

**Technical Reference**

MCD manifold design guidelines, tooling, torque specifications, port and cavity dimensions



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Technical Reference

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# General Guidelines for Manifold Blocks Design



## WARNING

This information is designed to assist the engineering professional in the design of manifold blocks and related hydraulic systems. It is the designer's responsibility to verify the adequacy of the design through appropriate verifications, review and testing of the final design.

## Reviewing Circuit

All designs begin with a schematic circuit design inspired by the application. Before the planning stage, review the design utilizing the following steps:

- Match schematic symbols to model codes.
- Note size and cavity of each valve and write it on schematic.
- Note port numbers of the valves and write them on schematic.
- Note manifold port types and sizes specified by customer.
- Note pressure, flow and material of manifold block (steel or aluminum).

Circuit questions should be answered by the customer before beginning a design. It is also recommended that schematic hydraulic regions or networks be color coded using color pens. Regions or networks may be broken down in individual colors (pressure, tank, pilot, etc.) but it may be easier to design if regions are broken down into sub-regions such as pressure from port one of a solenoid valve to port two

of a relief valve. Colored layers may be assigned later to match schematic circuit coloring.

## Initial Design

Once the circuit is fully understood, it is advisable to lay the design out by hand first. Things to consider while planning the design are:

- Block size is often specified by customer.
- Specify an overall envelope size, in addition to the specified block size. Overall envelope size includes block size and any valves or fittings protruding from the manifold block.
- Restrictions specified for a mounting surface of the manifold block. Valves and ports may be restricted from a particular surface.
- Specify mounting holes, threaded holes and thru holes (if necessary).
- Arrange valves in a logical manner. Valves and ports in the same regions should be located in close proximity to each other.
- Eliminate as many turns in the regions as possible to reduce the number of cross drill holes or construction lines. This helps keep pressure drops (DP) and manufacturing costs down.

## Material Sizes

To obtain an optimal cost manifold it is desirable to

select a standard material size for the manifold, compare the block size with the standard material size table. See Standard Material Sizes (page M-5). If a standard size is not available, a cut plate may be used.

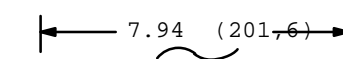
## Hydraulic Schematic

If a schematic is desired on the assembly, it may be created from existing symbols. As an alternative, the entire circuit may be created outside of an assembly and imported as a symbol (block). All of the Vickers screw-in cartridge valves have schematic symbols which can be found in the SICV Cartridge Valve Library of Symbols CD, used in conjunction with AutoCad software. Schematic symbols not found in the library may be created on an "as needed" basis.

## Accurate Design

All dimensions on CAD design must be accurate and to scale in order to be utilized by CAM software in conjunction with CNC machine tools. Manually or interactively modified dimension cannot be tolerated.

Example:



Note

Failure to ensure that CAD dimensions are accurate and to scale may result in improper machinery by CNC Machine Tools.

## Datum Point

The datum point or origin point (0,0,0) on machining drawings is the upper left corner when facing the front view.

## Assembly Dimensioning

Dimension all ports, mounting holes and overall envelope size.

## External Clearances

Allow enough room for clearance around solenoid coils, handknobs, levers and wrench clearance for fittings. If 90° elbow fittings are to be used, some may be required to swing a full 360 arc.

## Assembly Notes

Notes are added for standard or special assembly, handling, or shipping instructions, as well as special stampings.

## Port Table

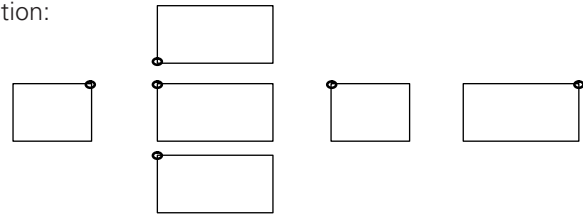
Include a port table with names and sizes of all ports.

## Standard Tooling

In order to obtain fast turnaround on designs, limit the tooling used to that listed in the standard tooling table. See Preferred Tooling for Machining Manifolds (page M-6).

# General Guidelines for Manifold Blocks Design

Datum Point Example in orthographic third angle projection:



## Squaring up the Block

Always “square up” the raw block before machining the cavities, ports and holes. This is to eliminate any potential “drill walk” which leads to scrapped manifolds. When squaring up a block, remove approximately 0.015” of material from each face for Aluminum blocks and 0.030” of material from each face for steel blocks. This is done to ensure that all six faces are parallel or perpendicular. Finished machining should reflect the squared up dimensions. See Standard Material Sizes (Table 1).

Example: 4.0" x 5.0" x 6.0" (101.6 mm x 127 mm x 152.4 mm) block will be dimensioned to 3.97" x 4.97" x 5.97" (100.8 mm x 126.2 mm x 151.6 mm)

## Creation of Machining Table

Create a machining operation table or bore chart. Machining depths are given from the surface of the block. List all drill depths, mills, taps and form tools in the machining table. Call out drill depths at the shoulder depth of the drill, not to the drill point depth.

