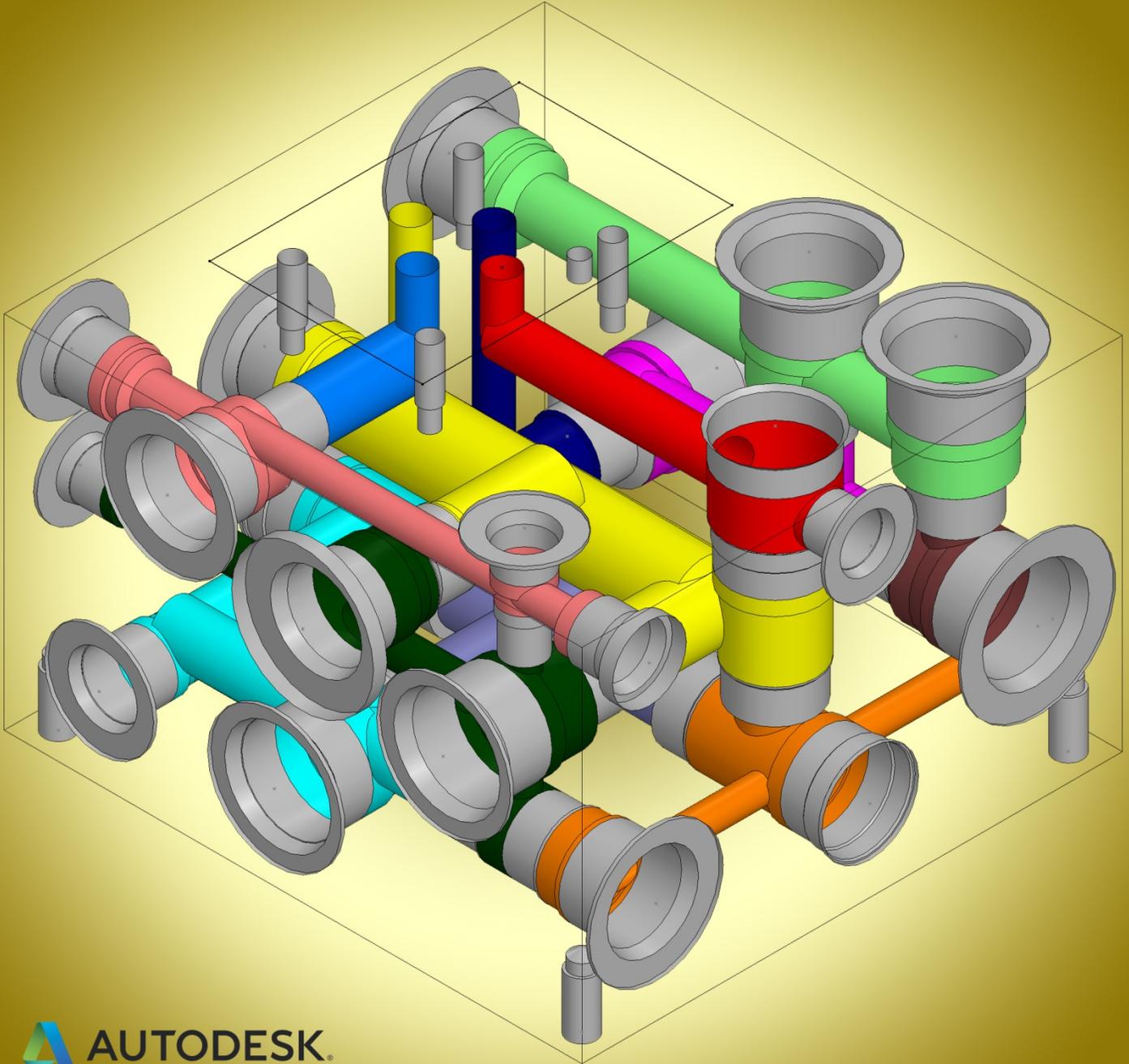


User Manual

MDTools® Essential AI2014

for Autodesk® Inventor®



 **AUTODESK.**
Authorized Developer



MDTools® Essential AI2014

manifold design software for Autodesk® Inventor® 2014

Do more...

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General

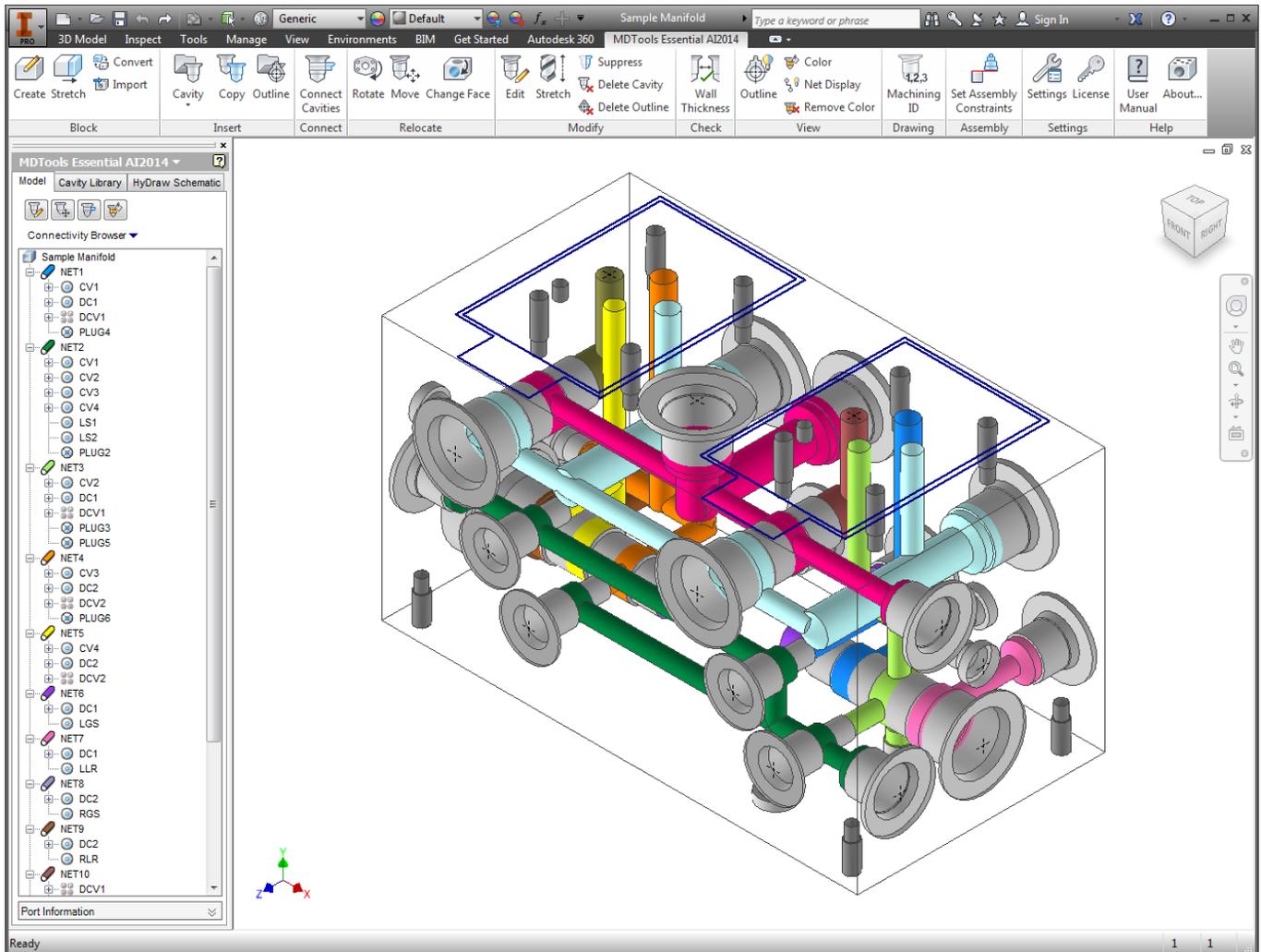
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Contents

1.	Introduction	3
2.	Installation.....	6
	BASICS	9
3.	MDTools Essential AI2014 Workspace	10
4.	HyDraw Schematic Interface	18
5.	MDTools Cavities	20
6.	Design Basics	24
7.	Using Angle Holes.....	26
	DESIGN COMMANDS.....	28
	Block Commands	29
8.	Create Block	30
9.	Stretch Block.....	36
10.	Convert Block.....	37
11.	Import Manifold	38
	Insert Cavity	39
12.	Insert Cavity (...from Library).....	40
13.	Insert Cavities (...from HyDraw Schematic).....	45
14.	Copy Cavity	46
15.	Insert Outline	47
	Make Connections.....	48
16.	Connect Cavities.....	49
	Relocate Cavity.....	52
17.	Rotate.....	53
18.	Move Cavity.....	54
19.	Change Face	57
	Modify Cavity	58
20.	Edit Cavity.....	59
21.	Stretch	63
22.	Suppress Cavity.....	64
23.	Delete Cavity	65
24.	Delete Outline	66
	Design Check.....	67
25.	Check Wall Thickness.....	68
	Block Display	70
26.	Display Outline.....	71
27.	Recolor Cavities.....	72
28.	Net Display	73

29.	Remove Color	75
	Drawing.....	76
30.	Generate Machining ID	77
	Assembly.....	79
31.	Set Assembly Constraints	80
	MDTools Settings.....	84
32.	Settings.....	85
33.	License	89
	Help	90
34.	User Manual	91
35.	About MDTools	92
	DRAWING COMMANDS.....	93
36.	Create Views	94
37.	Footprint	95
38.	Show Machining ID	96
39.	Export Machining Chart.....	97
40.	Create Machining Callout	98
	ASSEMBLY COMMANDS	100
41.	Set Assembly Constraints	101
42.	Assembly Interface.....	104
43.	Assemble Plugs	106
	Appendix	107
44.	Command Overview.....	108

1.Introduction



VISUALIZES

Color-coded cavities and flow paths

Cavities divided into port areas and dead areas

DESIGNS

Embedded design rules

Drag and move cavities using move handle

Color-coded flow paths

Cavity libraries with machining details

Connections with smooth bends

Interactive Stretch Block

CHECKS

Wall thickness between two cavities

AUTOMATES

Auto Machining Drawing and Chart

MDTools® HyDraw® Interface

COMPREHENSIVE

Major OEM libraries included

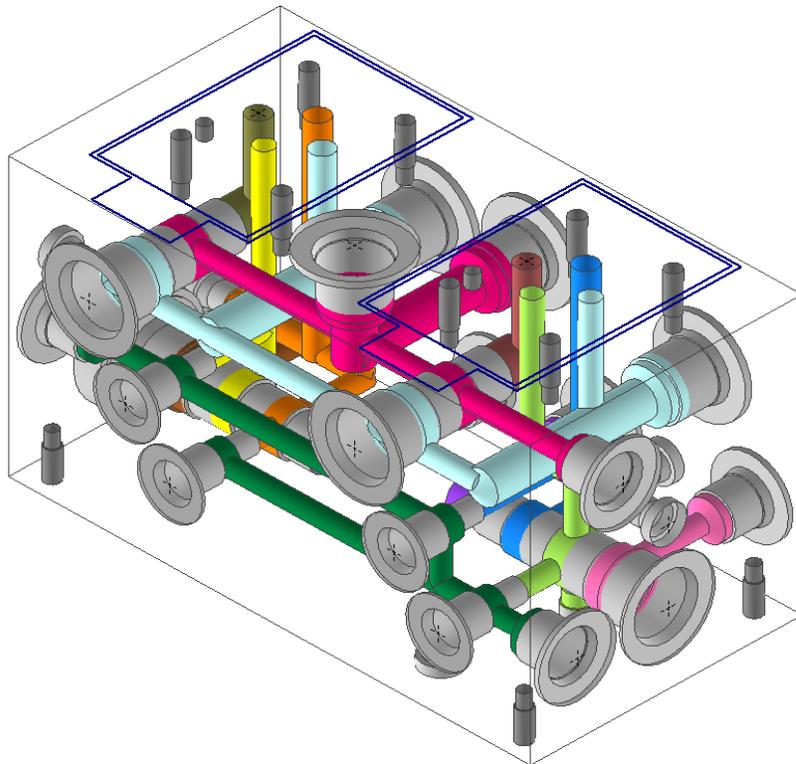
Both cartridge and interface valves used

1. Welcome to MDTools Essential AI2014

MDTools® Essential AI2014, the 3D Manifold design software from VEST provides you with power tools to automate the manifold design, checking, documentation, and modeling process within the **Autodesk® Inventor®** environment.

As a designer of hydraulics manifold blocks using both cartridge and interface valves, you will find MDTools Essential AI2014 an invaluable tool enabling you to be more productive.

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

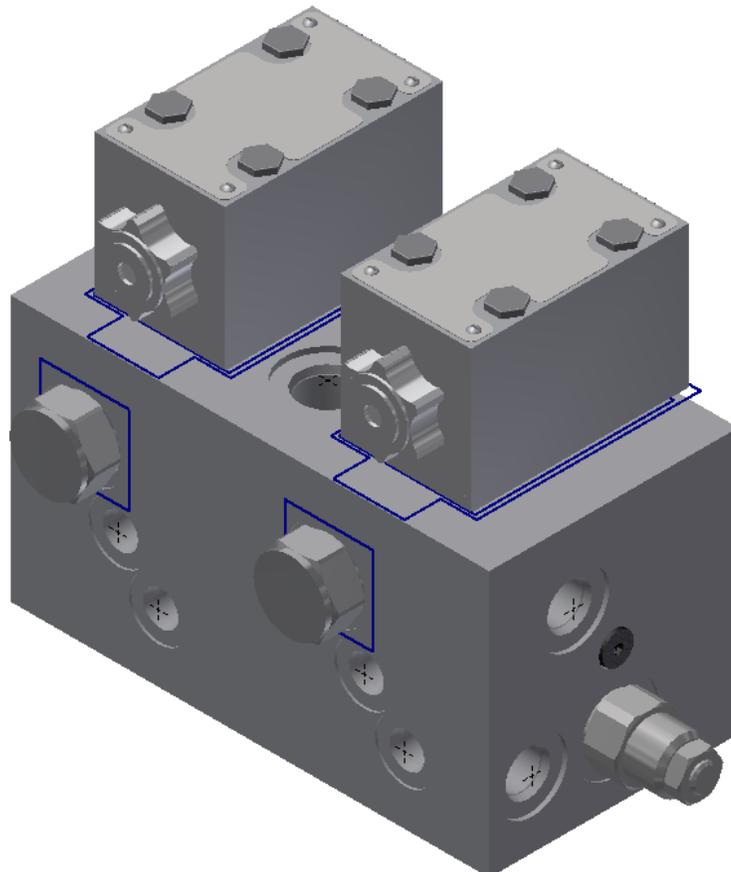


MDTools Essential designed manifold

MDTools Essential AI2014 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.

The Machining Chart command enables you to automatically extract the cavity machining data from the block model, and export the machining chart to Microsoft® Excel®.



MDTools Essential Manifold Assembly

2. Study Guidelines

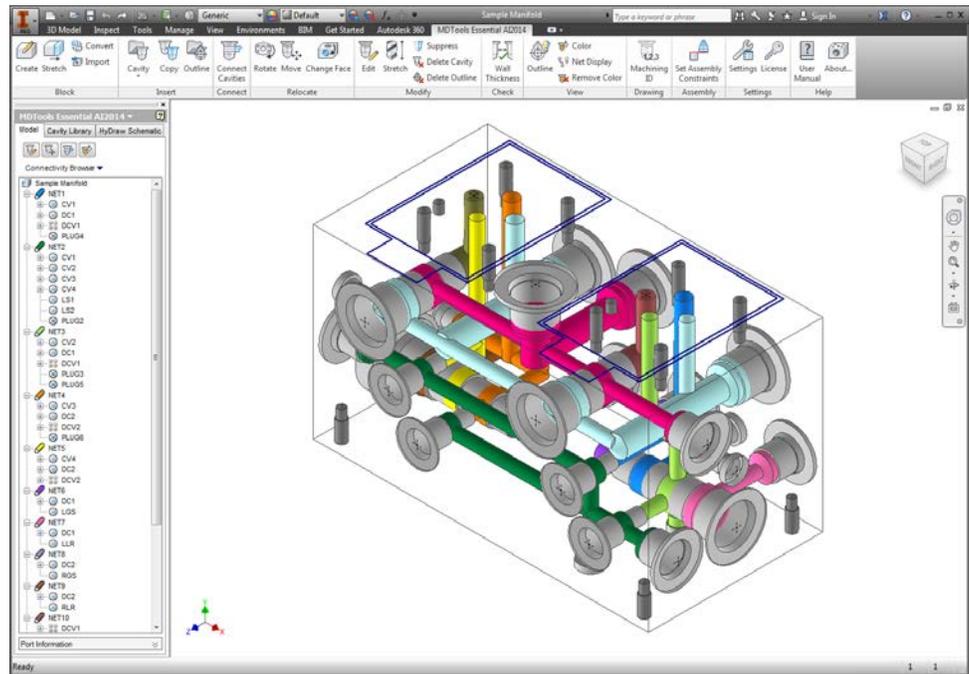
The MDTools® Essential AI2014 User Manual provides comprehensive information on the manifold design software.

First time users of MDTools Essential 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 Essential AI2014.

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



3. If you have a Question

If you have a question about MDTools Essential AI2014, email us at support@VESTusa.com

Please include the following:

- Version number of the software you are using.

To see the version of MDTools Essential on your machine, go to:

MDTools Essential AI2014

> **About MDTools**

on the Part MDTools Essential AI2014 ribbon command tab.

- Configuration of your machine.
- Exact messages, if any, on the screen. Send a screen capture, if possible.
- Description of the problem and what you were doing when the problem occurred.
- Description of how you tried to solve the problem.

2. Installation

Install MDTools® Essential AI2014 using the installation program. The installer creates all required directories and installs MDTools Essential AI2014 on your system.

1. System Requirements

- Intel Core i5 2.4 GHz Processor.
- 8 GB RAM.
- Microsoft Windows 7*/Windows 8 (64 Bit) operating system.
- Microsoft Windows 7*/Windows 8 (64 Bit) operating system.
- Microsoft Access Database Engine 2010 (64 Bit)
- Microsoft .NET Framework 3.5.
- Autodesk Inventor 2013⁺/ 2014 (64 bit).
- Other system requirements, per Autodesk Inventor version used.

* Not compatible with any other 32-bit version of Microsoft Office programs.
+ SP2 or Higher is essential for Languages other than English.

2. Software Installation

Insert the MDTools Essential AI2014 CD-ROM in the CD drive of your system.

If Auto run is not set, then:

1. Launch the *Setup* program.
Windows **Start...**
> **Run...** > **Browse...**
(Browse to E:\ MDToolsEssentialAI2014Start.exe assuming E is your CD drive).
2. Select MDToolsEssentialAI2014Start.exe
3. Click **Open**.

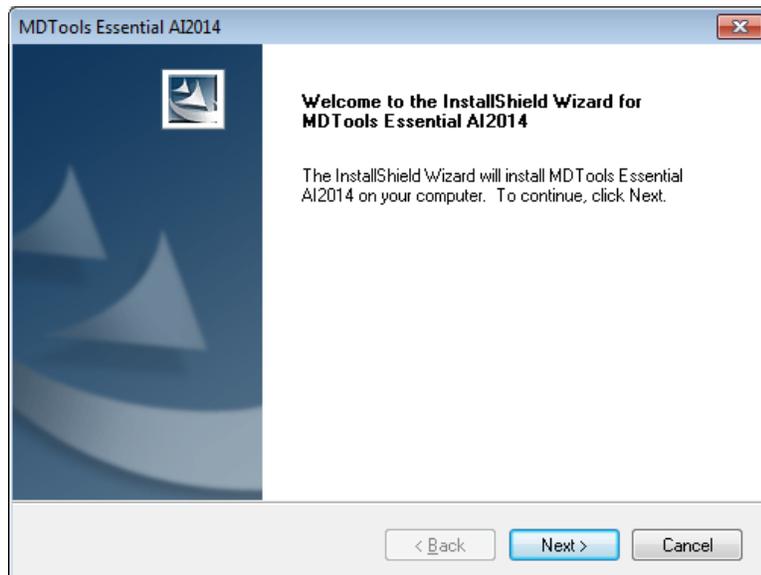
The MDTools Essential AI2014 setup dialog box displays.



MDTools Essential AI2014 Setup dialog box

Install MDTools Essential

1. Click **MDTools Essential**.
The MDTools Essential AI2014 InstallShield Wizard dialog box displays.
2. Respond to all the setup program prompts.
MDTools Essential AI2014 is installed on your system. The installation program automatically creates the required directories in your system.



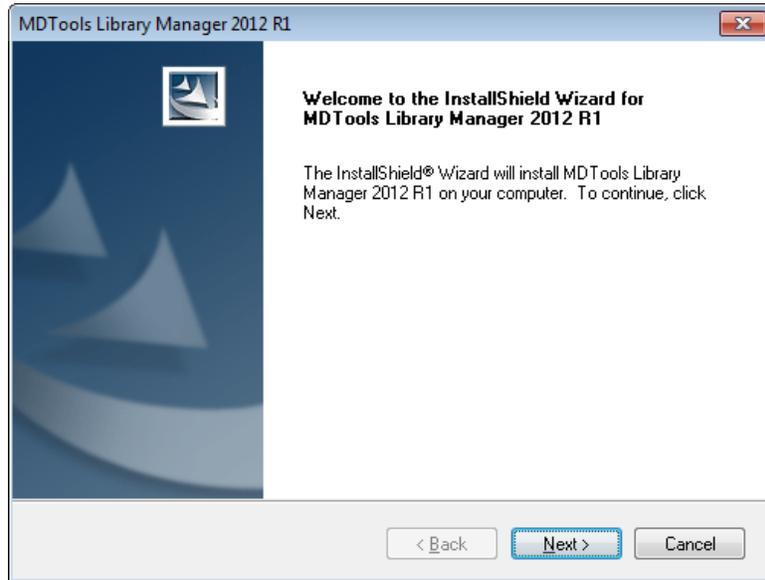
MDTools Essential AI2014 Installation Wizard

Install MDTools Library Manager

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

Note:

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



MDTools Library Manager Installation wizard

Install Hardware Lock Manager

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

Note:

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



Hardware Lock Manager Installation wizard

Hardware Key Installation

MDTools Essential AI2014 is protected with the Sentinel Super Pro key provided with the software.

Attach the Sentinel Super Pro key to the USB port of your computer.

Set License Option in Inventor Part Model Menu

1. Set the license path through the Part Model menu.
2. MDTools Essential AI2014
> **License Options**

The MDTools License Options dialog box displays.

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

4. 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.

5. 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.

6. 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.

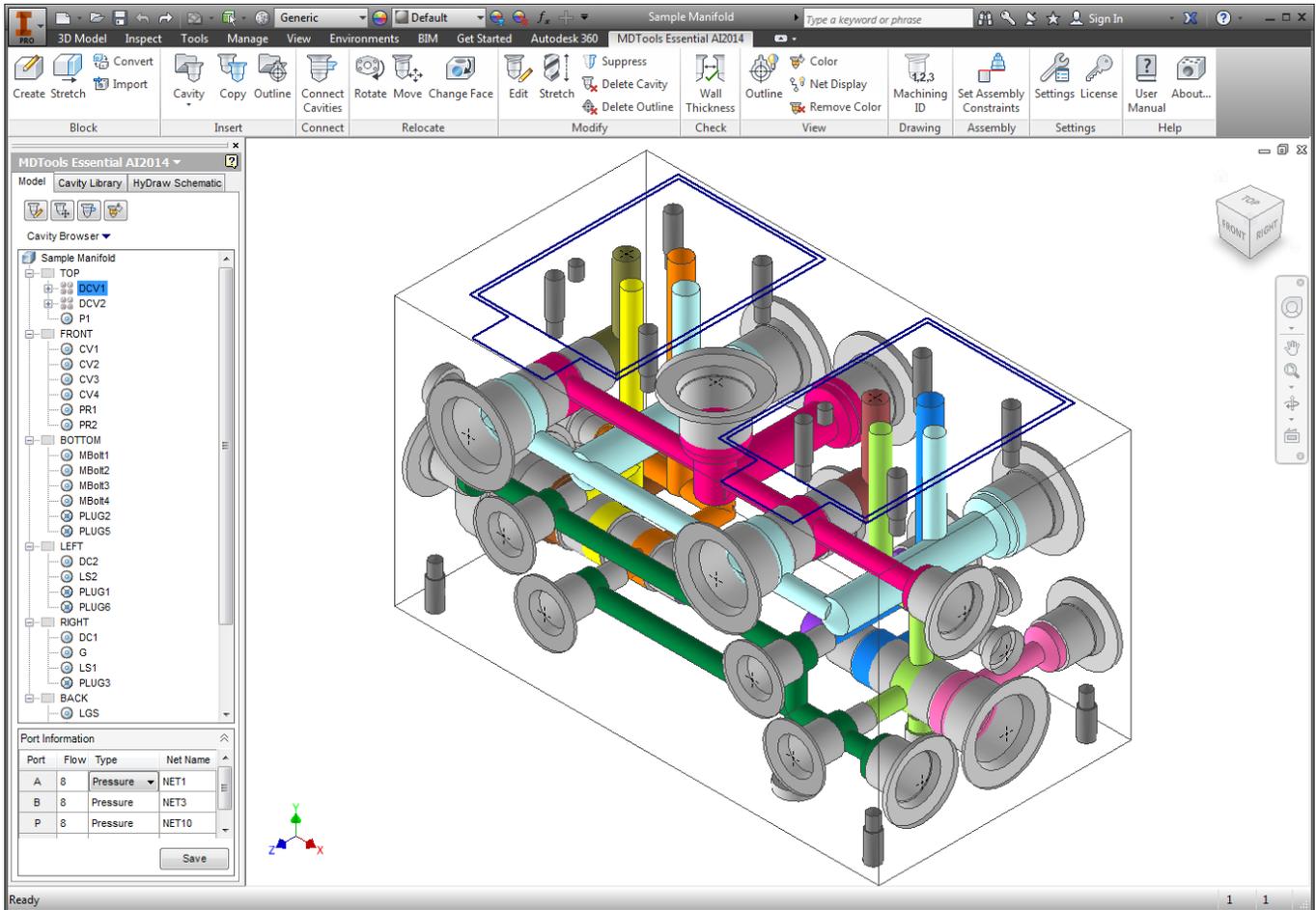
7. Click **OK** to continue.

The screenshot shows the 'License Option' dialog box. At the top, there is a title bar with the text 'License Option' and a close button (X). Below the title bar, there is a text input field labeled 'Server Name / IP Address' containing the text 'MDToolsServer'. To the right of this field is an 'Apply' button. Below this section is a 'License Info' section. On the left side of this section are two buttons: 'Get license' and 'Release license'. On the right side, under the heading 'Key Info', there are two input fields: 'Licenses' and 'License in Use', both containing the number '1'. At the bottom right of the dialog are 'OK' and 'Cancel' buttons.

MDTools License Option dialog box

BASICS

- 3 MDTools Essential AI2014 Workspace
- 4 HyDraw Schematic Interface
- 5 MDTools Cavities
- 6 Design Basics
- 7 Using Angle Holes



3.MDTools Essential AI2014 Workspace

Design, check, draw, and model manifolds within the **Autodesk Inventor** environment.

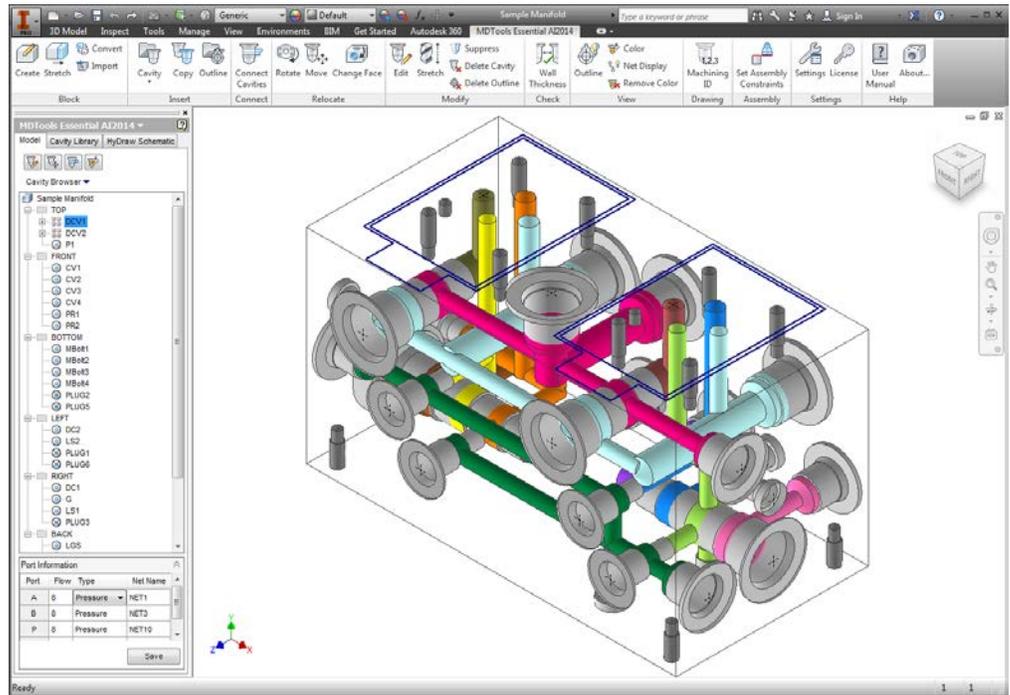
MDTools Essential AI2014 ribbon menu toolbar gives easy access to the commands. The classic menu setting of Inventor with the drop-down menu and panel bar is also available in MDTools Essential AI2014.

There are three sets of commands in MDTools Essential AI2014

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

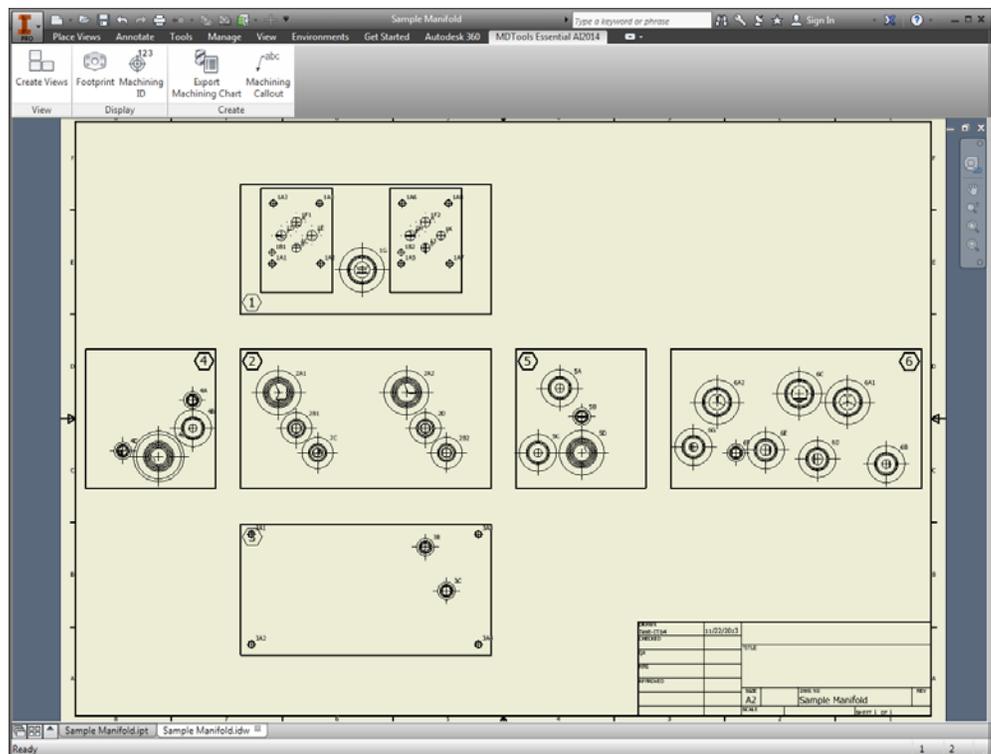
Note:

- MDTools Essential AI2014 add-in is loaded automatically in Inventor after installation.
- To modify the Load behavior:
Click Tools > Add-Ins > MDTools Essential AI2014.
- MDTools Essential AI2014 Part Model commands work only in the Part Model environment (.ipt file).



MDTools Essential AI2014 Part Model menu

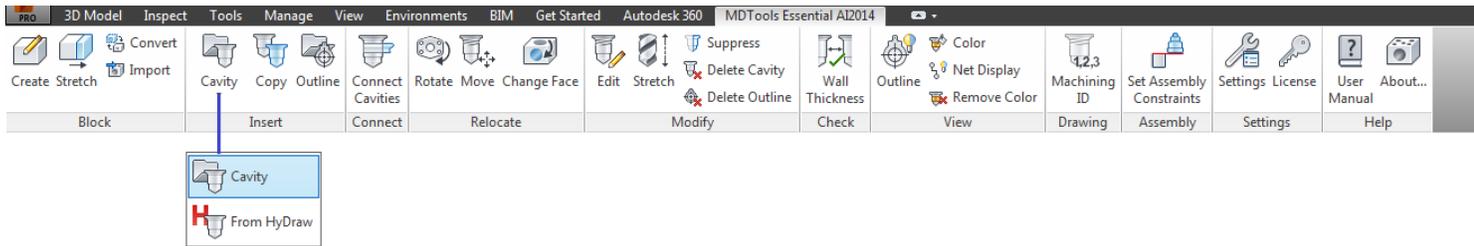
- MDTools Essential AI2014 2D Drawing commands work only in the 2D Drawing environment (.idw/.dwg file).
- MDTools Essential AI2014 Assembly commands work only in the Assembly environment (.iam file).
- MDTools menu displays when you edit part model in assembly. This does not work from the Assembly file.



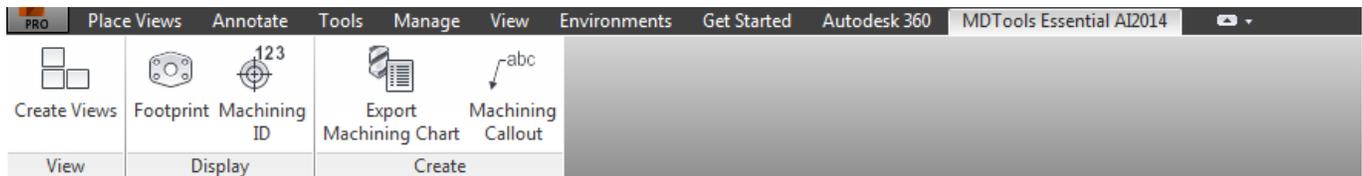
MDTools Essential AI2014 2D Drawing menu

1. MDTools Essential AI2014 Commands

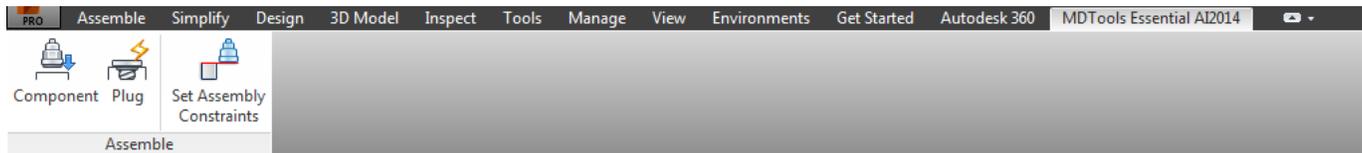
1. MDTools Essential AI2014 Part Model Ribbon Menu



2. MDTools Essential AI2014 Drawing Commands



3. MDTools Essential AI2014 Assembly Commands



Note:

Refer **Appendix** for command details

2. MDTools Essential AI2014 Browser

MDTools® adds its own browser bar to the Inventor browser bar list.
The MDTools Essential AI2014 browser is displayed as the default browser bar of a Part document.

Loaded/Unloaded:

Switches between loading and unloading the browser.

Load on Startup:

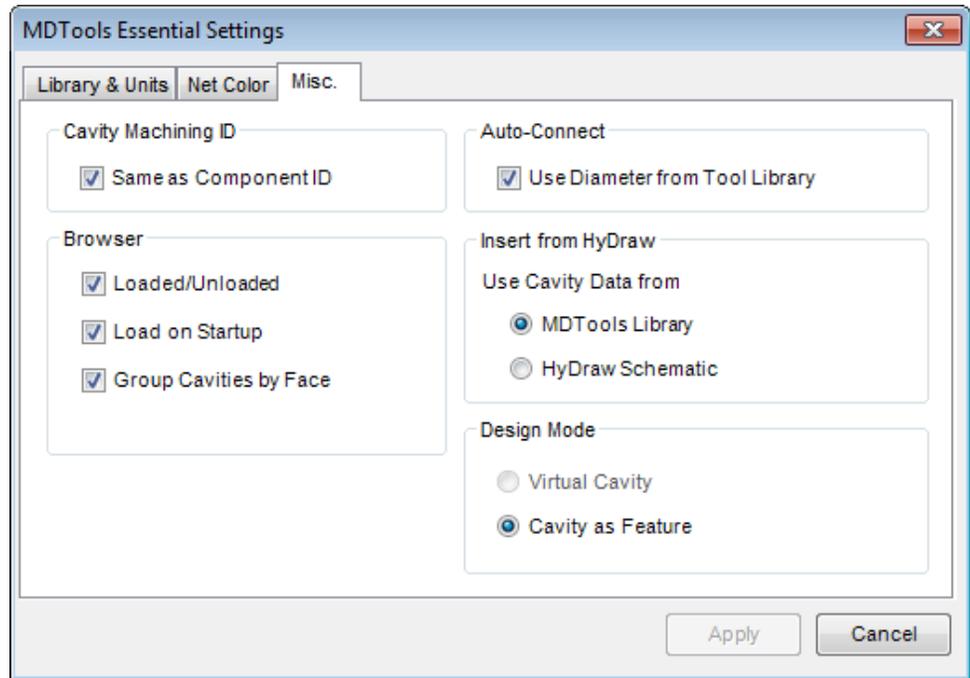
Switches between loading the browser on startup and loading the browser manually.

Group Cavities by Face:

Lists the cavities by face name in the Model browser.

Note:

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



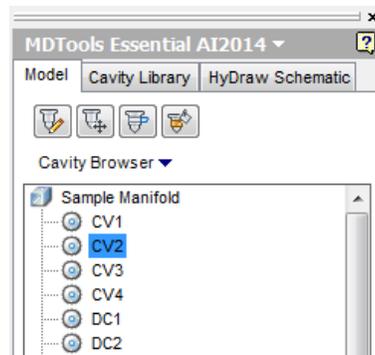
Browser Load Behavior: Load on Startup option

MDTools Browser Bar in Browser Pane

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

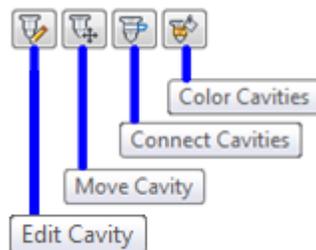
Note:

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

3. MDTools Essential AI2014 Cavity Browser

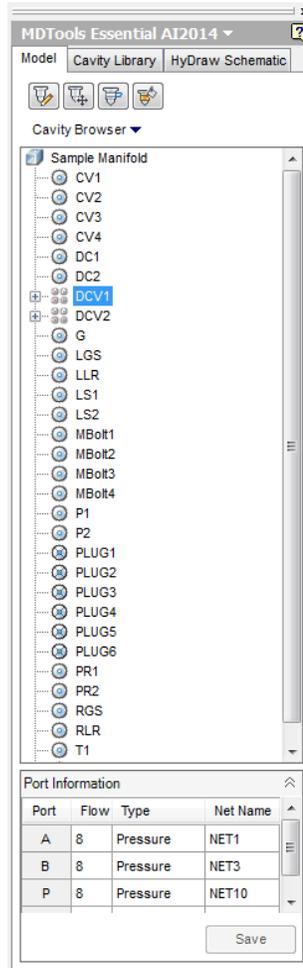
MDTools Cavity Browser:

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

Move the cursor over any cavity in the cavity list or on selection to highlight the selected cavity in the part model.

Note:

MDTools displays the construction ports with the X-mark icon in the browser.

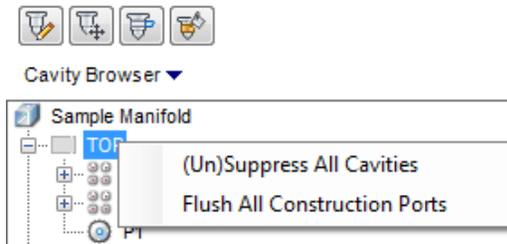


MDTools Cavity Browser

Cavity Browser Context Menu

Context Menu (right click) for the face node enables you to:

- (Un) Suppress All Cavities.
- Flush All Construction Ports.



Context menu: Face Node

Cavity Browser Context Menu

Selected Cavity

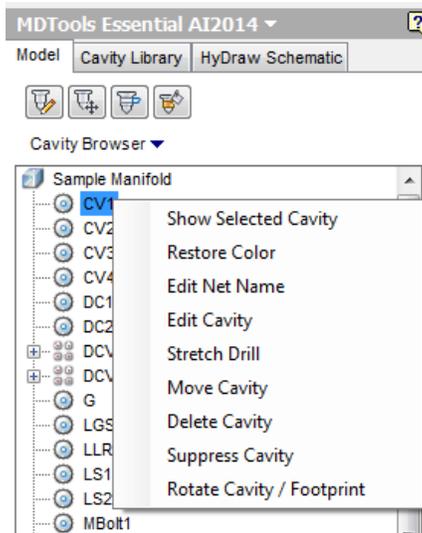
The context menu (right click) on the **selected cavity**:

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)

Edit Net Name

View and edit the net names of the selected cavity.

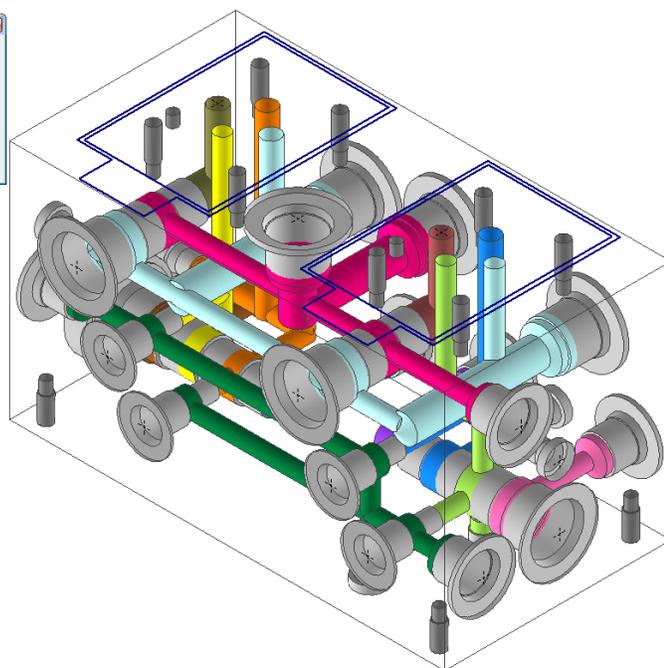
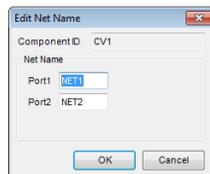
1. Right click the required cavity in the Cavity Browser.
2. Click **Edit Net Name**.

The Edit Net Name dialog box displays the net name of the selected cavity.

3. Edit the net names.
4. Click **OK**.

Invokes the other selected commands,

- Edit Cavity
- Stretch Drill
- Move Cavity
- Delete Cavity
- Suppress Cavity
- Rotate Cavity/Footprint



Edit Net Name dialog box

4. MDTools Essential AI2014 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.

The left-click context menu on the **selected face** enables you to Stretch block.



