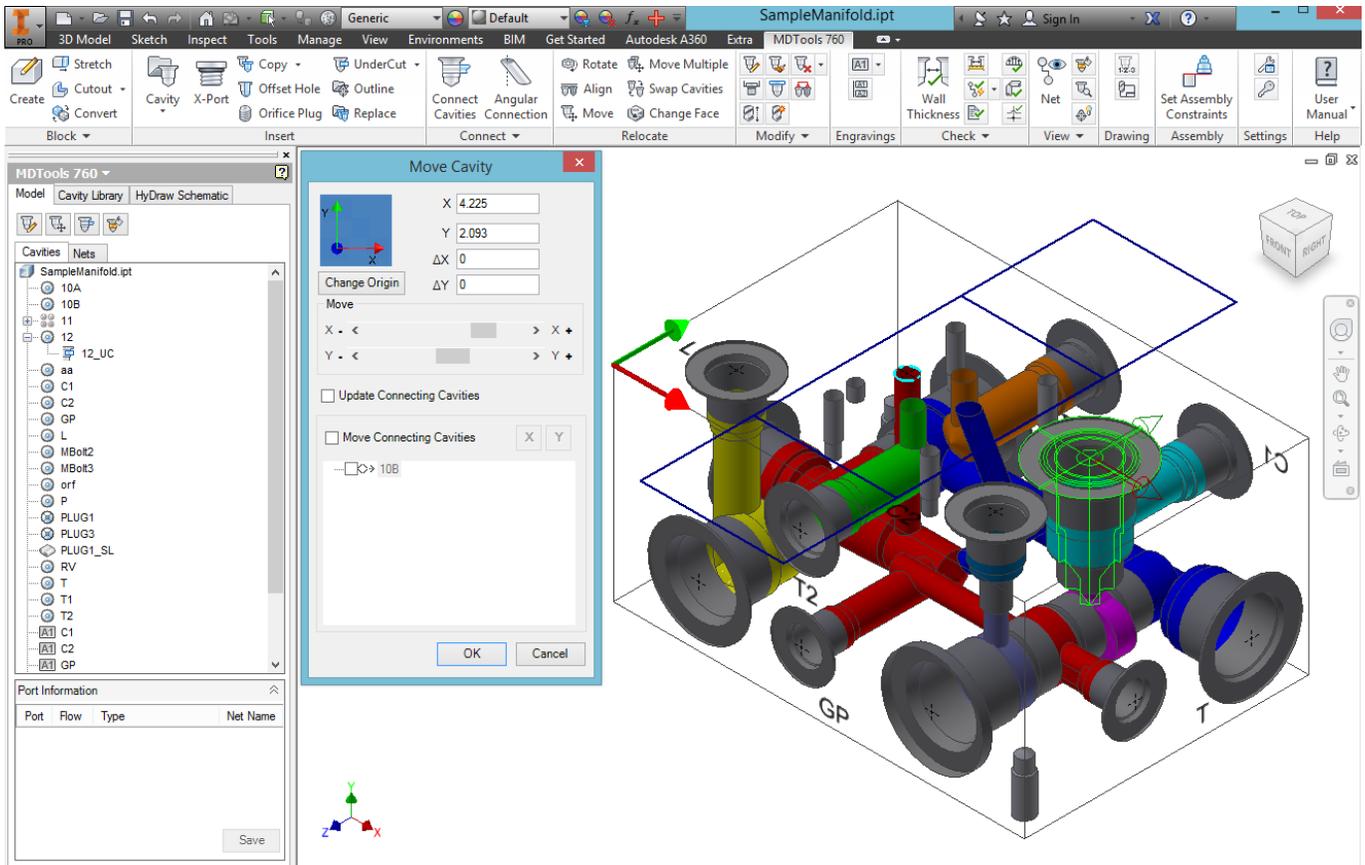
Assign the Net(flow path) name



Connectivity 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 degree.

1. MDTools 760 ribbon >Relocate panel >Rotate

The Rotate dialog box displays.

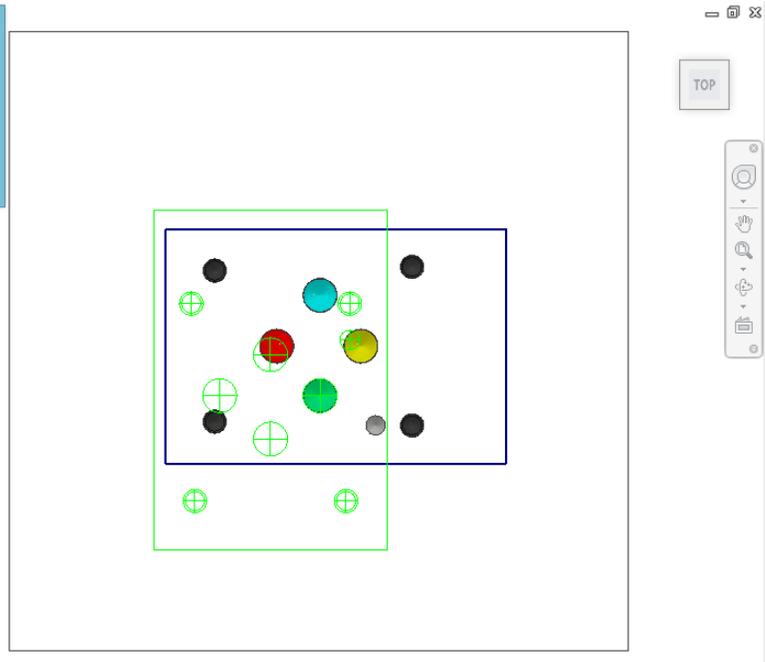
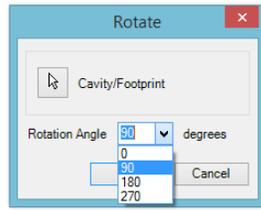
2. Select a cavity on the footprint or an independent cavity.

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

3. Enter the rotation angle in degrees.

4. Click **OK**.

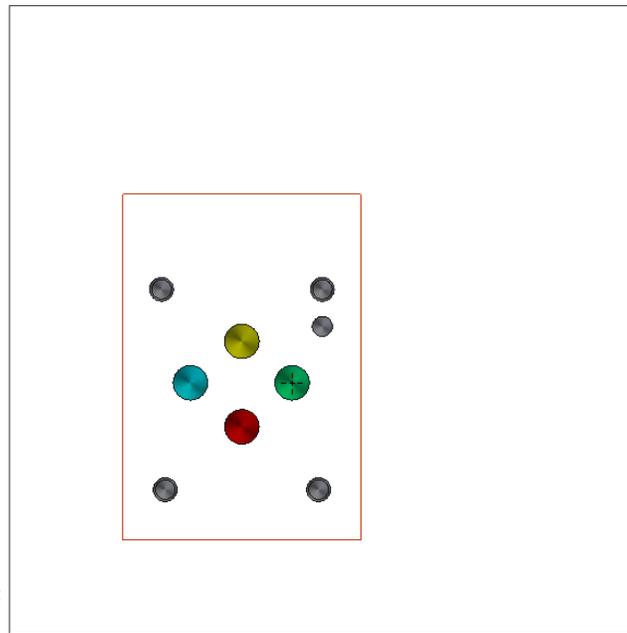
MDTools® rotates the footprint by the entered rotation angle about the center of main cavity of the footprint.



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°

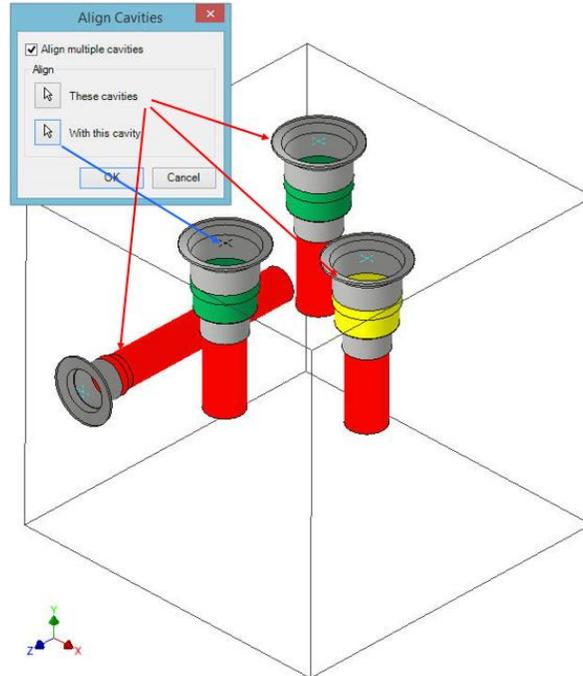
# 40. Align Cavities

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. MDTTools 760 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. Select the Align button
  - **These cavities:** Select the cavities you want to move and align with another cavity.
  - **With this cavity:** Select the cavity with which you want to align the selected cavities.
4. Click **OK**.

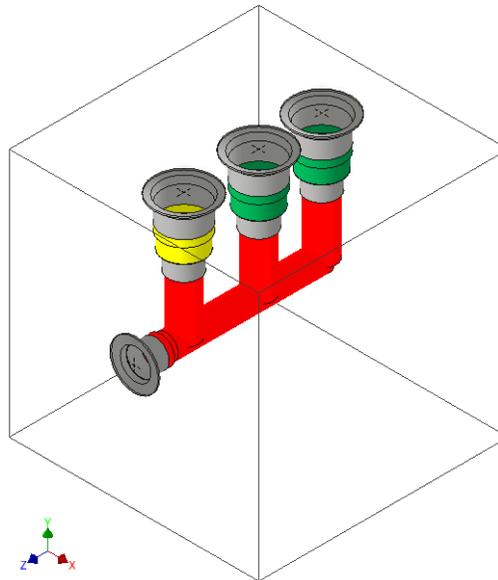


Align Cavities dialog box

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

### 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. MDTTools 760 ribbon  
>**Relocate** panel  
>**Move**

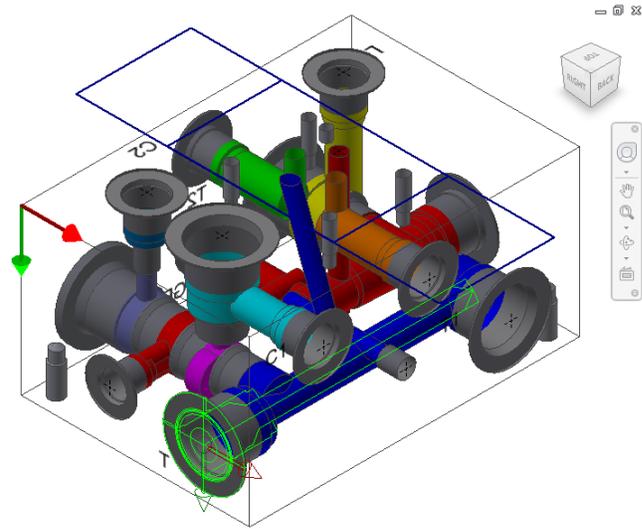
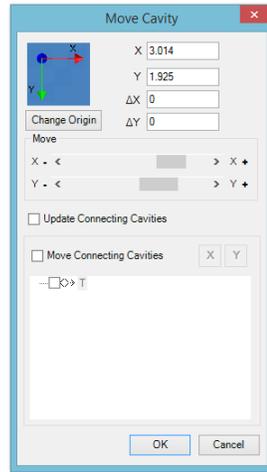
The *Select Cavity* dialog box displays.

2. Select a cavity on the manifold.

The *Move Cavity* dialog box displays. MDTTools® 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.

## Moving by Increment

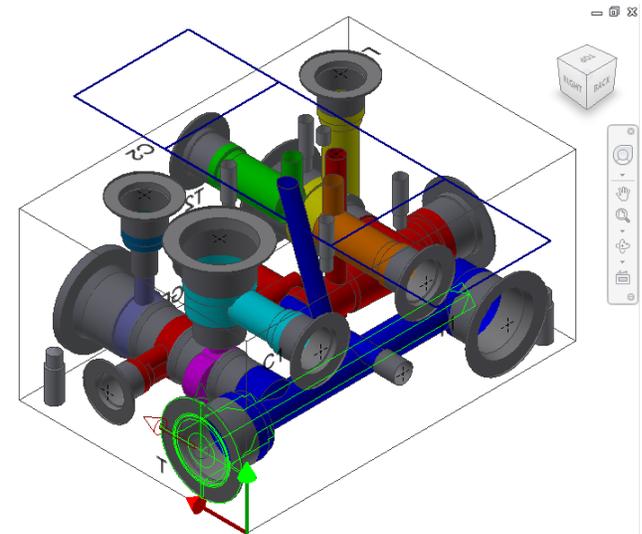
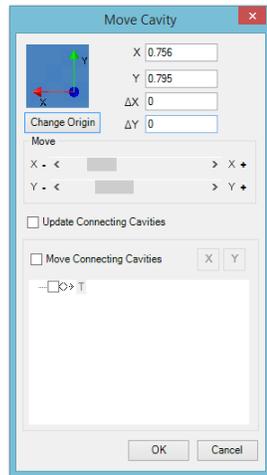
MDTools enables you to move a cavity by an incremental distance (0.05 inches/1.00 mm)

Click the scroll bar button.

After one click, MDTTools 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.



Origin changed and X and Y values updated

## Note

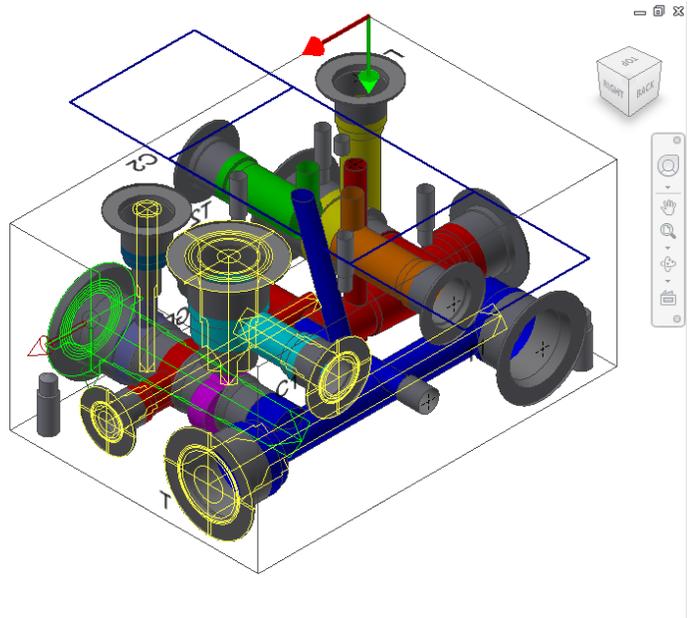
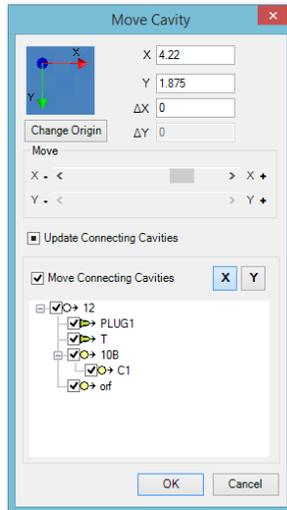
- Click **Change Origin** to change the face origin.
- MDTools® moves the Origin Indicator to the next corner when you click *Change Origin*.

*The X and Y location with respect to the new origin is displayed in the dialog box.*

## Update Connecting Cavities

1. Select the **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.*

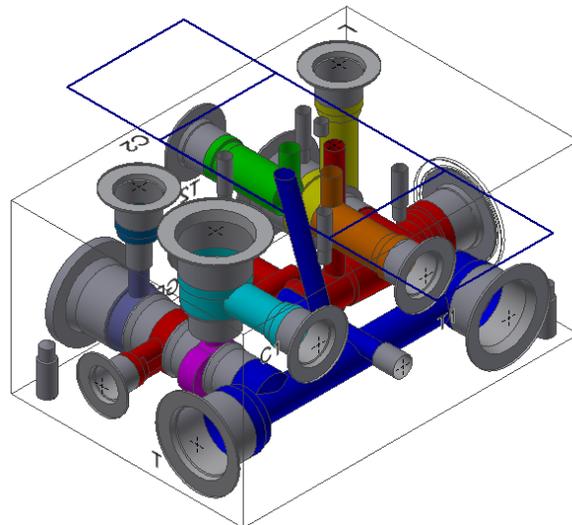


## Note

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



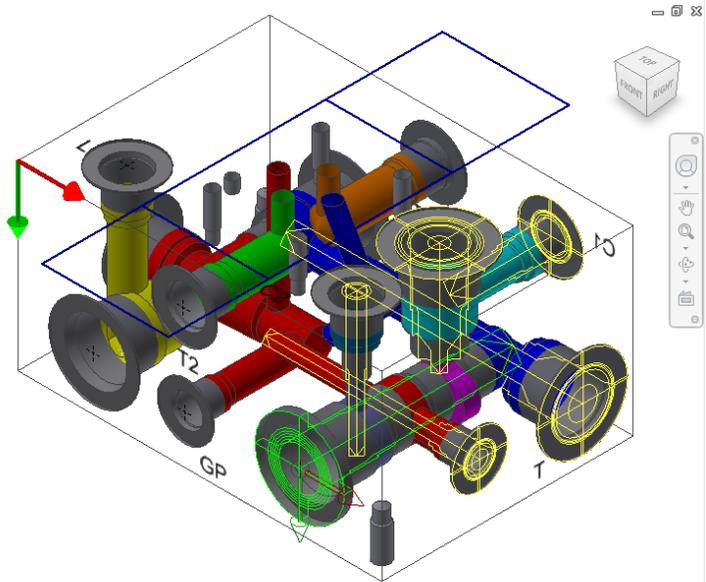
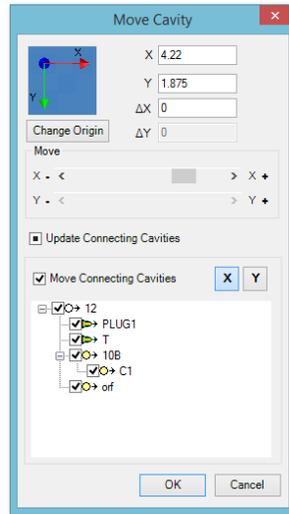
Parametric Move Cavity dialog box: Update Connecting Cavities



*Cavity relocated: Depth of connecting holes updated*

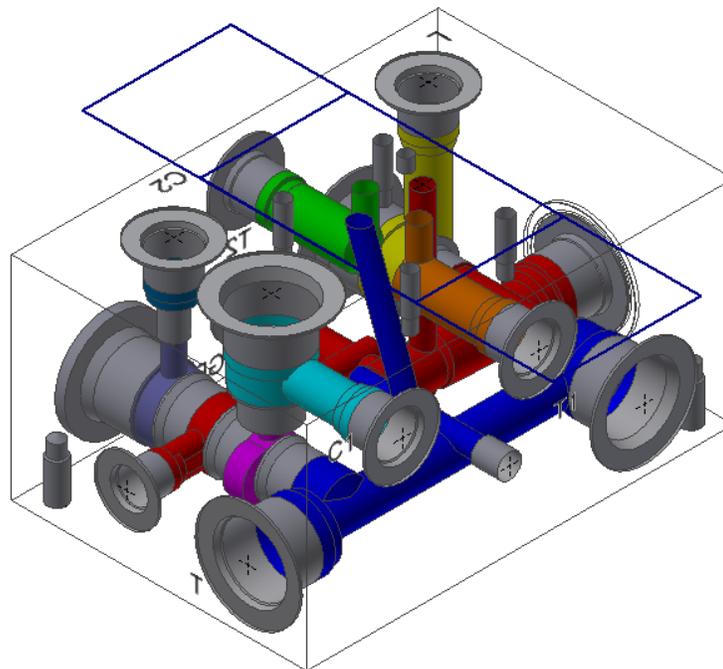
## Move Connecting Cavities

1. Select the **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**.



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 760 ribbon  
>**Relocate** panel  
>**Move**

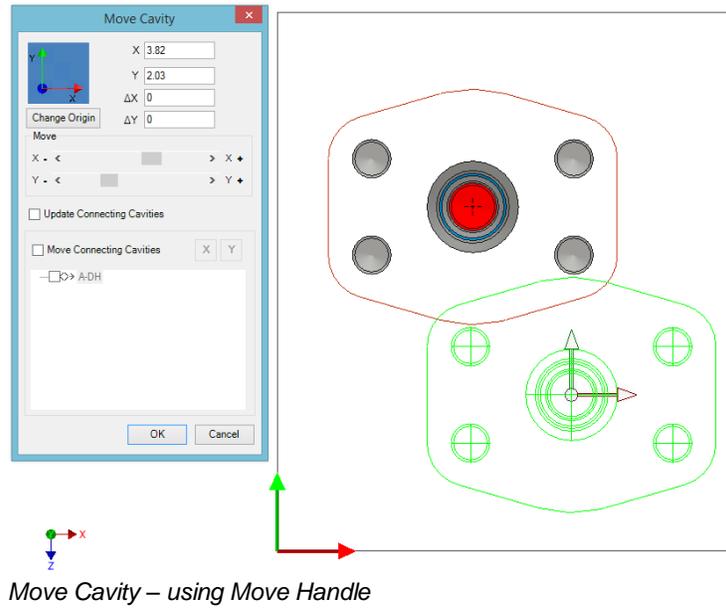
*The MDTools® Select Cavity dialog box displays.*

2. Select a cavity on the manifold.

*The Cavity Preview shows Move handle with center point and X and Y axis arrow indicator.*

3. Drag the center point to move any axis.

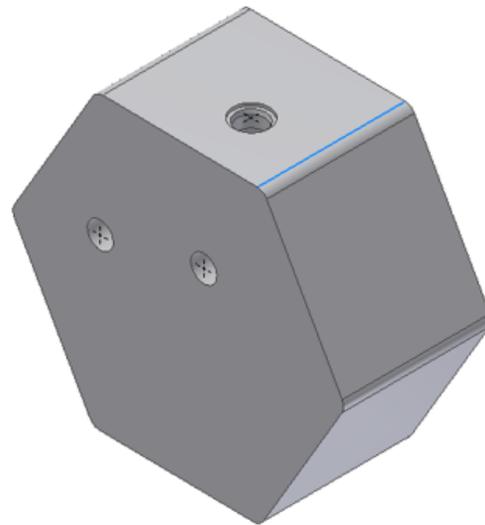
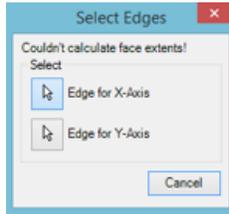
4. Drag the X or Y axis arrow to move the cavity along a single axis.



*Move Cavity – using Move Handle*

## Move a Cavity on a Non-Rectangular Manifold

- MDTools 760 ribbon  
>Relocate panel  
>Move  
*The MDTools® Select Cavity dialog box displays.*
- Select a cavity on the manifold.  
*The Select Edges dialog box displays.*
- 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.*



### Moving by Entering X and Y

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

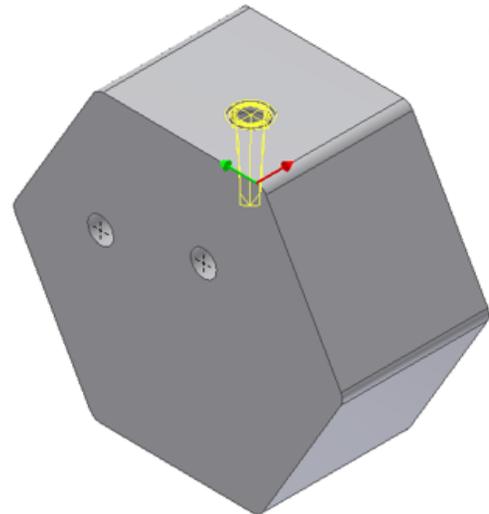
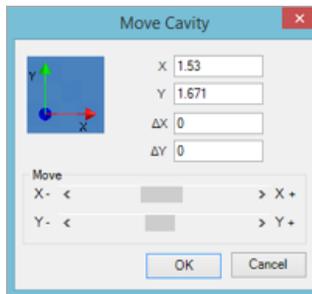


Select Edges dialog box

### Moving by Entering $\Delta X$ and $\Delta Y$

Relocate the cavity by entering a displacement.

- Enter  $\Delta X$ ,  $\Delta Y$ , or both, as required.
- Click **OK**.  
*MDTools moves the cavity by the  $\Delta X$  and  $\Delta Y$  values entered.*



### Moving by Increment

- 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.



Move Cavity dialog box: Cavities on non-rectangular block

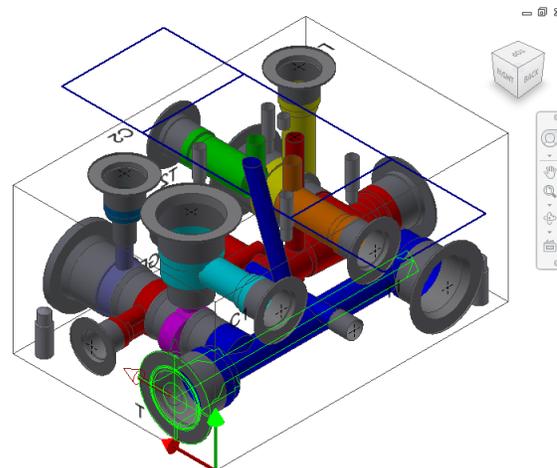
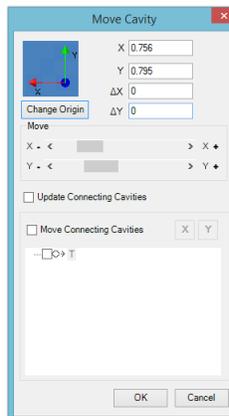
### Moving Cavities/Footprints Manually

Relocate the cavity manually by moving the cavity center point.

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

### Note

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



Parametric Move Cavity dialog box

# 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.

- MDTools 760 ribbon >**Relocate** panel >**Move Multiple**

The Move Cavities dialog box displays.

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

- Click the **Cavities to move** selection button.
- 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.

- Enter the displacement along each coordinate.

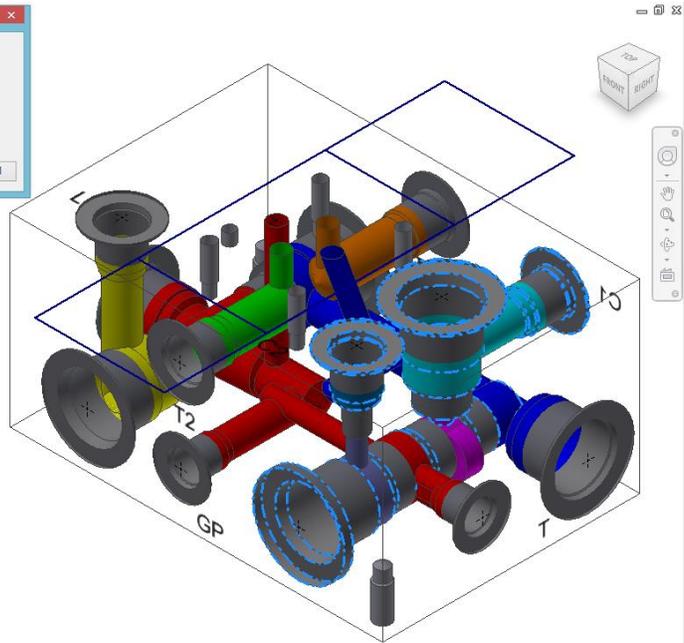
When you select cavities on perpendicular faces, MDTools display only one field to enter displacement, as the cavities have only one common coordinate.

- Click **OK**.

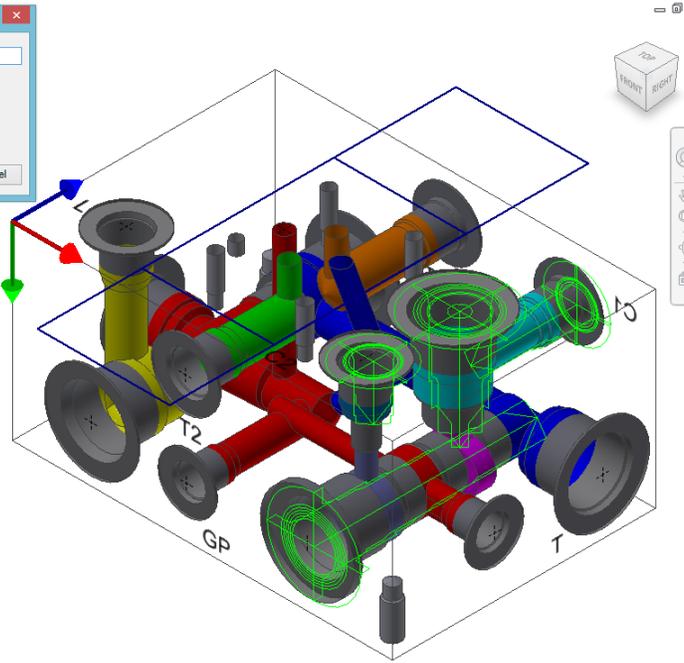
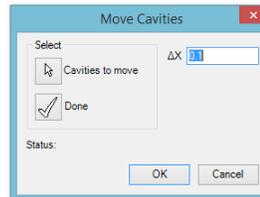
MDTools relocate the cavities by the specified distance and the coordinate symbol disappears.

### Note

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



Move Cavities dialog box



Move Cavities dialog box: Data field to enter displacement

# 43. Swap Cavities

Interchange the location of two cavities on a manifold.

1. MDTools 760 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**.

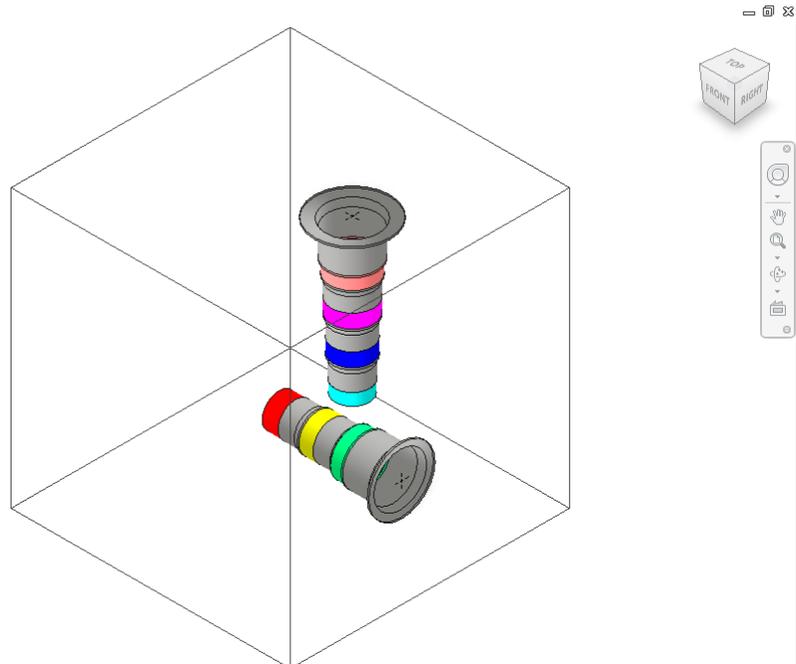
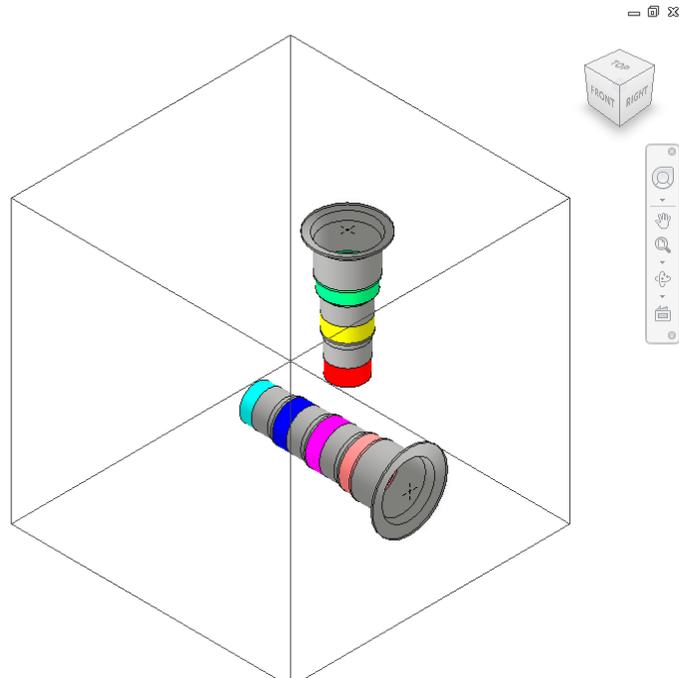
*Location of two cavities is interchanged on the manifold.*

### NOTE

Constrained Engravings does not move along with the cavity.



Swap Cavities dialog box



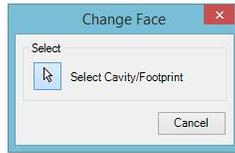
Cavities swapped

# 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.

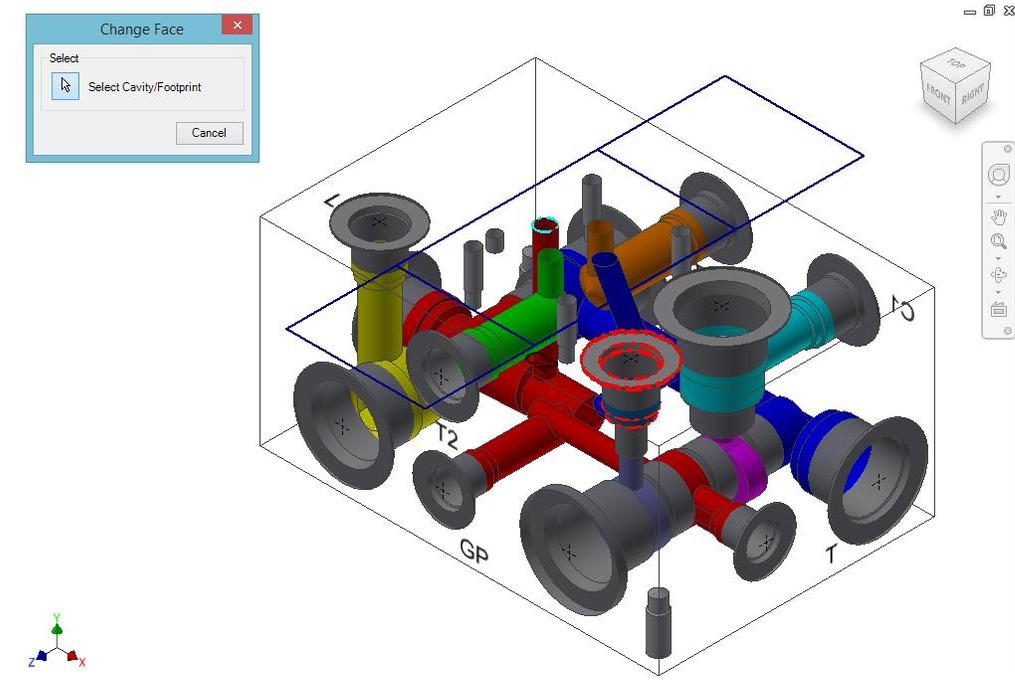
- MDTools 760 ribbon  
 >Relocate panel  
 >Change Face

The Change Face dialog box displays.



- 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.

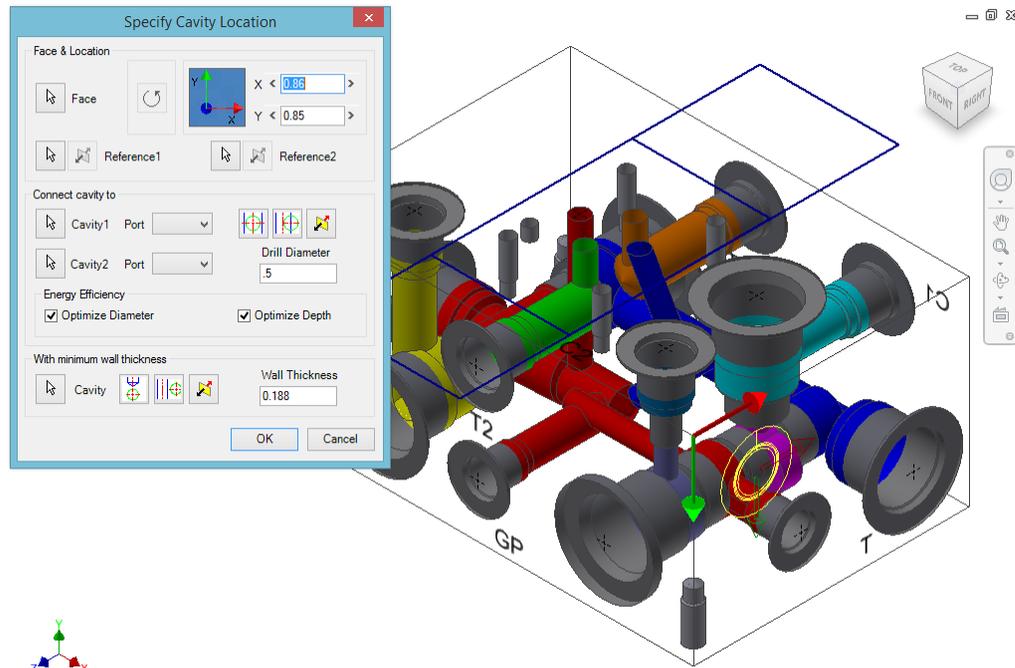
- Select the point on the manifold face, where you want to move the cavity.

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.



- Enter the X and Y distance from the block origin, if required.
- Drag the center point to move Cavity/Footprint any axis if required.
- Drag the X or Y axis arrow to move the cavity/Footprint along a single axis if required.
- Click **OK**.

MDTools relocates the cavity/footprint to the selected location on the manifold.



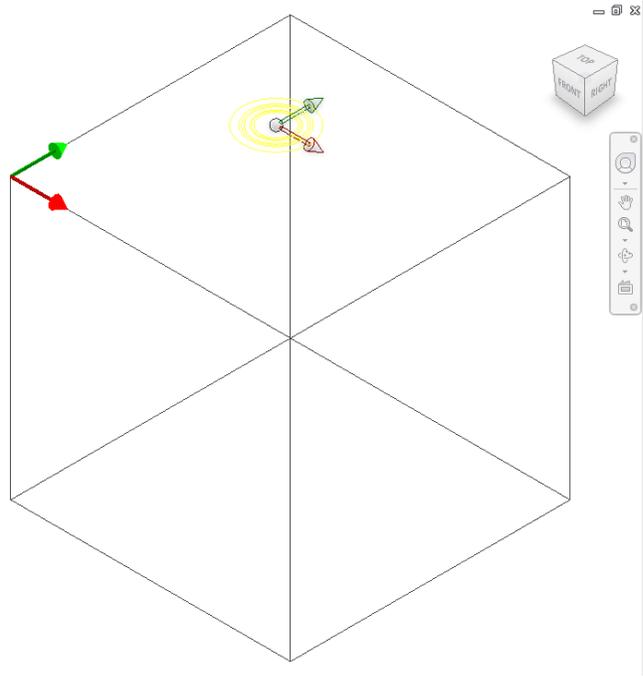
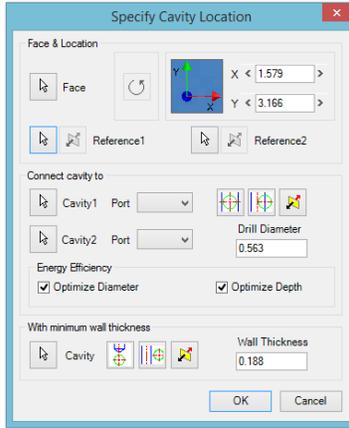
**Note**

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

# 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.*

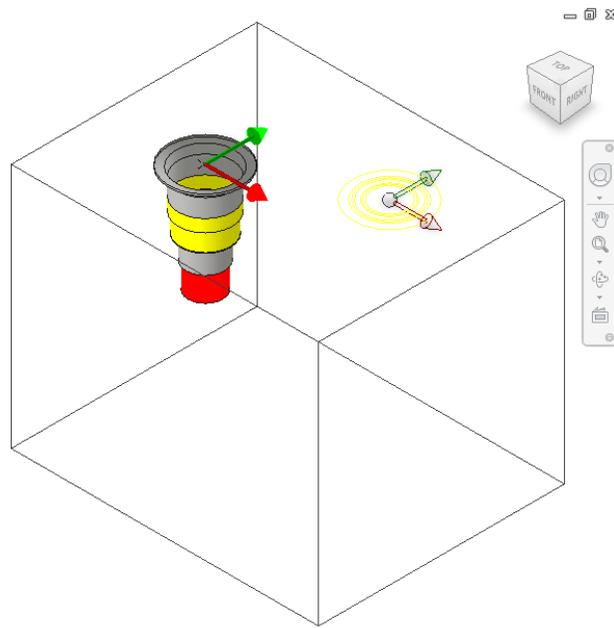
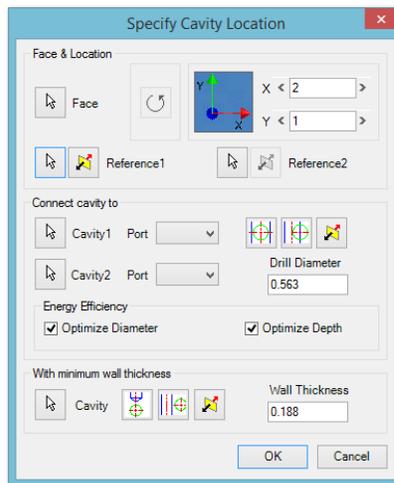


## Note

- 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 the cavity at the specified location.



*Position the new cavity with reference to an existing cavity*

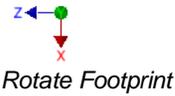
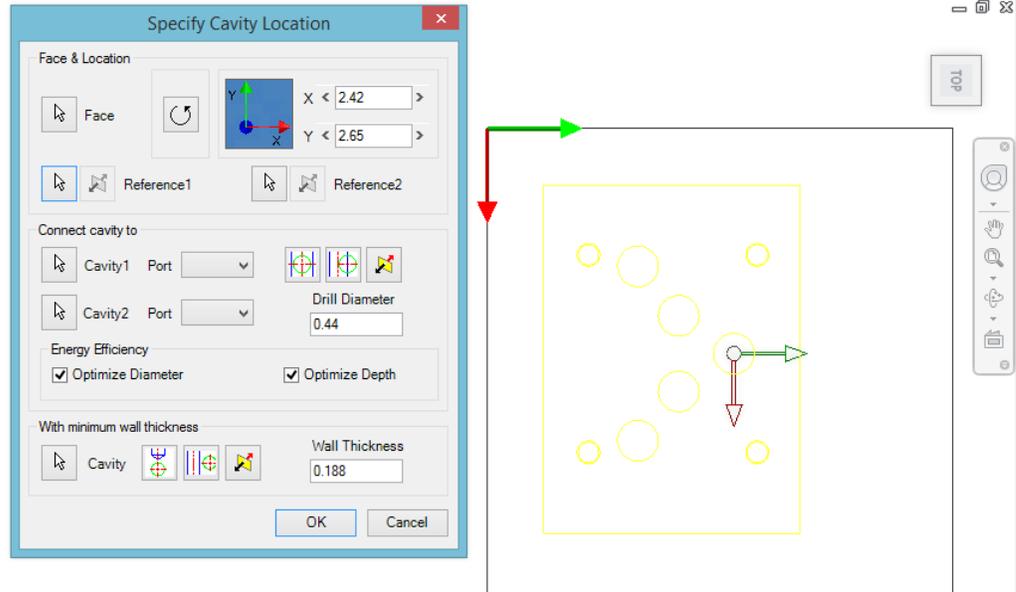
### 3 Rotate Footprint

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.*



## 4 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.

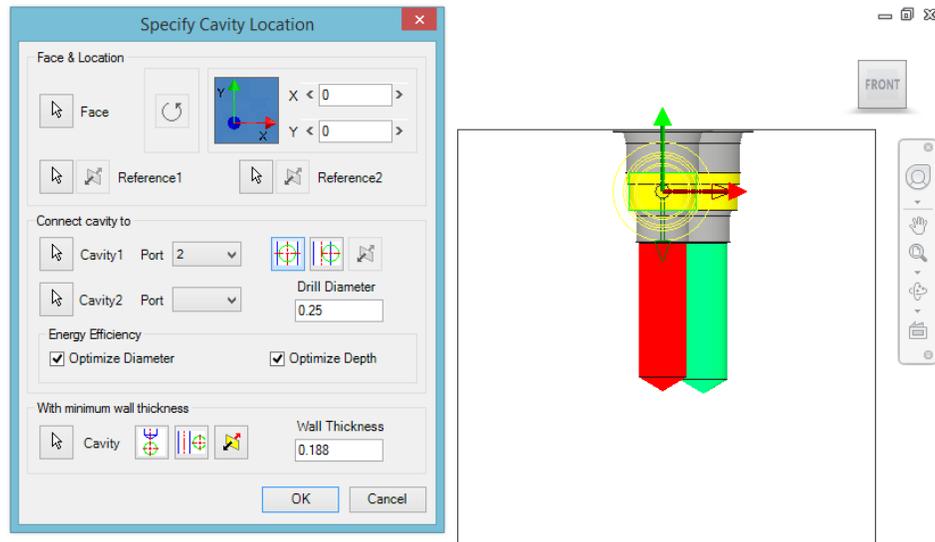
*MDTools automatically relocates the cavity to the overlapping center of the two cavity ports.*

7. Click **OK**.

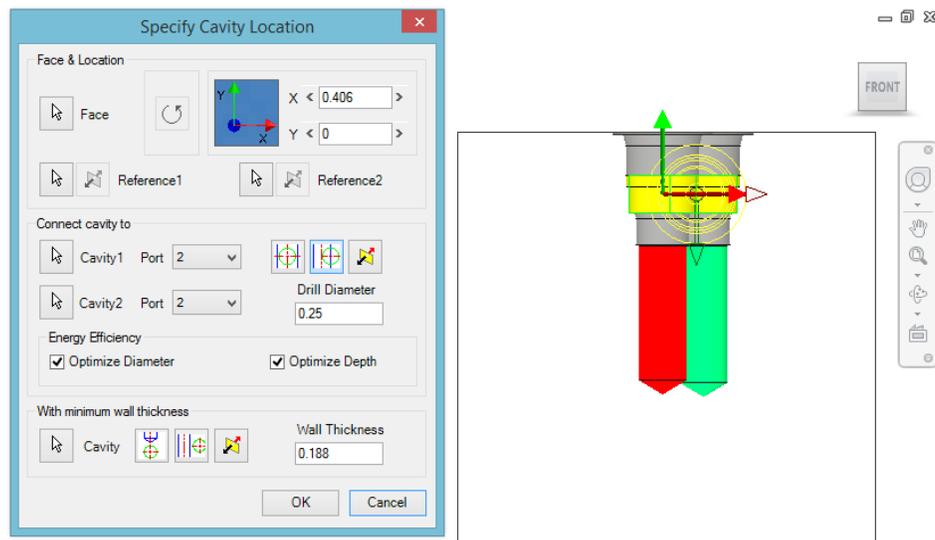
*MDTools creates the new cavity at the specified location and connects the cavity to the selected connecting cavities.*

### Note

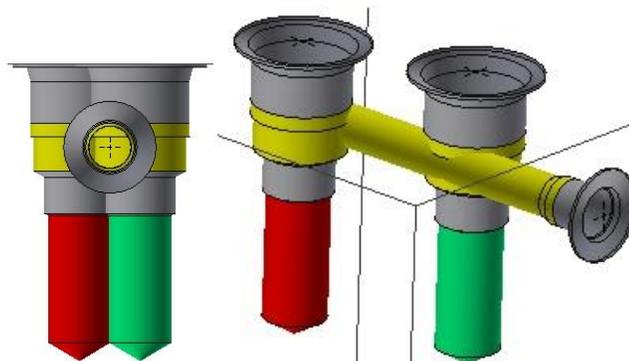
The Energy Efficient connectivity is applied, if either Optimize Diameter or Optimize Depth is selected.



  
Connecting Cavities



  
Positioning the cavity on the sides

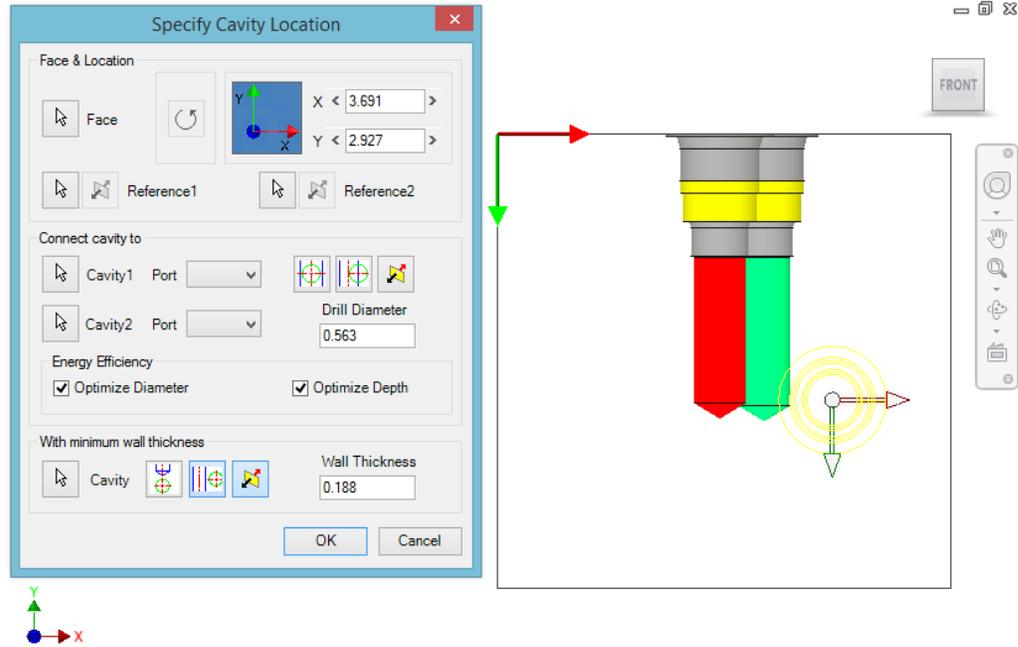


Cavities connected two existing cavities

## 5 Position with minimum wall thickness

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

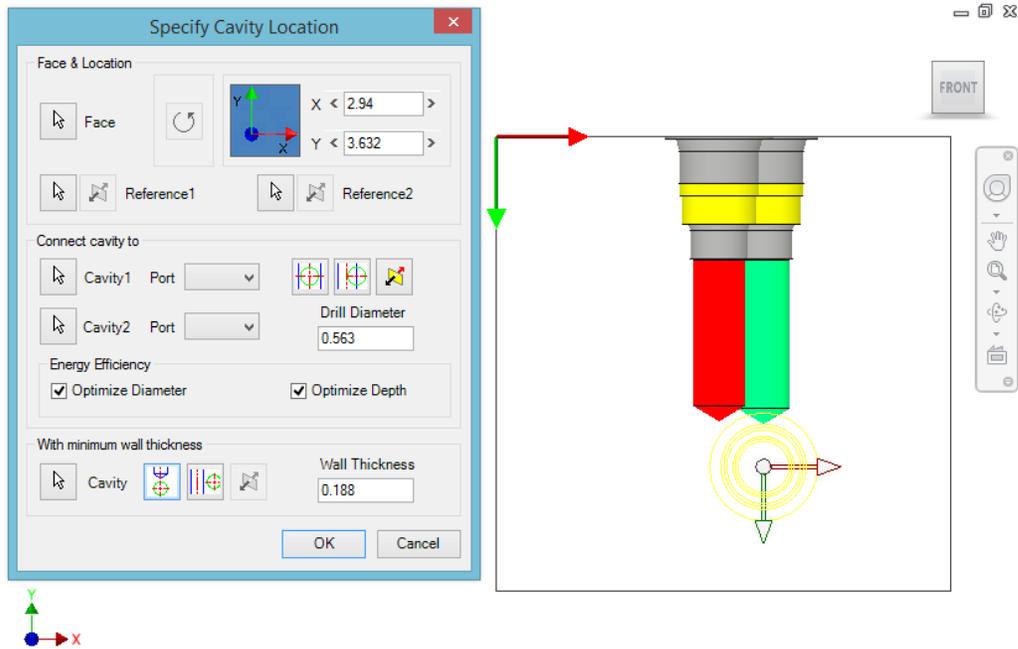
1. Click the select Cavity button.
2. Select an existing cavity on the manifold.
3. Click the **Move to Side** button to position the new cavity away from the selected cavity axis.
4. Click the **Flip Side** button to change the side, if required.
5. Repeat the above steps to position the cavity with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



*Positioning the new cavity using the Move to side option*

### Note

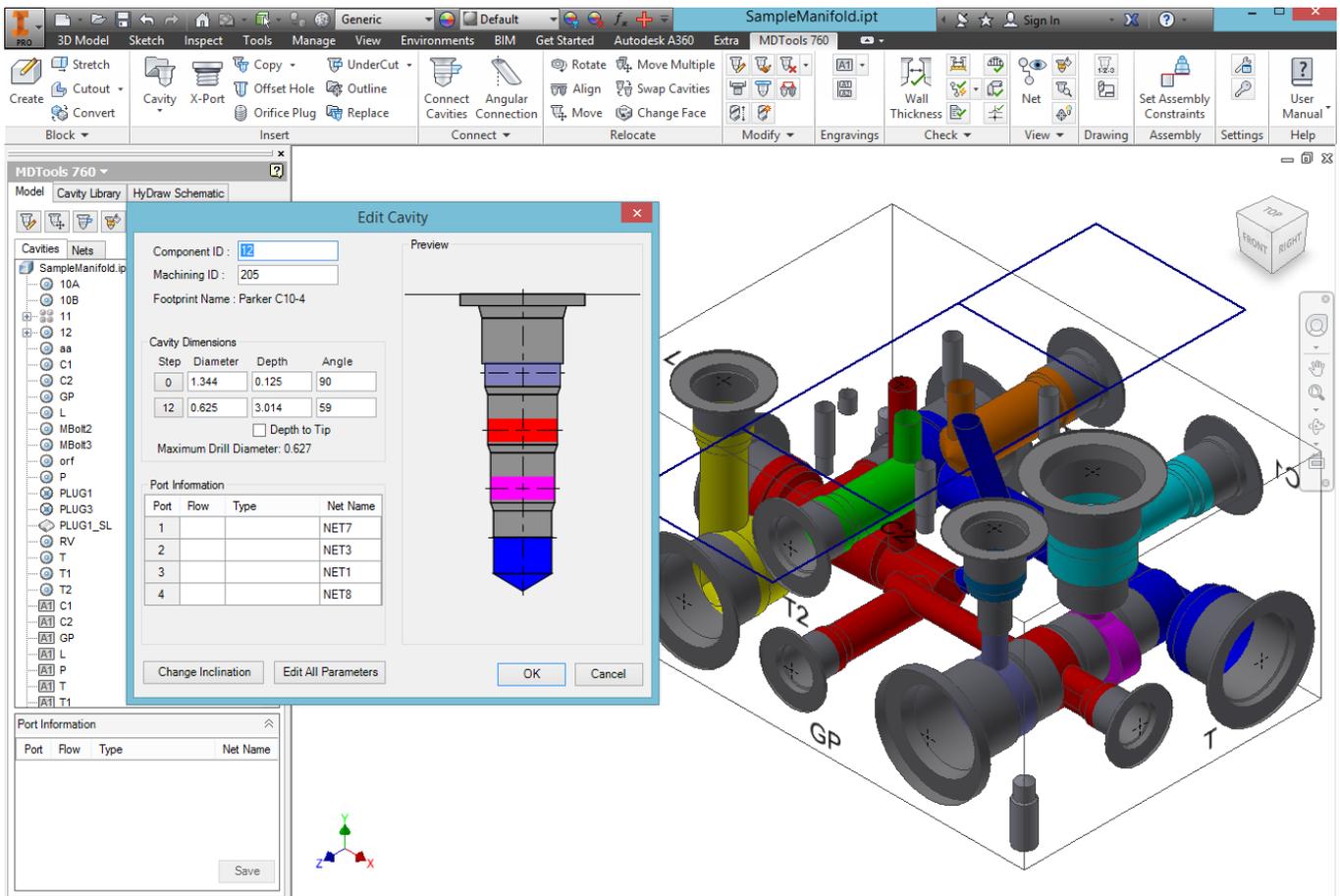
Choose the **Locate below Cavity tip** option when you want to locate the new cavity with the minimum wall thickness from the tip of an existing cavity.



*Positioning the new cavity below the cavity tip*

# Edit

- 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/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 760 ribbon  
>**Modify** panel  
>**Edit**

The MDTools® Select Cavity dialog box displays.

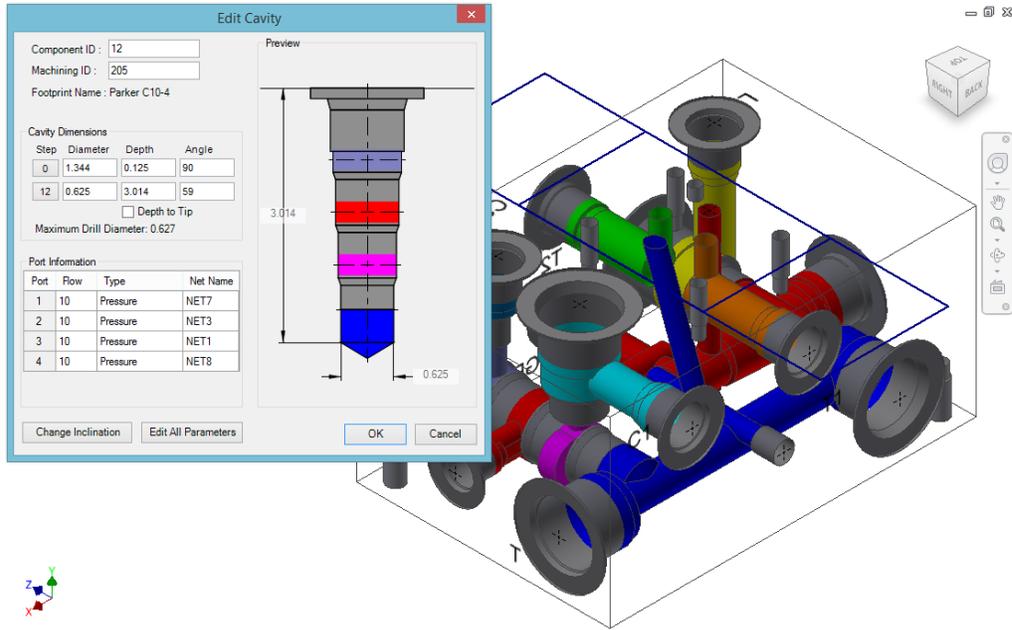
2. Select a cavity in the manifold.

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 design-specific cavity dimensions.