## Machining Depths

All machining depths are to the corner of the full diameter as opposed to the drill point. All depths are measured from the face plane (surface) of a manifold block.

Avoid any drill depths greater than 25 diameters. Additional line lengths may result in increasing pressure drops.

## Machining Notes

Machining notes are to be added for standard or special machining, handling and shipping instructions.

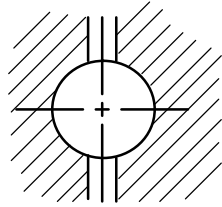
## Drillings

Drillings that go completely through a cavity port area should be on the center axis of the cavity wherever possible; see Figure (a). Otherwise it should

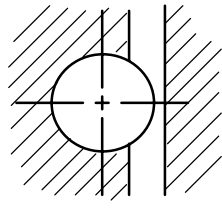
intersect the cavity tangent to the outside diameter of the bore it connects with; see Figure (b).

Note

Breaking into a cavity at some point in between these recommended areas will lead to drill walk and can result in a high scrap rate, as well as premature drill breakage.



(a)



(b)

## Spotface Depths

All SAE ports and cavities have spotface depths of .031" (.8 mm) unless otherwise specified. BSPP ports have spotface depths of .060" (1.5 mm) unless otherwise specified.

## Counterbores

In counterbore cases, the actual cavity spotface is located at the depth of the counterbore. When counterbore depths are greater than 0.125", the following diameters should be used:

VALVE SERIES COUNTERBORE		
	Inch	Metric (mm)
8	1.38"	35,0
10	1.38"	35,0
12	1.75"	44,5
16	2.00"	50,8
20	2.56"	65,0

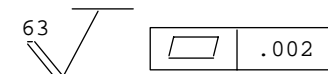
## Use of Expander Plugs and Zero Leak Gold SAE O-Ring Plugs

On small MCD packages, expander plugs can be used to block off construction

drilling at the surface of a face. Larger than a 12mm expander plug are not recommended in aluminum. Any construction drillings larger than 0.4" (10 mm) are plugged with zero leak gold SAE O-Ring plugs (internal hex type). The machining callout for these plugs can be either the industry standard SAE straight thread O-ring boss port configuration or the straight thread O-ring boss short port configuration. Refer to Port Dimensions (page M-9 and M-10).

## Surface Treatments

Any manifold face that calls for a surface mounted (gasket mounted) valve such as a DG4V type directional control valve, or a pump or motor interface, should have a minimum roughness callout of 63 microinches (.0016mm) and a flatness callout of .002" (.05mm). See examples below.



To prevent corrosion, steel manifolds are oil dipped or coated with rust protective fluid, unless otherwise specified. To prevent oxidation, aluminum manifold blocks are gold anodize, unless otherwise specified. Aluminum manifolds where the internally grounded coil is used should not be anodized. Prototypes are supplied without surface treatment.

# General Guidelines for Manifold Blocks Design/Standard material sizes

## Wall Thickness



### WARNING

Failure to follow the recommended wall thicknesses may lead to manifold failure. For pressures up to 3000 psi (210 bar), aluminum may be used, for pressures

above 3000 PSI (210 bar). Dura-Bar cast iron manifold material is recommended.

Larger cavities or bores require a greater wall thickness. The table below shows recommended minimum wall thicknesses for Aluminum and Dura-Bar.

DRILL SIZE/CAVITY BORE DIAMETER		WALL THICKNESS	
Inch Ø	Metric (mm) Ø	Inch	Metric (mm)
.250"	6,35	.125"	3,18
.250" up to .500"	6,35 up to 12,7	.250"	6,35
.500" up to .750"	12,7 up to 19,05	.375"	9,53
.750" up to 1.000"	19,05 up to 25,4	.500"	12,7
1.000" up to 1.312"	25,4 up to 33,34	.600"	15,24

Table 1 Standard Material Sizes

STANDARD 6061-T6 ALUMINUM BAR STOCK SIZES		
Size	Size	Size
2 x 2	3 x 3	4 x 5
2 x 3	3 x 3.5	4 x 6
2 x 4	3 x 4	4.5 x 4.5
2 x 5	3 x 4.5	5 x 5
2 x 6	3 x 5	5 x 6
2.5 x 2.5	3.5 x 3.5	5.5 x 5.5
2.5 x 3	3.5 x 4	6 x 6
2.5 x 3.5	3.5 x 4.5	
2.5 x 4	4 x 4	
2.5 x 4.5	4 x 4.5	

## Creating Bill of Material – BOM

Develop a BOM that includes quantity, model codes, part numbers and descriptions of the MCD. Model codes of some valves require pressure settings. A machining operation table or bore chart should be created. All plugs, orifice plugs, disks, check valves, pistons, and any other part should be included in the BOM.