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

The left-click context menu on the **selected cavity** enables you to:

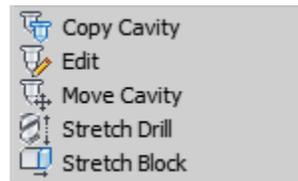
Edit, move, connect, align, copy, delete, rotate, and suppress cavity, stretch drill, and change face.



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

The right-click context menu 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

5. MDTools Essential AI2014 Cavity 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

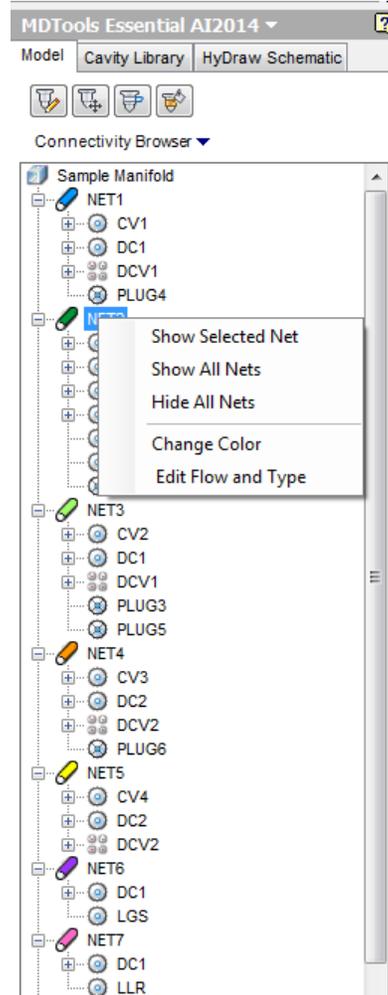
- Displays the selected net with the net color and all other nets with the Dead Area color.

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.

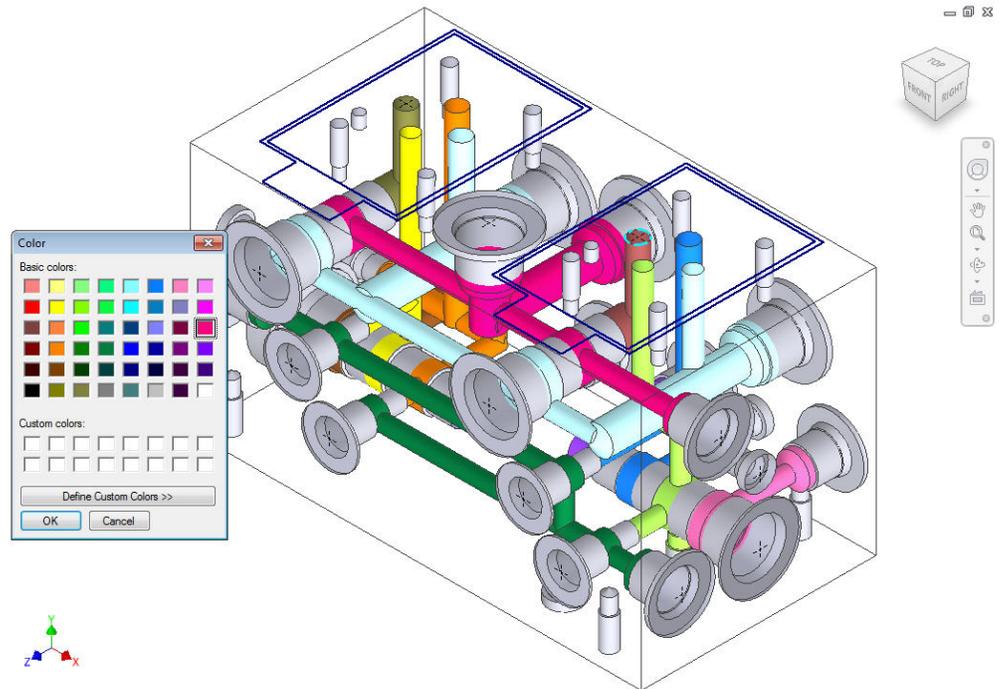


MDTools Connectivity Browser

Change Color

Changes the color of the selected net.

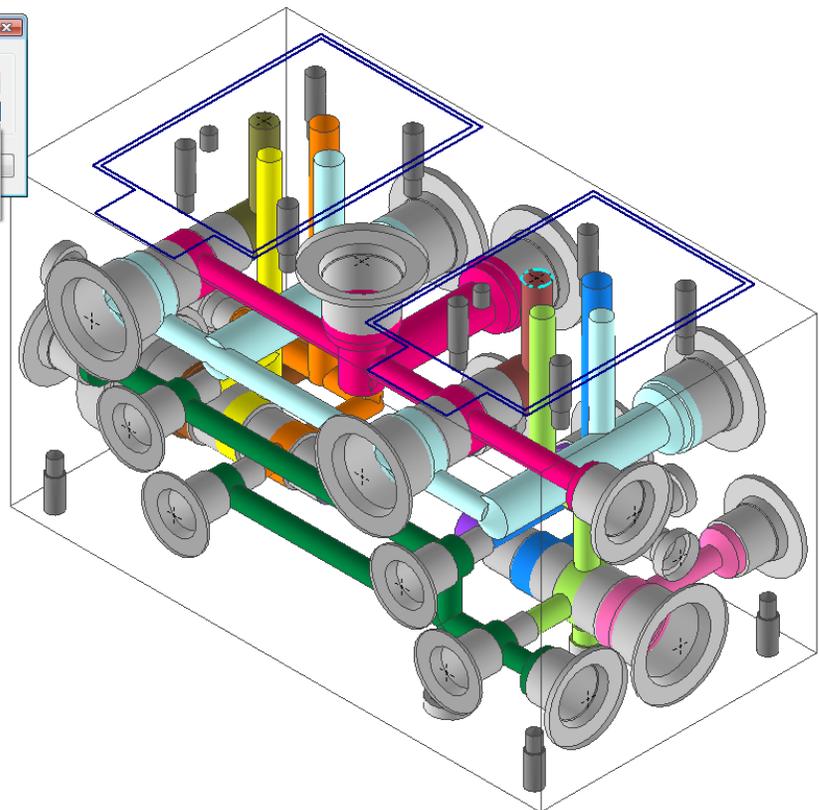
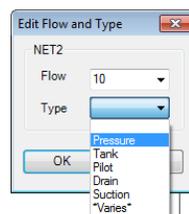
1. Select **Change Color** from the context menu.
The Color dialog box displays.
2. Select the new color for the selected net.
3. Click **OK**.
MDTools® updates the selected net with the new color.



Changing net color

Edit Flow and Type

1. Select **Edit Flow and Type** from the context menu.
The Edit Flow and Type dialog box displays.
2. Enter or Select the listed flows.
3. Select **Type**.
(Pressure/Tank/Pilot/Drain/Suction).
4. Click **OK**.
MDTools updates the selected net with the defined flow and type.



Note:

- Select the *Varies* option for the net, which has a varying flow and type.
- The Flow and Type are only for reference and not for internal calculation.

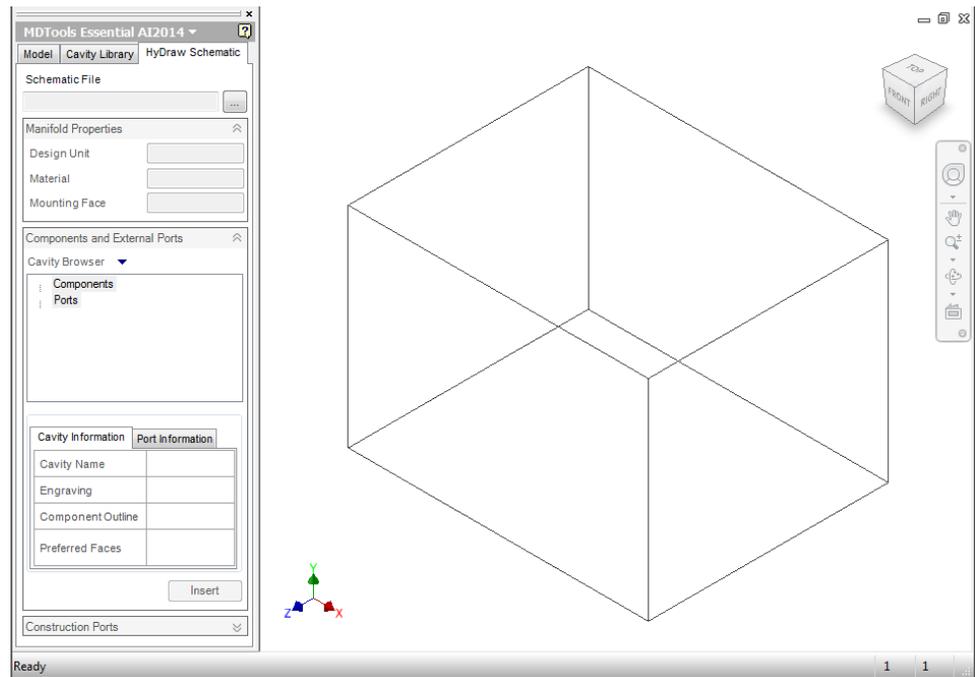


Edit Flow and Type

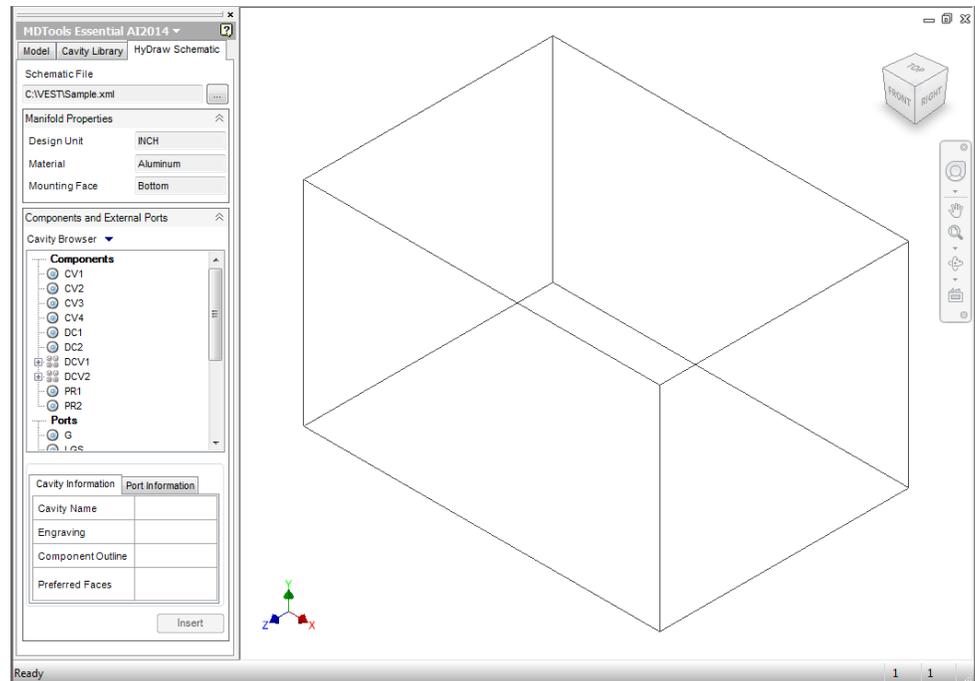
4. HyDraw Schematic Interface

Automatically read an XML exported from a HyDraw® created schematic drawing and insert all the required cavities with connectivity information into a model.

1. MDTools Essential AI2014
> **Insert** panel
> **From HyDraw**
The HyDraw Schematic tab displays in browser.
2. Click **Browse** and select the XML file exported from the HyDraw schematic drawing.
3. Click **Open**.
MDTools® automatically populates the Cavity Explorer with all the components from the schematic drawing.



HyDraw Schematic Interface



HyDraw Schematic Interface : Schematic data populated

Manifold Properties

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

Manifold Properties

Design Unit: INCH

Material: Aluminum

Mounting Face: Bottom

HyDraw Schematic : Manifold Properties Section

Components and External Ports

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

Select a component or port from the list to view the cavity and the port information.

Components and External Ports

Cavity Browser

Components

- CV1
- CV2
- CV3
- CV4
- DC1
- DC2
- DCV1
- DCV2
- PR1
- PR2

Ports

- G
- LGS
- LLR
- LS1

DCV1

Cavity Information | **Port Information**

Cavity Name	D03
Engraving	DCV1
Component Outline	✓
Preferred Faces	Top

Insert

Cavity Information		Port Information	
Port	Flow	Type	Net
A	8	Pressure	NET-10
B	8	Pressure	NET-9
P	8	Pressure	NET-12
T	8	Tank	NET-1

Cavity Information

Cavity Name Name of the cavity in the library

Component Outline Component outline defined for cavity, or

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

Port Information

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

HyDraw Schematic : Components and Ports Section

Construction Ports

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

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

This function is available only with the Export from QuickManifolds option.

Construction Ports

Cavity Name: SP-02

Flush

Insert

HyDraw Schematic : Construction Ports Section

5. MDTools Cavities

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

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

5.1 Modeling Cavities

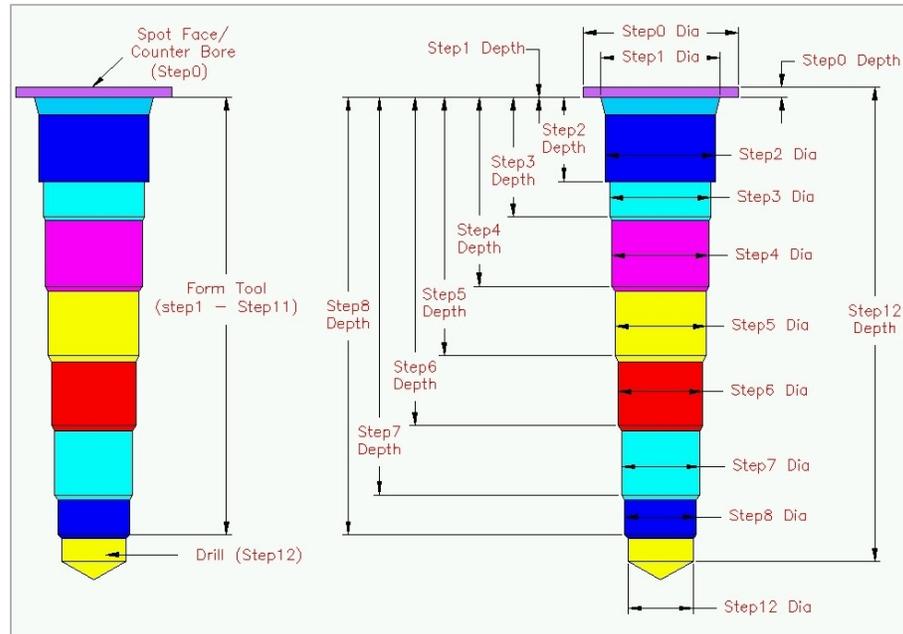
Geometry of a cavity is defined in terms of its dimensions, and its relationship with the step number and step dimensions.

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

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

Note:

Depth for Step1 through Step11 is measured from Step0.



MDTools Cavity Geometry

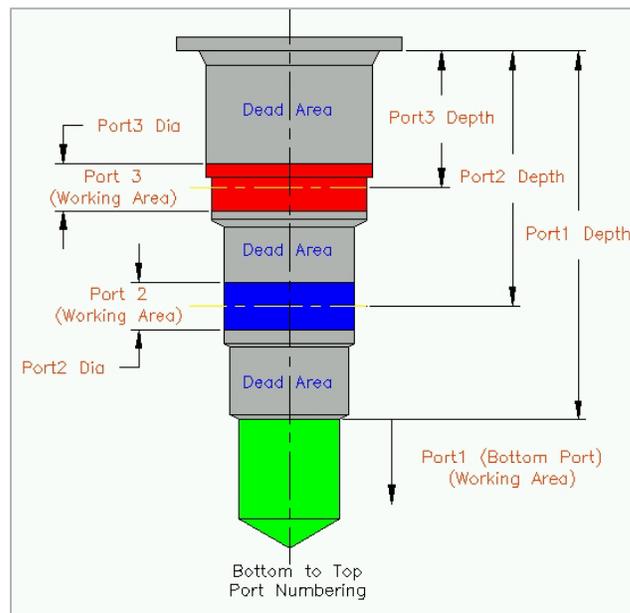
1. Cartridge Valve Cavities

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

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

Note:

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



Typical 3-port Cartridge Valve Cavity

2. Ports

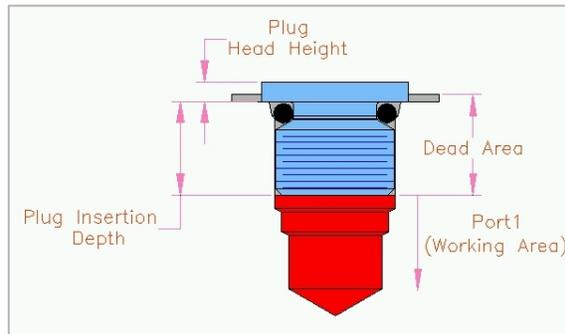
Cavities of ports are divided into working and dead areas.

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

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

Note:

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

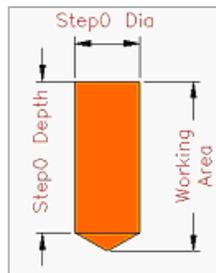


Port Cavity

3. Drill Holes

The complete cavity is treated as Working Area.

Hole dimensions are entered in Step0 of the cavity.



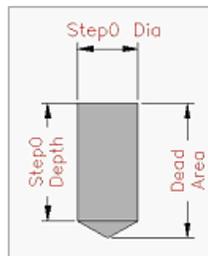
Drill Hole

4. Locating Pin Holes

The complete cavity is treated as Dead Area.

Hole dimensions are entered in Step0 of the cavity.

All the dimensions are fixed.



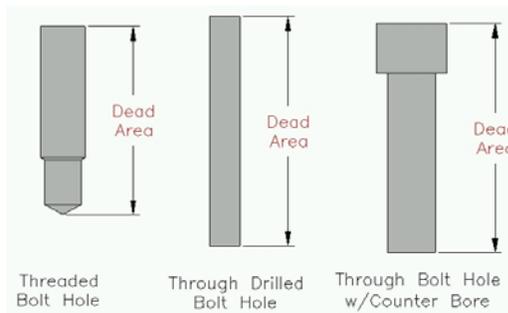
Location Pin Hole

5. Bolt Holes

The complete cavity is treated as Dead Area.

Three variations of bolt holes are used in manifold design.

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

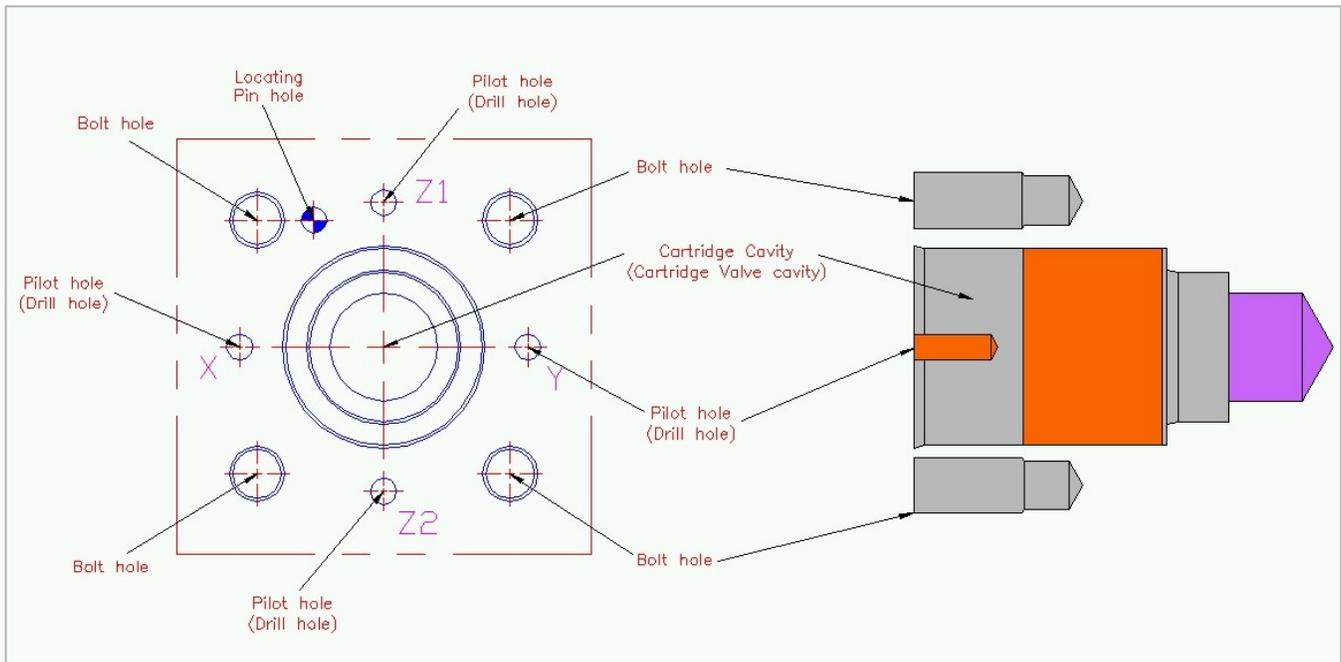


Bolt Hole

5.2 Footprints

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

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



Typical slip-in cartridge valve footprint

5.3 Nets (Flow paths)

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

1. Net List

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

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

5.4 Creating a Net List from a Schematic

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

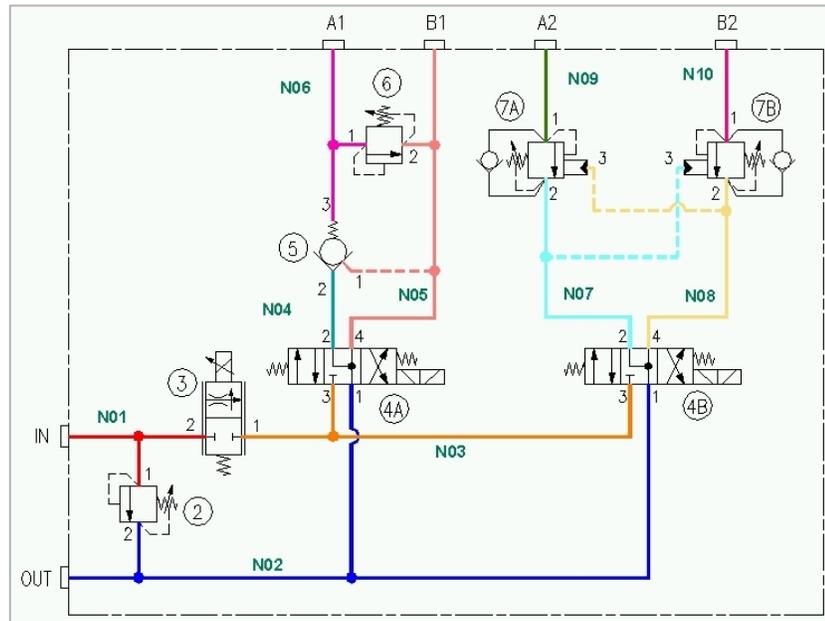
MDTools consistent naming system between schematics and the manifold encompasses:

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

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

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

- 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.
- For designing the manifold, consider these ports as components and assign the component names as the port names.



Typical schematic showing nets

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

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

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

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

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

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

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

Refer the schematic and check the listing for other nets.

6. Design Basics

MDTools® divides cavities into working and dead areas for accurate checking of problems, 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, NPT port, etc), cartridge valve cavity, or bolt hole.

Modeling Cavities

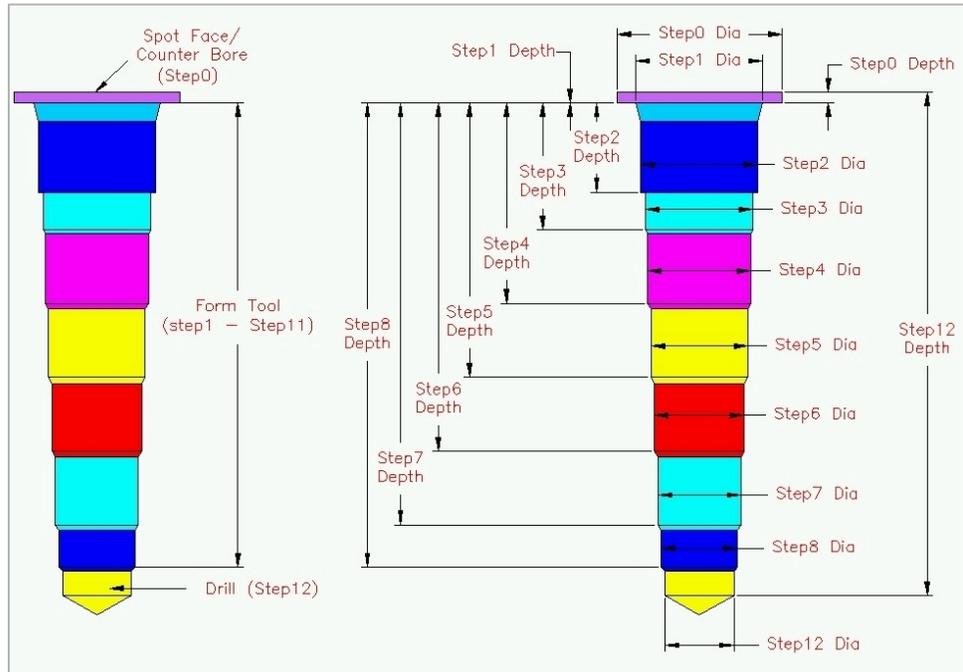
Geometry of a cavity in terms of its dimensions, and relationship with the step number and step dimensions.

Each step, generally consisting of a cylindrical and conical pair in the cavity profile is denoted by the term **Step** in MDTools.

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

Note:

Depth for Step1 through Step11 is measured from Step0.



Modeling MDTools Cavities

Ports

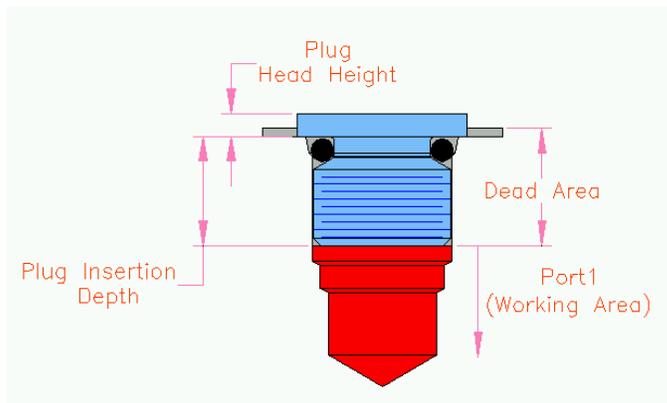
Cavities of ports are also divided into working and dead areas.

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

The area above the insertion depth is considered as 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 wall thickness checks.



Plug – Port: Dead Area and Working Area

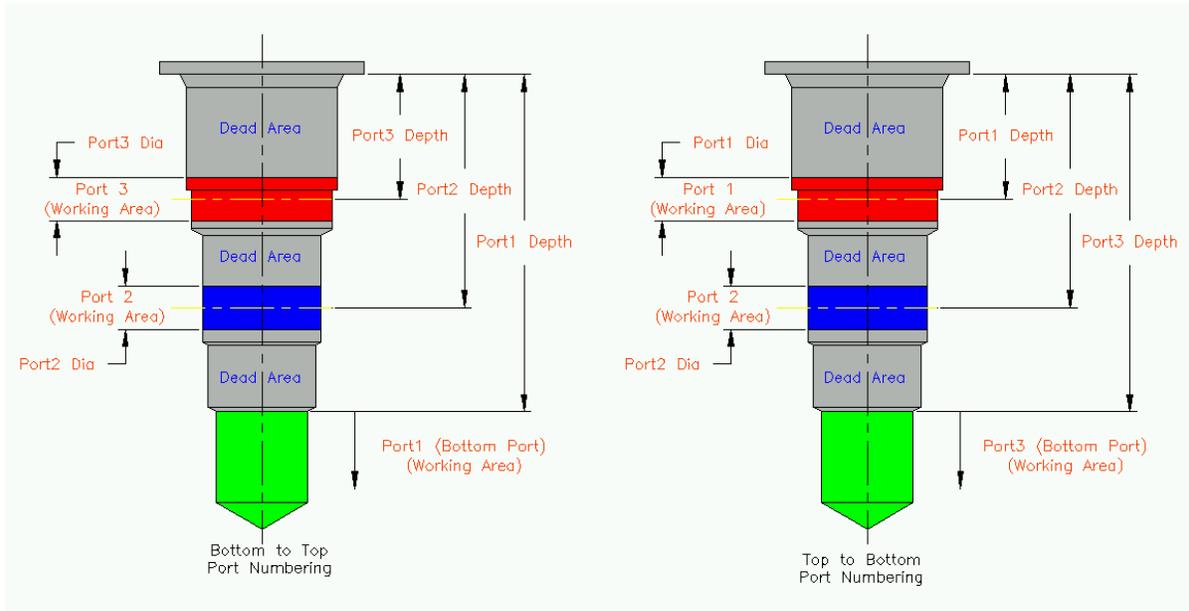
Cartridge valve Cavity

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 as Dead Areas.

Note:

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

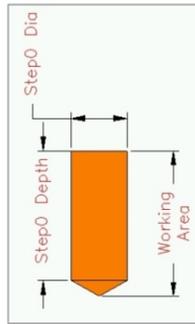


3 port Cartridge Valve Cavity

Drill holes

The complete cavity is treated as Working Area.

Hole dimensions are entered in Step0 of the cavity.



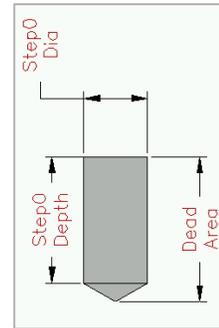
Drill Hole

Locating Pin Holes

The complete cavity is treated as Dead Area.

Hole dimensions are entered in Step0 of the cavity.

All the dimensions are fixed.



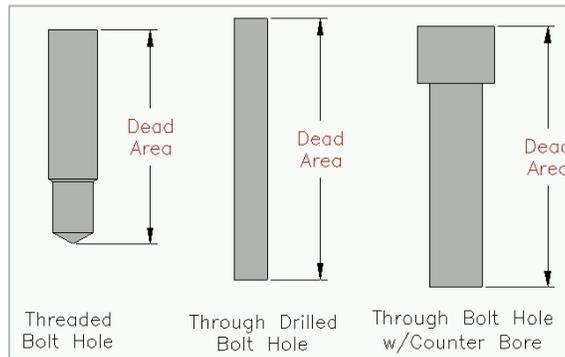
Locating Pin Hole

Bolt Holes

The complete cavity is treated as 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)



Bolt Holes

7. Using Angle Holes

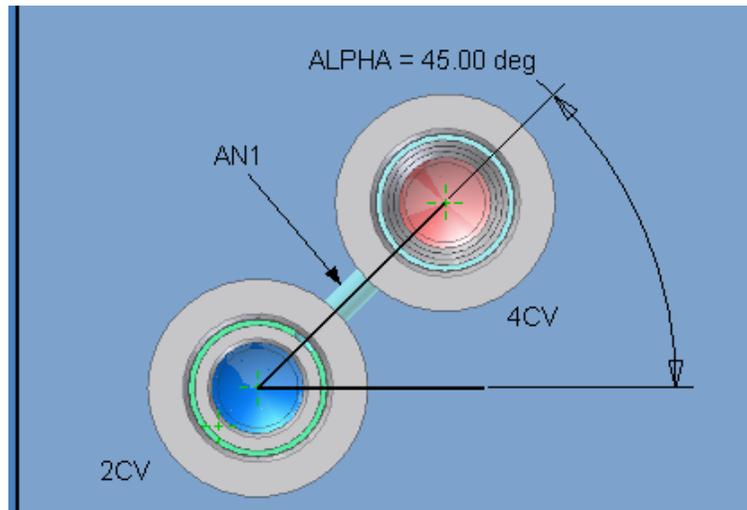
Compact manifolds, using minimum number of cross drills are often possible using angle drill holes. MDTools® Essential is equipped to model, visualize, and design using angle holes.

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

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

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

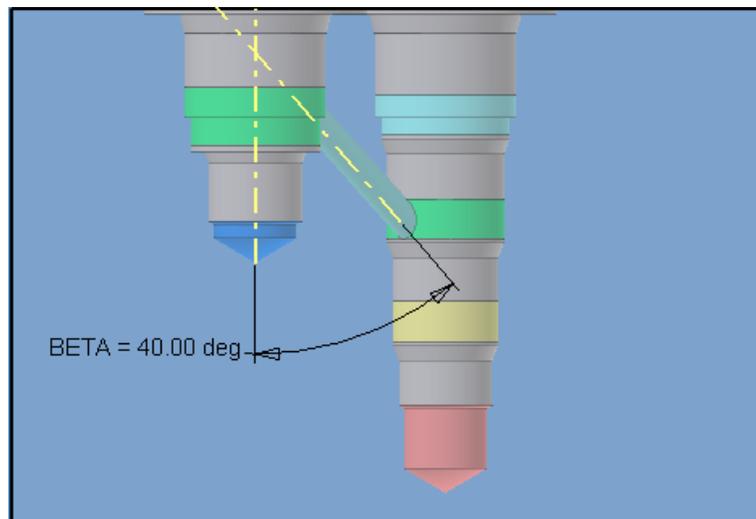
This connection is made using a compound angle drill AN1.



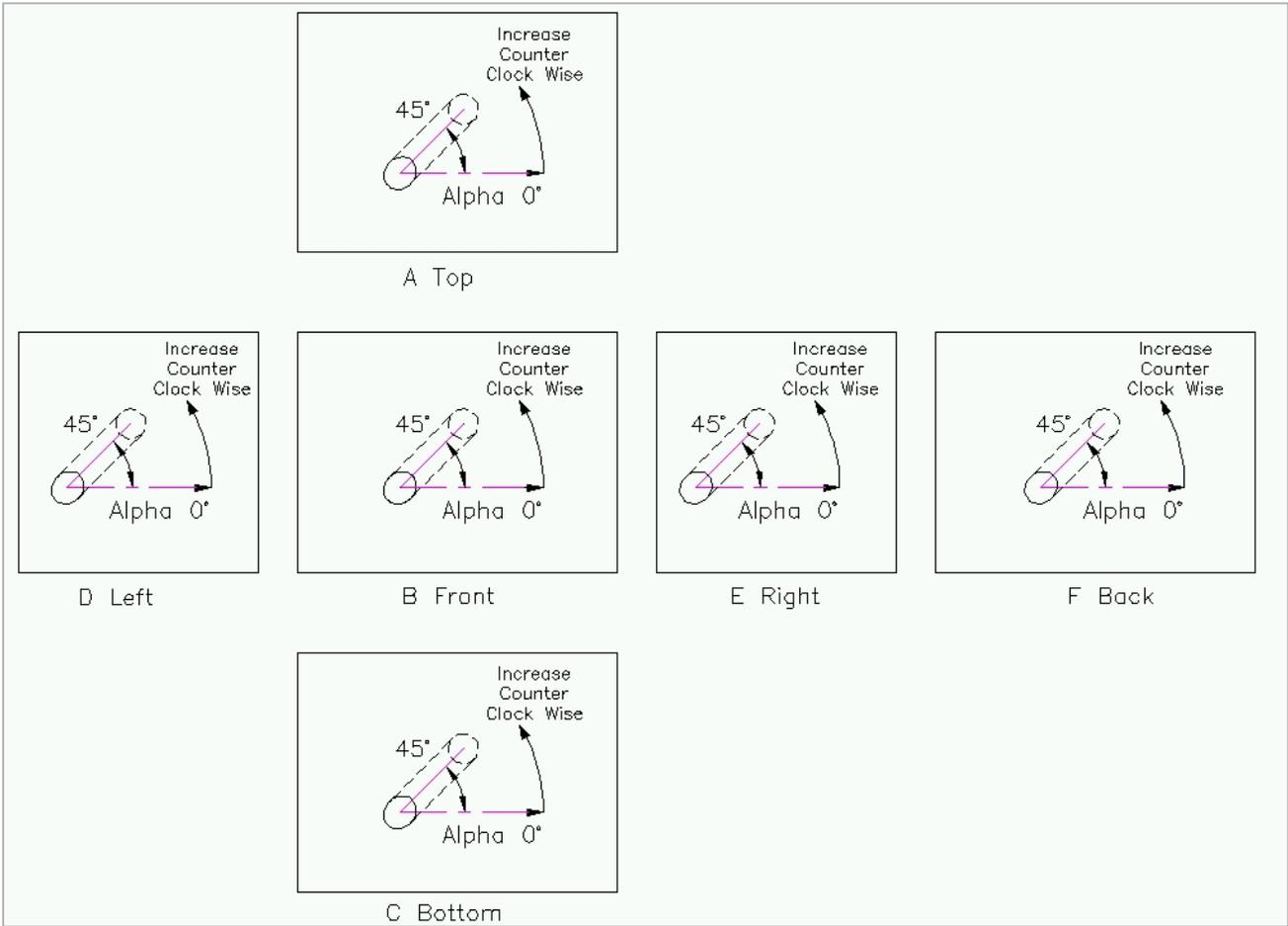
Alpha - rotation on the surface

Note:

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



Beta - inclination from surface Normal

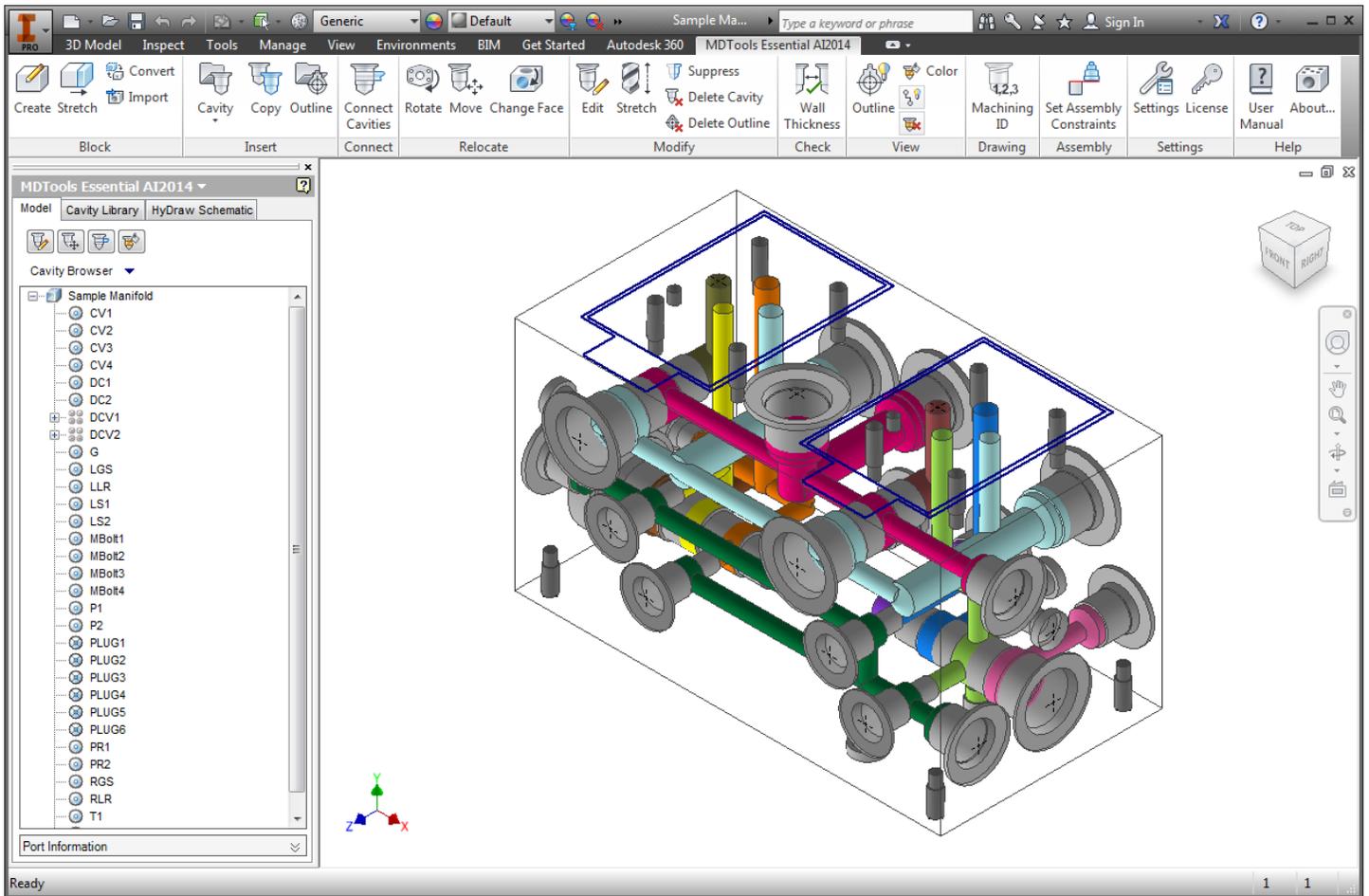


Alpha angle convention used in MDTools

Note:

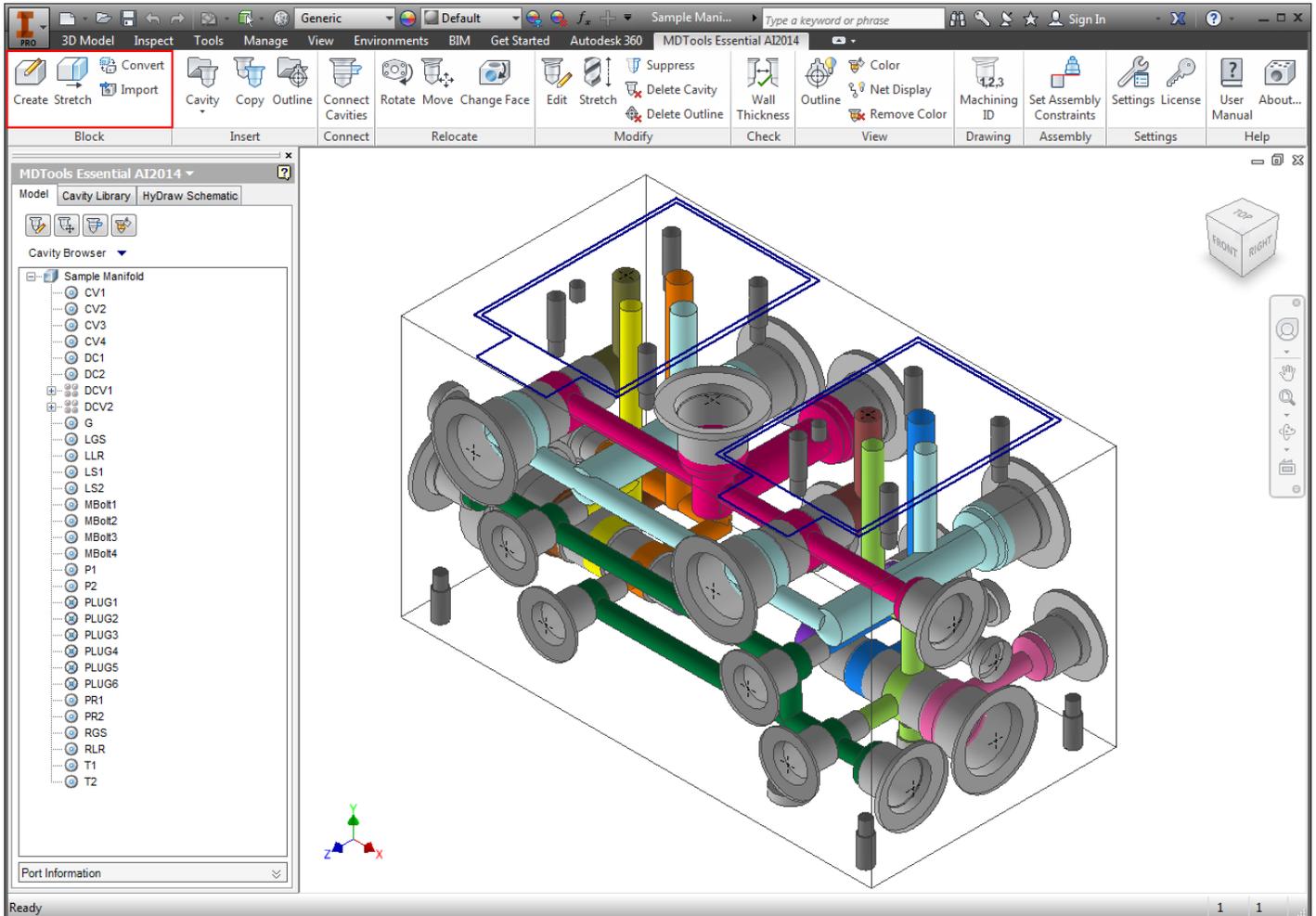
The depth of an angle hole shown in the Edit Cavity dialog box is the depth along the axis of the angle hole.