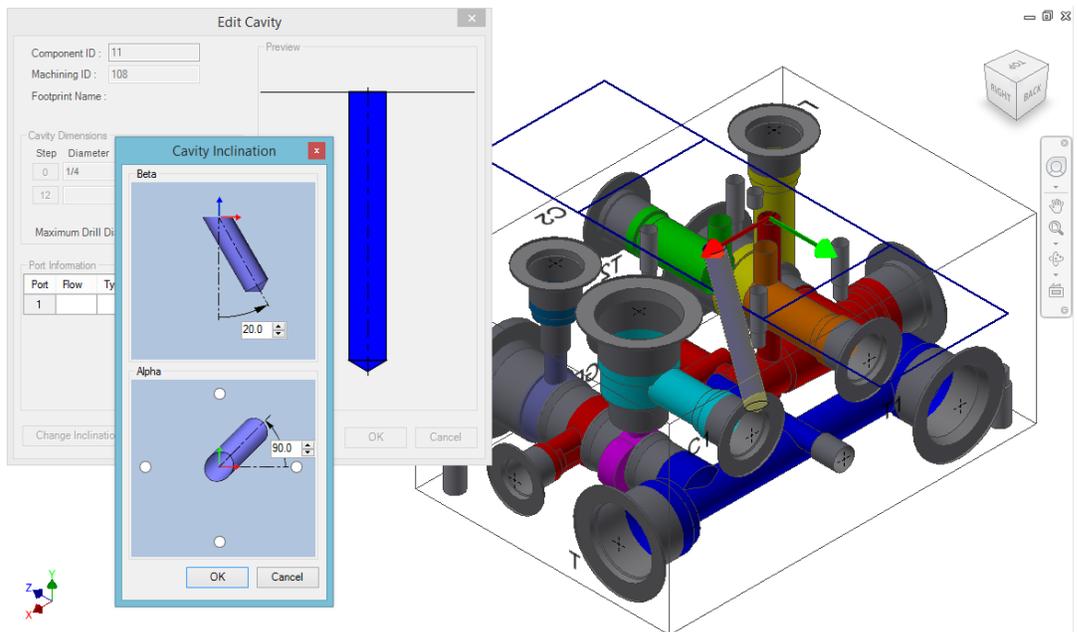


Edit Cavity dialog box

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

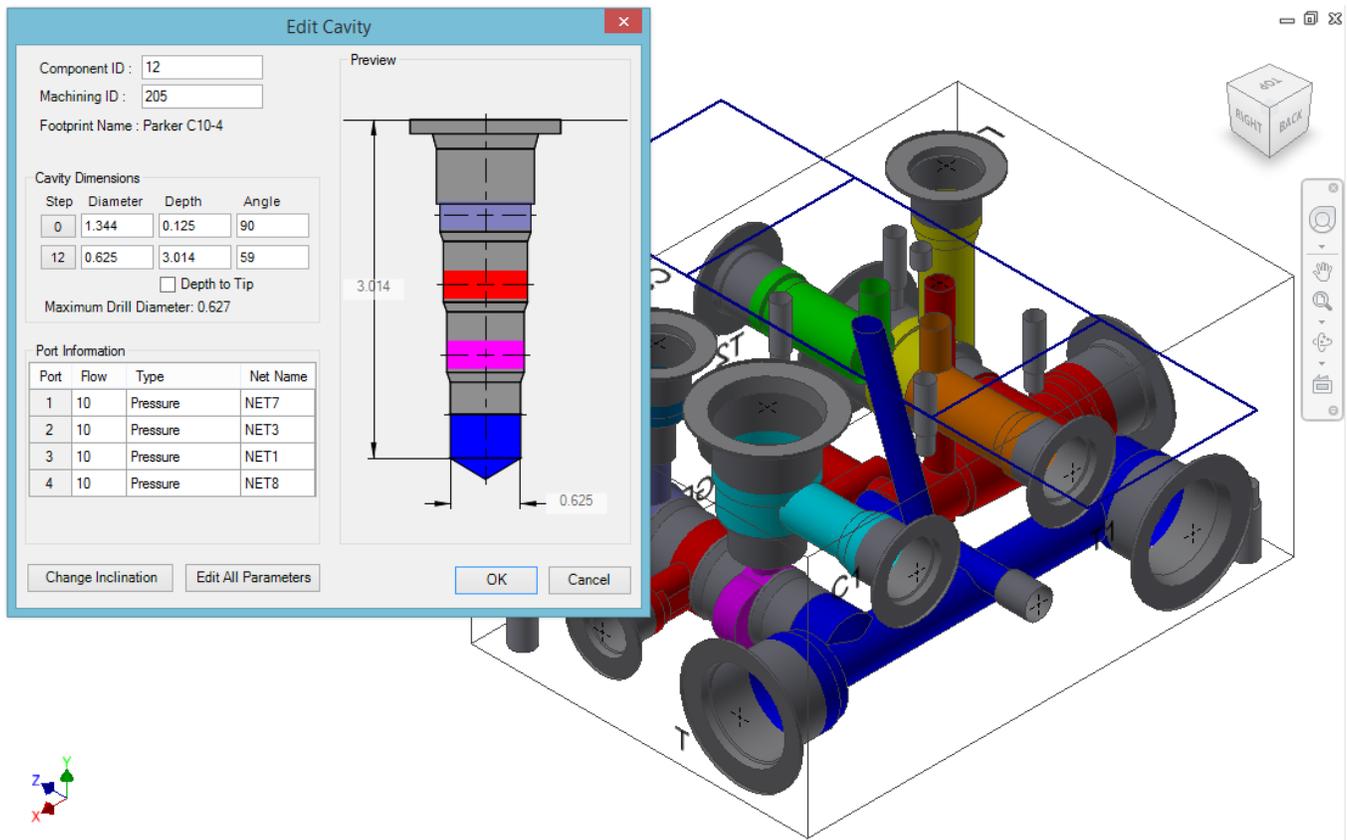
### Note

- Click **Change Cavity Inclination** to change the inclination of a cavity.
- Select the **Depth to Tip** option to get the drill depth up to the tip.



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 at Net Name column, Net Name pop up occur to select a net from the existing nets.

## Selecting drill diameter

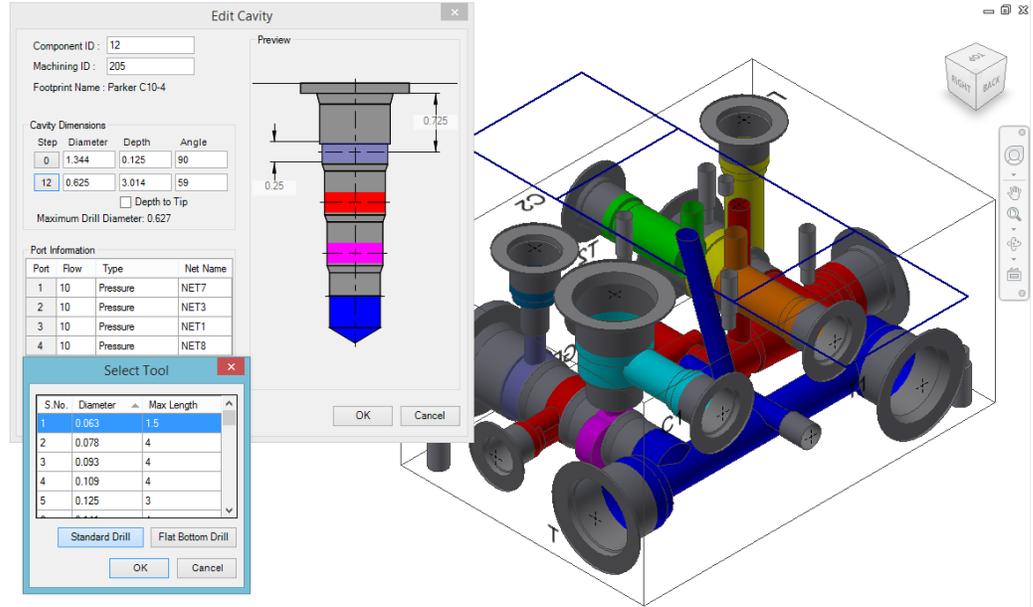
Select and use a drill from a standard drill list.

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 Drill Depth Tip option in MDTools Settings.

*You can also override **Depth to Tip** option locally.*

## Selecting spot face diameter

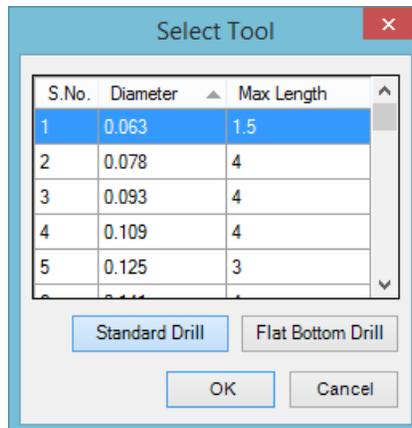
Select and use a spot face from a standard spot face tool list.

1. Click Step 0 button before 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 760 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:

The screenshot shows the 'Edit All Cavity Parameters' dialog box. It includes fields for Component ID (12) and Cavity Machining ID (205). The Footprint OEM Name is 'Parker C10-4' and the Cavity Type is 'Cartridge Valve'. The Cavity Dimensions table has 12 rows with columns for Step, Diameter, Depth, and Angle. The Machining Sequence table has 6 rows with columns for Operation, Tool Name, Diameter, and Depth. The Port Information table has 4 rows with columns for Port, Dia, Depth, Flow, Type, Net Name, and Connecting. The Thread Detail table has 2 rows with columns for Step#, Size, Pitch, and Class. The Inclusion section has Beta and Alpha fields. There is a Comments field at the bottom. A Preview window on the right shows a 3D model of a valve assembly with a red cavity and a blue plug.

*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 '?'.*
- **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.

MDTools 760

>Modify panel  
>Edit

The Edit Cavity dialog box displays.

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

The Edit All Cavity Parameters dialog box displays.

2. 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.

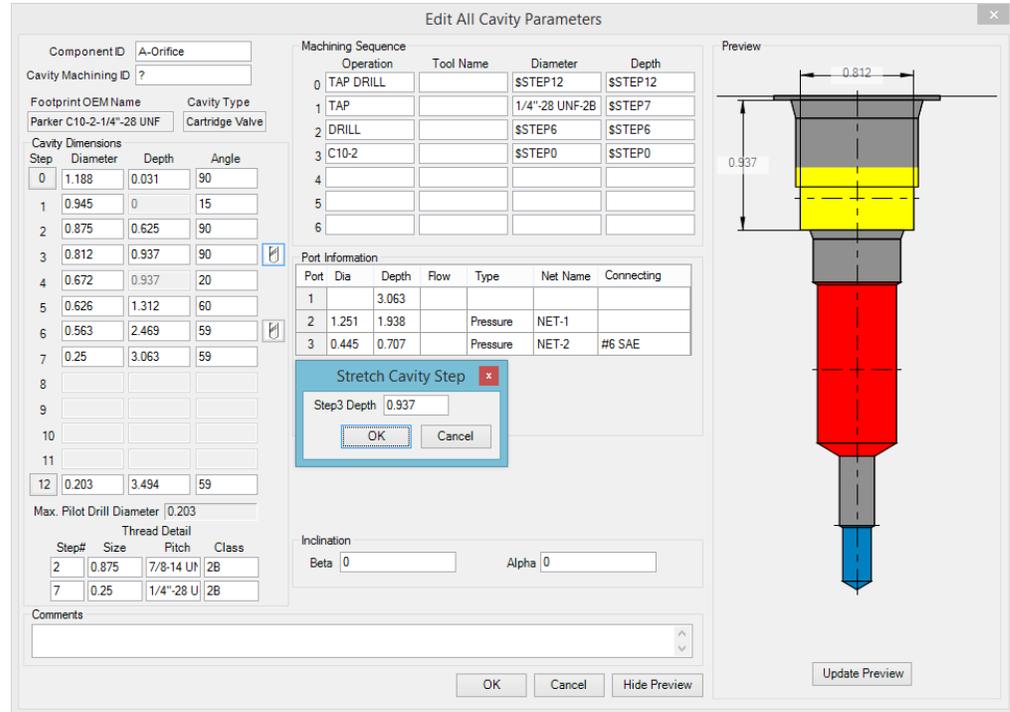
3. Enter the new step depth in the Stretch Cavity Step dialog box.

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

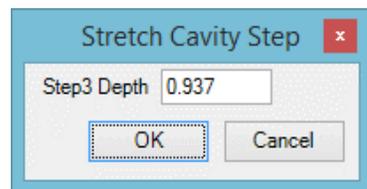
5. Click **OK** in the Edit All Cavity Parameters dialog box to save the changes.

### Note

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



Edit All Cavity Parameters dialog box



Stretch Cavity Step dialog box

## 2 Sink Orifice Plug

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

MDTools 760 ribbon  
>**Modify** panel  
>**Edit**

*The Edit Cavity dialog box displays.*

1. Click the **Edit All Cavity Parameters** button.

*The Edit All Cavity Parameters dialog box displays.*

2. Click , the **Sink Orifice Plug** icon, displayed next to the cavity dimensions step

*The Sink Orifice Plug dialog box displays.*

3. Enter the new step depth.

Step	Diameter	Depth	Angle
0	1.344	0.125	90
1	0.947	0	15
2	0.875	0.625	90
3	0.812	0.875	20
4	0.751	1.5	20
5	0.689	2.125	20
6	0.626	2.5	60
7			
8			
9			
10			
11			
12	0.625	3.014	59

Port	Dia	Depth	Flow	Type	Net Name	Connecting
1		2.5			NET7	
2	0.25	1.968			NET3	# 2 SAE
3	0.25	1.344			NET1	# 2 SAE
4	0.25	0.725			NET8	# 2 SAE

*Edit All Cavity Parameters dialog box*

4. 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*

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

### Note

- The Sink Orifice Plug icon will be 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.

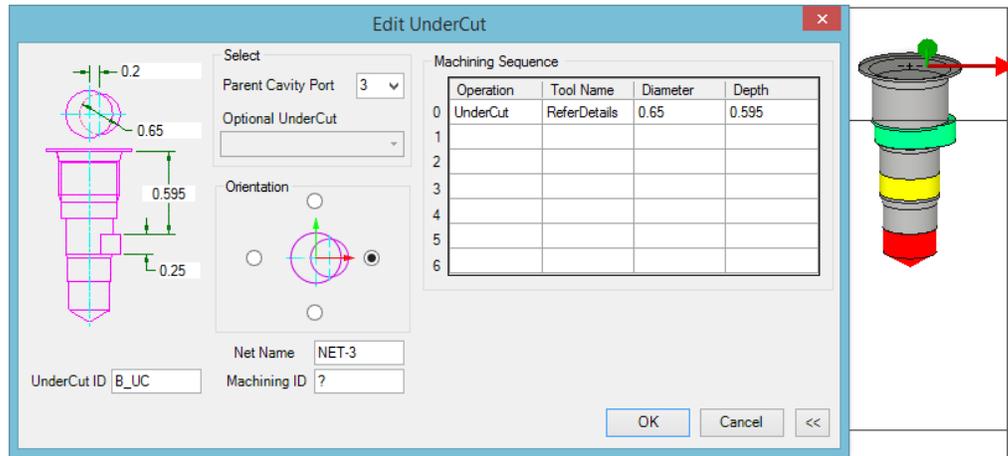
### 3 Edit UnderCut

Change all the values used when creating the undercut, if you select UnderCut.

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

MDTools 760 ribbon  
 >Modify panel  
 >Edit  
 >UnderCut

The Edit UnderCut dialog box displays.



Edit UnderCut dialog box

2. Select the undercut you want to edit.
3. Select linked undercuts.  
Or

Select the port of the cavity to have default values for that port.

4. Change the offset distance, if required.

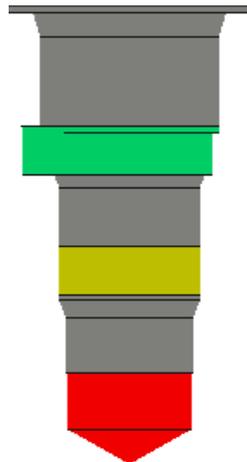
Enter the desired distance between the center of the undercut and the selected cavity.

5. Change the undercut diameter, if required.
6. Change the undercut depth, if required.

Enter the desired depth of the undercut from the spot face of the cavity.

7. Change the undercut height, if required.
8. Change the orientation, if required.
9. Change the Cavity ID, Machining ID, and Net Name, if required.
10. Change the Machining sequence, if required.
11. Click **OK**.

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



Undercut position changed

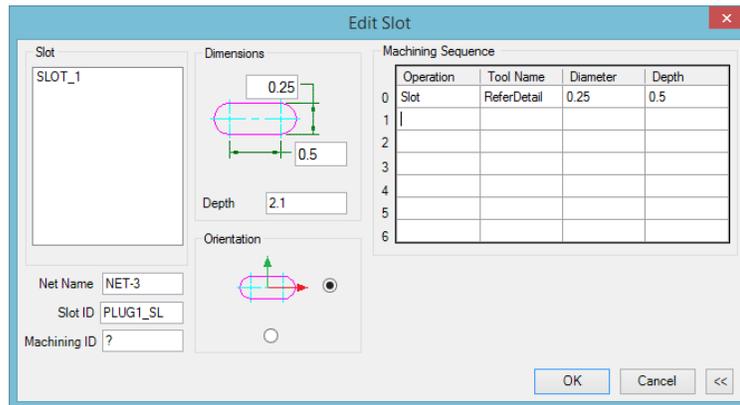
## 4 Edit Slot

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

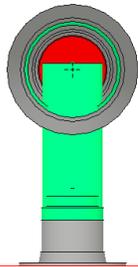
*MDTools® modifies the existing slot according to the new specifications.*

1. MDTools 760 ribbon  
>**Modify** panel  
>**Edit**  
>**Slot**  
*The Edit Slot dialog box displays.*
2. Select the slot you want to edit.
3. Select any pre-defined slot, if required and exist for the cavity.
4. Change the Slot ID, if required.
5. Change the slot diameter, if required.
6. Change the slot depth, if required.
7. Change the orientation, if required.
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: changed parameters*

## 5 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 760 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.

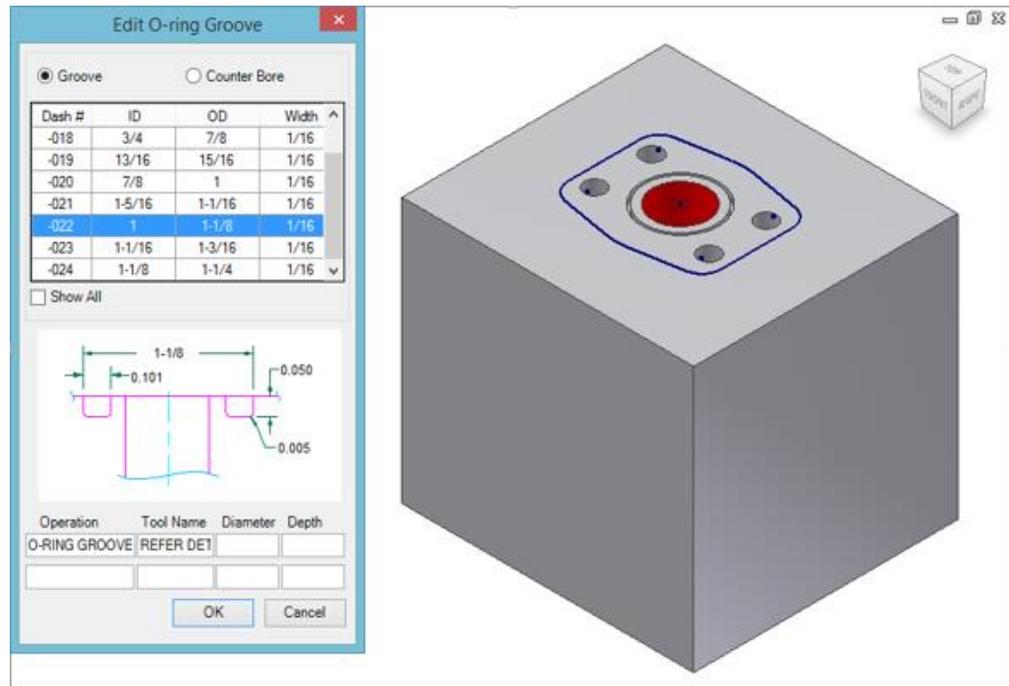
3. Change the O-ring groove dimensions either by selecting an O-ring or by manually modifying the dimensions.
4. Change the machining sequence information, if required.
5. Click **OK**.

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

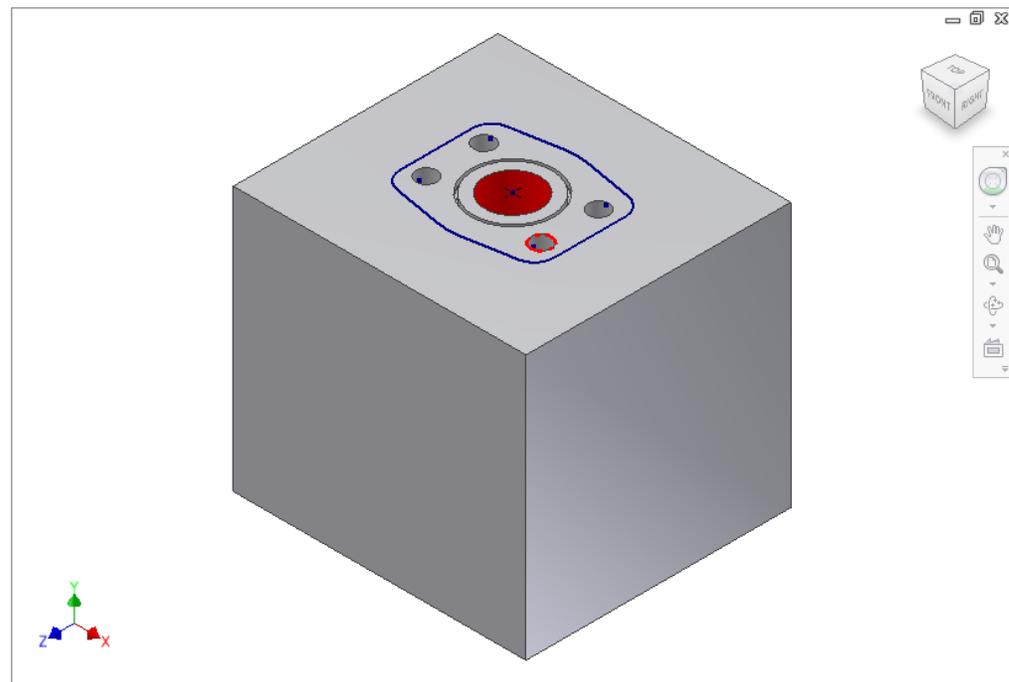
### Note

Use \$Step for diameter and Depth field to easily maintain the machining Chart information.

\$Step takes the outer diameter as the diameter value in Machining Chart.



Edit O-Ring Groove dialog box



MDTools automatically recreates the O-ring groove

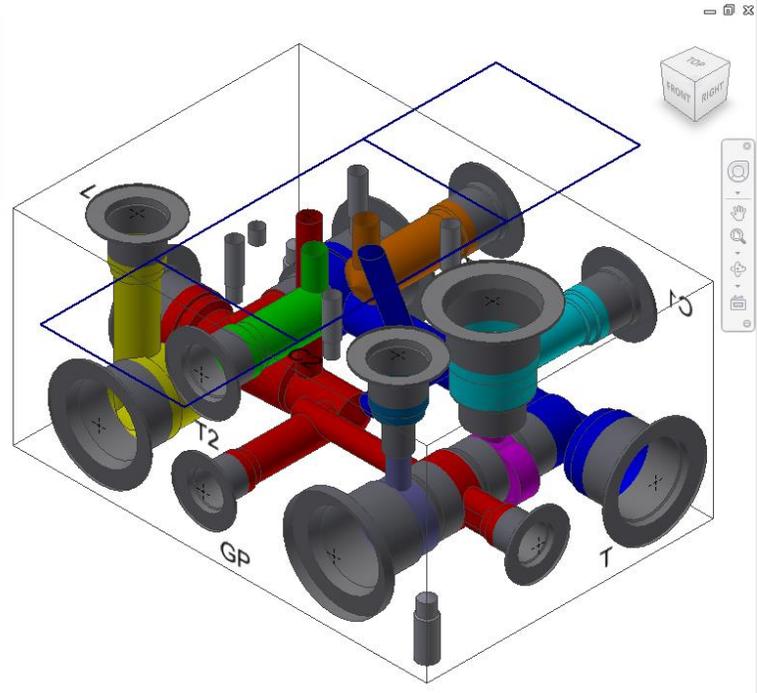
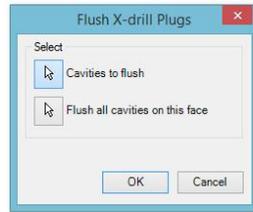
# 46. Flush X-drill Plugs

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.

MDTools 760 ribbon  
>Modify panel  
>Flush

The Flush X-drill Plugs dialog box displays.



## Flush selected X-drill Plugs

1. Click the **Cavities to flush** selection button and select the cavities to flush plugs.

The default option is Cavities to flush.

2. Click **OK**.

MDTools® automatically flushes the selected cavities by increasing their spot face depths.



Flush X-drill Plugs dialog box

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

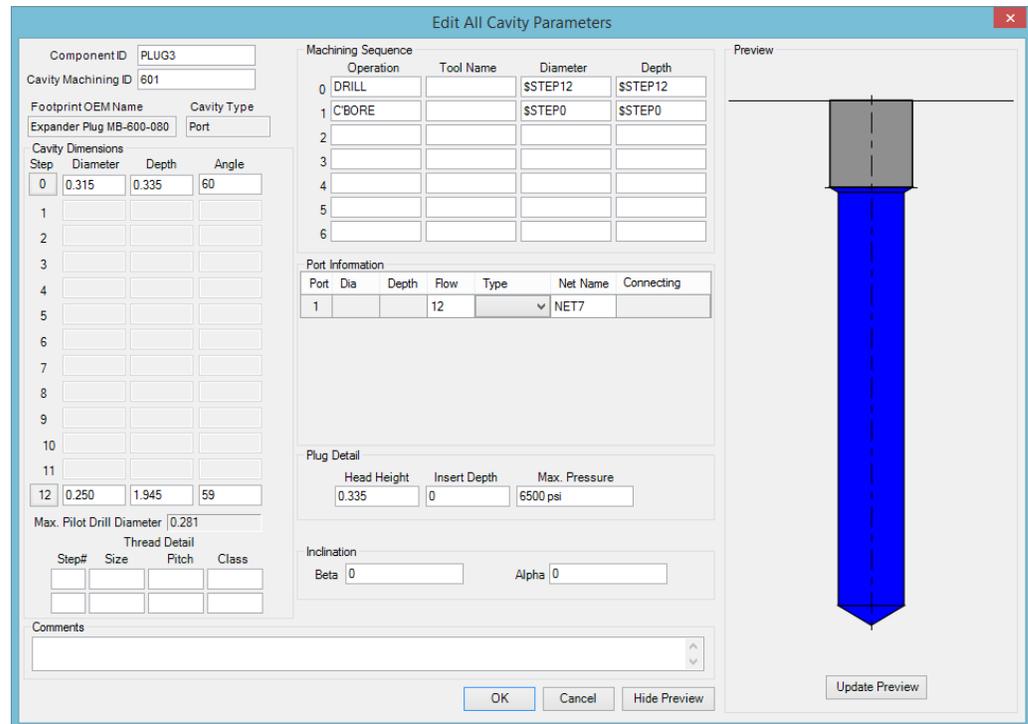
## Flush X-drill Plugs on a selected face

1. Click



2. Select the face.
3. 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 760 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.

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.

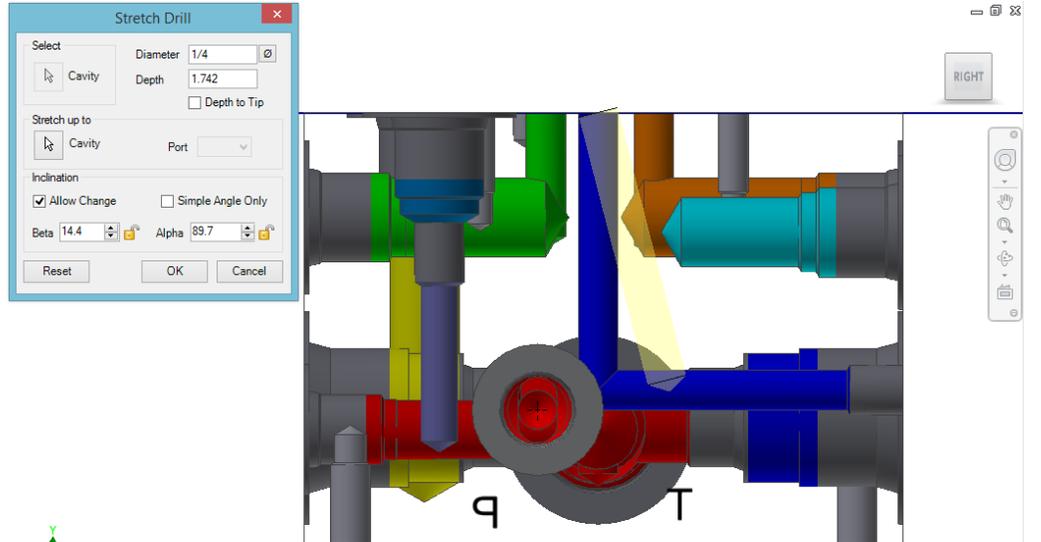
The **Stretch up to** function allows you to stretch the cavity to the selected cavity's port.

8. Select the 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.

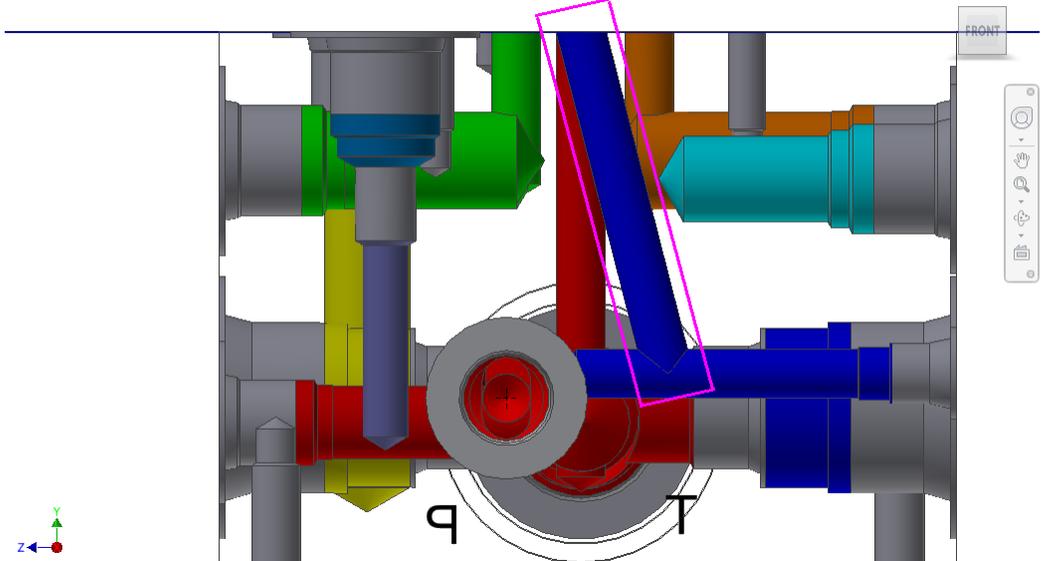
### Note

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

10. Select **Simple Angle Only** to lock Alpha.
11. Click **OK**.



Stretch Drill dialog box: Changing the drill depth by dragging

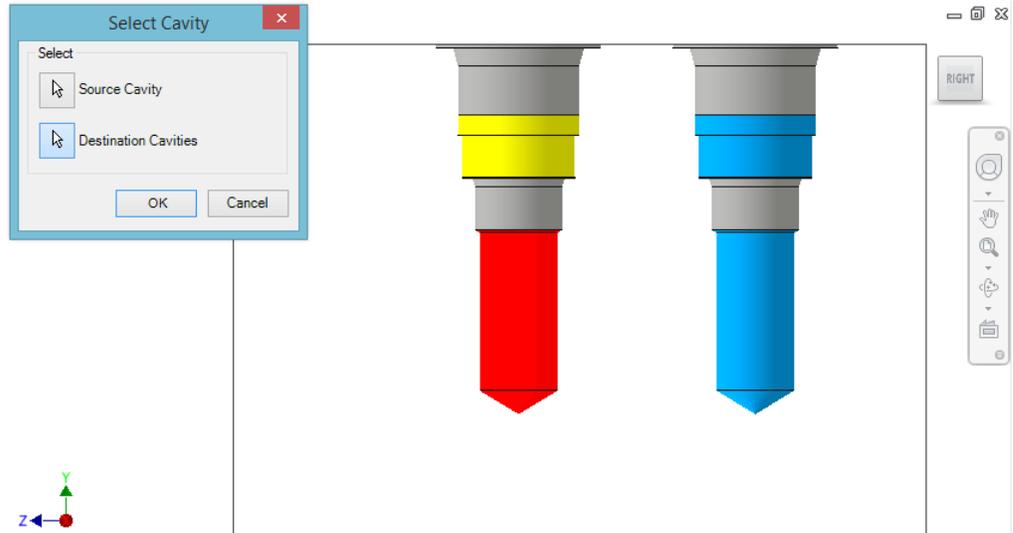


Stretched Drill

# 48. Match Properties

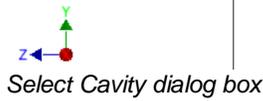
Match the properties of two or more cavities. You can match drill diameter, drill depth, drill tip angle, spot face/LS depth, cavity inclination (Alpha and Beta), net name, and cavity machining information.

- MDTools 760 ribbon > **Modify** panel > **Match Properties**  
The *Select Cavity* dialog box displays.
- Select the source cavity.
- Select the destination cavities.
- Click **OK**.



The *Match Cavity Properties* dialog box displays.

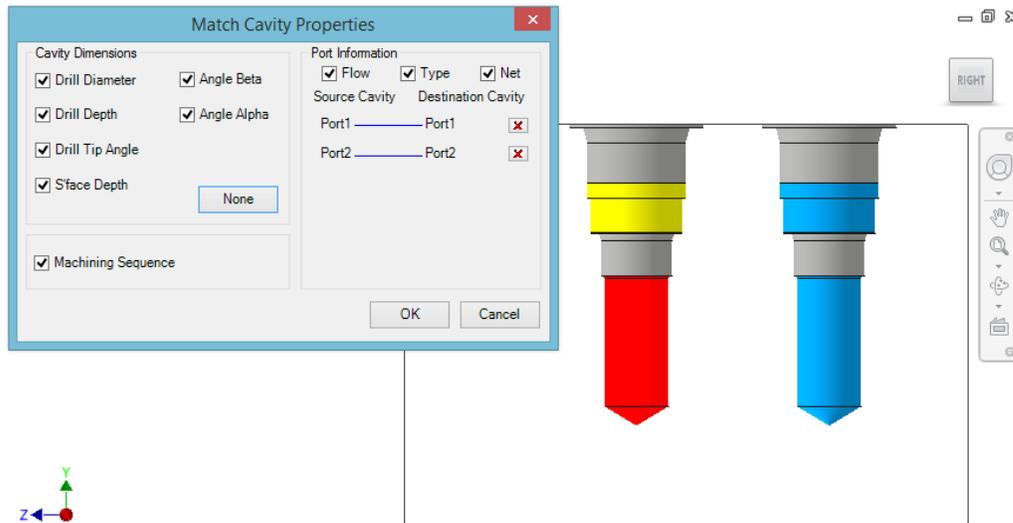
- Select properties you want to match.
- Click **OK**.  
MDTools® updates the selected properties of the destination cavities with that of the source cavity.



## Match Net Name

- Click the source cavity port:  
For example, Port1 Net.
- Click the destination cavity port:  
For example, Port2 Net.

MDTools displays a line connecting the selected ports to match the net names.



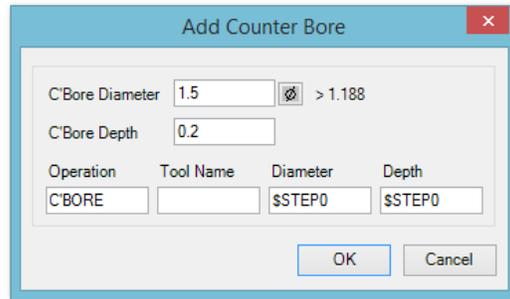
- Click  to delete the selection.



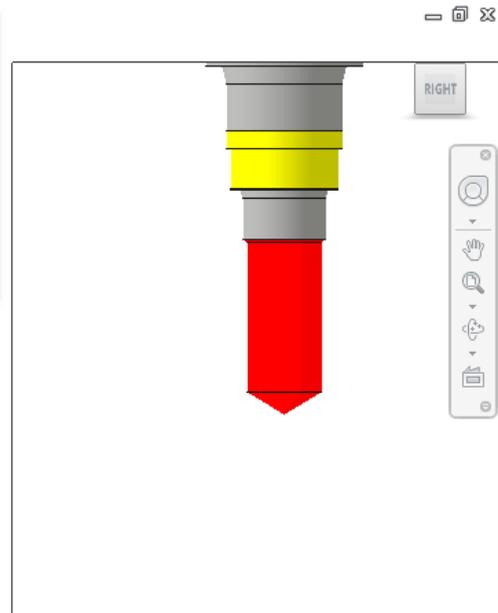
# 49. Add Counter Bore

Automatically add a counter bore operation to an existing cavity.

1. MDTTools 760 ribbon >Modify panel >Add Counter Bore  
The Select Cavity dialog box displays.
2. Select the cavity in which you want to add the counter bore.  
The Add Counter Bore dialog box displays.
3. Enter the counter bore diameter and depth.
4. Change the machining details, if required.
5. Click **OK** to add the counter bore to the selected cavity.

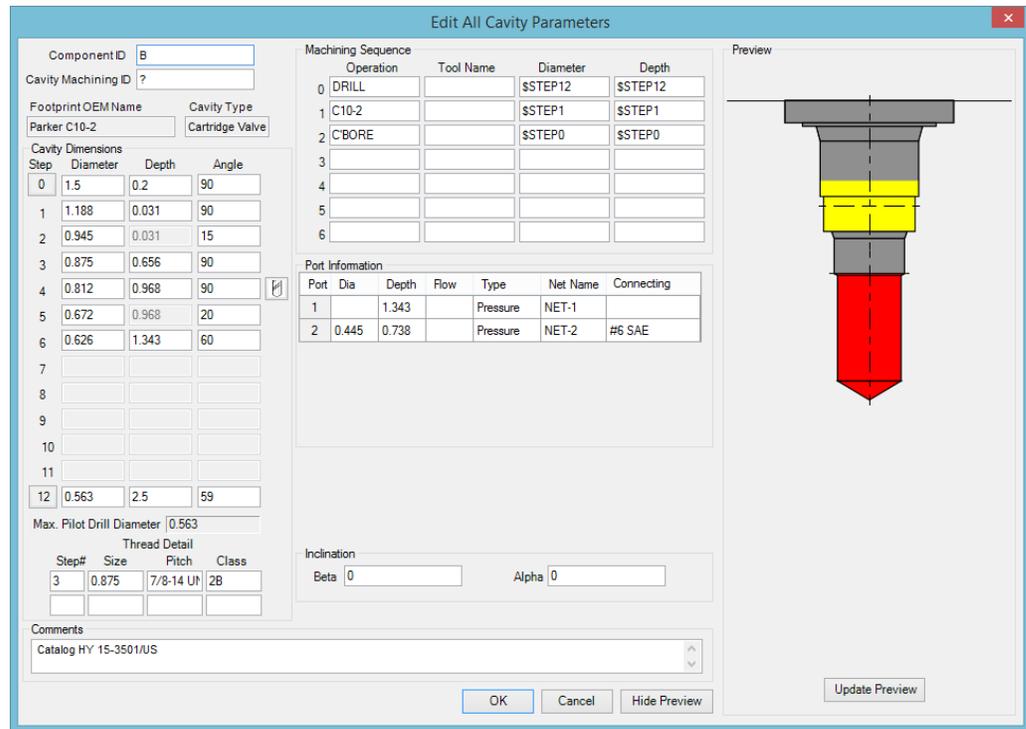


Add Counter Bore dialog box



## 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 760 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.
4. Select **Depth to Tip** option if you want to enter the drill depth value from the depth to the tip.

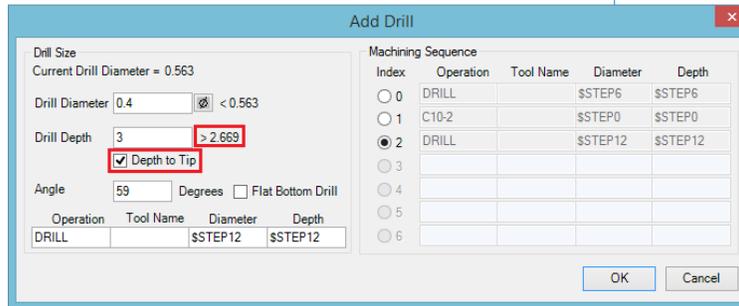
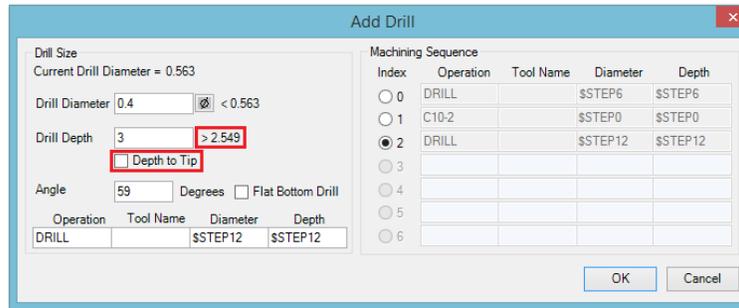
5. Select the location of a new machining operation in the cavity machining sequence.

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

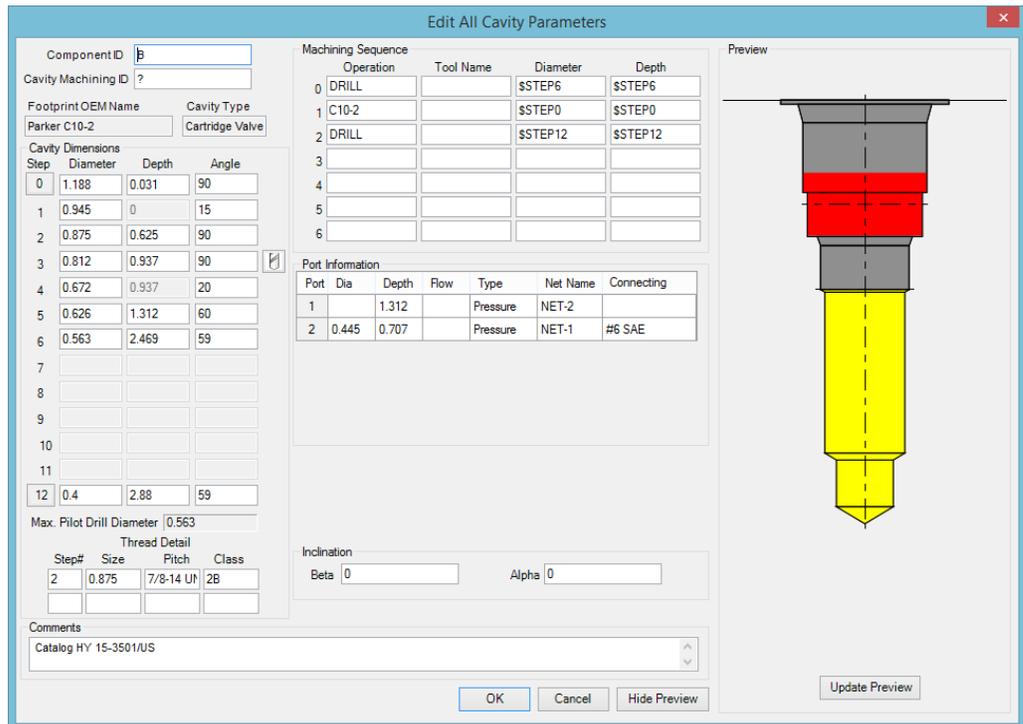
6. Change the machining details, if required.

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

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



Add Drill dialog box



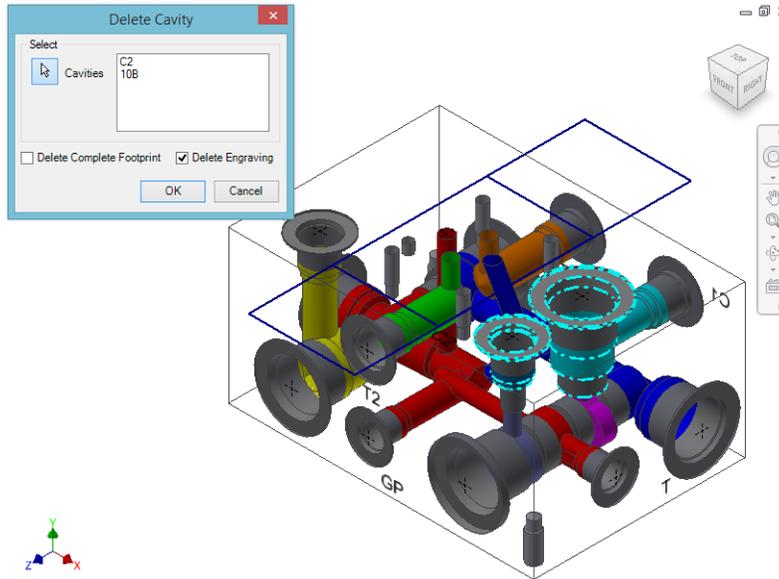
Cavity data after adding the drill

# 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.

- MDTools 760 ribbon  
>**Modify** panel  
>**Delete Cavity**  
dropdown  
>**Delete Cavity**

The *Delete Cavity* dialog box displays.



- Select the 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 will be deleted only when the **Delete Complete Footprint** option is selected.

- Click **OK**.

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

### Note

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

### Deleting a single cavity from a footprint

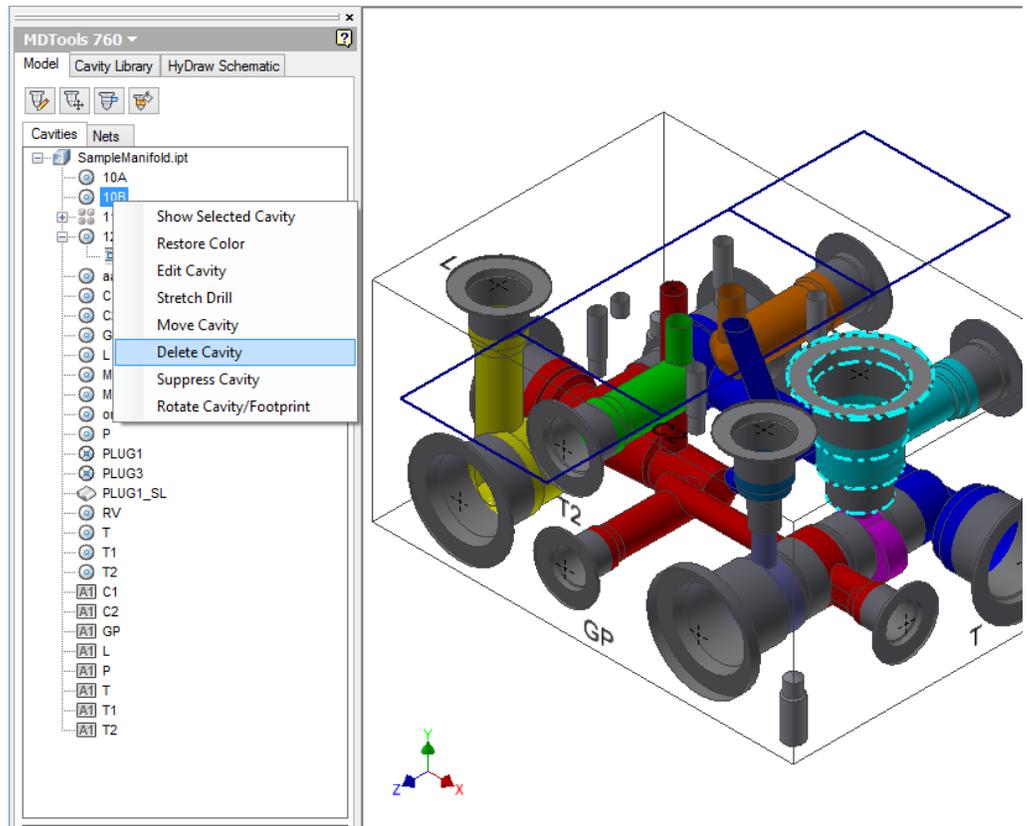
To delete a single cavity from a footprint, use the Delete Cavity option on the MDTools Cavity browser context menu.

- Select the cavity from the MDTools Cavity browser.
- Right-click the selected cavity.

The context menu displays.

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

MDTools deletes the selected cavity from the footprint.



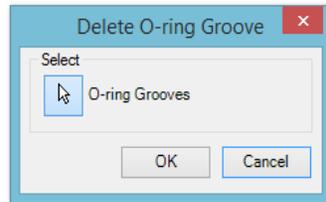
Delete single cavity from a footprint

## 52. Delete O-ring Groove

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

1. MDTools 760 ribbon  
>Modify panel  
>Delete Cavity  
dropdown  
>Delete O-ring  
Groove

The Delete O-Ring Groove dialog box displays.

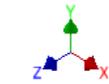


2. Select all O-ring grooves you want to delete.

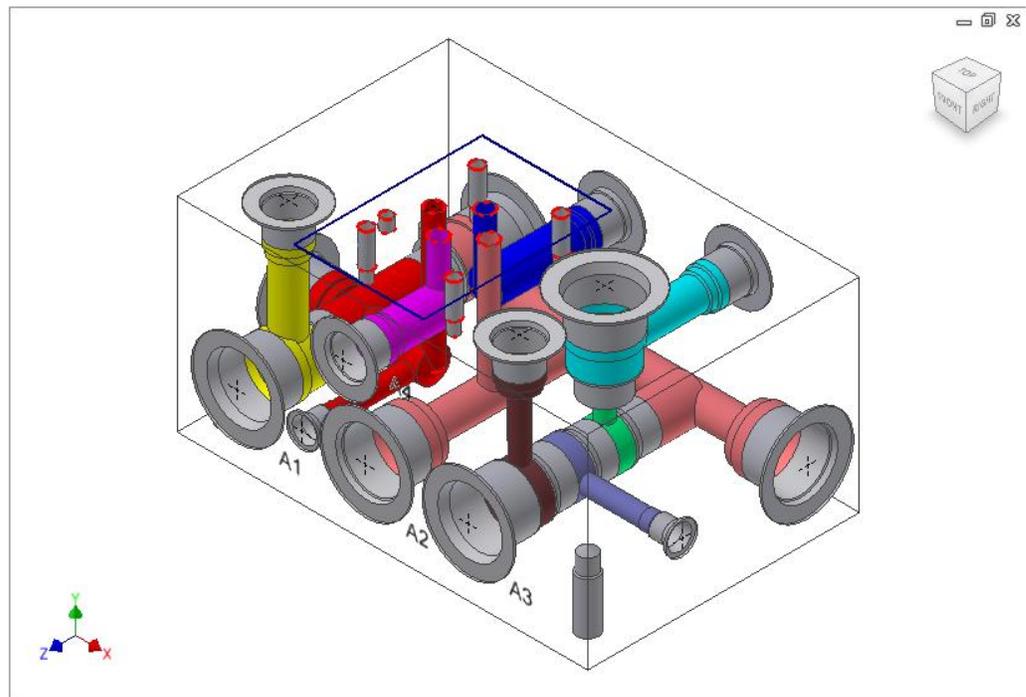
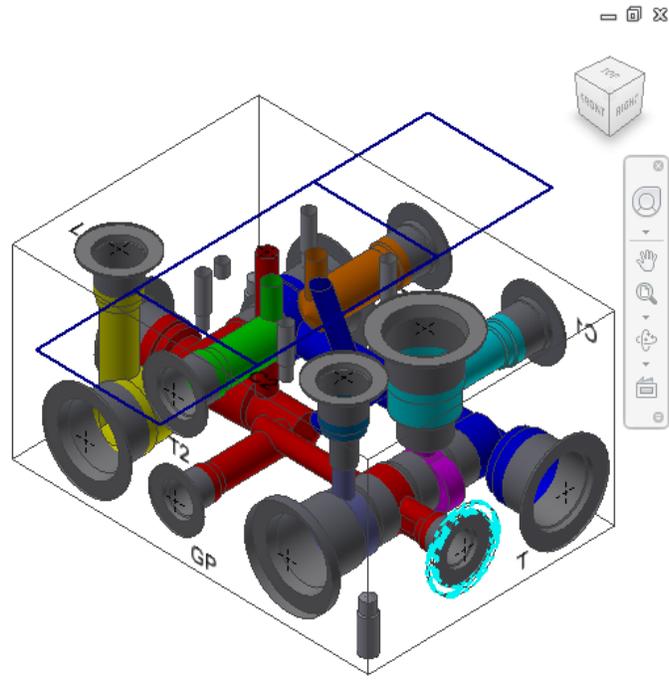
When you move the cursor over an O-ring groove, it gets highlighted.

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



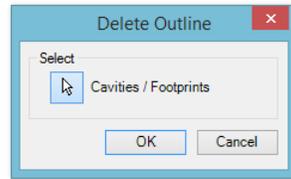
O-ring groove deleted

## 53. Delete Outline

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

1. MDTools 760 ribbon  
>**Modify** panel  
>**Delete Cavity**  
dropdown  
>**Delete Outline**

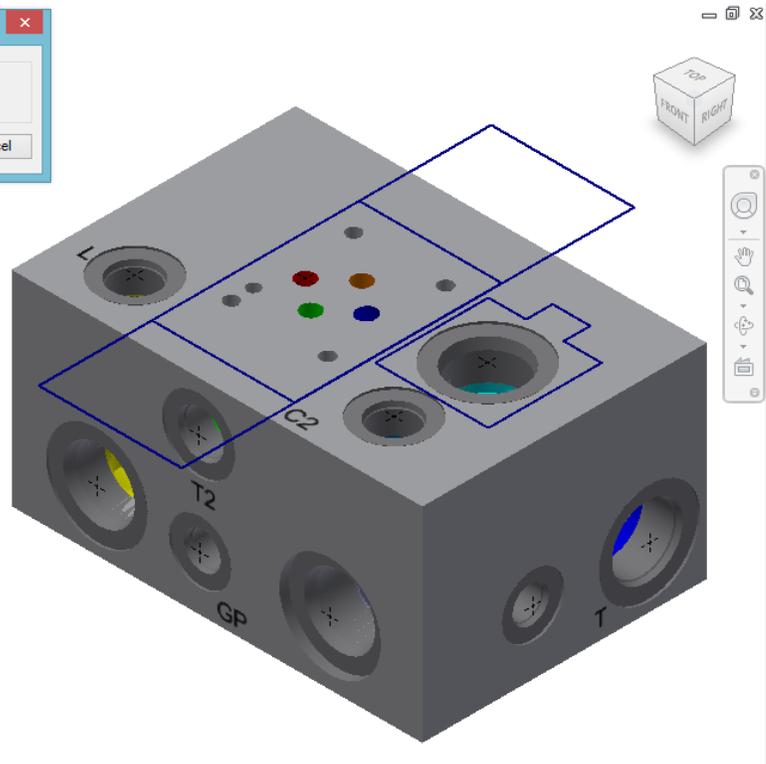
The *Delete Outline* dialog box displays.



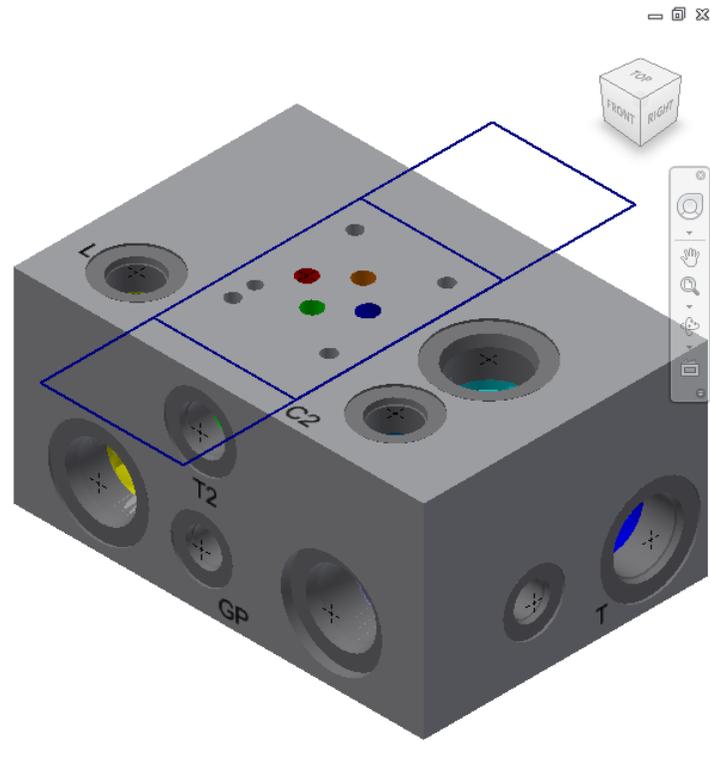
2. Select the cavities/footprints from which you want to delete the outline.

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 760 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

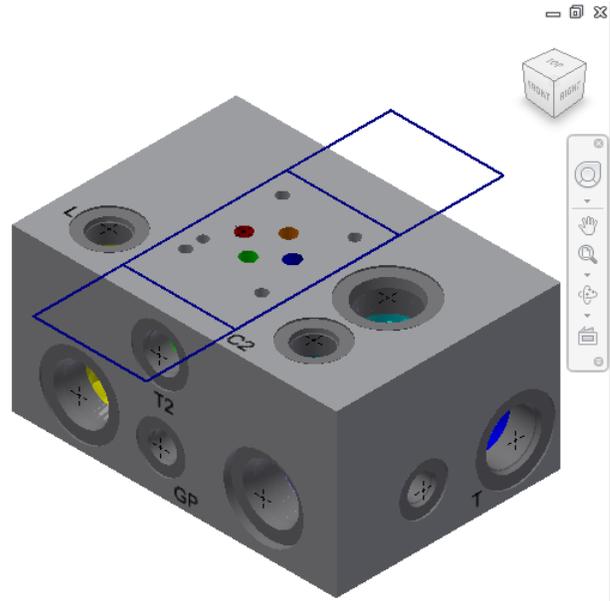
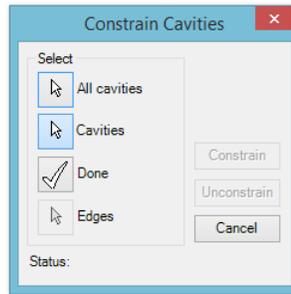
When you need to constrain the cavities to another cavity, first select the cavity to which you want to constrain.

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

The Constrain and Unconstrain buttons are enabled.

3. Click **Constrain**.

All the 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.