## Life Cycle of Manifold Blocks

Be aware that designing to these general guidelines will not guarantee the manifold will survive any finite number of cycles. The only way to properly assure a specified life is to run a thorough testing of both burst and endurance in the actual application circuit.

## Preferred Tooling for Machining of Custom Manifolds

### PREFERRED TOOLING FOR MACHINING MANIFOLDS

Spot Drill Size	Jobber Length Drill Size	Screw Machine Length Drill Size	Size
1" x 90	#38 (.1015)	5/32"	1/2"
Dexport C-16 spot face	#29 (.136)	11/64"	37/64"
Dexport C-16 short spot face	D (.246)	3/16"	43/64"
1/4" spot drill	R (.339)	#1 (.228)	45/64"
	R (.339)	F (.257)	51/64"
	U (.368)	3/8"	13/32"
	59/64"	27/64"	1-7/32"
		7/16"	

Drill Size inches	Size Inches	Size Inches	Rougher
1/8" (3-1/2" flute length)	11/32" (6" flute length)	11/16" (6" flute length)	C-4-2 C-12-3
1/8" (6" flute length)	3/8" (6" flute length)	3/4" (6" flute length)	C-4-3 C-12-3S
3/16" (6" flute length)	3/8" (8" flute length)	51/64" (6" flute length)	C-7-3 C-12-4
#7 (.201) (6" flute length)	13/32" (6" flute length)	13/16" (6" flute length)	C-8-2 C-16-2
7/32" (6" flute length)	7/16" (6" flute length)	7/8" (6" flute length)	C-8-3 C-16-3
1/4" (3-1 / 2" flute length)	7/16" (8" flute length)	15/16" (6" flute length)	C-8-4 C-16-3S
1/4" (6" flute length)	31/64" (6" flute length)	31/32" (6" flute length)	C1-8-2 C-16-4
1/4" (8" flute length)	1/2" (6" flute length)	1" (6" flute length)	C-10-2 C-20-2
9/32" (3-1 / 2" flute length)	1/2" (8" flute length)	1-3/32" (6" flute length)	C-10-3 C-20-3
9/32" (6" flute length)	17/32" (6" flute length)	1-1/8" (6" flute length)	C-10-3S C-20-3S
5/16" (3-1 / 2" flute length)	9/16" (6" flute length)	1-1/4" (8" flute length)	C-10-4 C-20-4
5/16" (6" flute length)	39/64" (6" flute length)	1-3/8" (6" flute length)	C-12-2
5/16" (8" flute length)	5/8" (6" flute length)	1-13/32" (6" flute length)	
11/32" (3-1 / 2" flute length)	43/64" (6" flute length)	1-1/2" (6" flute length)	

Finish Tool	Flat Bottom Drill Size Inches	Reamer Size Inches	Slot Cutter	End Mill
C-4-2	C-12-2	7/16"	#3 T	1/2"
C-4-3	C-12-3	13/32"	#5 T	3/8"
C-8-2	C-12-3S	1/2"	C-12-2UT	7/16"
C-8-3	C-12-4	17/32"	#6 T	13/32"
C-8-4	C-16-2	43/64"		13/16"
C2-8-2	C-16-2 (undersized)	39/64"	Ball End Mill	7/8"
C-10-2	C-16-3	1-3/32"	9/32"	15/16"
C-10-2 (undersized)	C-16-3S	1-13/32"	11/32"	1"
C-10-3	C-16-4			1-13/16"
C-10-3S	C-20-2			1-3/8"
C-10-4	C-20-2 (undersized)			1-1/2"
	C-20-3			2"
	C-20-3S			2.562"
	C-20-4			
				16mm

## Preferred Tooling for Machining Custom Manifolds

### PREFERRED TOOLING FOR MACHINING MANIFOLDS CONTINUED

Port Tool					
SAE #2	Dexport #8	Dexport #24	SP-05	SP-16	BSPP-75-8225
SAE #3	Dexport #10	Waukesha #20	SP-06	BSPP-13-8221	BSPP-125-8227
SAE #4	Dexport #12	SP-02	SP-08	BSPP-25-8222	
SAE #5	Dexport #14	SP-03	SP-10	BSPP-38-8223	
SAE #6	Dexport #16	SP-04	SP-12	BSPP-50-8224	

Sense Check Tool	Counter Sink	Drill	Center Drill	Press Tap
SC-4-2-75	2" x 90	1/4" x 90	#5	#6-32 X
SC-4-2-88	2" x 5"			#10-24 X
	1/4" x 90			1/4"-20 X