DESIGN COMMANDS



Block Commands

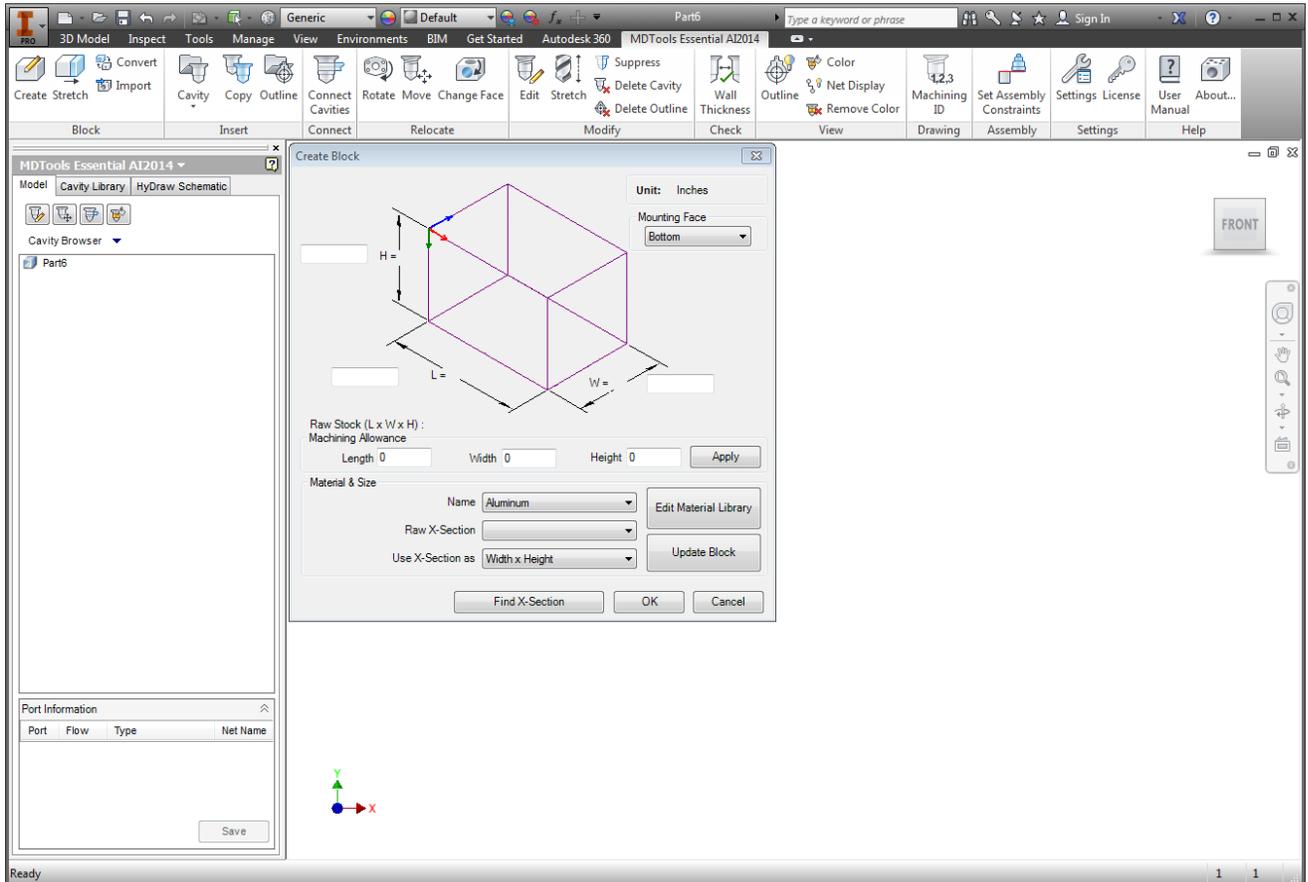
- 8 Create Block
- 9 Stretch Block
- 10 Convert Block
- 11 Import Manifold



8. Create Block

Automatically draws the manifold block in Inventor drawing space, based on the required manifold length, width, and height entered; or by selection of the required material cross section from an existing material X-section database, and input of the corresponding length.

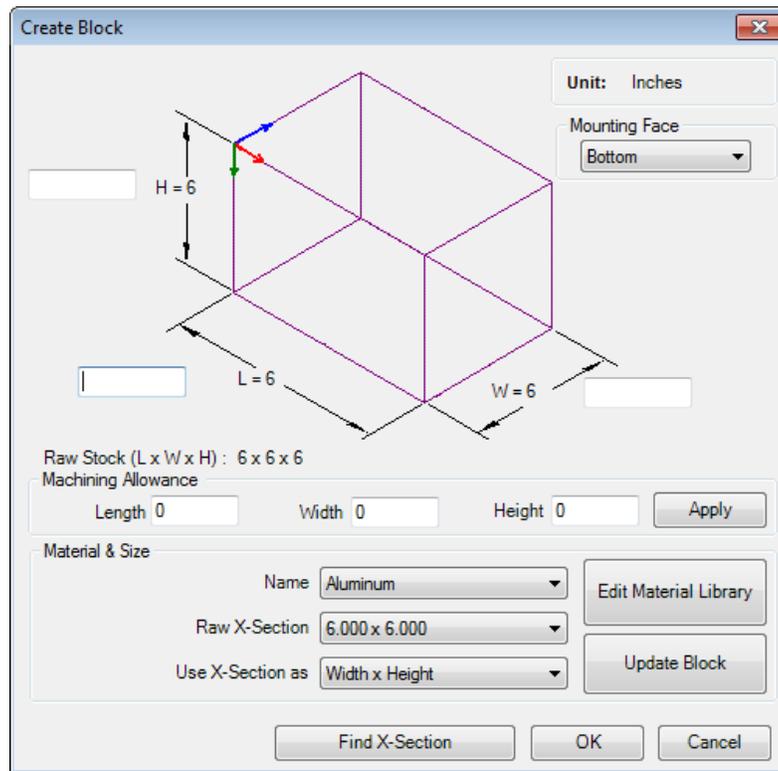
The Machining allowance values on the raw X-section can also be specified.



8.1 Create Block - Dimensions entered manually

1. MDTools Essential AI2014
 >Block panel
 >Create (Block)
 The Create Block dialog box displays.
2. Enter the required dimensions manually.
3. Enter the manifold dimensions in the data fields:
 - H Manifold Height
 - L Manifold Length
 - W Manifold Width
4. Enter the machining allowance for each of the 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 in the Inventor workspace.

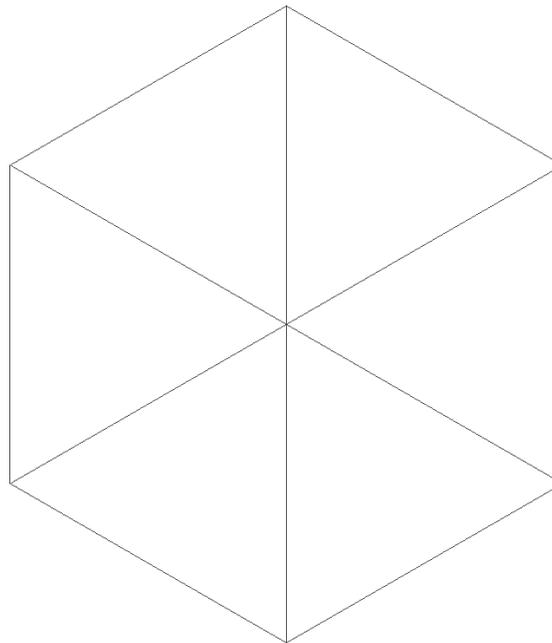
Note:

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

Block Length, Block Height, and Block Width.



A Block Drawn in Inventor

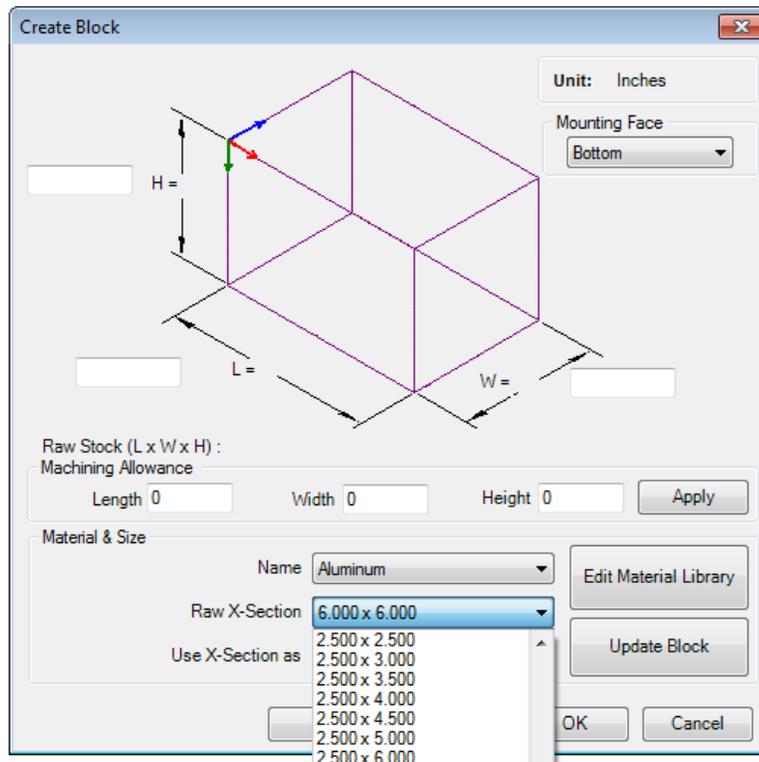


8.2 Create Block - using Material X-Section Libraries

MDTools Essential AI2014
> **Create** (Block)

The Create Block dialog box displays.

1. Select the material from the **Name** drop-down menu in the Material & Size section.
*The default material is Aluminum.
You can change the material, if required.*
2. Select the raw X-section from the **Raw X-Section** list of the selected material.
3. Select the required option from the **Use X-Section as** list.
You can use the X-section in any of the possible combination of length, width, and height.
4. Click **Update Block**.
MDTools® updates the block dimensions with the selected X-section, per the selection made in the Use X-Section as option.

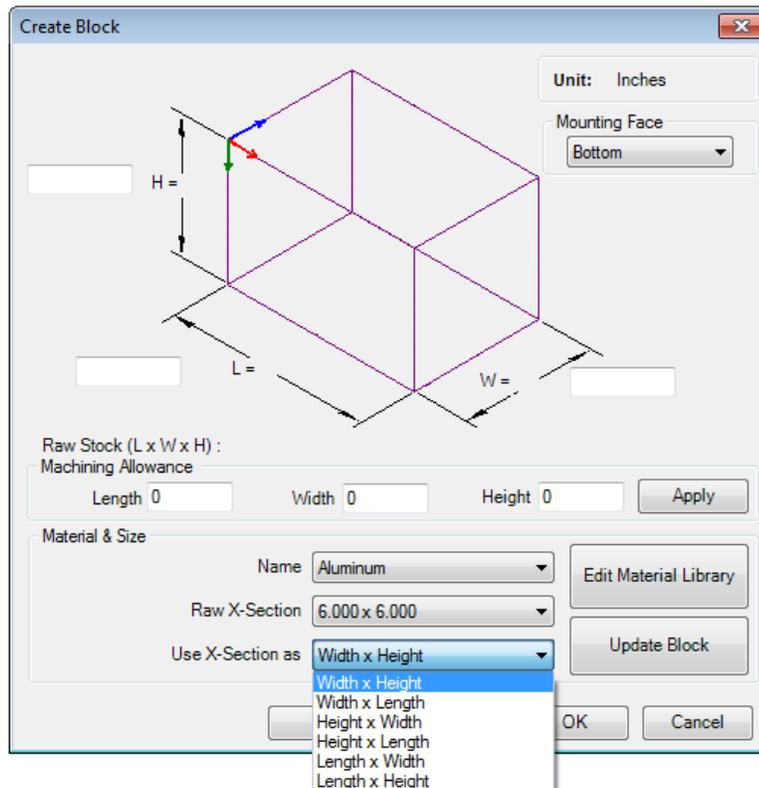


Create Block dialog box showing the material X-section dimensions

5. Enter the third dimension for the block.
For example, if X-section is used for block width and height, then enter the block length.
6. Enter the machining allowance for each of these dimensions.
7. Click **Apply**.
The machining allowance is subtracted from the respective manifold dimension when drawing the manifold.

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



Create Block dialog box: Use X-Section as

8.3 Create Material X-Section Library

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

MDTools Essential AI2014
> **Create (Block)**

The Create Block dialog box displays.

Click **Edit Material Library**.

The Edit Material Library dialog box displays.

Add New Material

1. Enter the material name in the **Material** text box.

2. Click **Add**.

MDTools adds the new material into the library.

Change Material Name

1. Select the name of the material 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 entered.

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**.

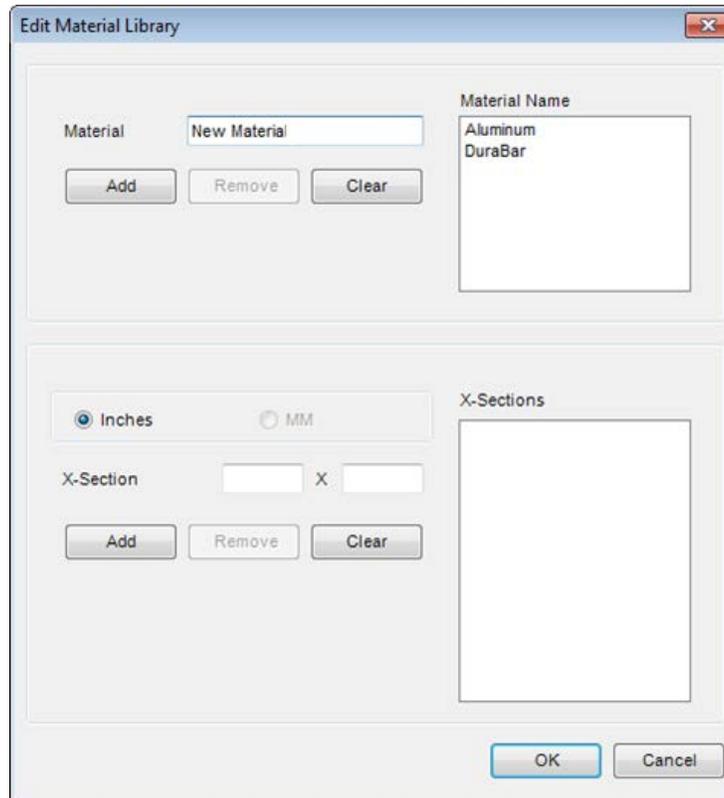
A message displays 'Do you want to delete selected material name?'

3. Click **Yes**.

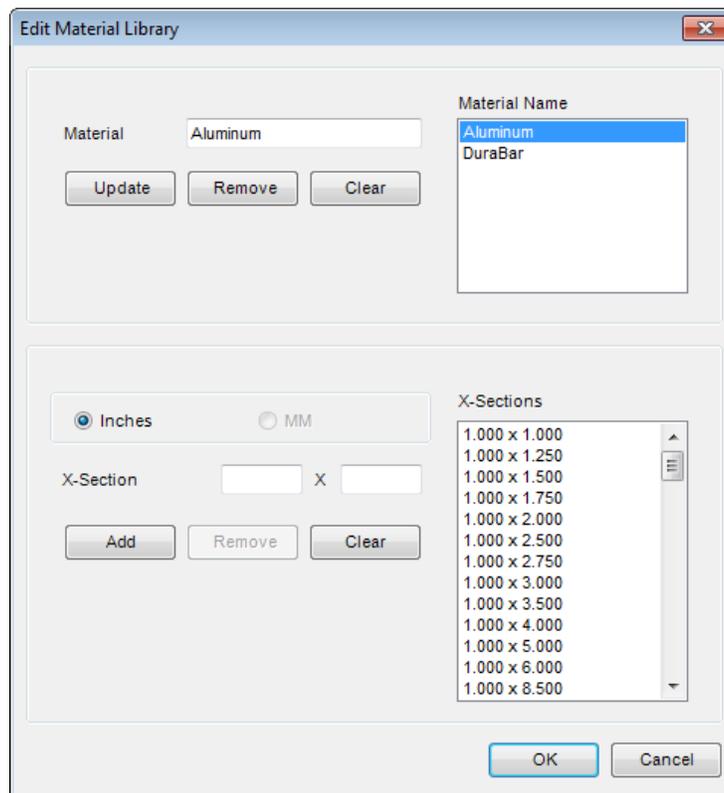
MDTools deletes the material from the Material library.

Note:

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



Edit Material dialog box: Add new material



Update material name

Add new X-section

Select a material name from the library

A list of X-section displays in the X-Sections list.

1. Select the unit: **Inches** or **MM**.
2. Enter the X-section dimensions in the text boxes.
3. Click **Add**.
MDTools® adds the new X-section to the library.

Change X-section dimension

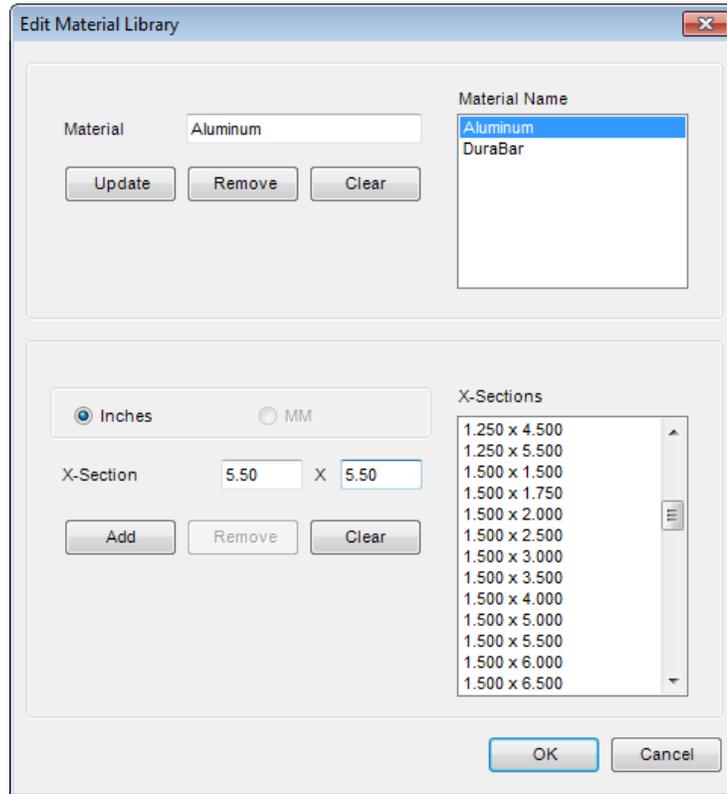
1. Select the X-section you want to change from the X-Sections list.
X-section dimensions are displayed in the text boxes for X-Section.
2. Select the X-section you want to change.
3. Change the dimension in the **X-Section** textboxes, as required.
4. Click **Update** to save the change.

Delete X-Section

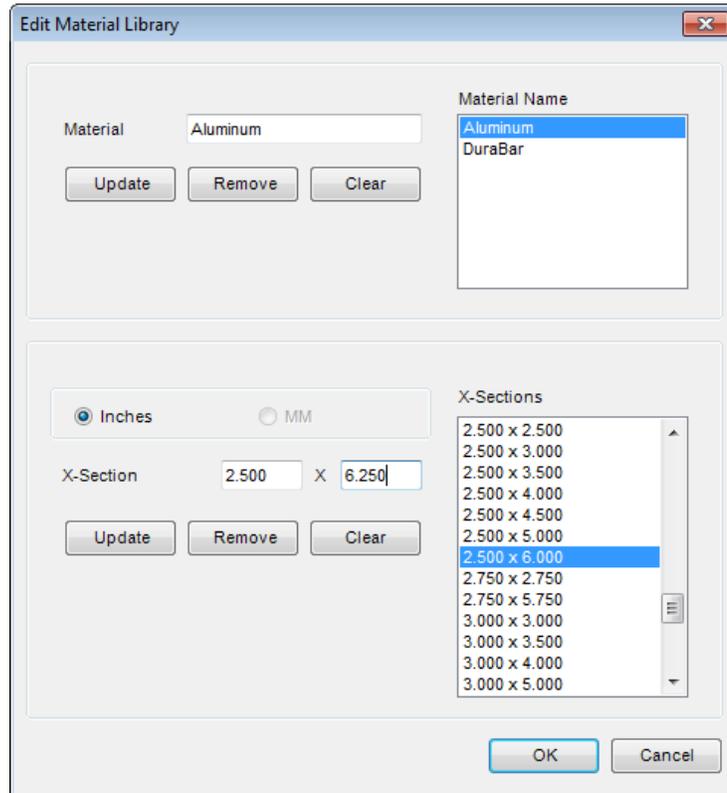
1. Select the X-section you want to remove from the library.
X-section dimensions are displayed in the text boxes for X-Sections.
2. Click **Remove**.
A message displays, 'Do you want to delete selected X-section?'
3. Click **Yes**.
MDTools deletes the selected X-section from the Material library.

Note:

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



Add new X-section



Change X-section dimensions

8.4 Find X-Section

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

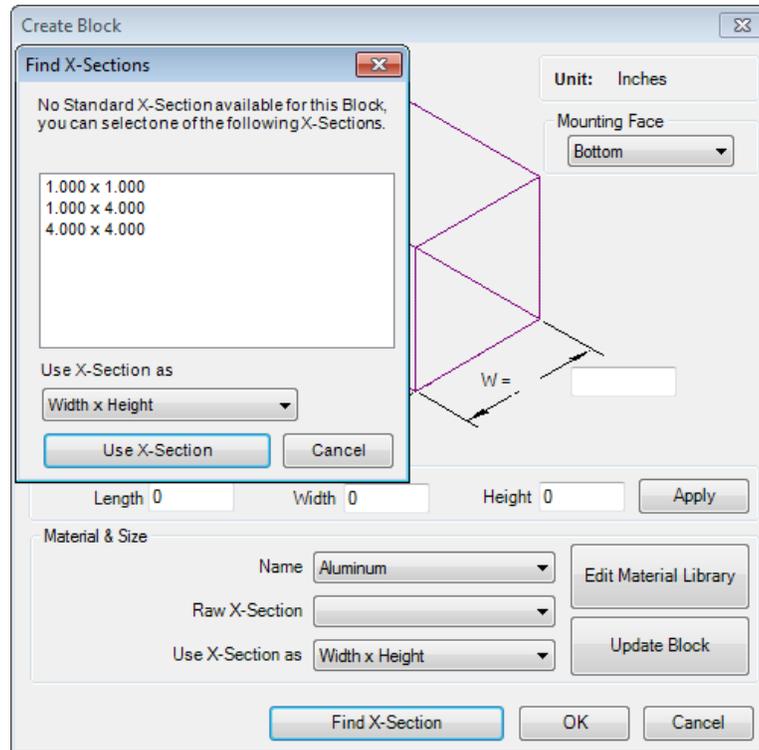
1. Select the desired material from the Material **Name** list from the Create Block dialog box.

2. Click **Find X-Section**.

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

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

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



Find X-Sections dialog box

Updating Block Dimensions

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

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

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

Note:

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

9. Stretch Block

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

1. MDTools Essential AI2014
> **Block** panel
> **Stretch (Block)**

MDTools® prompts to select a manifold face.

2. Select a face

The Stretch Block dialog box displays.

The select arrow appears on the selected face.

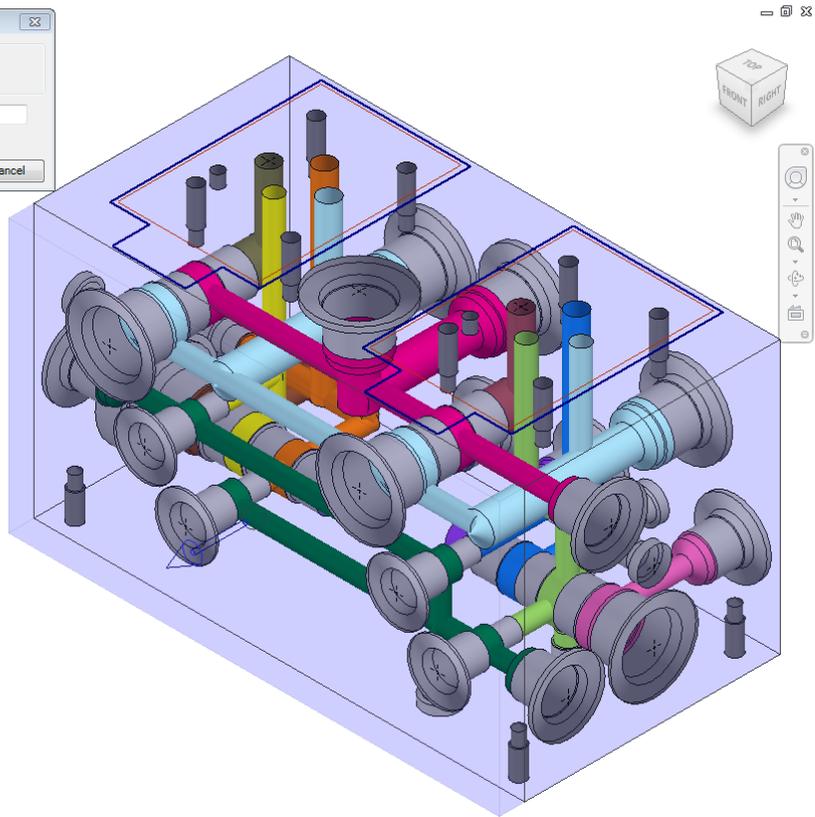
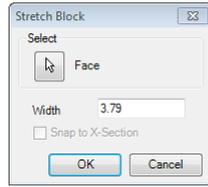
3. Select **Snap to X-Section** to snap the selected dimension to the available x-sections in the library.

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

5. Change the value in textbox, if required.

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

Location and drill depth of the cavities will be updated, if required.



Stretch Block dialog box

Note:

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

10. Convert Block

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

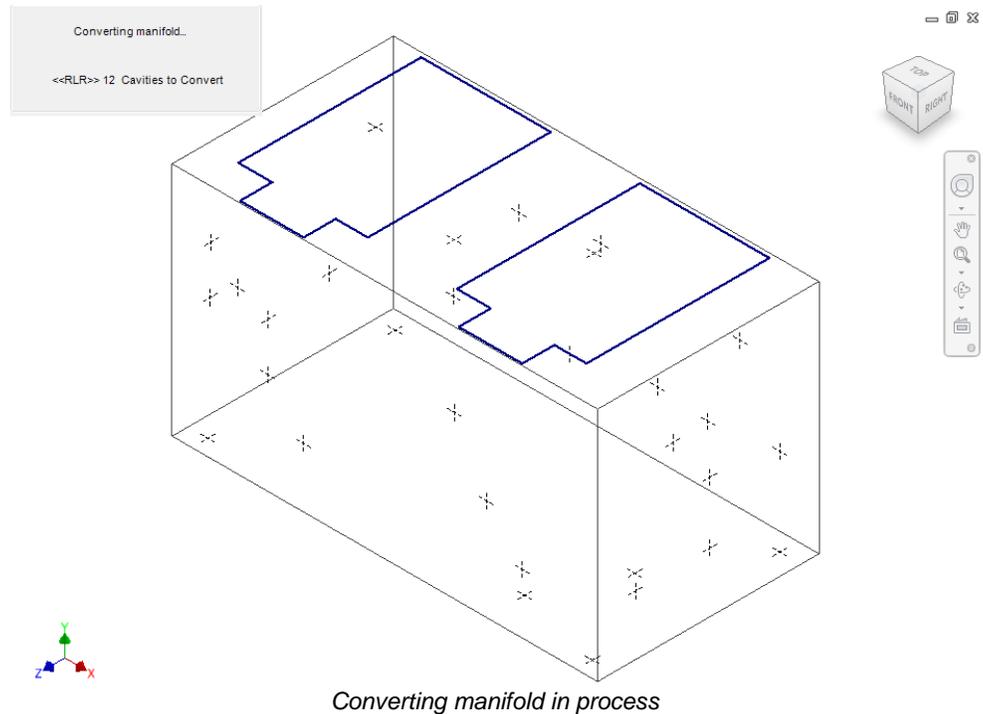
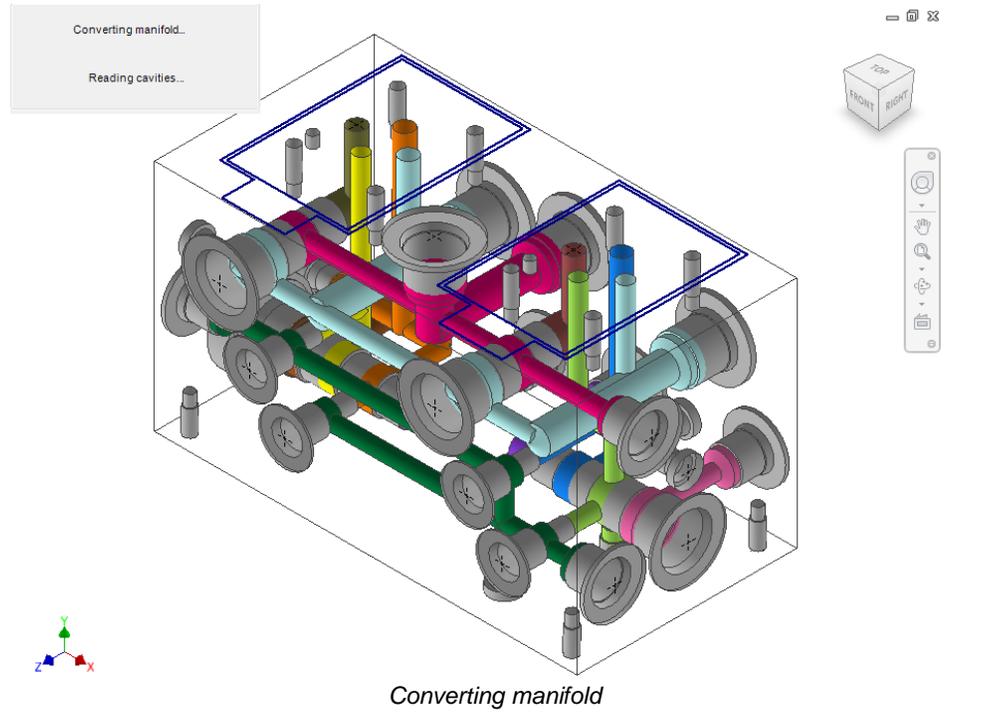
MDTools Essential AI2014
> **Block** panel
> **Convert**

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.



11. Import Manifold

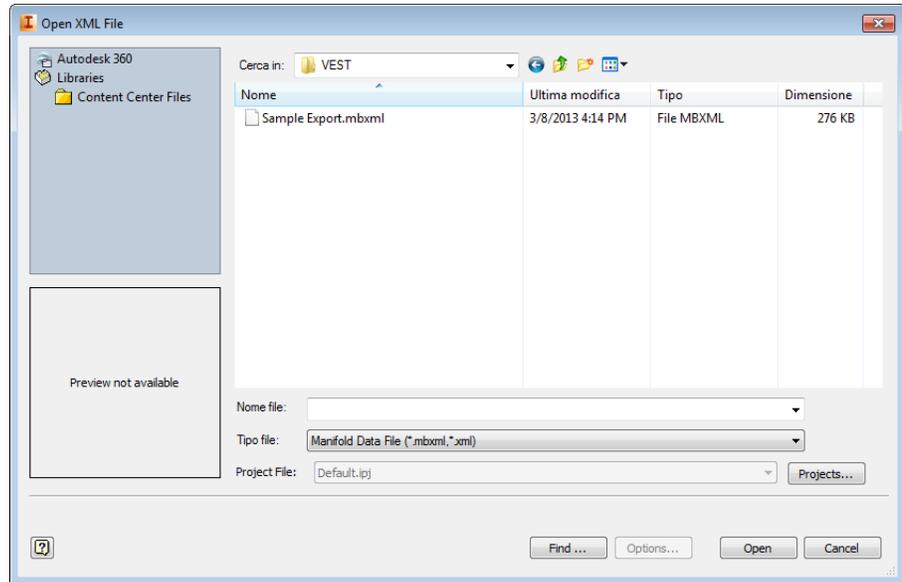
Import the MDTTools® manifold XML file and automatically create a new manifold in Inventor.

1. MDTTools Essential AI2014
> **Block** panel
> **Import**

The Open XML File dialog box displays.

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

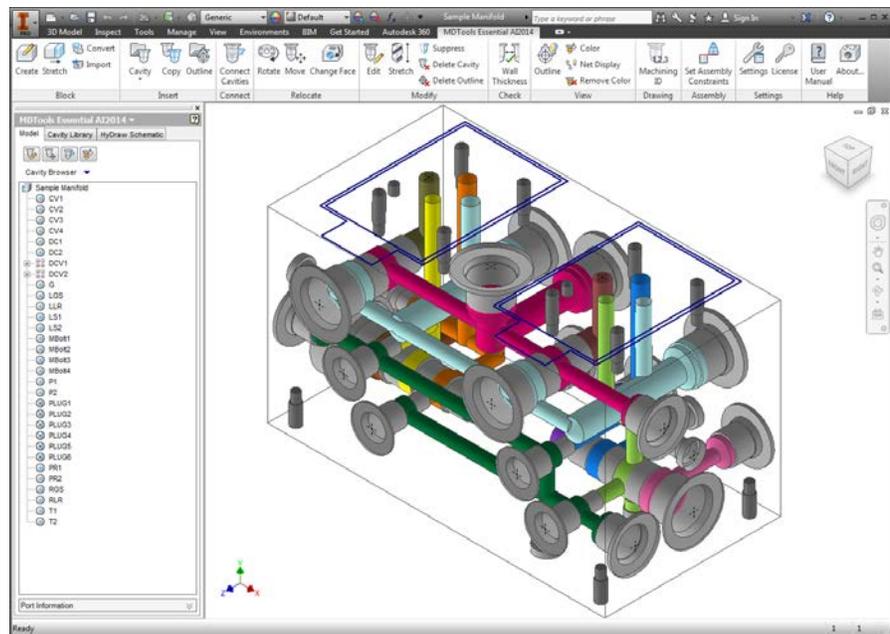
The program reads the input manifold data file and creates a new manifold in Inventor.



Open XML File dialog box

Note:

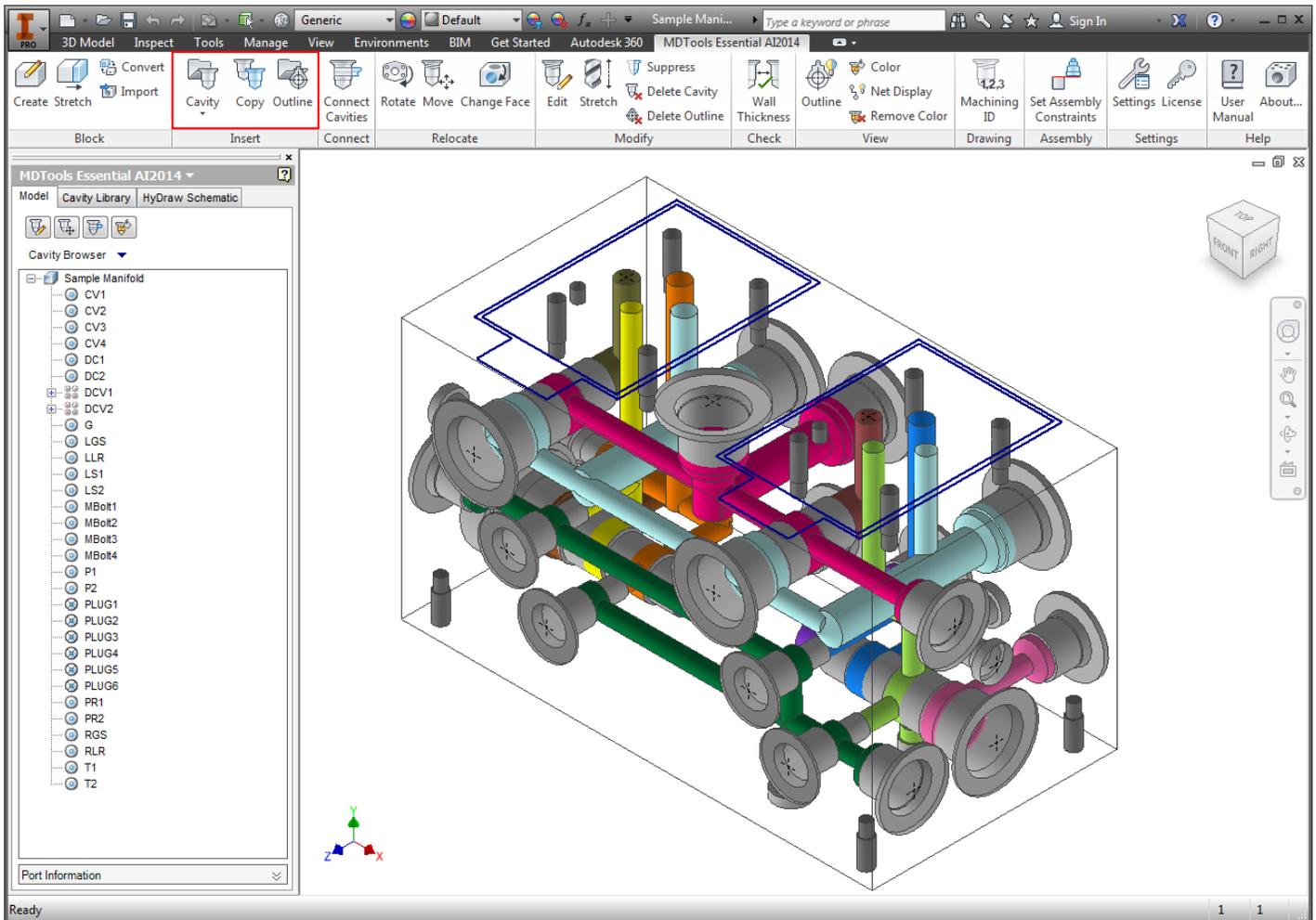
- When you import a manifold, MDTTools creates the manifold in the Virtual Cavity mode.
- Use the Convert command to convert the block design to a Feature-based cavity design.



Imported Manifold in Inventor

Insert Cavity

- 12 Insert Cavity (...from Library)
- 13 Insert Cavity (...from HyDraw Schematic)
- 14 Copy Cavity
- 15 Insert Outline



12. Insert Cavity (...from Library)

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

Insert Cavity/Footprint.

- MDTools Essential AI2014
> **Cavity**
The Cavity Library tab in the browser gets activated.

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

Or,

Select the required library from the dropdown.

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

- Select the required cavity/footprint. Enter **Component ID**.

When you insert a cavity/footprint for a component in a schematic, use the ID of the component in the schematic as the component ID for the cavity/footprint.

If you insert a cavity for a construction hole, then select the Construction Port option to automatically assign the component ID.

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

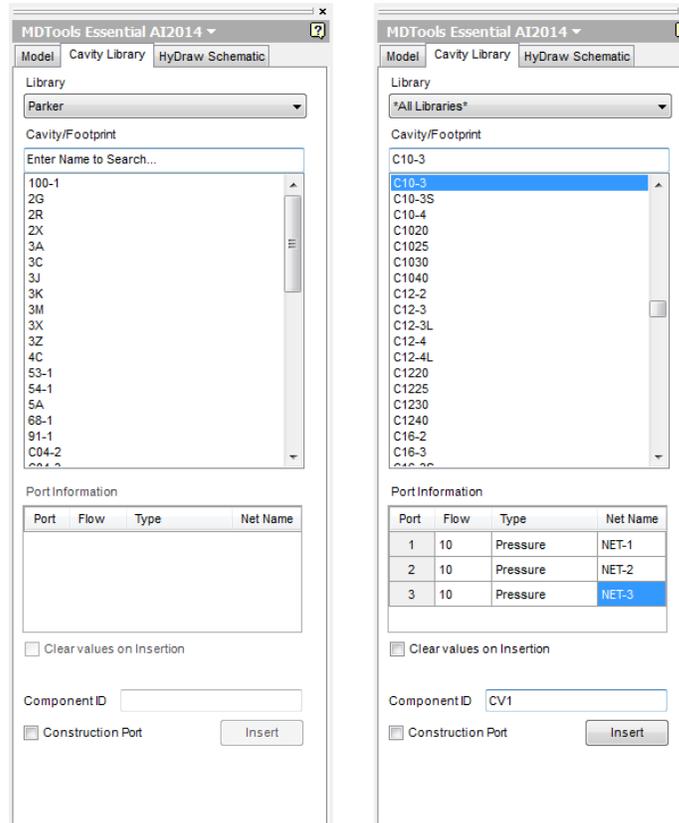
The Specify Cavity Location dialog box displays.

- Select the point on the manifold face, where you want to insert the cavity.
MDTools® displays a preview of the selected cavity at the selected point on the manifold.

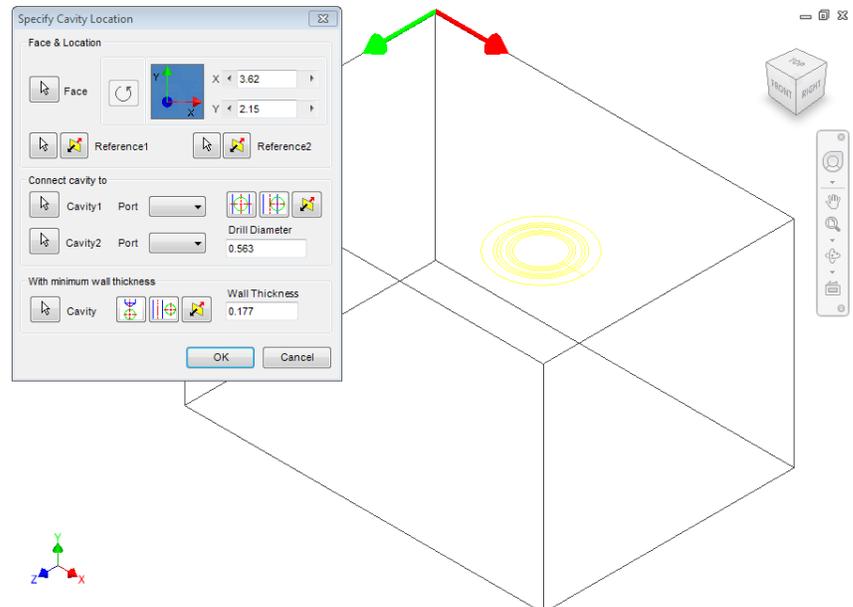
- Enter the X and Y distance from the block origin.
- Click **OK** to insert the cavity at the specified location.