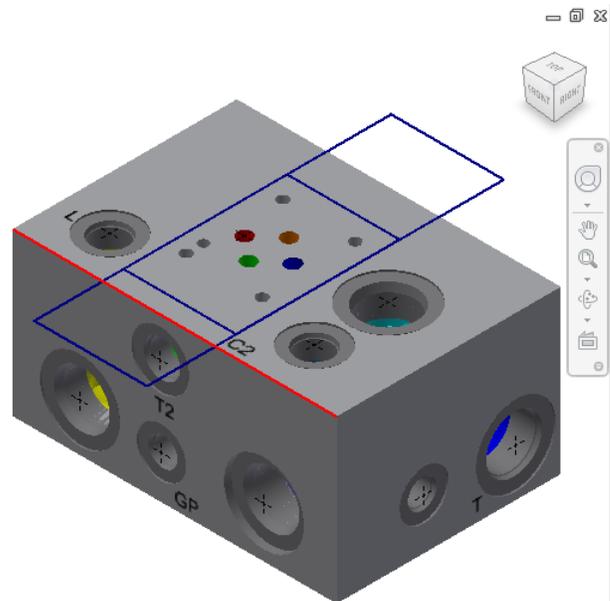
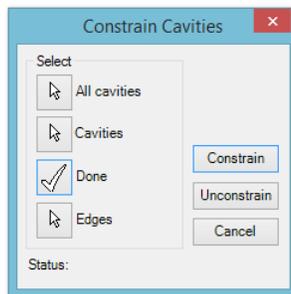
### Constrain All Cavities

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

All the cavities are constrained to the first cavity inserted on the manifold.

### Note

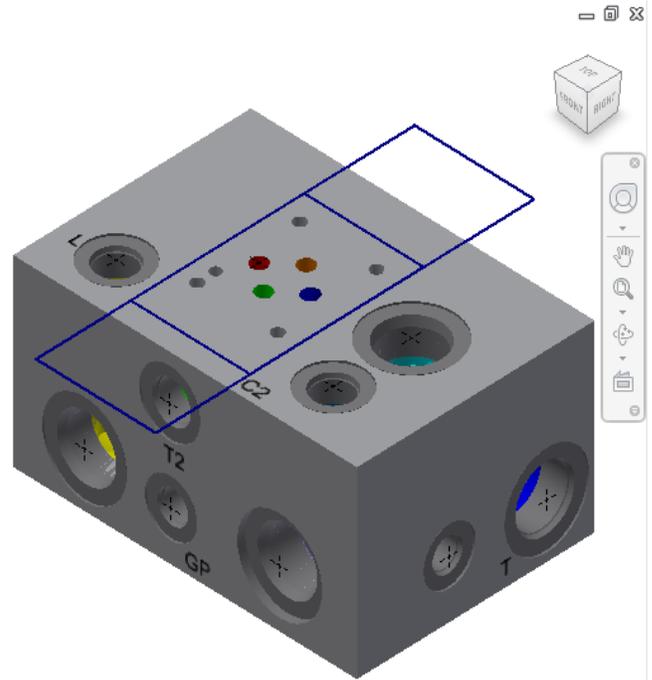
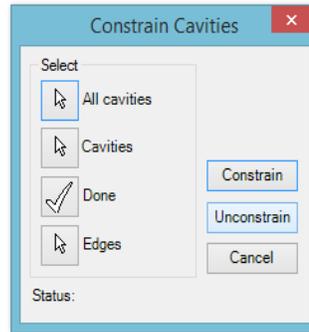
The center point of the cavities becomes invisible on constraining the cavities to another cavity or an edge.



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*

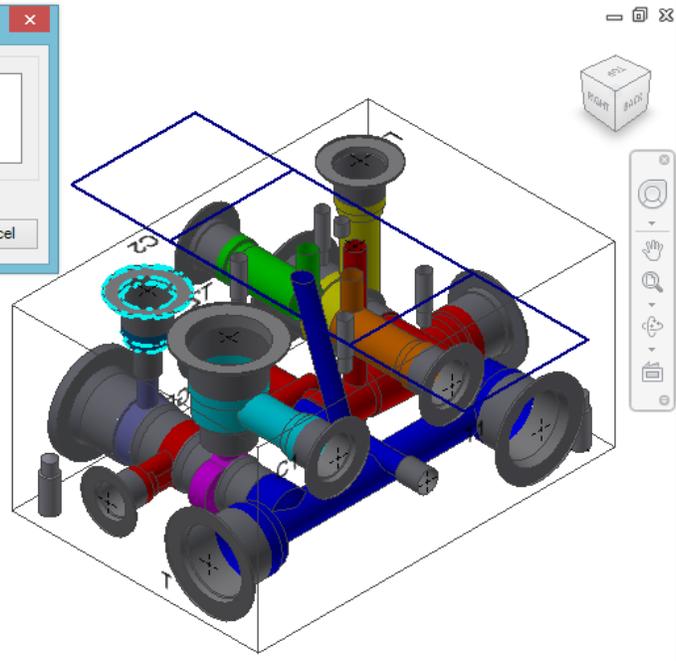
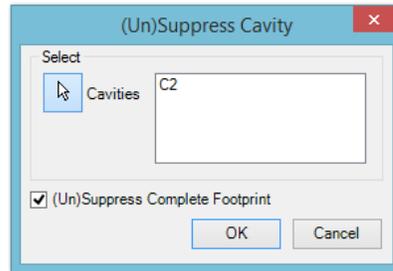
# 55. Suppress/Unsuppress Cavities

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

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

MDTools 760 ribbon  
>Modify panel  
>Suppress

The (Un)suppress Cavity dialog box displays with the Cavities option 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.

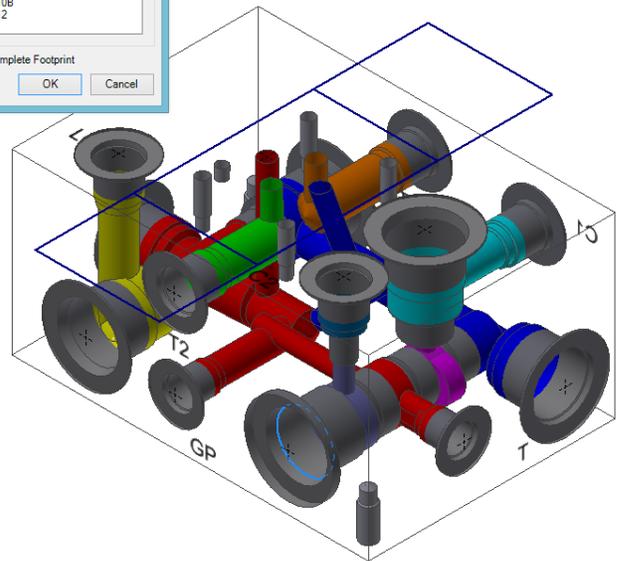
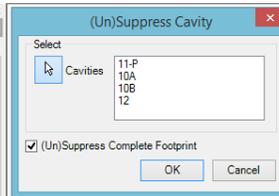
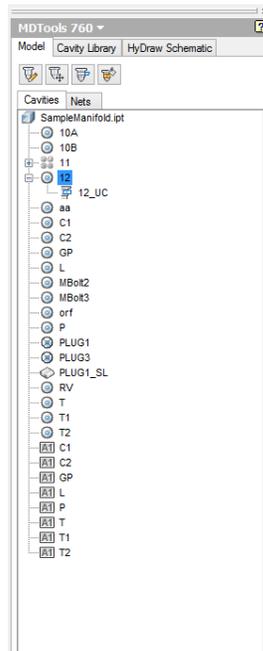


(Un)Suppress Cavity dialog box

## Unsuppressing Cavities

1. Select the cavity/footprint you want to unsuppress.
2. Select the cavity from the browser.
3. Click **OK**.

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



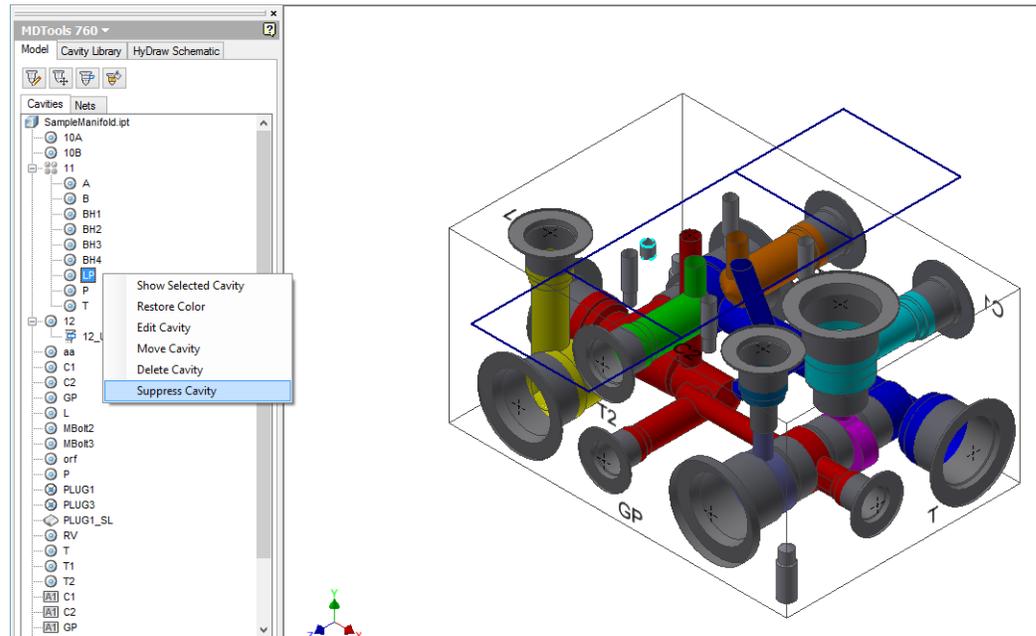
Select cavities from the browser

## Suppressing a single cavity in a footprint

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

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

*MDTools suppresses the selected cavity in the footprint.*



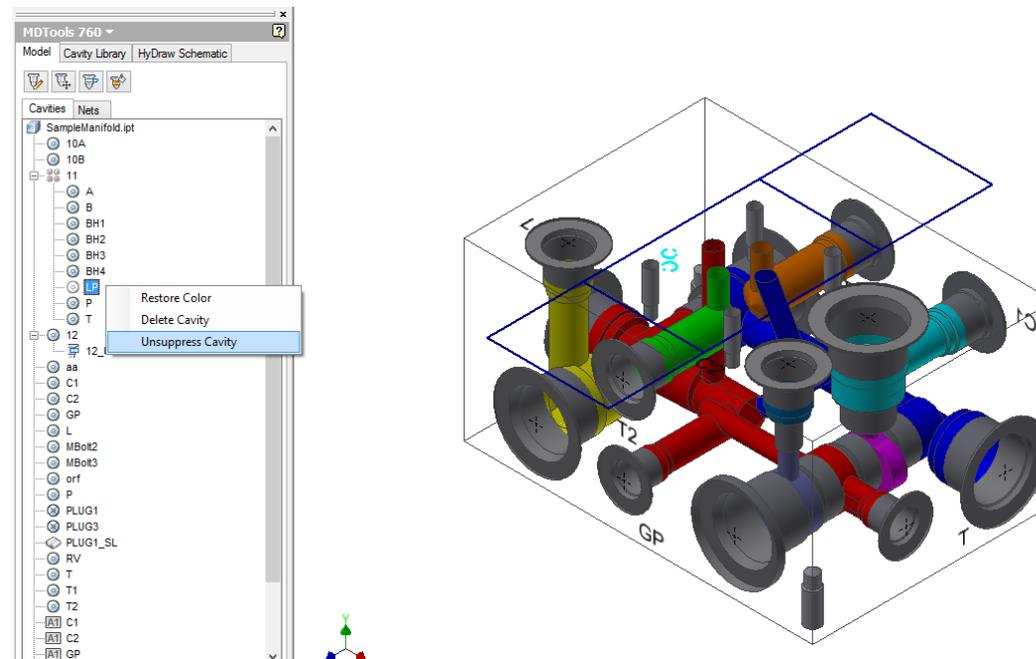
*Suppress a single cavity in a footprint*

## Unsuppressing a single cavity in a footprint

To unsuppress a single cavity in a footprint, click the Unsuppress Cavity option on the MDTools® Cavity 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.

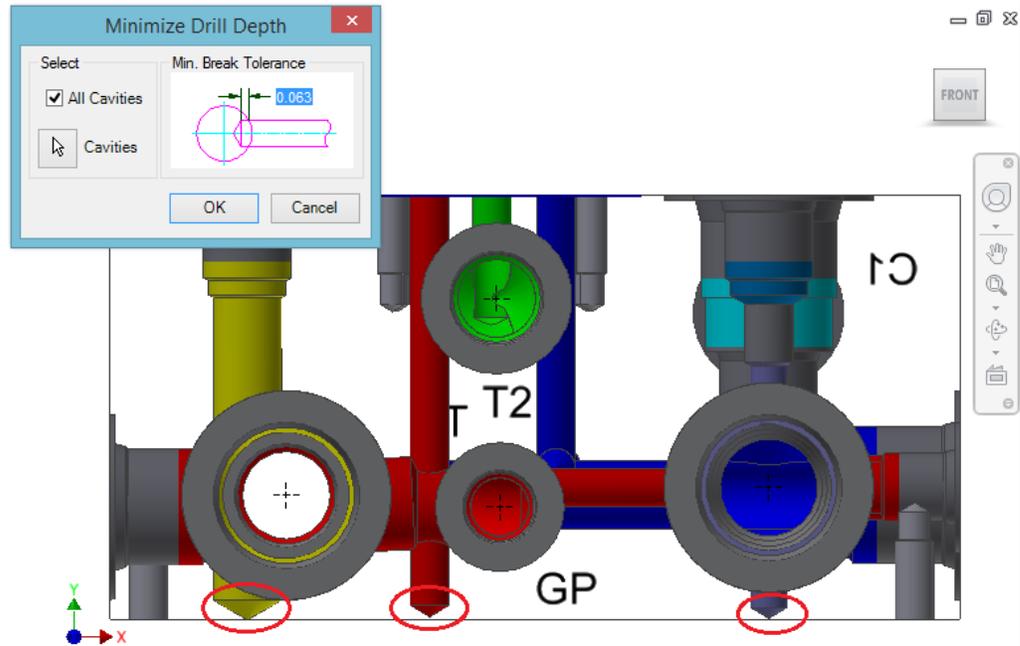
1. MDTools 760 ribbon >**Modify Block** panel >dropdown >**Minimize Depth**

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**.

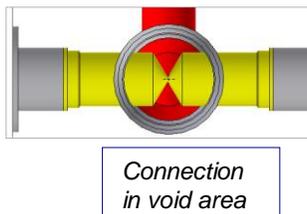
MDTools® updates the drill depth of all the selected cavities to the minimum specified.



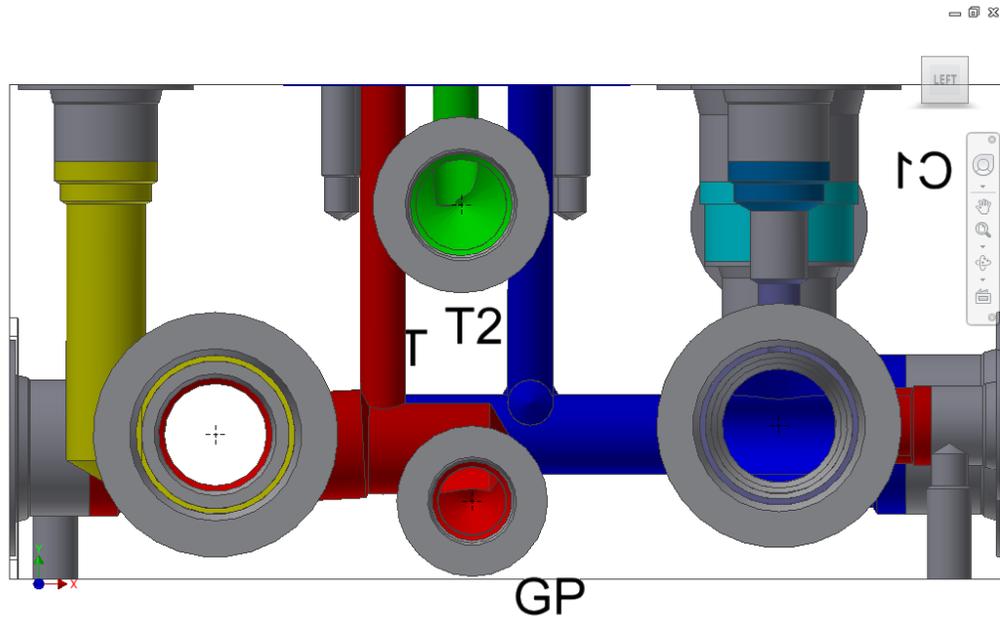
Minimize Drill Depth dialog box

**Note:**

If two cavities connecting another cavity intersect inside the empty cavity space (refer the figure below), then MDTools will be 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 in order 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 760 ribbon >Modify panel >Update Precision

The Update Precision dialog box displays.

### Location Precision

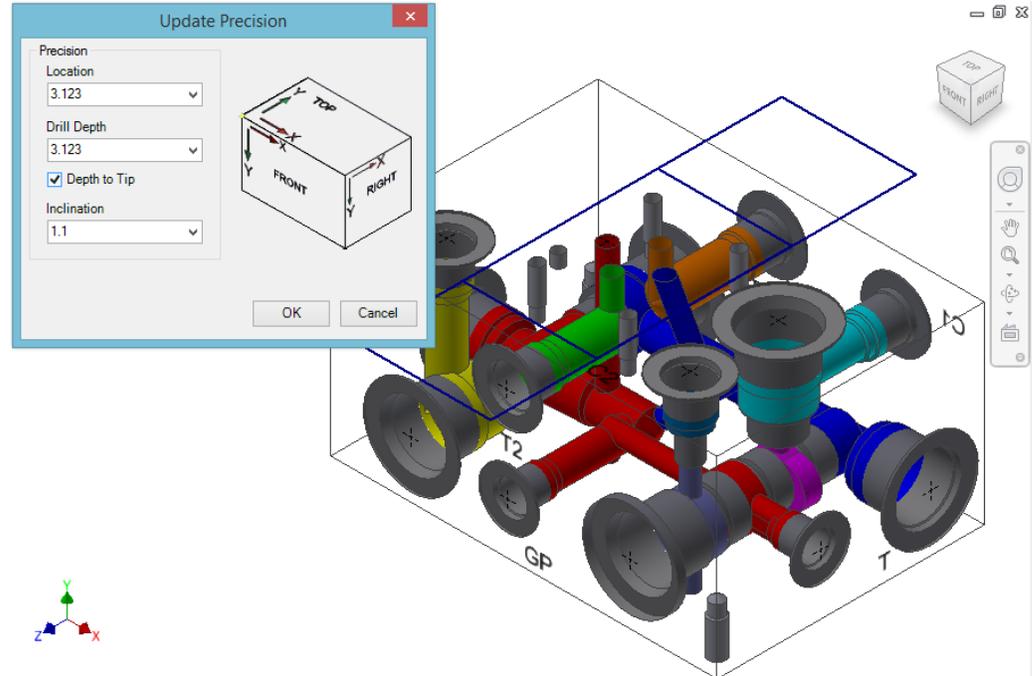
2. Select the desired location precision from the dropdown list.

### Drill Depth Precision

3. Select the desired drill depth precision from the dropdown list.

### Note

Select the Depth to Tip precision, as required.

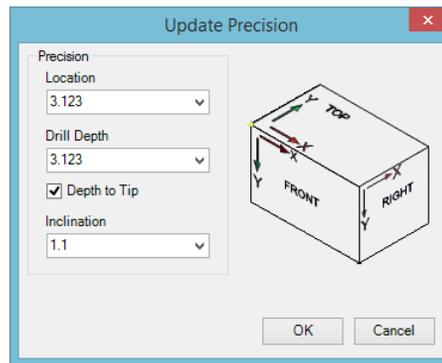


Manufacturing Precision dialog box

### Inclination Precision

4. Select the desired angle precision from the dropdown list.
5. If you don't want to change any of the above mentioned precision values, use the default Do Not Change option.
6. Click **OK**.

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



### Note

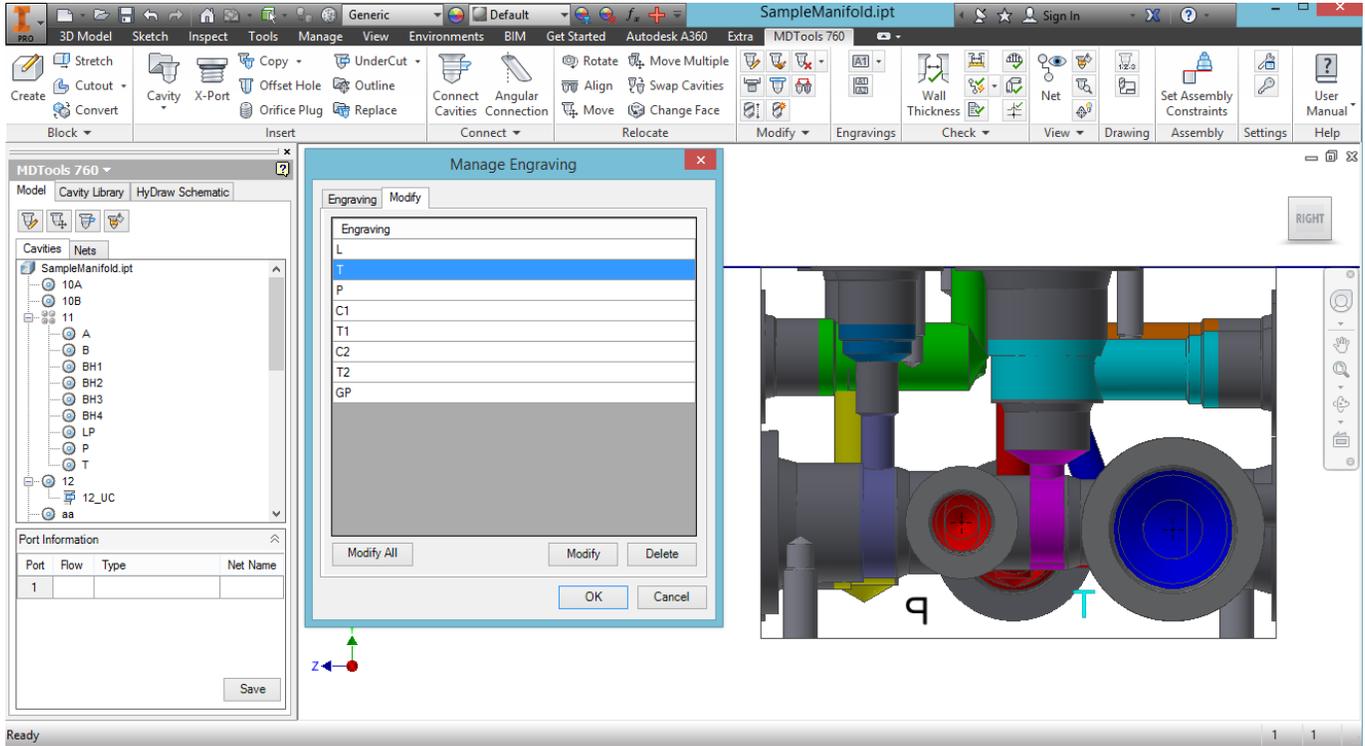
- When you apply location precision, cavities are relocated with respect to the default coordinate system.
- In case of footprints, MDTools applies location precision on the cavity marked as 'Dimension from This Cavity'.
- When updating the location, MDTools relocates the complete footprint, and the 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

- 57 Manage Engravings
- 58 Copy Engravings
- 59 Align Engravings



# 58. Manage Engravings

Create planer sketch text, representing text engraving on the manifold and automatically converting client graphics text (if they exist) to planer sketch text.

- MDTools 760 ribbon >**Engravings** panel >dropdown >**Manage**

The Manage Engravings dialog box displays.

- Select the cavity.  
MDTools® display the Component ID of the selected cavity as the default text. You can change the engravings, if required.

### Engraving Tab

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

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

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

- Enter **Depth of Cut**.  
The default Depth of Cut is 0.4 in inches and 1 in millimeters.

- Select **Cosmetic** to create the texts without depth on the manifold.

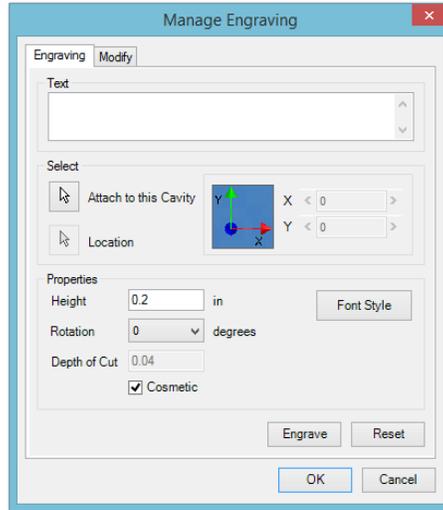
Otherwise, the text is engraved on the manifold face.

The Cosmetic option is selected by default.

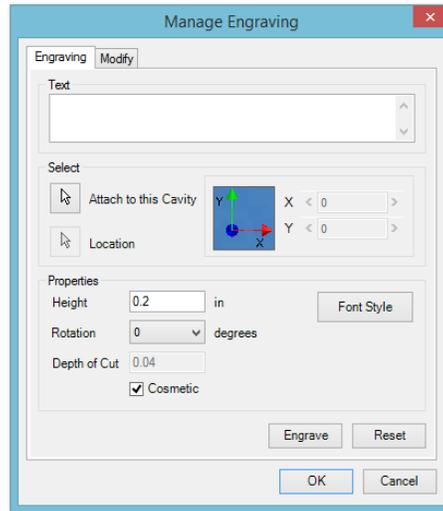
- Click **Font Style**.  
You can change the font type and font style (Regular/Italic/Bold/Bold Italic) for the engravings.

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

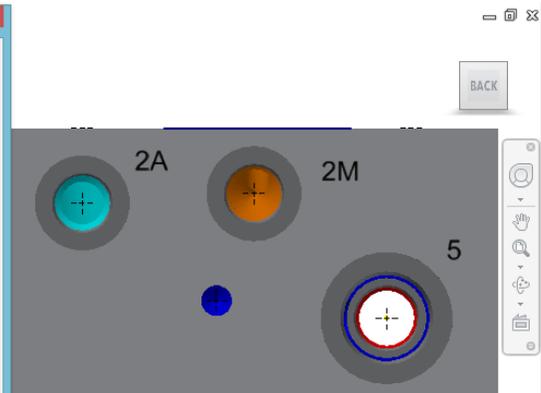
- Click **Engrave**.  
MDTools creates and displays the planer sketch text or engraved text at the selected location.
- Repeat the above steps to create all the text engraving on the manifold.



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.*

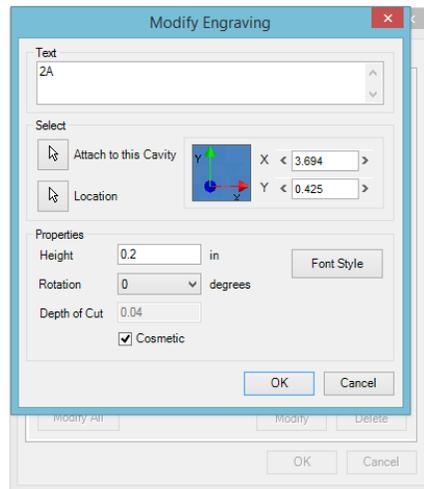
3. Click **Modify**.  
*The Modify Engraving dialog box displays.*

4. Change the text properties.

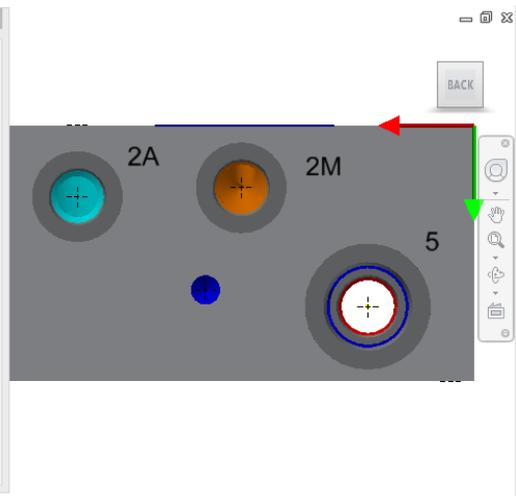
5. Click **OK** to save the modifications.  
*You can apply the engraved property on the planer sketch text.*

*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.*



Modify Engraving dialog box



## 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**.

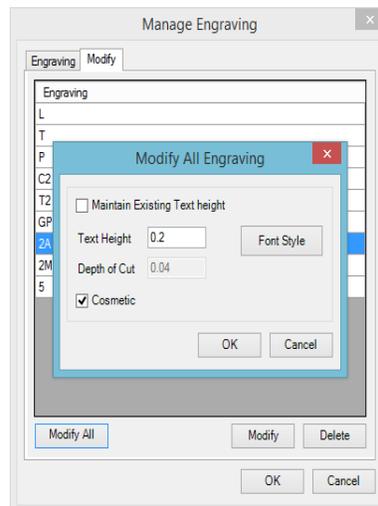
*You can change the font type and font style (Regular/Italic/Bold/Bold Italic) for all the engravings.*

*Select Cosmetic, if required.*

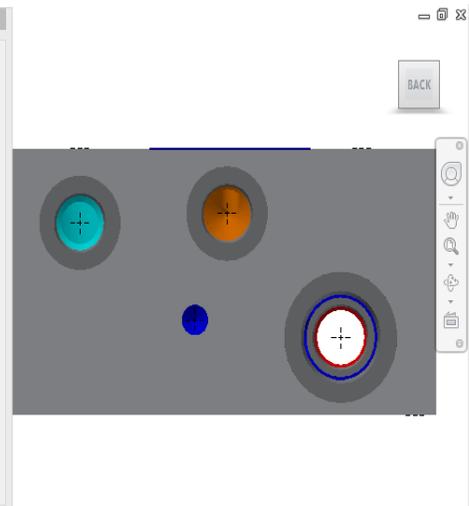
5. Click **OK** to save the modifications.

*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.*



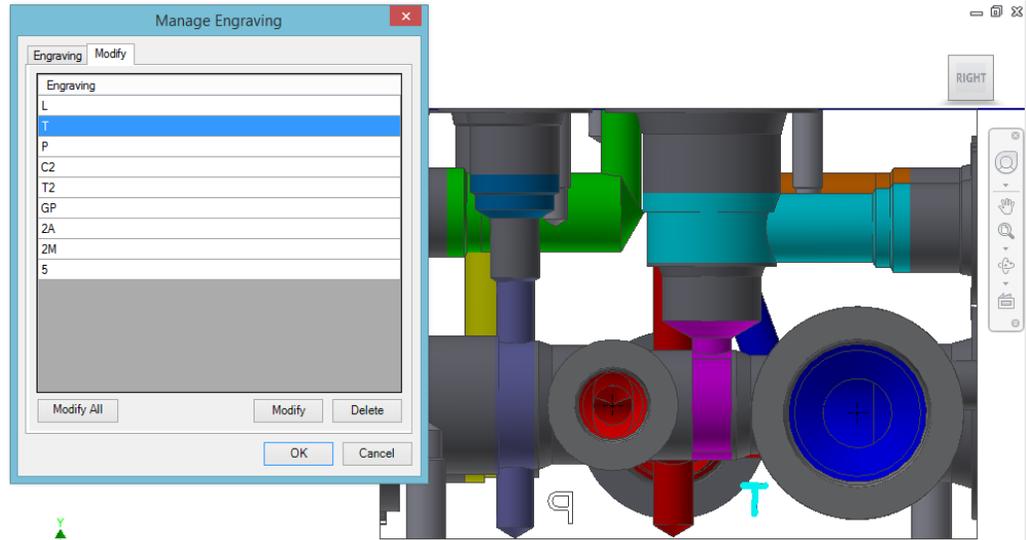
Modify All Engraving dialog box



### 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.*

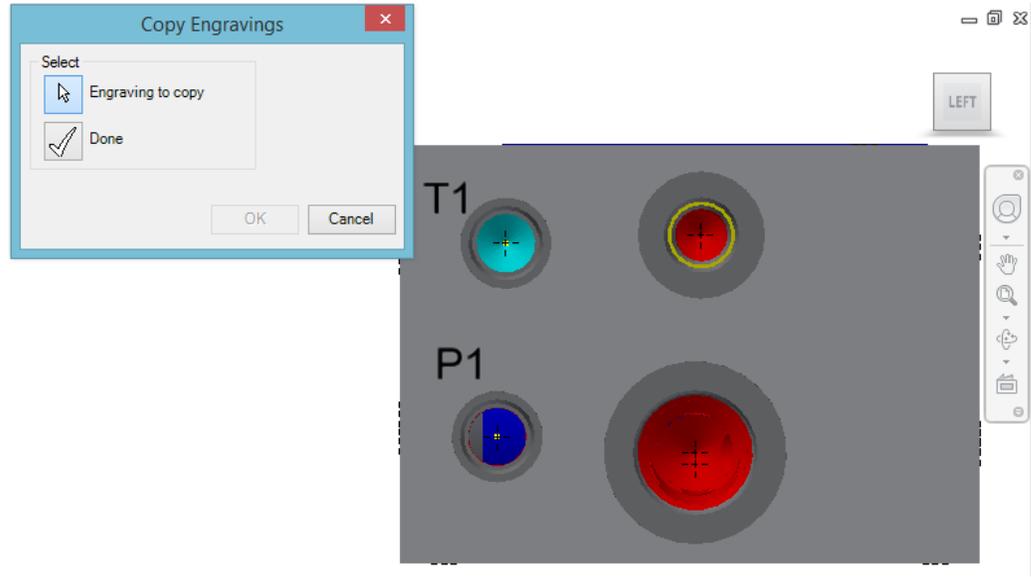


  
*Delete engravings*

# 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.

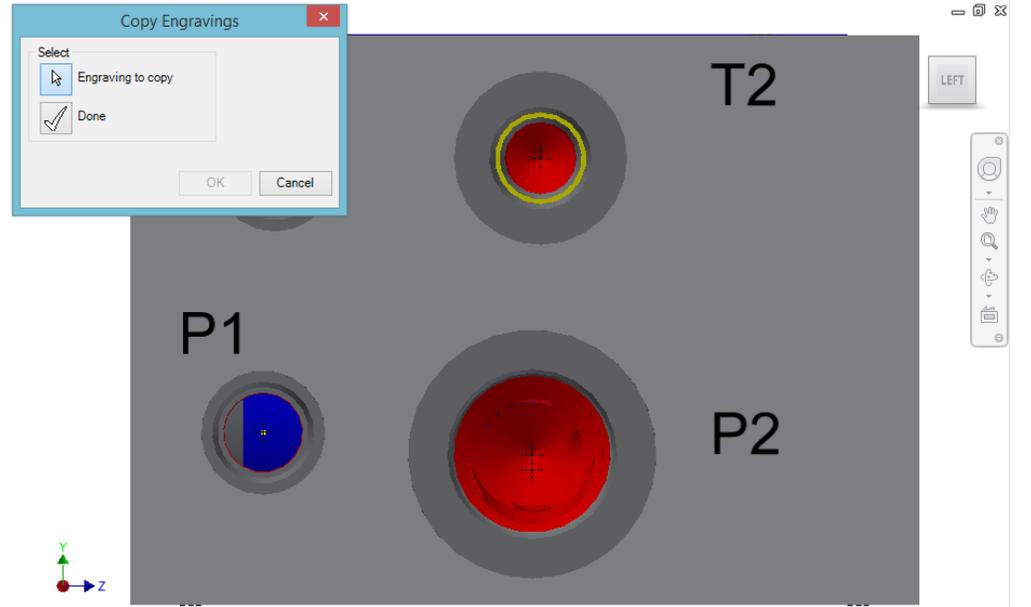
1. MDTTools 760 ribbon >**Engravings** panel >dropdown >**Copy**  
*The Copy Engravings dialog box displays.*
2. Select **Engraving to copy**, and then click the **Done** button.  
*After clicking Done, the  $\Delta X$ ,  $\Delta Y$  and count appears.*
3. Enter values for  $\Delta X$  and  $\Delta Y$ .
4. Enter count to set the number of copies.
5. Click **OK** to create the copies of the selected engravings.



Copy Engravings dialog box

### 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 MDTTools® appends a number at the end, then increments that number by the count.



Engravings copied

# 60. Align Engravings

## Types of Alignment

The Engravings is aligned in three ways:

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

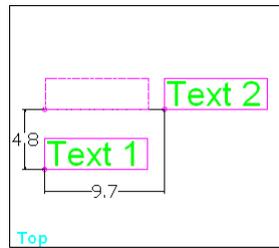
The left bottom corner of the textbox is used as a reference point for all alignment calculations.

### 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.

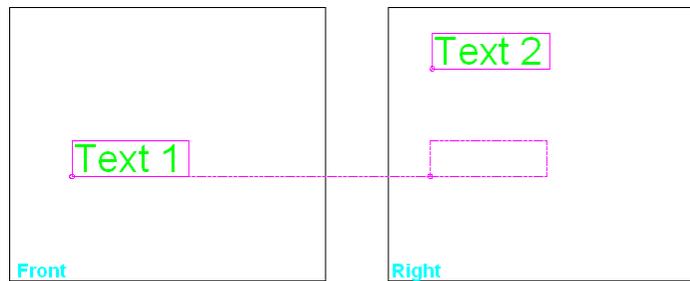


Same Face Alignment

### Perpendicular Face Alignment

When Text 1 and Text 2 are on perpendicular faces, then Text2 is aligned with Text1 on the common axis of both faces.

The relocation of Text 2 is shown in dotted lines.

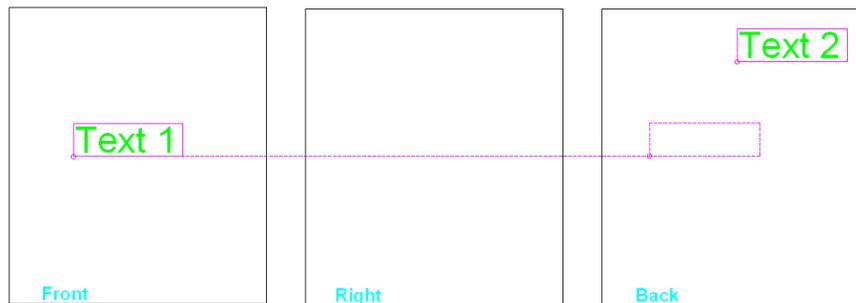


Perpendicular Face Alignment

### 3 Opposite Face Alignment

When Text 1 and Text 2 are on opposite faces, then Text2 is aligned with the reference point of Text1.

The relocation of Text 2 is shown in dotted lines.

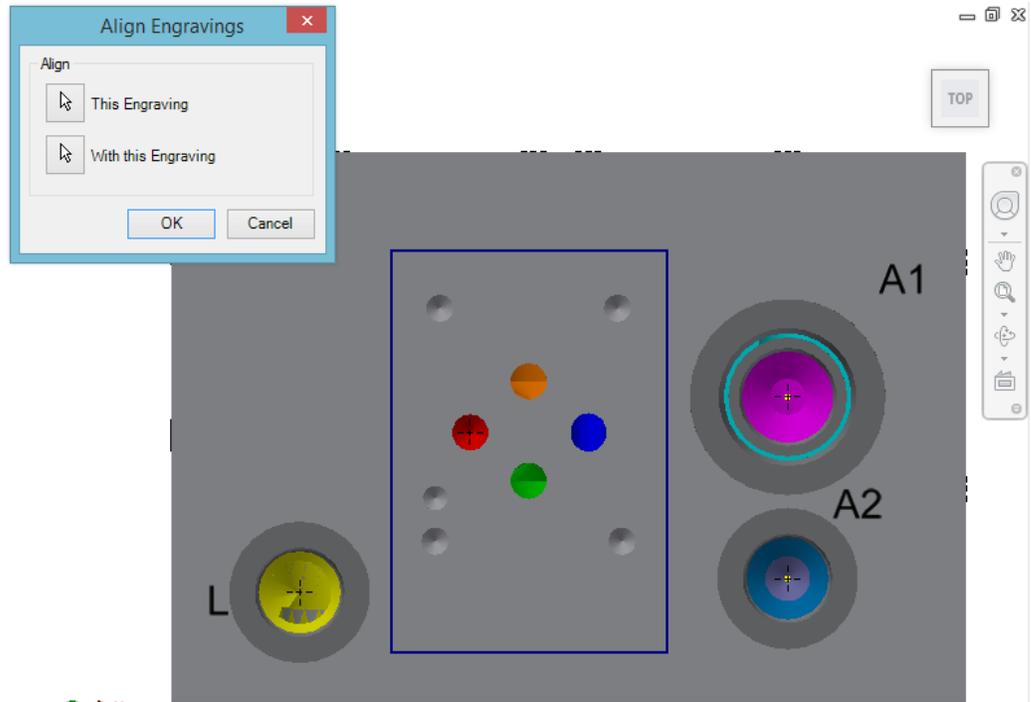


Opposite Face Alignment

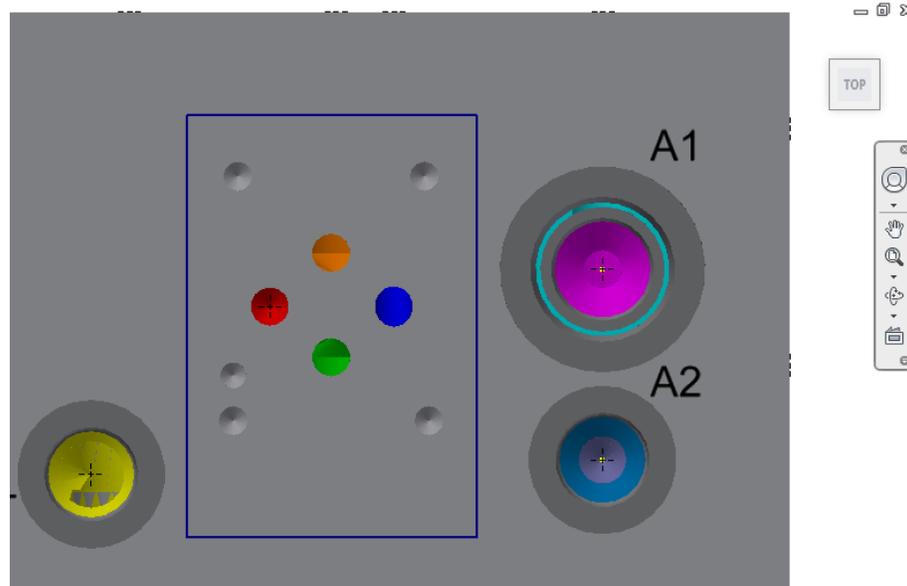
## Align Engravings

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

1. MDTools 760 ribbon >Engravings panel >Align  
The Align Engravings dialog box displays.
2. Select **This Engraving**, which need to be moved in order to align it with other engravings.
3. Select **With this Engravings**, with which the previously selected engravings will be aligned.
4. Click **OK** to align the two selected texts.
5. Click **Cancel** to close the dialog box.



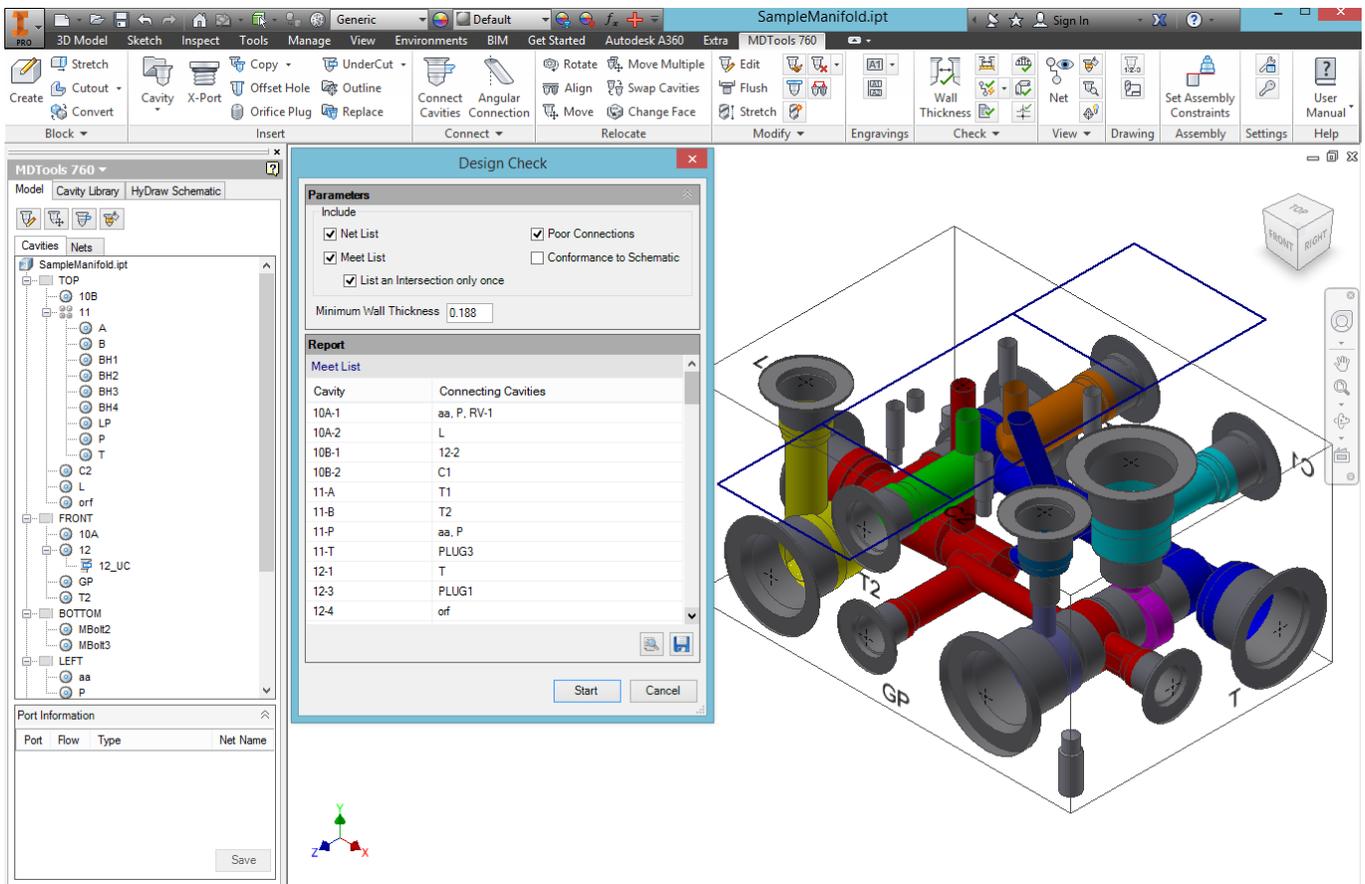
Align Engravings dialog box



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 the 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.

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

MDTools 760 ribbon

>Check panel

>Wall Thickness

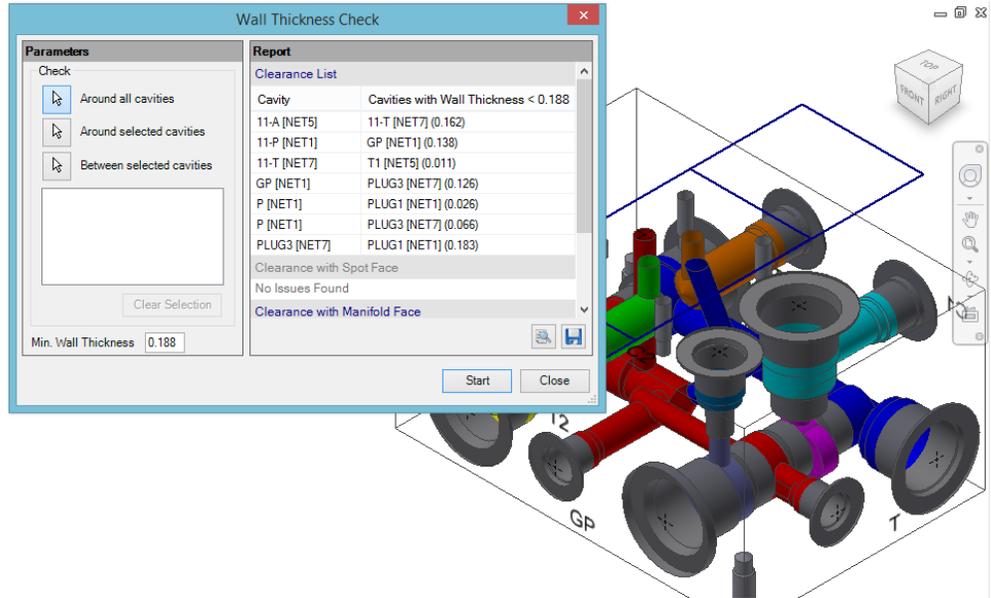
The Wall Thickness Check dialog box displays.

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.

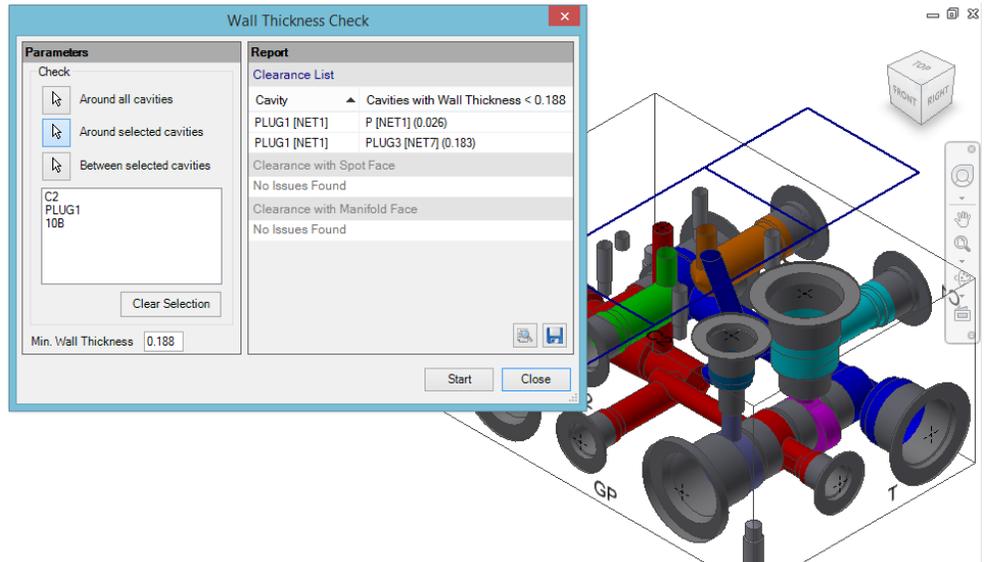


Wall Thickness Check dialog box

## 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.



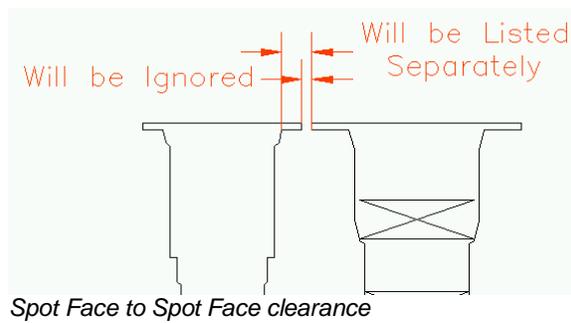
## Between selected cavities

MDTools displays the wall thickness between selected cavities.

1. Click the required **Check** button.
2. Enter the minimum wall thickness required in the **Check for** section.  
The default minimum wall thickness is displayed according to the settings.
3. Select **Include Manifold Faces** to check the wall thickness w.r.t faces.
4. Click **Start Wall Thickness Check**.  
MDTools displays the result as per the selection of the **Check** button.
5. Click **Save** in a Text file to save the list.  
The Save As dialog box displays.
6. 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.*
- *MTools® does not list the minimum wall thickness between locating pin and bolt hole, in case of a footprint.*



## CAUTION!

- *MTools 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

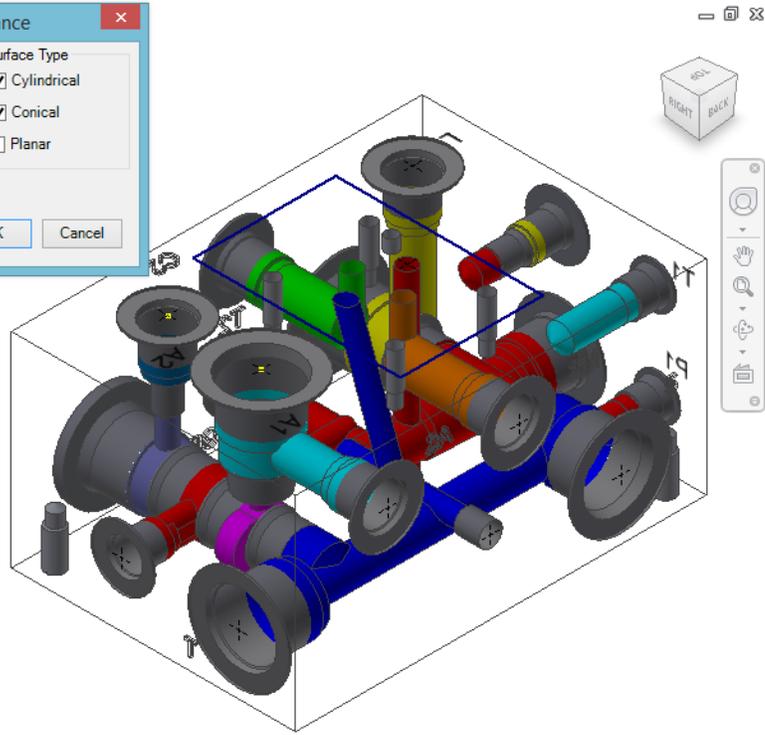
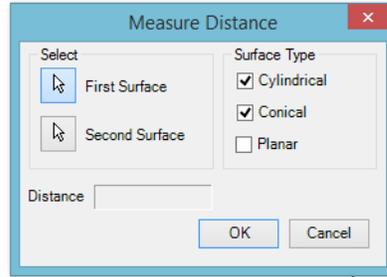
Measure the distance between two cavity surfaces or measure the distance between a cavity and a manifold surface.

- 1. MDTools 760 ribbon >Check panel >Measure

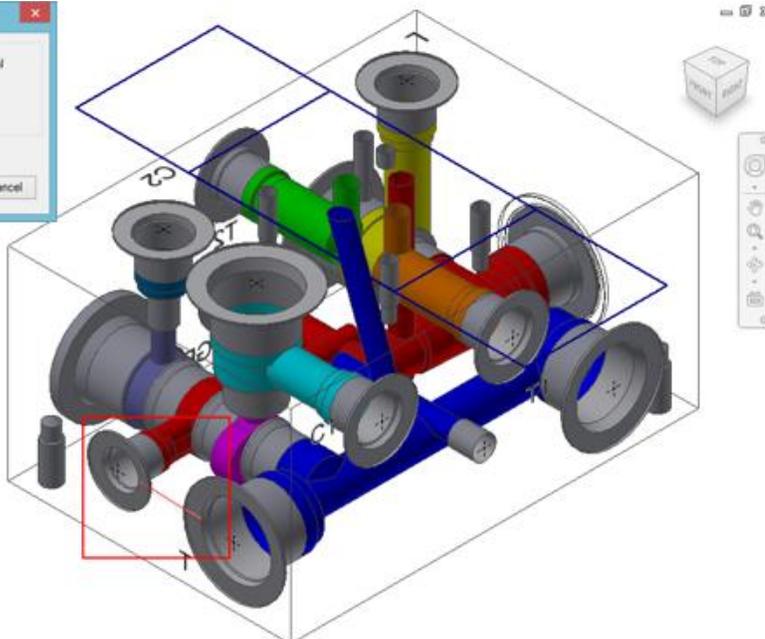
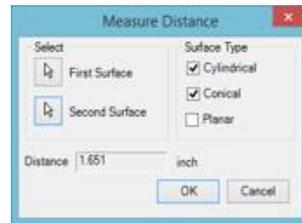
The Measure Distance dialog box displays.

- 2. Click the **First Surface** selection button.
- 3. Select the type of surface, as required. Cylindrical/Conical/Planar
- 4. Select the **Second Surface**.
- 5. Select the type of surface, as required.

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

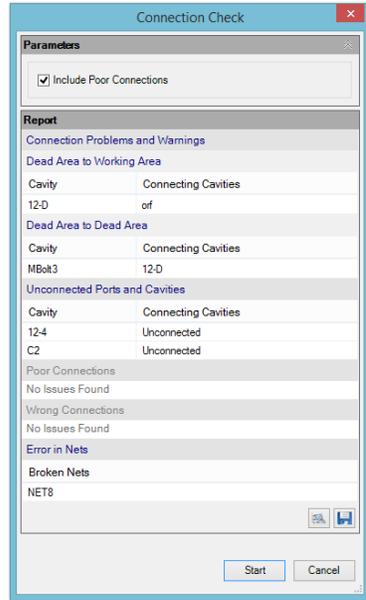
The Connection feature checks:

- 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.

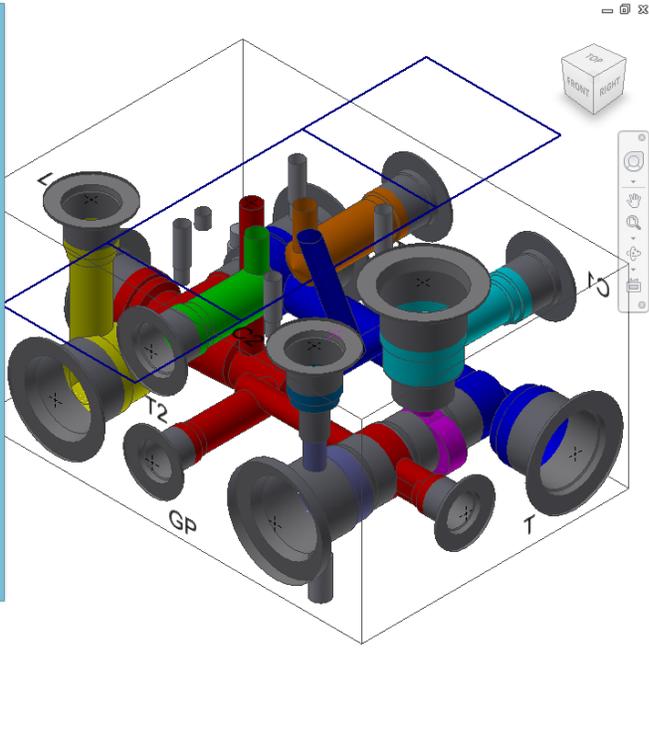
1. MDTools 760 ribbon  
 >Check panel  
 >Connection  
 dropdown  
 >Connection

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 will be listed in this section with approximate % of intersection area.



Quick Connectivity Check dialog box

3. Click **Start Connectivity Check**.

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. Click  to save the list.