Tap				Pulley Tap
1/4"-20	5/8"-11	1/8"-28 BSPP	1/2"-14 NPTF	1/4"-20
5/16"-18	5/8"-18	1/4"-19 BSPP	3/4"-14 NPTF	5/16"-24
5/16"-24	3/4"-16	3/8"-19 BSPP	1"-11 1/2 NPTF	7/16"-20
3/8"-16	7/8"-14	1/2"-14 BSPP	M10 x 1.5 Metric	9/16"-18
3/8"-24	1"-14	3/4"-14 BSPP	M10 x 1.25 Metric	3/4"-16
7/16"-14	1-1/16"-12	1"-11 BSPP		
7/16"-20	1-3/16"-12	1/16"-27 NPTF		
1/2"-13	1-5/16"-12	1/8"-27 NPTF		
1/2"-20	1-5/8"-12	1/4"-18 NPTF		
9/16"-18	1-7/8"-12	3/8"-14 NPTF		

# Torque Specifications

For cartridge valves and fittings

## INSTALLATION TORQUE: CARTRIDGE INTO CAVITY

Cartridge Size	For application pressure <210 Bar (3000 PSI)	For application pressure 210 Bar (3000 PSI) to 350 Bar
	Aluminum cavity Nm (ft. lbs)	Steel cavity Nm (ft. lbs)
4 Series	8.2 - 13.6 (6 - 10)	8.2 - 13.6 (6 - 10)
8 Series	34.0 - 40.8 (25 - 30)	34.0 - 40.8 (25 - 30)
10 Series	47.6 - 54.4 (35 - 40)	68.0 - 75.0 (50 - 55)
12 Series	81.6 - 95.2 (60 - 70)	102.0 - 115.0 (75 - 85)
16 Series	108.8 - 122.4 (80 - 90)	136.0 - 149.6 (100 - 110)
20 Series	128 - 155 (95 - 115)	163.0 - 183.0 (120 - 135)

## INSTALLATION TORQUE: PLUGS AND FITTINGS INTO ALUMINUM OR STEEL MANIFOLDS

Nominal Size	Installation Torque Nm (ft. lbs)
SAE 2	4.6 - 5.6 (3.4 - 4.1)
SAE 3	6.8 - 9.5 (5 - 7)
SAE 4 1/4" BSPP	8.2 - 13.6 (6 - 10)
SAE 5	13.6 - 20.4 (10 - 15)
SAE 6 3/8" BSPP	20.4 - 27.2 (15 - 20)
SAE 8 1/2" BSPP	34.0 - 40.8 (25 - 30)
SAE 10 5/8" BSPP	47.6 - 54.4 (35 - 40)
SAE 12 3/4" BSPP	81.6 - 95.2 (60 - 70)
SAE 14	108.8 - 122.4 (80 - 90)
SAE 16 1" BSPP	136.0 - 149.6 (100 - 110)
SAE 20 1.1/4" BSPP	149.6 - 163.2 (110 - 120)

## INSTALLATION TORQUE: MISCELLANEOUS

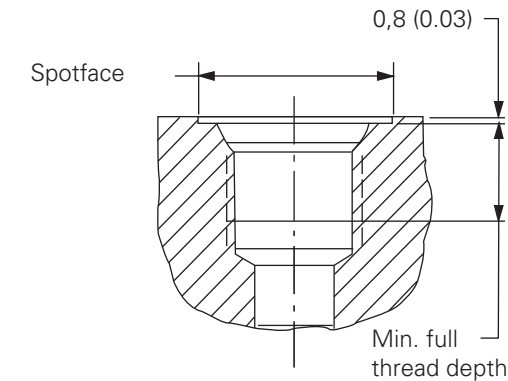
	Installation Torque Nm (ft. lbs)
1/2-20 Retaining nut, short or long, used on standard solenoid valves	5.4 - 8.2 (4 - 6)
1/2-20 Large retaining nut used on explosion proof solenoid coils	9.5 - 13.6 (7 - 10)
1/2-20 Cap nut used on RV, FC, ETC.	9.5 - 13.6 (7 - 10)
10-24 Set screw used on Knobs	4.1 - 5.4 (3 - 4)
7/8-24 Nut used on SV1-16-3-*-** solenoid valves	13.6 - 20.4 (10 - 15)

# Port Information

SAE and BSPP Ports

## Port Dimensions

Key Dimensions in Standard Housings – mm (inch)



## SAE SIZES

SAE size	Thread size	Minimum spotface ø	Minimum full thread depth
4	0.437" -20 UNF-2B	21,1 (0.82)	11,5 (0.45)
6	0.563" -18 UNF-2B	24,7 (0.96)	12,7 (0.50)
8	0.750" -16 UNF-2B	30,2 (1.18)	14,2 (0.56)
10	0.875" -14 UNF-2B	34,2 (1.34)	16,6 (0.65)
12	1.062" -12 UN-2B	41,3 (1.62)	19,0 (0.75)
16	1.312" -12 UN-2B	48,6 (1,91)	19,0 (0.75)

## BSPP SIZES

BSPP thread size	Minimum spotface ø	Minimum full thread depth
1/4"	24 (0.94)	12,2 (0.48)
3/8"	27 (1.06)	12,2 (0.48)
1/2"	33 (1.29)	15,0 (0.59)
3/4"	42 (1.65)	16,3 (0.64)
1"	47 (1.85)	19,1 (0.75)



# Port Information

Short SAE ports

## Port Dimensions

Short Port – Straight Thread  
O-Ring Boss – SP-\*\*

Note

To be used for SAE plugged construction holes only. Not intended to be used for external porting with standard fittings.