Note:

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



Library Tab

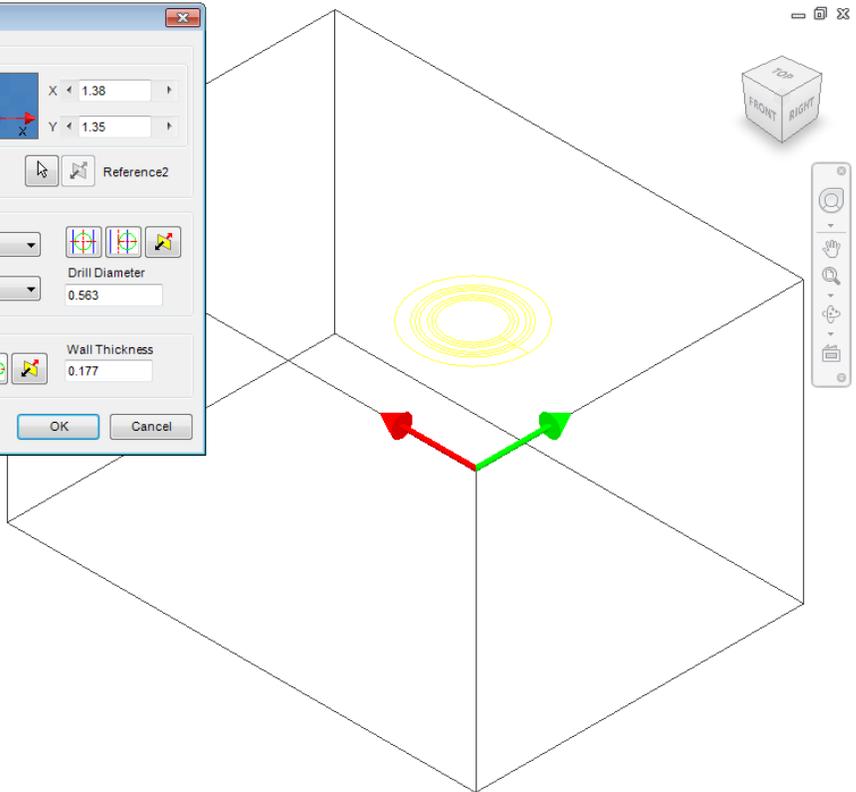
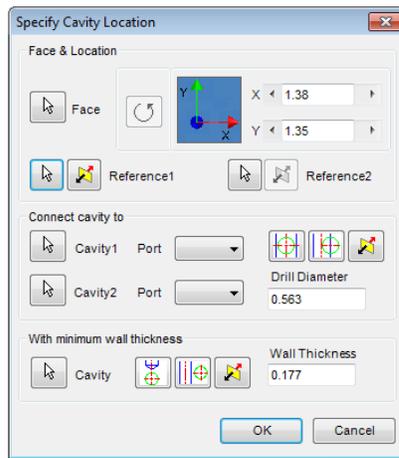


Specify Cavity Location dialog box

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.



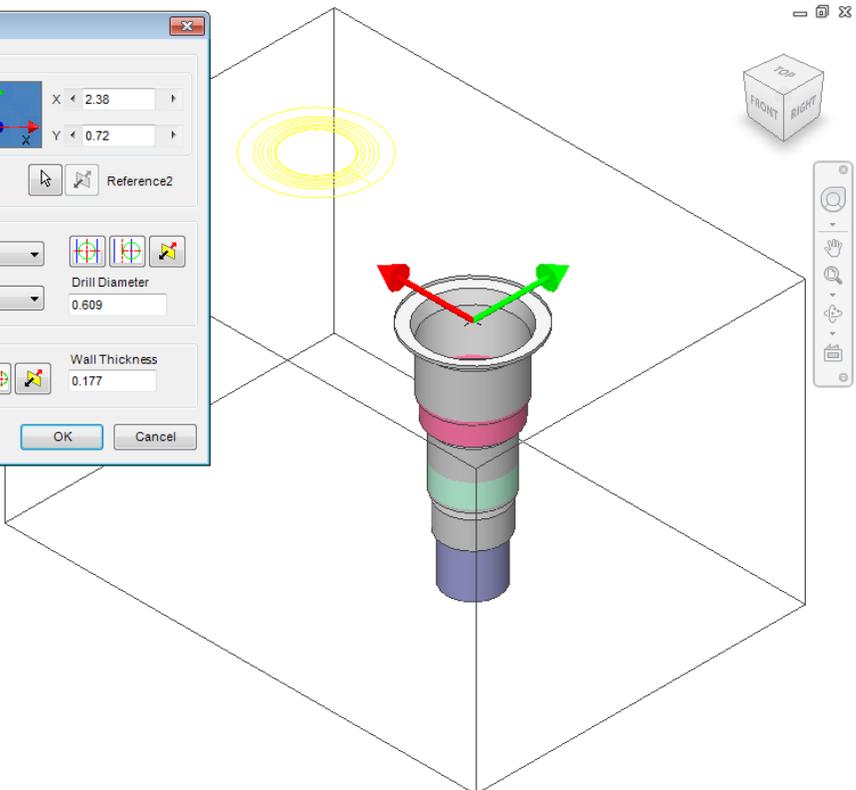
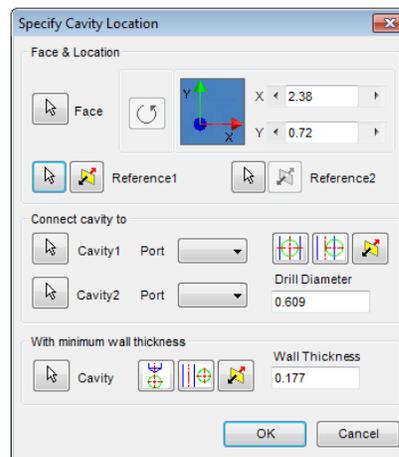
Note:

- Select Reference2 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 a 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 on changing the X and Y values.



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

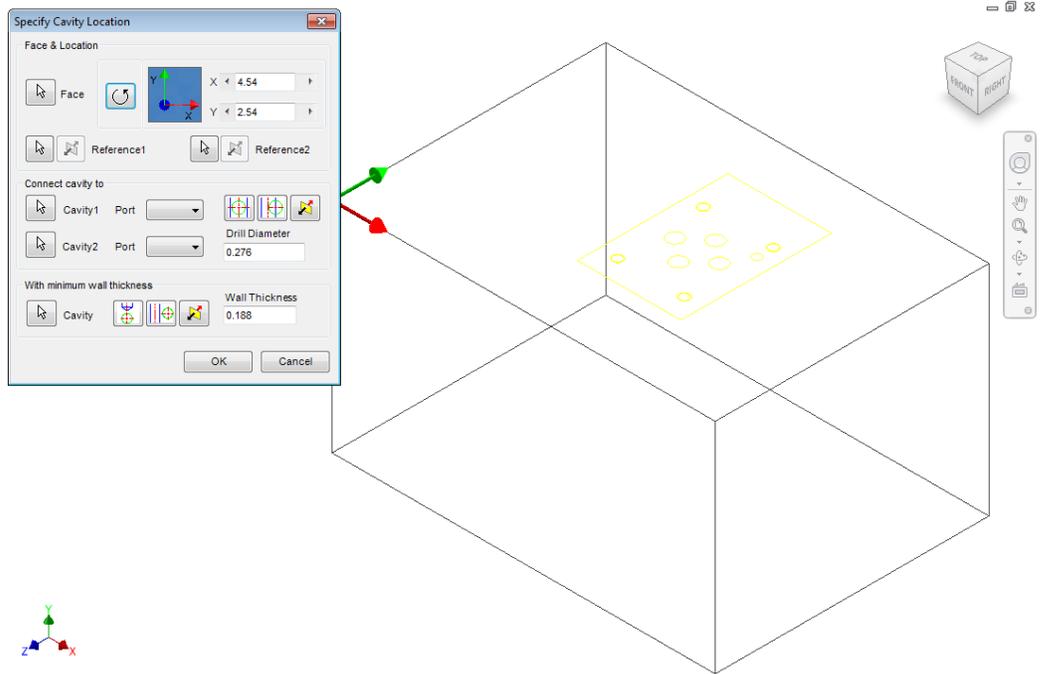
Position a new cavity with reference to an existing cavity

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.



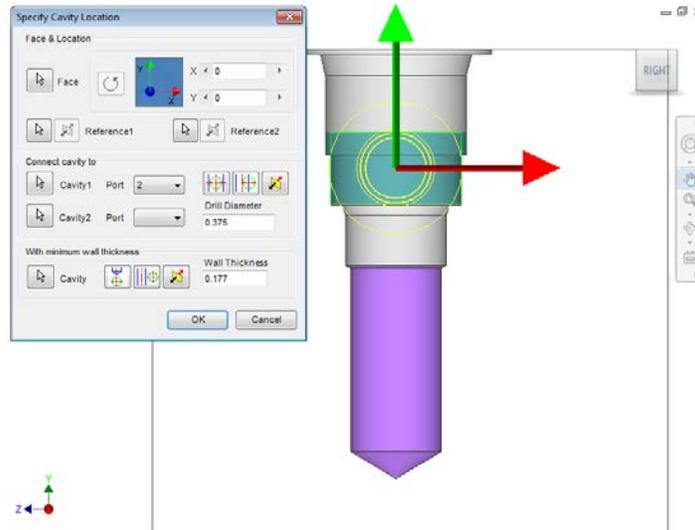
Rotate Footprint

3. Connect Existing Cavities

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

1. Click the selection button for cavity1.
2. Select the connecting cavity1.
3. Select the connecting port on the first cavity.

MDTools® automatically relocates the cavity to the port center and displays the drill diameter.

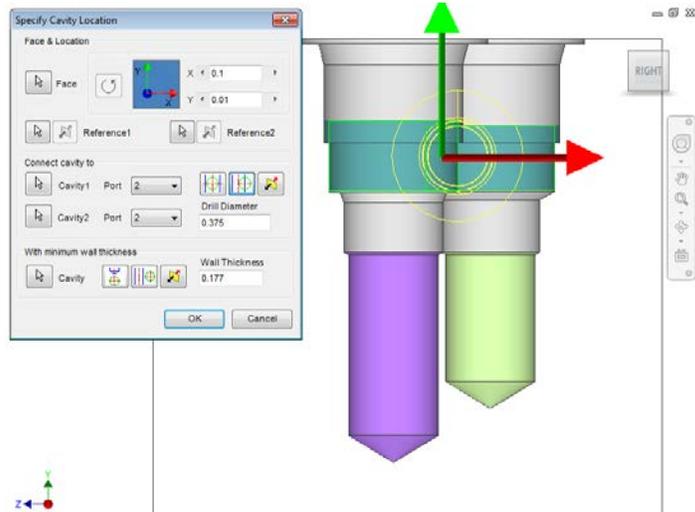


Connecting to an existing cavity

- 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.

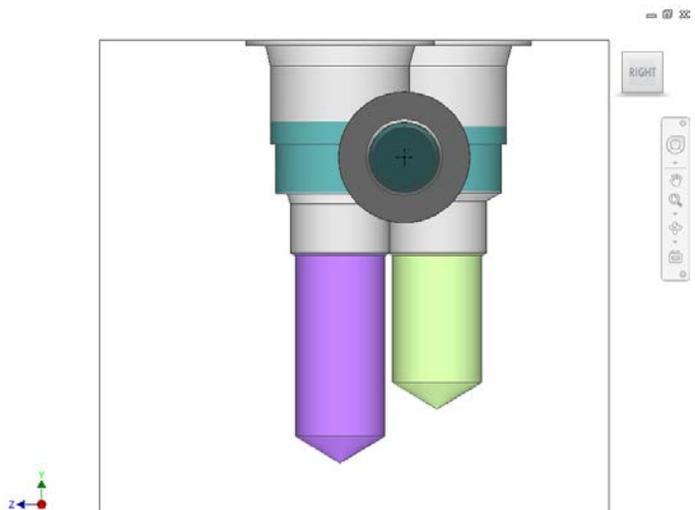
4. Click **OK**.
- MDTools creates the new cavity at the specified location and connects the cavity to the selected connecting cavities.*



Positioning the cavity on sides

Note:

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

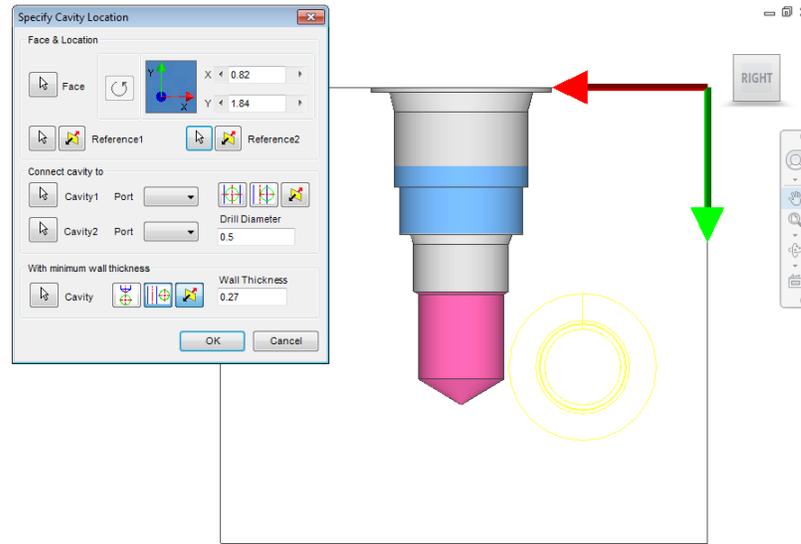


Connecting two existing cavities

Position with minimum wall thickness

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

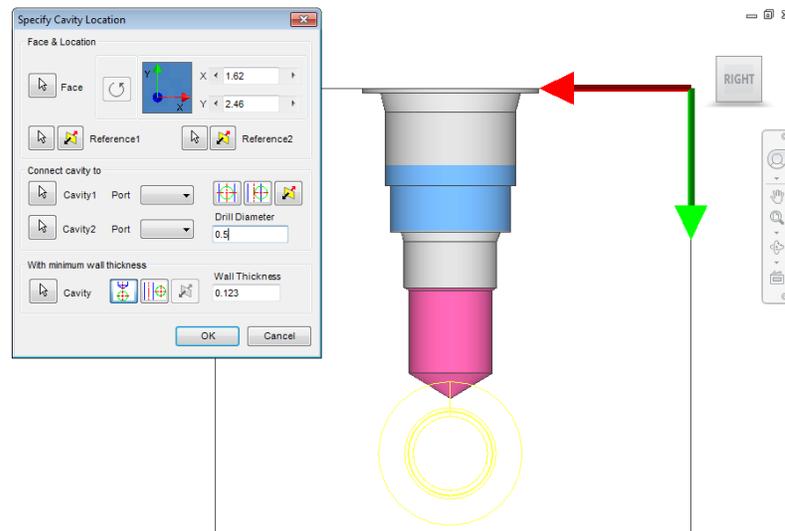
1. Click the selection button for cavity.
2. Select an existing cavity on the manifold.
3. Click the Move to side button to position the new cavity away from the selected cavity axis.
4. Click the Flip side button to change the side, if required.
5. Repeat the above steps to position the cavity with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



 Positioning new cavity using the Move to side option

Note:

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



 Positioning new cavity below the cavity tip

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

Automatically read an XML file exported from a HyDraw® created schematic drawing and insert all the required cavities with the connectivity information into MDTools®.

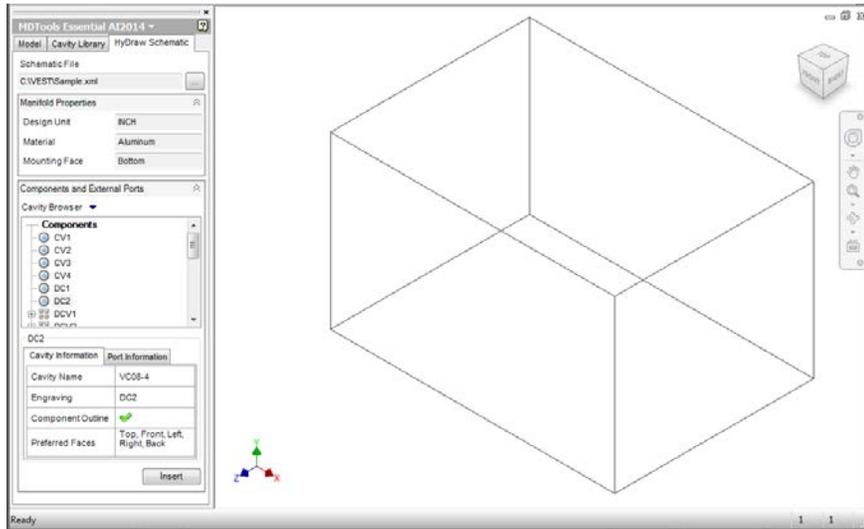
- MDTools Essential AI2014
 - > **Insert** panel
 - > **Cavity** dropdown
 - > **From HyDraw**

The HyDraw Schematic tab in the browser gets activated.

- Click **Browse** and select the HyDraw schematic XML file.

- Click **Open**.

MDTools populates the schematic data in the browser.



MDTools HyDraw Interface : Component data populated

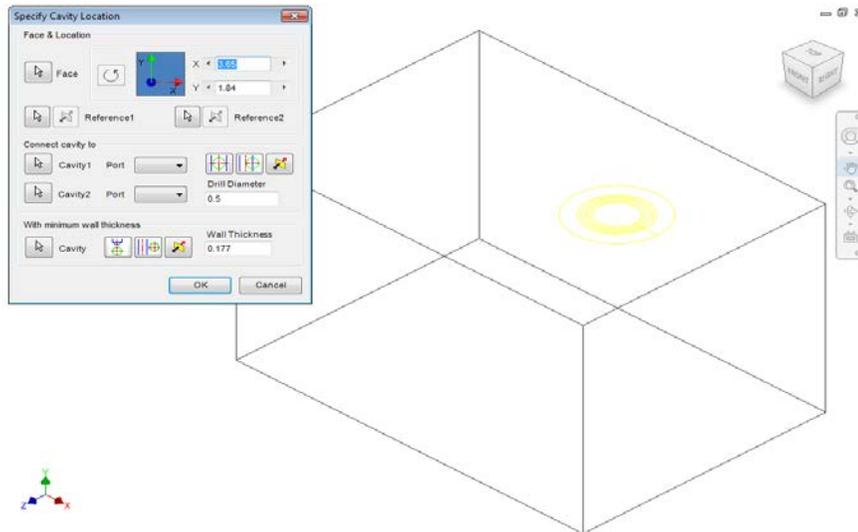
The Insert Cavity option on the HyDraw Schematic Interface dialog box enables you to insert the cavity for a selected component with the connectivity and flow information.

- Select a component or external port from the list.
- Click Insert Cavity.

Specify Cavity Location dialog box displays.

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

The cavity is inserted at the specified location. MDTools inserts component outline (if defined) with the cavity automatically.

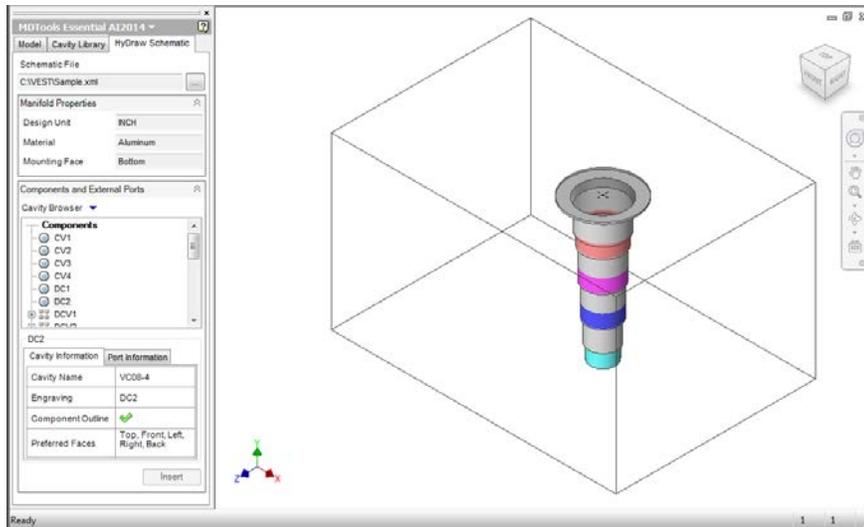


Specify Cavity Location dialog box

Note:

Once a cavity is inserted in the manifold it is displayed in black against a shaded background in Cavity Explorer and Connectivity Explorer.

Refer Chapter 4 for details. (MDTools HyDraw Interface)



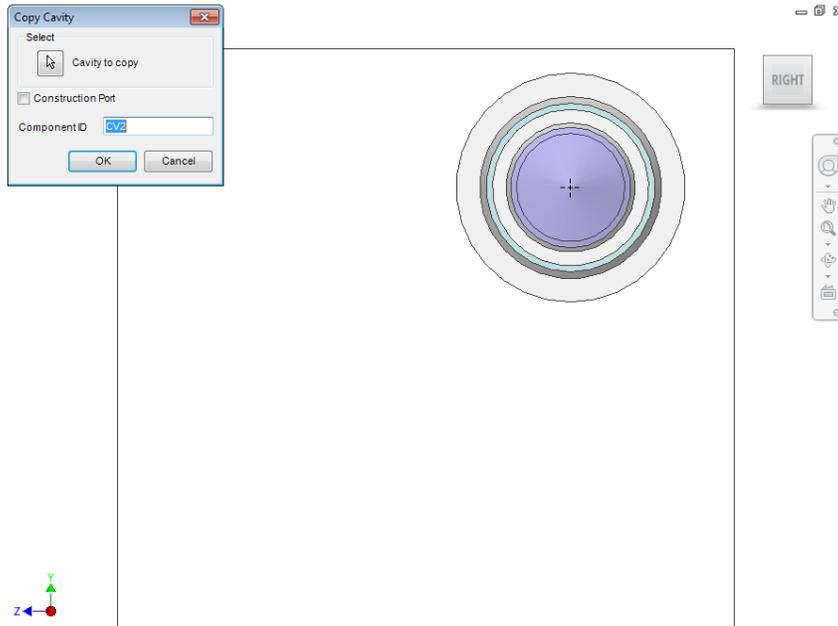
Cavity inserted with connectivity information

14. Copy Cavity

Create a copy of an existing cavity/footprint on the manifold.
All the parameters including the connectivity information are copied to the new cavity.

MDTools Essential
AI2014
> Insert panel
> Copy

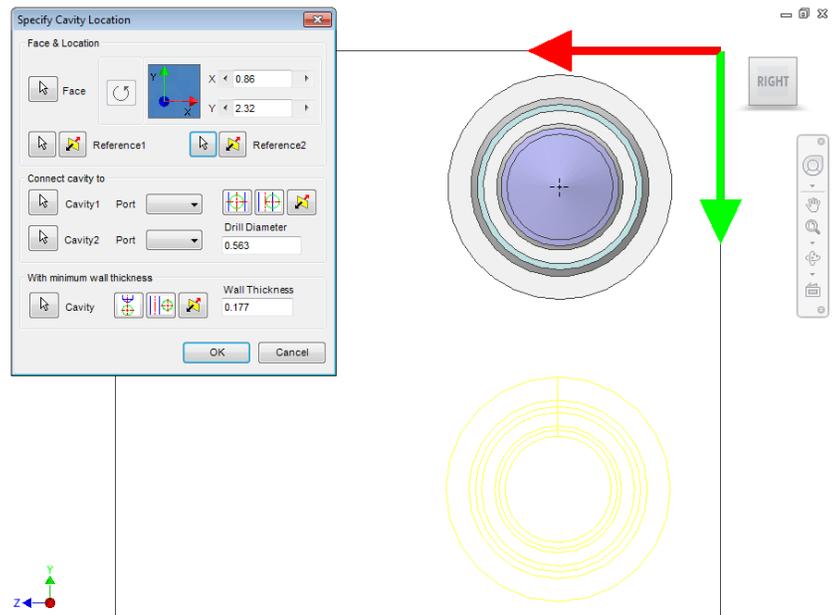
The Copy Cavity dialog box displays.



Copy Cavity dialog box

1. Click the **Select** button and then select the cavity you want to copy.
2. Enter **Component ID** for the new cavity/footprint.
3. Select the **Construction Port** option. when a new cavity is used as a construction hole
If this option is selected, then MDTools® automatically assigns the component ID.
4. Click **OK**.

The Specify Cavity Location dialog box displays.



Specify Cavity Location dialog box

5. Select a point on the manifold face where you want to insert the cavity and pick connecting cavities.
6. Click **OK**.

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

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

Note:

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

15. Insert Outline

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

1. MDTools Essential AI2014
> **Insert** panel
> **Outline**

The *Insert Outline* dialog box displays.

2. Select the outline from the list.

MDTools® displays a preview of the selected component outline.

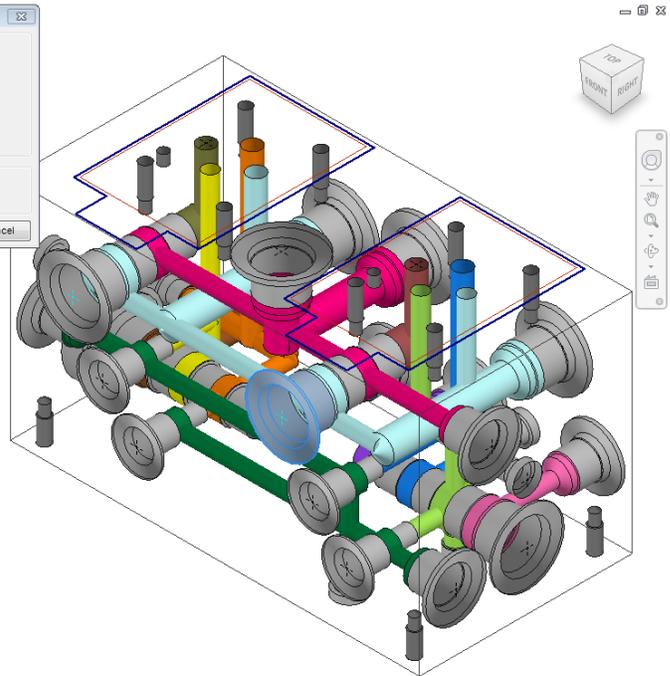
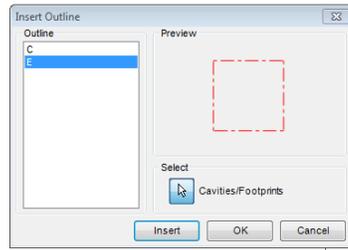
3. Click the Cavities/Footprints **Select** button.

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

4. Click **Insert**.

MDTools creates a component outline around the selected cavities.

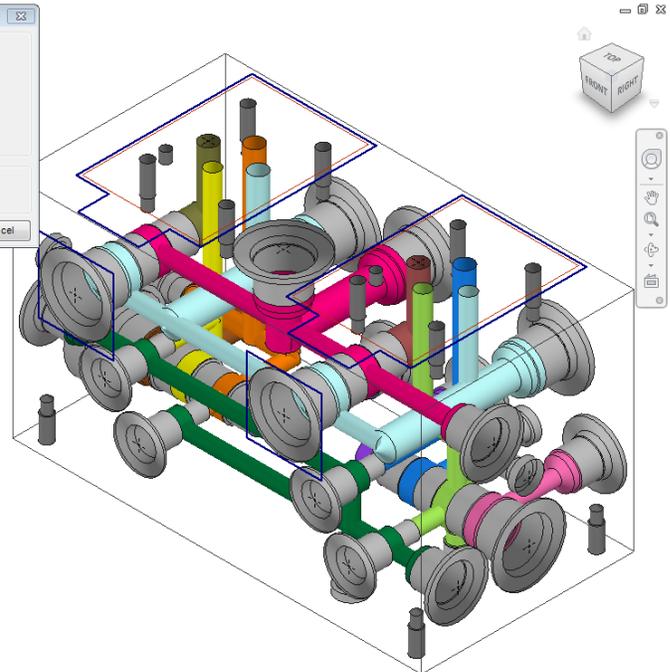
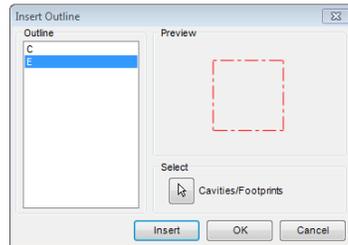
5. Click **OK**.



Insert component Outline dialog box

Note:

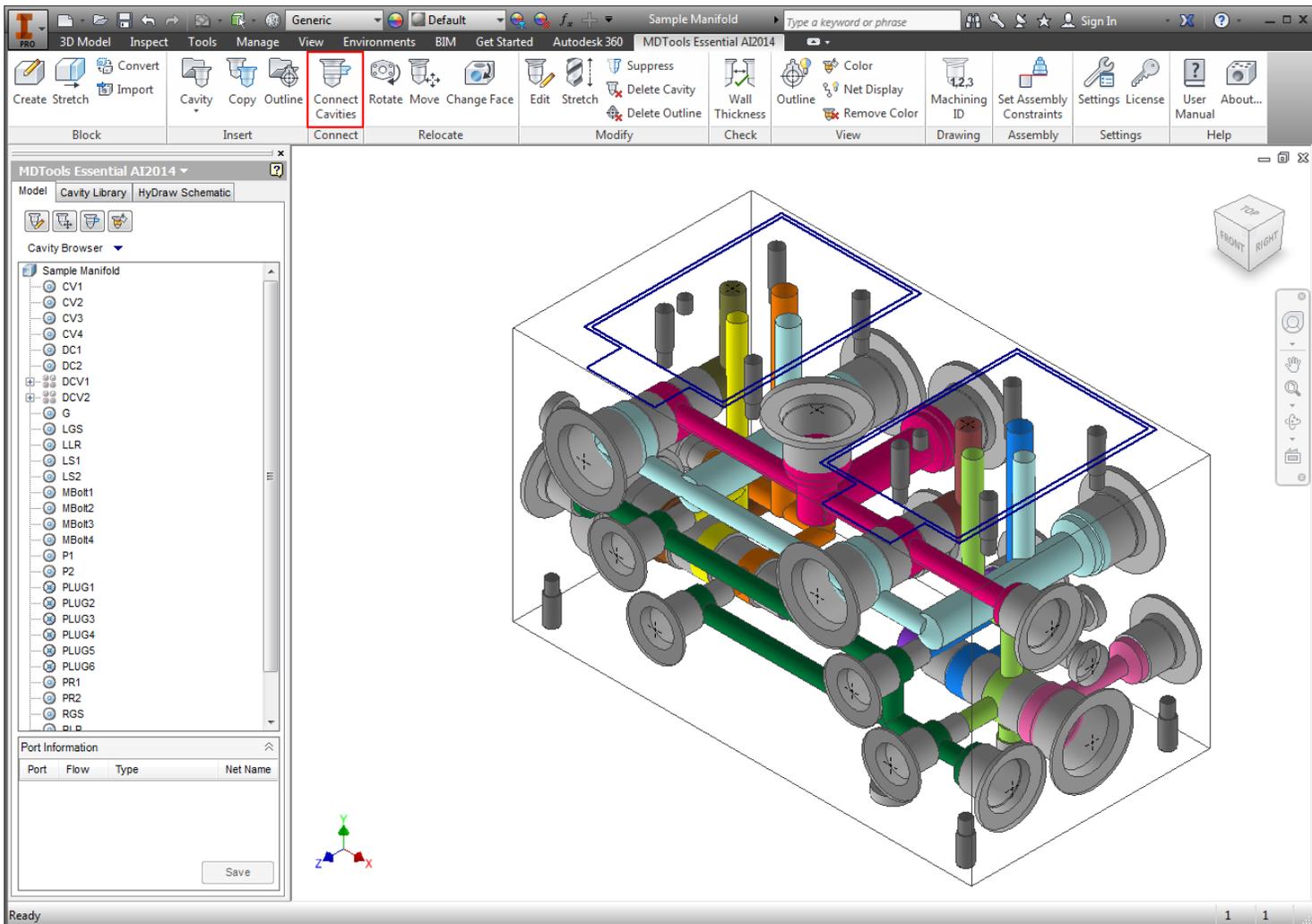
Use the MDTools Envelope Library program to create the Component Outline library.



Component outline created on the selected cavities

Make Connections

16 Connect Cavities



16. Connect Cavities

Interactively create connections between cavities.

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

1. MDTools Essential AI2014

- > **Connect** panel
- > **Connect Cavities**

The Connect Cavities dialog box displays.

2. Select the cavity to connect.

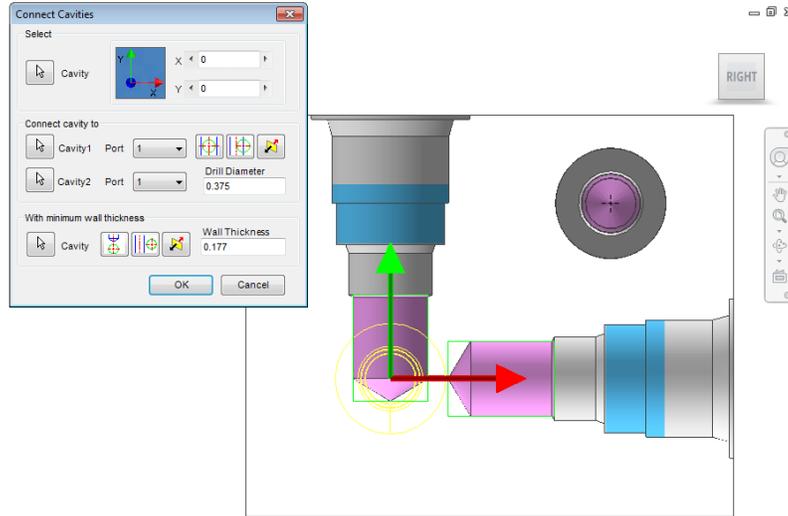
Select the cavity you want to move and connect to another cavity.

3. Select connecting Cavity1.

4. Select the connecting port on cavity1.

Note:

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



 Connect Cavities dialog box

5. Click the selection button for Cavity2.

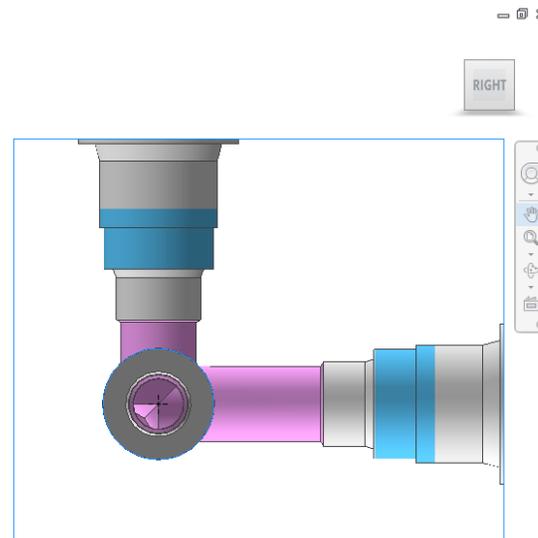
6. Select connecting cavity2.

7. Select the connecting port on cavity2.

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

8. Click **OK**.

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



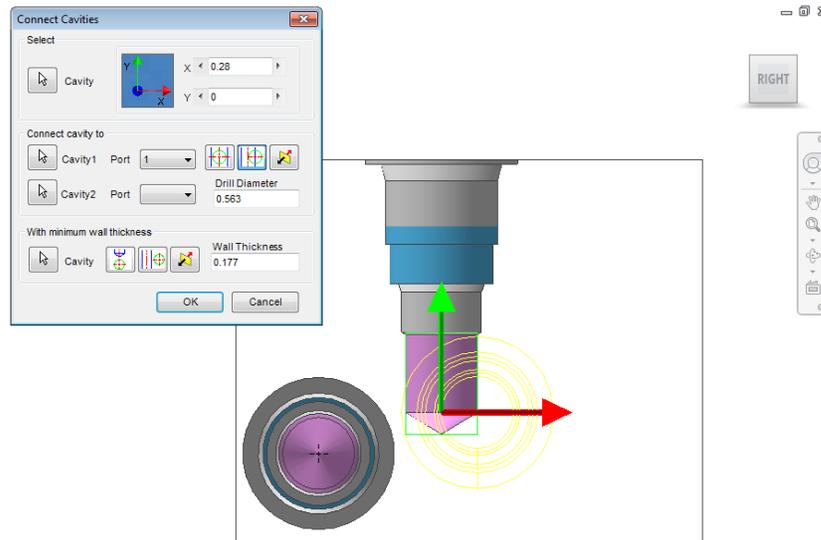
Cavities connected using the Connect to Cavity command

Note:

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

1. 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.

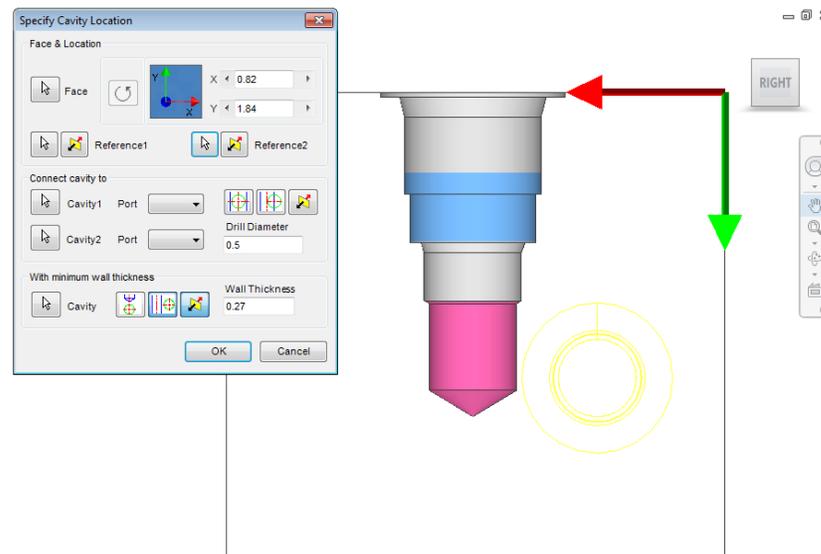


Positioning the cavity using the Relocate to side option

2. Position with minimum wall thickness

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

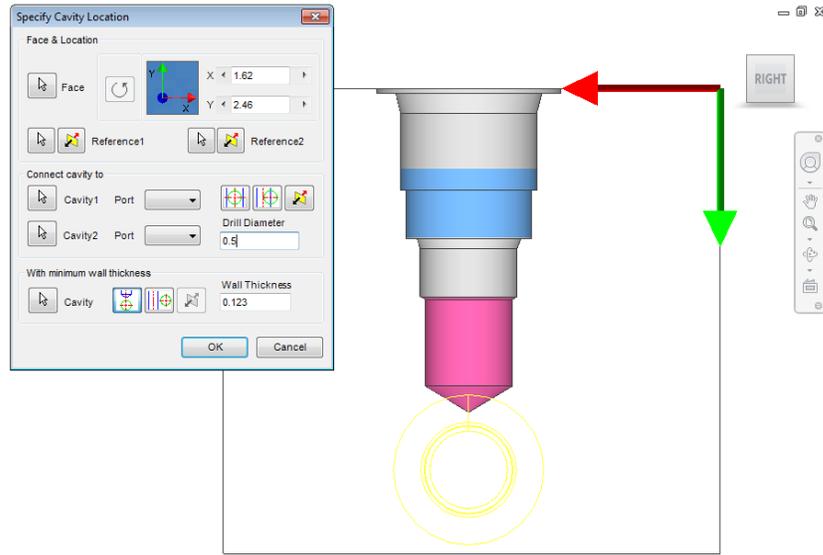
1. Click the selection button for cavity.
2. Select an existing cavity on the manifold.
3. Click the Move to side button to position the new cavity away from the selected cavity axis.
4. Click the Flip side button to change the side, if required.
5. Repeat the above steps to position the cavity with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



Positioning the cavity using the Move to side option

Note:

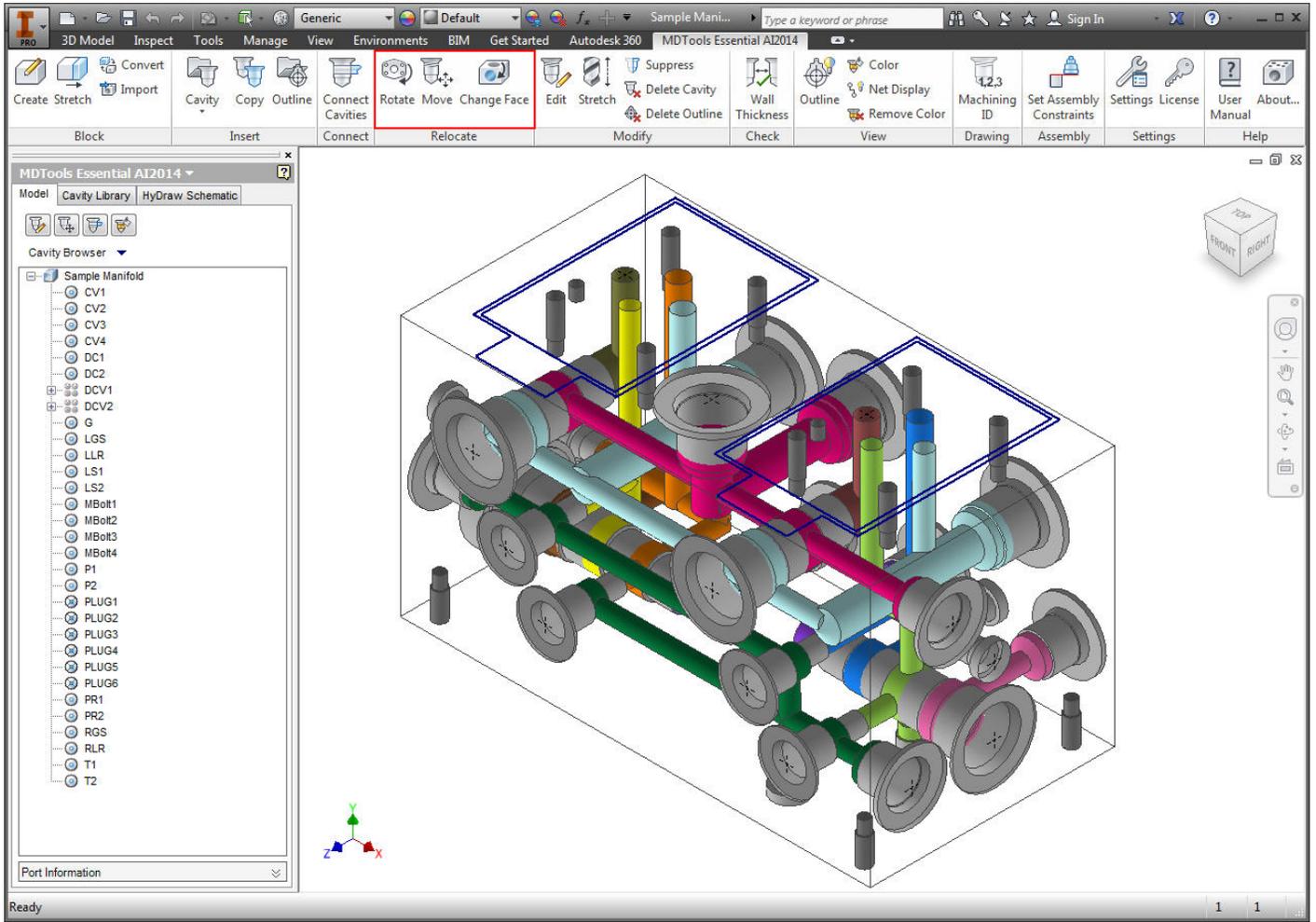
Choose the Locate below cavity tip option to locate the cavity with the minimum wall thickness from the tip of an existing cavity.