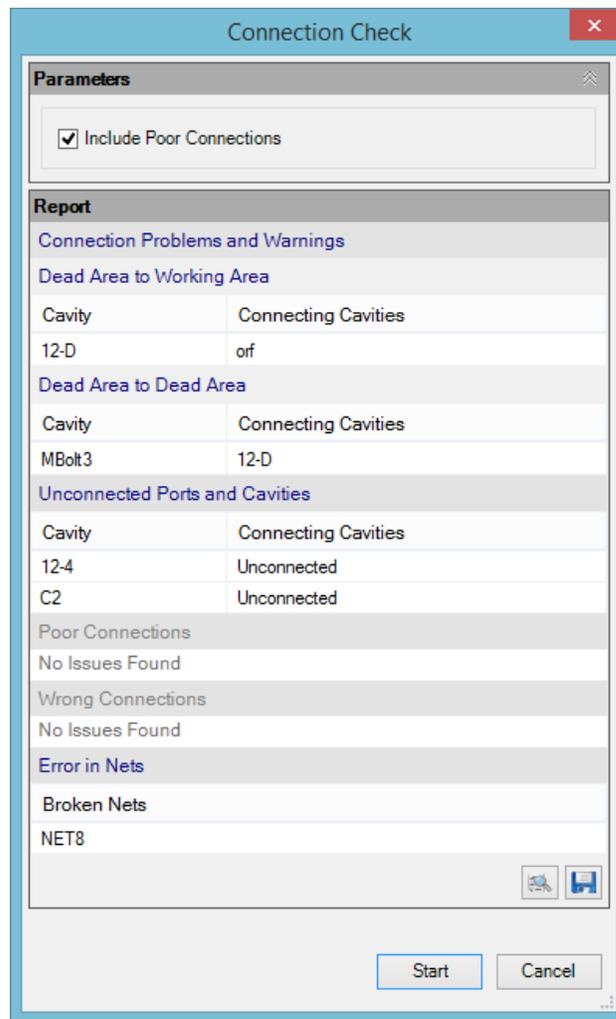
The Save As dialog box displays.

5. Enter an appropriate file name.
6. Click **Save**.

**Note**

- The **Wrong Connections** list of cavities indicates 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.

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

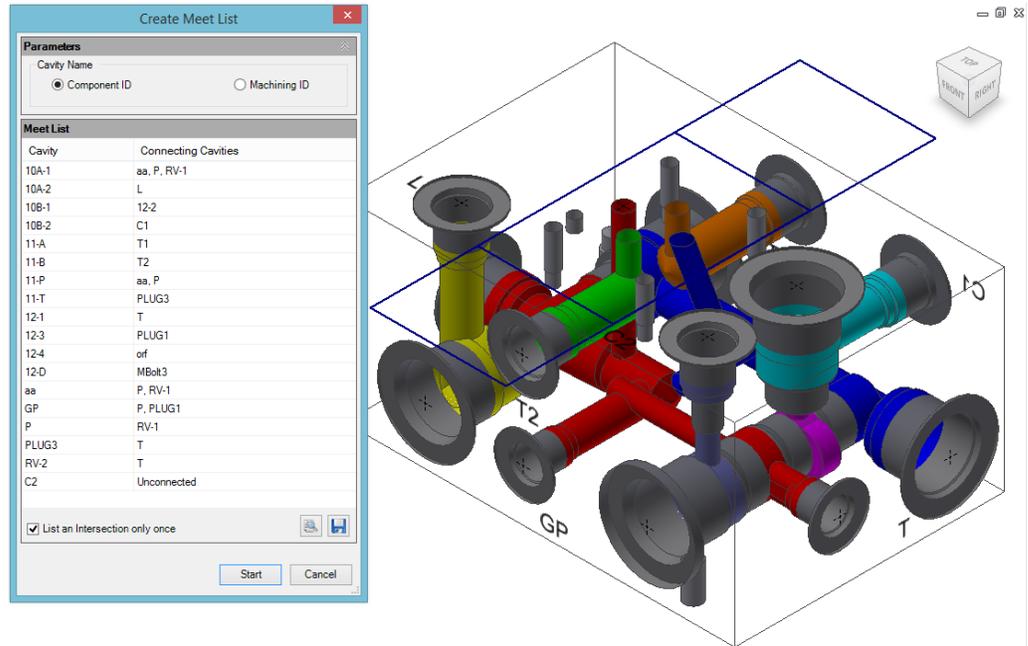


*Quick Connectivity List*

# 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.

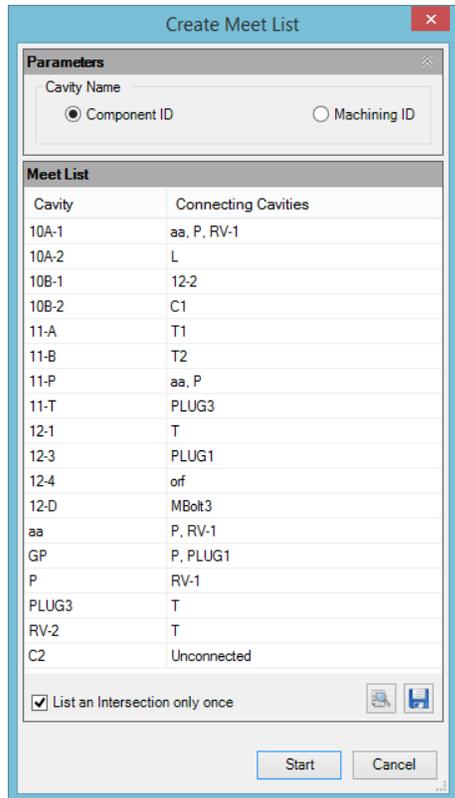
- MDTools 760 ribbon  
 >Check panel  
 >Connection  
 dropdown  
 > **Create Meet list**  
*The Create Meet List dialog box displays.*
- Choose the preferred **Display ID** for the cavities.  
*Either the Machining ID or the Component ID can be used as the display ID for cavities.*
- Select the **List an Intersection only once** option to remove the repetitive information from the report.



- Click **Create Meet list**.  
*MDTools® checks the internal connectivity and displays the list of connecting cavities.*



- Click  to save the list.  
*The Save As dialog box displays.*
- Enter an appropriate file name and click Save.



Connection Check List

## 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.
- 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.

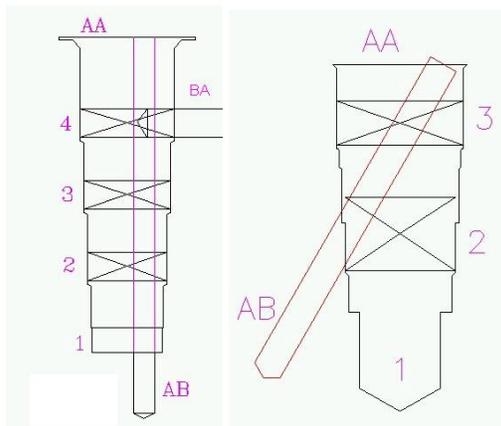


Fig (a)

Fig (b)

## 2 Cartridge valve side port connection

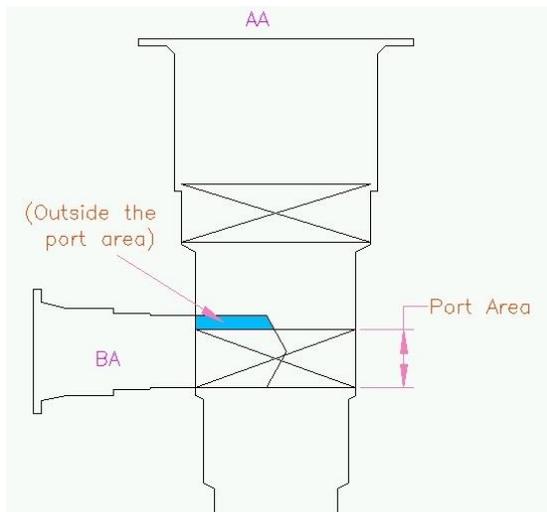
The Connection Check feature checks drill breakage outside the specified port area of a cartridge valve cavity.

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.



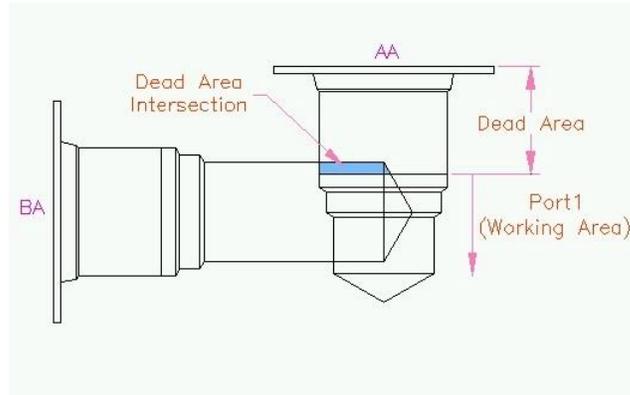
Cross-drill cutting outside the port area

### 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

1. MDTools 760 ribbon  
>Check panel  
>Design

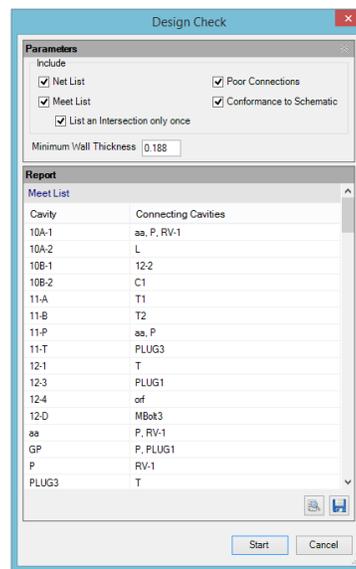
The Design Check dialog box displays.

Select the parameters you want to check.

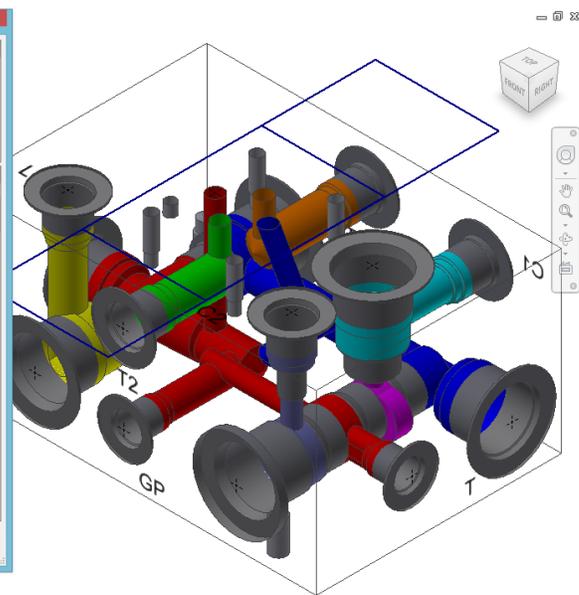
2. Click the Net list option to include three sections in the report.
  - a. Design Net list
  - b. Connectivity Net list
  - c. Net list comparison

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.
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 Design Check**.

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

8. Click  to save the list.

*The Save As dialog box displays.*

9. Enter an appropriate file name.

10. Click **Save**.

**Caution!**

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

\*\*\*\*\*

**MDTools 700 Series Design Check Report**

Drawing Name: SampleManifold.ipt  
Date/Time: 5/30/2013 1:31:15 PM  
Revision:

Connection Check List

Cavity	Connecting Cavities
10A-1	aa, P, RV-1
10A-2	L
10B-1	12-2(BC~13%)
10B-2	C1
11-A	T1
11-B	T2
11-P	aa, P
11-T	PLUG3
12-1	T
12-2	10B-1(BC~13%)
12-3	PLUG1_SL(BC~11%)
12-4	orf
aa	10A-1, 11-P, P, RV-1
C1	10B-2
GP	P
L	10A-2
orf	12-4
P	10A-1, 11-P, aa, GP, RV-1
PLUG1_SL	12-3(BC~11%)
PLUG3	11-T, T
RV-1	10A-1, aa, P
RV-2	T
T	12-1, PLUG3, RV-2
T1	11-A
T2	11-B
C2	Unconnected
PLUG1	Unconnected

Connection Problems and Warnings

**Dead Area To Working Area**

Cavity	Connecting Cavities
12-3	PLUG1_SL

Dead Area To Dead Area

Cavity	Connecting Cavities
--------	---------------------

Clearance List

Cavity	Cavities with Wall Thickness < 0.197
11-A[NET5]	11-T[NET7] (0.162)
11-BH3	11-LP(0.114)
11-P[NET1]	GP[NET1] (0.138)
11-T[NET7]	T1[NET5] (0.011)
GP[NET1]	aa[NET1] (0.195)
GP[NET1]	PLUG3[NET7] (0.126)
PLUG3[NET7]	PLUG1[NET1] (0.183)
P[NET1]	PLUG1[NET1] (0.026)
P[NET1]	PLUG3[NET7] (0.066)

Clearance with Spot face

Cavity	Cavities with Wall Thickness < 0.197
--------	--------------------------------------

Clearance with Manifold face

-----  
Cavity                      Faces with Wall Thickness < 0.197  
-----

Net List  
**Design Net List**

-----  
NET1            10A-1, 11-P, 12-3, aa, GP, P, PLUG1, RV-1  
NET2            10A-2, L  
NET3            10B-1, 12-2  
NET4            10B-2, C1  
NET5            11-A, T1  
NET6            11-B, T2  
NET7            11-T, 12-1, PLUG3, RV-2, T  
NET8            12-4, orf  
NO NET DETAIL      C2  
-----

Connectivity Net List

-----  
Net-1            10A-1, 11-P, aa, GP, P, RV-1  
Net-2            11-A, T1  
Net-3            11-B, T2  
Net-4            11-T, 12-1, PLUG3, RV-2, T  
Net-5            10A-2, L  
Net-6            10B-1, 12-2  
Net-7            12-4, orf  
Net-8            10B-2, C1  
UNCONNECTED PORTS/ CAVITIES    C2, PLUG1  
-----

Net List Comparison

-----  
Net Name :        NET1  
Design Net List :    10A-1, 11-P, 12-3, aa, GP, P, PLUG1, RV-1  
Connectivity Net List :    10A-1, 11-P, aa, GP, P, RV-1  
-----

Net Name :        NET2  
Design Net List :    10A-2, L  
Connectivity Net List :    10A-2, L  
-----

Net Name :        NET3  
Design Net List :    10B-1, 12-2  
Connectivity Net List :    10B-1, 12-2  
-----

Net Name :        NET4  
Design Net List :    10B-2, C1  
Connectivity Net List :    10B-2, C1  
-----

Net Name :        NET5  
Design Net List :    11-A, T1  
Connectivity Net List :    11-A, T1  
-----

Net Name :        NET6  
Design Net List :    11-B, T2  
Connectivity Net List :    11-B, T2  
-----

Net Name :        NET7  
Design Net List :    11-T, 12-1, PLUG3, RV-2, T  
Connectivity Net List :    11-T, 12-1, PLUG3, RV-2, T  
-----

Net Name :        NET8  
Design Net List :    12-4, orf  
Connectivity Net List :    12-4, orf  
-----

Wrong Connections

-----  
Cavity                      Connecting Cavities  
-----

Error in Nets  
Nets

-----

# 66. Check Velocity in Block

Check velocity in the block and quickly identify hotspots in the design.

- MDTools 760 ribbon  
>Check panel  
>Velocity

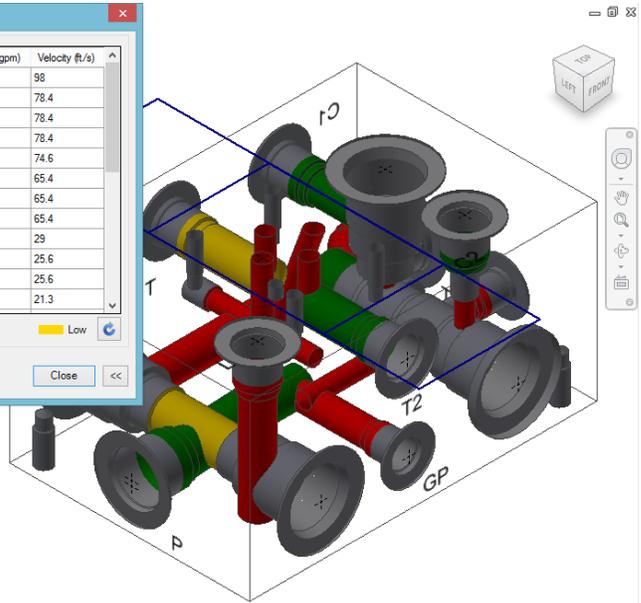
The Check Velocity in Block dialog box displays the pressure and tank nets.

- Select required net(s).

The Cavity/Port, Drill/Port Dia, Flow, and Velocity of each port are displayed in the grid.

Pressure and Tank Nets	Cavity/Port	Drill/Port Dia	Flow (gpm)	Velocity (ft/s)
All Nets				
Net Not Defined				
NET1	11-A (D03)	0.25	15	98
NET2	11-P (D03)	0.25	12	78.4
NET3	PLUG3 (MB-600-080)	0.25	12	78.4
NET4	PLUG1 (#4 SAE)	0.25	12	78.4
NET5	of {5/16"-24 UNF}	0.234	10	74.6
NET6	11-B (D03)	0.25	10	65.4
NET7	11-T (D03)	0.25	10	65.4
NET8	10B-1 (C10-2)	0.25	10	65.4
	GP (#4 SAE)	0.375	10	29
	L (#6 SAE)	0.438	12	25.6
	T (#10 SAE)	0.438	12	25.6
	C1 (#6 SAE)	0.438	10	21.3

Velocity : High Nominal Low



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 MDTTools® Settings > Energy Efficiency tab page.
- Double click on 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 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 has to 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.

- MDTools 760 ribbon  
>Check panel  
>Bend

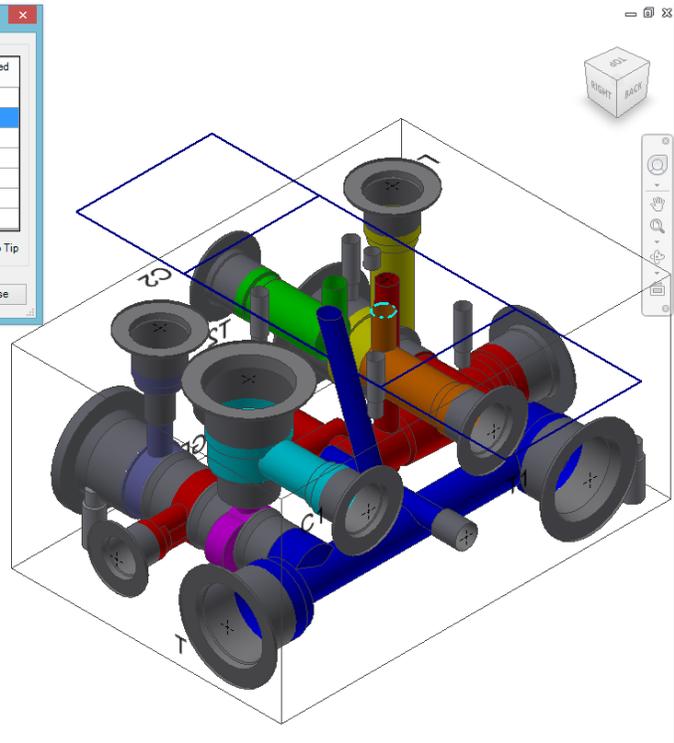
The Check Bend dialog box displays the cavity, connecting cavity, current depth, and recommended depth.

Cavity	Connecting Cavity	Current Depth	Recommended Depth
<input type="checkbox"/> 10A-1	RV-1	1.944	1.889
<input checked="" type="checkbox"/> 11-A	T1	0.836	0.662
<input type="checkbox"/> 11-B	T2	0.783	0.662
<input type="checkbox"/> GP	P	1.892	1.99
<input type="checkbox"/> L	10A-2	2.331	2.12
<input type="checkbox"/> PLUG1	GP	3.138	3.018
<input type="checkbox"/> T1	11-A	1.632	1.57

- Select the check box for each cavity.

The selected cavity gets highlighted in the model.

- Click the **All** button to select all the affected cavities.



### Note

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

- Click **Update**.

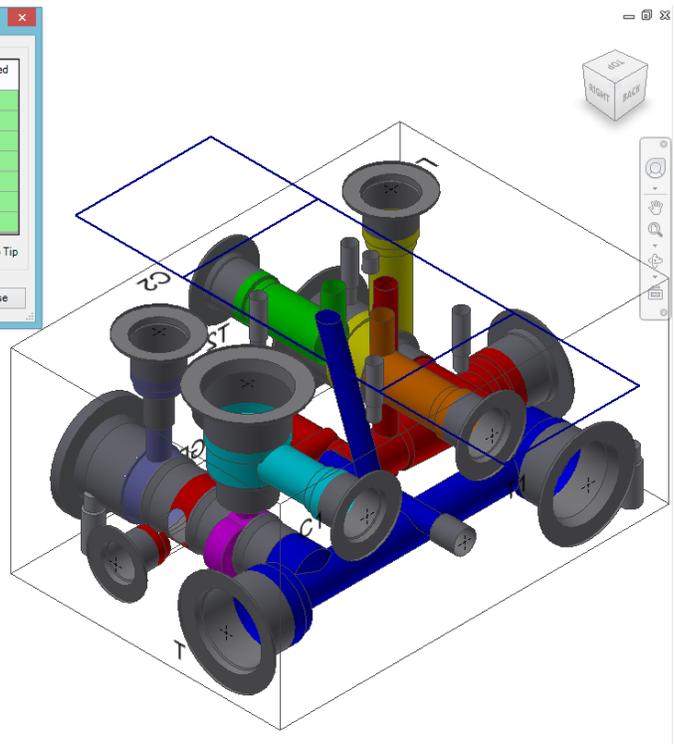
The recommended depth is applied to the current depth and the affected rows turns green.

Check Bend dialog box

Cavity	Connecting Cavity	Current Depth	Recommended Depth
<input type="checkbox"/> 10A-1	RV-1	1.889	1.889
<input type="checkbox"/> 11-A	T1	0.662	0.662
<input type="checkbox"/> 11-B	T2	0.662	0.662
<input type="checkbox"/> GP	P	1.99	1.99
<input type="checkbox"/> L	10A-2	2.12	2.12
<input type="checkbox"/> PLUG1	GP	3.018	3.018
<input type="checkbox"/> T1	11-A	1.57	1.57

### Note

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



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

1. MDTools 760 ribbon

> Check panel

> **Check Conformance to Schematic**

The Check Conformance to Schematic dialog box displays.

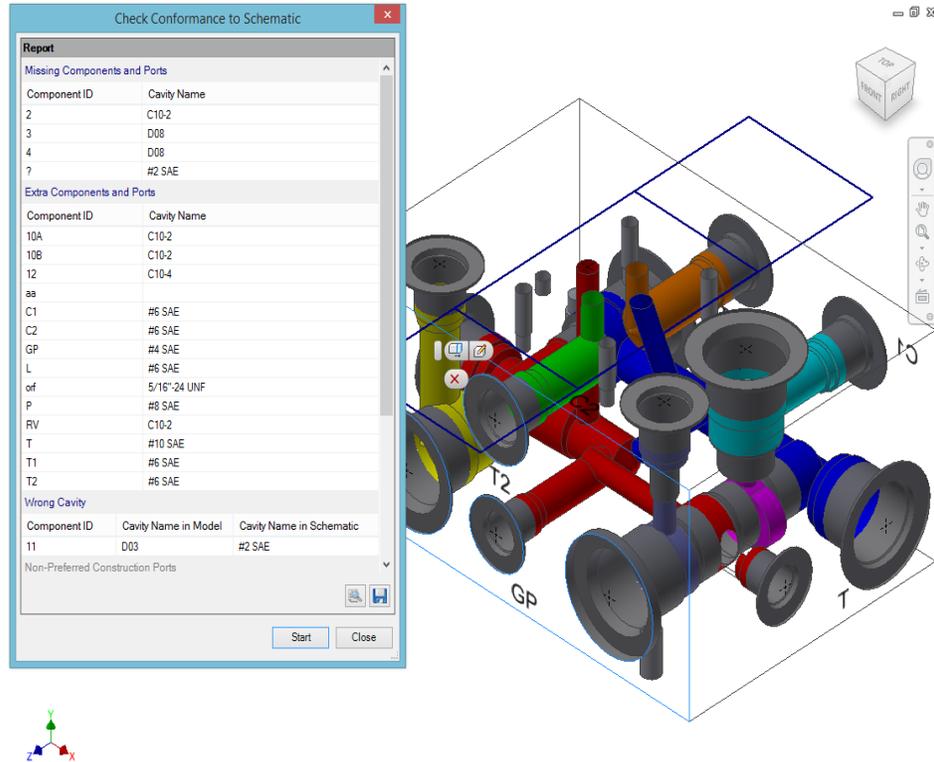
2. Click **Start Conformance Check**.

MDTools® checks the manifold design against the HyDraw schematic.

3. Click **Save** in text file to save the list.

4. Enter an appropriate file name in the Save as dialog box.

5. 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 schematic interface.

### Non-Preferred Construction Ports section

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

### Wrong Net Name section

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

### Wrong Flow section

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

### Wrong Port Type section

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

## Note

This command will not validate the mounting hole information.

# 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 a specified value

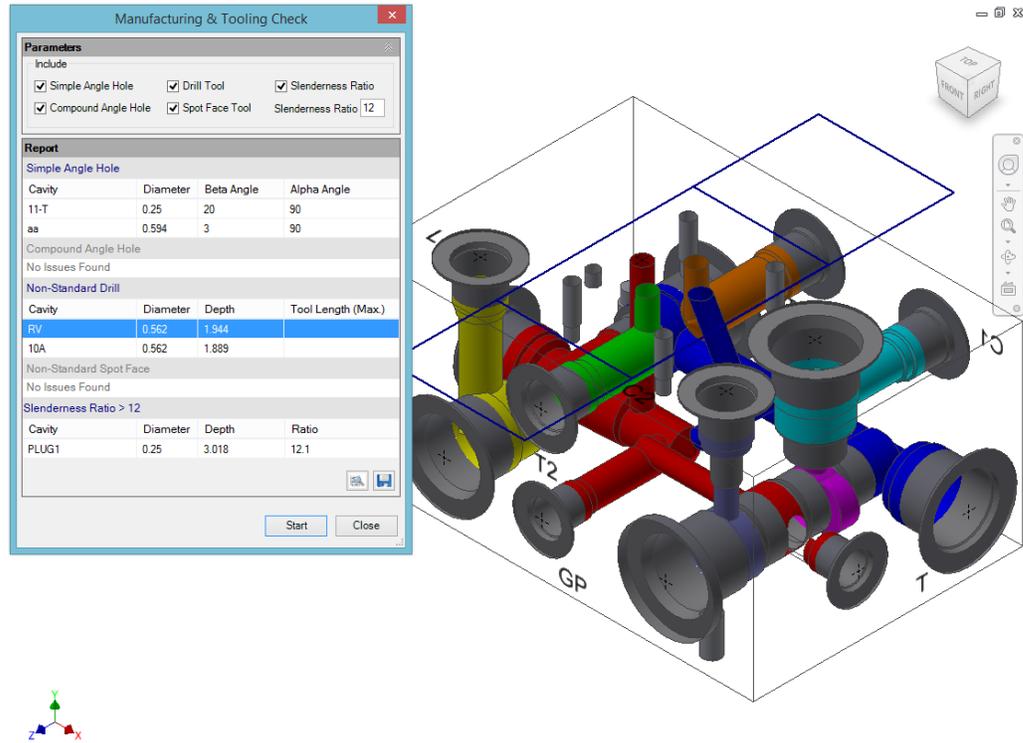
1. MDTools 760 ribbon  
>Check panel  
>Manufacturing

The Manufacturing & Tooling Check dialog displays.

2. Select the parameters you want to check.

3. Enter the slenderness ratio.

The default slenderness ratio value is 25.



Manufacturing & Tooling Check dialog box

4. Click **Start Manuf. & Tooling Check**.

MDTools® checks the manifold design for the selected parameters and lists the cavities deviating from the rule in the dialog box.

5. Click **Save** in a text file to save the list.

The Save As dialog box displays.

6. Enter an appropriate file name and click **Save**.

## 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.
- 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 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

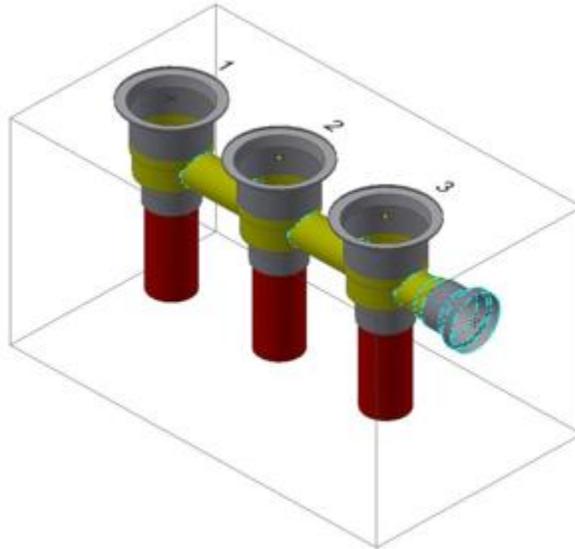
Check the design and recommend the Offset connection, when three or more cavities are connected inline.

1. MDTTools 760 ribbon  
>**Check** panel  
>**Connection Offset**

*The Check Connection for Offset dialog box displays.*

2. Click **Start Connection Check**.

*MDTools® checks the manifold design for offset and recommends the cavity and the connecting cavities.*

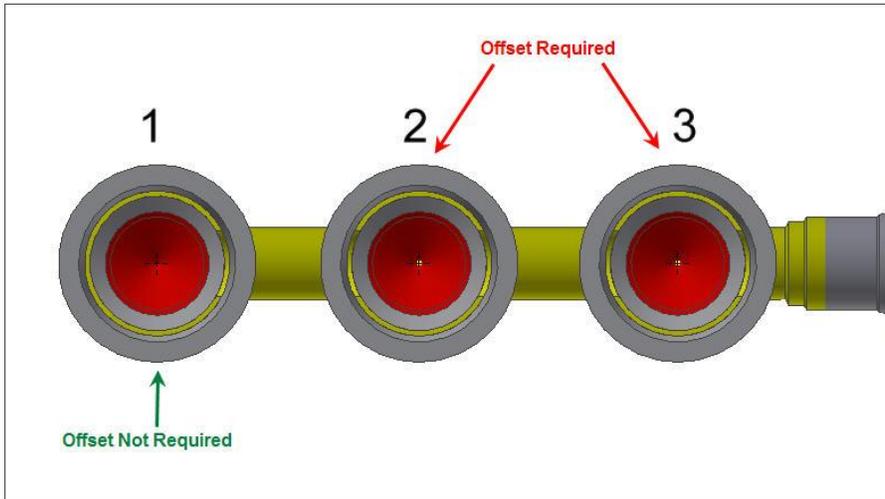


Check Connection for Offset dialog box

# Offset Connection Rules

## Case 1:

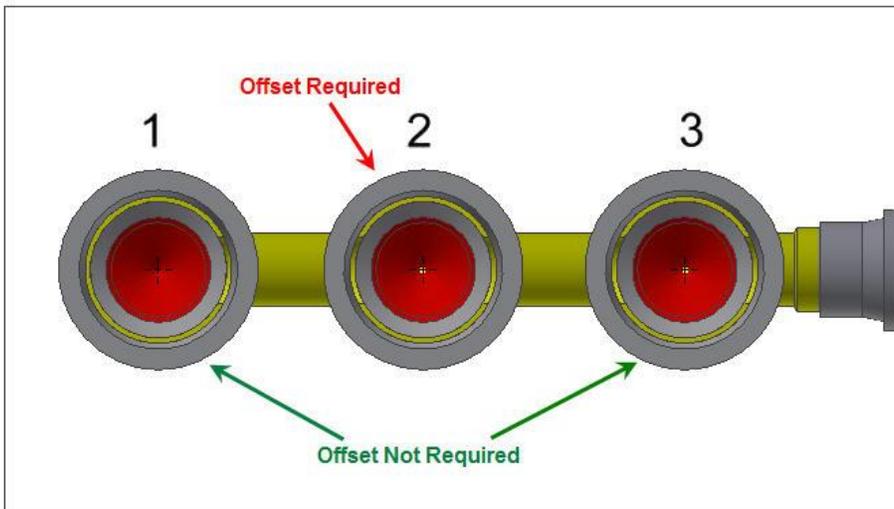
Work port/CV bottom port is connected to more the two cartridge valve side ports



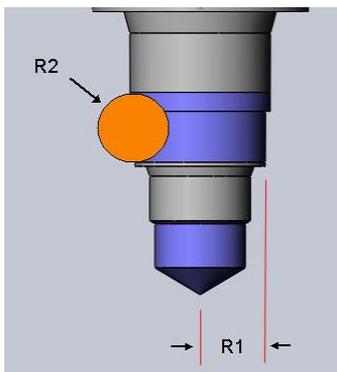
All CVs except the last one should be placed at an offset from the connecting cavity.

## 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.

1. MDTools 760 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. Click  to save the list.  
*The Save As dialog box displays.*

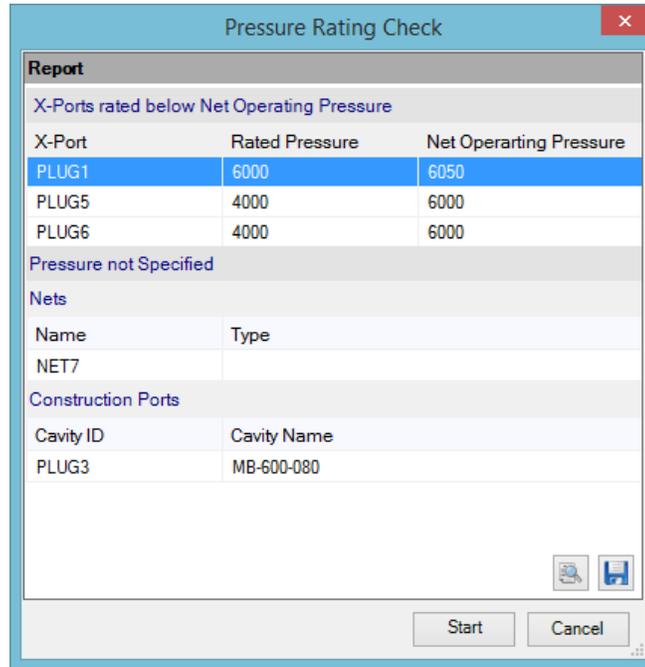
### Report:

Check Pressure Rating report contains two sections.

1. **X-Ports rated below Net Operating Pressure:**  
Lists all construction ports which have lower rated pressure than Net operating pressure.
2. **Pressure not Specified:**  
Lists all construction ports and nets for which pressure is not specified in the manifold.

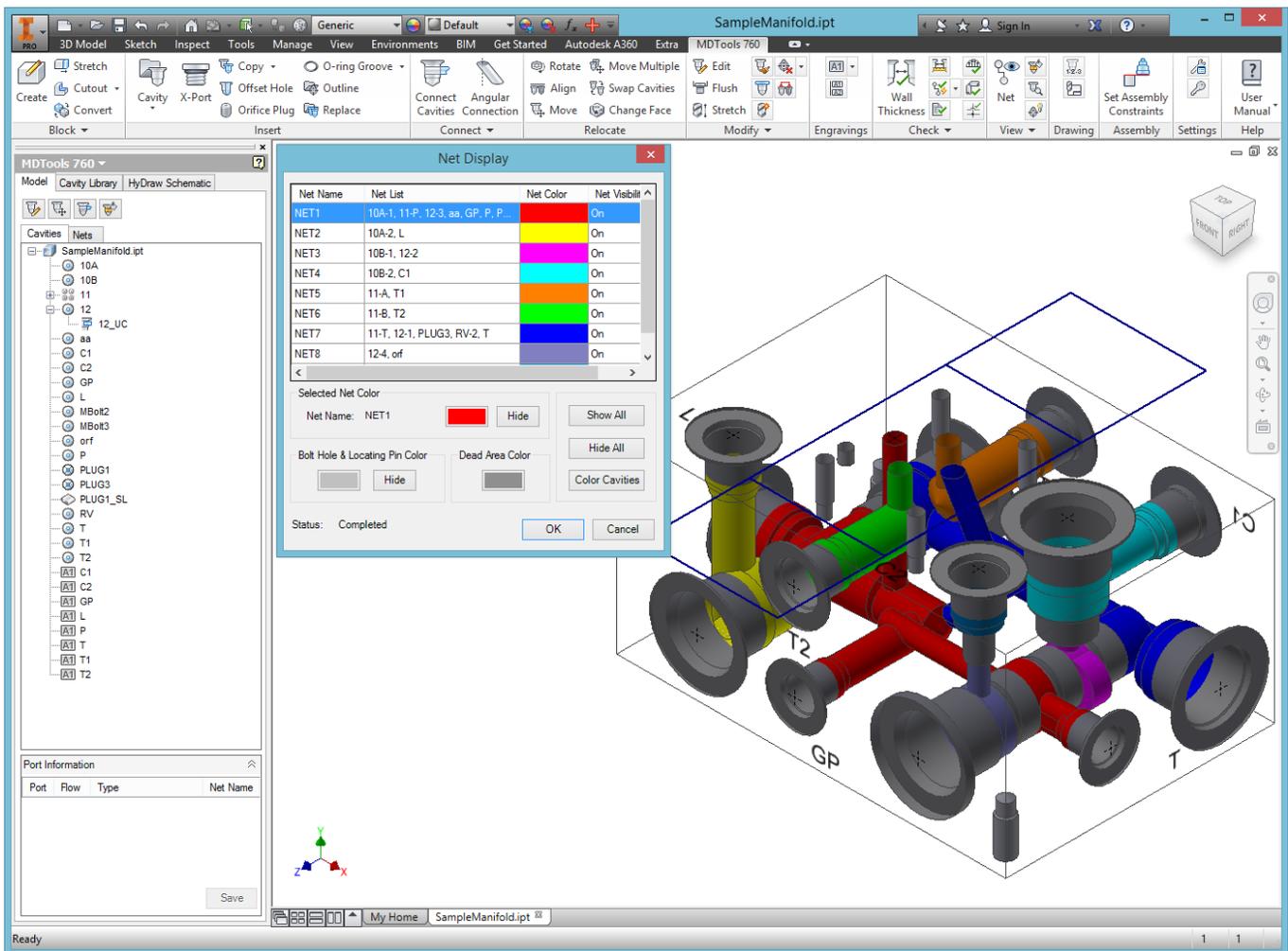
This section contains two subsections.

- a) **Nets:**  
List all the nets which do not have operating pressure value or value is 0.
- b) **Construction Ports:**  
List all the construction ports which do not have pressure value or value is 0.



# Display Options

- 71 View a Net
- 72 Color Cavities
- 73 Locate Cavity
- 74 Show/Hide Outline
- 75 Show/Hide Cavity ID
- 76 Net Display
- 77 Show/Hide Cavity Center
- 78 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 a selected net.

MDTools® displays the cavities/ports in the selected net in green and all the other cavities/ports in the Dead Area color.

1. MDTools 760 ribbon >View panel >Net

The View a Net dialog box displays with the list of nets in the manifold.

2. 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.

3. Select the face: Top, Bottom, Left, Right, Front, or Back.
4. Click the face where you want to place a cavity to connect to the selected net.

MDTools displays the selected manifold face parallel to the screen.

### Note

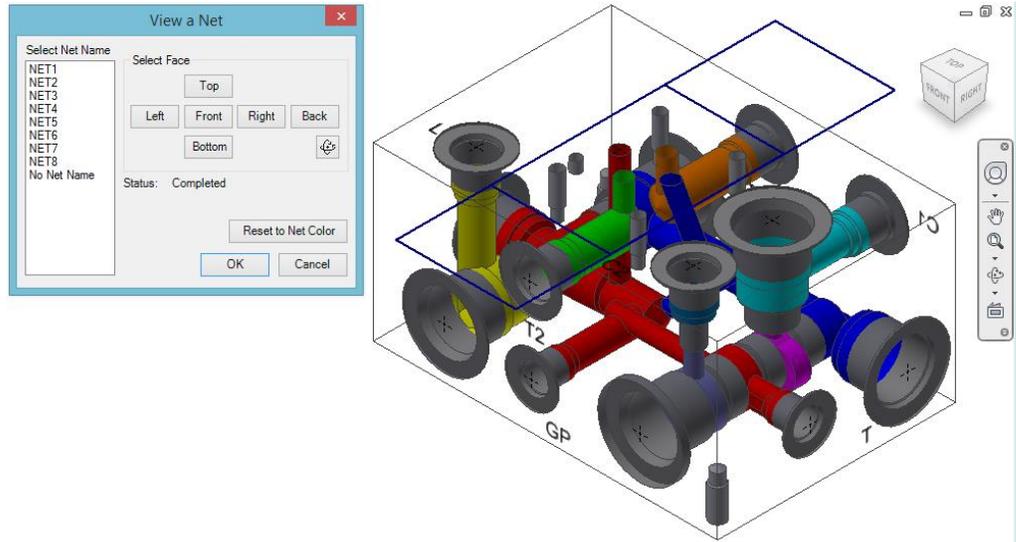
- Use the Rotate button to rotate the block.

### Reset to the Net Color

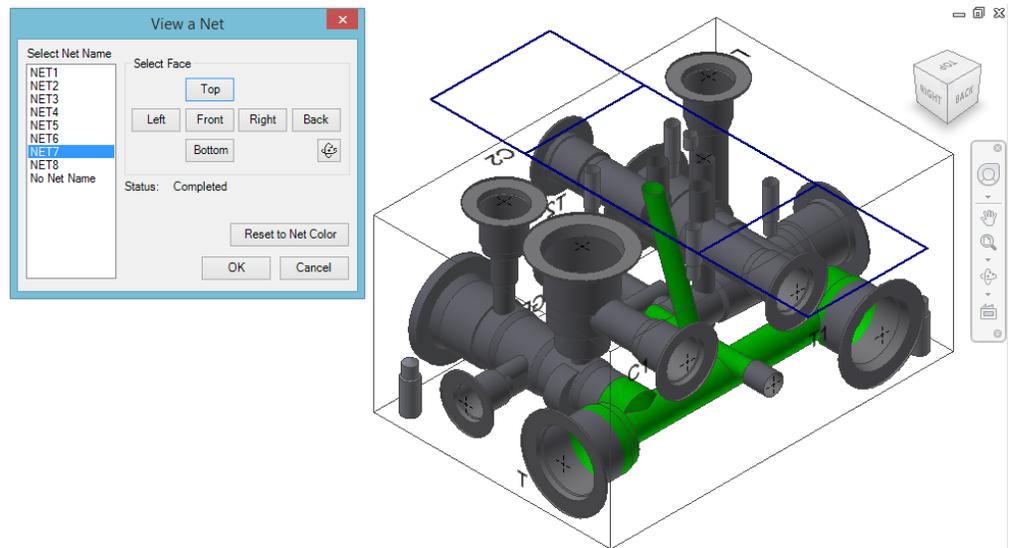
Click **Reset to Net Color** to revert to your default color settings for nets.

### Note

Default colors are the colors assigned to the nets in MDTools Settings>Net Display.



View a Net dialog box



Areas in the selected net displayed in green

## 73. Color Cavities

*Shade or update the shading of cavities on the manifold.*

MDTools 760 ribbon  
>View panel  
>Color

*The Coloring Cavities message box displays.*

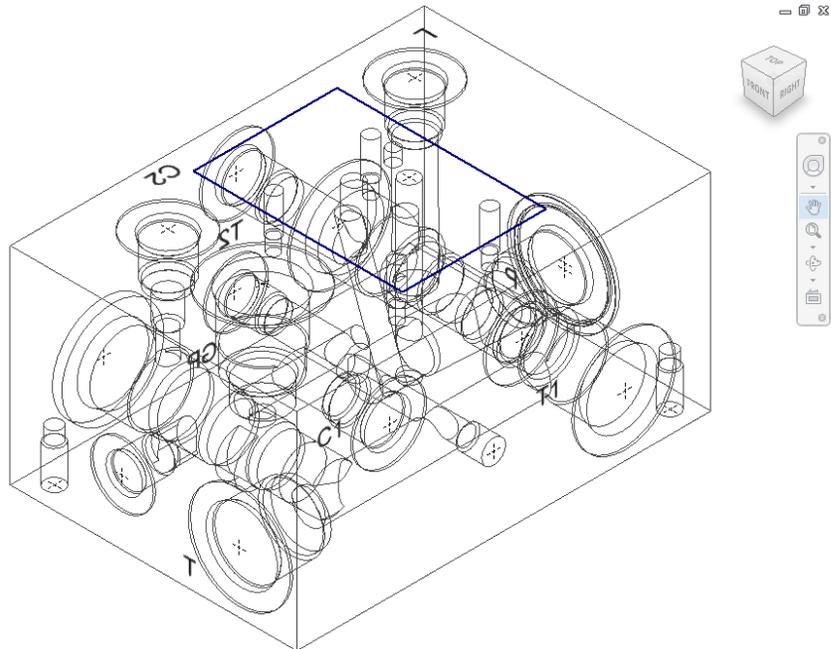
*MDTools® shades all the cavities on the manifold.*

### Note

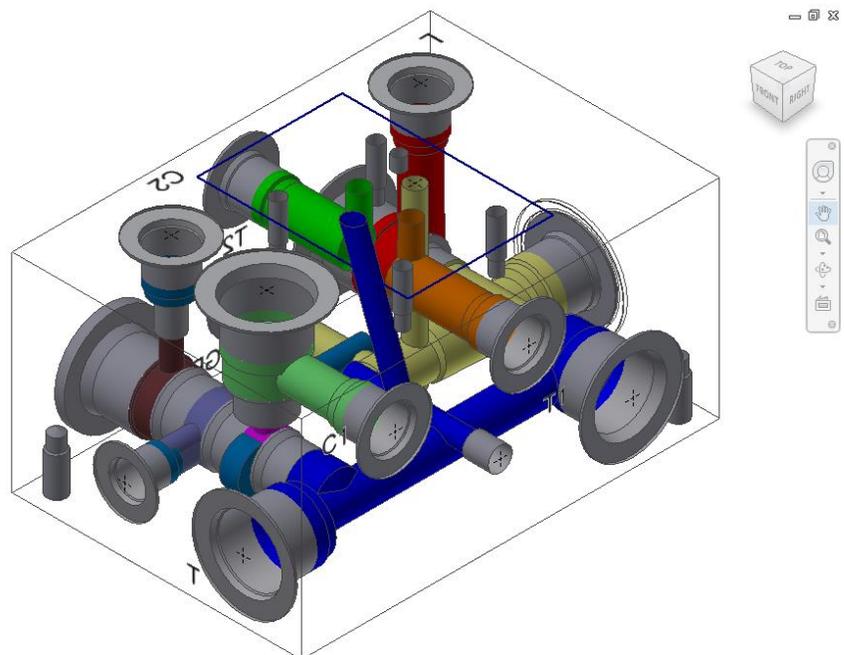
- Terminate the command by pressing the Esc key.
- Run this command from the MDTools browser.
- Shading of cavities cannot be saved with the part model (limitation in Autodesk Inventor). Therefore, you must shade the cavities when you reopen the manifold, if the MDTools browser is not set to Load on Startup.



*The Coloring Cavities message box*



*Cavities shaded automatically with their net colors*



# 74. Locate Cavity

Easily locate cavities on a manifold.

1. MDTools 760 ribbon >View panel >Locate

The Locate Cavity dialog box displays the list of cavities on the manifold.

2. Select a cavity in the list.

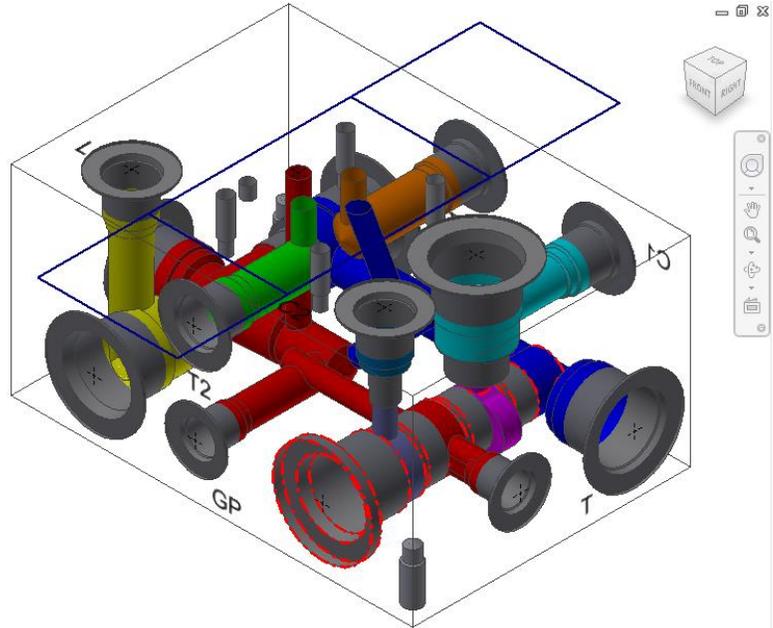
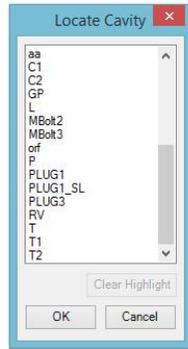
MDTools® highlights the selected cavity.

3. Select the next cavity you want to locate.

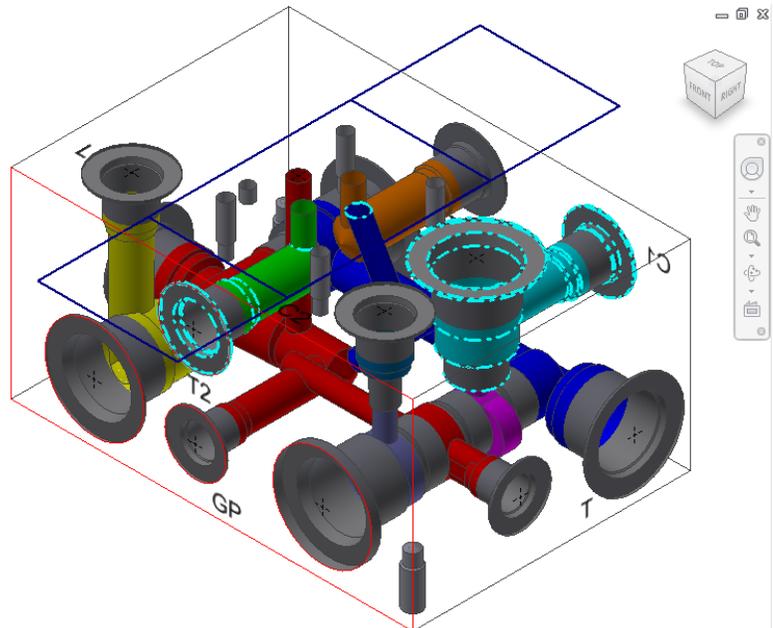
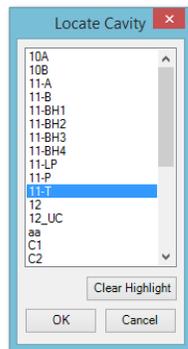
MDTools highlights the selected cavity.

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 760 ribbon  
>**View** panel  
>**Outline**

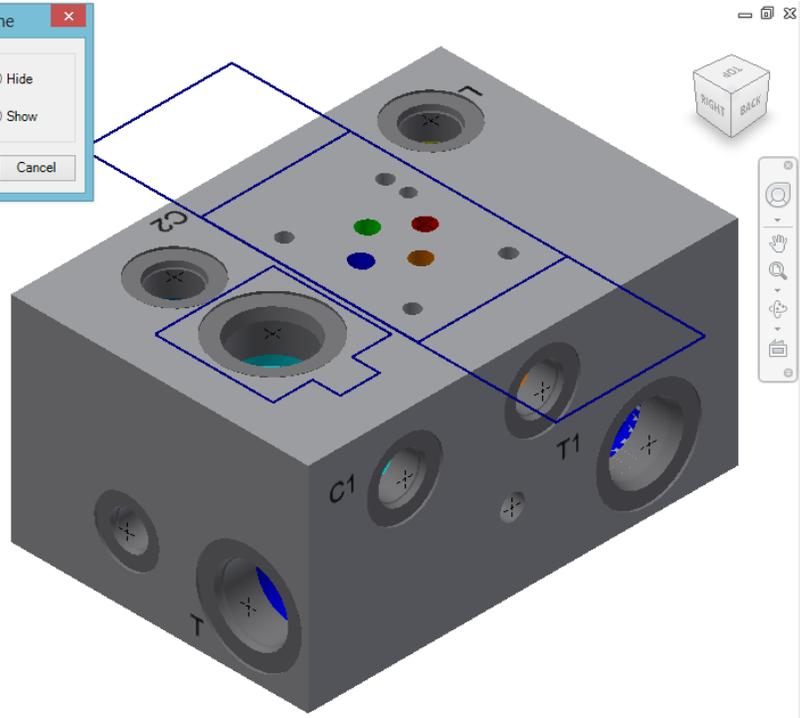
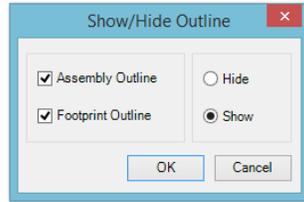
The *Show/Hide Outline* dialog box displays.

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 show or hide the cavity ID of a selected cavity.

- MDTools 760 ribbon  
>View panel  
>Slide out menu  
>**Cavity ID**

The Show/Hide Cavity ID dialog box displays.

- Select the display option.  
*Component ID is selected by default.*

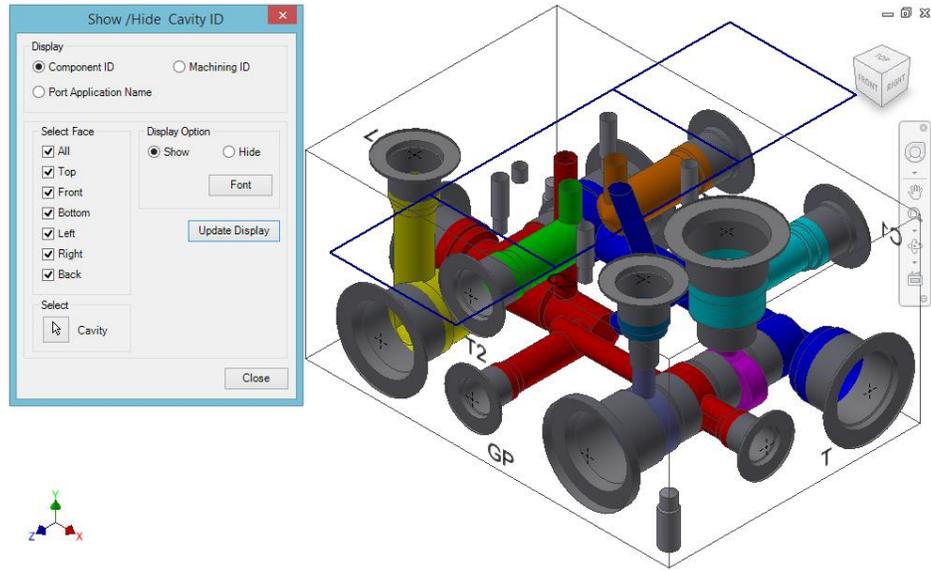
- Select the faces.  
*Front and Top faces are selected by default. Select the All option to display the cavity IDs of all the cavities on the manifold.*

- Select the **Show or Hide** option.  
*The Show option is selected by default. Select the Hide option to hide the cavity ID.*

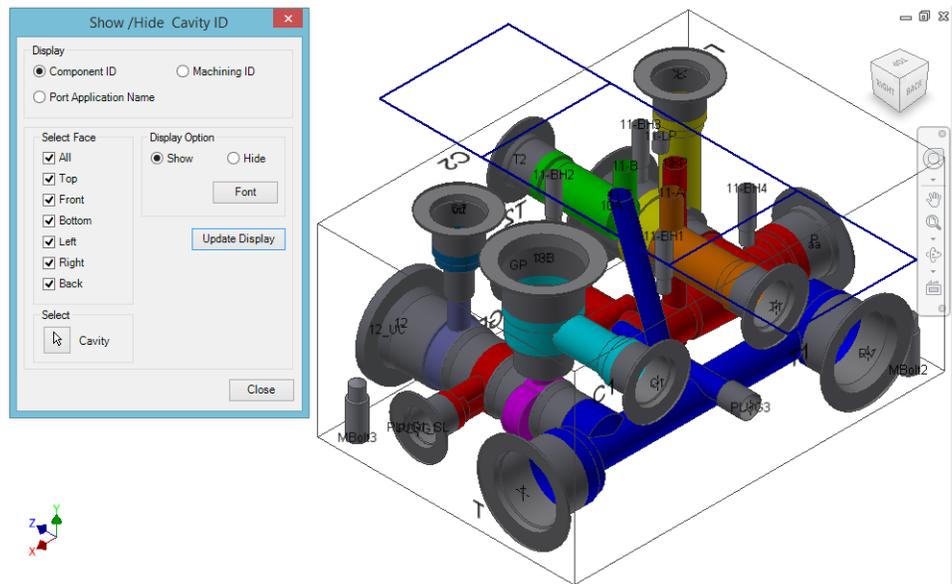
- Click **Font Style** to change the font style.  
*The Font dialog box displays with default styles.*

Font *Arial*  
Style *Regular*  
Size *16*  
Color *Black*

- Change the font properties, if required.
- Click **Update Display**.  
*MDTools® displays the cavity ID on the cavity center.*



Show/Hide Cavity ID dialog box



Cavity ID displayed on the center of cavities

## Show/Hide Single Cavity ID

- Click the **Cavity** selection button.
- Select the cavity.

MDTools display the cavity ID on the cavity center.

### 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.

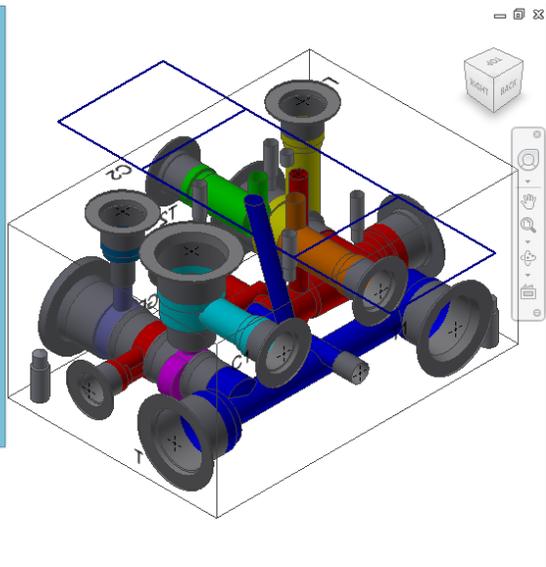
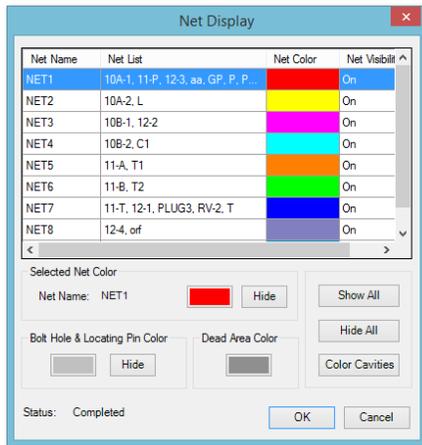
# 77. Net Display

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

MDTools 760 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.



Net Display dialog box

MDTools displays the net name and color in the dialog box.