**a** Diameter U shall be concentric with thread pitch diameter within 0.0005 in. (0.13mm) FIR, and shall be free from longitudinal and spiral tool marks. Annular tool marks up to 100 mu in. max. are allowed

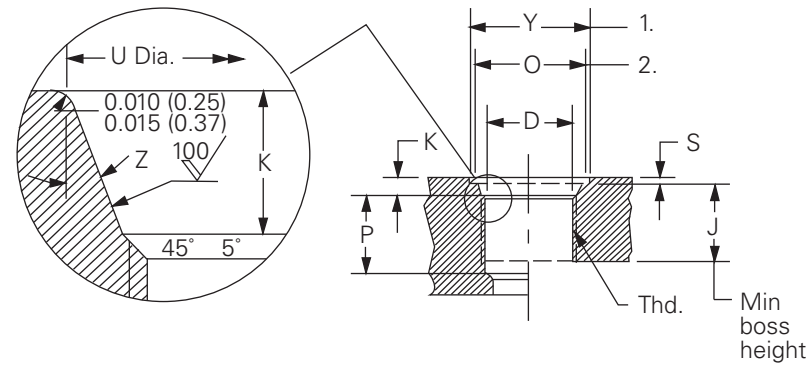
**b** If face of boss is on a machined surface, dim. Y and S need not apply

**c** Tap drill depths given require use of bottoming taps to produce the specified full thread lengths. Where standard taps are used, the tap drill depths must be increased accordingly.

**d** Nominal tubing O.D. is shown for the standard inch sizes and the conversion to equivalent to mm sizes. Figures are for reference only, as any boss can be used for a tubing size, depending upon other design criteria

DASH NO.	NOMINAL TUBING	MILLIMETER	THREAD SIZE	J FULL	K
	O.D. <sup>d</sup>	mm (inch)	SAE J475 ISO R725 inch	thd Depth Min.	+0.4 (+0.015) -0.0 (-0.000) mm (inch)
02	0.125"	–	5 / 16 –24UNF–2B	.31"	1.9 (0.07)
03	0.1875"	4 (0.1575)	3 / 8 –24UNF–2B	.31"	1.9 (0.074)
04	0.250"	6 (0.235)	27 / 16 –20UNF–2B	.35"	2.4 (0.093)
05	0.3125"	8 (0.3150)	1 / 2 –20UNF–2B	.36"	2.4 (0.093)
06	0.375"	10 (0.3937)	9 / 16 –18UNF–2B	.38"	2.5 (0.097)
08	0.500"	12 (0.4724)	3 / 4 –16UNF–2B	.45"	2.5 (0.100)
10	0.625"	16 (0.6299)	7 / 8 –14UNF–2B	.50"	2.5 (0.100)
12	0.750"	–	1 1 / 16 –12UN–2B	.59"	3.3 (0.130)
16	1.000"	25 (0.9842)	1 5 / 16 –12UN–2B	.59"	3.3 (0.130)

DASH NO.	O	P <sup>c</sup>	S <sup>b</sup>	U DIA. <sup>a</sup>	Y	Z		
	Min. mm	Min. inch	Min. inch	+0.005 -0.000 inch	+0.13 -0.0 mm	inch		
						± 1°		
02	0.438	11	0.468"	0.0312"	0.358	9.1	0.439"	12
03	0.500	13	0.468"	0.0312"	0.421	10.7	0.531"	12
04	0.563	15	0.438"	0.0312"	0.487	12.4	0.594"	12
05	0.625	16	0.438"	0.0312"	0.550	13.9	0.656"	12
06	0.688	18	0.515"	0.0312"	0.616	15.6	0.719"	12
08	0.875	22	0.563"	0.0312"	0.811	20.6	0.906"	15
10	1.000	26	0.625"	0.0312"	0.942	23.9	1.031"	15
12	1.250	32	0.719"	0.0312"	1.148	29.2	1.281"	15
16	1.500	38	0.906"	0.0312"	1.398	35.5	1.562"	15



# Cavity Tools

## Roughing Tools

Roughers are basically step drills which leave .030" per cutting diameter and .015" above all radii for the finishing reamer, with an additional .015" depth in the cavity bottom as clearance. The roughing tool is necessary to prepare the cavity for the finishing reamer, which has not been designed for the primary forming or bottom cutting.