Positioning the cavity below the cavity tip

Relocate Cavity

- 17 Rotate
- 18 Move Cavity
- 19 Change Face



17. Rotate

Rotate a footprint/cavity on the manifold surface.

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

1. MDTools Essential AI2014
> **Relocate** panel

> **Rotate**

The Rotate dialog box displays.

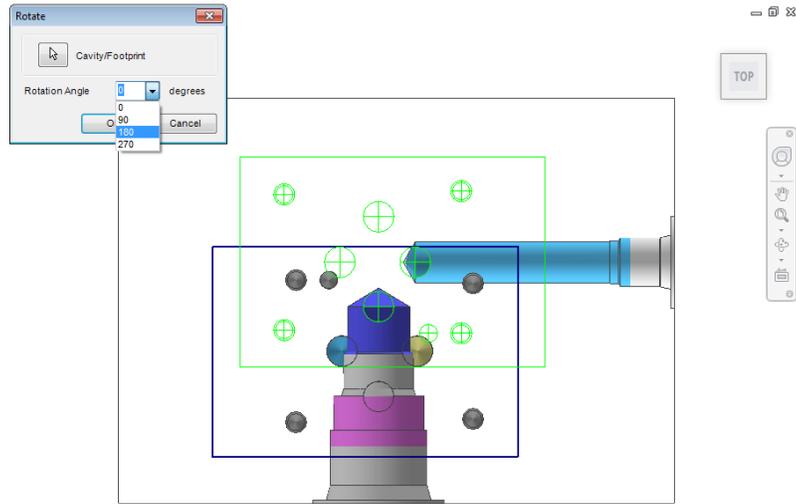
2. Select a cavity on the footprint.

When you move the cursor over a cavity, it will be highlighted. This indicates the selected cavity.

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

4. Click **OK**.

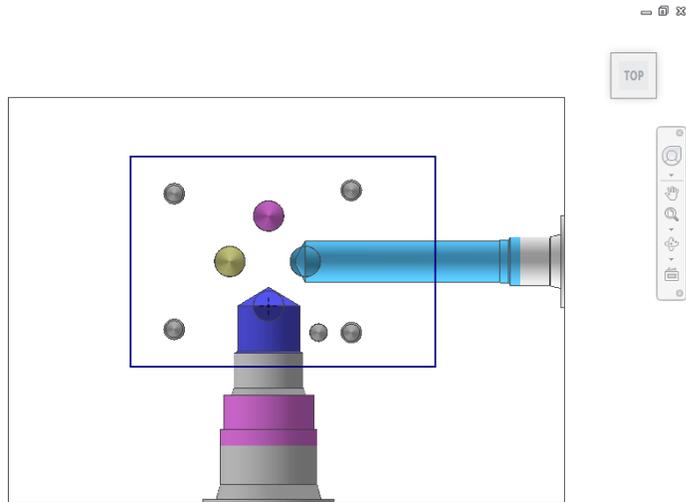
MDTools® rotates the footprint by the rotation angle entered, about the center of parent cavity of the footprint in a counter clockwise direction.



Rotate Footprint dialog box

Note:

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



Footprint rotated by 90 degrees

18. 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).

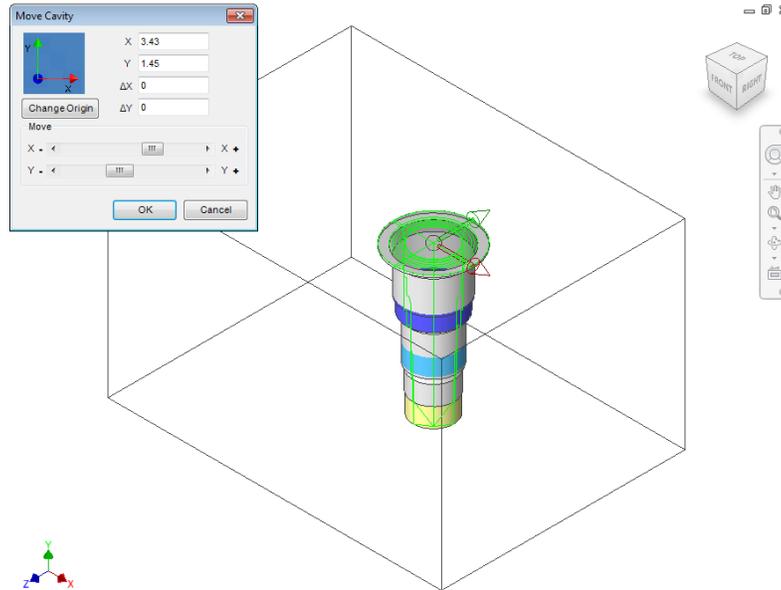
1. MDTTools Essential AI2014
 > Relocate panel
 > Move

2. Select a cavity on the manifold.

The Move Cavity dialog box displays.

MDTools® displays the origin indicator on the manifold face.

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



Move Cavity dialog box

Moving by Entering X and Y

Relocate the cavity by entering X and Y

1. Enter X, Y, or both, as required.
2. Click **OK**.

MDTools relocates the cavity to the new location.

Moving by Entering ΔX and ΔY

Relocate the cavity by entering displacement.

1. Enter ΔX, ΔY, or both, as required.
2. Click **OK**.

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

1. Moving by Dragging Cavity in Model

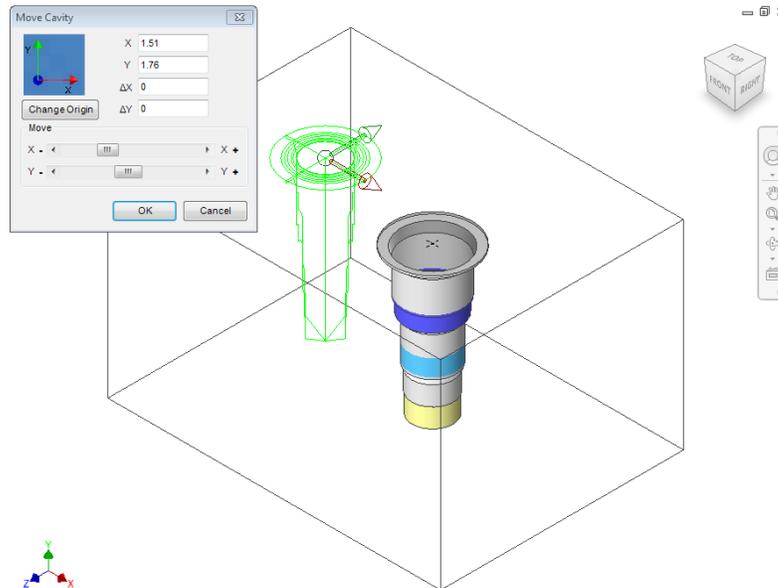
MTools® enables you to move a cavity by dragging the cavity in the model.

1. Select cavity center point in the model.

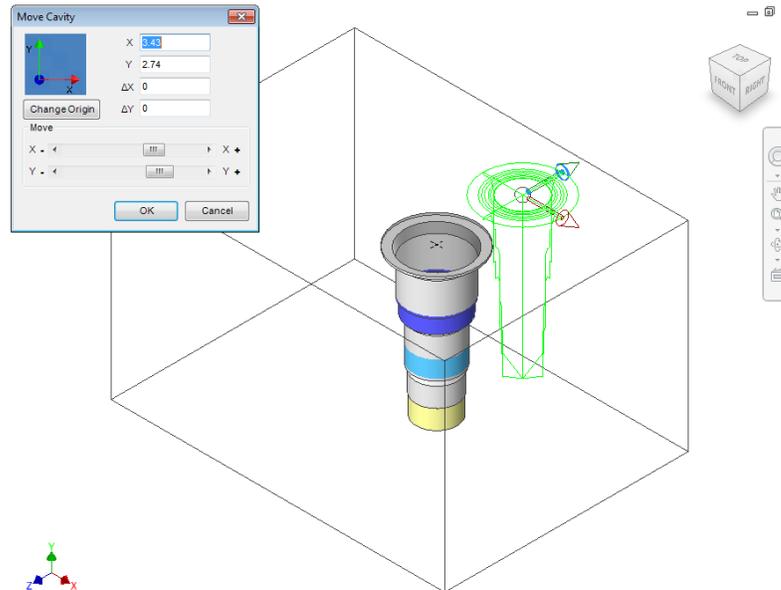
Or,

Select one of the directional arrows to move the cavity in the desired direction only.

2. Drag the cavity to the desired location.



Moving Cavity by dragging the cavity center point.



Moving Cavity by dragging the directional arrow.

2. Moving by Increment

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

- Click the scroll bar button.

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

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

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

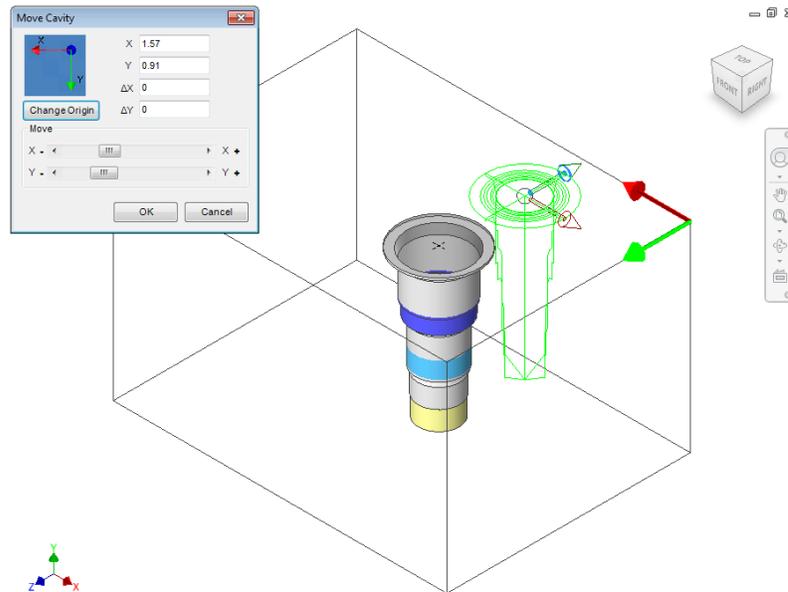
Note:

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

3. Moving the origin

- 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.



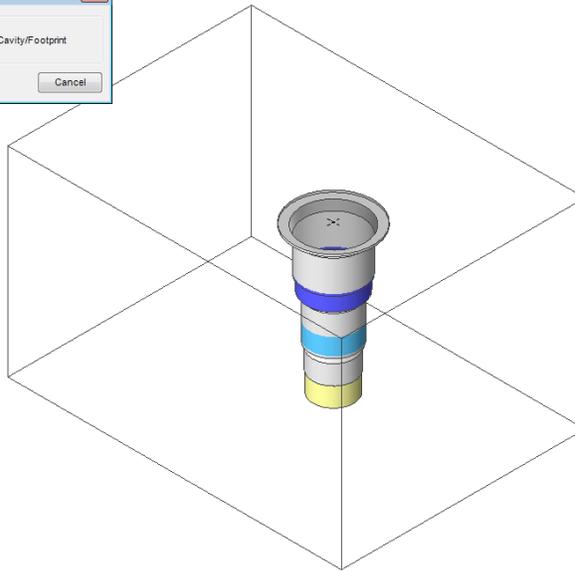
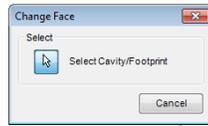
Origin changed and X and Y values updated

19. Change Face

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

- MDTools Essential AI2014
 - > **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:

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

- Select the point on the manifold face, where you want to relocate the cavity and pick connecting cavities.

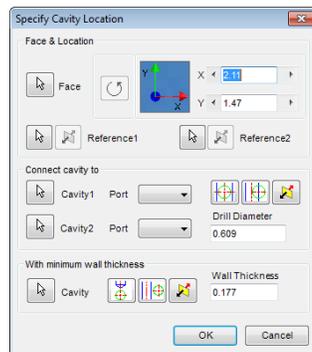
MDTools® displays a preview of the selected cavity at the selected point on the manifold.



Change Face dialog box

- Click **OK**.

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

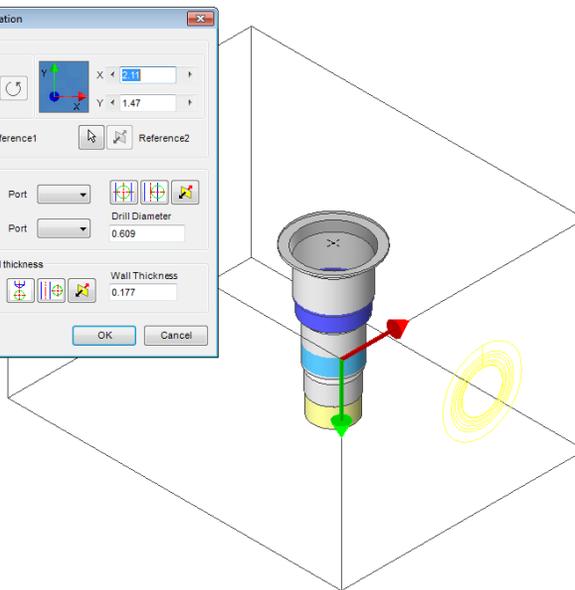


Note:

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

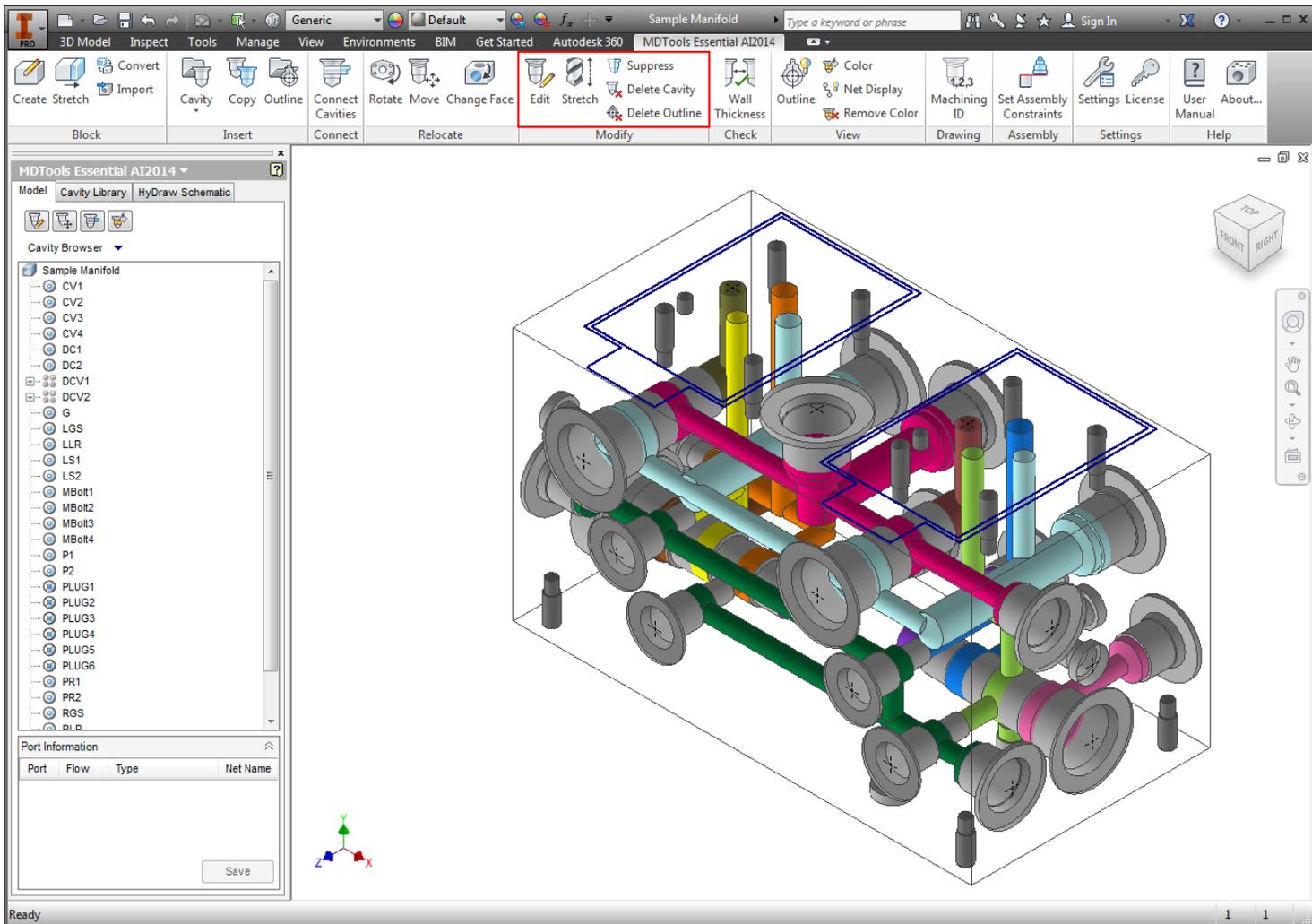


Specify Cavity Location dialog box



Modify Cavity

- 20 Edit Cavity
- 21 Stretch
- 22 Suppress Cavity
- 23 Delete Cavity
- 24 Delete Outline



20. 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 tool) from a tooling knowledge base. This helps avoid the use of non-standard drills and spot faces.

- MDTools Essential AI2014
 - > **Modify** panel
 - > **Edit**

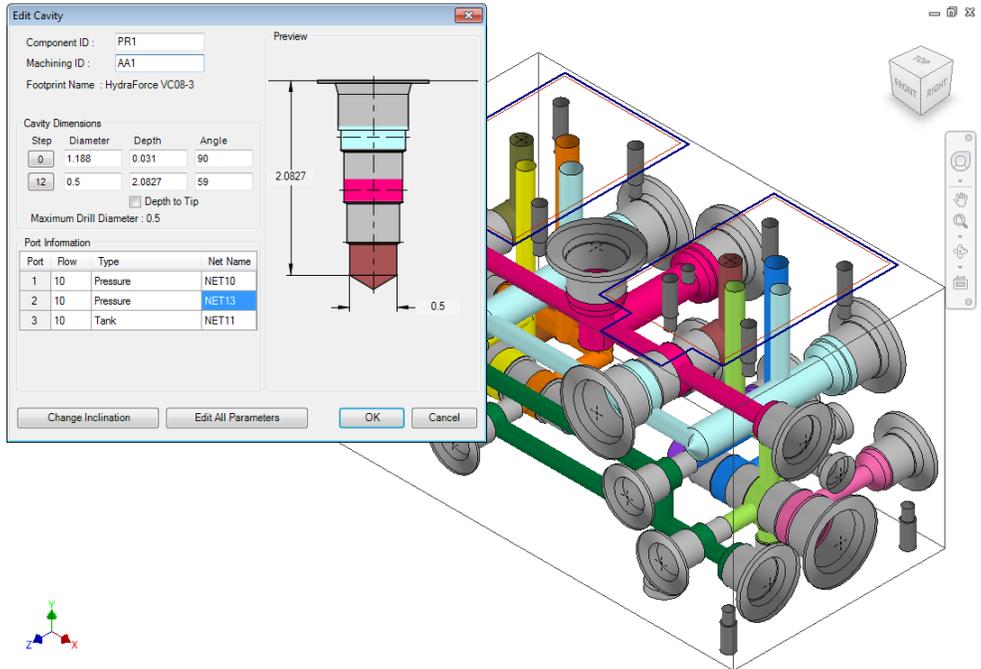
The *Select Cavity: Edit Cavity* dialog box displays.

- Select and click the highlighted cavity on the manifold.

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

The *Edit Cavity* dialog box displays.

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

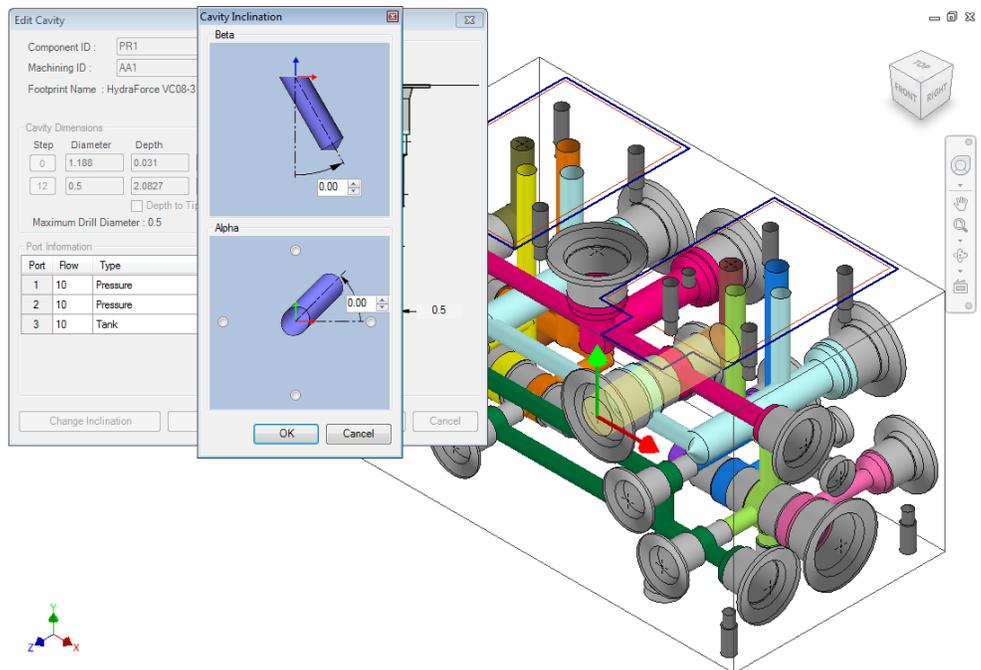


- Click **Edit All Parameters**.
- View or change all the cavity parameters.

Edit Cavity dialog box

Note:

- Click **Change Cavity Inclination** to change the inclination of a cavity.
- Check the **Depth to Tip** option and enter the value in Step12 depth text field to specify the depth to tip value.



Angle Dimension

The **Edit Cavity** dialog box displays:

Component ID

The component ID for the cavity.

Machining ID

*The default ID is '?'.
This ID is used to identify the hole in the block machining drawing and the machining chart.*

Cavity Dimensions

- Spot face and drill dimensions
- Cavity Insertion angles (Alpha and Beta)

Inclination angle is only applicable to drill holes, ports, or cartridge valve cavities.

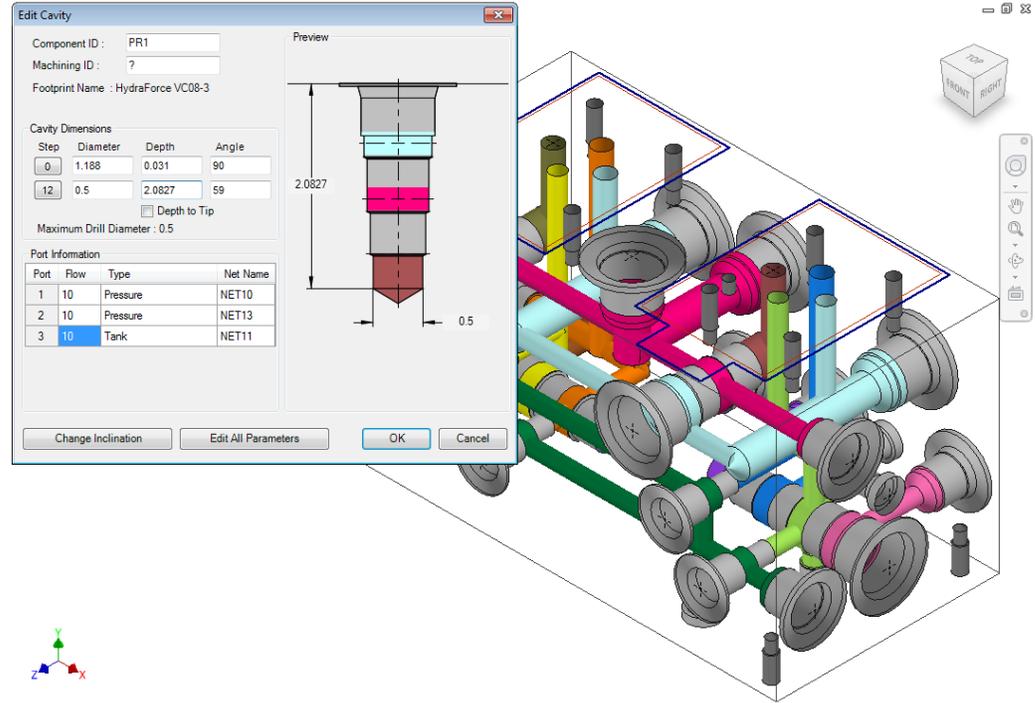
- Maximum Nose (Drill) Diameter

This is a reference parameter, therefore not editable during design.

Port Information

- Enter flow, type, and net name for the cavity.

When the net name is edited, the color of the cavity is updated according to the color assigned to the net.



Edit Cavity: Cartridge valve cavity

1. Selecting Drill Diameter from Drill List

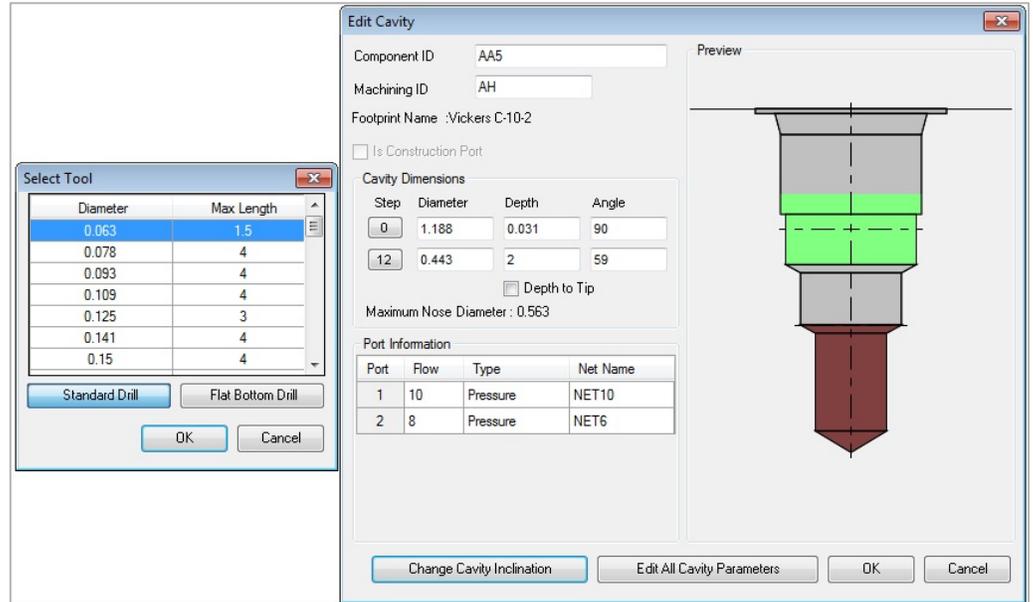
MDTools® enables you to select and use a drill from a standard drill list.

1. Click the Step button before drill dimensions.

The Select Tool dialog box displays.

2. Select a drill from the list.
3. Click **OK**.

MDTools updates the drill diameter of the cavity with the selected diameter.



Select Tool and Edit Cavity dialog box

Note:

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

2. Selecting Spot Face Diameter from the Spot Face Tool list

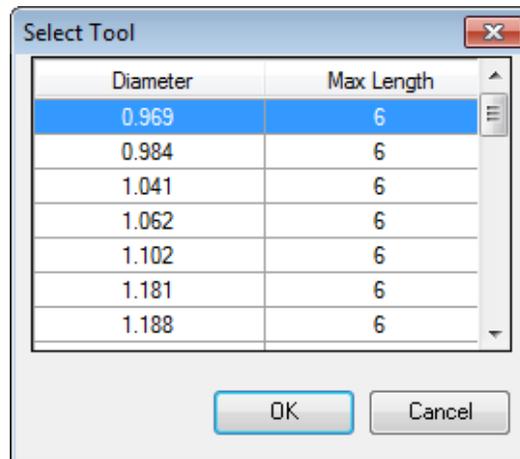
MDTools enables you to select and use a spot face from a standard spot face tool list.

1. Click Step button before spot face dimensions.

The Select Tool dialog box displays with a spot face tool list.

2. Select a spot face tool from the list.
3. Click **OK**.

MDTools updates the spot face diameter of the cavity with the selected spot face tool diameter.

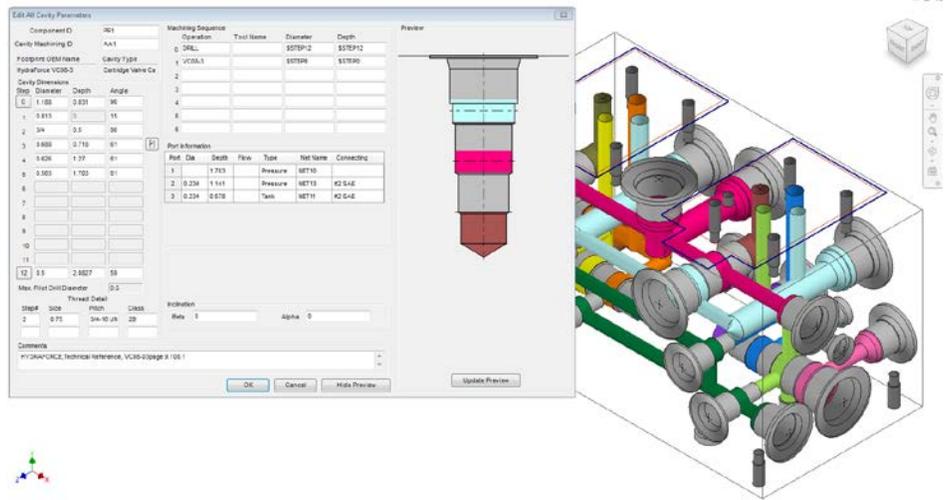


Spot face tool list

Edit All Cavity Parameters

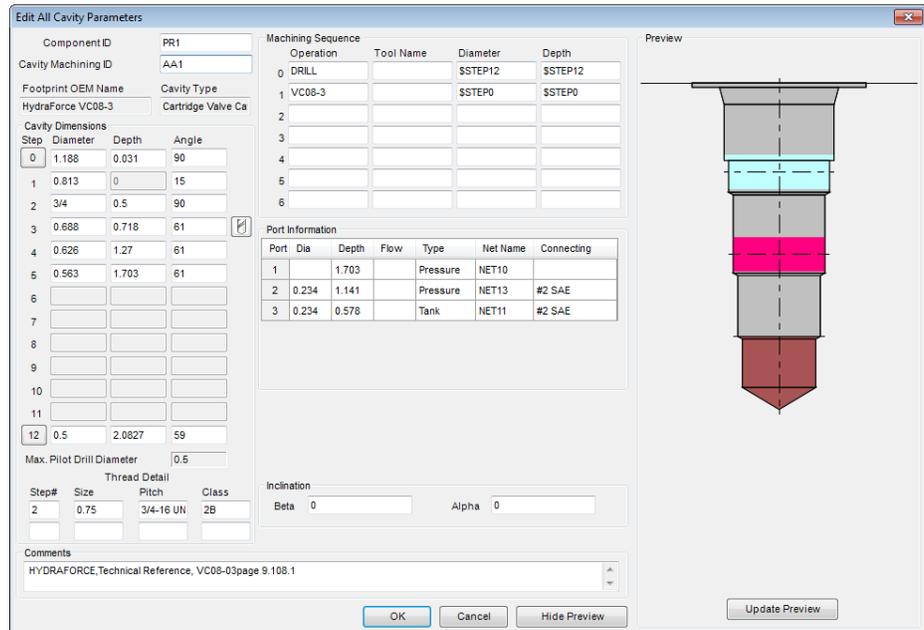
View and change all the cavity dimensions and other parameters within Inventor. You can also select a tool (Drill or Spot Face) from a tooling knowledge base.

1. MDTools Essential AI2014
 > **Modify** panel
 > **Edit**
 The *Edit Cavity* dialog box displays
2. Click Edit All Parameters.
 The *Edit All Cavity Parameters* dialog box displays showing all the parameters of the cavity.
3. View the associated parameters and change the values, if required.



Edit All Cavity Parameters dialog box

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



Edit All Cavity Parameters dialog box

Note:

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

21. Stretch

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

1. MDTools Essential AI2014
> **Modify** panel
> **Edit**

The *Stretch Drill* dialog box displays.

2. Select a cavity to stretch.

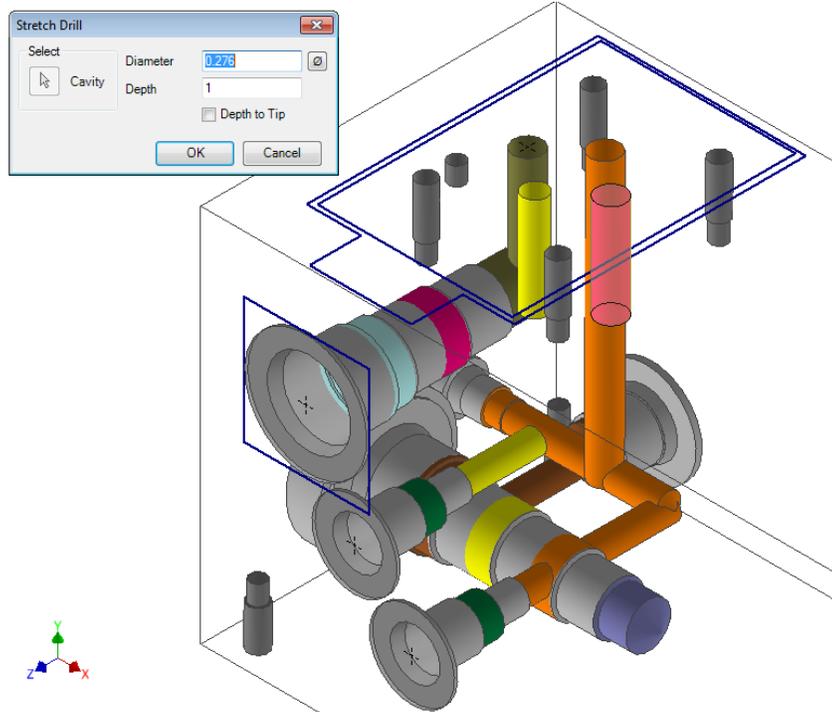
MDTools® displays the preview of the drill in the selected cavity.

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

3. Select and drag the arrow at the bottom of the cavity to the required depth.

4. Release the mouse button on reaching the required depth.

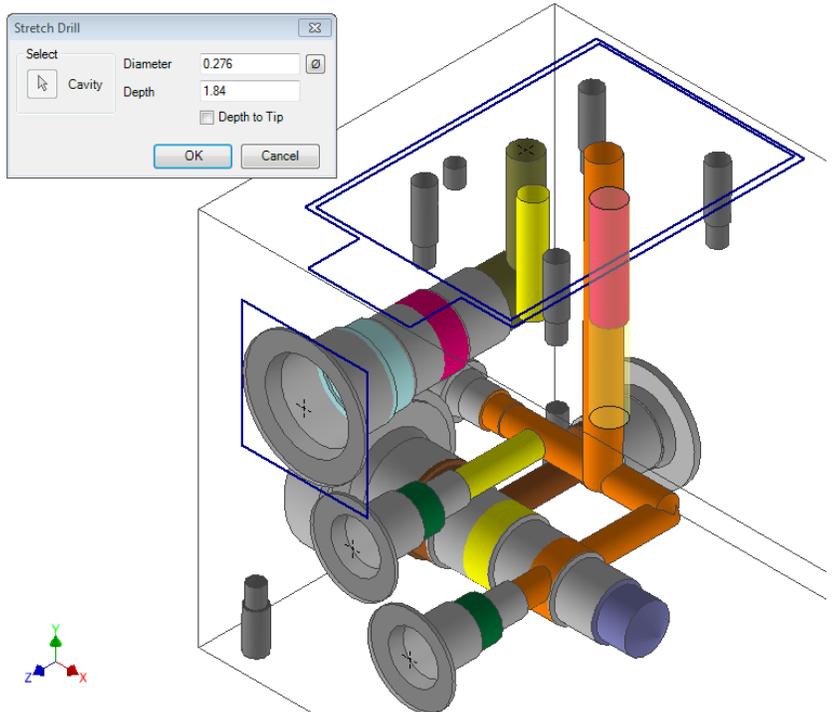
MDTools displays the new depth in the dialog box. Change the drill depth, if required.



Stretch Drill dialog box

5. Click **OK**.

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



Change the drill depth by dragging

Note:

- The drill depth cannot be increased beyond the manifold block
- To restrict the drill tip in a plane switch to a view plane parallel to that plane.

22. Suppress Cavity

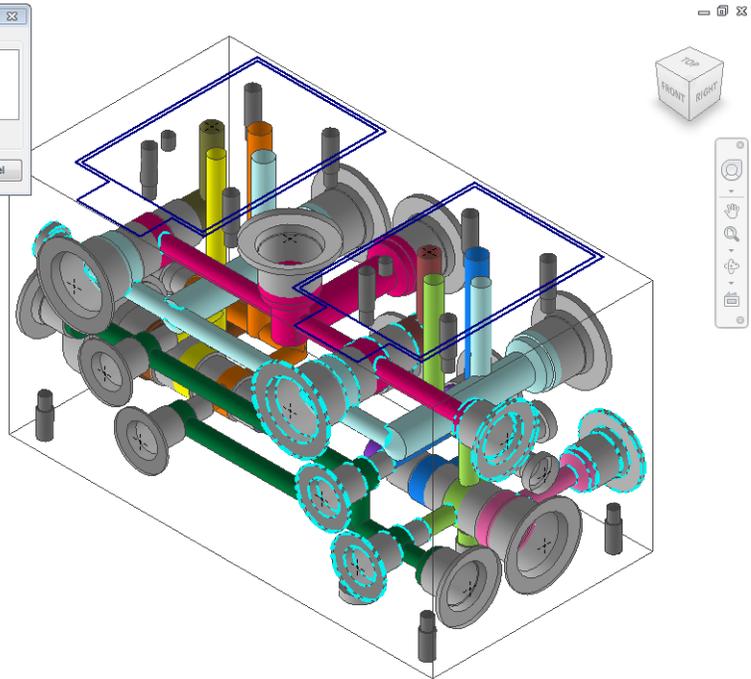
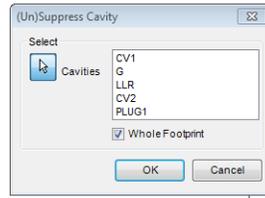
Suppress a cavity/footprint or Unsuppress a suppressed cavity/footprint.
When you suppress the cavity, MDTools® automatically suppresses all the features used to create the cavity.

MDTools Essential
AI2014

- > **Modify** panel
- > **Suppress**

The (Un)Suppress Cavity dialog box displays.

The Select Cavity option is selected by default.



Suppressing cavities

1. Select the cavity/footprint you want to suppress.
2. Click **OK**.

MDTools suppresses the selected cavities.

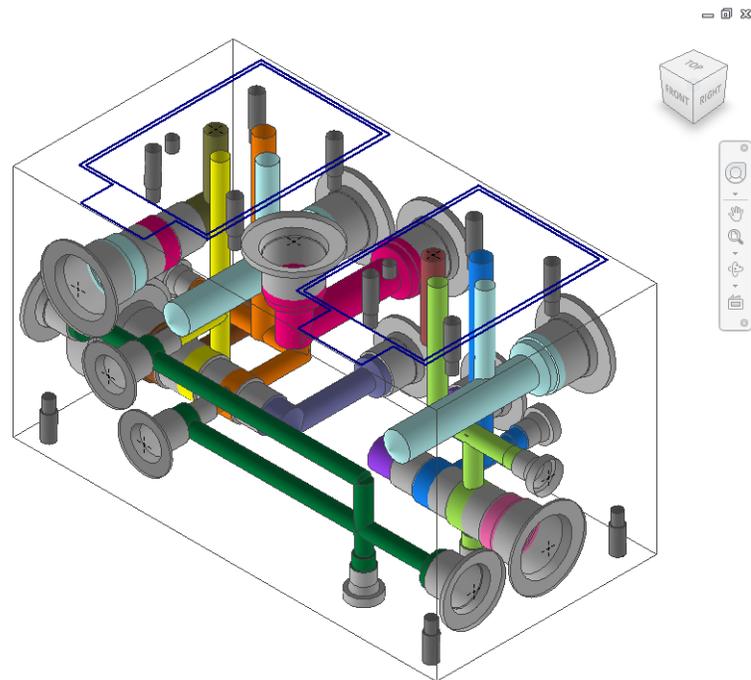


Suppress Cavity dialog box

Un-suppressing Cavities

1. Select the cavity/footprint you want to (Un)suppress.
2. Select the cavity from the browser.
3. Click **OK**.

MDTools un-suppresses the selected cavities; if the cavity belongs to a footprint, then the complete footprint will be un-suppressed.



Selecting cavity to Unsuppress from the browser

Note:

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

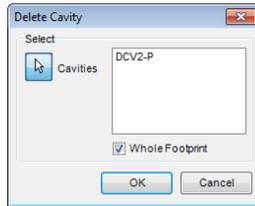
23. Delete Cavity

Automatically delete the selected Cavities/Footprints.
MDTools® cavity consists of multiple Inventor features.
All the features used to create the cavity/footprint are automatically deleted.

1. MDTools Essential AI2014

> **Modify** panel
> **Delete Cavity**

The Delete Cavity dialog box displays.

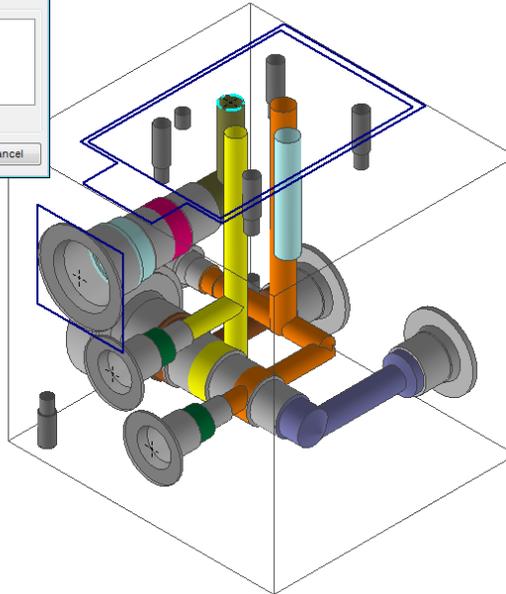


2. Select Cavities/Footprints, you want to delete.

When you click the cursor over a cavity, it is highlighted. This indicates the selected cavity.

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

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

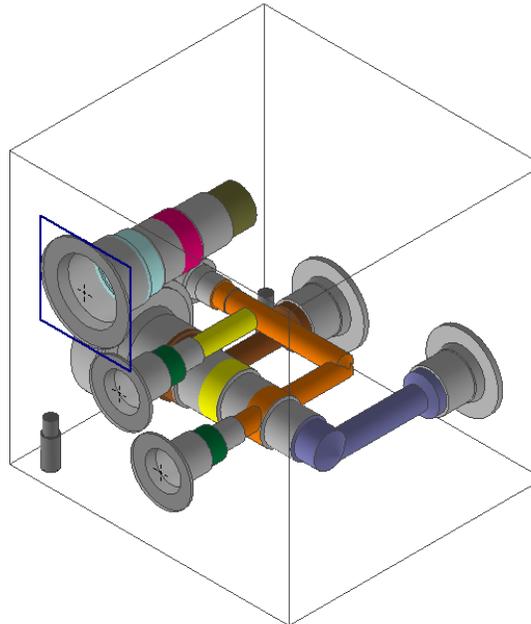


Cavity highlighted after selecting the cavity

3. Select the **Select Whole Footprint** option to delete the whole footprint.

4. Click **OK**.

MDTools deletes all the features used to create cavities/footprints in Inventor.