3. Click **Show** to display the selected net.
4. Click **Hide** to hide the selected net.

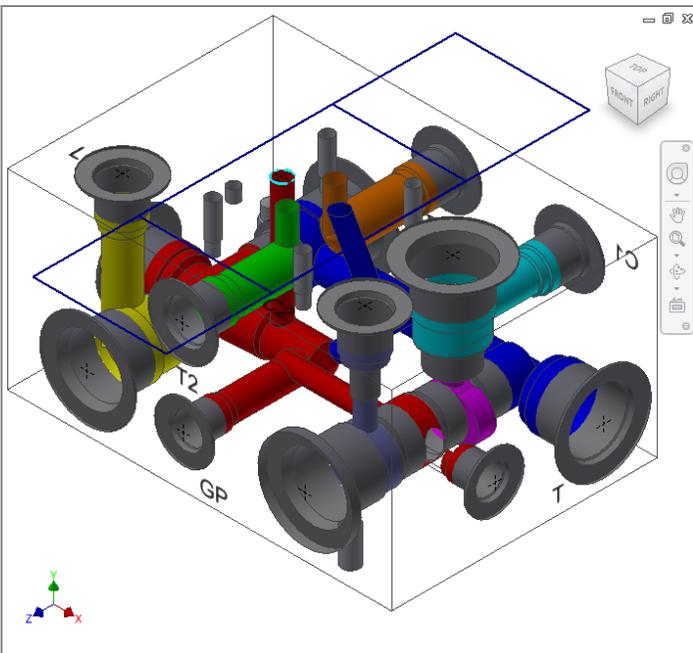
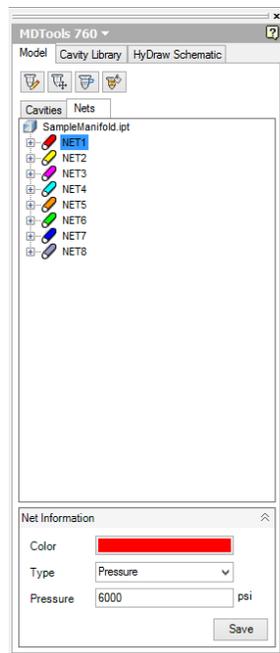
MDTools displays the selected net with the selected net color.

MDTools hides the selected net.

## 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.



Nets displayed with different colors

## Show/Hide Bolt Holes and Locating Pins

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

1. 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

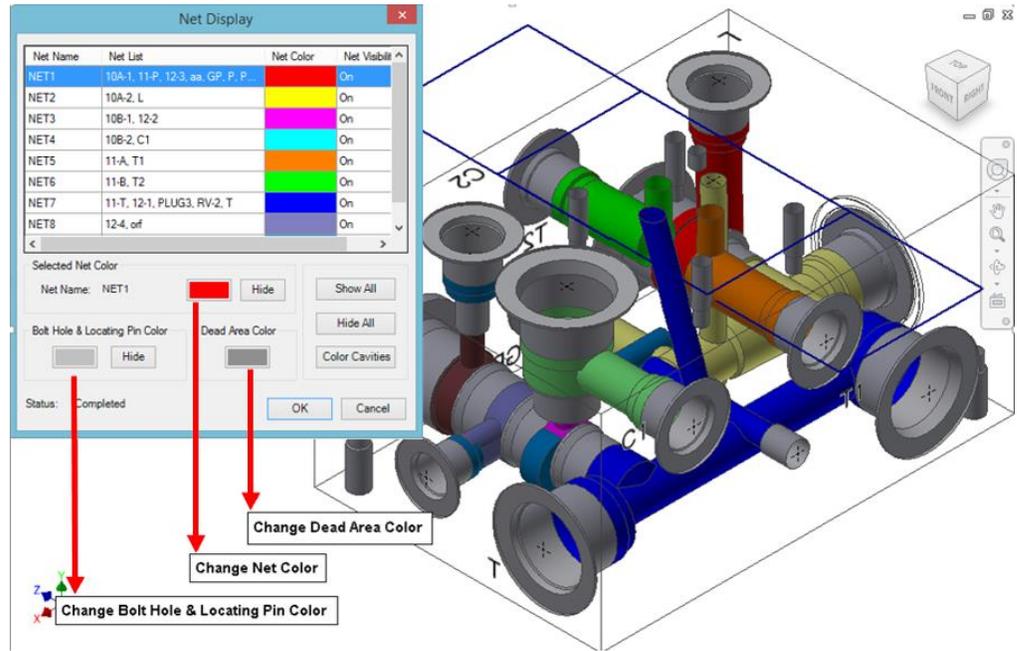
- Click the color button for a selected net to change the selected net color.
- Click the Bolt Hole & Locating Pins Color button to change the color of bolt holes and locating pins.
- Click the Dead Area Color button to change the color of Dead Areas in cavities.

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.

MDTools 760 ribbon  
>View panel  
>Slide out menu  
>Cavity Center

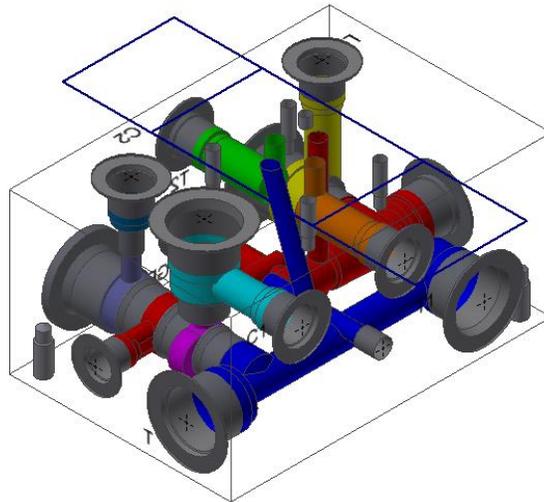
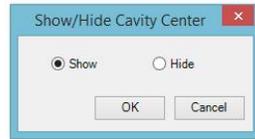
The Show/Hide Cavity Center dialog box displays.

1. Select **Show/Hide**.
2. Click **OK**.

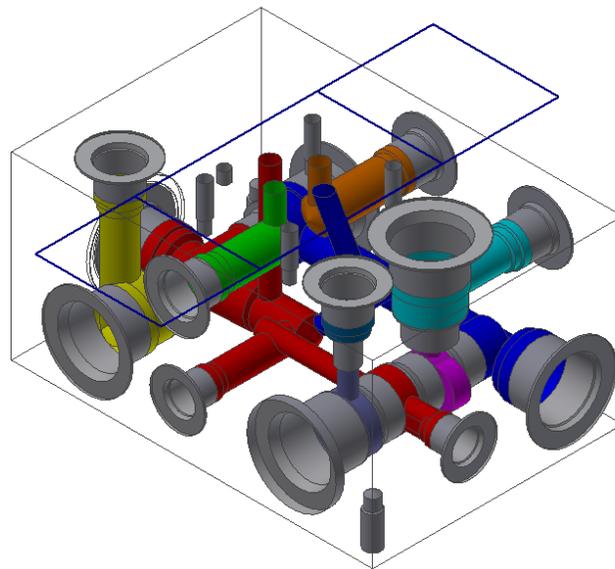
MDTools® makes the cavity center points visible or invisible, as required.

### 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.

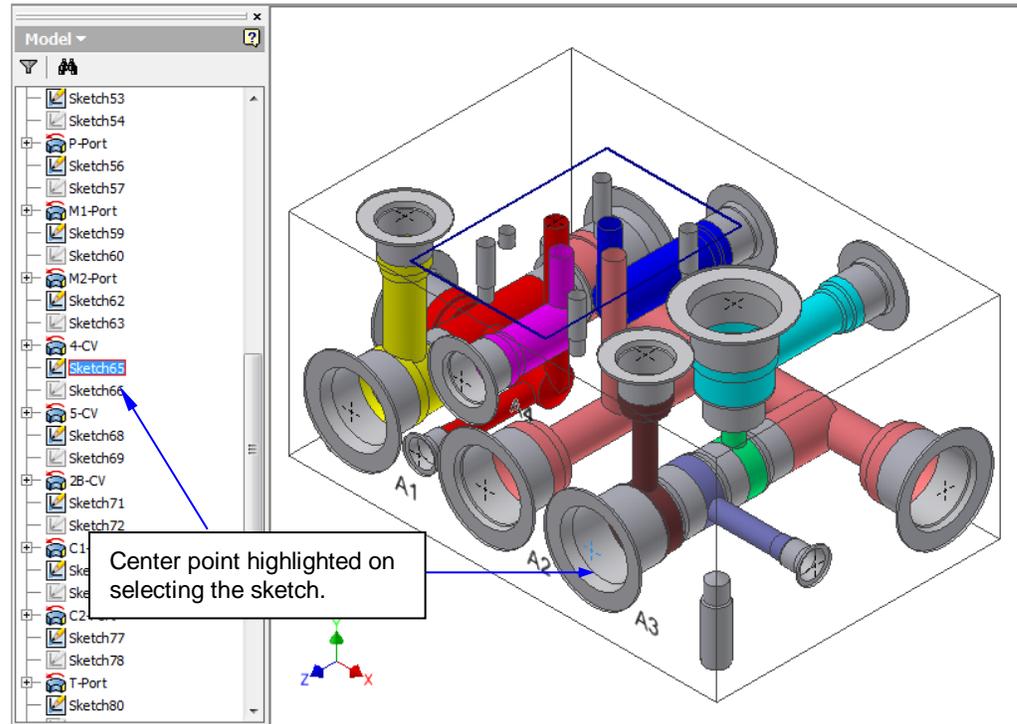


## Show/Hide Center Point Manually

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 particular cavity.

# 79. Remove Color

Remove the shading of cavities on the manifold.

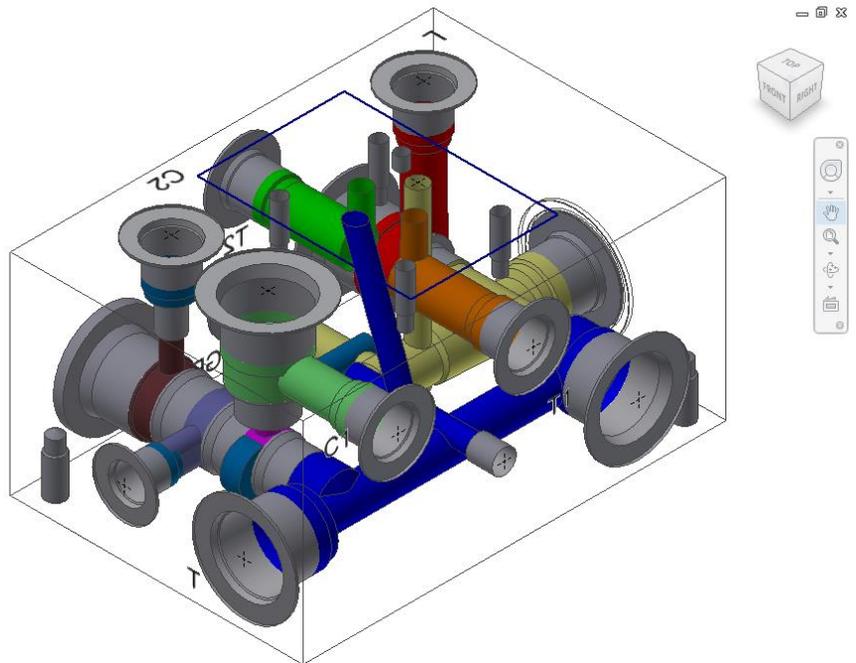
## Removing Cavity Shading

- >View panel
- >Slide out menu
- >Remove Color

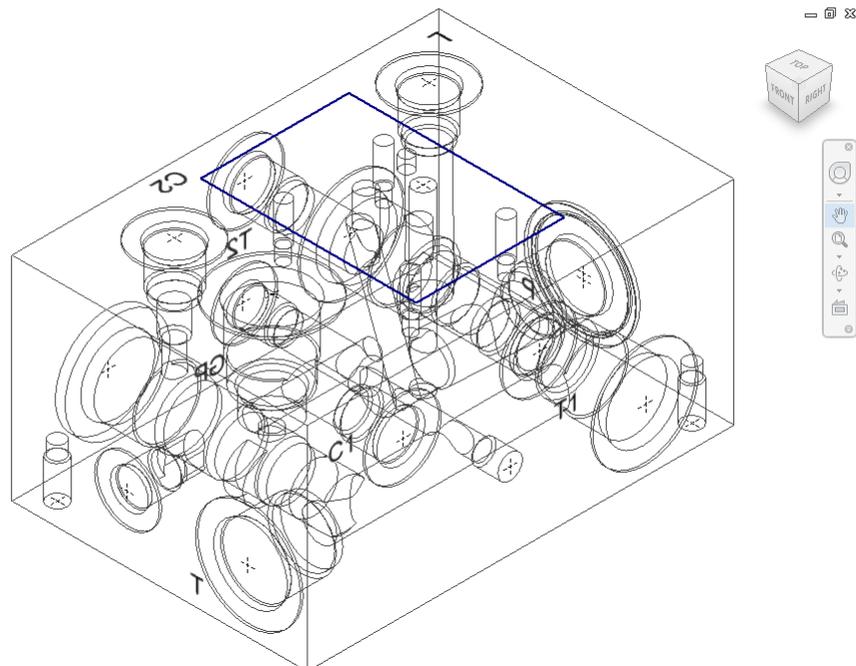
*MDTools® removes the shading of all the cavities on the manifold.*

### Note

- You can terminate the command by pressing the Esc key.



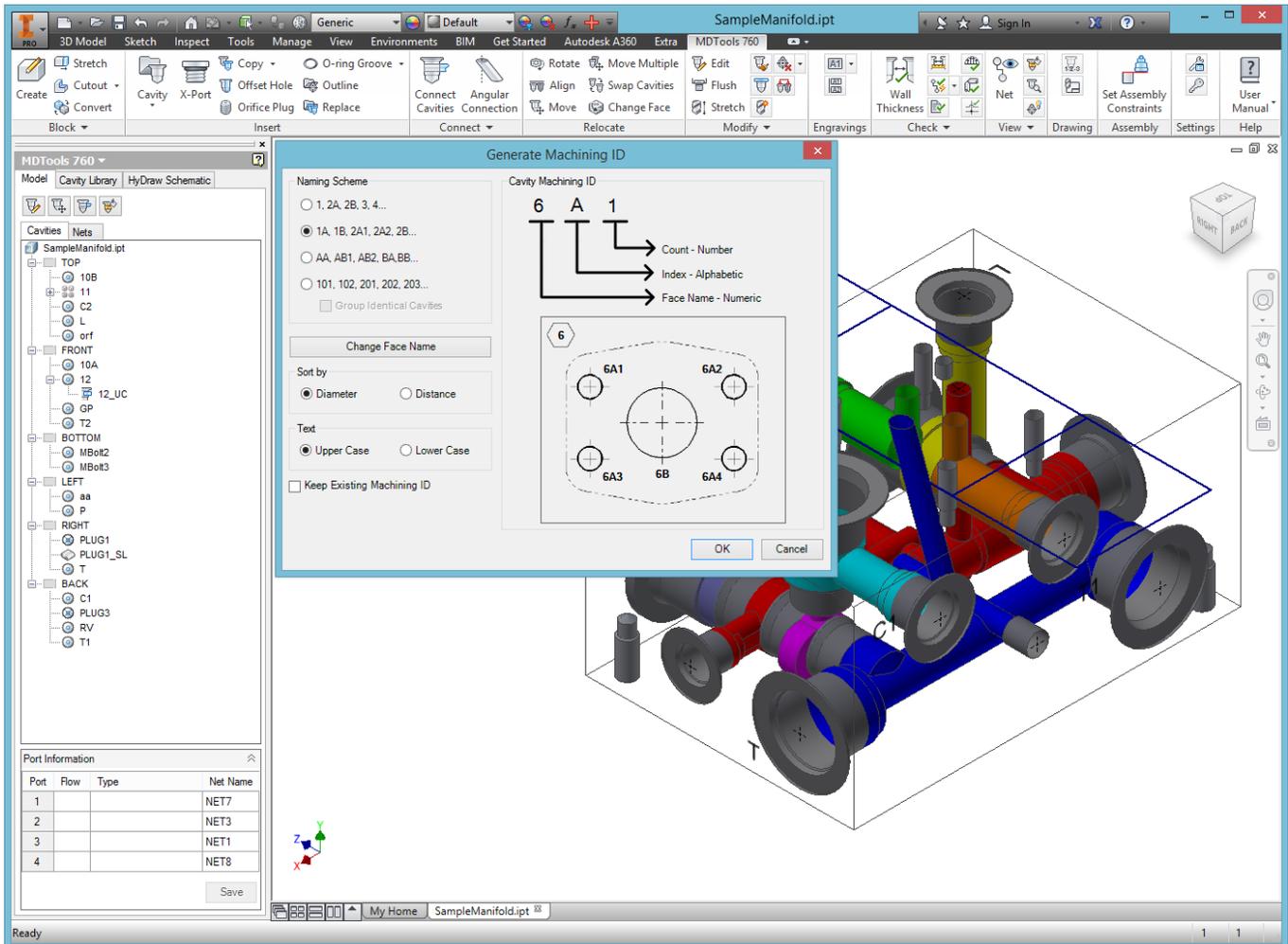
Cavities shaded with their net colors



Cavities shading removed using Remove Color

# Part Model Drawing Commands

- 78 Generate Machining ID
- 79 Create Machining Drawing
- 80 Set Assembly Constraints



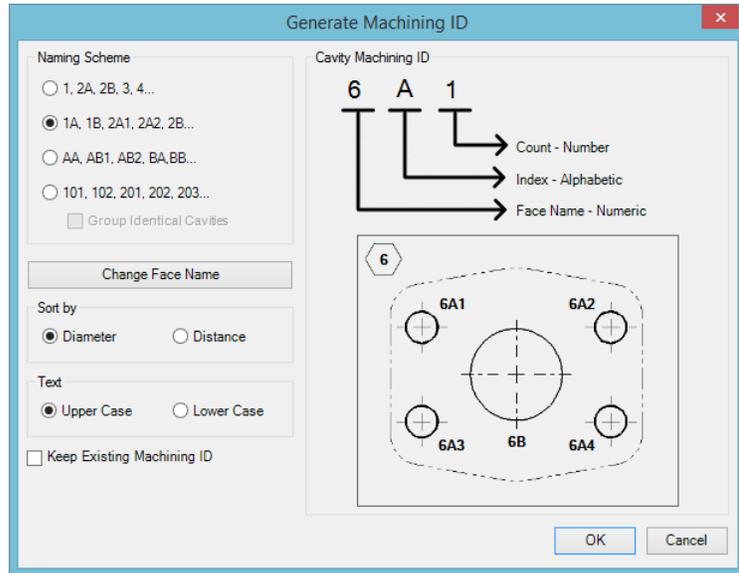
# 80. Generate Machining ID

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. MDTTools 760 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,,

Select the Group Identical Cavities option, if required.

### Note

Grouping is not applicable for scheme 1, 2A, 2B, 2, 4...

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 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 will be unavailable if:

Current naming scheme is different than last used naming scheme when a manifold is revised.

or

Face names are different than the last used face names to assign machining IDs when a manifold is revised.

6. Click **Generate Cavity Machining ID**.

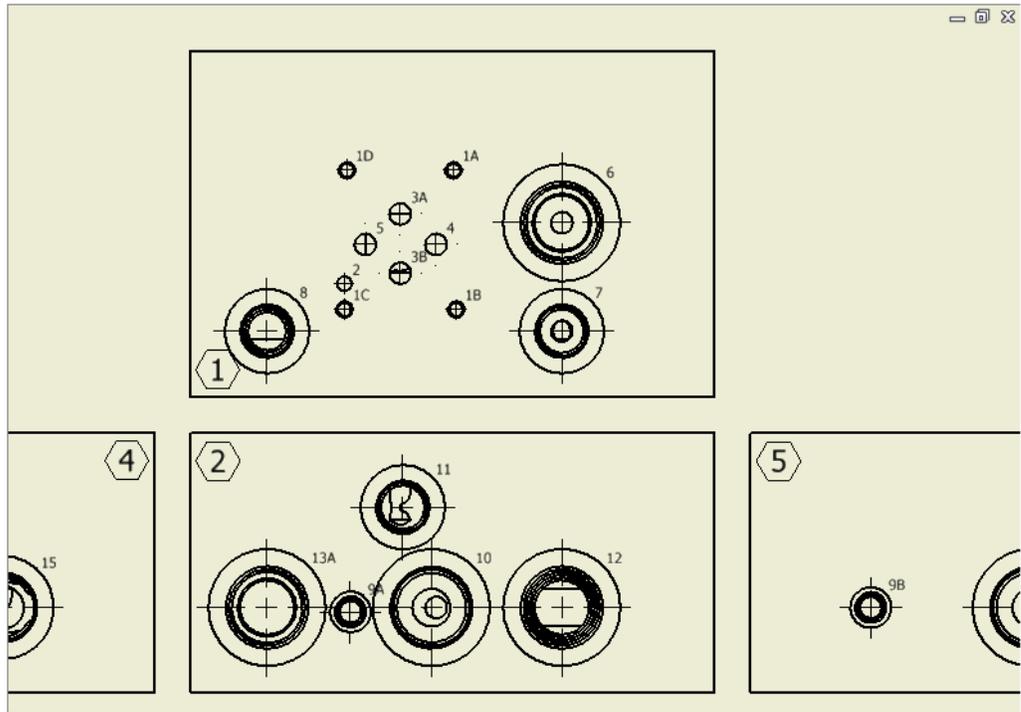
# 1. Naming Scheme

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.

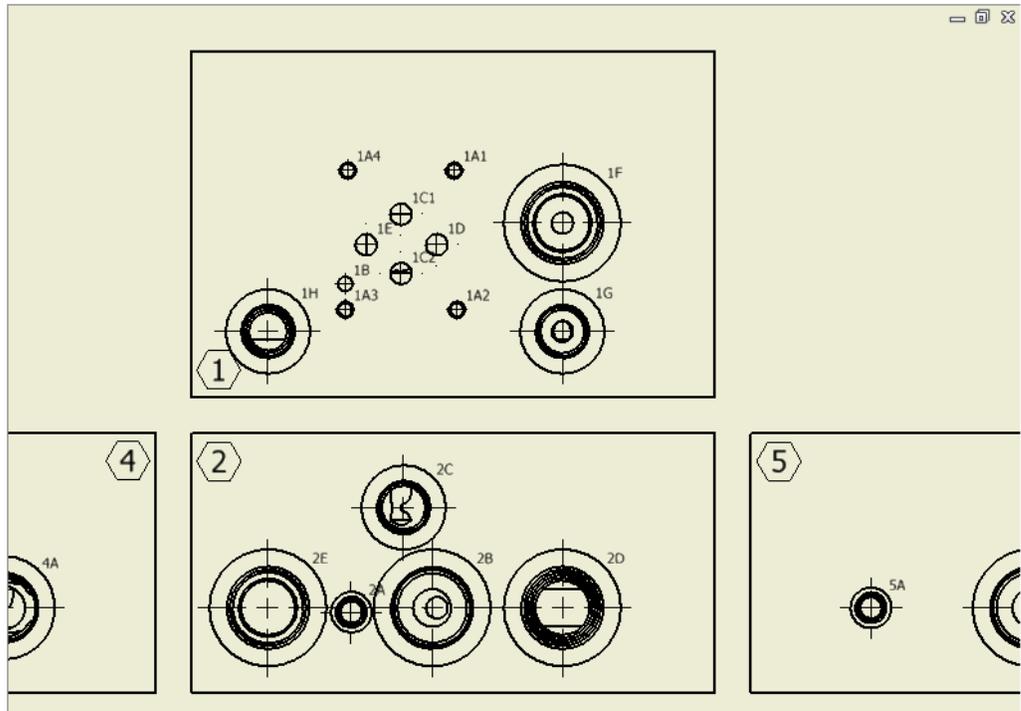
*The number is incremented with each non-identical cavity found on the face starting with the cavity found with the smaller diameter on the first face.*



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

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

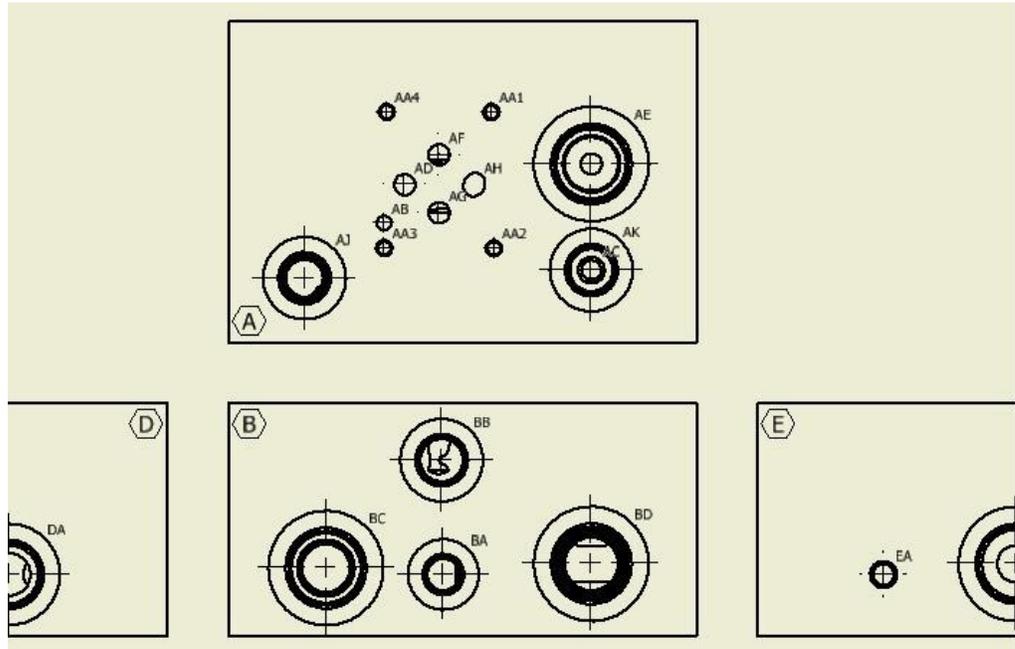
- Name of the cavity is a Numerical Face Name + Alphabetical Cavity Index
- Count is an alphabet and Naming option: Distance



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

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

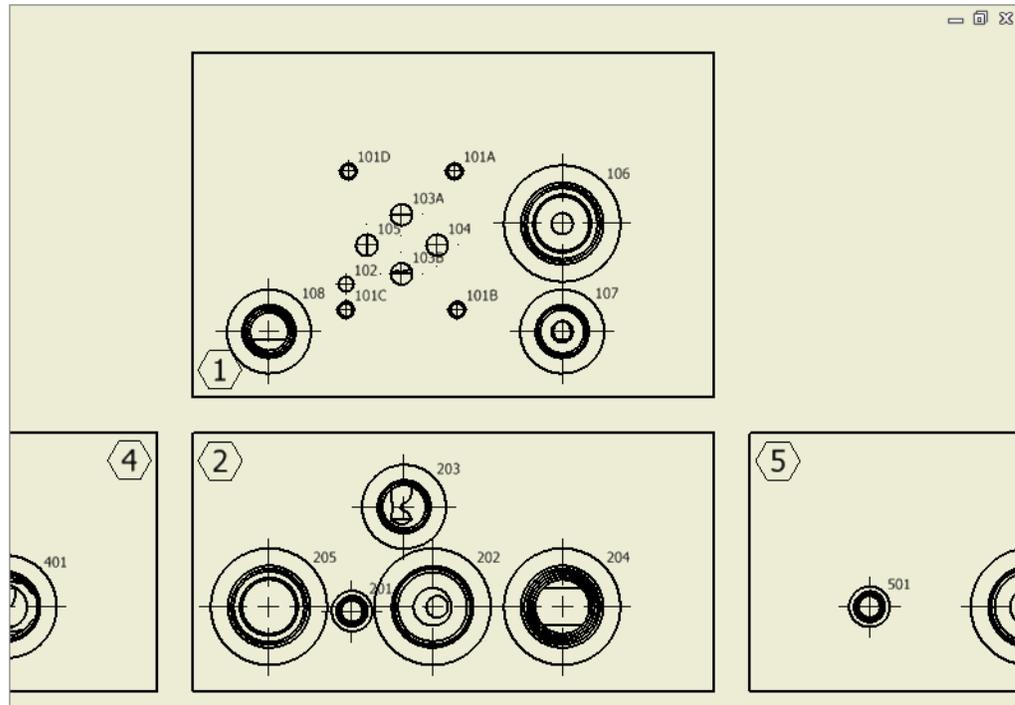
- Name of the cavity is an Alphabetical Face Name + Alphabetical Cavity Index
- Count is an alphabet and Naming option: Diameter



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

### 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. Working: Keep Existing Machining ID

- **New cavity inserted**

Insert/Copy/Copy multiple

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

Otherwise

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

- **Cavity deleted/suppressed**

No change required.

Deleted ID will be missing in the new list

- **Cavity face changed**

Change Face/Swap cavities

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

Otherwise

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

- **Cavity dimensions changed**

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

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

Otherwise

- If a cavity belongs to a group of identical cavities then,

1. If same change is applied to all, then no change is required.

Otherwise

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

**Note:**

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

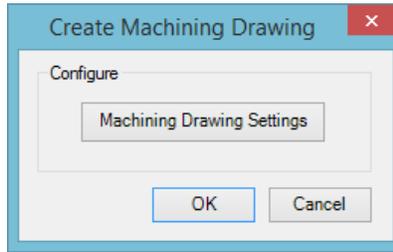
# 81. Create Machining Drawing

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 760 ribbon  
>**Drawing** panel  
>**Create**

The Create Machining Drawing dialog box displays.



Machining Drawing dialog box

2. Click **Machining Drawing Settings** to change the preset configurations.

The Machining Drawing Settings dialog box displays.

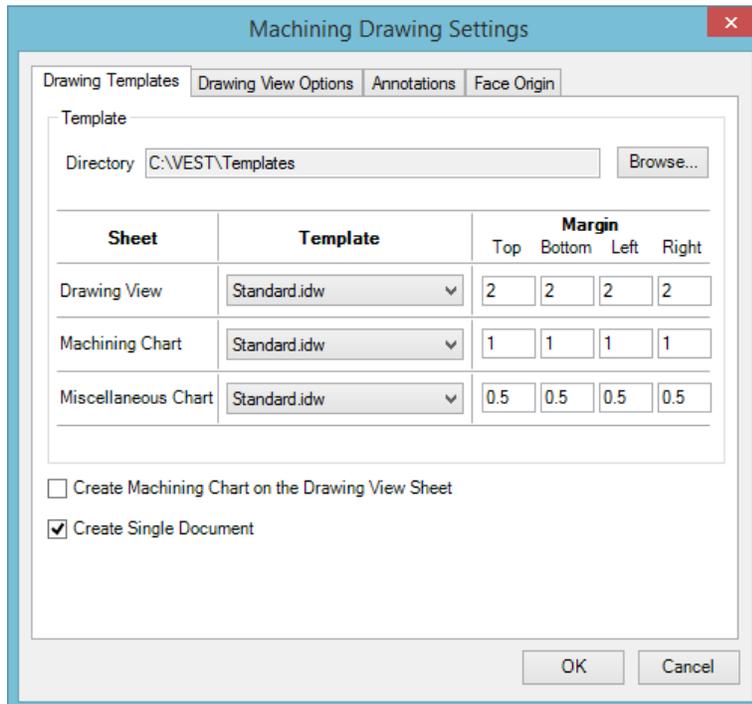
3. Click **OK** to initiate the automatic creation of the machining drawing.

## Machining Drawing Settings

The Machining Drawing Settings dialog box enables you to configure the various options to 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 will be 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 Create Machining Chart on the Drawing View Sheet to draw 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.



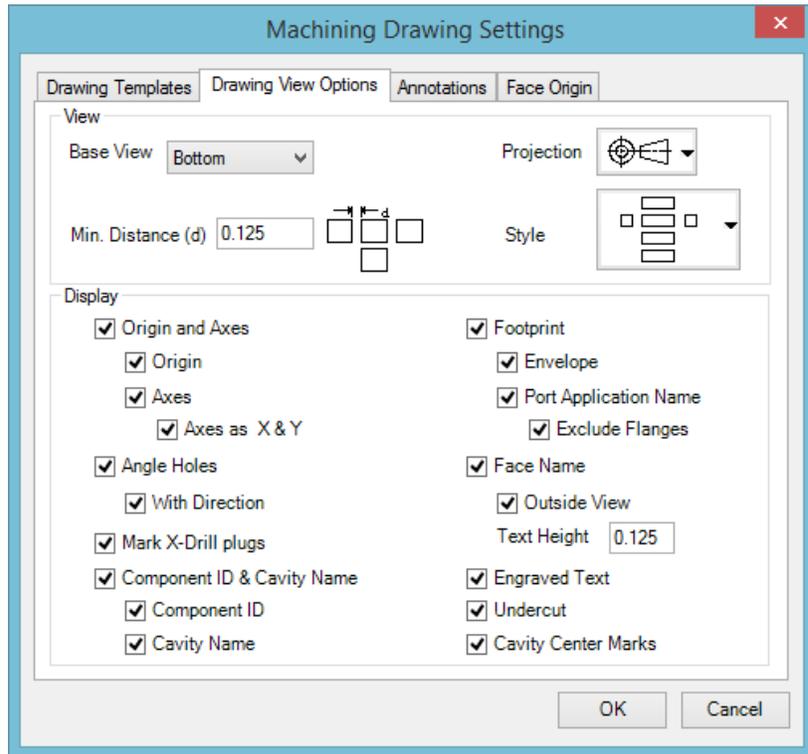
Machining Drawing Settings dialog box: Drawing Templates

## Working of Margin feature

1. **Drawing View:** Views will be placed considering the given clearance value.
  - a) **Top**  
Distance between top most view and sheet inner border
  - b) **Bottom**  
Distance between bottom most view and sheet inner border
  - c) **Left**  
Distance between left most view and sheet inner border
  - d) **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.
  - a) **Top**  
Distance between top of machining chart and sheet inner border
  
  - b) **Bottom**  
Distance between bottom of machining chart and sheet inner border
  
  - c) **Left**  
Distance between left end of machining chart and sheet inner border
  
  - d) **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.
  - a) **Top**  
Distance between top of the chart and sheet inner border
  
  - b) **Bottom**  
Distance between bottom of the chart and sheet inner border
  
  - c) **Left**  
Distance between left end of the chart and sheet inner border
  
  - d) **Right**  
Distance between right end of the chart and sheet inner border

## 2 Drawing View Options

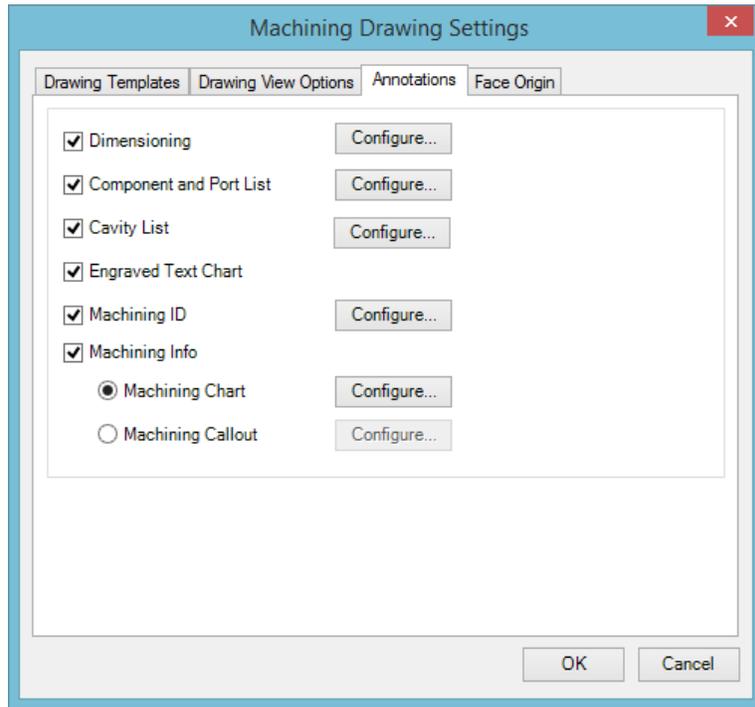
- Specify Base view or reference view. Other views will be placed based on the selected base view.
- Specify the projection type for the drawing views by selecting the required button.
- Specify the **Min. Distance (d)** value between the views. MDTools® maintains this minimum clearance between the views when placing the views on the sheet.
- Select placement style of drawing views.
- Select **Origin and Axis** to display the origin and axes.
  - Select **Axes as X & Y** to display the axes as X and Y for each face, otherwise the block axes will be 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

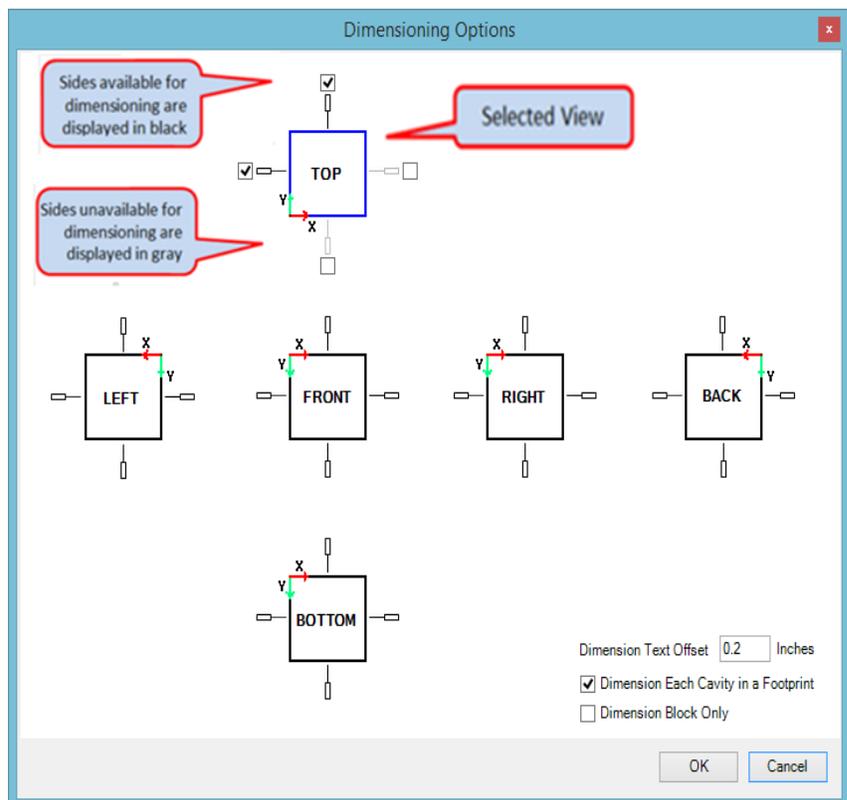
- Select the cavity **Dimensioning** option to dimension the cavities in the drawing views and then click **Configure**.
- Select **Components and Ports List** to create the Components and Ports List chart and then click **Configure**.
- Select **Cavity List** to create cavity table and then click **Configure**.
- Select **Engravings Chart** to create the Engravings chart.
- Select **Machining ID** to display the machining ID of the cavities and then click **Configure**.
- 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.



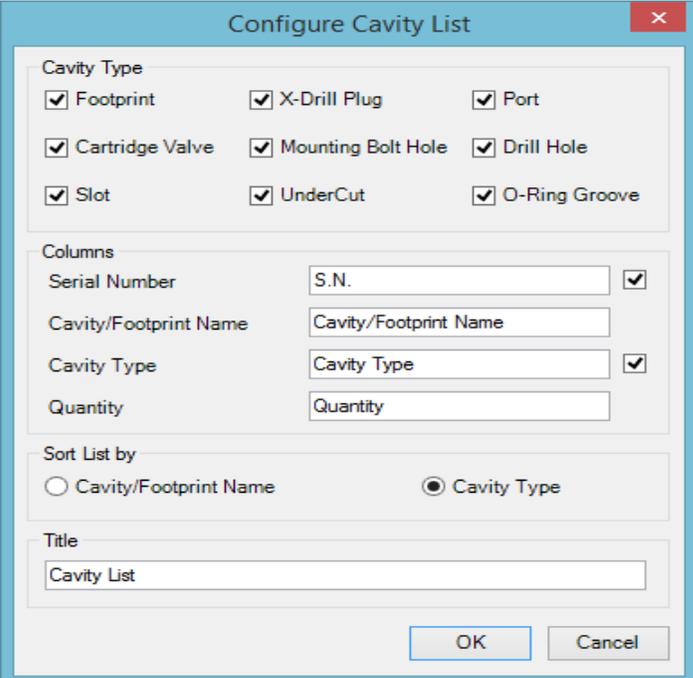
Dimensioning Options dialog box

## 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.

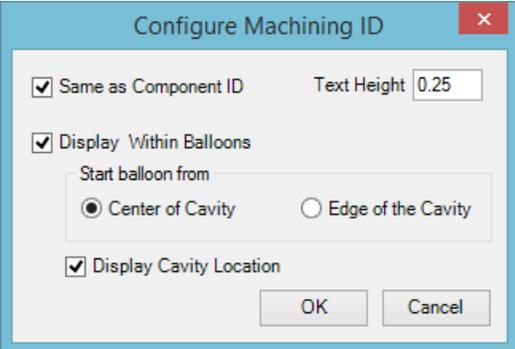
1. Select/Deselect the **Cavity Type** option to display or hide a type of cavity.
2. You may change the **column** headers for the customized column headings.
  - Select/Deselect the Serial Number option to display or hide the serial numbers in the table.
3. Select the **Sort List by** option.
4. Change the **title**, if required.
5. Click **OK** to save the settings.



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 dialog box

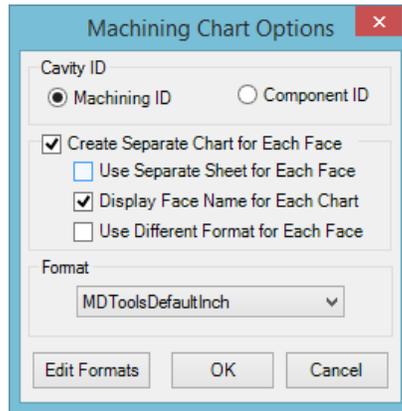
## 4 Configure Machining Chart

Create or update the format used for the Machining Chart.

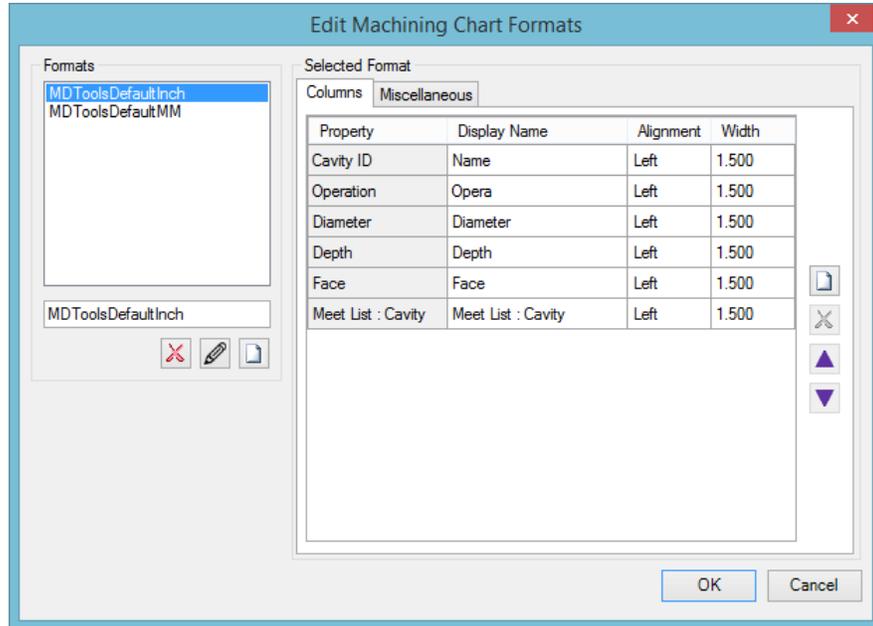
1. Select **Machining ID** or **Component ID** to use as Cavity ID in the Machining Chart.
2. Select **Create Separate Chart for Each Face** to create separate Machining Charts for all the faces. Otherwise, a combined Machining Chart will be created.
3. Select **Use Separate Sheet for Each Face** to 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 machining Chart formats.
8. Click **OK** to save the settings.

### Note

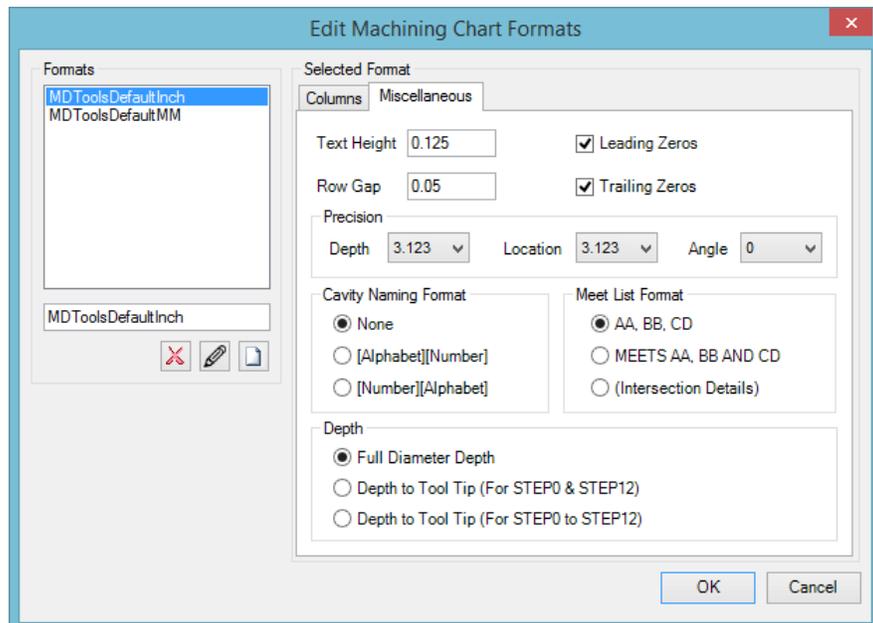
For detailed information, refer to Chapter 98, Create Machining Chart.



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**.

### Note

For detailed information, refer to Chapter 98 Create Machining Chart

	Operation		Tool Name		Diameter		Depth	
	Prefix	Suffix	Prefix	Suffix	Prefix	Suffix	Prefix	Suffix
0	-	-	-	-	-	-	-	-
1								
2								
3								
4								
5								
6								

M/c. Sequence

Rows

Row 0  
 Row 1  
 Row 2  
 Row 3  
 Row 4  
 Row 5  
 Row 6

Selected Order

Operation  
ToolName  
Diameter  
Depth

Depth

Full Bore Depth  
 Depth to tool tips (For STEP0 & STEP12)  
 Depth to tool tips (For STEP0 to STEP12)

No. of Decimal Places: 2  
Text Height: 0.125

Show Trailing Zero

Show Alpha Angle

Compound Angle Only

Angle Prefix: Angle  
Beta Caption: Beta  
Alpha Caption: Alpha

OK Cancel

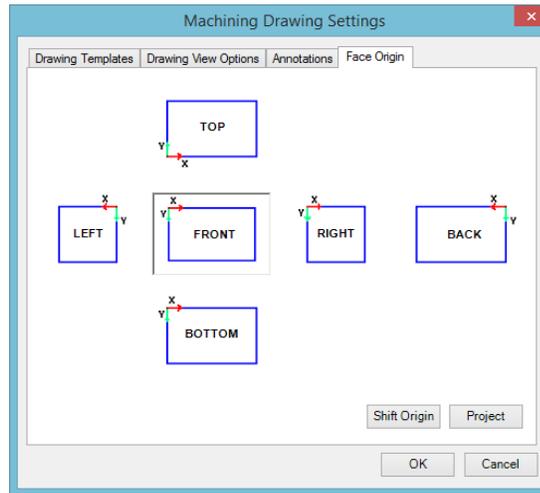
Machining Callout Setting dialog box

## 4 Face Origin

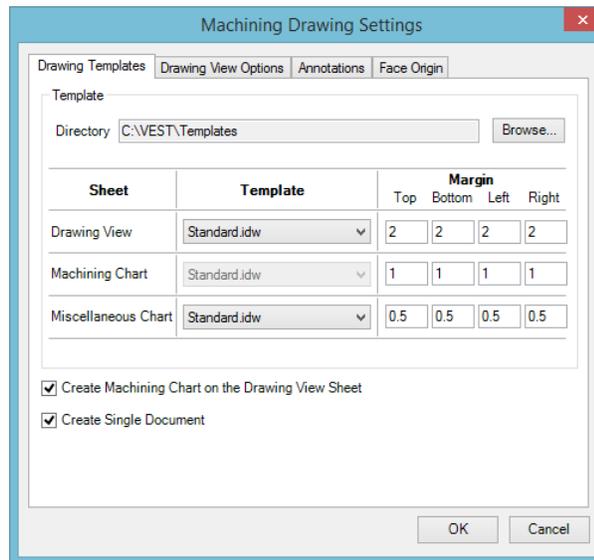
The **Face Origin** command enables you to set the origin for each face in the 2D drawing.

*The updated Auto Dimensioning and Create Machining Chart features will use the newly set origins.*

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

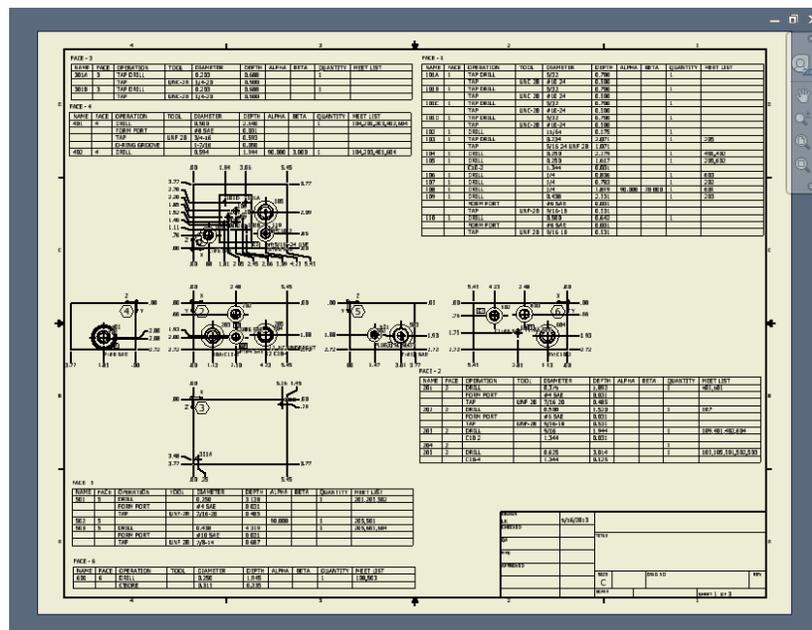


Include Machining Chart with Views

### Note:

Create Machining Chart on the Drawing View Sheet.

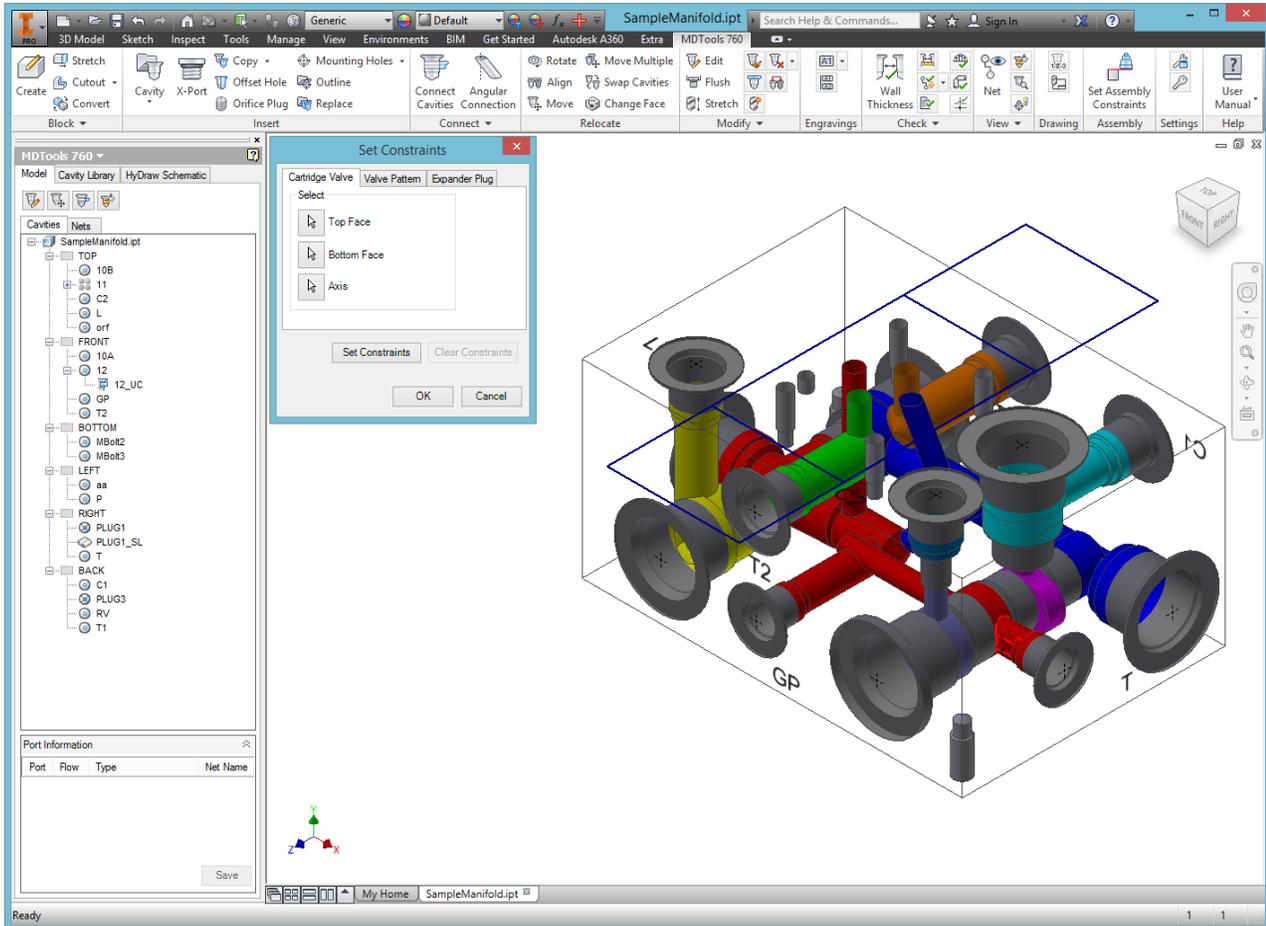
- If you select the Create Machining Chart on the Drawing View Sheet option, then the machining chart will be drawn on the main sheet with drawing views, outside the sheet.
- This option will override some of the Machining Chart configurations, such as Use Separate Sheet for Each Face.
- On selecting this option, the template for machining chart would not be used or available for selection.



Machining Chart on main sheet with views.

# Assembly

## 82 Set Assembly Constraint



## 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.*

1. MDTTools 760 ribbon  
>**Assembly** Panel  
>**Set Assembly Constraints**

*The Set Constraints dialog box displays.*

The Set Constraints dialog box contains the following tabs.

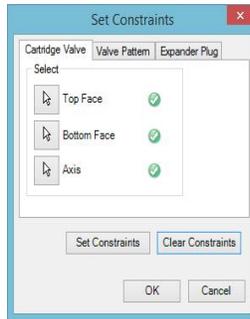
### Cartridge Valve tab

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.

2. 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.



Set Constraints dialog box: Cartridge Valve tab

3. Select the **Top Face** button.
4. Select the top face work plane.
5. Select the **Bottom Face** button.
6. Select the bottom face work plane.
7. Select the **Axis** button.
8. Select an axis passing through the valve body.
9. 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.*

10. 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.

## 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.*

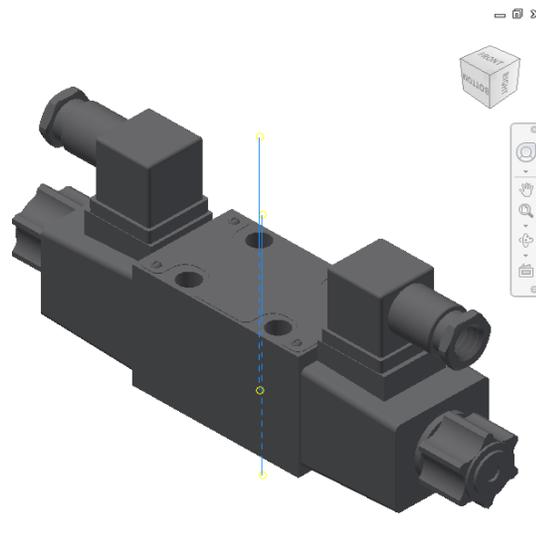
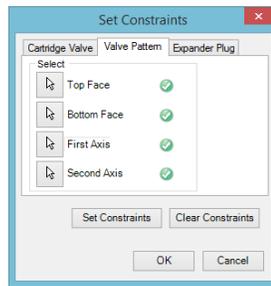
*Now, this part is ready for use with the Assembly Interface.*

13. Save the Part Model.
14. Click **OK**.

### 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 pin.
- Create an axis that passes through the bolt hole BH1 for valves with no locating pin.



Set Constraints dialog box: Valve Pattern tab

## 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 pin.
- Create an axis that passes through the bolt hole BH2 for valves with no locating pin.

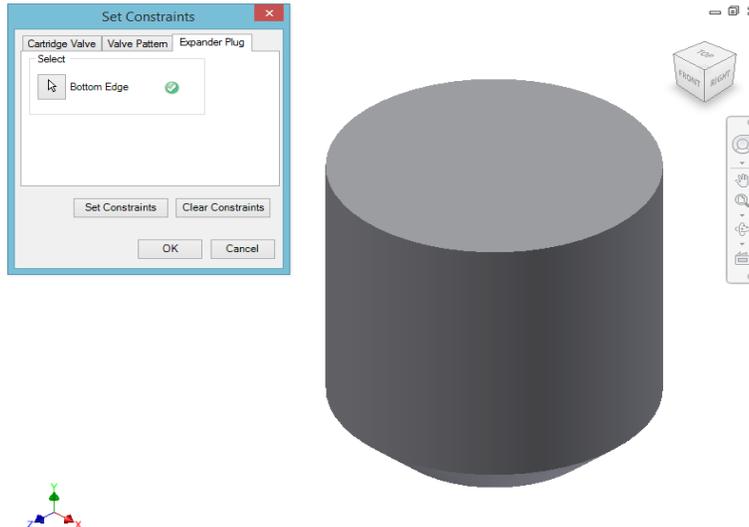
LP1 is a locating pinhole with the port application name LP1, and LP2 is a locating pinhole with the port application name LP2 on the footprint.

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.