CAVITY	FOR MATERIAL	MODEL CODE	PART NUMBER
<b>2-Way</b>			
C-4-2	Aluminum / Steel	RT-4-2-AS-8306	02-173997
C-8-2	Aluminum / Steel	RT1-8-2-AS-8028	02-165580
C-10-2	Aluminum	RT-10-2-A-8030	889509
C-10-2	Steel	RT-10-2-S-8035	889510
C-12-2	Aluminum / Steel	RT-12-2-AS-8213	02-160625
C-16-2	Aluminum	RT-16-2-A-8031	889515
C-16-2	Steel	RT-16-2-S-8036	889516
C-20-2	Aluminum	RT-20-2-A-8032	565822
C-20-2	Steel	RT-20-2-S-8037	889519
<b>3-Way</b>			
C-4-3	Aluminum / Steel	RT-4-3-AS-8304	02-173271
C-8-3	Aluminum / Steel	RT1-8-3-AS-8291	02-162384
C-10-3	Aluminum	RT-10-3-A-8038	889511
C-10-3	Steel	RT-10-3-S-8043	889512
C-12-3	Aluminum / Steel	RT-12-3-AS-8217	02-153261
C-16-3	Aluminum	RT-16-3-A-8039	565825
C-16-3	Steel	RT-16-3-S-8044	889517
C-20-3	Aluminum	RT-20-3-A-8041	02-165581
C-20-3	Steel	RT-20-3-S-8046	566706
<b>3-Way Short</b>			
C-10-3S	Aluminum	RT-10-3S-A-8099	565824
C-10-3S	Steel	RT-10-3S-S-8209	566703
C-12-3S	Aluminum / Steel	RT-12-3S-AS-8220	02-113178
C-16-3S	Aluminum	RT-16-3S-A-8040	02-165582
C-16-3S	Steel	RT-16-3S-S-8045	566704
C-20-3S	Aluminum	RT-20-3S-A-8042	889520
C-20-3S	Steel	RT-20-3S-S-8047	566705
<b>4-Way</b>			
C-8-4	Aluminum / Steel	RT-8-4-AS-8292	02-172803
C-10-4	Aluminum	RT-10-4-A-8072	889513
C-10-4	Steel	RT-10-4-S-8073	889514
C-12-4	Aluminum	RT-12-4-A-8313	02-176377
C-16-4	Aluminum	RT-16-4-A-8074	889518
C-16-4	Steel	RT-16-4-S-8075	565828
C-20-4	Aluminum	RT-20-4-A-8076	565829
C-20-4	Steel	RT-20-4-S-8077	566707
<b>5-Way Short</b>			
C-12-5S	Aluminum	RT-12-5-A-8350	02-187301
C-12-5S	Steel	RT-12-5-S-8358	02-187309
C-16-5S	Aluminum	RT-16-5-A-8352	02-187303
C-16-5S	Steel	RT-16-5-S-8360	02-187311
C-20-5S	Aluminum	RT-20-5-A-8354	02-187305

# Cavity Tools

## Finishing Tools

These finishing tools have been designed as precision reamers for finishing operations only. They are not intended for primary forming or bottom cutting operations. Vickers recommends that a finishing tool only be used in a properly roughed hole. Failure to conform to this practice will produce unsatisfactory size and finishes and possibly break the tool.

CAVITY	FOR MATERIAL	MODEL CODE	PART NUMBER
C-20-5S	Steel	RT-20-5-S-8356	02-187307
<b>2-Way</b>			
C-4-2	Aluminum	FT-4-2-A-8297	02-182339
C-8-2	Aluminum / Steel	FT1-8-2-AS-8070	02-112933
C-10-2	Aluminum / Steel	FT-10-2-AS-8048	566235
C-12-2	Aluminum / Steel	FT-12-2-AS-8214	02-162162
C-16-2	Aluminum / Steel	FT-16-2-AS-8078	565832
C-20-2	Aluminum / Steel	FT-20-2-AS-8079	565833
<b>3-Way</b>			
C-4-3	Aluminum	FT-4-3-A-8275	02-172006
C-8-3	Aluminum / Steel	FT-8-3-AS-8295	02-171292
C-10-3	Aluminum / Steel	FT-10-3-AS-8050	565834
C-12-3	Aluminum / Steel	FT-12-3-AS-8244	02-163001
C-16-3	Aluminum / Steel	FT-16-3-AS-8080	565836
C-20-3	Aluminum / Steel	FT-20-3-AS-8082	889358
<b>3-Way Short</b>			
C-10-3S	Aluminum / Steel	FT-10-3S-AS-8210	566708
C-12-3S	Aluminum / Steel	FT-12-3S-AS-8242	02-162998
C-16-3S	Aluminum / Steel	FT-16-3S-AS-8081	889356
C-20-3S	Aluminum / Steel	FT-20-3S-AS-8083	889359
<b>4-Way</b>			
C-8-4	Aluminum / Steel	FT-8-4-AS-8296	02-171291
C-10-4	Aluminum / Steel	FT-10-4-AS-8052	565838
C-12-4	Aluminum / Steel	FT-12-4-AS-8312	02-175596
C-16-4	Aluminum / Steel	FT-16-4-AS-8084	566571
C-20-4	Aluminum / Steel	FT-20-4-AS-8085	889360
<b>5-Way Short</b>			
C-12-5S	Aluminum	FT-12-5-A-8351	02-187302
C-12-5S	Steel	FT-12-5-S-8359	02-187310
C-16-5S	Aluminum	FT-16-5-A-8353	02-187304
C-16-5S	Steel	FT-16-5-S-8361	02-187312
C-20-5S	Aluminum	FT-20-5-A-8355	02-187306
C-20-5S	Steel	FT-20-5-S-8357	02-187308