Automatically deletes whole footprint

Note:

- If the parent cavity of a footprint is selected and the Select Whole Footprint option is not checked, the footprint is not deleted.
- If the cavity has Outline attached to it, then it will also be deleted with the cavity.

24. Delete Outline

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

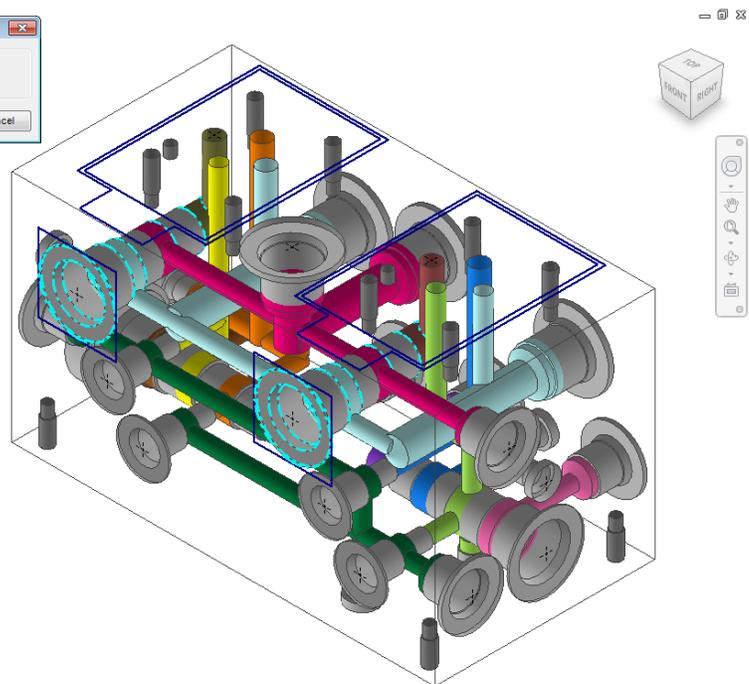
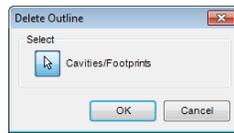
MDTools Essential AI2014

- > **Modify** panel
- > **Delete Outline**

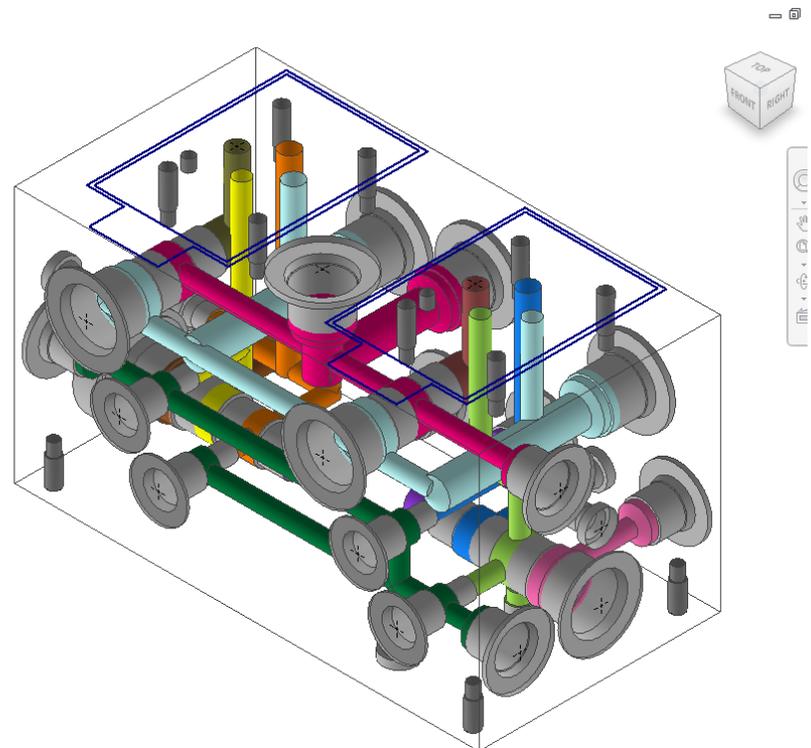
The Delete Outline dialog box displays.

1. Select the cavities/footprints from which you want to delete the component outline.
2. Click **OK**.

MDTools automatically deletes the component outline around the selected cavities/footprints.



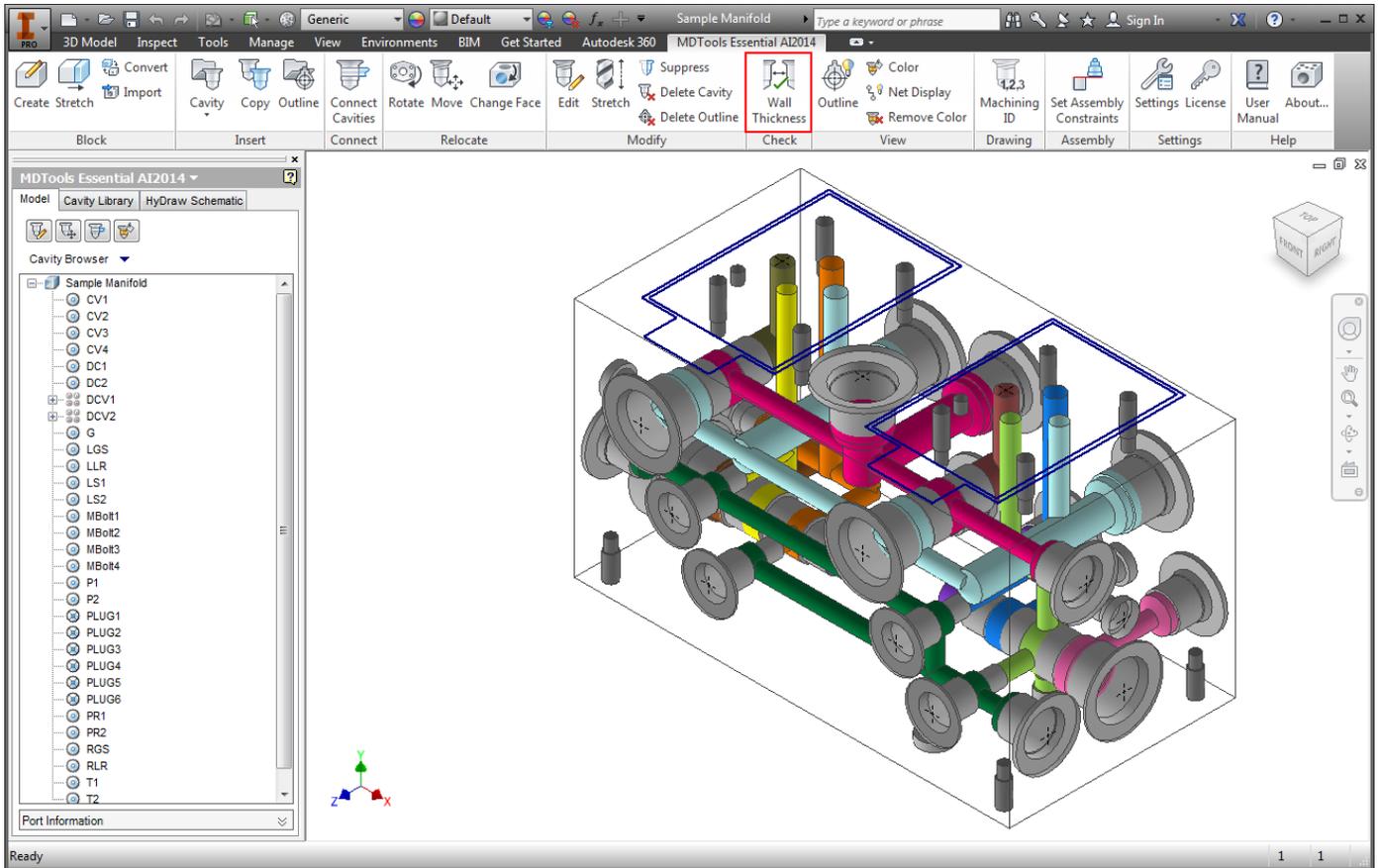
Delete Outline dialog box



Component Outline automatically deleted

Design Check

25 Check Wall Thickness



25. Check Wall Thickness

Check the Wall Thickness –between two selected cavities.

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

1. MDTools Essential AI2014
 - > **Check** panel
 - > **Wall Thickness**

Wall Thickness: Between Two Cavities dialog box displays.

2. Enter the minimum wall thickness required.

The default minimum wall thickness is displayed according to the value defined in MDTools Options.

3. Select the required cavities for the wall thickness check.

4. Click Start Wall Thickness Check.

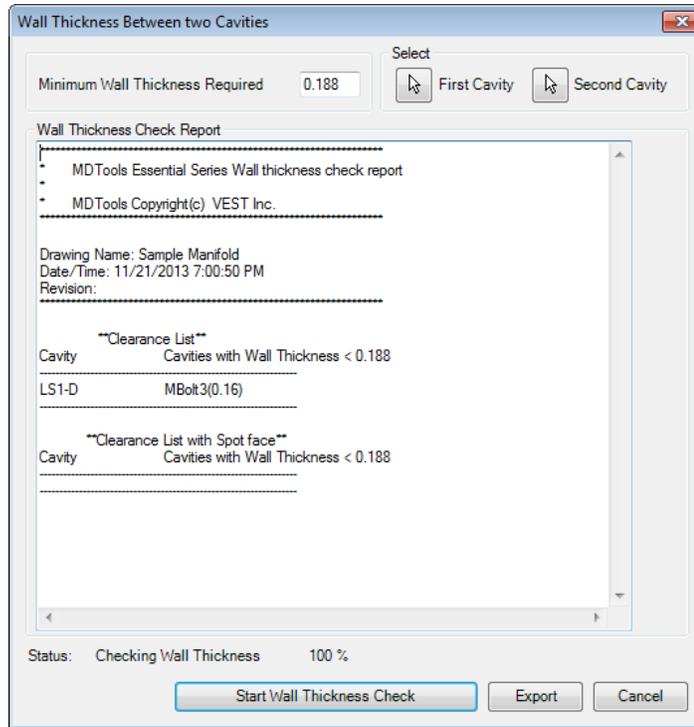
MDTools® checks the internal wall thickness between cavities and displays the list of cavities with wall thickness less than the specified value.

5. Click **Export** button to save the list.

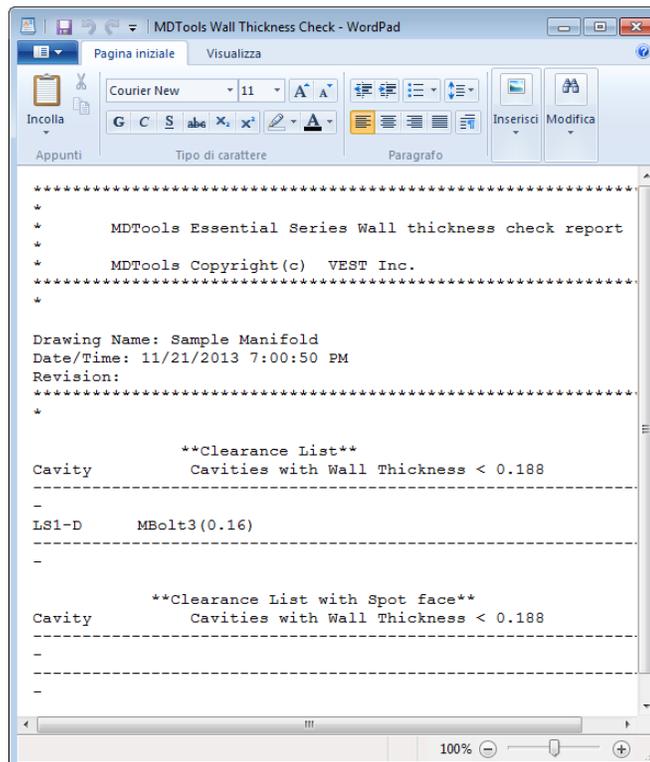
The Save As dialog box displays.

6. Enter an appropriate file name.

7. Click **Save** to save the list.



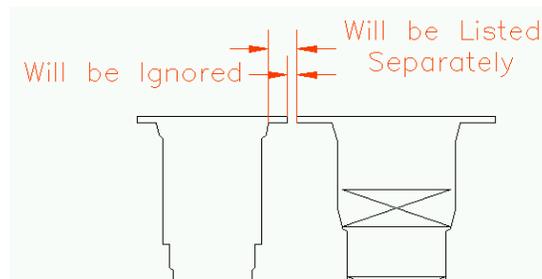
Check Wall Thickness dialog box



Wall Thickness Check Report

Note:
VEST, Inc.

- Wall thickness between spot faces of two cavities is ignored in the wall thickness check.
- Other than the spot face to spot face clearance, clearance problems between the spot face of cavity1 and cavity2 in the manifold is listed separately.



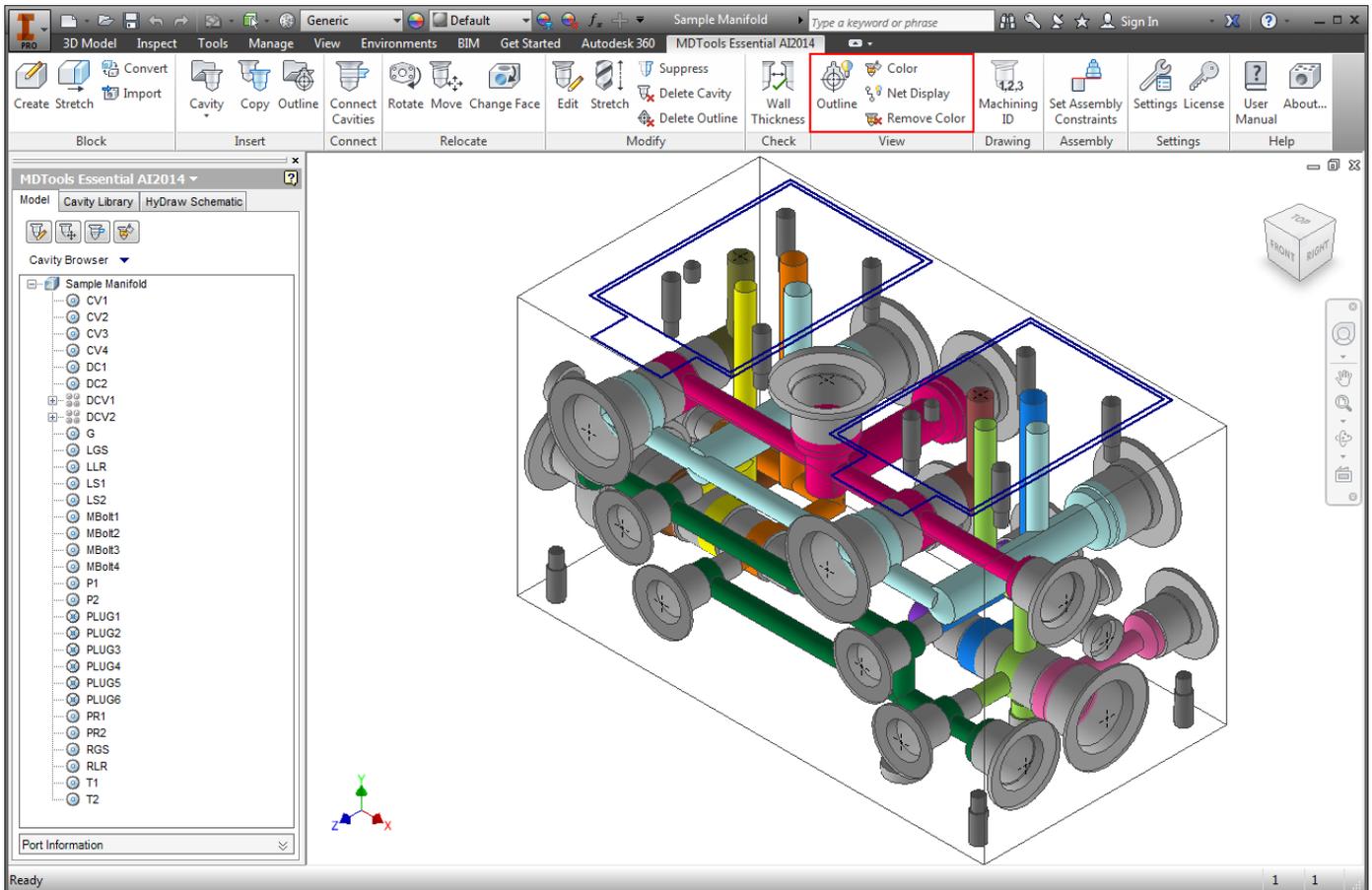
Wall thickness between spot face

CAUTION!

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

Block Display

- 26 Display Outline
- 27 Recolor Cavities
- 28 Net Display
- 29 Remove Color



26. Display Outline

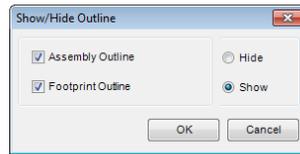
Toggle the visibility of component outlines and footprint envelopes on the manifold.

1. MDTools Essential AI2014

> **View** panel

> **Display Outline**

The Show/Hide Outline dialog box displays.



2. Select the Envelope type.

Both the Assembly Envelope and Footprint Envelope options are selected by default.

3. Select the display option.

To turn the visibility 'off', select the Hide option. Else, select the Show option

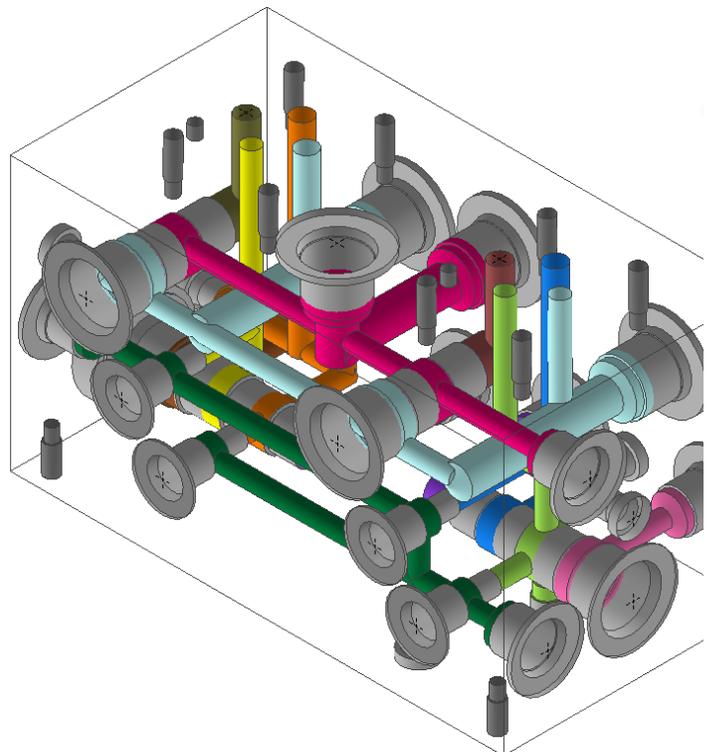
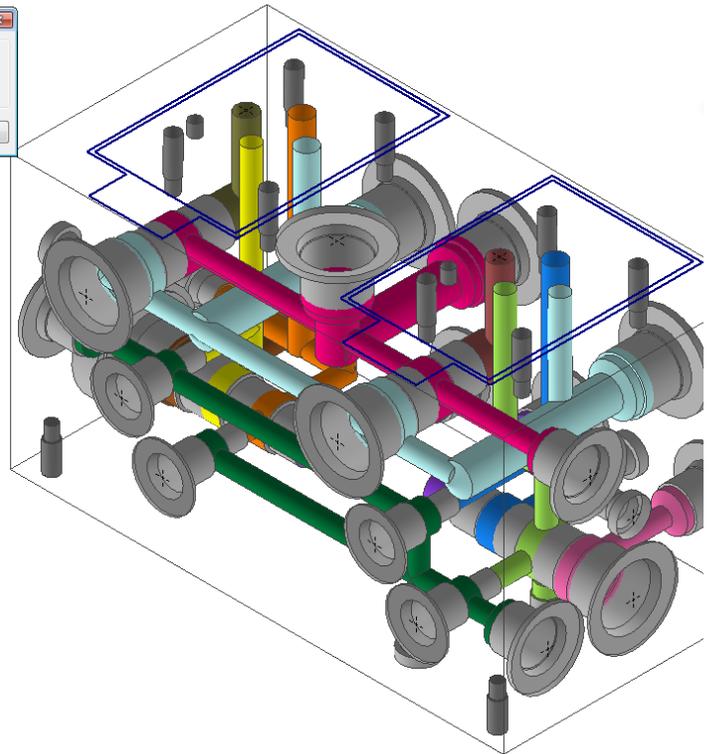
Show is the default state.

4. Click **OK**.

If the Hide option is selected, then MDTools® turns the visibility of the entire selected envelope types on the manifold to 'off', else all the envelopes are visible.



Display Envelope/Outline dialog box



Visibility of envelopes switched off

27. Recolor Cavities

Shade or update the shading of cavities on the manifold.

MDTools Essential AI2014

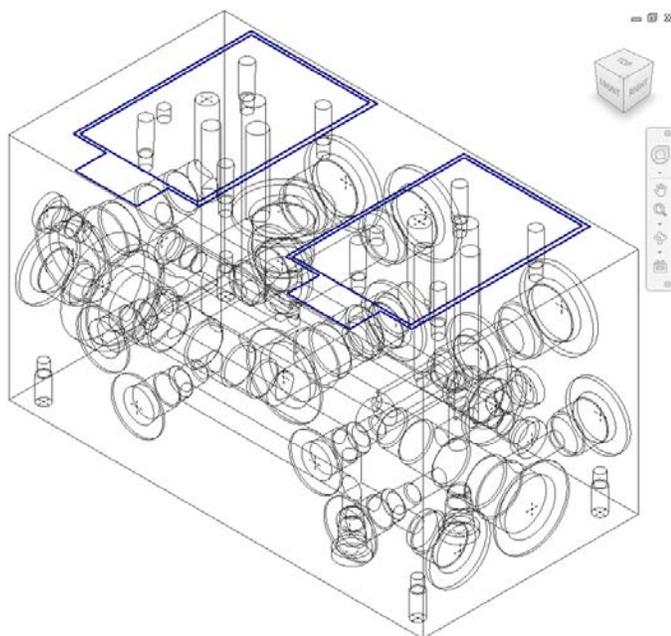
- > **View** panel
- > **Color**

The *Coloring Cavities* message box displays.

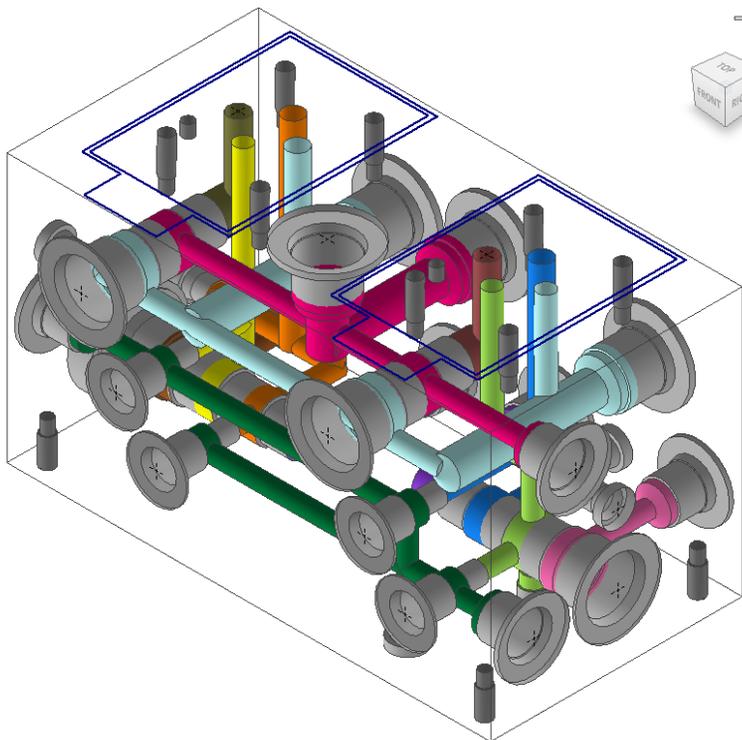
MDTools® shades all the cavities on the manifold.

Note:

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



The *Coloring Cavities* message box



Cavities shaded automatically with their net colors

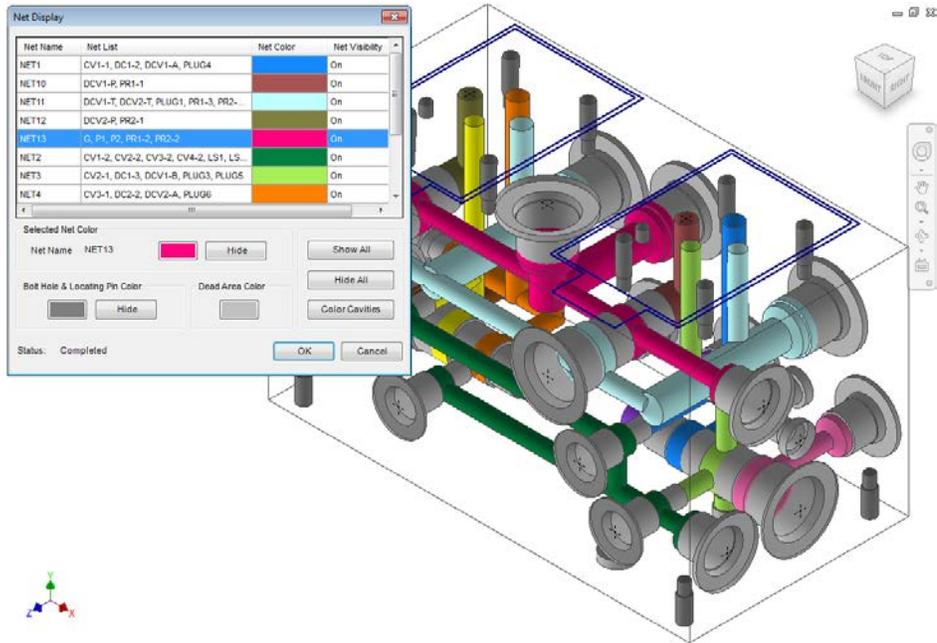
28. Net Display

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

- MDTTools Essential AI2014
- > **View** panel
- > **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

Show or hide a single net in the manifold.

You can select one net at a time.

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



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

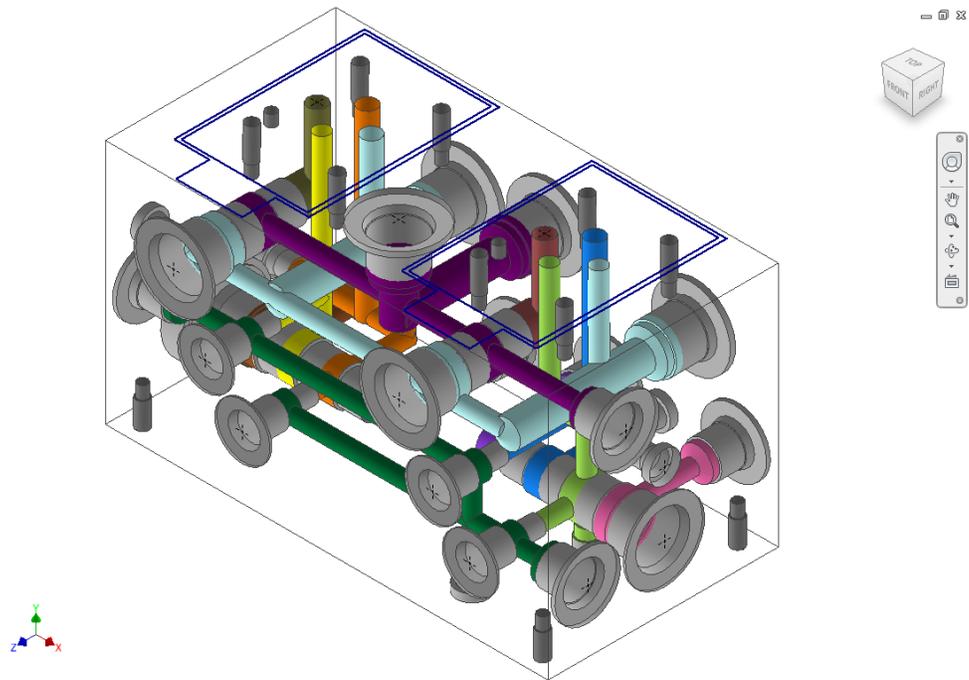
3. Click **Hide** to hide the selected net.
MDTools hides the selected net.

Show/Hide All Nets

Show or hide all the nets in the manifold.

4. Click **Show All**.
MDTools shows each net in the manifold with a different color.
Show/Hide Bolt Holes and Locating Pins

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



5. Click the **Show** button in the Bolt Holes & Locating Pin Color section.

MDTools displays the bolt holes and locating pins on the manifold.

Note:

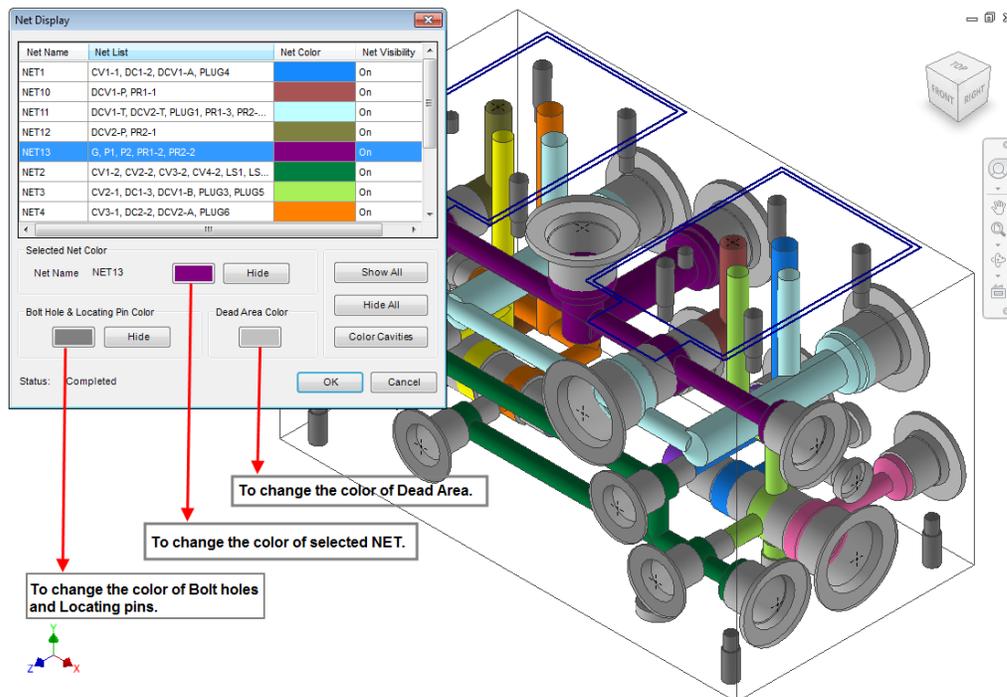
- Use the Hide button to switch off the visibility of a single net.
- Use the Hide All option to switch off the visibility of all the nets.

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.



Note:

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

Manage Colors : Change color

2. Select the required color from the Color dialog box.
3. Click OK.

MDTools® automatically updates the color and the net display.

Note:

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

29. Remove Color

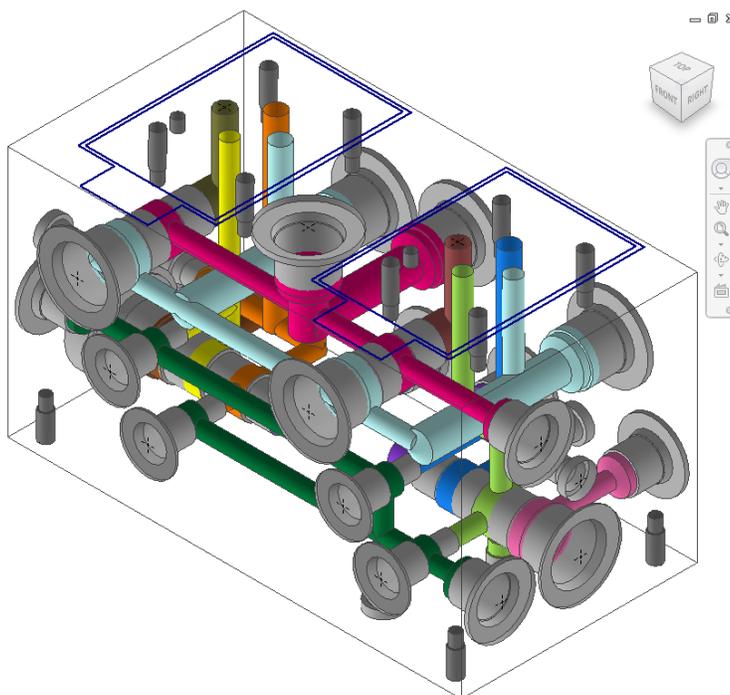
Remove the shading of cavities on the manifold.

Removing Cavity Shading

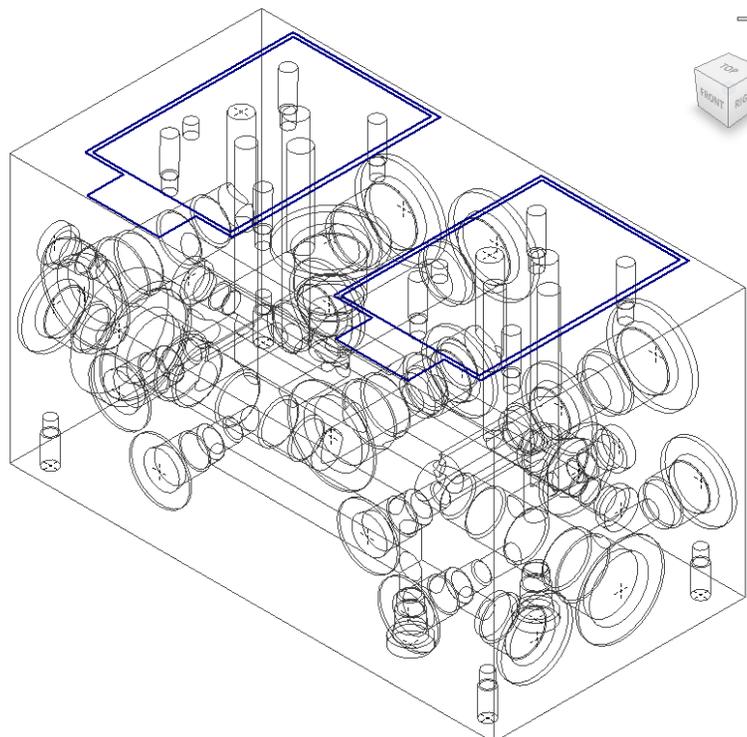
MDTools Essential AI2014

- > View panel
- > Remove Color

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



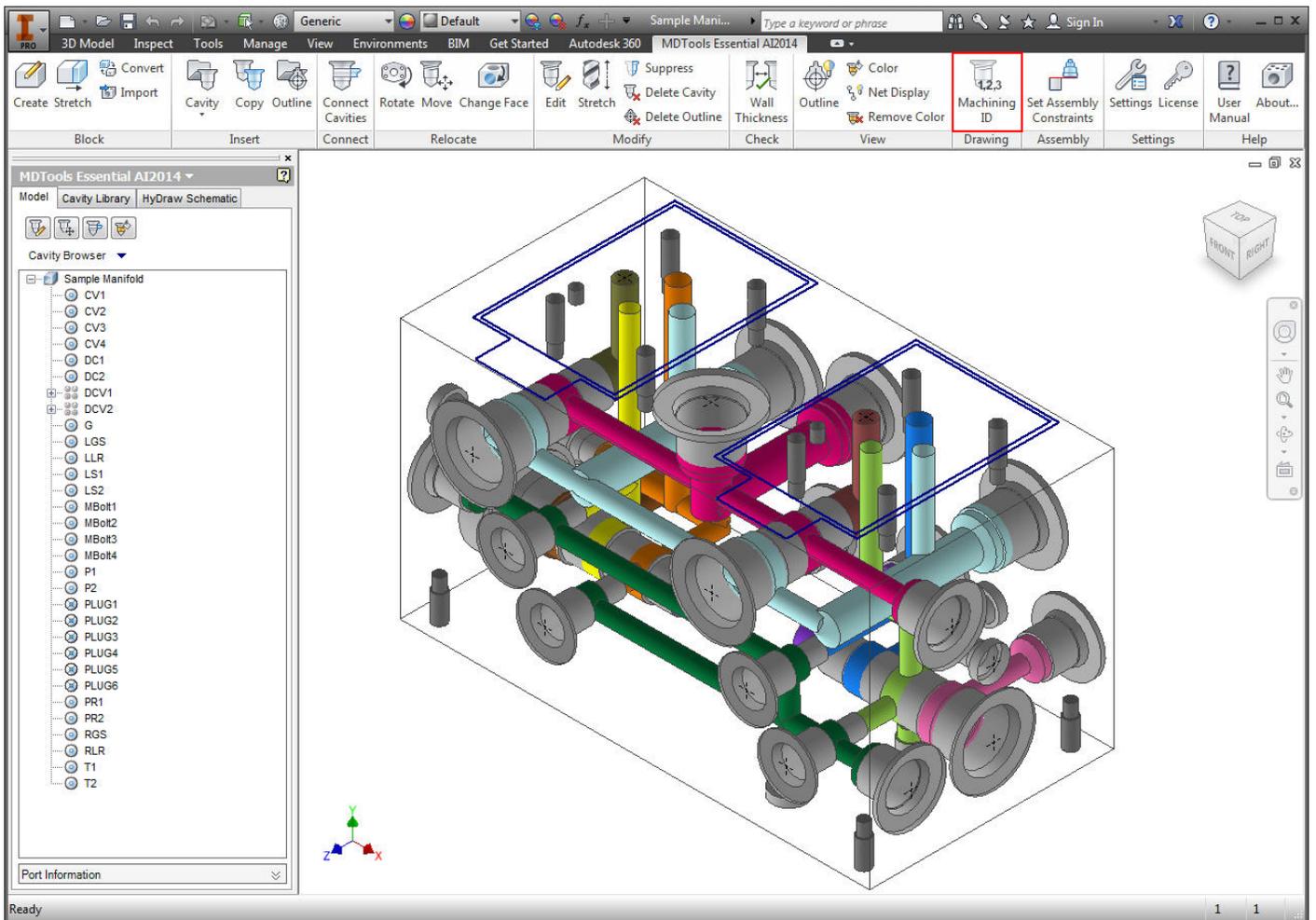
Remove Color of Cavities



Color removed from Cavities

Drawing

30 Generate Machining ID



30. Generate Machining ID

Automatically generate machining IDs for all the cavities on the manifold based on the diameter or distance naming options, and one of the four alternative numbering options.

You can select between upper and lower case alphabets for cavity machining IDs.

The Generate Machining ID command depends on the following.

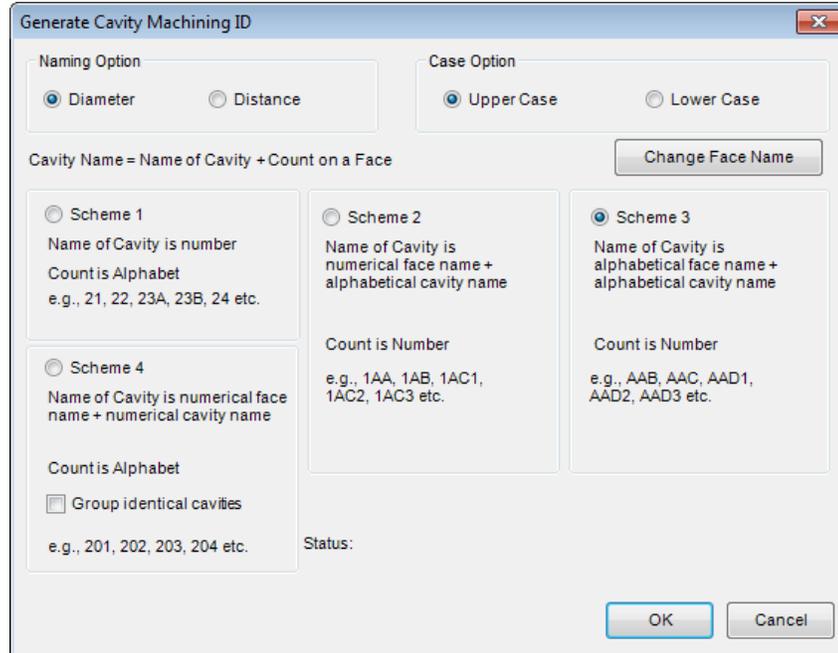
- The naming option selected
- The naming (numbering) scheme selected
- The face on which the cavity is located

MDTools Essential AI2014

> **Drawing panel**

> **Machining ID**

The Generate Machining ID dialog box displays.



Generate Cavity Machining ID dialog box

1 Select Naming Option

Diameter

- Cavities with smaller diameters (in Step 0 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.

2 Select Case Option

Upper Case

- Cavity names are displayed using upper case letters. For example, e.g. AA, AB, AC...

The default option is Upper Case.

Lower Case

- Cavity names are displayed using lower case letters. For example, e.g. aa, ab, ac...

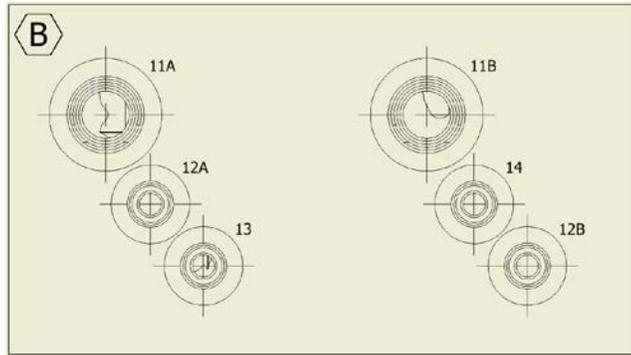
3 Select Cavity Naming Scheme

Scheme1: Number

- 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.

e.g., 21, 22, 23A, 23B, 23C, 24 etc.



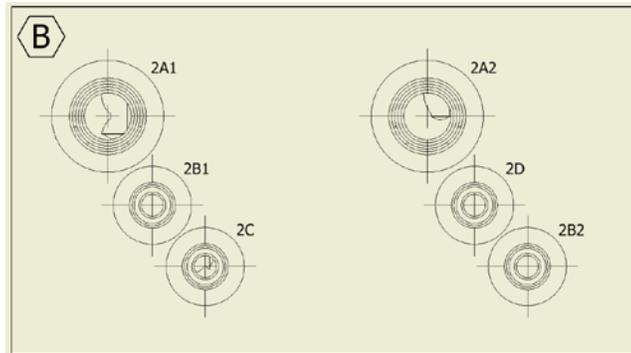
Scheme1

Scheme2: Number + Alphabet

- Name of the cavity is a numerical face name + alphabetical cavity name.
- Count is a number and Naming Option: Distance

The number designates the face name; the alphabets are incremented in alphabetical order (alphabets I & O are left out) with each non-identical cavity found on the face.

e.g., 1AA, 1AB, 1AC1, 1AC2, 1AC3 etc.