## 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*

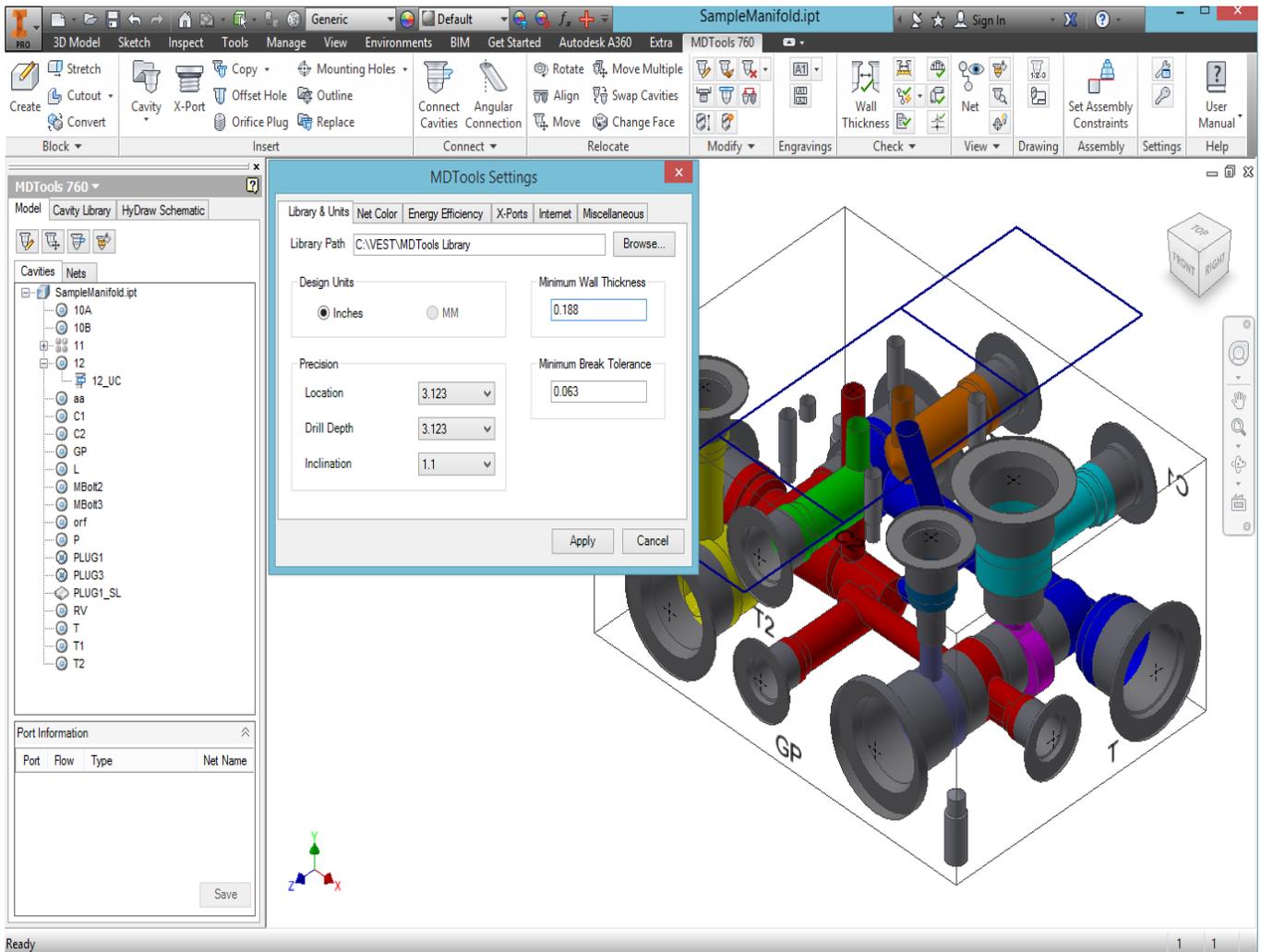
## Clear Constraints

Click **Clear Constraints** to automatically delete the assembly constraints from the selected Part model.

# Settings

83 MDTools Settings

84 MDTools License Option in Inventor Part Model Menu



# 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.

MDTools 760 ribbon

- >Settings panel
- >Settings

The MDTools Settings dialog box displays.

## 1 Library &Units

### 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.

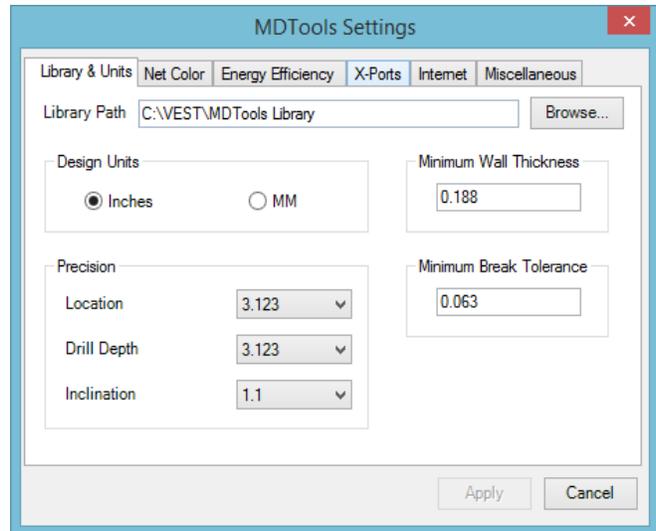
3. Click **OK** to confirm the selection.

The new library path displays in the Insert Cavity dialog box.

4. Click **Apply**.

MDTools saves the change in the library path.

5. Click **OK**.



MDTools Settings dialog box: Library &Units

### Alternatively,

Set the library path and unit from the Edit Library dialog box of the MDTools® 760 Inventor Library program.

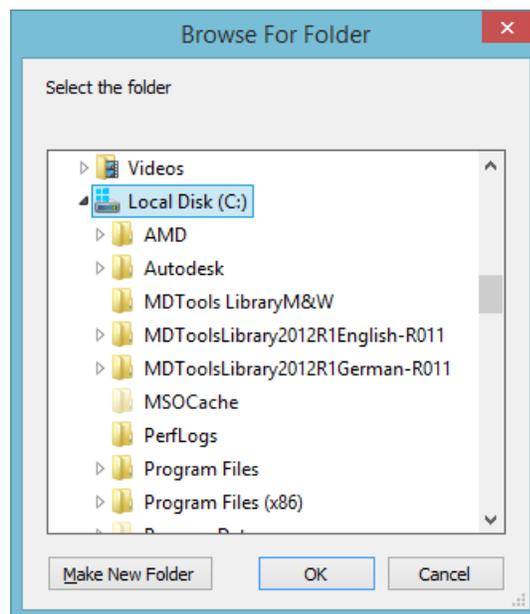
1. Select Start > Programs > VEST > MDTools Library Manager > **MDTools Cavity Library**

OR

2. Click , the MDTools Cavity Library icon on the desktop, to run the MDTools Cavity Library program.
3. Click **OK** to save the change in the library path from the Edit Library dialog box. If you click Cancel, then the path and unit will not be saved.

#### Note

- Library path is stored in the system registry.
- Set the library path on all the systems, independently.
- As the library path is stored in the system registry, you must have the administrative privilege to save any changes in the library path.



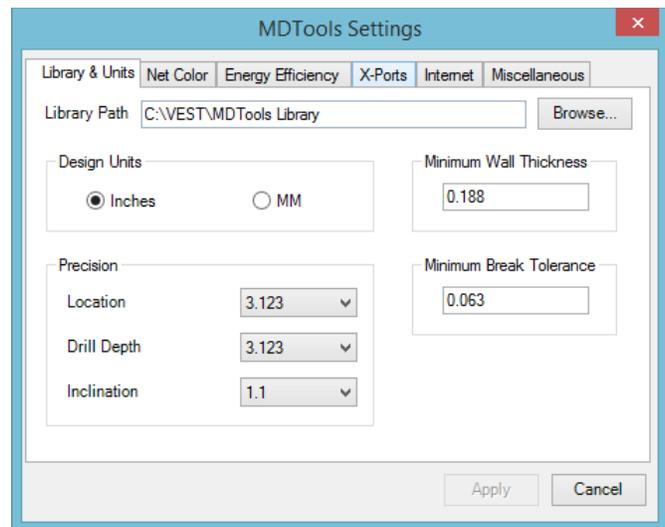
Browse for Folder dialog box

## 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

### CAUTION!

- Set the design unit before inserting the first cavity.
- You cannot change the units in the middle of the design process.



MDTools Settings dialog box: Library &Units

## 2 Net Color

### Net Color Display

**Automatic** Automatically updates the color of all the cavities in the manifold

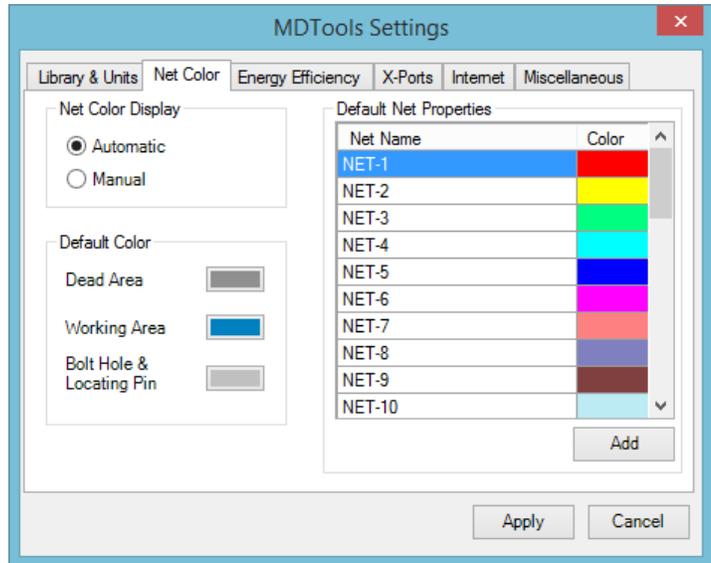
**Manual** Only updates the color of the modified cavity

### 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

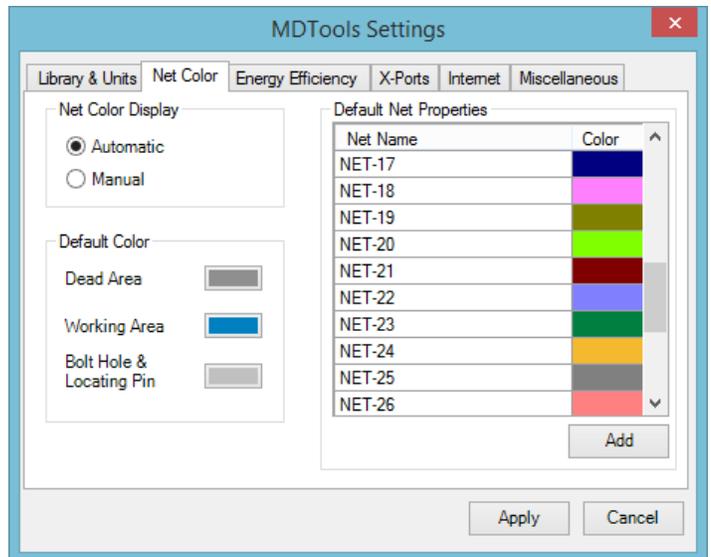
**Default Nets** View the default name and color for a number of defined nets (flow paths)

**Add a Net** Click Add to add a new net,

Change the default net name assigned by clicking the newly added net name

**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: Net Color

### 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 in for a specific cavity/port on a net in the Check Velocity command.

Imperial        Sets the unit to Inch.

Metric         Sets the unit to MM.

#### Note

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

#### Pressure Net/Tank Net

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

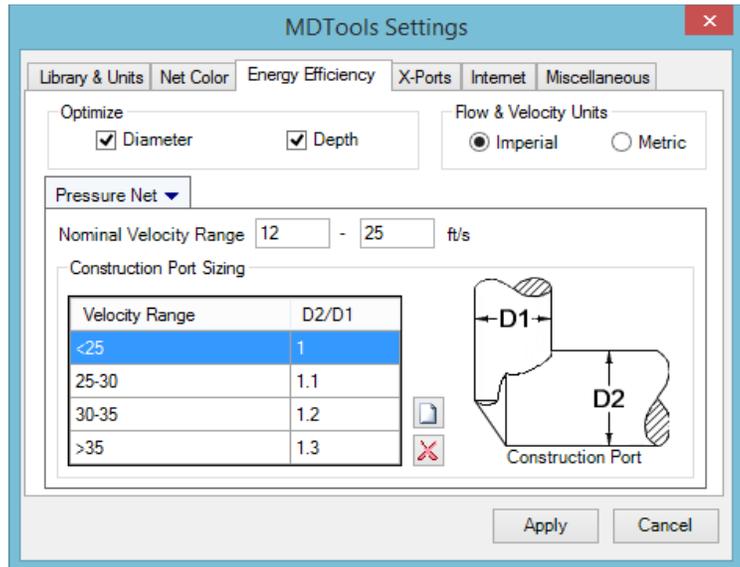
In the Check Velocity command; it is used to check if the velocity range is high, low, or nominal.

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

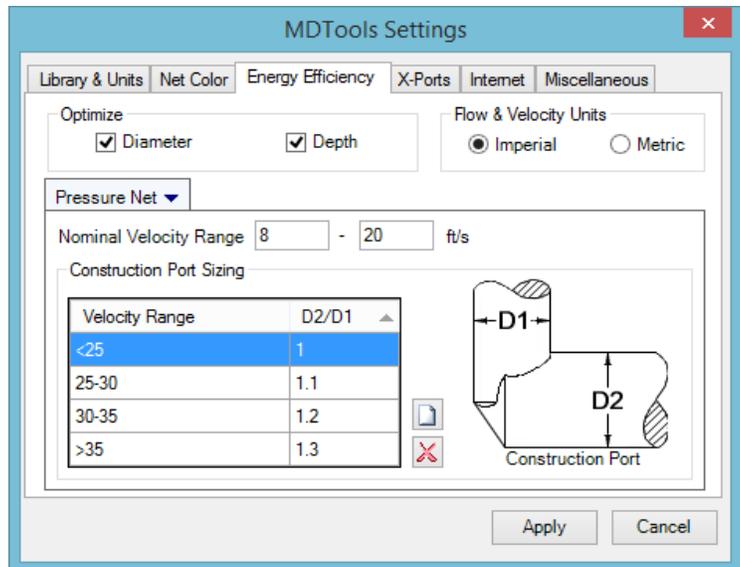
#### Note

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



MDTools Settings dialog box: Energy Efficiency

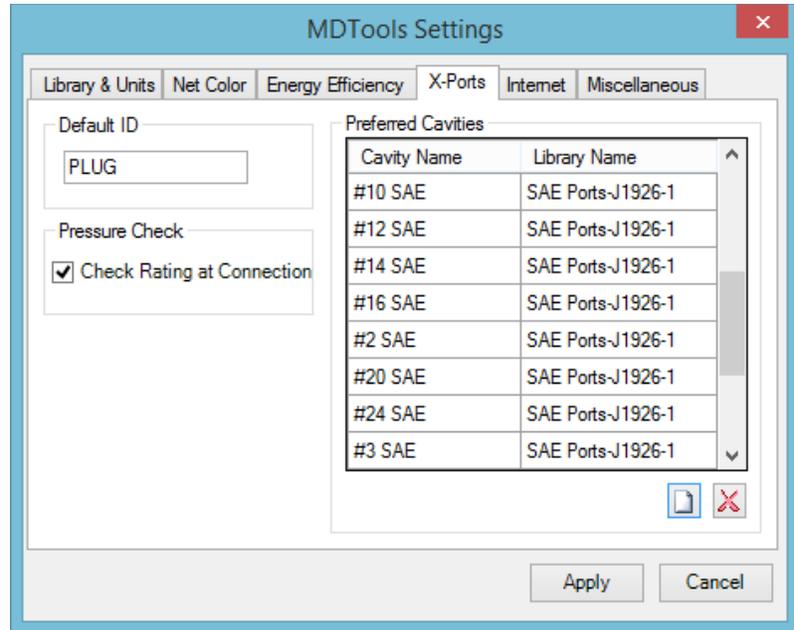
## 4 X-Ports

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

1. Click  to add construction plug.  
*The Select Preferred Cavities dialog box displays the libraries that contain ports.*
2. Select the required library.  
*The cavity is listed on the right pane.*
3. Select cavities to add or click **All** to select all the cavities.
4. Click **Add**.  
*The selected cavities are added to the library.*
5. Click **Cancel** to close the dialog box.



MDTools Settings dialog box: Library Path

#### Delete Preferred Cavity

1. Select the cavity to delete.
2. Click  to delete the cavity.

#### Default ID

Sets the component ID for the construction holes in the manifold.

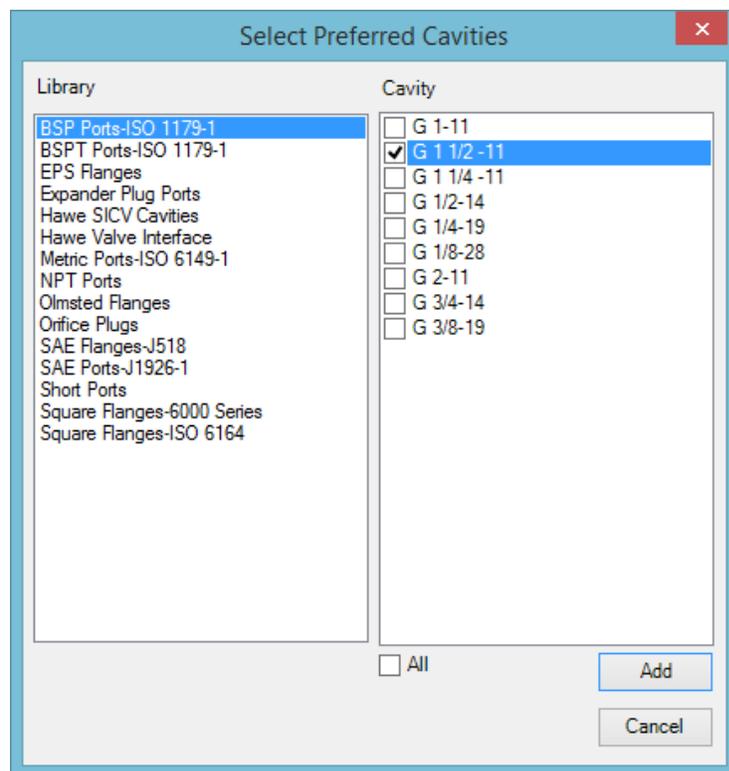
#### Pressure Check

Select **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 Connection option validates construction ports in followings MDTools command.

- Inserts Construction port from MDTools browser.
- Inserts 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. Under 'LAN Settings', the 'Proxy Server' radio button is selected. The 'Address' field contains 'http://proxyserver' and the 'Port' field contains '80'. The 'Authentication Required' checkbox is checked. The 'User Name' field contains 'myusername' and the 'Password' field is masked with asterisks. A message at the bottom of the dialog states 'You must restart Inventor for settings to take effect.' The 'Apply' and 'Cancel' buttons are visible at the bottom right.

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 **Full Diameter** if you want to use the drill depth excluding the drill tip.

Select **Tip** if you want to use the drill depth up to the drill tip.

### 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 on the manifold node.

#### Show Engravings:

Show or Hide engravings in Model Browser. This Option is also available in MDTools Cavity Browser. When you right Click on Manifold Node.

### Auto-Connect

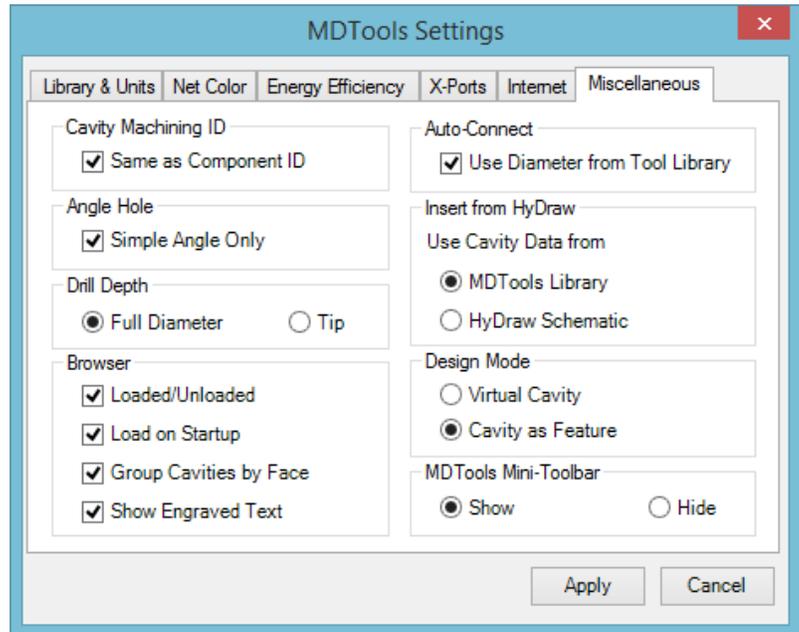
**Use Diameter from Tool Library** allows you to use the drill tools that are listed in your Tool Library.

### Insert from HyDraw

Use the cavity data from the MDTools® Library or HyDraw® Schematic.

#### Note

Pressure rating validation for Construction Port is only applicable for HyDraw Schematic.



MDTools Settings dialog box:Misc.

## 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.

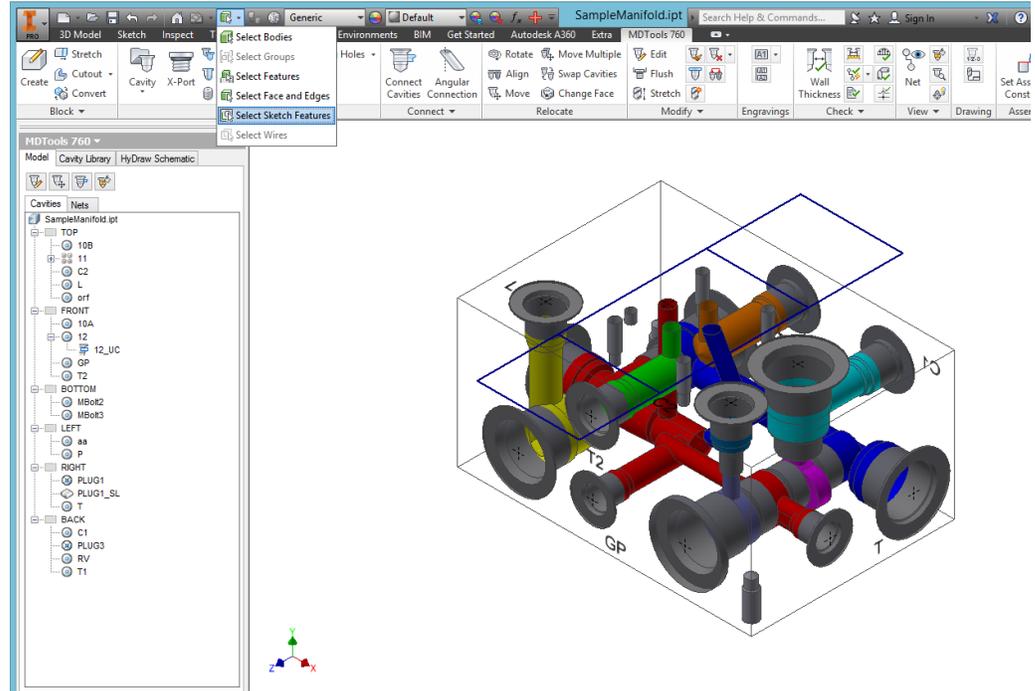
No Inventor feature is created for cavities in the Virtual Cavity design mode.

### 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 Inventor part model.



Setting Select Sketch Features

## MDTools Mini-Toolbars

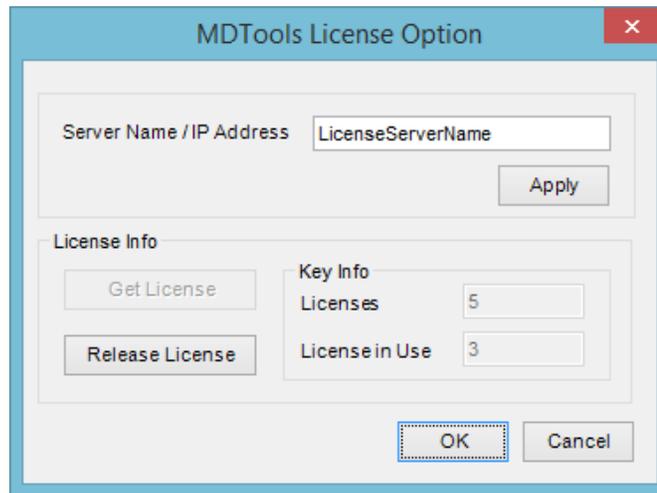
### Show/Hide

Show or hide MDTools mini-toolbars when you click cavity, footprint, O-ring, Undercut and manifold.

## 84. MDTools License Option in Inventor

Set the license path through the Inventor, MDTools® 760 Ribbon menu.

1. MDTools 760 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 760 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.

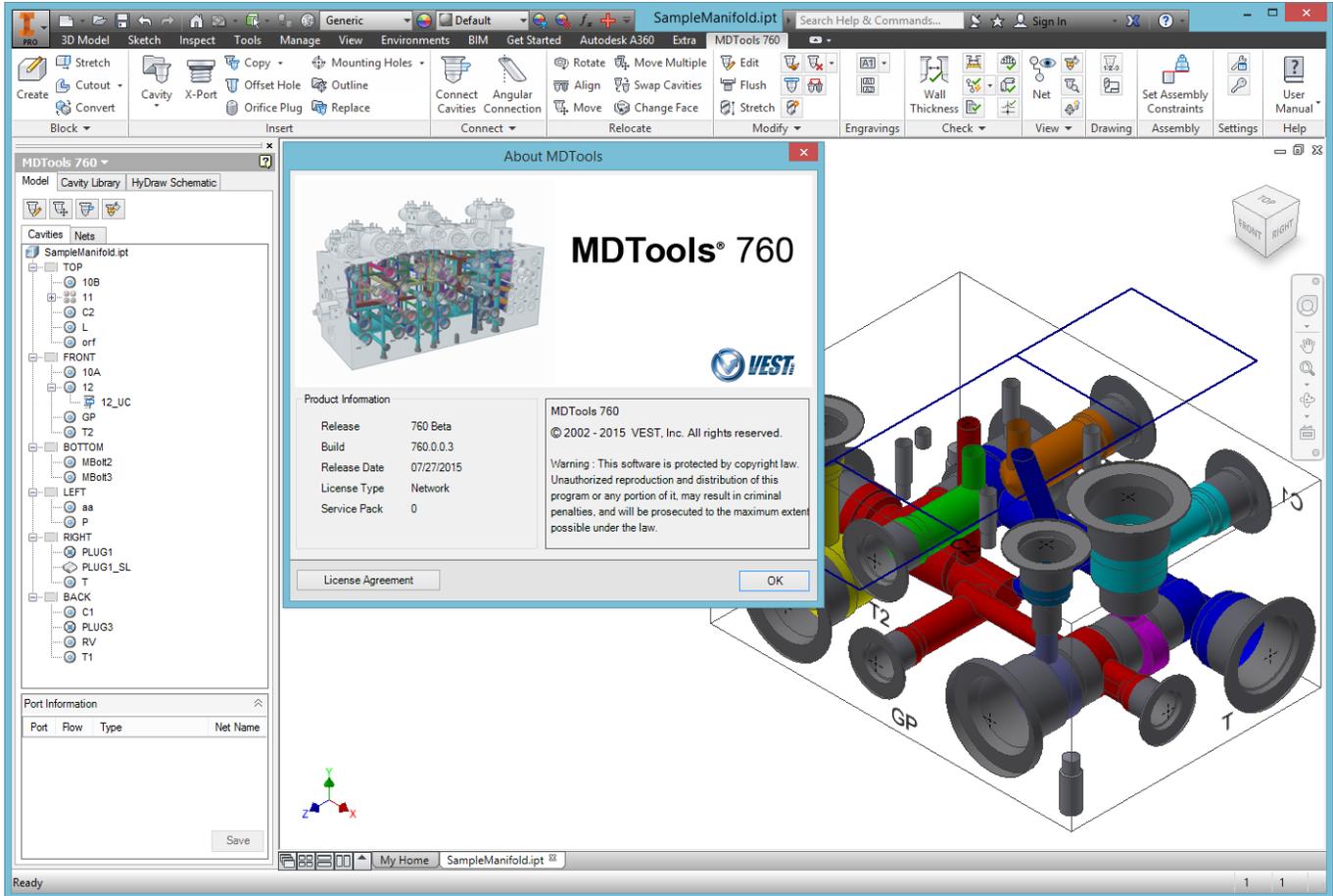


The screenshot shows the MDTools License Option dialog box. It features a title bar with the text "MDTools License Option" and a close button (X). The main area is divided into two sections. The top section is labeled "Server Name / IP Address" and contains a text input field with the value "LicenseServerName" and an "Apply" button. The bottom section is labeled "License Info" and contains two buttons: "Get License" and "Release License". To the right of these buttons is a "Key Info" section with two fields: "Licenses" with the value "5" and "License in Use" with the value "3". At the bottom right of the dialog are "OK" and "Cancel" buttons.

MDTools License Option dialog box

# Help

- 85 User Manual
- 86 About MDTools



## 85. User Manual

*Open the MDTools® 760 user manual in the PDF format.*

MDTools 760 ribbon  
>**Help** panel  
>**User Manual**

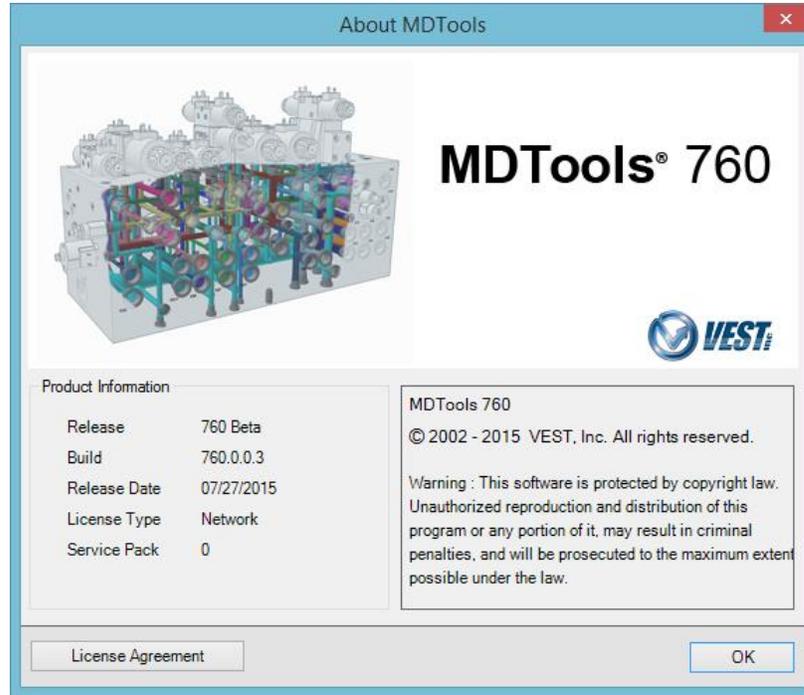
*The MDTools User Manual opens in the PDF format.*

# 86. About MDTools

View the MDTools® version and build number.

MDTools 760 ribbon  
>Help panel  
>About MDTools

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



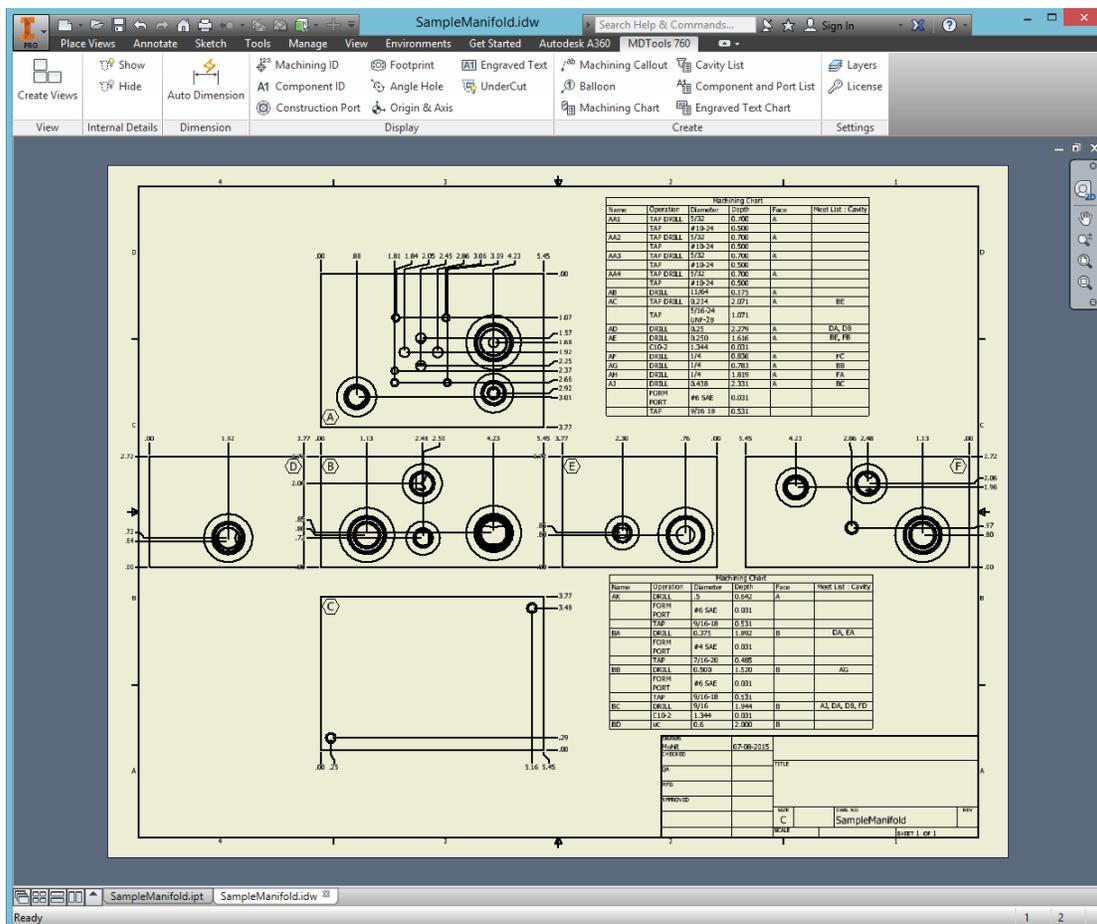
About MDTools dialog box



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.

1. MDTools 760 ribbon >View panel>Create Views  
The Create Views dialog box displays.
2. Click **Browse**.  
The Open File dialog box displays.
3. Select the block part model or the assembly model.
4. 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.
- 2 Define the scaling between the views dimensions and part model dimensions.
  - 3 Select the current projection type.  
The Third Angle projection is selected by default.
  - 4 Specify the Base view or reference view.
  - 5 Select placement style of views.

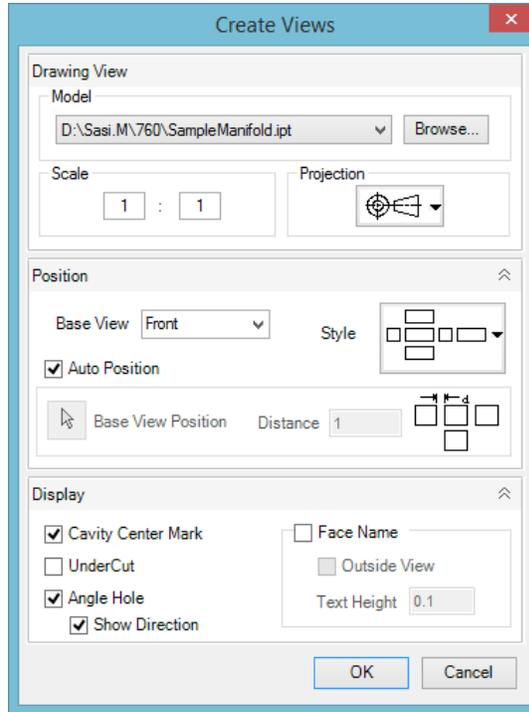
### 6 Auto Position

Select this option for MDTools® to position all the views automatically.  
Otherwise, manually select the base view position and distance between views.

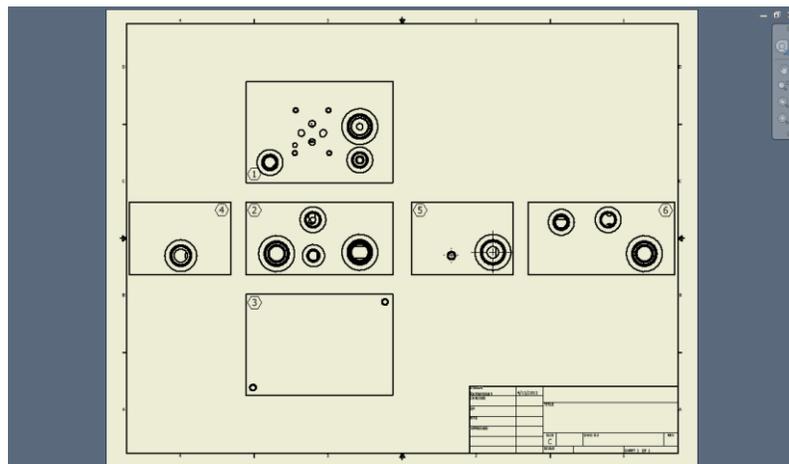
MDTools calculates the distance between the views based on the sheet and the block size.

### Display

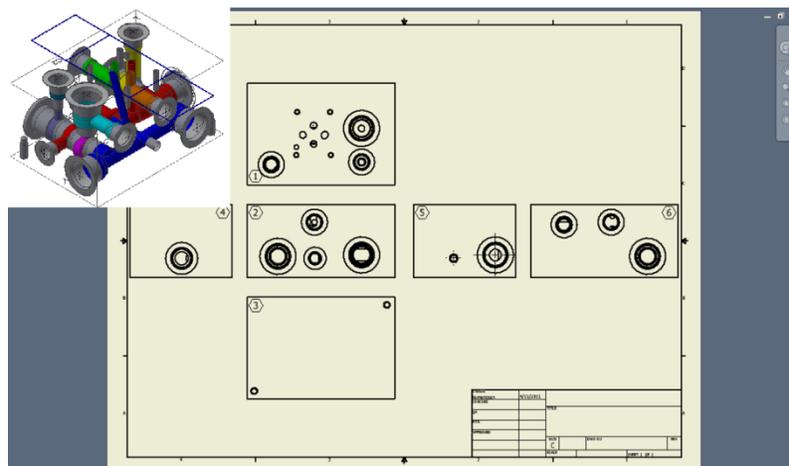
- 7 Select the **Cavity Center Mark** option.  
MDTools displays cavity center mark in drawing views.
- 8 Select the **Undercut** option.  
MDTools displays undercuts as circles in drawing views.
- 9 Select the **Angle Hole** option.  
Select the **Show Direction** Option.  
MDTools displays angle holes with direction in drawing views.
- 10 Select the **Face Name** option.  
Select the **Outside view** option.  
MDTools displays face name outside



Create Views dialog box



Six views of the manifold created automatically



*the view boundary.*

Enter the text height for the face  
name text

11 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.

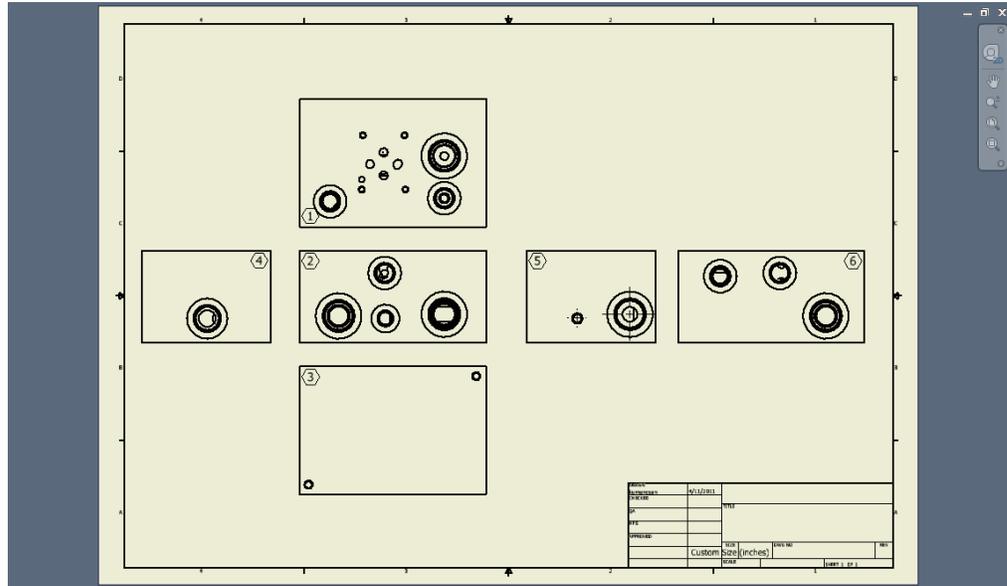
# 88. Show Internal Details

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 760 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 760: 2D Drawing Views

## Limitations: Show Internal Details

- After using the Show Internal Details command some of the MDTools 760 commands will not work properly for the processed sheet.

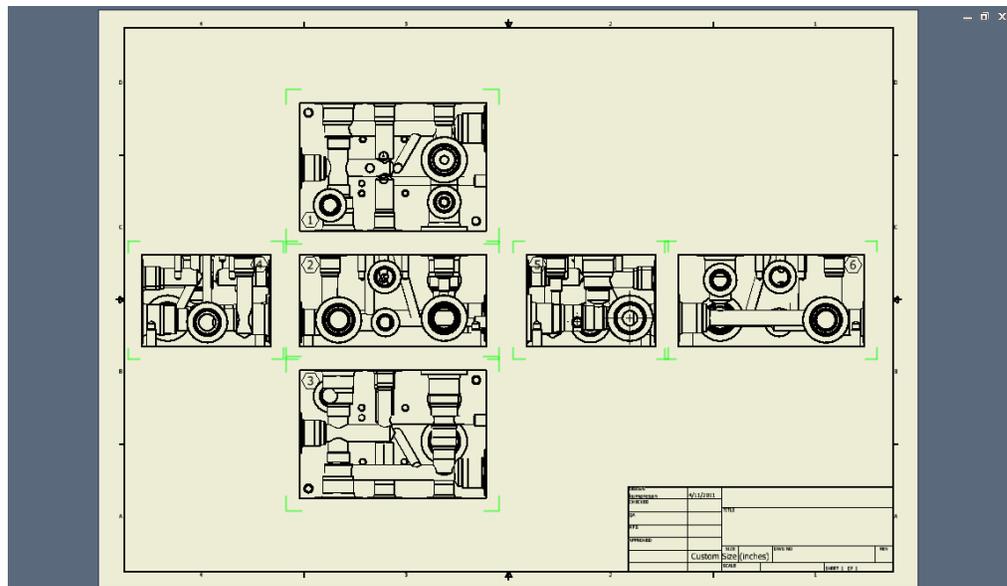
To avoid this, use the command after completion of the all machining drawing process.

- 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 will be created with the same name as the part document name suffixed with “\_Internal”.

Do not delete this file.



MDTools 760: 2D Drawing Views with Internal Details

## 89. Hide Internal Details

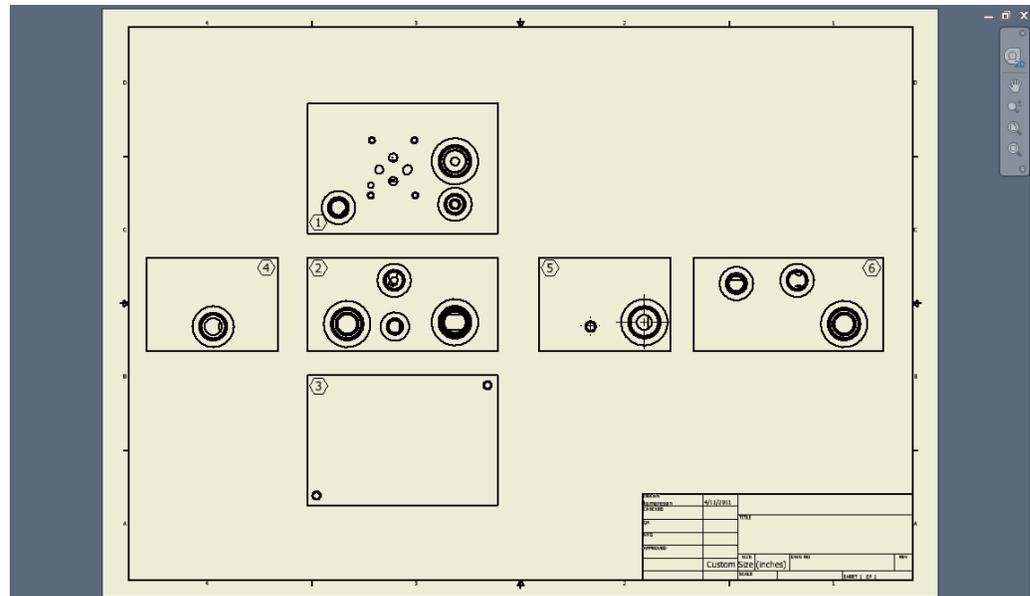
Hide the internal details in all the views of the 2D drawing in the active sheet.

MDTools 760 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® 760 command.



MDTools 760: 2D Drawing Views

# 90. Auto Dimension

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

- MDTools 760 ribbon  
>**Dimension** panel  
>**Auto dimension**  
*The Auto Dimension dialog box displays.*
- Sides available for dimensioning are displayed in black.
- Sides unavailable for dimensioning are displayed in gray.
- 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.

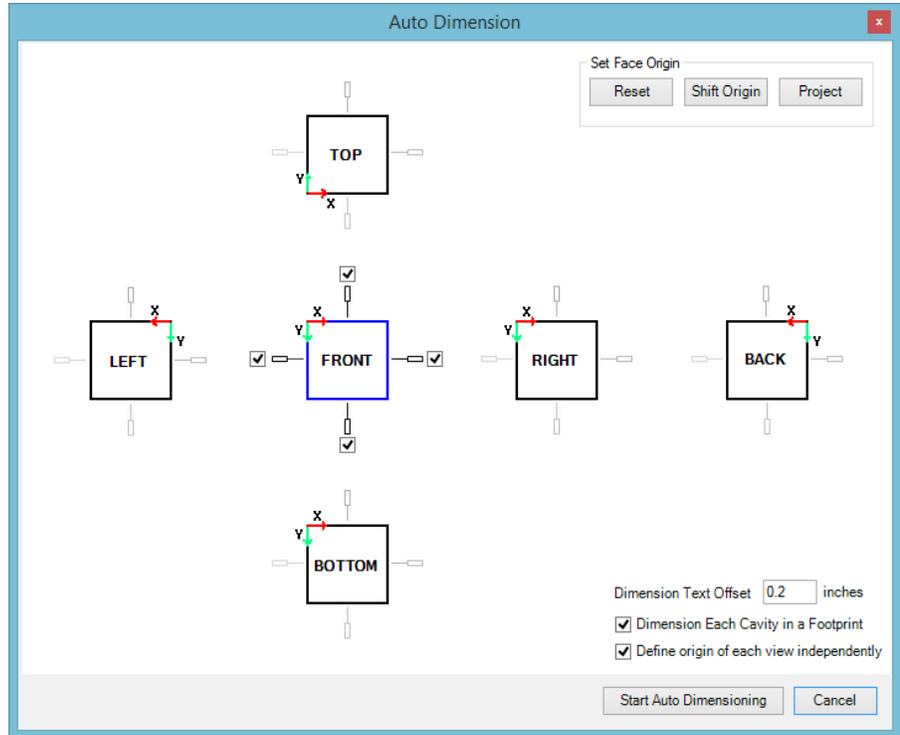
- Enter **Dimension Text Offset**, i.e., the distance between the dimension text and the block.
- Click Project to project current face origin to other face and update origin of other faces.
- Select **Dimension Each Cavity in a Footprint** to dimension all the cavities in footprints. Otherwise, only the cavity marked 'dimension from this cavity' is dimensioned.
- Select **Define origin of each view independently** to define each view origin independently.

If unselected, Shift option will shift current face origin and project other face origin according to current face origin.

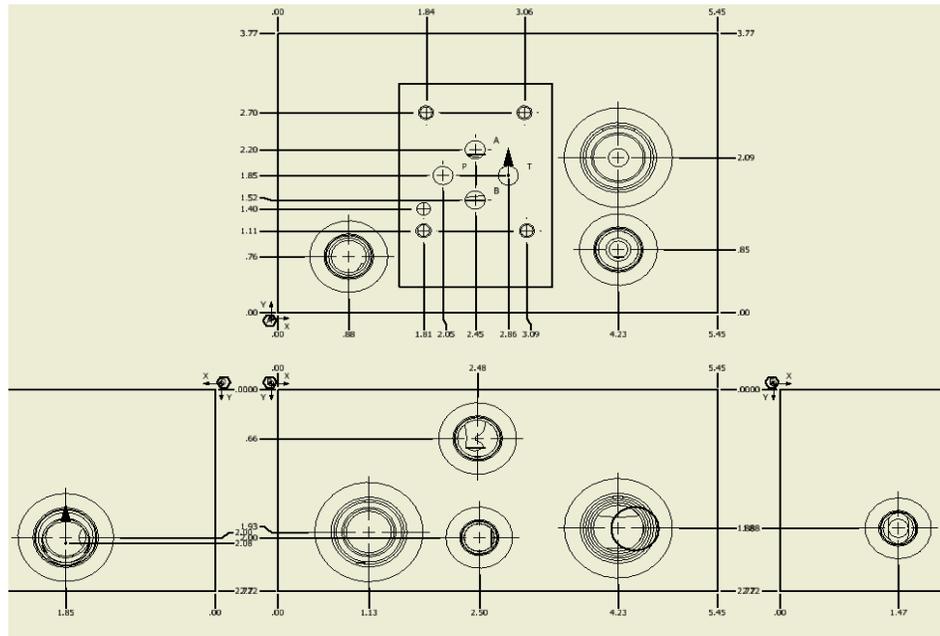
*The default option is Both sides.*

- 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 760 ribbon  
>**Display** panel  
>**Machining ID**  
*The Show Machining ID dialog box displays.*
- 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**.

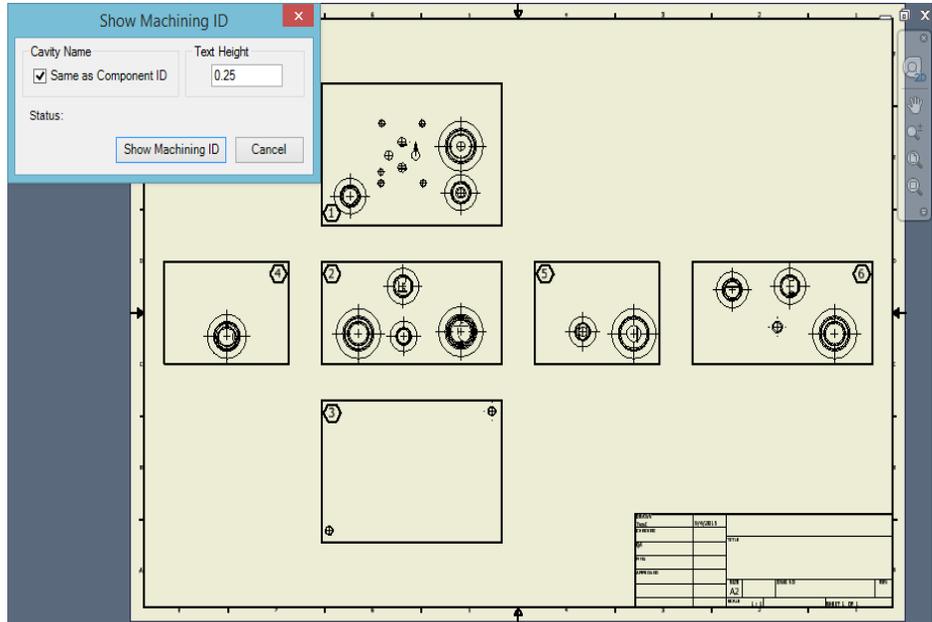
MDTools® displays the cavity machining ID near the outermost circle at 45 degrees from the center of each cavity. This enables no overlapping of cavities, other cavity machining ID and stamping text in that view.

In case of overlapping, Machining ID will rotate around the cavity circle.

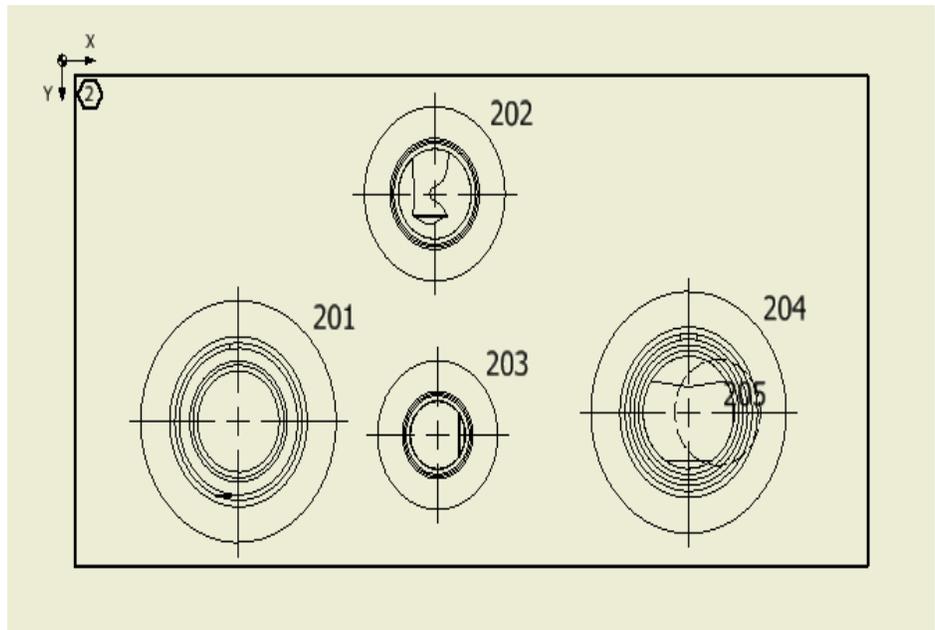
The cavity ID for all the cavities in a view is created inside a single sketch. All cavity IDs in a view move together when you drag the cavity ID text.

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.



Show Machining ID dialog box



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
- Undercut and slot machining ID are always located at 45 degree angle.
- Non rectangular block Machining ID may overlap with manifold edges.
- The Machining ID command will not work, if you do not use the view names, per naming conventions.
- Machining ID will not cross View border.

# 92. Show Component ID

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

- MDTools 760 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.

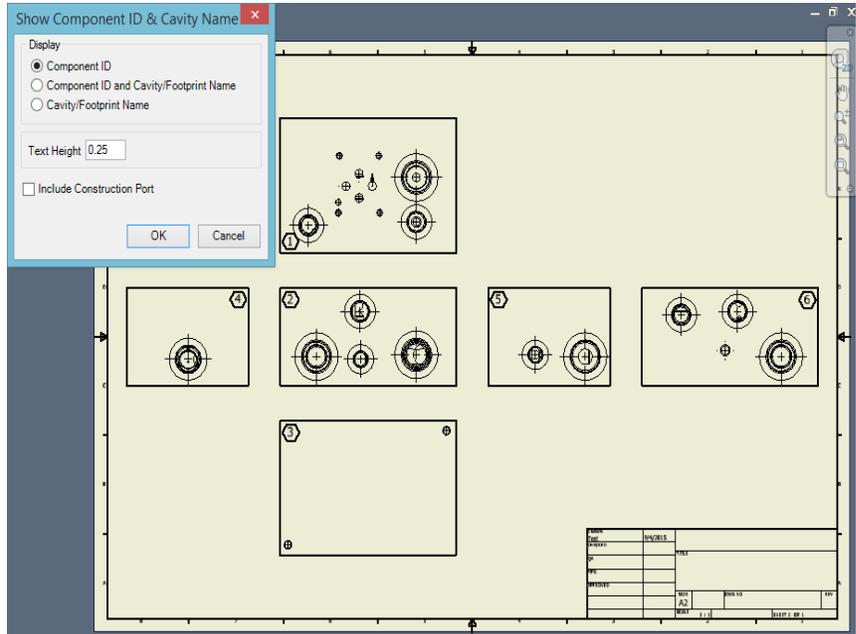
To move a single component ID, double click one of the IDs to open the sketch containing the component IDs.

Drag the cavity component ID to the desired location.

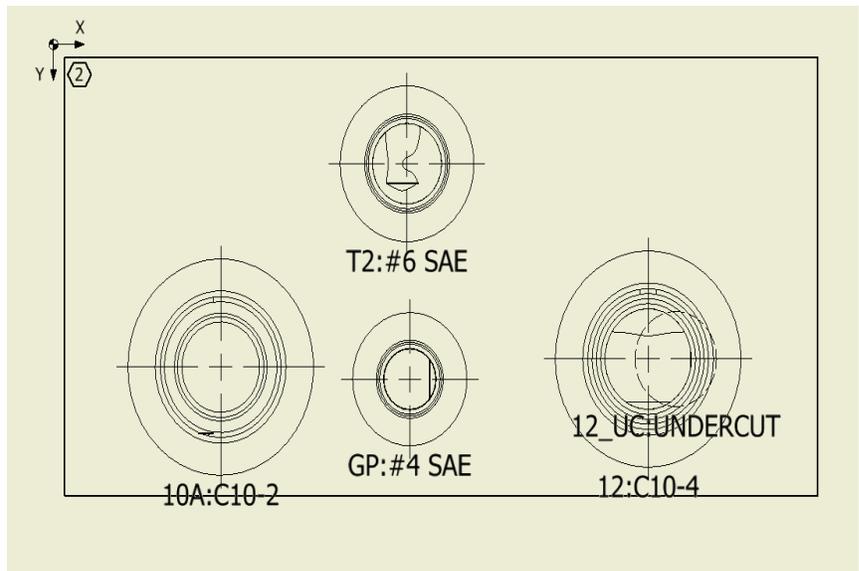
### Note

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

Top	A
Front	B
Bottom	C
Left	D
Right	E
Back	F
- The Component ID command will not work, if you do not use the view names, per naming conventions.



Show Component ID & Cavity Name dialog box



Component ID with cavity name in 2D drawing

# 93. Mark Construction Port

Automatically mark the construction ports on each view in 2D drawing views.

MDTools 760 ribbon  
>Display panel  
>Construction Port

MDTools® marks construction holes in each drawing view of the 2D drawing.

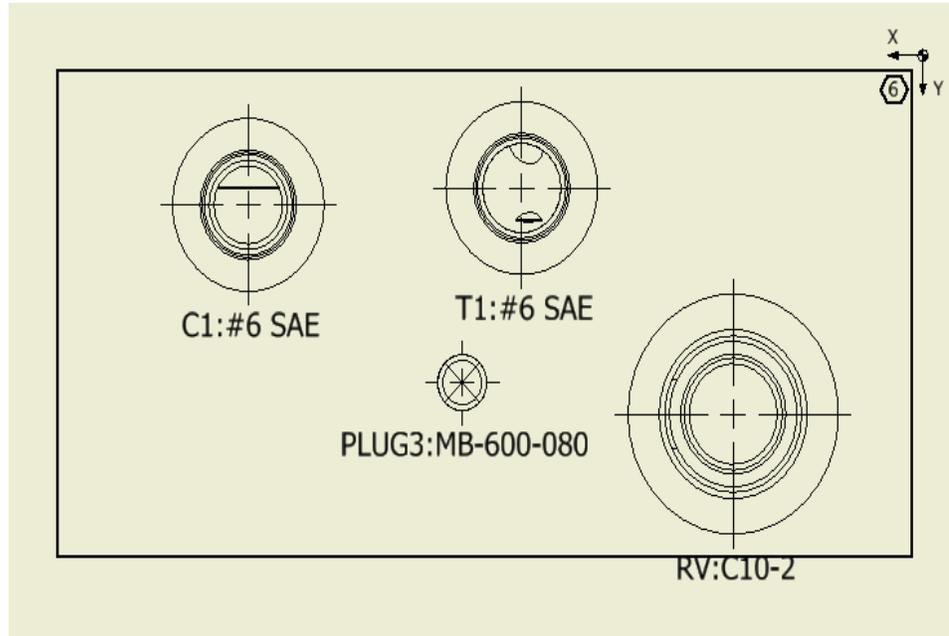
In "X" view, mark of the construction hole is created in a separate layer named "X-Drill".