## Finishing Form Tools Speed & Feed for Aluminum 6061-T6 (T651)

This information is recommended as a good starting point. Speeds and/or feeds may be increased or decreased depending on actual machining conditions.

Note

Finish form tools may require 1/2 to 1 1/2 second dwell to obtain necessary finish.

CNC MACHINE TOOL		BRIDGEPORT / LAGUN TYPE MACHINES			
Tool Size	RPM	IPM	Tool Size	RPM	IPM
C-10-2	600	4	C-10-2	800-1000	5-6
C-10-3			C-10-3		
C-10-4			C-10-4		
C-16-2			C-16-2		
C-16-3	500	3	C-16-3	250	2 1/2
C-16-3S			C-16-3S		
C-16-4			C-16-4		
C-20-2			C-20-2		
C-20-3			C-20-3		
C-20-3S			C-20-3S		
C-20-4			C-20-		

# C-\*\*-2 Cavity Dimensions

## Dimensions

mm (inch)

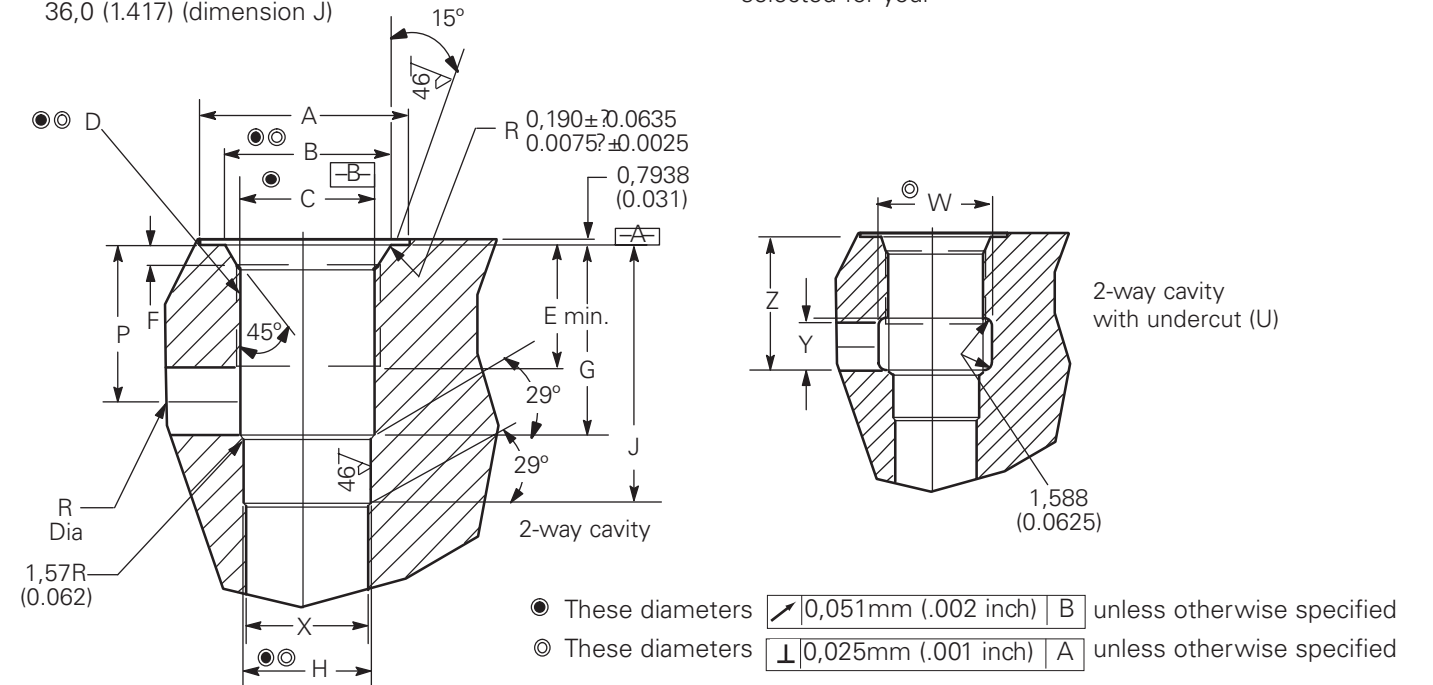


### WARNING

For EPV-10 & CV16-10, the cavity should be machined to the 14,29 (0.562) max diameter (dimension X) and to the maximum depth of 36,0 (1.417) (dimension J)

Cavity bores can be machined accurately in aluminum or steel. The necessary UNF, or UN threads may be machined using standard small tools, possibly already in your machine shop or from a local tool supplier.