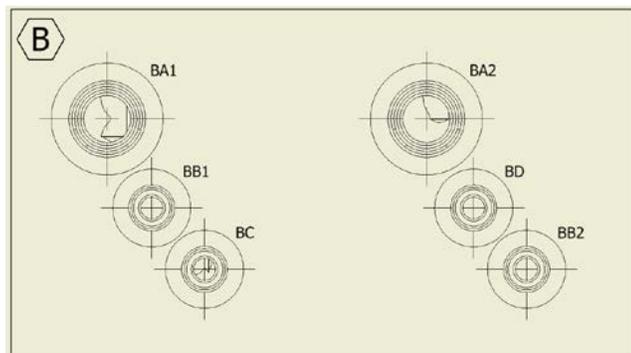
Scheme2

Scheme3: Alphabet + Alphabets

- Name of the cavity is an alphabetical face name + alphabetical cavity name.
- Count is a number and Naming Option: Diameter

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.

e.g., AAB, AAC, AAD1, AAD2, AAD3 etc.

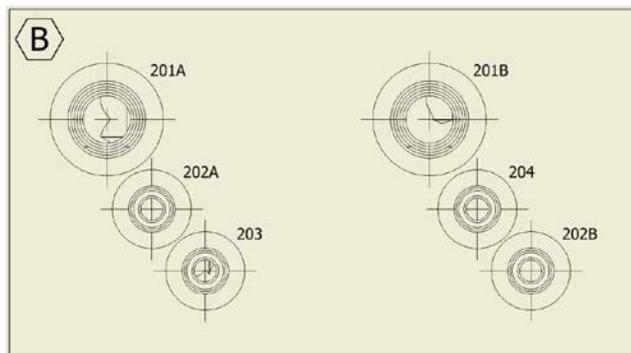


Scheme3

Scheme4: Count

- Name of the cavity is a numerical face name + numerical cavity name.
- Count is a number

e.g., 201, 202, 203, 204 etc.



Scheme4

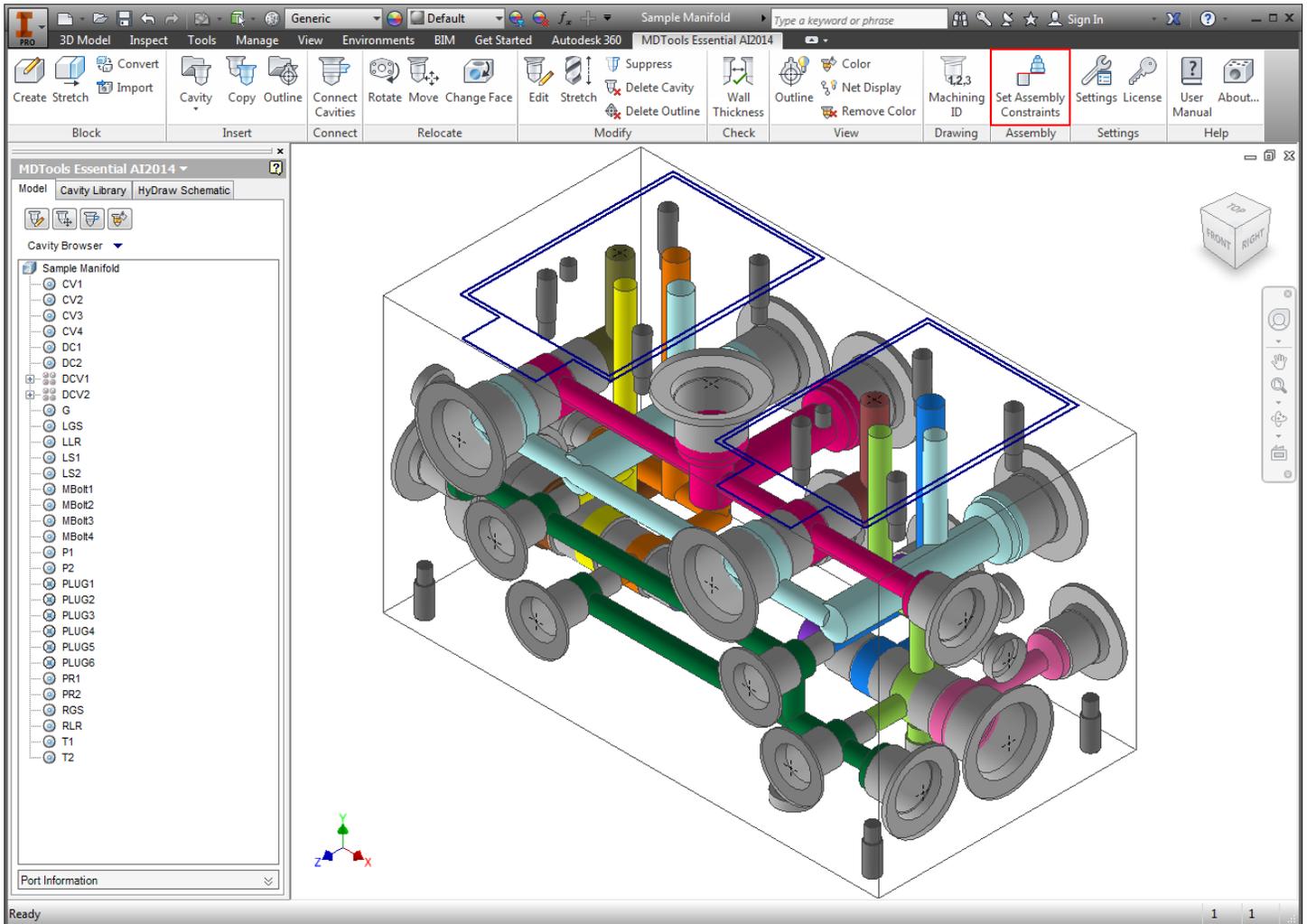
4 Click Generate Cavity Machining ID

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.

Assembly

31 Set Assembly Constraints



31. Set Assembly Constraints

Set all the assembly constraints on part/assembly models.

Set assembly constraints on all the part/assembly models to make them work with the Assembly Interface.

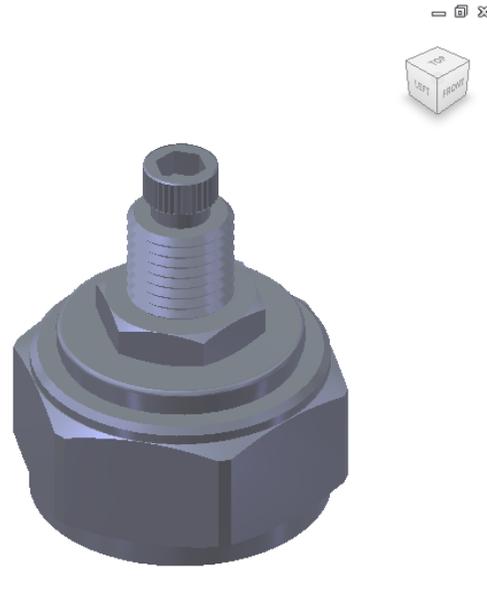
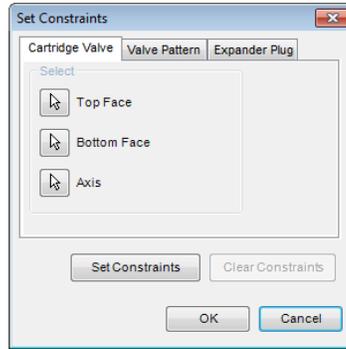
Parts without the assembly constraints will not get assembled on the manifold.

- Open the part/assembly model of valve in Inventor.
- MDTTools Essential AI2014 > **Assembly** panel > **Set Assembly Constraints**

The Set Constraints dialog box displays.

The Set Constraints dialog box contains the following tabs.

- Cartridge Valve
- Valve Pattern
- Expander Plug



Set Constraints: Cartridge Valve tab

1. Cartridge Valve Tab

Set the assembly constraints for cartridge valves, port fittings, and plugs. For these components, you need to specify the three parameters, Top Face, Bottom Face, and Axis.

1. Create work planes for top and bottom face.

Note:

Work planes should be used to define the top and bottom face. Bottom work plane will mate with the spot face of the cavity during assembly. So, the bottom work plane must be created on the face that needs to mate with the spot face of the cavity.

2. Select the **Top Face** button.
3. Select the top face work plane.
4. Select the **Bottom Face** button.
5. Select the bottom face work plane.
6. Select the **Axis** button.
7. Select an axis passing

through the valve body.

- 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.

- Save the model.

Note:

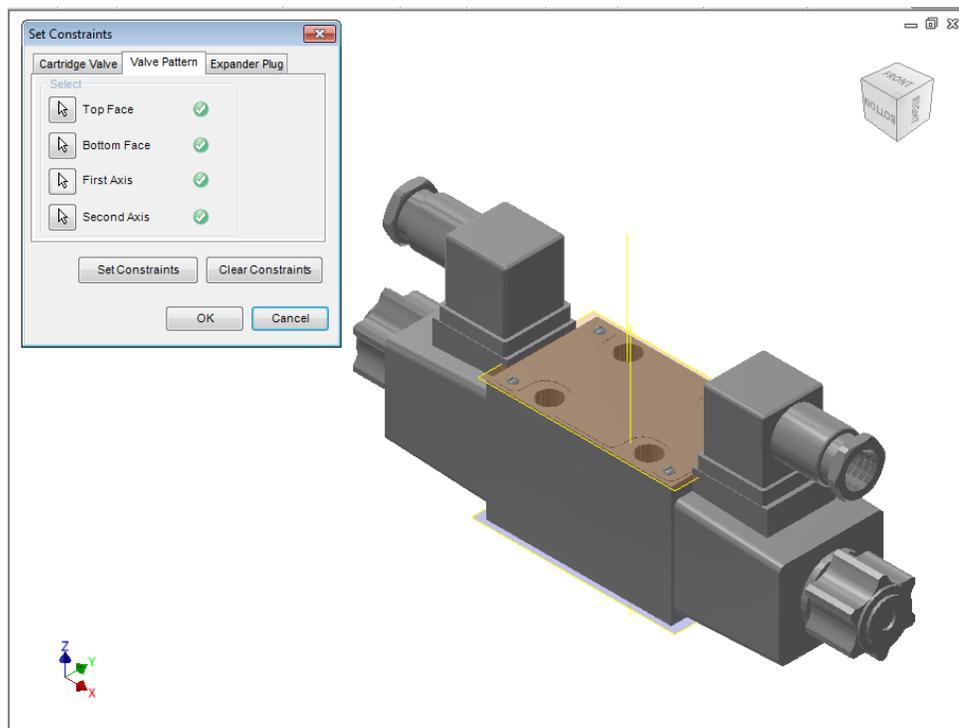
Use this option to set the assembly constraints for solenoid coils and lock nut/manual overrides on the screw-in cartridge solenoid valves.

2. Valve Pattern Tab

- Set the assembly constraints for the surface mounted valves, slip in cartridge valves, or flanges.

For these components, you need to specify four parameters: Top Face, Bottom Face, First Axis, and Second Axis.

- Create work plane for the top and bottom face.
- Create the first axis. Create a Work axis that passes through LP/LP1/BH1.
- Create the second axis. Create a work axis that passes through LP2/BH2.
- Select the **Top Face** button.
- Select the top face work plane.
- Select the **Bottom Face** button.
- Select the bottom face work plane.
- Select the first **Axis** button.
- Select the axis passing through LP/LP1/BH1.
- Select the second Axis button.
- Select the axis passes through LP2/BH2.
- Click **Set Constraints** to set assembly constraints.



Set Constraints dialog box: Valve Pattern tab

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

14. Save the part model.
15. Click **OK**.

Note:

First Axis

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

Second Axis

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

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

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

3. Expander Plug Tab

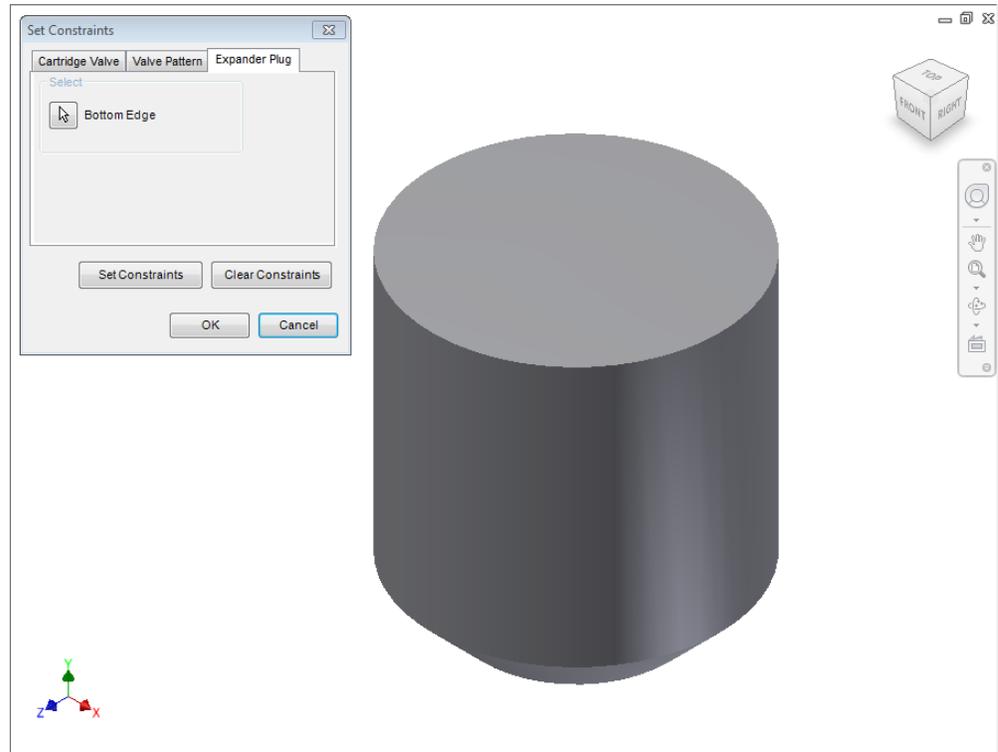
If there is no spot face in the cavity (Step0 angle is not equal to 90), then you must use the Expander Plug tab to set the assembly constraints, for example in the expander plug ports.

In such cases, you need to set only one constraint, i.e., Bottom Edge.

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

Clear Constraints

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

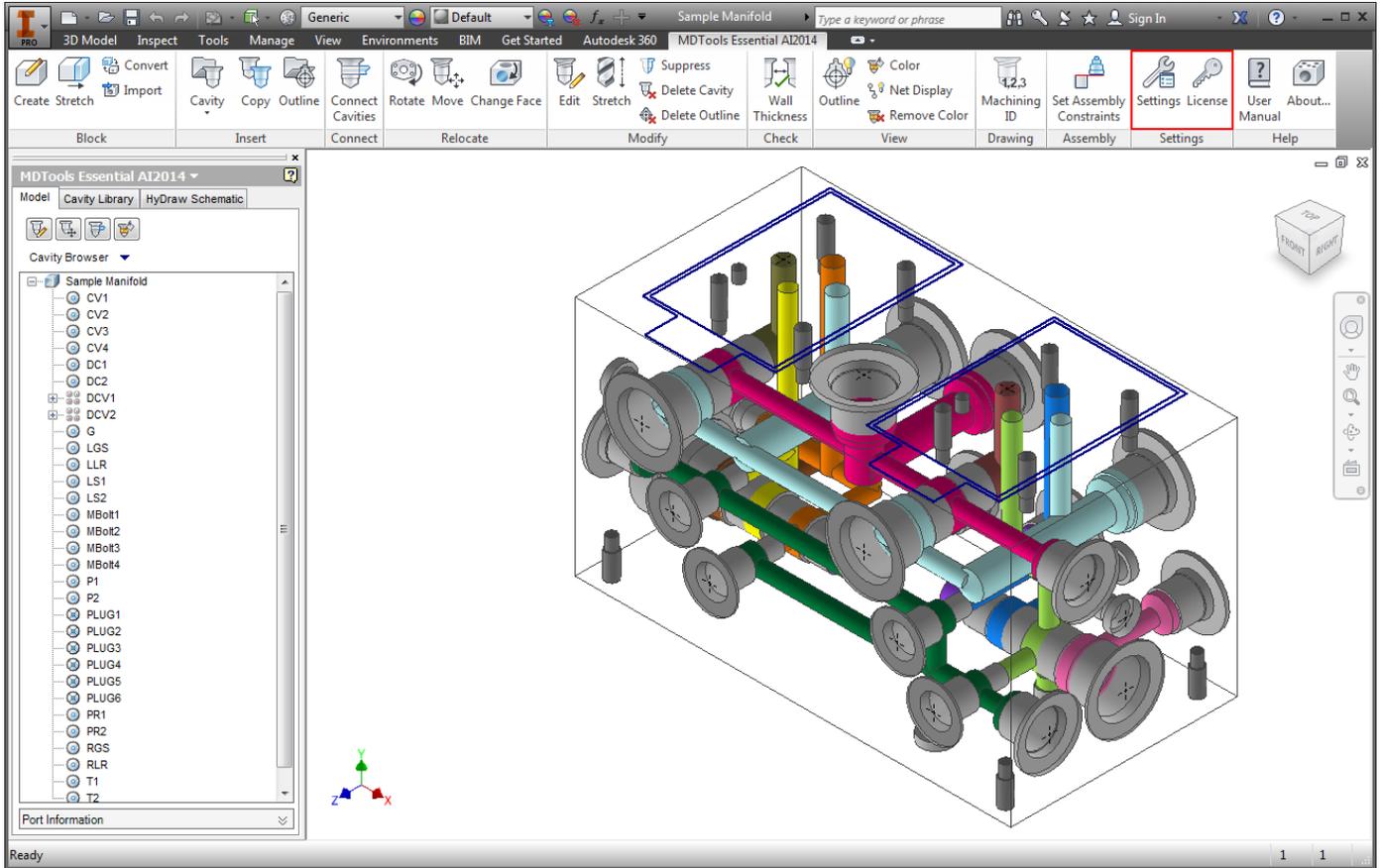


Set Constraints dialog box: Expander Plug tab

MDTools Settings

32 Settings

33 License



32. Settings

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

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

MDTools Essential AI2014

> **Settings** panel

> **Settings**

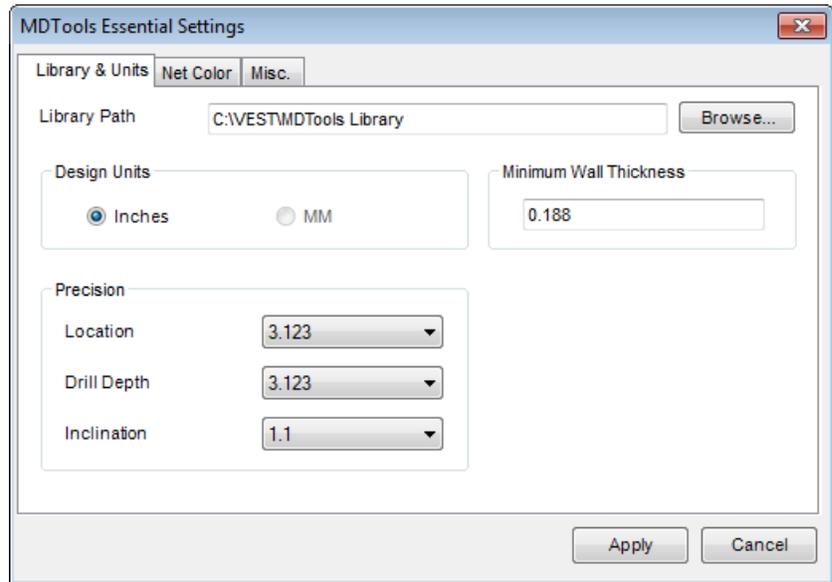
The MDTools Essential Settings dialog box displays.

Units

Design Unit: Sets the design unit. Inches or MM

Precision: Sets the manufacturing precision for the design Location, Drill Depth and Inclination

Minimum Wall Thickness: Sets the default minimum wall thickness



Library and Units Tab

CAUTION!

Set the design units before inserting the first cavity.

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

Library Path

The Library Path sets the location of the MDTools library.

1. Click the browse button to search the Library Path....

The Browse for Folder dialog box displays.

2. Browse and select the folder containing the MDTools library.

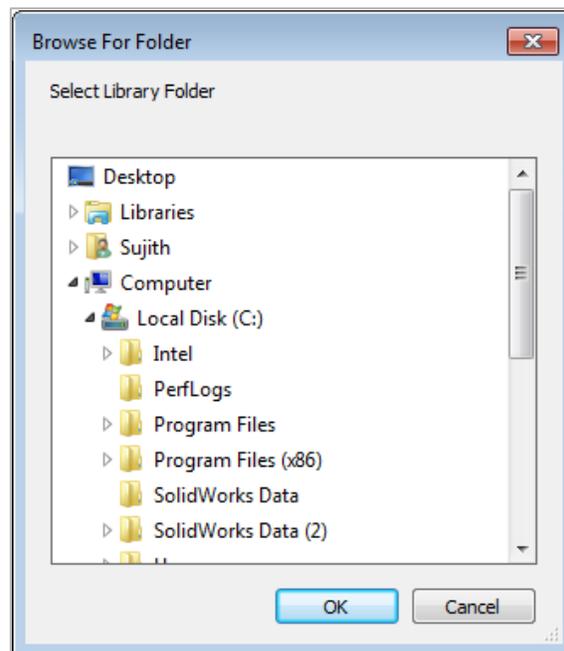
You can also change the library path by entering the new library path in the Library Path text box.

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

MDTools saves the change in the Library Path and Unit Settings.

5. Click **OK**.

The Browse for Folder dialog box closes.



Browse for Folder dialog box

Note:

Set the library path on all the systems independently.

Net Color

Default Color

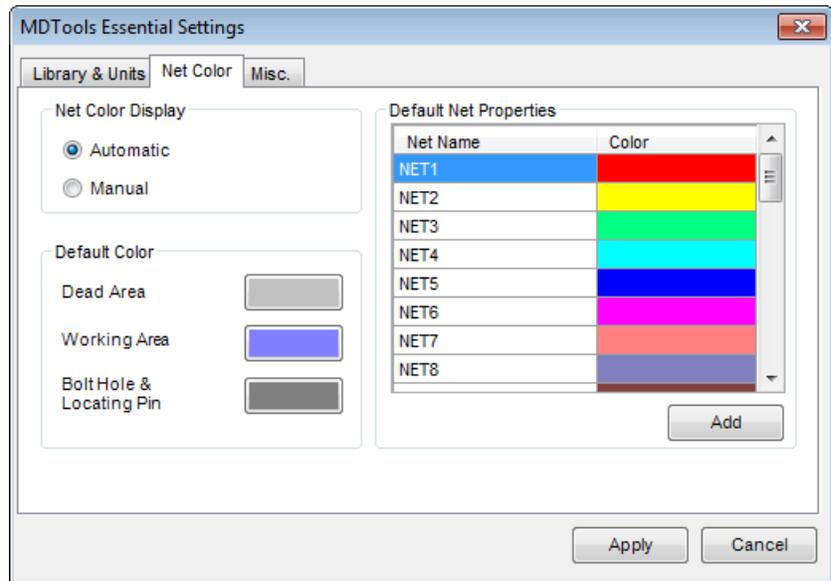
- Dead Area Sets the color for the dead areas on the cavity
- Working Area Sets the default color of the working areas on the cavity
- Bolt Hole & Locating Pin Sets the color for locating-pin holes and bolt holes

Default Net Properties

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

Note:

- Number of nets cannot be less than 25.
 - MDTools® automatically assigns a new color to the newly added net.
- Ensure that you use a visibly distinct color for the net.



MDTools Settings dialog box: Net Color

Miscellaneous

Cavity Machining ID Switches between Cavity Machining ID, same as the component ID or not

Browser

Loaded Switches the browser between Loaded and Unloaded

Load on Startup Switches the browser setting between loading the browser on startup and loading the browser manually

Group cavities by Face Switches between grouping of cavities in manifold by face or not

Insert from HyDraw

Use Cavity Data from:

MDTools Library Cavity inserted using geometric data available in MDTools® library

HyDraw Schematic Cavity inserted using geometric data stored in HyDraw® Schematic XML file.

Auto-Connect:

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

Design Mode

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

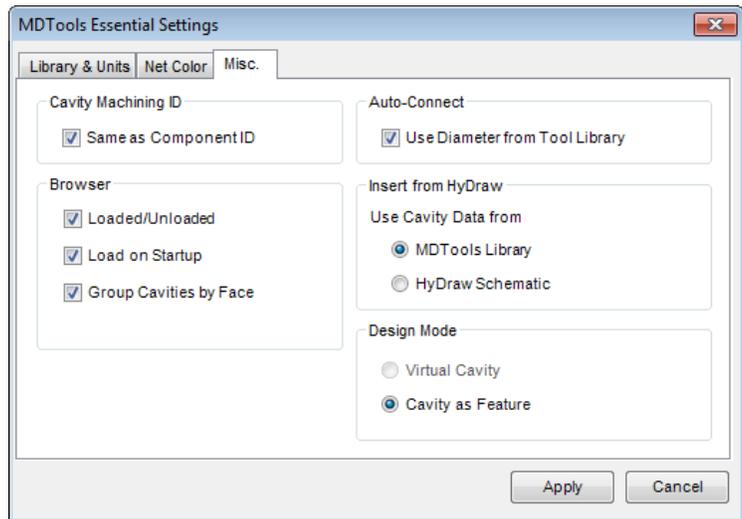
Virtual Cavity

Quickly design the manifold and then switch to feature-based manifold design mode using the Convert Manifold Command.

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

Cavity as Feature

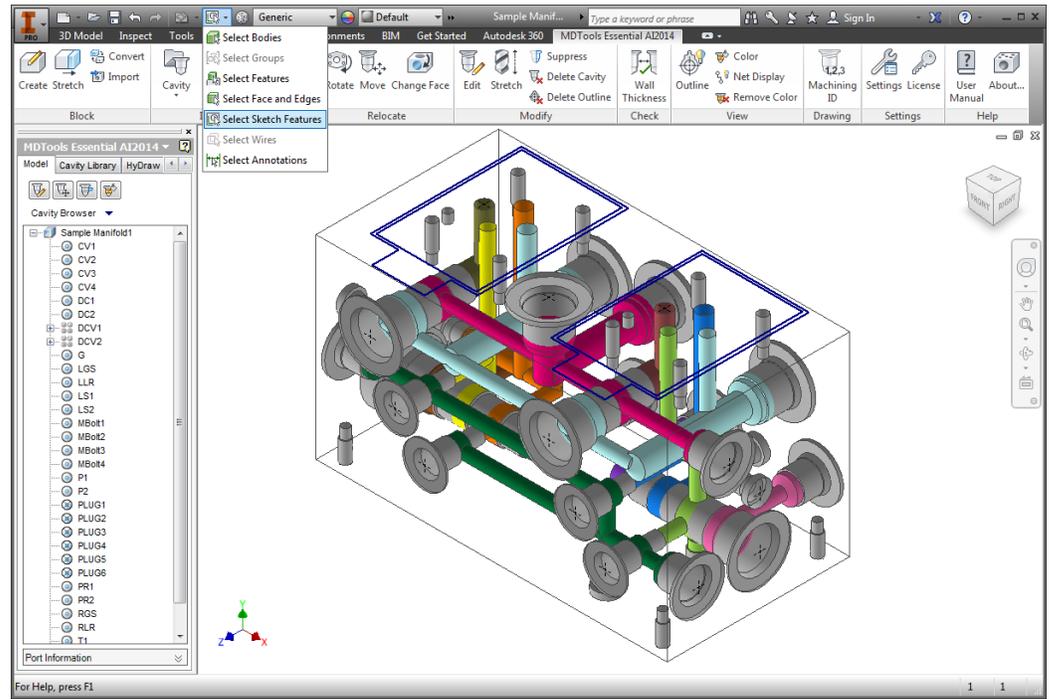
Cavities are created as revolve feature in Inventor.



Miscellaneous Tab

Selecting a Virtual Cavity

Set the selection option to the **Select Sketch Features** option in Inventor part model.

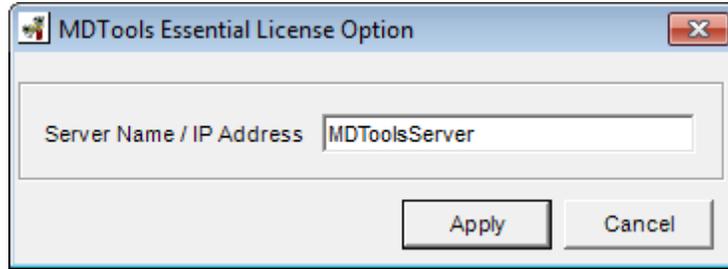


Setting Select Sketch Features

33. License

1. Set the license path through the Part Model menu.
2. MDTools Essential AI2014
 - > **Settings** panel
 - > **License**

The MDTools Essential License Option dialog box displays.

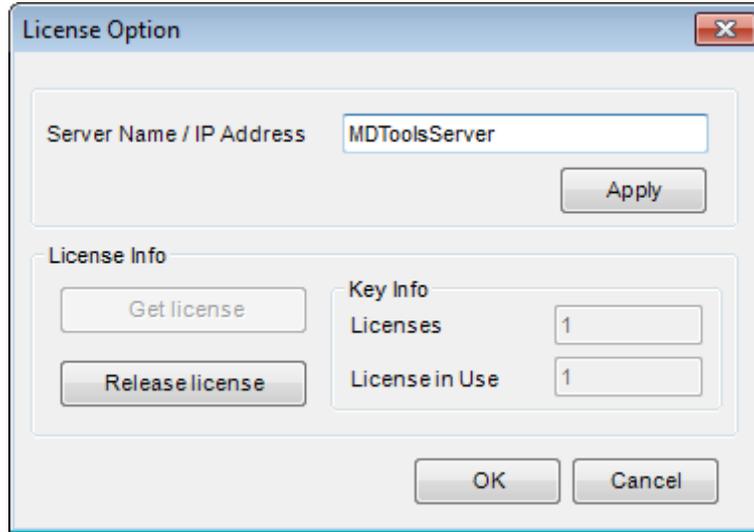


MDTools Essential License Option dialog box

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

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

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



License Options dialog box

5. 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.

6. 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.

7. Click **OK** to continue.

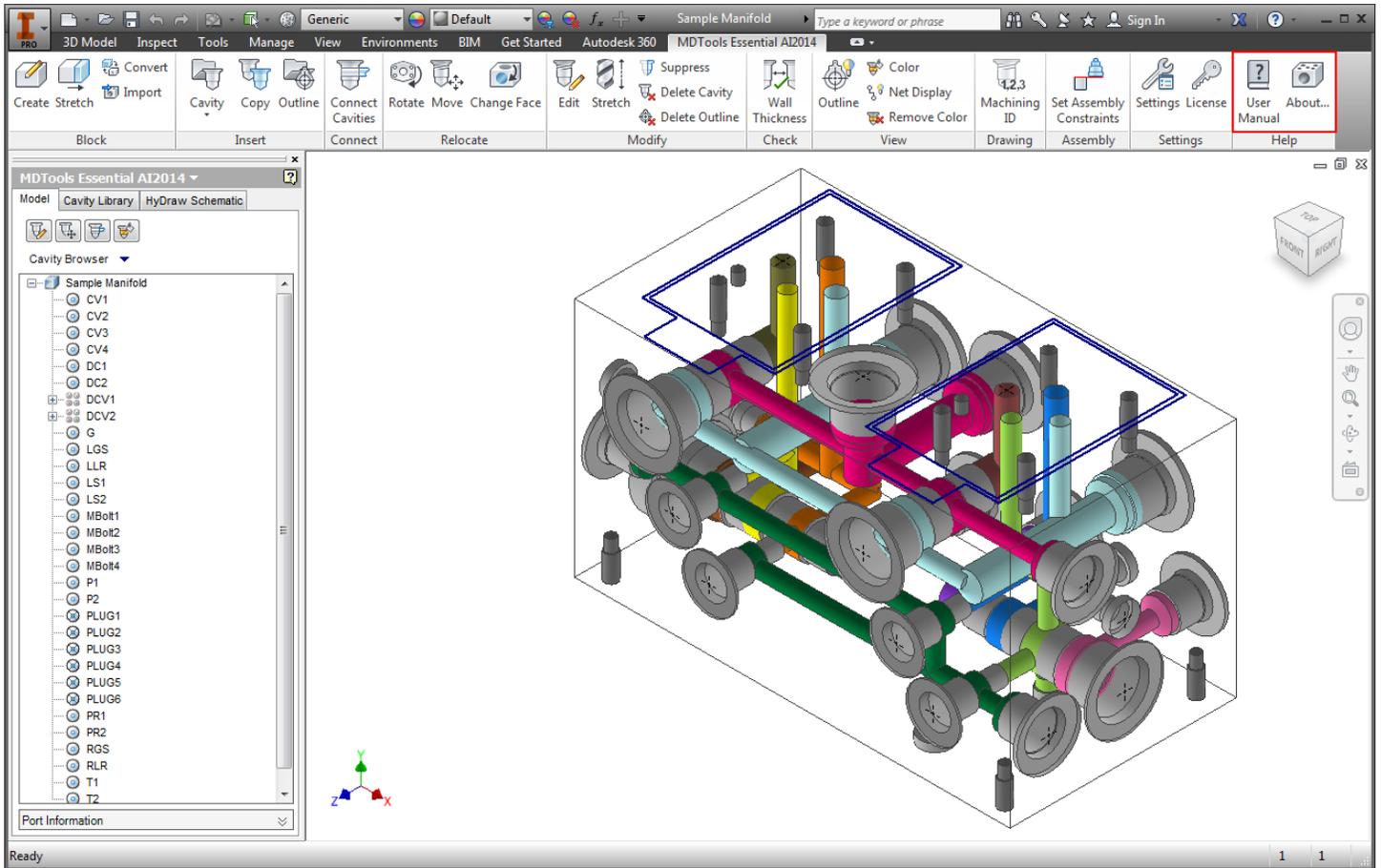
Note:

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

Help

34 User Manual

35 About MDTools



34. User Manual

Open the MDTools Essential AI2014 user manual in the PDF format.

MDTools Essential AI2014

> **Help** panel

> **User Manual**

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

35. About MDTools

View the MDTools® version and build number.

MDTools Essential AI2014

> **Help** panel

> **About**

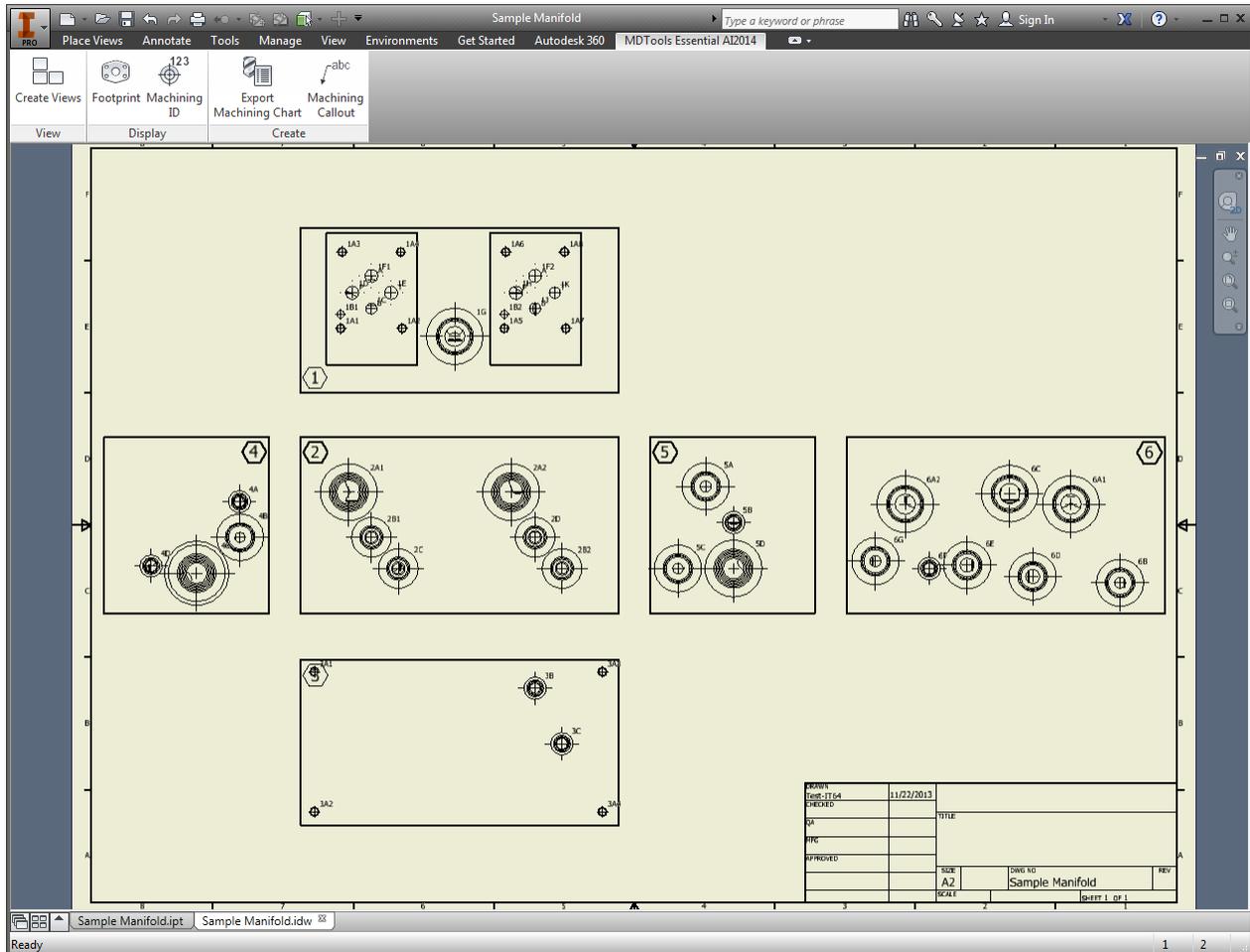
*The About MDTools
Essential dialog box opens and
displays the MDTools version
and the build number.*



About MDTools Essential dialog box

DRAWING COMMANDS

- 36 Create Views
- 37 Footprint
- 38 Show Machining ID
- 39 Export Machining Chart
- 40 Create Machining Callout



36. Create Views

Automatically create 2D views of a manifold.

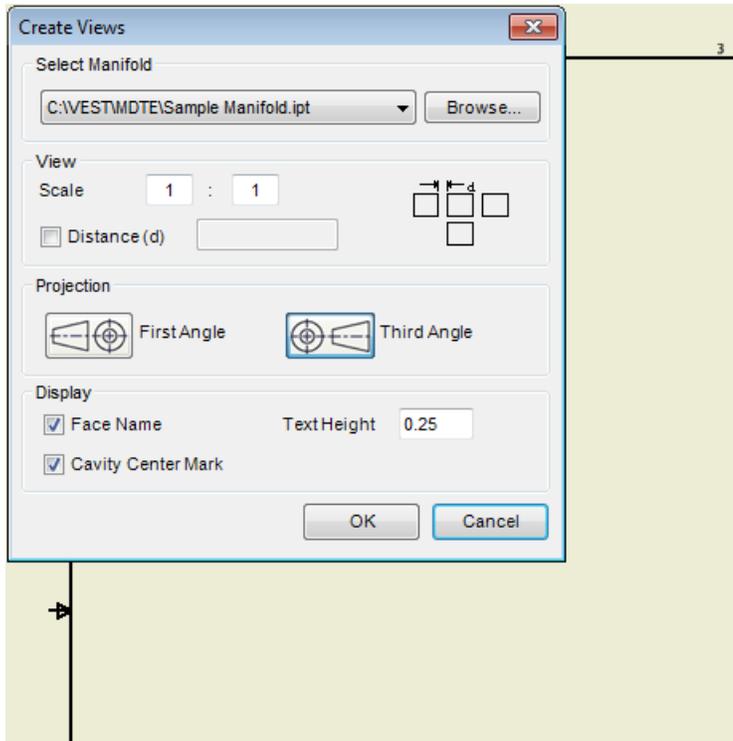
1. MDTools Essential AI2014
 - > Views
 - > Create Views

The Create Views dialog box displays.

2. Click **Browse**.
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.
- You can also select the part model or assembly model from the list.



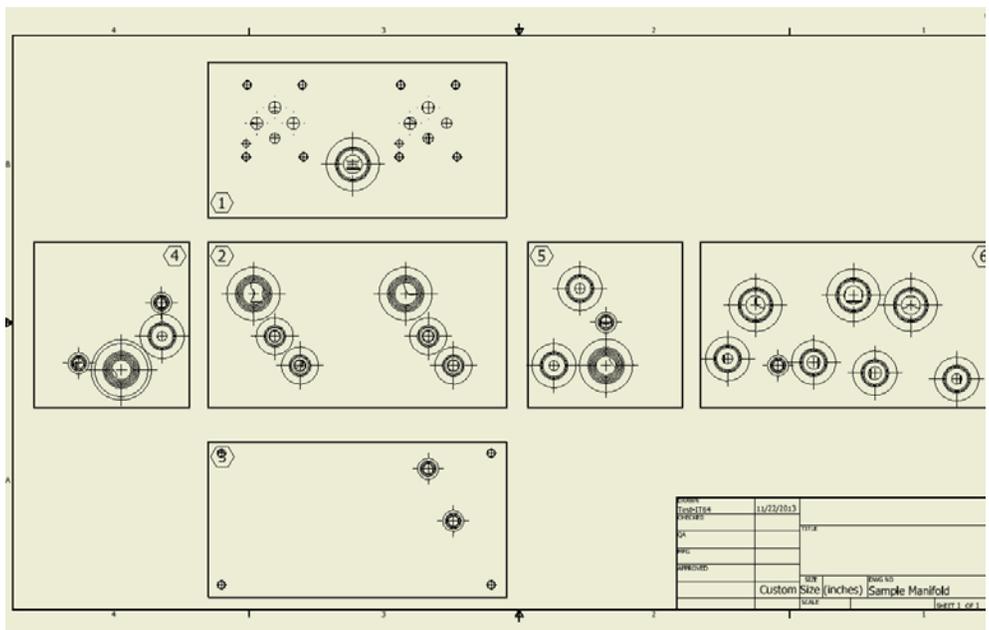
Create Views dialog box

5. Select the current projection type.
- The Third Angle projection is selected by default.

6. Specify the distance between views.
- If the distance is not specified, MDTools® calculates the distance between the views based on the sheet and the block size.

7. Select the **Show Face Name** option.
8. Select the **Cavity Center Mark** option.
9. Enter the text height for the face name text.
10. 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.



Six views of the manifold created automatically

Note:

- Top view: **A**
 - Front view: **B**
 - Bottom view: **C**
 - Left view: **D**
 - Right view: **E**
 - Back view: **F**
- All 2D drawing commands of MDTools support redefined faces in the Part Model.
 - 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.

37. Footprint

Automatically displays the port application name for footprint cavities near the cavities and the envelope in the 2D drawing views.

MDTools Essential AI2014

> Display panel

> Footprint

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

Exclude Port Application Name for flanges, if required.

The port name and footprint outline is created inside a single sketch in a view.

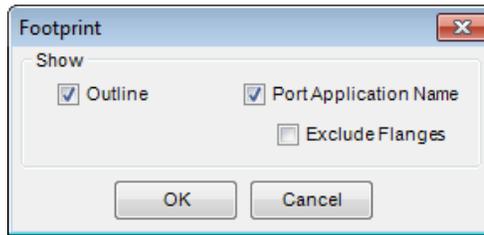
The port name and footprint outline in a view moves together when you drag the view position.