### Note

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

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

- The 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 names for footprint cavities near the cavities and footprint envelopes in 2D drawing views.

MDTools 760 ribbon  
>Display panel  
>Footprint

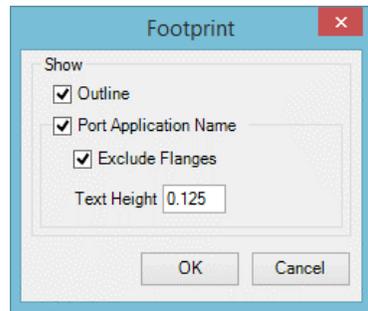
MDTools® displays the port name and draws the outline around the footprint.

Exclude **Port Application Name** for flanges, if required.

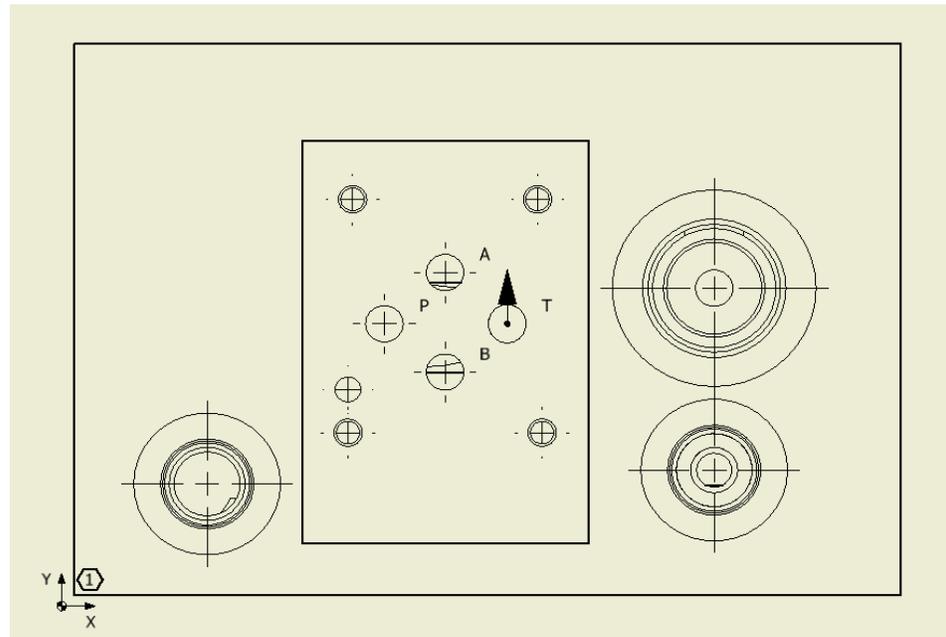
Enter **Text Height** for the Port Application name.

The port name and footprint outline is 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.



Footprint dialog box



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

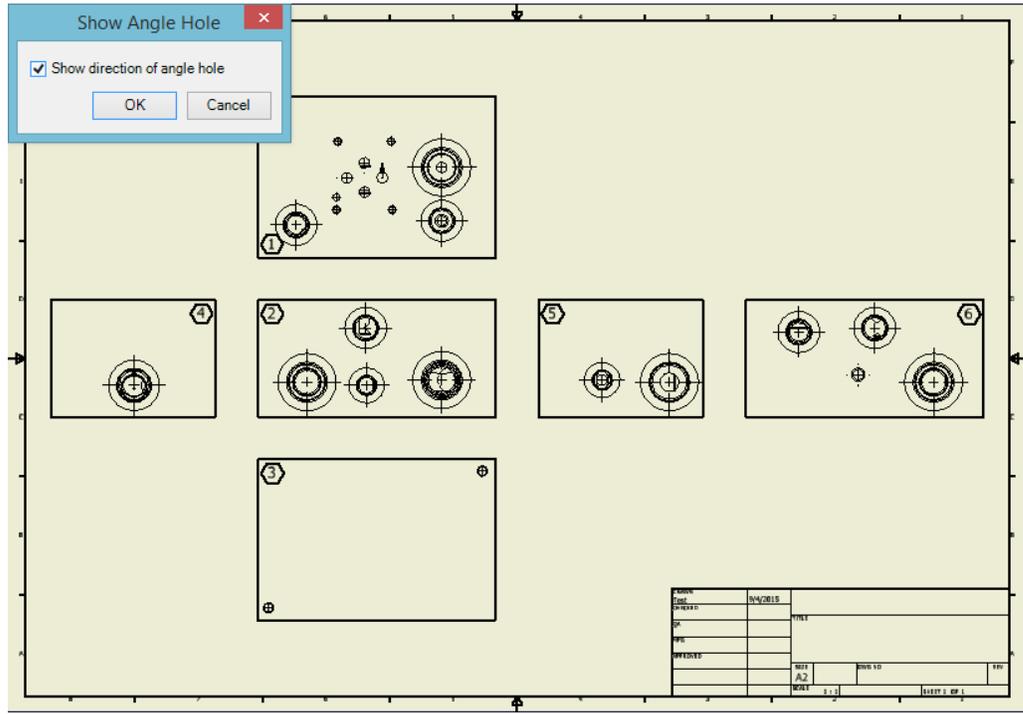
- The Footprint command will not work if you do not use the view names, per naming conventions.
- After you delete the footprint from the part model, the port name and footprint envelope will not be automatically deleted from the 2D drawing.
- The dash dot line type in Inventor is used to draw the footprint envelope.

# 95. Show Angle Hole

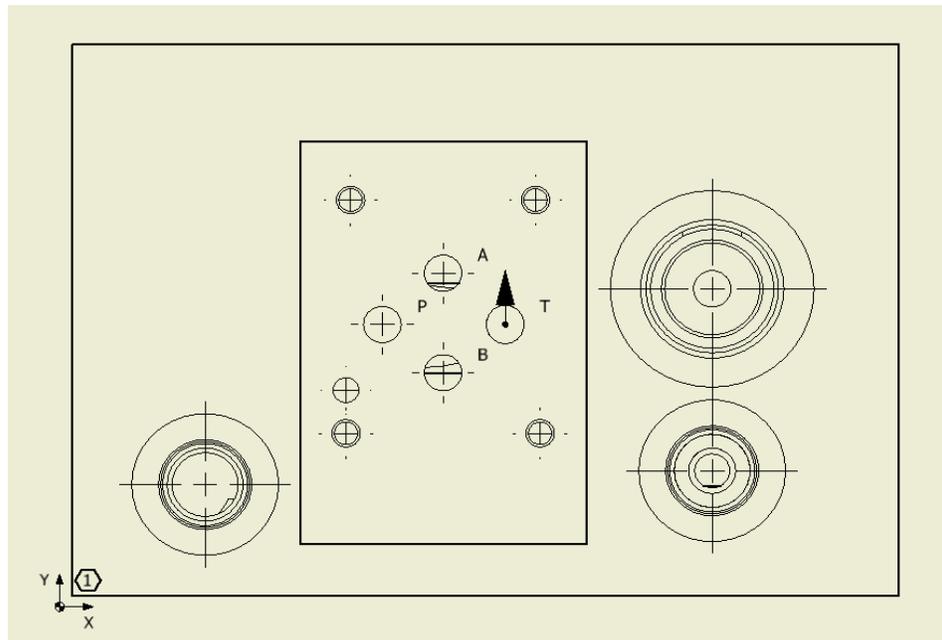
Automatically display the top view of the angle holes in the 2D drawing views.

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

1. MDTools 760 ribbon >Display panel >Angle Hole  
*The Show Angle Hole dialog box displays.*
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.*



Show Angle Hole dialog box



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 760 ribbon  
 >Display panel  
 >Origin & Axes

MDTools® displays the face origin & axes direction in each drawing view according to the drawing projection angle.

The face origin is marked by a half-filled circle and the axes direction is indicated by an arrow and X, Y, Z axes notation.

This is created inside a single sketch in a view.

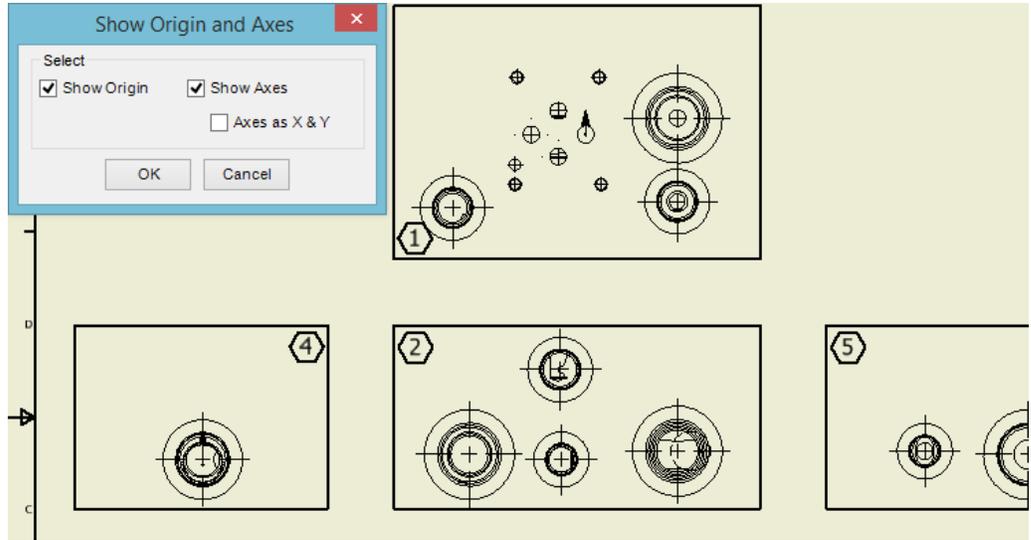
The face origin and axes direction in a view moves together when you drag the view position.

To move an origin & axes, drag the origin and axes to the desired location.

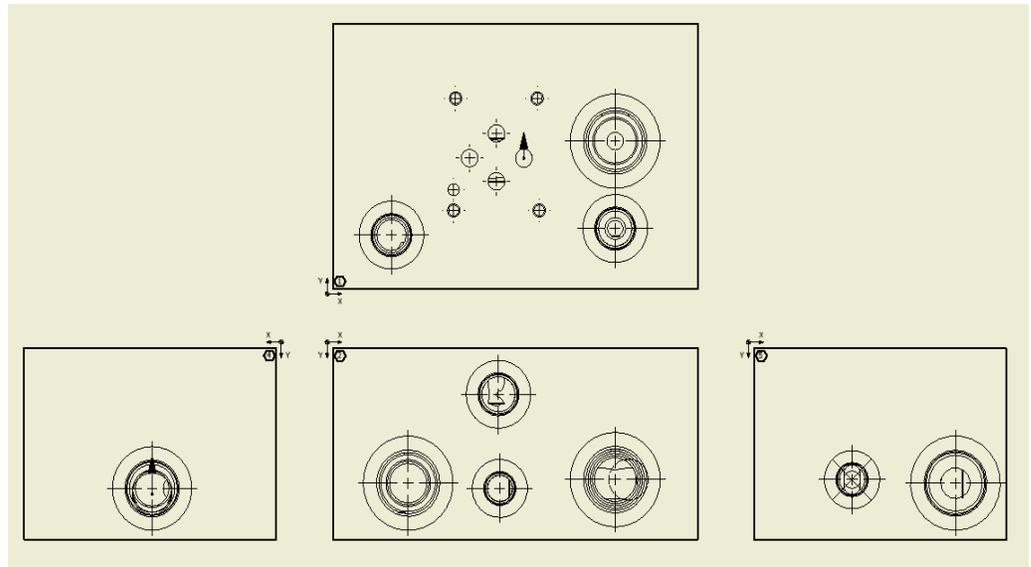
**Note**

- 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 760 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.

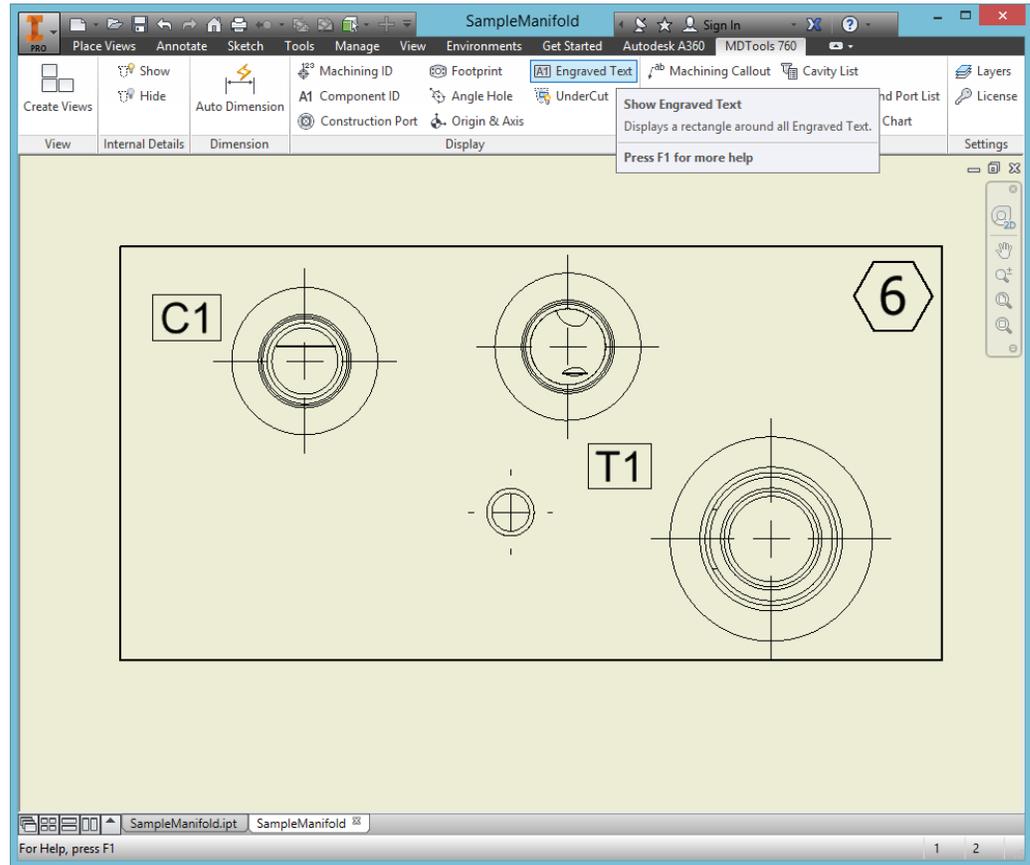
All the engravings and enclosed boxes in a view move together when you drag the view position.

Drag the engraving to the desired location.  
You cannot move the engraved text.

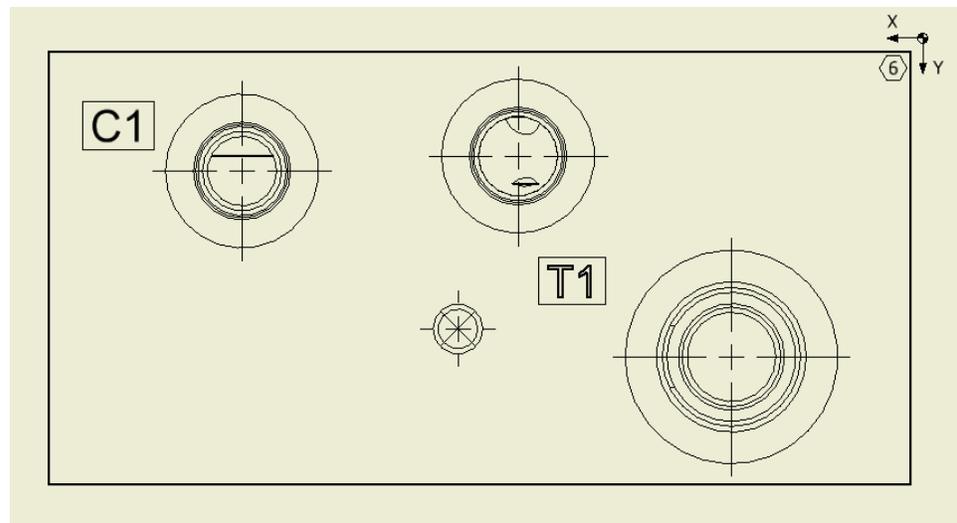
### Note

- 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.



Engravings displayed in the 2D drawing view



Engraved text with enclosed box displayed in the 2D drawing

# 98. Show UnderCut

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

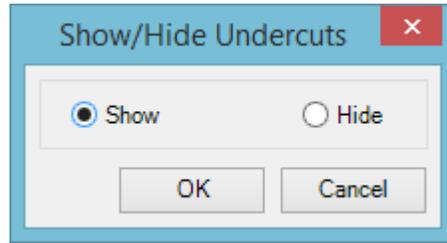
MDTools 760 ribbon  
>Display panel  
>UnderCut

### Show

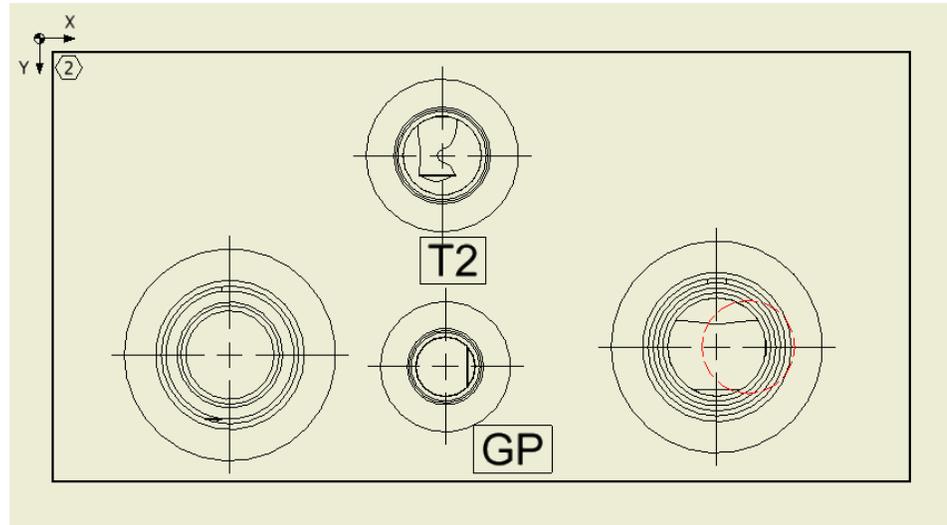
MDTools® displays the top view of undercuts as circles in the 2D drawing.

### Hide

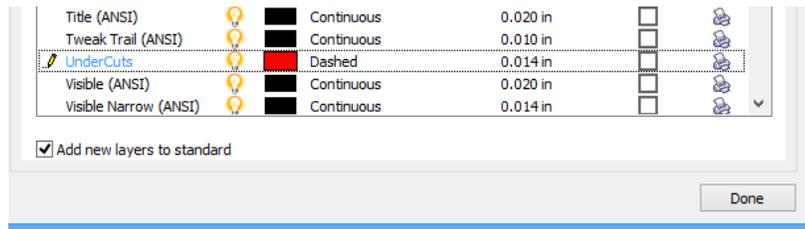
MDTools removes the top view of undercut circles in the 2D drawing.



Show/Hide Undercut Dialog box.



Undercut display in 2D Drawing views.



Undercut layer setting.

### Note

Undercuts will be placed on a separate layer.

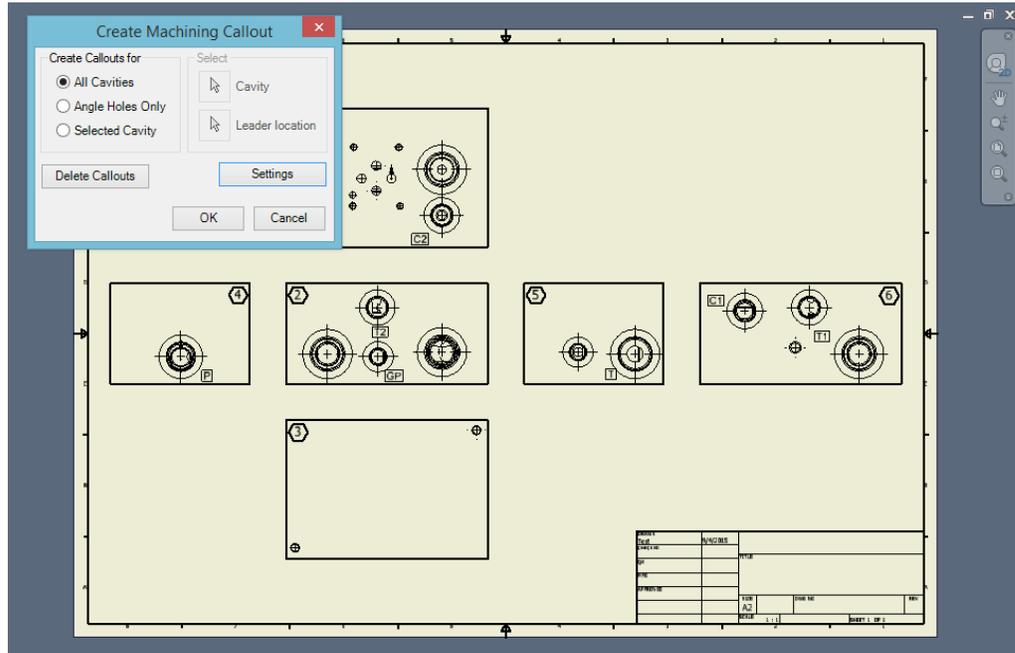
Change the layer using the MDTools layer command.

# 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 will be retained.

1. MDTools 760 ribbon >Create panel >Machining Callout  
The Create Machining Callout dialog box displays.
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.



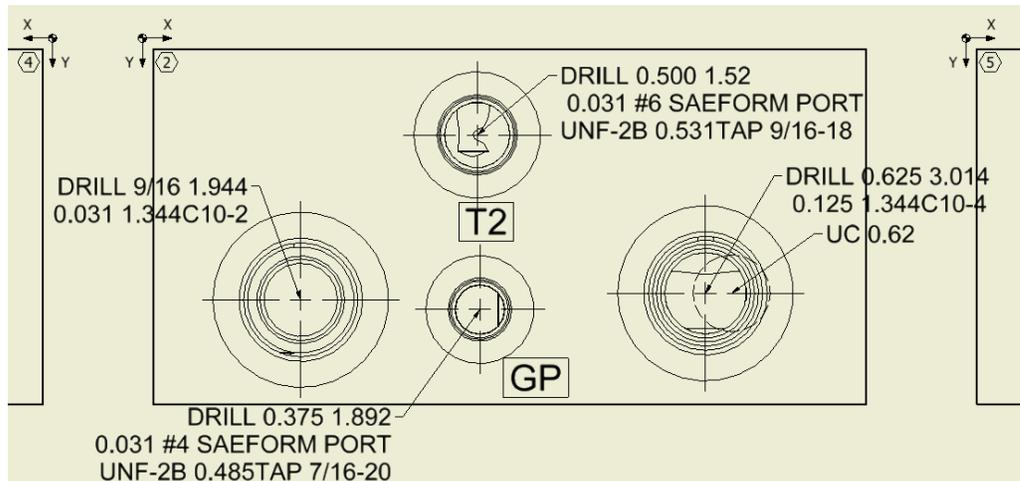
Create Machining Callout dialog box

### All Cavities

To create the machining callout for all cavities,

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 Only

To create the machining callout for just the angle holes in the block, use the **Angle Holes Only** option.

### **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 particular 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.

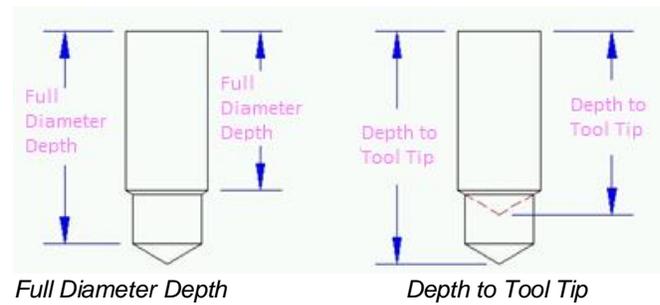
## Changing the Column Name (Heading)

### 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. You can have 1 to 5 decimal place accuracy for the depth and diameter.

### 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, /&lt;

### 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. MDTTools 760 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 for All Cavities

To create balloons for all cavities, select the **Create For, All Cavities** option.

MDTools® inserts balloons on all the cavities with machining ID. The leader is placed at an angle of 45 degree 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.

## Move a Balloon

To move a balloon, drag the balloon to the desired location.

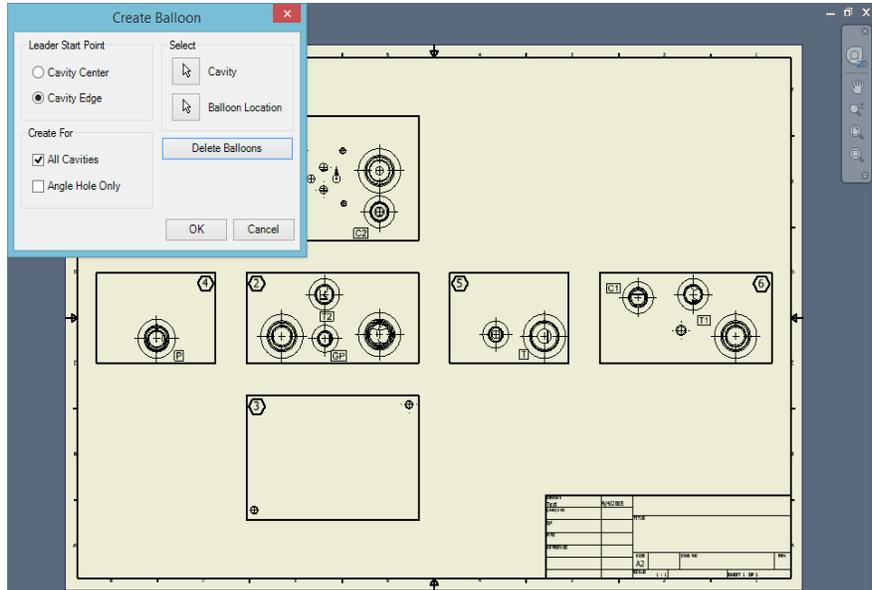
The text automatically moves with the balloon.

## Delete Balloons

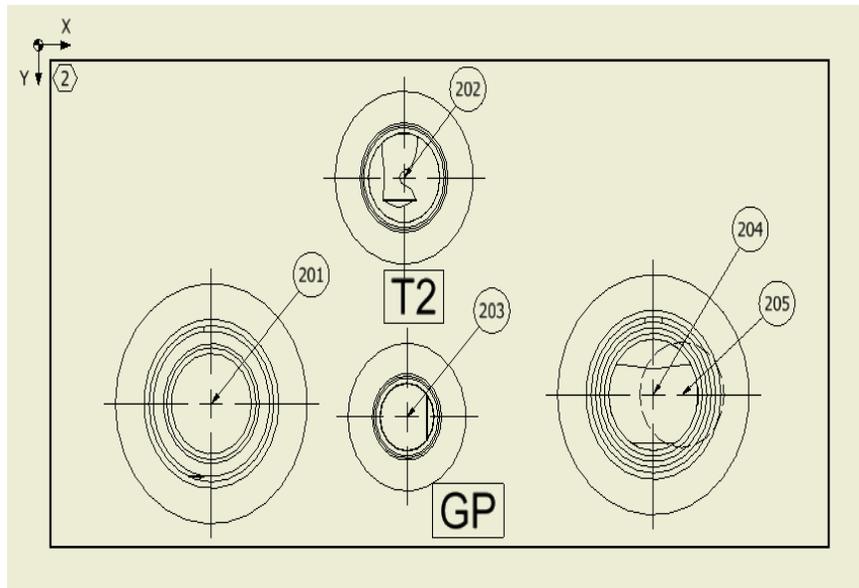
To delete all balloons, click **Delete Balloons**.

## 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.



Create Balloon dialog



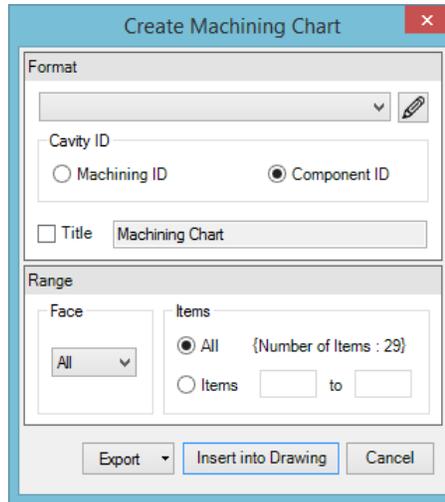
Balloons displayed for the selected cavity

# 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 760 ribbon  
>**Create** panel  
>**Machining Chart**  
*The Loading Cavities List message box displays and is followed by the Create Machining Chart dialog box.*



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.

Machining Chart					
Name	Operation	Diameter	Depth	Face	Meet List : Cavity
201	DRILL	0.375	1.892	B	401, 501
	FORM PORT	#4 SAE	0.031		
	TAP	7/16-20	0.485		
202	DRILL	0.500	1.520	B	107
	FORM PORT	#6 SAE	0.031		
	TAP	9/16-18	0.531		
203	DRILL	9/16	1.944	B	109, 401, 402, 604
	C10-2	1.344	0.031		
204	uc	0.6	2.000	B	
205	DRILL	0.625	3.014	B	103, 105, 501, 503
	C10-4	1.344	0.125		

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 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 Machining Operation information.

## Edit Machining Chart dialog box

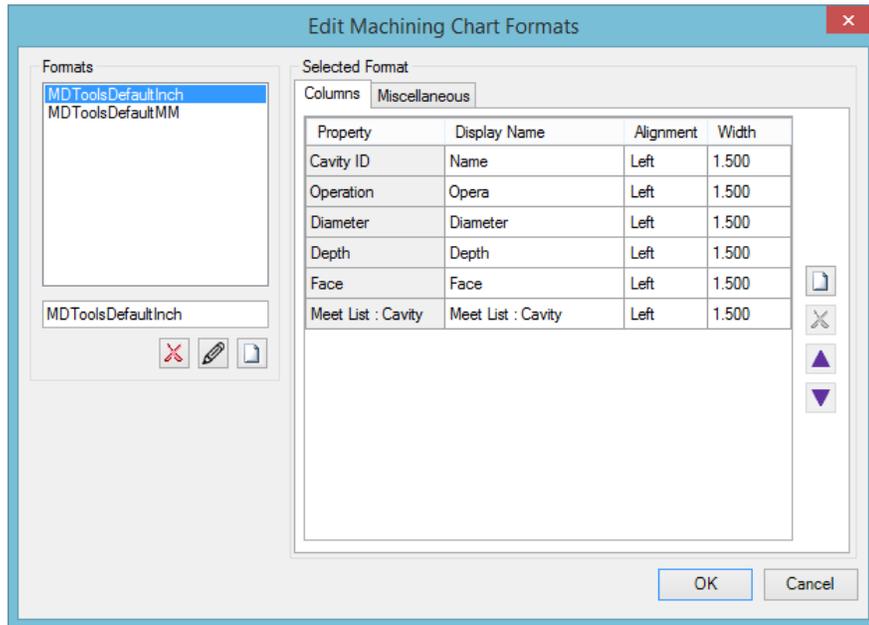
The Edit Machining Chart dialog box has options to enable output of the machining chart, per the user requirements.

1. Select a format from the **Formats** section.

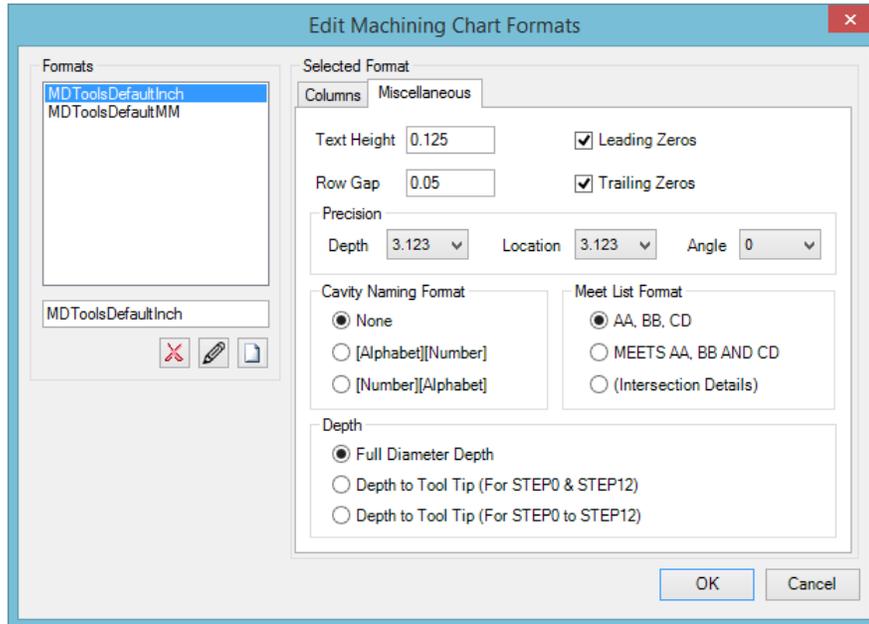
*Columns of selected formats are displayed in the Columns tab page.*

*Other settings of the machining chart will be 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.



*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 will be 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 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 made.

## Column Width

Specify the column width of machining chart.

### Location Precision

List the cavity center coordinates (X and Y) and set the precision of these 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.

## Leading Zeros

Add leading Zeros to numeric values.

## Trailing Zeros

Add trailing Zeros to numeric values.

## Precision

**Depth:** Select the number of decimal places for the Depth and Diameter entries in the bore chart.

You can have an accuracy of 1 to 4 decimal places for Depth and Diameter.

**Angle:** Set the precision of cavity Alpha angle and Beta angle values.

## Location:

List the cavity center coordinates (X and Y) and set the precision of these values.

**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 selected **intersection details** in the Meet list section then only select columns dialog box contains all the Meet lists columns.
- If you want to 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 used, Refer to Cavity Naming Format given below for details.
- MDTools totals the quantity in a machining chart only if the cavity geometry dimensions of identically named cavities are the same, else, the cavities will be 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 (,).

Machining Chart					
Cavity ID	Face	Operation	Diameter	Depth	Meet List : Cavity
104	1	DRILL	.25	2.279	401, 402
105	1	DRILL	1/4	.783	202
106	1	DRILL	1/4	.836	602
107	1	DRILL	1/4	1.819	603
108	1	TAP DRILL	.234	2.071	204

Meet List option AA, BB, CD

**Meets AA, BB and CD**

MDTools lists the meeting cavities in the Meet List for a cavity.

Machining Chart					
Cavity ID	Face	Operation	Diameter	Depth	Meet List : Cavity
104	1	DRILL	.25	2.279	MEETS 401 AND 402
105	1	DRILL	1/4	.783	MEETS 202
106	1	DRILL	1/4	.836	MEETS 602
107	1	DRILL	1/4	1.819	MEETS 603
108	1	TAP DRILL	.234	2.071	MEETS 204

Meet List option Meets AA, BB, CD

For clarity, it prefixes the list with the word, MEETS.

**(Intersection Details)**

MDTools® lists the meeting cavities in the Meet List for a cavity with Intersection details.

Machining Chart								
Cavity ID	Operation	Meet List	Meet List : Start D	Meet List : End DI	Meet List : Start	Meet List : End D	Meet List : Edge	Meet List : Center
401	DRILL	402	0.682	0.594	0.612	1.975	0.000	0.000
	FORM PORT	601	0.5	9/16	0.850	1.412	0.075	-0.206
	TAP	201	0.5	9/16	0.850	1.412	0.075	-0.206
	O-RING GROOVE	104	0.5	0.25	1.925	2.175	0.000	0.000
402	DRILL	203	0.5	0.375	2.312	2.688	0.000	0.000
		401	0.594	0.682	0.598	1.989	0.000	0.000
		201	0.594	9/16	0.856	1.418	0.092	-0.189
		601	0.594	9/16	0.856	1.418	0.092	-0.189
501		104	0.594	0.25	1.912	0.000	0.000	0.000
	DRILL	204	0.25	0.751	0.850	1.600	0.000	0.000
	FORM PORT	203	0.25	0.375	2.762	3.138	0.125	-0.062
	TAP							

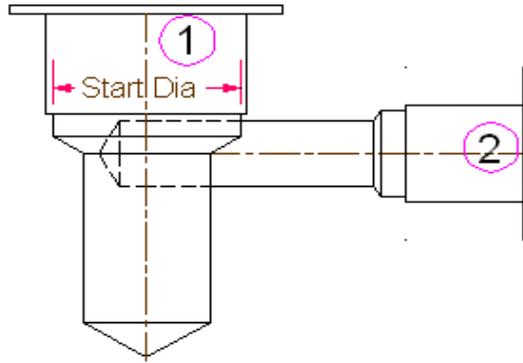
You can add meet list columns by clicking Add options in Columns page.

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.

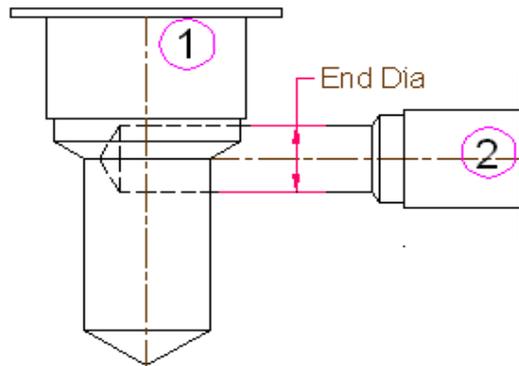
Larger step diameter of the first cavity in the intersecting area is considered the **Start Dia**.



### End Dia

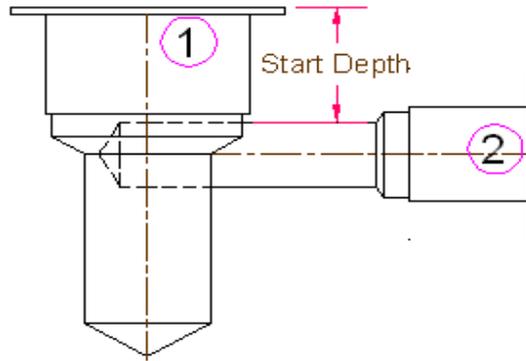
The End Dia in the Machining Chart defines the Step diameter of the second cavity at the meet point of the first cavity.

Larger step diameter of the second cavity in the intersecting area is considered the **End Dia**.



### Start Depth

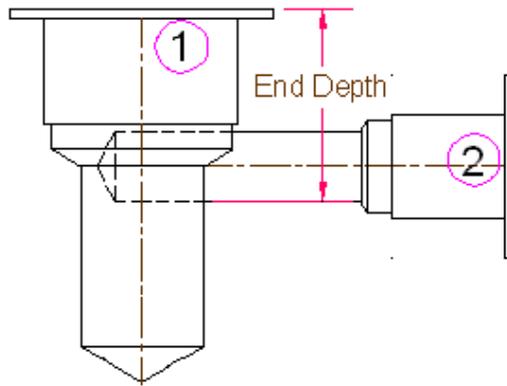
Start Depth is the distance from the spot face of the first cavity to the nearest connecting edge of the second cavity.



### End Depth

End Depth is the distance from the spot face of the first cavity to the end connecting edge of the second cavity.

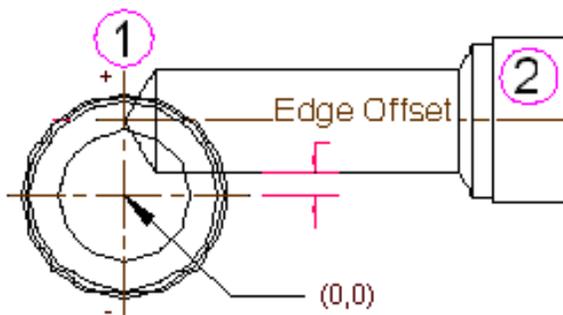
If the first cavity terminates before the second cavity center axis, then the End Depth is considered the null value.



### Edge Offset

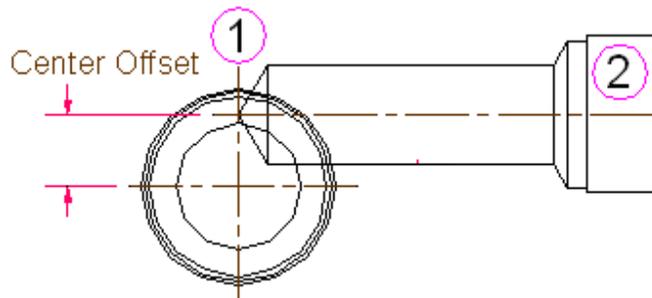
The Edge Offset is the distance between the center of the first connecting cavity to the nearest connecting edge of the second connecting cavity.

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.

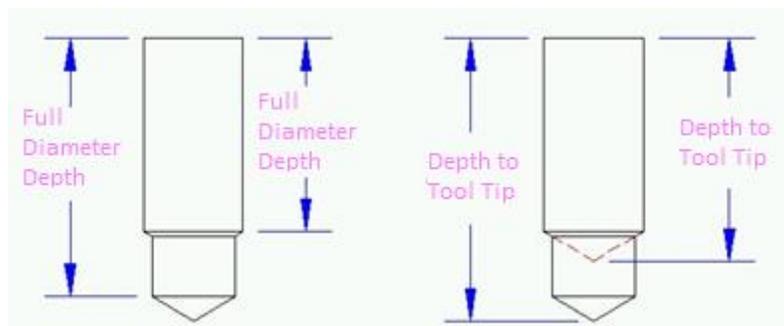


### Depth

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.



Full Diameter Depth

Depth to Tool Tip

### **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 dropdown 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 **Export** button to export Machining Chart format.

1. Click Export Split 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*

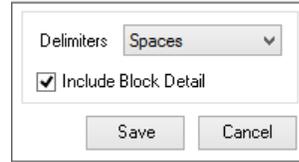
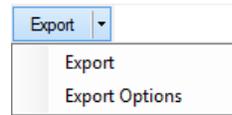
Tab Delimited

*...separated by tabs*

Comma (,) Delimited

*...separated by commas*

- Include block details, such as Block dimensions or Block material, when exporting the machining chart into a text file.
2. Click **Save** to save the options.

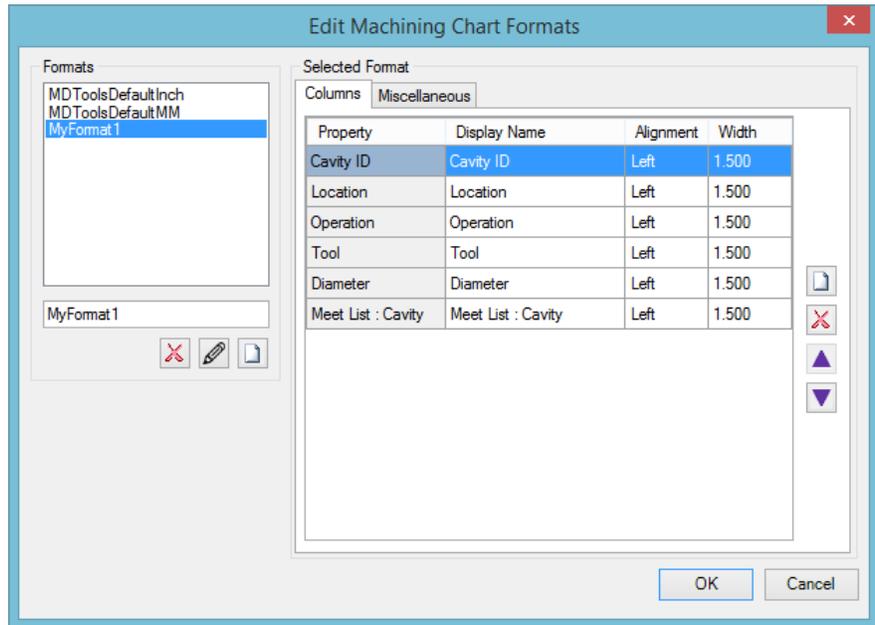


## Saving Machining Chart Formats

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, Saving a Machining Chart format, and save it with the name, **MyFormat1**.

## Using Saved Formats

1. Click the **Formats** dropdown option.

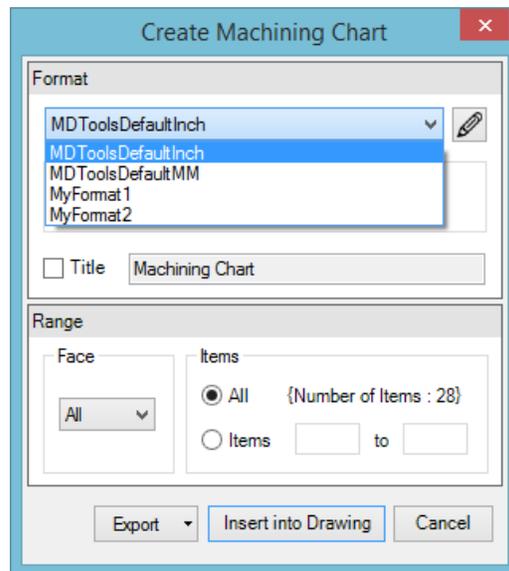
*The existing formats are displayed.*

2. Select the desired format.

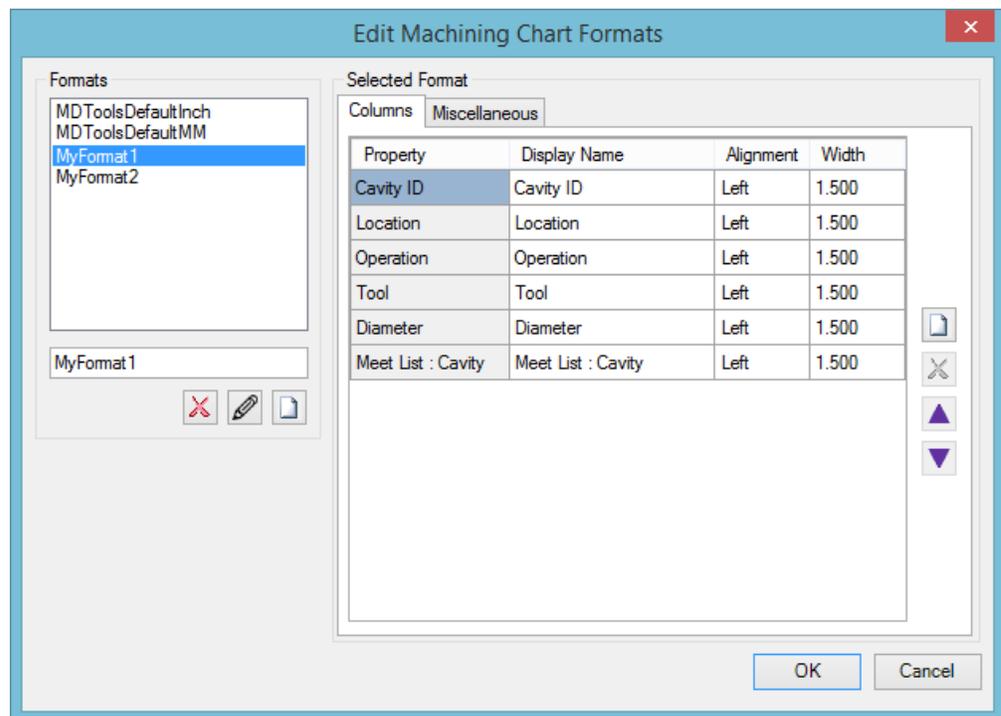
3. Click , the Edit option.

*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 760 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.
- 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.
- Click **Insert into Drawing** in the Create Cavity List dialog box.

*MDTools® insert cavity list table into 2D drawing views.*

### 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 will be used when creating the text file.*

*The Select Top Left Corner message displays.*

- 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 Cavity list.

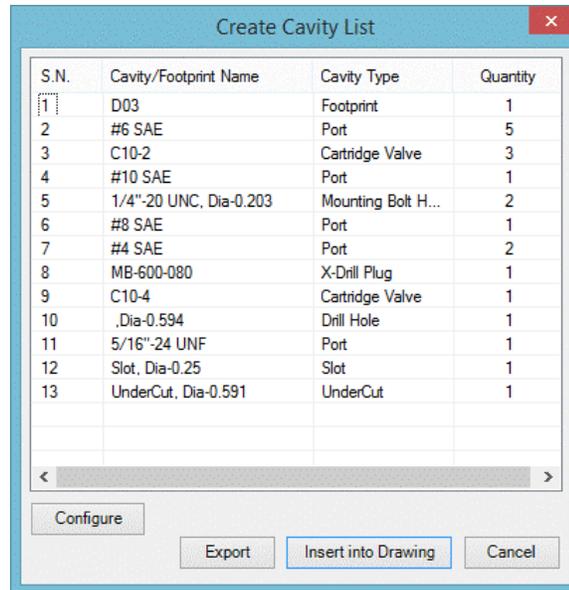
*MDTools® creates the cavity table in the selected window.*

*If the selected window is insufficient in size to create the complete cavity table, the Select Top Left Corner message displays.*

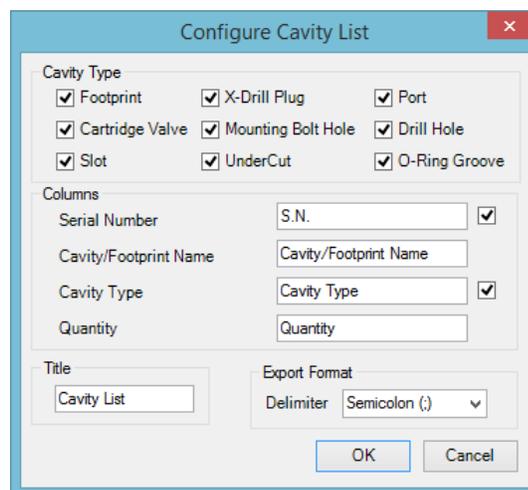
- Repeat the above steps, till the complete cavity table is created in the drawing.

### Note

*The active text style in Inventor is used to create the cavity table.*



Create Cavity List dialog box



Configure Cavity List dialog box

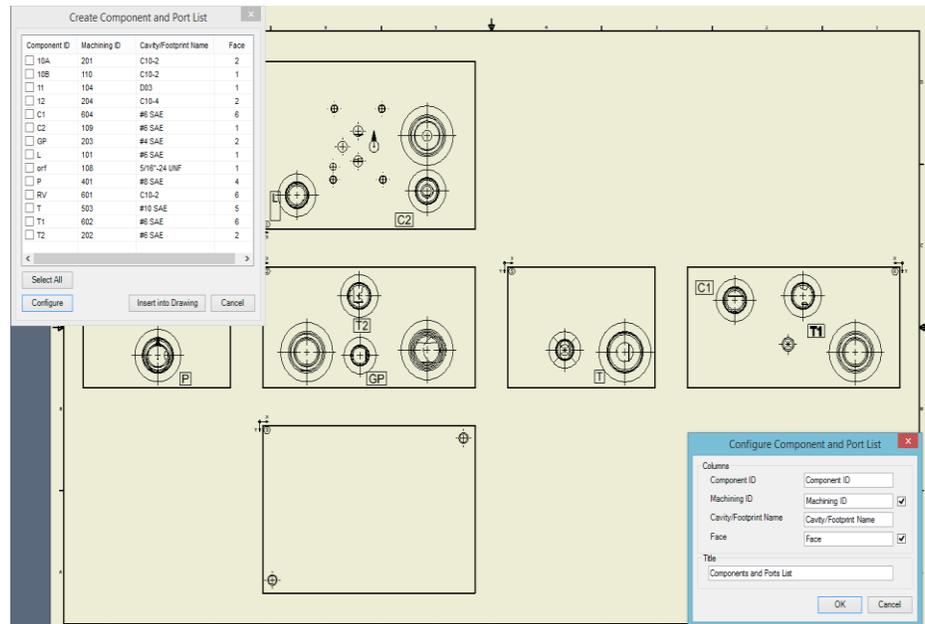
S.N.	Cavity/Footprint Name	Cavity Type	Quantity
1	D03	Footprint	1
2	#6 SAE	Port	5
3	C10-2	Cartridge Valve	3
4	#10 SAE	Port	1
5	1/4"-20 UNC, Dia-0.203	Mounting Bolt Hole	2
6	#8 SAE	Port	1
7	#4 SAE	Port	2
8	MB-600-080	X-Drill Plug	1
9	C10-4	Cartridge Valve	1
10	,Dia-0.594	Drill Hole	1
11	5/16"-24 UNF	Port	1
12	Slot, Dia-0.25	Slot	1
13	UnderCut, Dia-0.591	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 760 ribbon  
>**Create** panel  
>**Components and Ports List**  
**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.
- 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.



Create Component and Port List dialog box

Components and Ports List			
Component ID	Machining ID	Cavity/Footprint Name	Face
10A	201	C10-2	2
10B	110	C10-2	1
11	104	D03	1
12	204	C10-4	2
C1	604	#6 SAE	6
C2	109	#6 SAE	1
GP	203	#4 SAE	2
L	101	#6 SAE	1
orf	108	5/16"-24 UNF	1
P	401	#8 SAE	4
RV	601	C10-2	6
T	503	#10 SAE	5
T1	602	#6 SAE	6
T2	202	#6 SAE	2

Component and Port table inserted into a 2D drawing

### Note

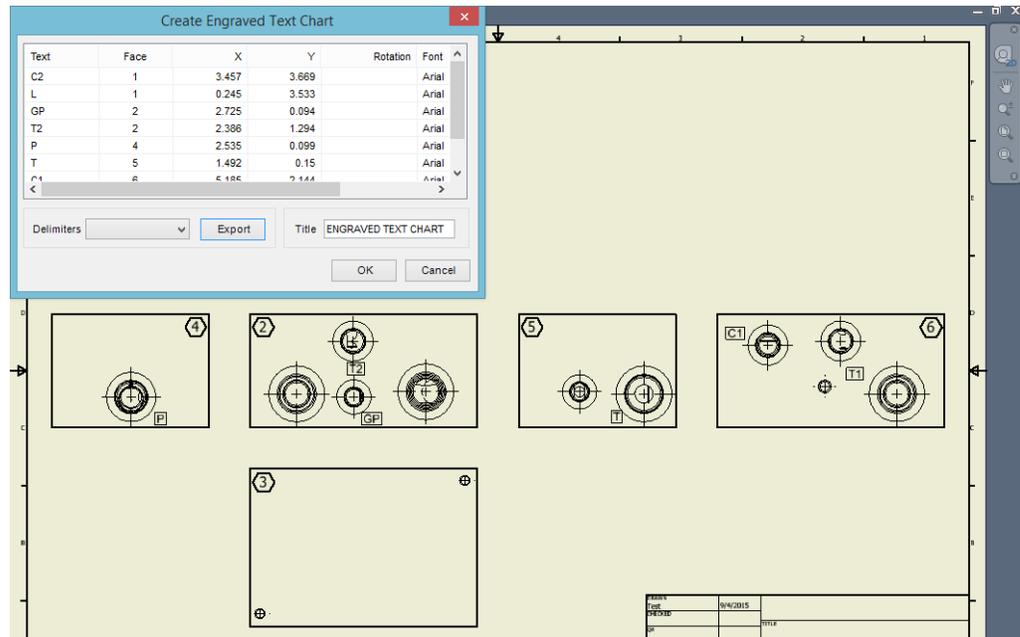
The active text style in Inventor is used to create the Components and Ports List.

# 104. Create Engraved Text Chart

Insert an engraving text chart consisting of the texts, face, X and Y co-ordinates of the location of the texts rotation, font, and text size in the 2D drawing.

- MDTools 760 ribbon  
>Create panel  
>Engraved Text Chart

The Create Engraved Text Chart dialog box displays.



Create Engraved Text Chart dialog box

- Change the table title, if required.
  - 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	1	3.457	0.101		Arial	0.2
L	1	0.245	0.237		Arial	0.2
GP	2	2.725	2.626		Arial	0.2
T2	2	2.386	1.426		Arial	0.2
P	4	1.235	2.621		Arial	0.2
T	5	2.278	2.57		Arial	0.2
C1	6	5.185	0.576		Arial	0.2
T1	6	2.3	1.548		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 760 ribbon >Settings panel >Layers

The Drawing Layers dialog box displays.

Various MDTools objects 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.

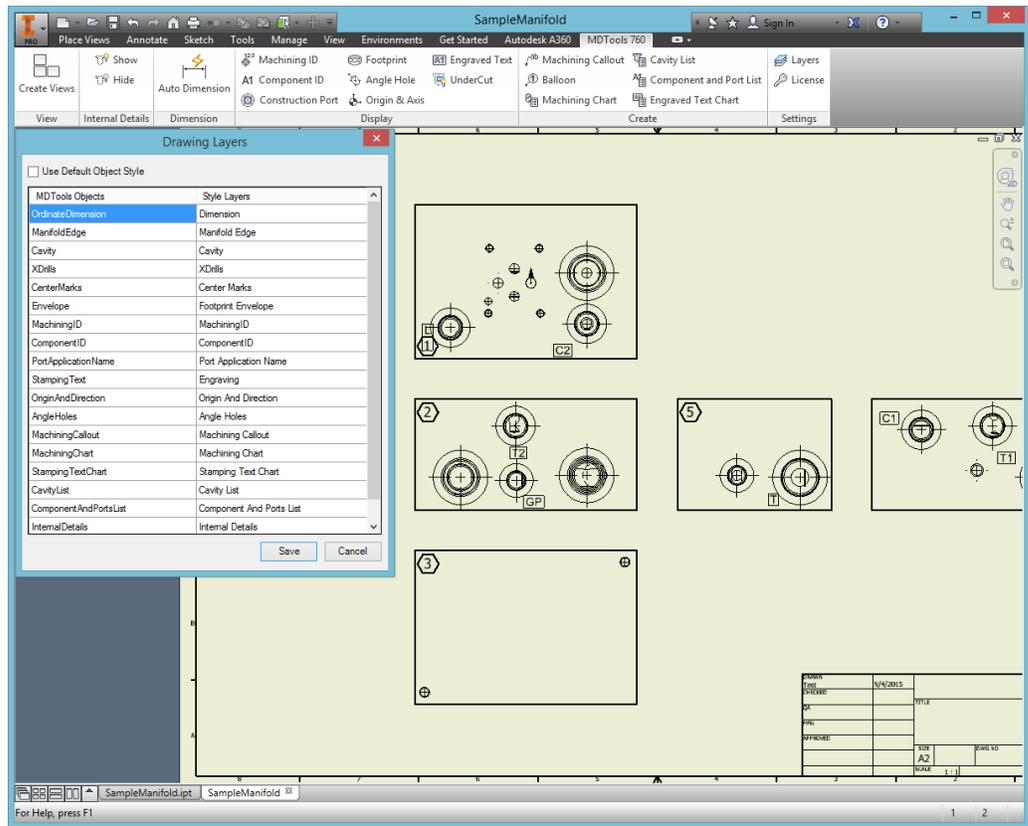
For example, Click Show Machining ID.