Note:

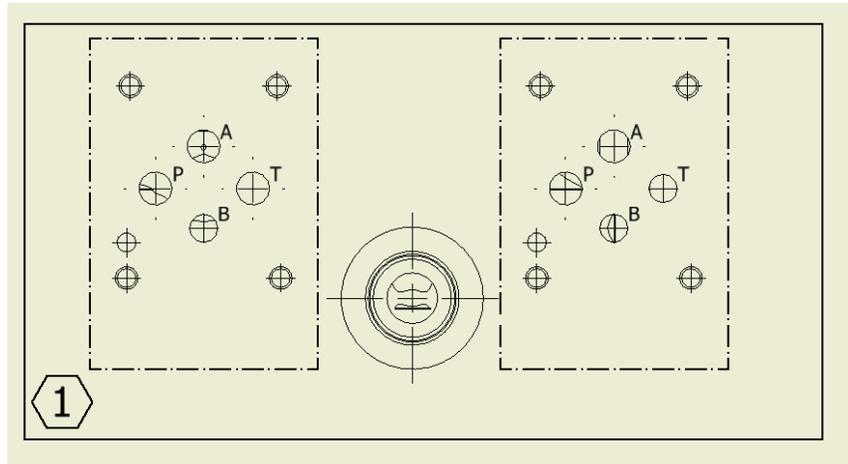
- If 2D views are created manually, then use the following naming convention for the manifold views.

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.



Show Footprint dialog



Port application name with cavity in 2D drawing

38. Show Machining ID

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

- MDTools Essential AI2014
 > **Display** panel
 > **Machining ID**
 The Show Machining ID dialog box displays.

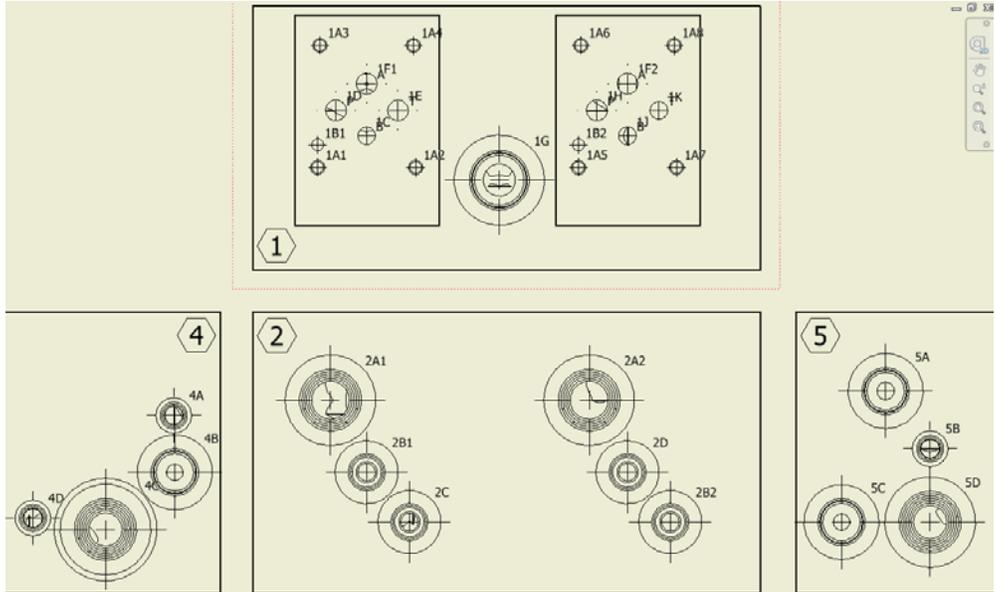


- Select **Same as Component ID**, if you want to use the component ID as the cavity machining ID.

Show Machining ID dialog box

Set the default option from the MDTools Settings dialog box.

- Click Show Machining ID.
 MDTools® displays the cavity machining ID near the outermost circle at 45 degrees from the center of each cavity.



Cavity machining ID on 2D drawing

Note:

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

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

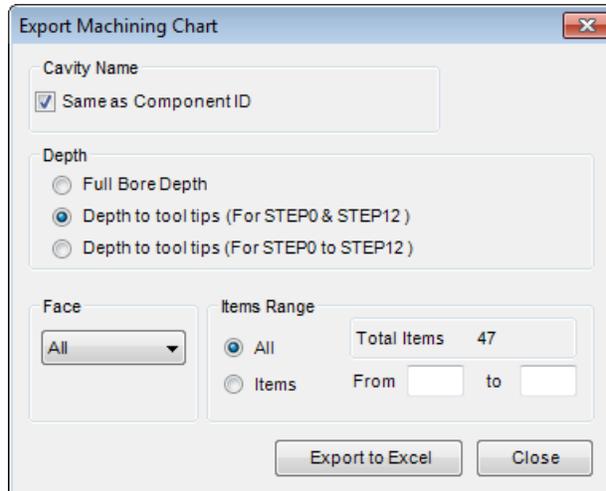
39. Export Machining Chart

Once the design of a manifold is complete and checked, the machining chart of the design can be automatically extracted from the manifold and exported into the Excel sheet.

Automatically extract the machining data from all the cavities and export the machining chart.

Exporting the Machining Chart

- MDTools Essential AI2014
 > Create panel
 > Export Machining Chart
 The Loading Cavities List message box displays followed by the Export Machining Chart dialog box.
- Select **Same as Component ID**, if you want to use the component ID as the cavity name.
- Select Depth, as required.
- Select a face from the Include group box, if you want to export the machining chart for any particular face otherwise select **All**. (*All is the default option*)



Export Machining Chart dialog box

- Select **All Items** in the Include group, if you want to export a complete machining chart.
 Or,
 Select the **Selected Items** option and enter the start and end item index to export a list of specific item range.
- Click **Export to Excel**.
 Excel sheet with exported machining chart opens
- You can **Save** this sheet.

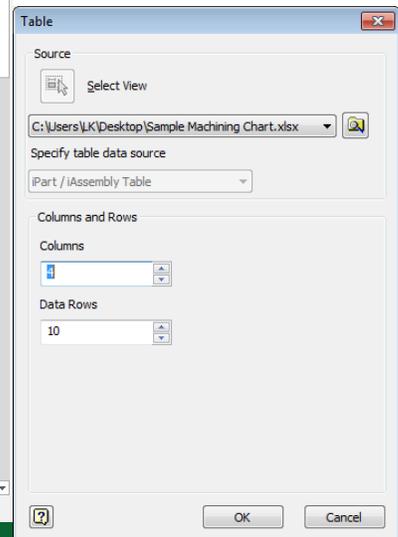
Note:

You can import the Machining Chart in Excel format to the drawing using Inventor Command.

- Go to Annotate → General (Table Section).
The Table dialog displays.
- Click **Browse for file** and provide the Machining Chart in Excel Format.
- Click **OK**, to insert into the drawing.

NAME	OPERATION	DIAMETER	DEPTH
1A1	TAP DRILL	5/32	0.747
	TAP	#10-24	0.555
1A2	TAP DRILL	5/32	0.747
	TAP	#10-24	0.555
1A3	TAP DRILL	5/32	0.747
	TAP	#10-24	0.555
1A4	TAP DRILL	5/32	0.747
	TAP	#10-24	0.555
1A5	TAP DRILL	5/32	0.747
	TAP	#10-24	0.555
1A6	TAP DRILL	5/32	0.747
	TAP	#10-24	0.555
1A7	TAP DRILL	5/32	0.747
	TAP	#10-24	0.555
1A8	TAP DRILL	5/32	0.747
	TAP	#10-24	0.555
1B1	DRILL	0.160	0.223
1B2	DRILL	0.160	0.223
1C	DRILL	0.234	2.920
1D	DRILL	0.276	1.424
1E	DRILL	0.276	1.533
1F1	DRILL	0.276	2.835
1F2	DRILL	0.276	2.835
1G	DRILL	0.422	1.443
	FORM PORT	ISO 6149-1-M18 X 1.5	0.079
	TAP	M18x1.5-6H	0.650
1H	DRILL	0.276	1.243

Exported Machining Chart in Excel



Inventor Ribbon Menu

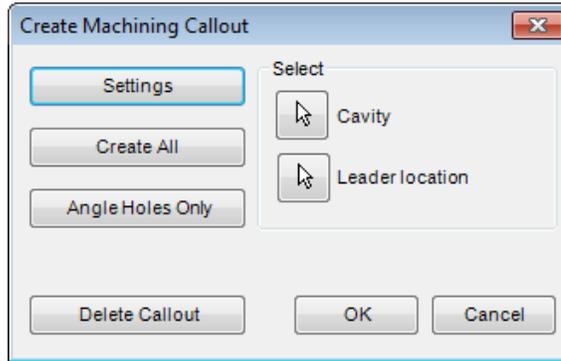
Annotate → General – Table Dialog

40. Create Machining Callout

Automatically create leader-type cavity machining callout for all the cavities in the 2D drawing.

It automatically extracts the cavity machining detail from all the cavities and inserts with the leader on the cavities.

MDTools Essential AI2014
 > **Create** panel
 > **Machining Callout**
 The **Create Machining Callout** dialog box displays.



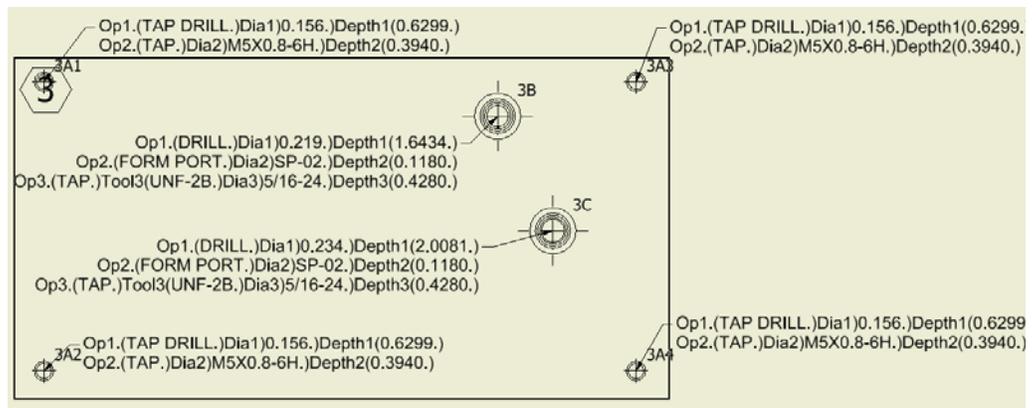
Create Machining Callout dialog box

Create Machining Callout for Cavities

To create the machining callout for all cavities, Click **Create All**.

MDTools® inserts the leader on all cavities consisting of machining detail. It places the leader from the cavities center at an angle of 45 degrees.

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



Machining Callout displayed for all the cavities in the 2D drawing

To create the machining callout for a cavity

1. Click the **Cavity** select button.

The **Select Leader point** button becomes active automatically.

2. Click the **Leader Location** select button.
3. Select the point where you want to place the leader.
4. Click **OK**.

- To delete callouts, click **Delete Callouts**.
- 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.

Configure the output of the Machining Callout

Create Machining Callout dialog box > **Settings**

1. Specify prefixes and suffixes for all the machining sequence rows and columns in the **Operations, Tool Name, Diameter and Depth**.
2. Specify the order of the machining sequence with the options available in the **Machining Sequence** group.

The Selected Order list shows the order in which the machining operation sequence are created for a particular row.

There are 7 row options available.

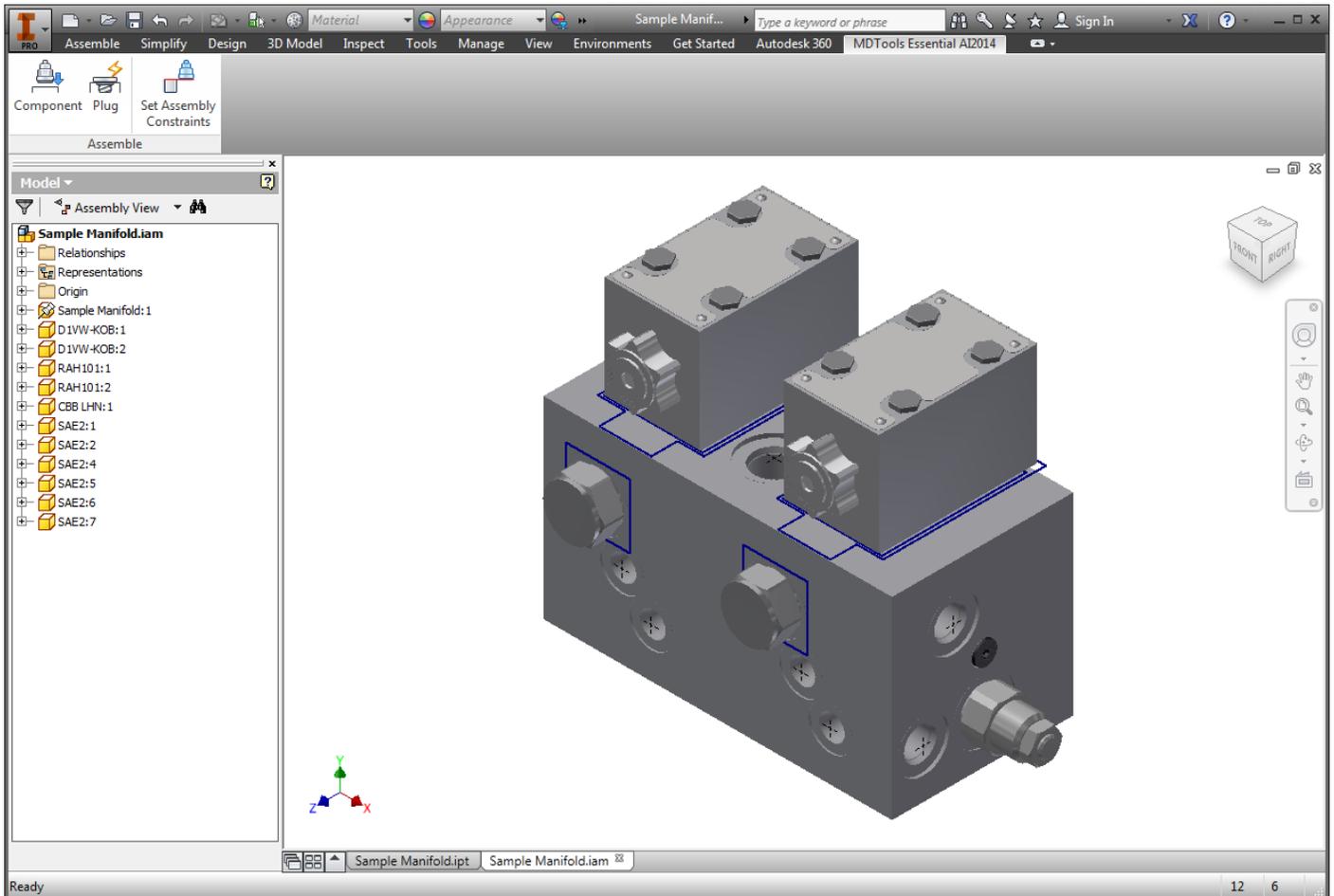
The order list is easily built by selecting a machining sequence row and clicking the up or down arrow button, in the desired order.

Machining Callout Setting

3. Select the number of decimal places for the *Depth* and *Diameter* entries in the callout from the dropdown.
4. Specify the value of text height for the callout text.
5. Select the **Depth** option.
6. Select the **Show Trailing Zero** option to display the trailing zero in the cavity diameter and depth.
7. Select the **compound angle hole only** option to show the alpha angle for the simple angle holes in the machining callout.
8. Specify **Angle Prefix** for the Alpha and Beta angle to display in the machining callout. For example, /Angle:
9. Specify **Beta Caption** for the Beta angle in the machining callout. For example, Beta =
10. Specify **Alpha Caption** for the Alpha angle in the machining callout. For example, Alpha =.
11. Click **OK** to save changes.

ASSEMBLY COMMANDS

- 41 Set Assembly Constraints
- 42 Assembly Interface
- 43 Assemble Plugs



41. Set Assembly Constraints

Set all the assembly constraints on part/assembly models.

Set assembly constraints on all the part/assembly models to make them work with the Assembly Interface.

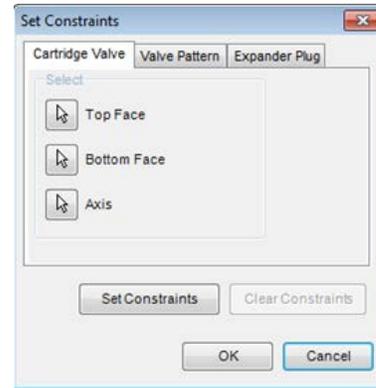
Parts without the assembly constraints will not get assembled on the manifold.

- Open the part/assembly model of valve in Inventor.
- MDTTools Essential AI2014
 - > **Assemble** panel > **Set Assembly Constraints**

The Set Constraints dialog box displays.

The Set Constraints dialog box contains the following tabs.

- Cartridge Valve
- Valve Pattern
- Expander Plug



Set Constraints dialog box

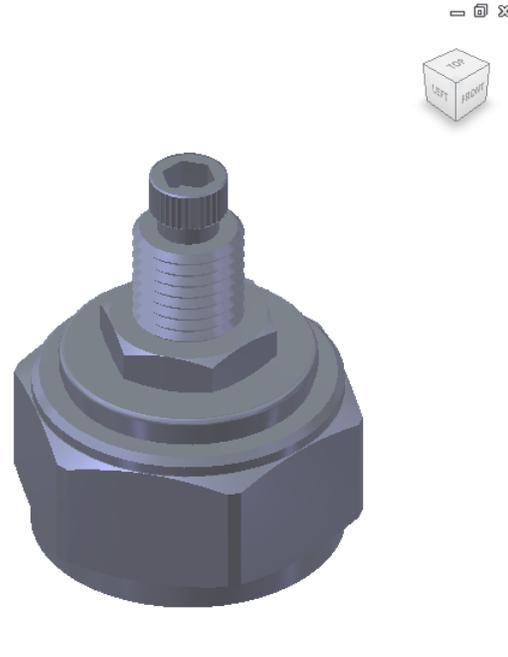
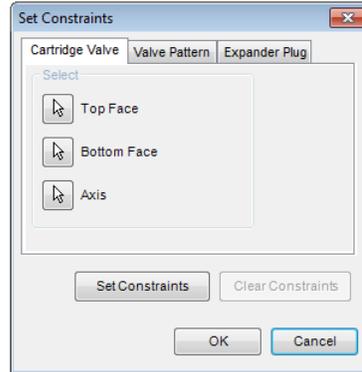
1. Cartridge Valve Tab

Set the assembly constraints for cartridge valves, port fittings, and plugs. For these components, you need to specify the three parameters, Top Face, Bottom Face, and Axis.

1. Create work planes for top and bottom face.

Note:

Work planes should be used to define the top and bottom face. Bottom work plane will mate with the spot face of the cavity during assembly. So, the bottom work plane must be created on the face that needs to mate with the spot face of the cavity.



Set Constraints: Cartridge Valve tab

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

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

Now, this part is ready for use with the Assembly Interface.
9. Save the model.

Note:

Use this option to set the assembly constraints for solenoid coils and lock nut/manual overrides on the screw-in cartridge solenoid valves.

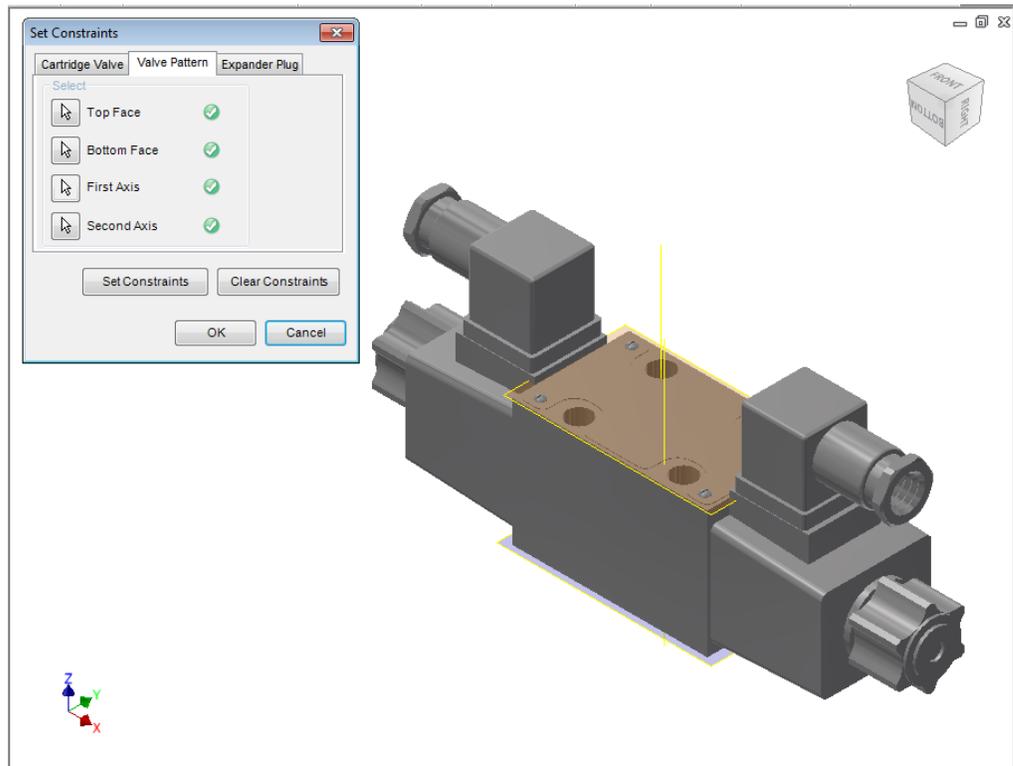
2. Valve Pattern Tab

- Set the assembly constraints for the surface mounted valves, slip in cartridge valves, or flanges.

For these components, you need to specify four parameters: Top Face, Bottom Face, First Axis, and Second Axis.

- Create work plane for the top and bottom face.
- Create the first axis. Create a Work axis that passes through LP/LP1/BH1.
- Create the second axis. Create a work axis that passes through LP2/BH2.

- Select the **Top Face** button. Set Constraints dialog box: Valve Pattern tab



- Select the top face work plane.
- Select the **Bottom Face** button.
- Select the bottom face work plane.
- Select the first **Axis** button.
- Select the axis passing through LP/LP1/BH1.
- Select the second Axis button.
- Select the axis passes through LP2/BH2.
- Click **Set Constraints** to set assembly constraints.

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

- Save the part model.
- Click **OK**.

Note:

First Axis

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

Second Axis

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

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

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

3. Expander Plug Tab

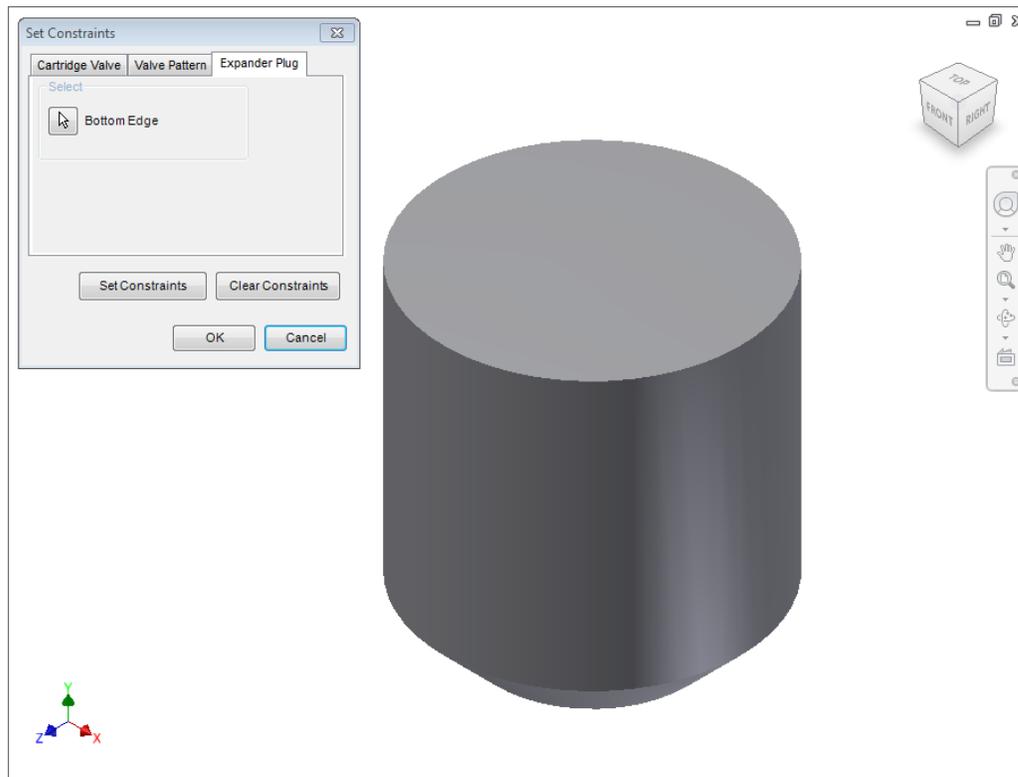
If there is no spot face in the cavity (Step0 angle is not equal to 90), then you must use the Expander Plug tab to set the assembly constraints, for example in the expander plug ports.

In such cases, you need to set only one constraint, i.e., Bottom Edge.

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

Clear Constraints

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



Set Constraints dialog box: Expander Plug tab

42. Assembly Interface

Automatically assemble all the components on a manifold. MDTools® automatically creates all the required constraints and assembles the components at the correct location.

Create a new assembly drawing (.iam) and place the manifold into the assembly drawing using the **Place Component** command in Inventor.

1. MDTools Essential AI2014 > **Assemble** panel > **Component**

The *Assembly Interface* dialog box displays. MDTools displays the cavity IDs of all the cavities in the dialog box.

2. Click **Browse** and select the folder containing the part files.
3. Click **OK**.

Note:

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

Selecting Valves

1. Select the cavity by selecting the cavity ID.
2. Click **Select Valve**.
3. Select the required valve.
4. Click **OK**.

The *Select Part File* dialog box closes.

The *Assembly interface* dialog box displays.

5. Click **>** to add the selected cavity to the assembly list.

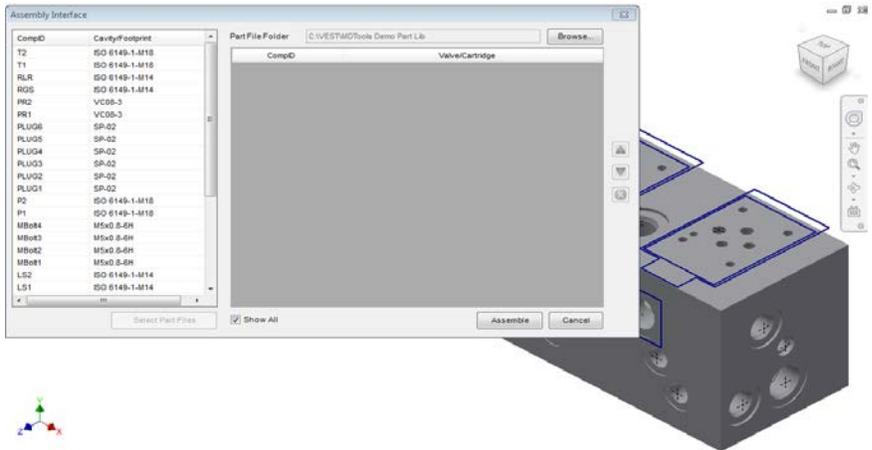
MDTools moves the selected cavity from the cavity ID list and displays the assembly details on the right side.

Note:

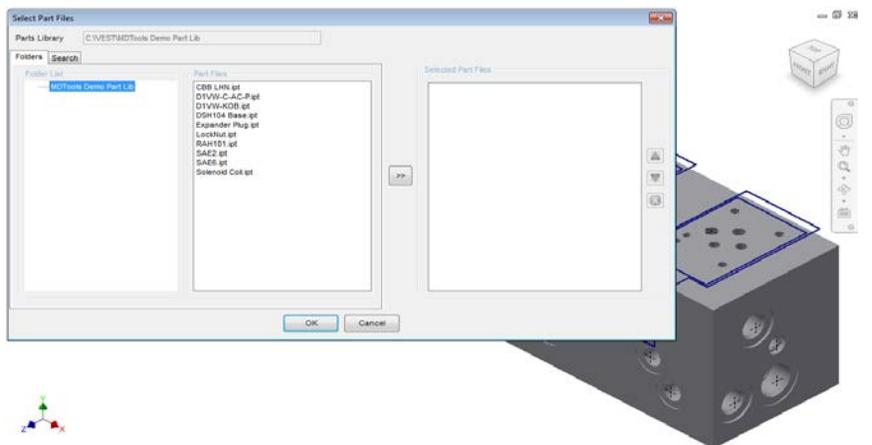
If the selected cavity is a Solenoid valve cavity, then you should select the solenoid coil and manual override/lock nut before adding the cavity into the assembly list.

6. Similarly, select part files for all the cavities on the manifold.
7. Click **Assemble**.

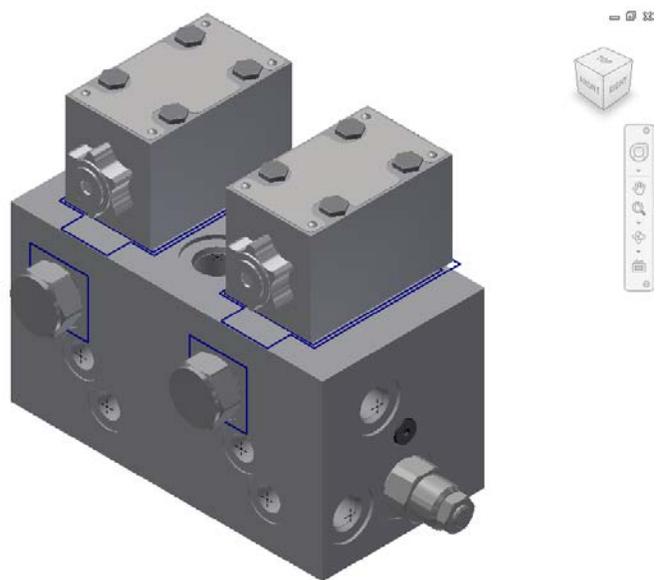
MDTools automatically assembles all the selected components at their locations on the manifold.



Assembly Interface dialog box



Select Part File dialog box



Assembly created using MDTools

Same Component for Multiple Cavities

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

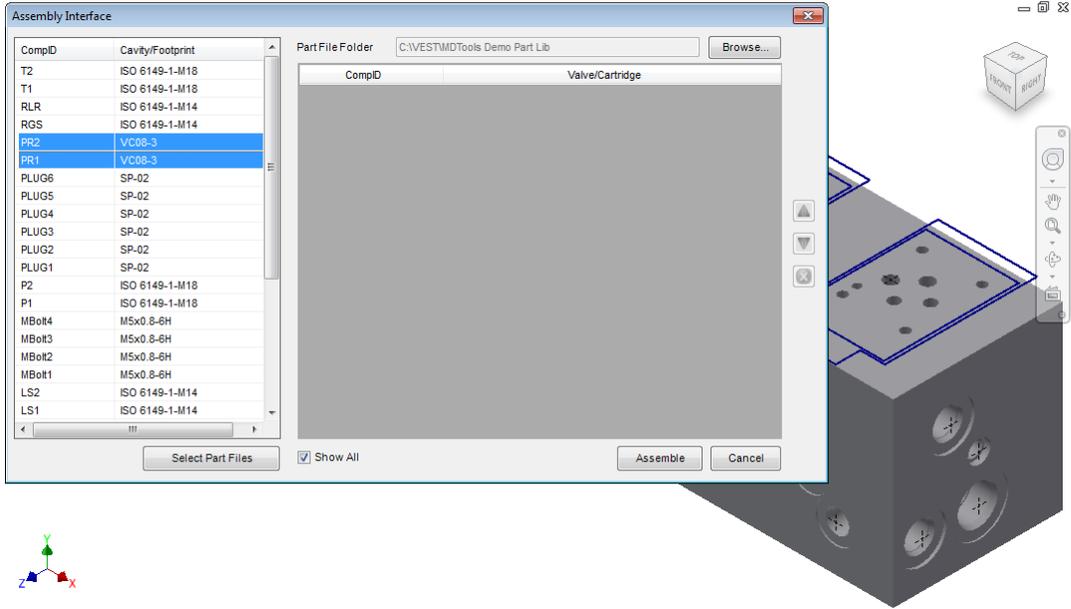
1. Select the cavities from the list, one by one.

Note:

Hold the **Ctrl** key to enable multiple cavity selection.

2. Select the component using the **Select Valve** option.
3. Click  to add the selected cavities into the assembly list.

MDTools® adds all the selected cavities into the assembly list.



Multiple Cavity selection

Note:

- Set assembly constraints on all the part models using the MDTools Set Assembly Constraints program to make it work with the Assembly Interface.
- Parts without the assembly constraints will not get assembled on the manifold.

Refer Chapter 31, *Set Assembly Constraints*, for details about assembly constraints.

43. Assemble Plugs

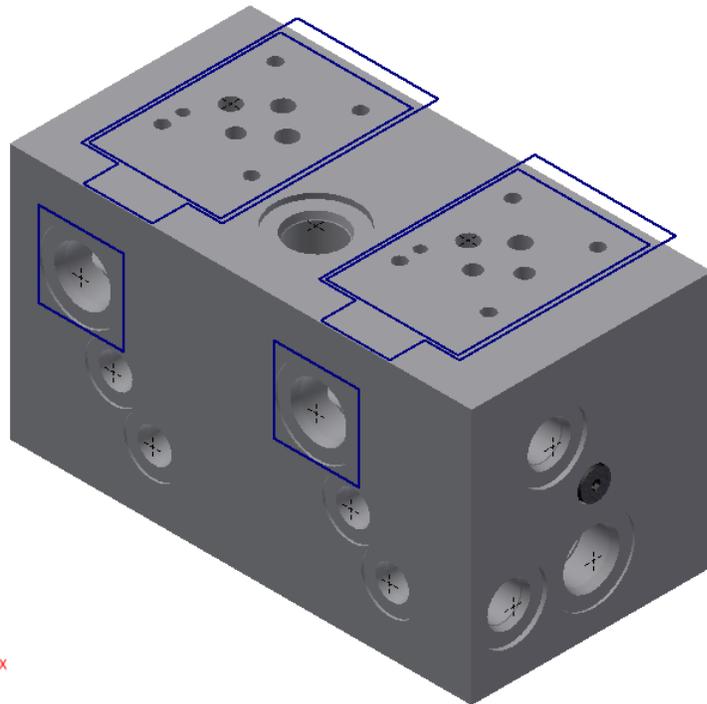
Automatically assemble plugs on all the construction (X-Drill) ports on a manifold.
MDTools® automatically creates all the required constraints and assembles the plugs at the correct location.

You can specify cavity and plug file path location using the MDTools Assembly Library.

Open the Assembly model in Inventor.

MDTools Essential AI2014
> **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.



Assemble the plugs on the construction ports in a manifold

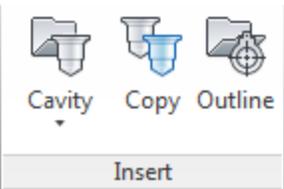
Appendix

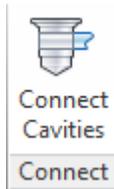
44 Command Overview

44. Command Overview

1. Part Model Commands

Command Name	Function	Ch
		
1. Block Panel	Block	
 Create	Automatically draw the manifold block in Inventor based on: <ul style="list-style-type: none"> • Required manifold length, width, and height • Required material cross section from an existing material, a cross section database, and the corresponding length 	9,10
 Stretch	Stretch the block in the specified direction	11
 Convert	Convert a virtual cavity design into a feature-based manifold design and vice versa.	14
 Import	Read the input manifold data file in the XML format and create a new manifold in Inventor.	17

		
2. Insert Panel	Insert	
 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.	19
 From HyDraw	Read a HyDraw® created schematic drawing and insert all the required cavities with the connectivity information.	20
 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.	23
 Outline	Create the outline of a valve assembly around the selected cavities/footprints.	32

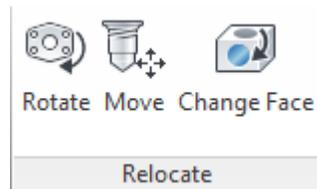
3. Connect Panel

Interactively create connections between cavities.

34

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.

4. Relocate Panel

Rotate the inserted footprint on the manifold surface.

37

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



Precisely move or relocate a cavity.

39

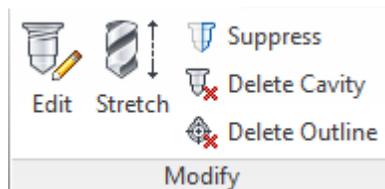
Specify the X and Y values from the face origin. Enter the displacement values, which is ΔX and ΔY .



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

42

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

5. Modify Panel

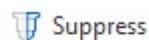
Edits a cavity.

43



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

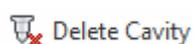
45



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

46

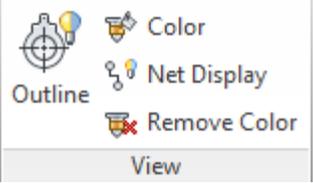
MDTools suppresses all the features used to create the cavity when you suppress a cavity.

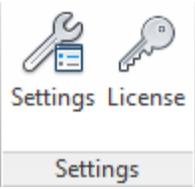
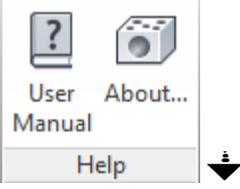


Delete the complete cavity/footprint.

49

All the features used to create the cavity/footprint in Inventor are automatically deleted.

Command Name	Function	Ch
 Delete Outline	Delete the assembly outline around the selected cavities/footprints created using this command.	51
6. Check Panel	 <p>Wall Thickness Check</p>	
 Wall Thickness	Measure the wall thickness between two cavities.	59
7. View Panel	 <p>Outline Color Net Display Remove Color View</p>	
 Outline	Toggle the visibility of component assembly outlines and footprint outlines on the manifold	68
 Color	Shade or update the shading of cavities on the manifold.	69
 Net Display	Locate a position or an area on a selected manifold face, where a cavity can be placed to connect with a selected net. MDTools® displays the cavities/ports in the selected net in green and all other cavities/ports in the dead area color.	71
 Remove Color	Remove the shading of cavities on the manifold.	75
8. Drawing Panel	 <p>Machining ID Drawing</p>	
 Machining ID	Generate Machining ID for all cavities in the specified format.	76
9. Assembly Panel	 <p>Set Assembly Constraints Assembly</p>	

Command Name	Function	Ch
 Set Assembly Constraints	Sets assembly constraints to a component model.	77
		
10. Settings Panel		
 Settings	Define various settings for MDTools® such as net color, units, and library path. Share the library with all designers in your organization so that all use the same data. Easily manage changes in standards or libraries within your organization.	78
 License	Set the license server path for MDTools Essential AI2014. Check for the license and select license from the specified license path.	79
		
11. Help Panel		
 User Manual	MDTools AI2014 User Manual.	80
 About...	About MDTools.	81

2. Drawing Commands

Command Name

Function

Ch



1. View Panel

View



Create Views

Create 2D views of the manifold.

82



2. Display Panel

Display



Footprint

Display the port names and footprint outlines in the 2D drawing views.

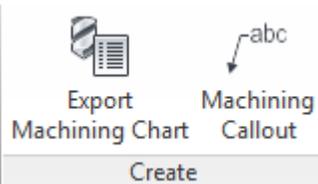
86



Machining ID

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

87



3. Create Panel

Create



Export Machining Chart

Extract the machining data from all the manifold cavities and create the machining chart.

93



Machining Callout

Create leader-type cavity machining callout for all cavities in the 2D drawing.

94

Extract the cavity machining detail from all cavities and insert with the leader on the cavities.

A

About MDTools · 92
Add new X-section · 34
Assemble Plugs · 106
Assembly Interface · 104

B

Bolt Holes · 21, 25
Browser Load Behavior · 87

C

Cartridge valve Cavity · 25
Cartridge Valve Cavity · 20
Cavity Browser Context Menu · 13, 14
Cavity Information · 19
Cavity Naming Scheme · 78
Change Face · 57
Check Wall Thickness · 68
Components and External Ports · 19
Connect Cavities · 49
Connect Existing Cavities · 43
Connectivity Browser Context Menu · 16
Construction Ports · 19
Convert Block · 37
Copy Cavity · 46
Create Block · 30
Create Block - Dimensions entered manually · 31
Create Block - using Material X-Section Libraries · 32
Create Machining Callout · 98
Create Material X-Section Library · 33
Create Views · 94
Creating Net List · 23

D

Default Net Properties · 86
Delete Cavity · 65
Delete Component Outline · 66
Design Check Basics · 24
Display Envelope/Outline · 71
Drill Holes · 21, 25

E

Edit All Cavity Parameters · 62
Edit Cavity · 59
Edit Net Name · 14
Export Machining Chart · 97

F

Find X-Section · 35
Footprints · 22

G

Generate Cavity Machining ID · 78
Generate Machining ID · 77

H

Hardware Key Installation · 7
HyDraw Schematic Interface · 18

I

Import Manifold · 38
Insert Cavity (...from HyDraw Schematic) · 45
Insert Cavity (...from Library) · 40
Insert Cavity/Footprint · 40
Insert Component Outline · 47
Install Hardware Lock Manager · 7
Install MDTools Essential · 6
Install MDTools Library Manager · 7
Installation · 6
Internal Details panel · 112
Introduction · 3

L

Library Path · 85
Locating Pin Holes · 21, 25

M

Machining Callout Setting · 99
Machining Chart · 97
Manifold Properties · 19
MDTools Assembly Commands · 11
MDTools Browser Bar in Browser Pane · 12
MDTools Cavities · 20
MDTools Cavity · 24
MDTools Drawing Commands · 11
MDTools Essential AI2014 Commands · 11
MDTools Essential AI2014 Workspace · 10
MDTools Essential Browser · 12
MDTools Essential Cavity Browser · 13, 16
MDTools Essential Part Model Context Menu · 15
MDTools Part Model Ribbon Menu · 11
MDTools Settings · 85
Miscellaneous · 87
Modeling Cavities · 20, 24
Move Cavity · 54
Moving by Dragging Cavity in Model · 55
Moving by Entering ΔX and ΔY · 54
Moving by Entering X and Y · 54
Moving by Increment · 56
Moving the origin · 56

N

Net Color · 86
Net Colors · 73
Net List · 22
Nets (Flow Paths) · 22

P

Port Information · 19
Ports · 21, 24
Position the cavity · 50
Position the cavity with reference to an edge or a cavity · 41
Position with minimum wall thickness · 44, 50

R

Recolor Cavities · 72
Remove Color · 75
Rotate Footprint · 42, 53

S

Same Component for Multiple Cavities · 105
Selecting Drill Diameter from Drill List · 61
Selecting Spot Face Diameter from the Spot Face Tool list · 112
Selecting Spot Face Diameter from the Spot Face Tool list · 108
Selecting Spot Face Diameter from the Spot Face Tool list · 61
Selecting Spot Face Diameter from the Spot Face Tool list · 113
Set Assembly Constraints · 80, 101

Set Assembly Constraints - Cartridge Valve tab · 101
Set Assembly Constraints - Cartridge Valve tab · 80
Set Assembly Constraints – Expander Plug tab · 83, 103
Set Assembly Constraints – Valve Pattern tab) · 81, 102
Set License Option in Inventor Part Model Menu · 8
Set License Options in Part Model Menu · 89
Show Footprint · 95
Show Machining ID · 96
Software Installation · 6
Stretch Block · 36
Stretch Drill · 63
Study Guidelines · 5
support · 5
Suppress Cavity · 64
Supressing Cavities · 64
System Requirements · 6

U

Units · 85
Un-supressing Cavities · 64
User Manual · 91
Using Angle Holes · 26

V

Virtual Cavity Selection · 88

W

Welcome to MDTools Essential AI2014 · 4

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