MDTools displays the cavity machining ID with the type, size, color etc. according to the layer, which is set for the Machining ID text.

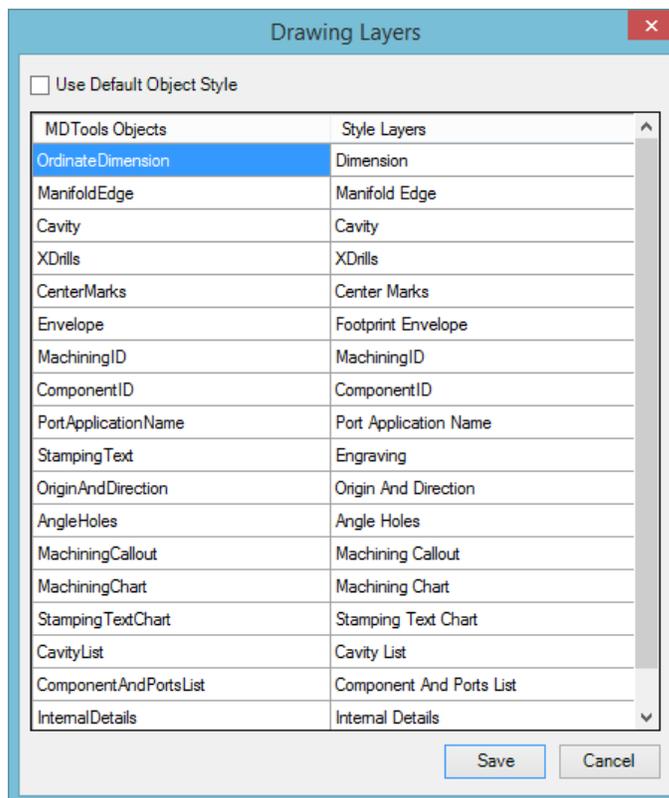
Modifying a layer characteristics or showing/hiding them would reflect on the MDTools objects using that layer.

## 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.



Setting Drawing Layers



Drawing Layers dialog box

## 106. MDTools License option

Set the MDTools® license path through the MDTools 2D Drawing ribbon.

1. MDTools 760 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 760 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.*

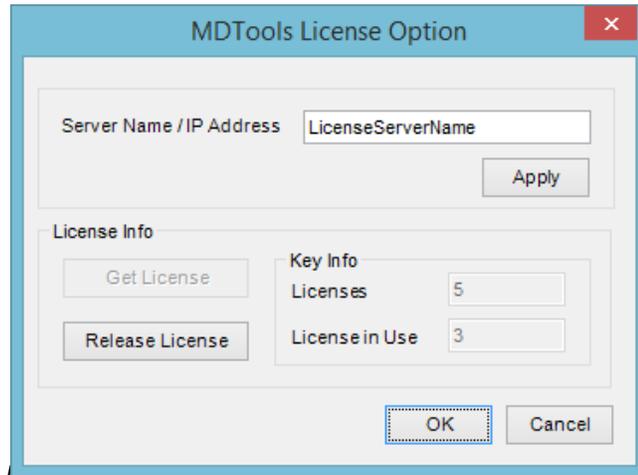
4. To release a license, click the **Release License** button.

*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.*

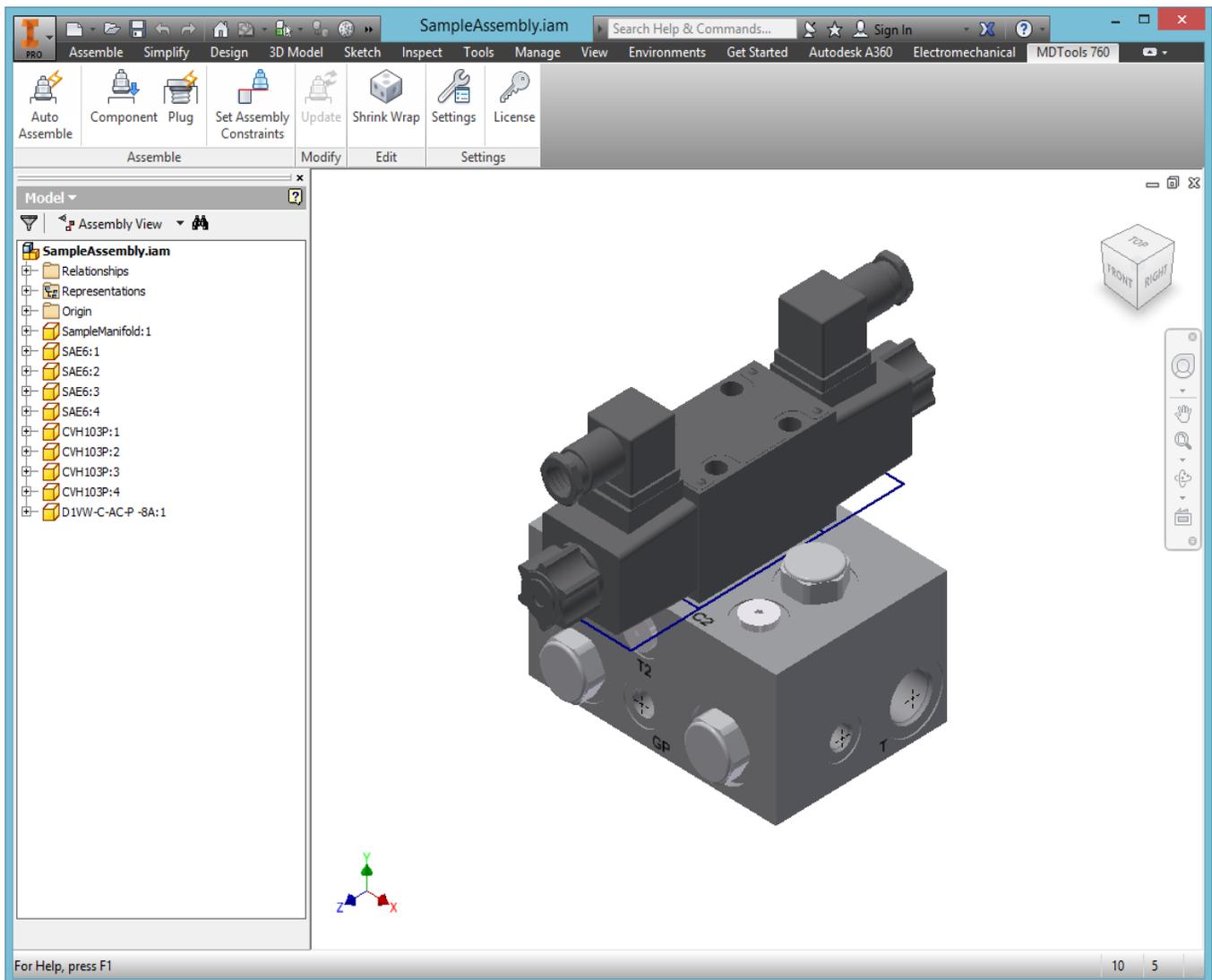
6. Click **OK** to continue.



MDTools License Option dialog box

# ASSEMBLY COMMANDS

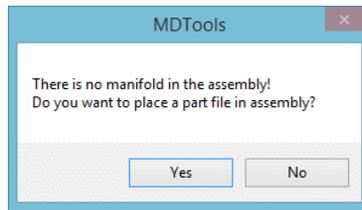
- 107 Auto Assemble
- 108 Assemble Component
- 109 Assemble Plugs
- 110 Set Assembly Constraints
- 111 Update Assembly
- 112 Shrink Wrap
- 113 MDTools Assembly Settings
- 114 MDTools License option



# 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.



Assembly Drawing

2. MDTools 760 ribbon >Assemble panel >Auto Assemble

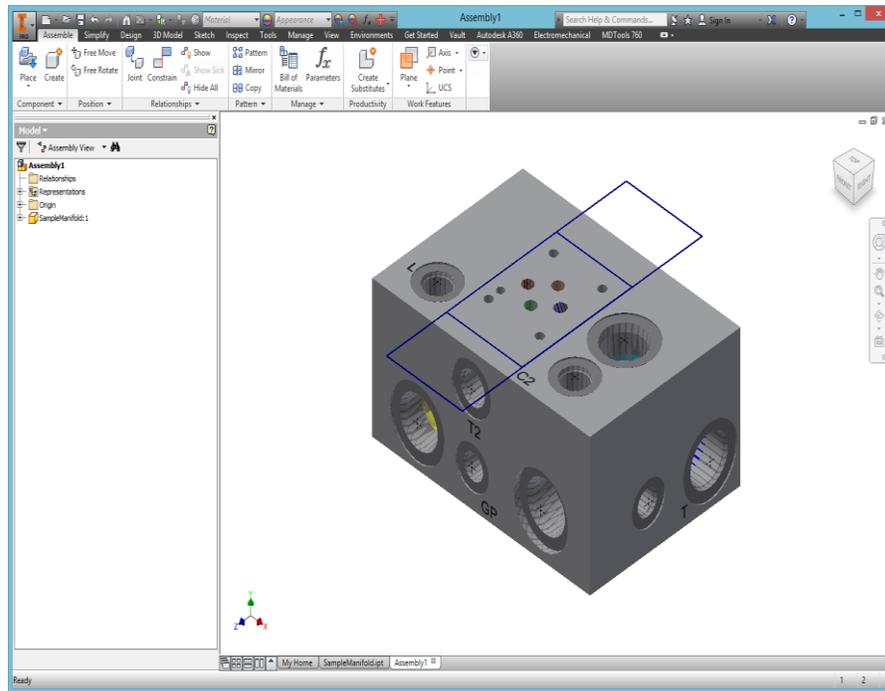
The component Models assigned in HyDraw Schematic are automatically assembled to the manifold.

### 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.

3. Click **Yes**.

The Place Component dialog box displays.



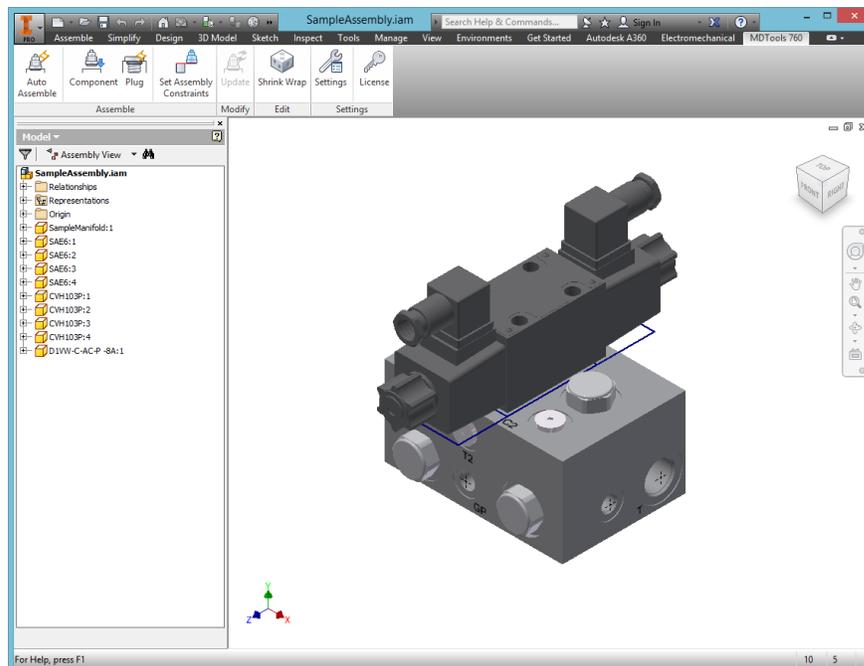
Manifold inserted to the Assembly Interface

4. 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.



Component Models 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 760 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**.  
The Place Component dialog box displays.
4. Select a component.  
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.

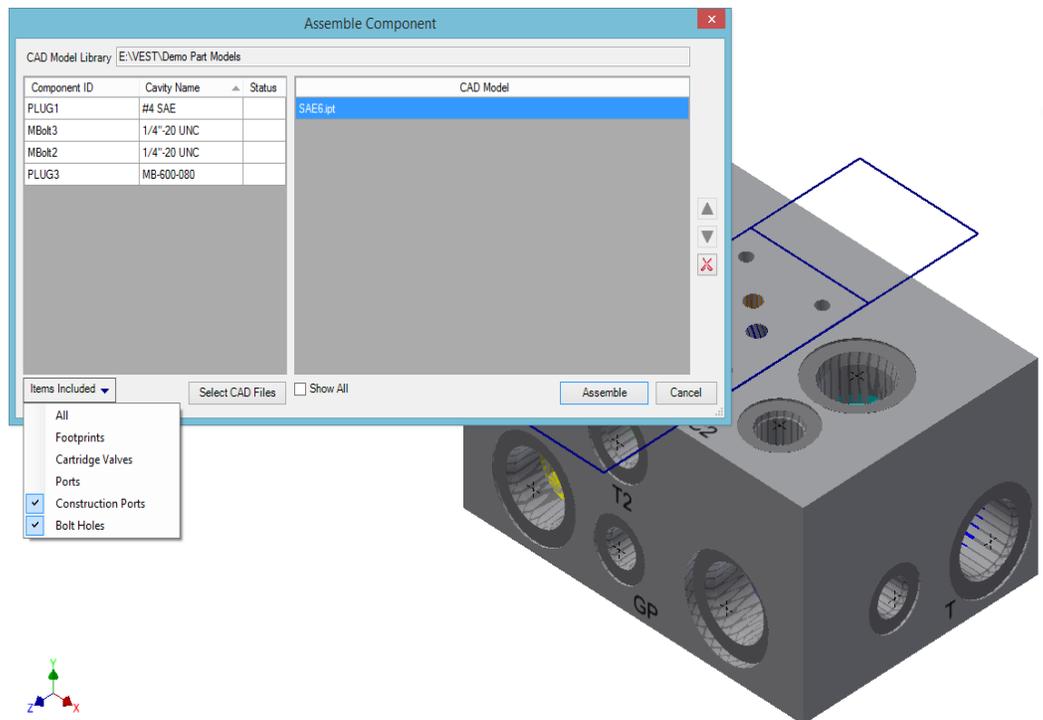
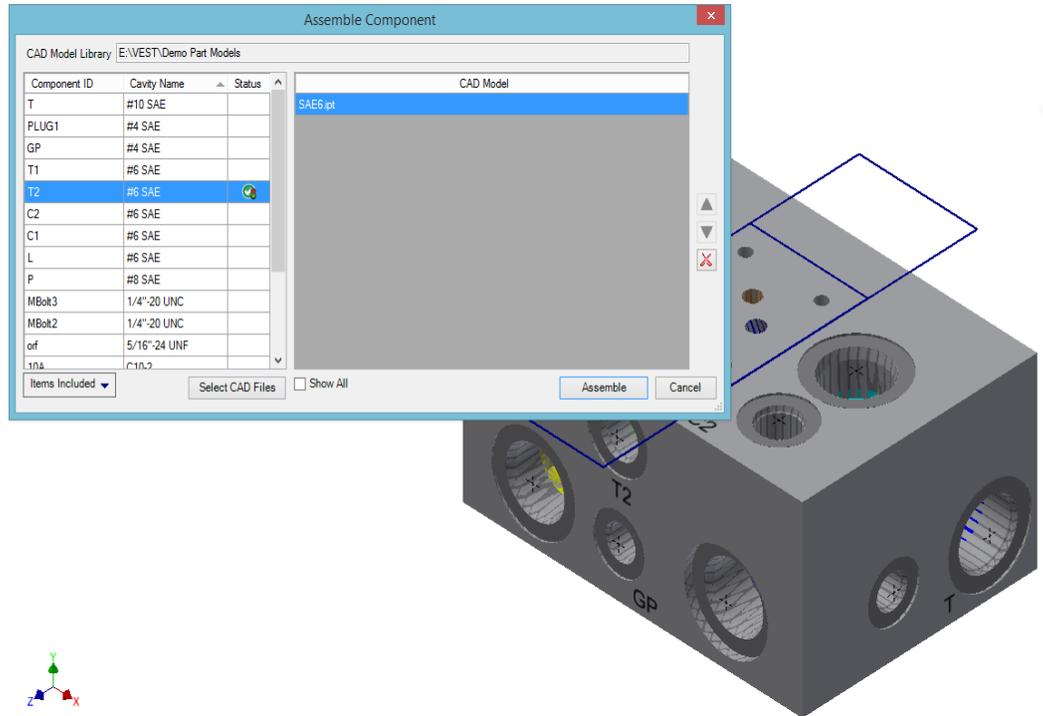
5. Click **Browse** and select the folder containing the Part files.  
The **Items included** option filters the cavity according to the Cavity/Footprint type.

**Note**

The library path is stored in the system registry; you must have administrative privilege to save changes to the library path.

**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.

**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**.

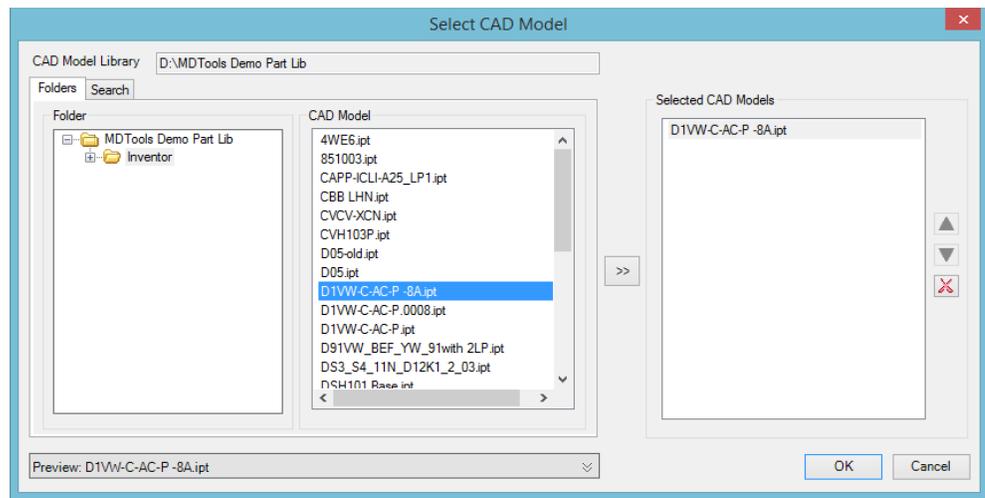
The Select CAD Model dialog box closes.

The Assemble Component dialog box displays.

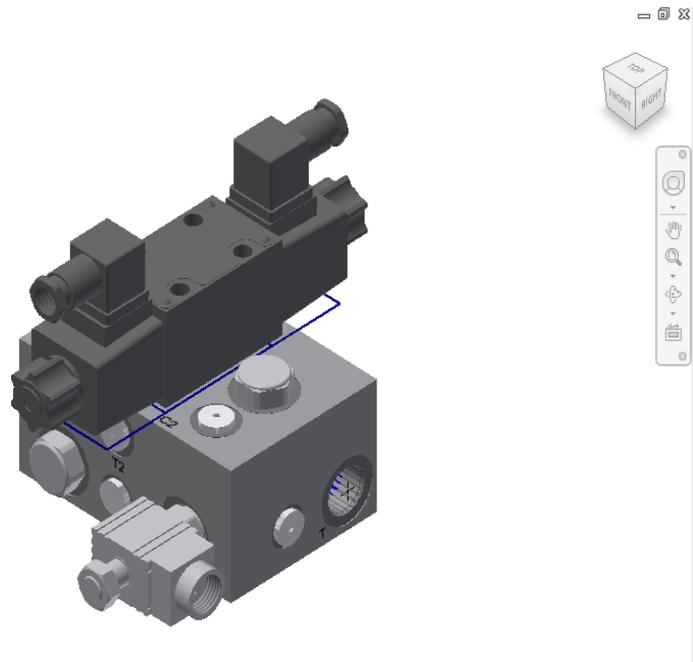
The Status of the selected cavity changes to .

**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.



Assembly Interface dialog box



Assembly created using MDTools

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.

## Same Component for Multiple Cavities

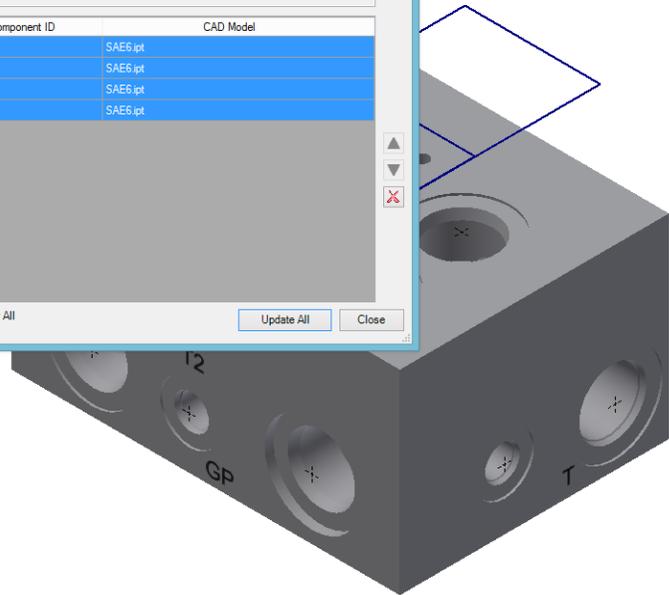
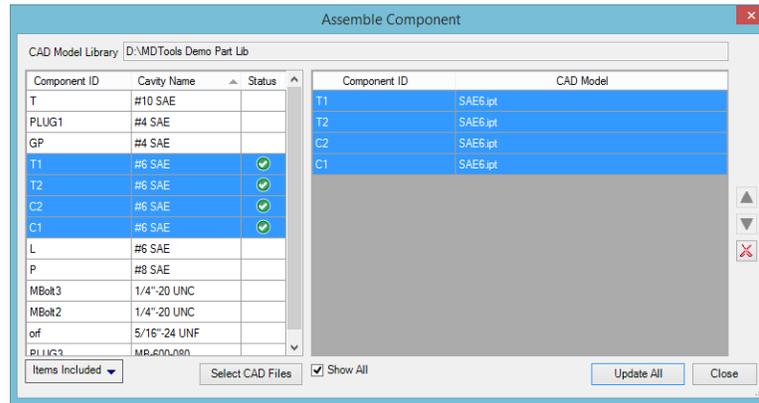
When multiple cavities use the same component, you can select the component for all the cavities together.

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 MDTTools® 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. (e.g. Component deleted, new component added, component assembly order changed, if multiple component and one or more component deleted etc.)

### Note

You can also see the assembled model by selecting a model from the CAD Model column.

# 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 MDTools Assembly Library.

1. Open the assembly model in Inventor.
2. Click MDTools 760 ribbon > **Assemble** panel > **Plug**  
*Automatically assembles the plugs onto all the construction (X- Drill) ports, which are assigned in the MDTools Assembly Library, in a manifold.*

### Note

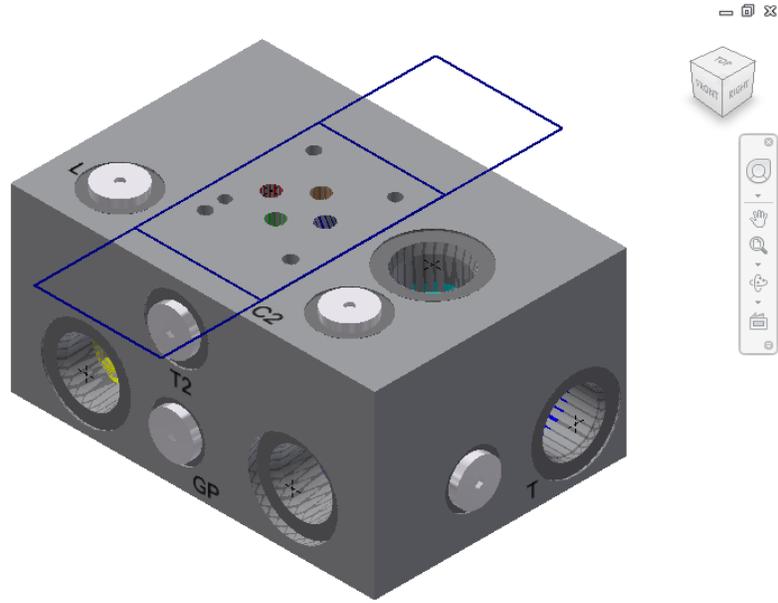
3. *If there is no manifold placed in the assembly, a message box displays. Click **Yes** to place a manifold in the assembly.*

*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 Assembly Library, 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.



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 without the assembly constraints are not assembled on the manifold.  
Open the part/assembly model of valve in Inventor.

1. MDTTools 760 ribbon  
>**Set Assembly Constraints**

The *Set Constraints dialog box* displays.

The Set Constraints dialog box contains the following tabs.

## 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.

2. 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.

3. Select the **Top Face** button.
4. Select the top face work plane.
5. Select the **Bottom Face** button.
6. Select the bottom face work plane.
7. Select the **Axis** button.
8. Select an axis passing through the valve body.
9. Click **Set Constraints** to set assembly constraints.

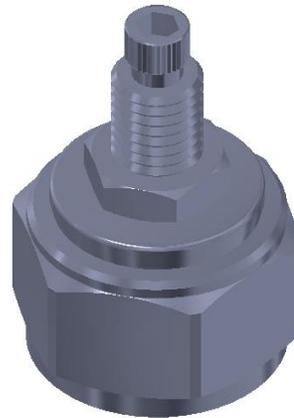
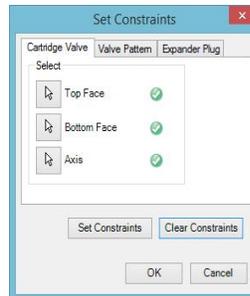
*MDTools® sets all the assembly constraints and the dialog box closes.*

*Now, this part is ready for use with the Assembly Interface.*

10. 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.



Set Constraints dialog box: Cartridge Valve tab



## 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.

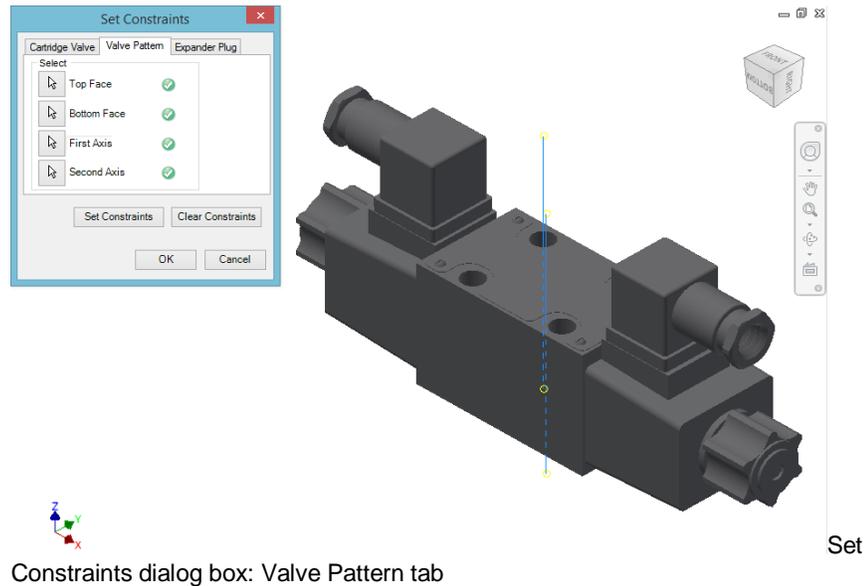
1. Create work planes for the top and bottom face.
2. Create the first axis.  
Create a work axis that passes through LP/LP1/BH1.
3. Create the second axis.  
Create a work axis that passes through LP2/BH2.
4. Select the **Top Face** button.
5. Select the top face work plane.
6. Select the **Bottom Face** 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.
13. Save the Part Model.
14. Click **OK**.

*MDTools® sets all the assembly constraints. The dialog box closes.  
Now, this part is ready for use with the Assembly Interface.*

### 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 pin.
- Create an axis that passes through the bolt hole BH1 for valves with no locating pin.



Constraints dialog box: Valve Pattern tab

Set

## 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 pin.
- Create an axis that passes through the bolt hole BH2 for valves with no locating pin.

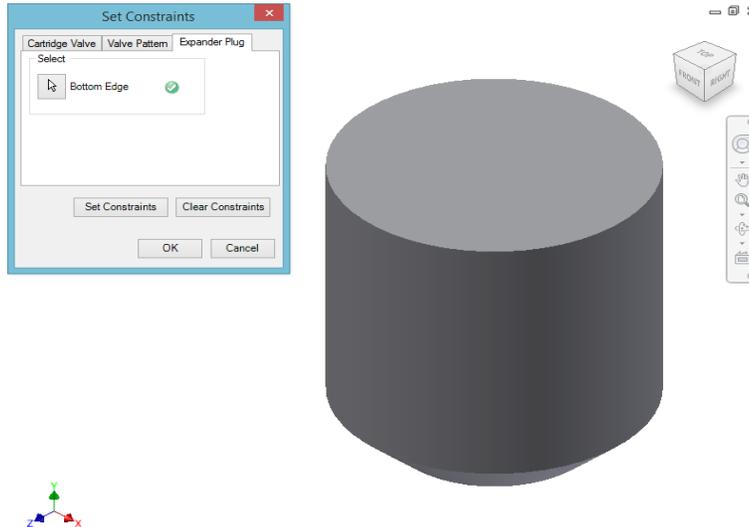
LP1 is a locating pinhole with the port application name LP1, and LP2 is a locating pinhole with the port application name LP2 on the footprint.

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.

## 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.

# 111. Update Assembly

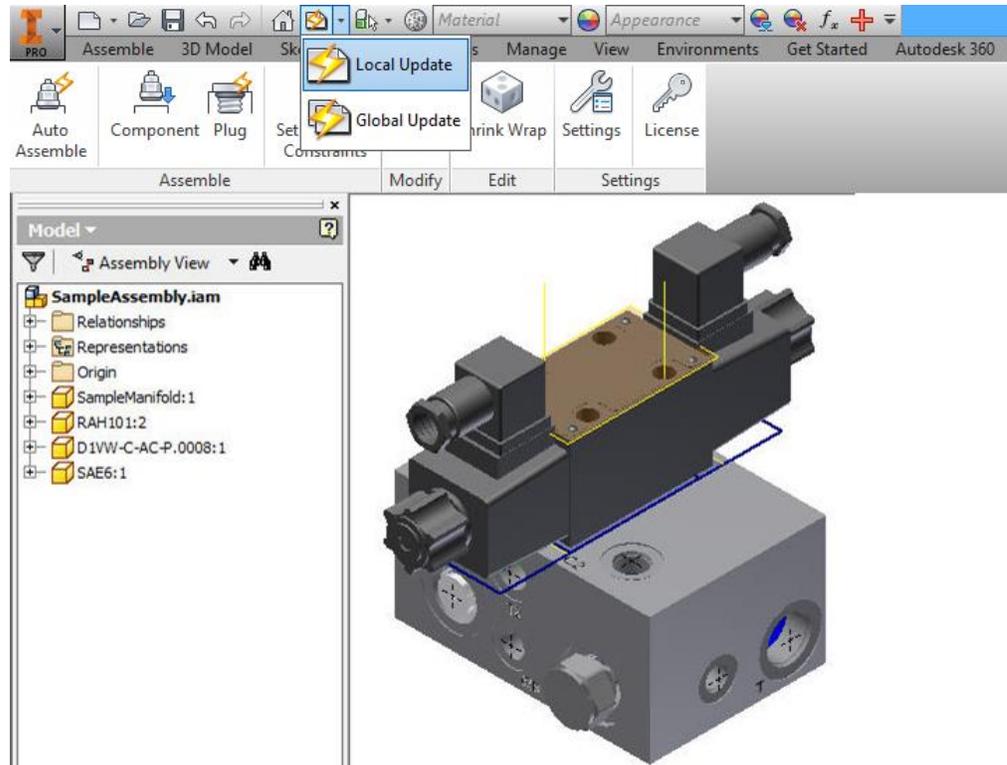
MDTools® automatically updates the assembly if the reference manifold of that assembly is modified.

1. Click **Local/Global update** in the Inventor Part menu.  
*The Inventor Update Component dialog box displays.*
2. Click **Accept**.
3. Click MDTools 760 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.(e.g. change face of cavities, swap cavities, delete cavities, suppress-unsuppressed cavities etc.)

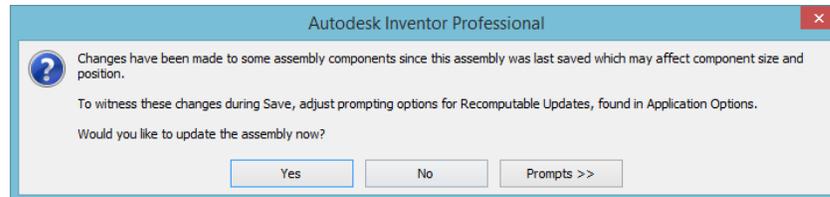


Local/Global Update options

## Updated Existing Assembly

1. Open an existing assembly, where the reference manifold is modified.

*Autodesk Inventor Professional message displays.*



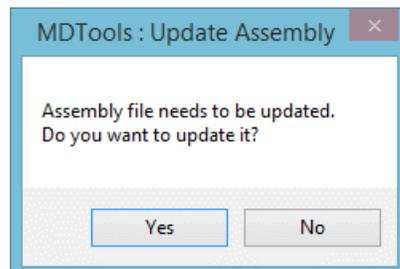
Message box

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 760 ribbon  
>Edit panel  
>**Shrink Wrap**

*The Shrink-Wrap dialog box displays.*

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

*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.

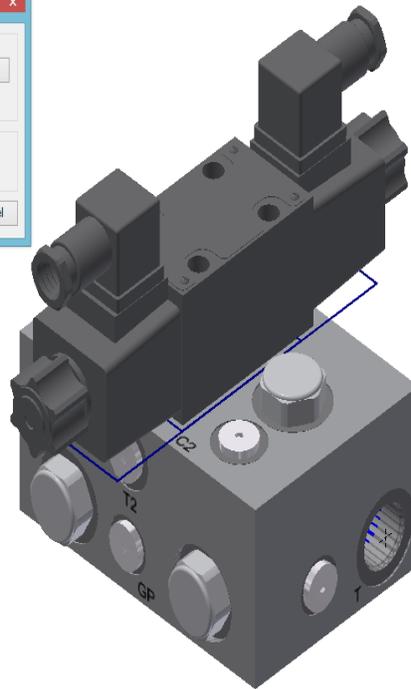
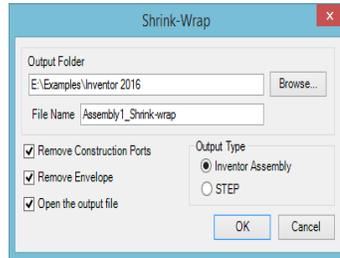
4. Select the Output type format you want to shrink--wrap the model.

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

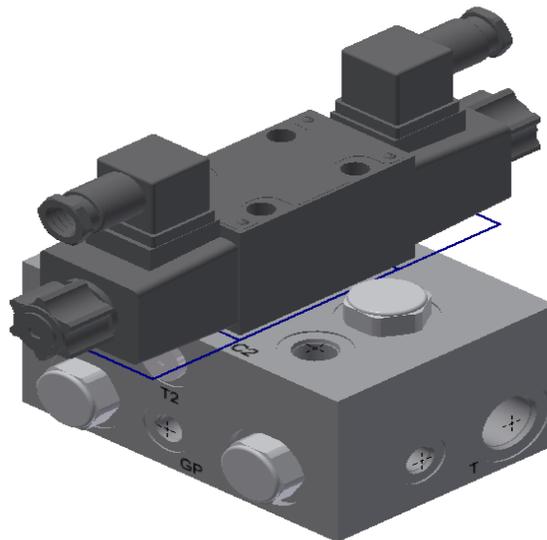
6. Select **Open the output file**.

7. Click **OK**.

*MDTools automatically removes all the internal details.*



Shrink-Wrap dialog box

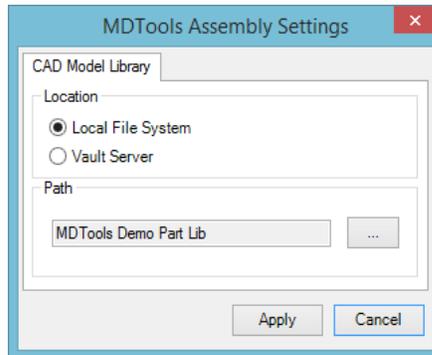


Internal details removed automatically

# 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.

1. MDTools 760 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 details in the Vault Server, Log In Details section.*

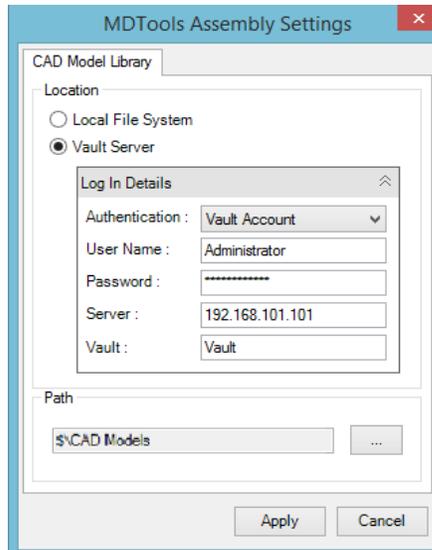


MDTools Assembly Settings dialog box

## Vault Server Details:

Specify the Vault Server login details in the Vault Server, Log In Details section.

- MDTools remembers the login details for current and future Inventor sessions.
  - Change the vault login details later, if required.
3. Click  to browse.  
The Browse option lists the folders on local machine or on vault server, based on the option selected in the Location section.
  4. Select the CAD Models folder.
  5. Click **Apply** to save the settings.



MDTools Assembly Settings : Vault Server – Log In Details

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 commands (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 Inventor session.

*If CAD Model location option is selected as the Vault Server. Then, assign plugs using the CAD Models location in Vault Server, MDTools Library Manager.*

# 114. MDTools License Option

Set the MDTools® license path from the MDTools Assembly ribbon.

1. MDTools 760 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 760 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.*

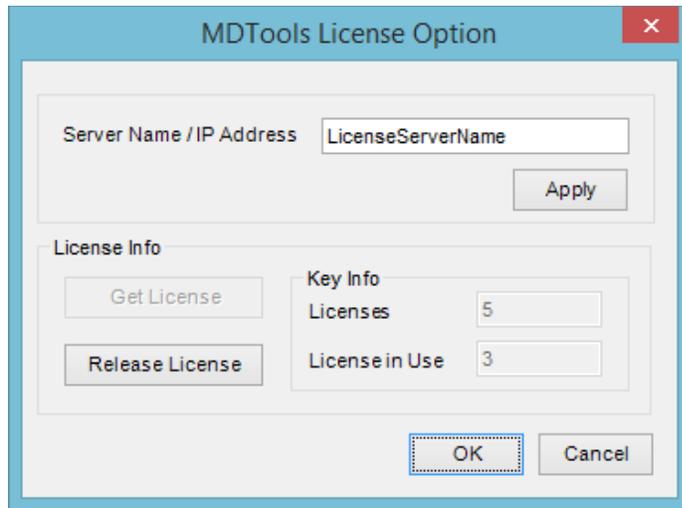
4. To release a license, click the **Release License** button.

*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

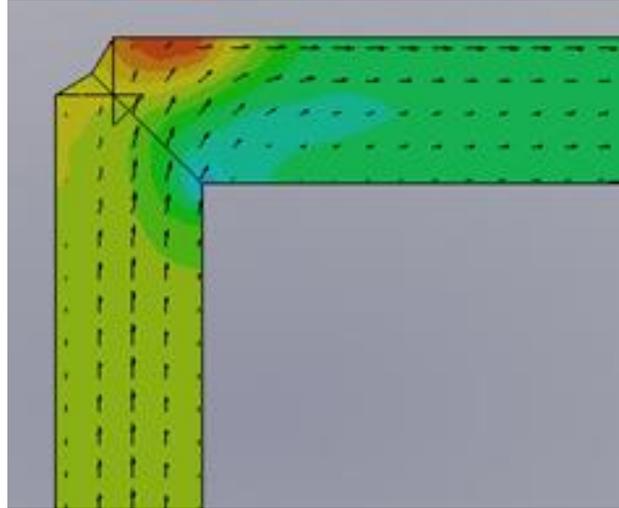
## 1 Bends in Drilled Circular Passages

### 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:

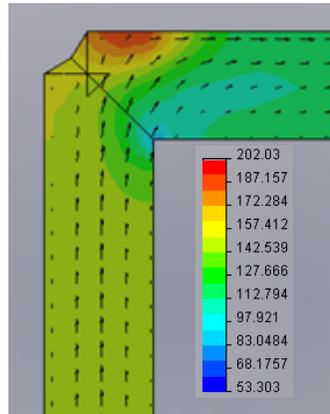


Fig 1a

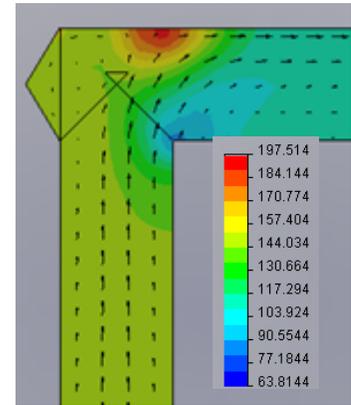


Fig 1b

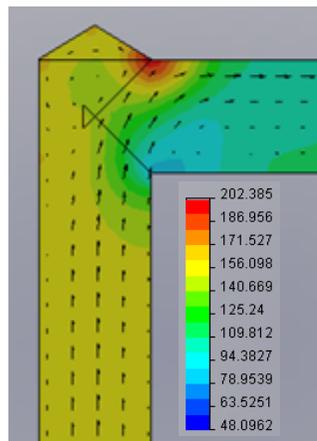


Fig 1c

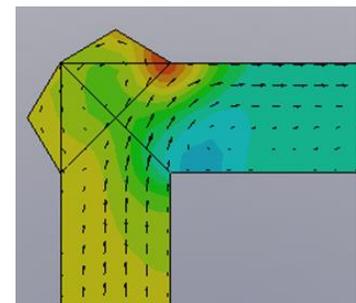


Fig 1d

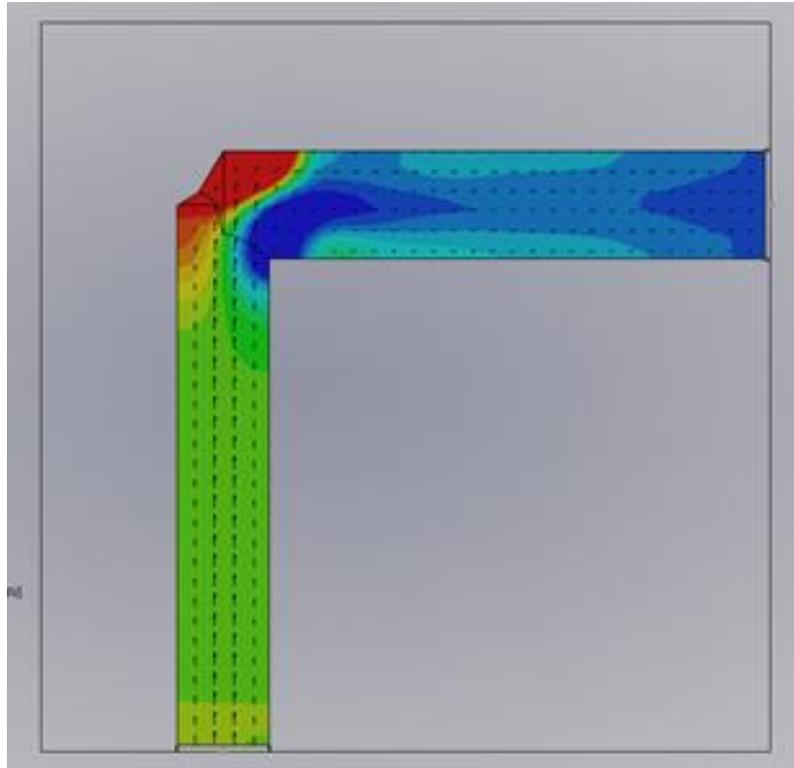
	Energy Drop (psi)
a MTools® - "Connect to Cavity"	35
b Outlet Extended	35
c Inlet Extended	44
d Both Extended	48

## 2 Sizing the Diameter of Construction Holes

When selecting a construction hole to make a connection, designers often maintain diameter of the target hole. Neither increasing nor decreasing the construction-hole diameter.

VEST conducted Finite Element Analysis based flow simulation research on holes which conduct hydraulic power, i.e. pressure and tank connections.

Expansion and contraction effects of the flow cause energy loss as flow bends and transits from one hole to another. A larger diameter for the construction hole results in lower pressure drop, regardless of the direction of flow. Beyond a certain relative size, upsizing of the diameter results in only marginal energy efficiency improvement.



MDTools® automatically selects an optimal upsized construction hole diameter.

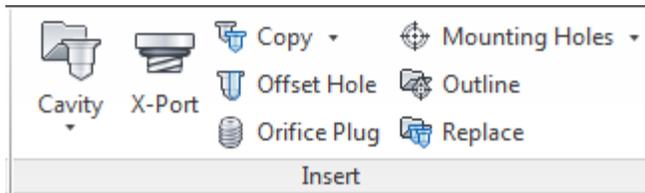
Oil velocity ranges that can be defined by users:

- High velocity range, where energy concerns dominate and dictate upsizing of holes
- Low oil velocity range, where energy concerns are not significant and manufacturing costs dictate downsizing of holes
- Nominal range

Pilot and Signal lines do not carry power and energy efficiency is of no concern. Diameters can be chosen on the basis of geometry, stress, and manufacturability.

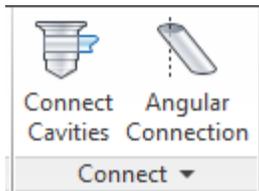
In rare cases, when a valve operates at flows significantly lower than the rated flow, then the bend losses are low and diameters can be downsized.





## 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.	21
	From HyDraw	Read a HyDraw® created schematic drawing and insert all the required cavities with the connectivity information.	22
	X-Port	Insert construction port for Energy Efficient connections	24
	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.	25
	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



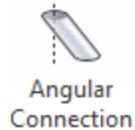
### 3. Connect Panel



Interactively create connections between cavities. 36

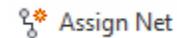
If a connection is not possible without relocating the cavity, then MDTools automatically relocates the connecting cavity to the port center.

In case of a bottom port, MDTools relocates the connecting cavity to the full diameter depth of the second cavity.

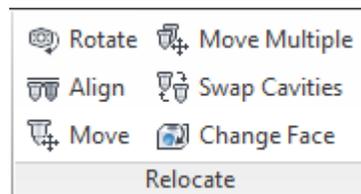


Create a connection between two cavities using an angular drill. 37

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



Display the nets (flow paths) with different colors inside the manifold. 38



### 4. Relocate Panel



Rotate the inserted footprint on the manifold surface. 39

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



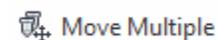
Align Multiple cavities on the manifold. 40

- 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.



Precisely move or relocate a cavity. 41

Specify the X and Y values from the face origin. Enter the displacement values, which is  $\Delta X$  and  $\Delta Y$ .



Move multiple cavities on the manifold simultaneously, by entering the displacement along their common coordinate. 42

- Cavities on the same or opposite faces can be moved along two coordinates.
- Cavities on perpendicular faces can be moved along a single coordinate.

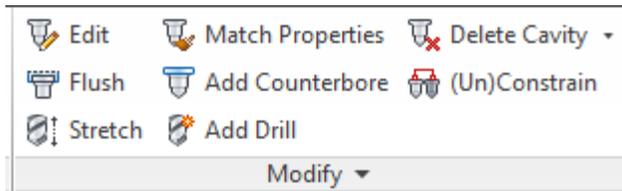


Interchange the location of two cavities on a manifold. The two cavities replace each other. 43



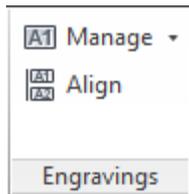
Relocate the cavity/footprint from one face of a manifold to another manifold face. 44

Connect the cavity with either one or two existing cavities on the block, when relocating the cavity.



## 5. Modify Panel

	<b>Edit</b>	Edits Cavity, UnderCut, Slot and O-Ring Groove	45
	<b>Flush</b>	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
	<b>Stretch</b>	Stretch the drill and change its depth by clicking and dragging the cavity to the required depth.	47
	<b>Match Properties</b>	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
	<b>Add Counterbore</b>	Add the counter bore to an existing cavity.	49
	<b>Add Drill</b>	Add a drill to an existing cavity.  MDTools® adds the machining operation in a user-specified row in the machining sequence.	50
	<b>Delete Cavity</b> ▾	▼	
	<b>Delete Cavity</b>	Delete the complete cavity/footprint.  All the features used to create the cavity/footprint in Inventor are automatically deleted.	51
	<b>Delete O-ring Groove</b>	Delete the selected O-ring grooves.	52
	<b>Delete Outline</b>	Delete the assembly outline around the selected cavities/footprints created using this command.	53
	<b>(Un)Constrain</b>	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
			
	<b>Suppress</b>	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
	<b>Minimize Depth</b>	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
	<b>Update Precision</b>	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. 58  
Automatically convert client graphics text (if they exist) to planer sketch text.

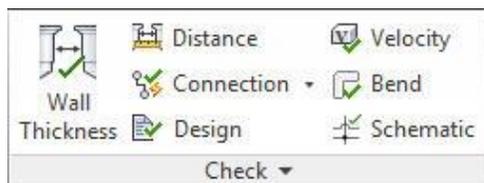
Copy

Create multiple copies of existing engravings on the manifold at specified distance from the location of selected texts. 59  
Various properties of the selected texts also get copied.

Align

Align two engravings on the manifold. 60

- 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. 61  
Measure the wall thickness between a cavity and a manifold surface.

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

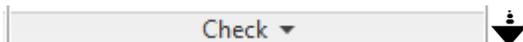
Check velocity in connections in the block. 66

Bend

Check quality of intersections for energy efficient bends. 67

Schematic

Check Conformance of design to the HyDraw® schematic. 68



Manufacturing

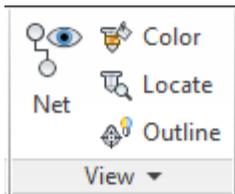
Check the manifold design for manufacturing and tooling limitations. 69  
Check the manifold for angle holes, compound angle holes, non-standard drills, non-standard spot faces, and drills with slenderness ratio more than a specified value.

Connection Offset

Check the design to recommend offset connections. 70

Pressure Rating

Check pressure ratings of construction ports 71



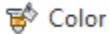
## 8. View Panel



Net

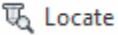
Locate a position or an area on a selected manifold face, where a cavity can be placed to connect with a selected net. 72

MDTools® displays the cavities/ports in the selected net in green and all other cavities/ports in the dead area color.



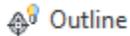
Color

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. 76

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.



Net Display

Display the nets (flow paths) with different colors. 77

Visually check the connections inside the manifold.

Change the color and the visibility of nets inside the manifold.



Cavity Center

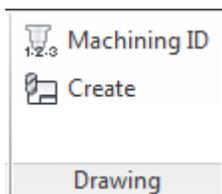
Change the visibility of cavity center points. 78

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



Remove Color

Remove the shading of cavities on the manifold. 79

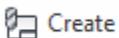


## 9. Drawing Panel



Machining ID

Generate Machining ID for all cavities in the specified format. 80



Create

Create 2D Machining drawing of the block. 81

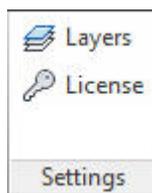


## 10. Assembly Panel



Set assembly constraints to a component model.

82



## 11. Settings Panel



Define various settings for MDTools® such as net color, units, and library path.

83

Share the library with all designers in your organization so that all use the same data.

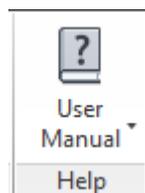
Easily manage changes in standards or libraries within your organization.



Set the license server path for MDTools760.

84

Check for the license and select license from the specified license path.



## 12. Help Panel



MDTools User Manual.

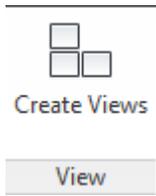
85



About MDTools.

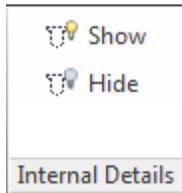
86

# Drawing Commands



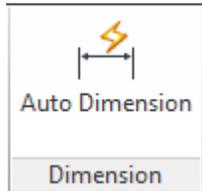
## 1. View Panel

Command Name	Function	Ch
 Create Views	Create 2D views of the manifold.	87



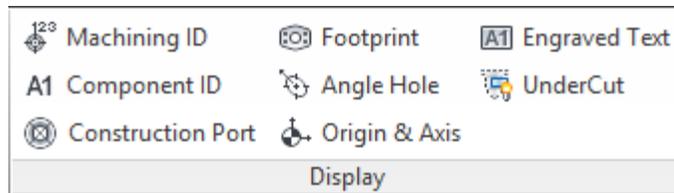
## 2. Internal Detail Panel

 Show	Show internal details of the manifold.	88
 Hide	Hide internal details of the manifold.	89



## 3. Dimension Panel

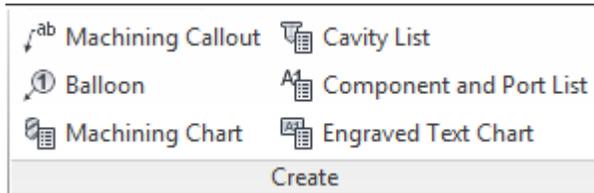
 Auto Dimension	Dimension all the cavity locations on all six views of the manifold in the 2D machining drawing.	90
---	--	----



## 4. Display Panel

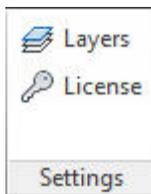
 Machining ID	Display the cavity machining ID near cavities in the 2D drawing views.	91
 Component ID	Display the Component ID near cavities in the 2D drawing views.	92
 Construction Port	Mark construction ports on each view in the 2D drawing views.	93
 Footprint	Display the port names and footprint outlines 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.	



#### 5. Create Panel

 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



#### 6. Setting Panel

 Layers	Set drawing layers for MDTools® objects.	105
 License	Set the license server path for MDTools760. Check the license and select license from the specified license path.	84

# Assembly Commands



## 1. Assemble Panel

Command Name	Function	Ch
 Auto Assemble	Automatically assembles components and construction plugs.	107
 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 Assembly Library.	109
 Set Assembly Constraints	Set assembly constraints for a component model.	110



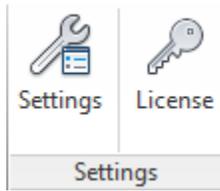
## 2. Modify Panel

 Update	MDTools® automatically updates the assembly, if the reference manifold of that assembly is modified.	111
--	--	-----



## 3. Edit panel

 Shrink Wrap	Remove all the internal design details of manifold and create a new “Shrink Wrap” block model without any internal connection details.	16
---	--	----



#### 4. Settings panel



Settings

Displays MDTools Assembly settings dialog box to configure Assembly settings.

113



License

Set the license server path for MDTools760.

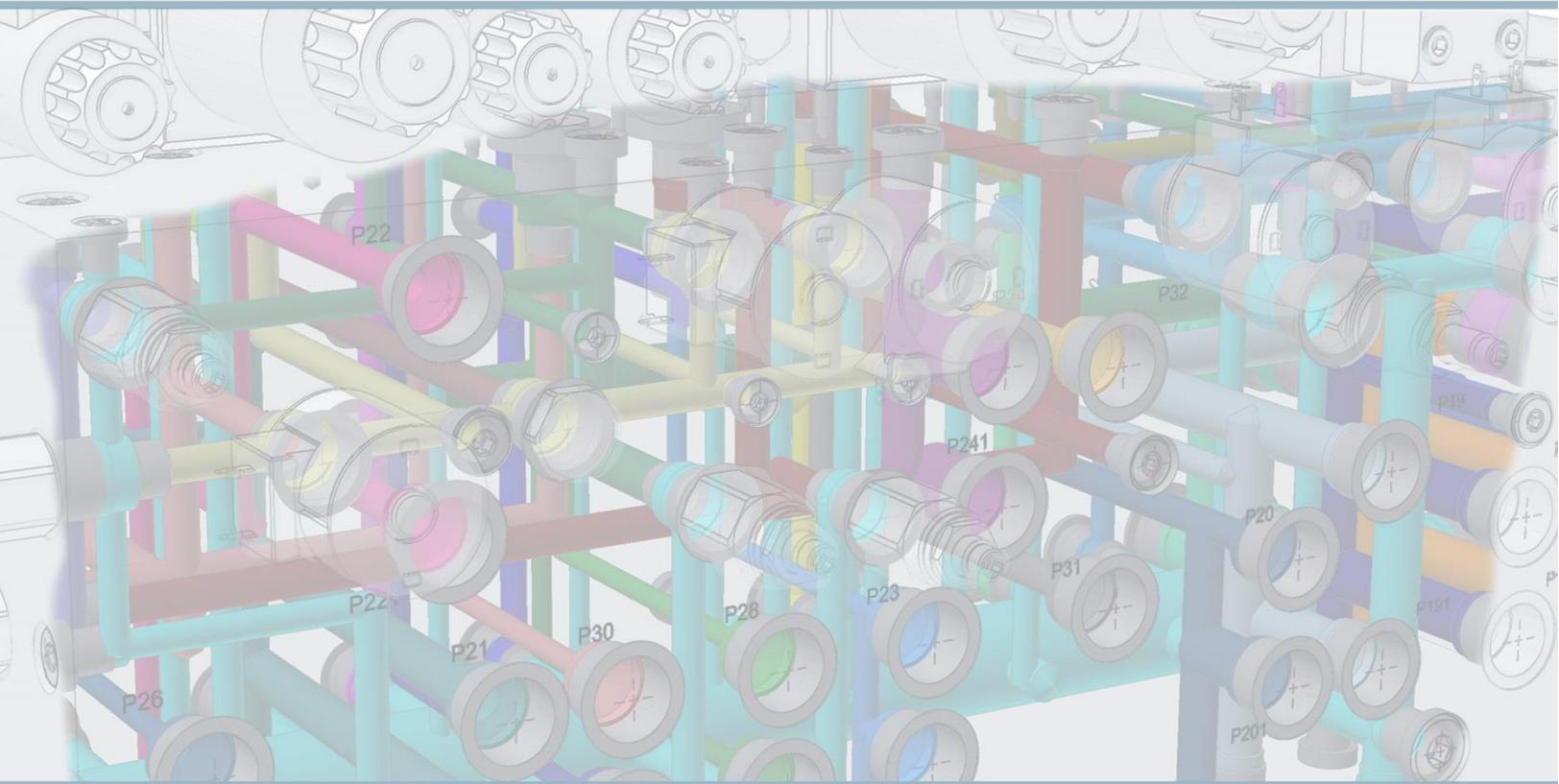
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Check the license and select license from the specified license path.



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