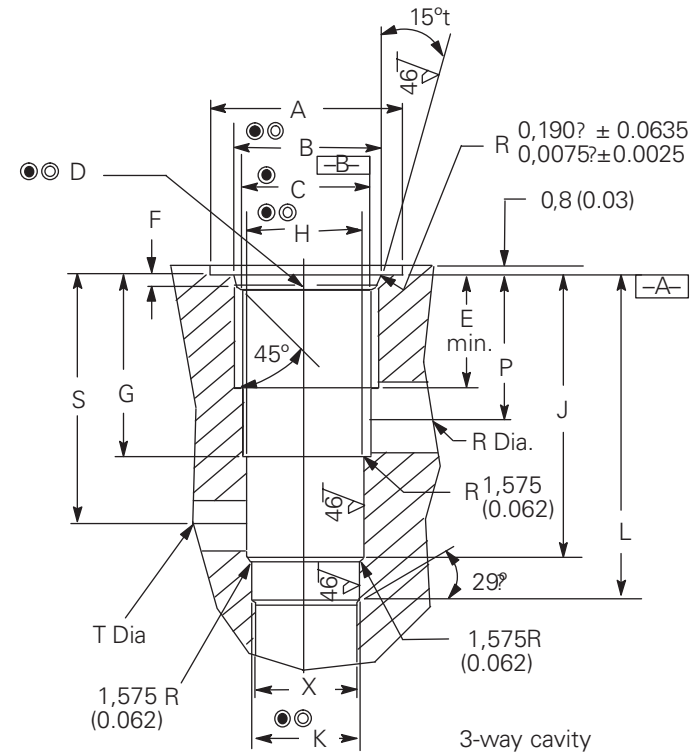
Either you, our customer, or Vickers can design and manufacture customized manifolds or housings dedicated to individual applications. We call the resulting valve packages Modular Circuit Designs (MCDs). Cartridges selected for your application can be accommodated in one or more MCDs, according to your requirements.



CAVITY	A	B	C	D	E	F	G	H	J	P	R	X
		+0,051 (+0.002)	±0,051 (±0.002)	Thread	Full Thread			±0,0254 (±0.001)			Max. Dia.	Max. Dia.
C-4-2	21,03 (0.828)	12,37 (0.487)	9,80 (0.386)	.4375"—20	9,53 (0.375)	2,36-2,74 (0.093-0.108)	15,49 (0.610)	8,74 (0.344)	23,37 (0.920)	9,93 (0.391)	6,35 (0.250)	6,35 (0.25)
C-8-2	30,16 (1.188)	20,65 (0.813)	17,47 (0.688)	.750"—16	12,70 (0.500)	2,54-2,92 (0.100-0.115)	19,05 (0.750)	12,72 (0.501)	30,17 (1.188)	14,68 (0.578)	8,74 (0.344)	11,11 (0.438)
C-10-2	30,16 (1.188)	24,00 (0.945)	20,62 (0.812)	.875"—14	15,88 (0.625)	2,54-2,92 (0.100-0.115)	23,81 (0.937)	15,90 (0.626)	33,32 (1.312)	18,23 (0.718)	11,11 (0.437)	14,29 (0.562)
C-12-2(U)	38,10 (1.500)	29,15 (1.148)	24,76 (0.975)	1.062"—12	22,22 (0.875)	3,30/3,68 (0.130-0.145)	34,92 (1.375)	23,82 (0.938)	46,35 (1.825)	27,94 (1.100)	12,70 (0.500)	22,22 (0.875)
C-16-2	44,45 (1.750)	35,58 (1.401)	31,34 (1.234)	1.312"—12	22,22 (0.875)	3,30/3,68 (0.130-0.145)	34,14 (1.344)	28,62 (1.127)	46,84 (1.844)	24,60 (0.968)	19,05 (0.750)	19,05 (0.750)
C-20-2	57,66 (2.270)	43,59 (1.716)	39,12 (1.540)	1.625"—12	20,64 (0.812)	3,35/3,73 (0.132-0.147)	44,45 (1.750)	36,55 (1.439)	58,72 (2.312)	30,96 (1.218)	25,40 (1.000)	30,16 (1.188)

CAVITY	W	Y	Z
C-12-2U (only)	30,82 (1.214)	12,70 (0.500)	34,29 (1.350)

## C-\*\*-3 Cavity Dimensions



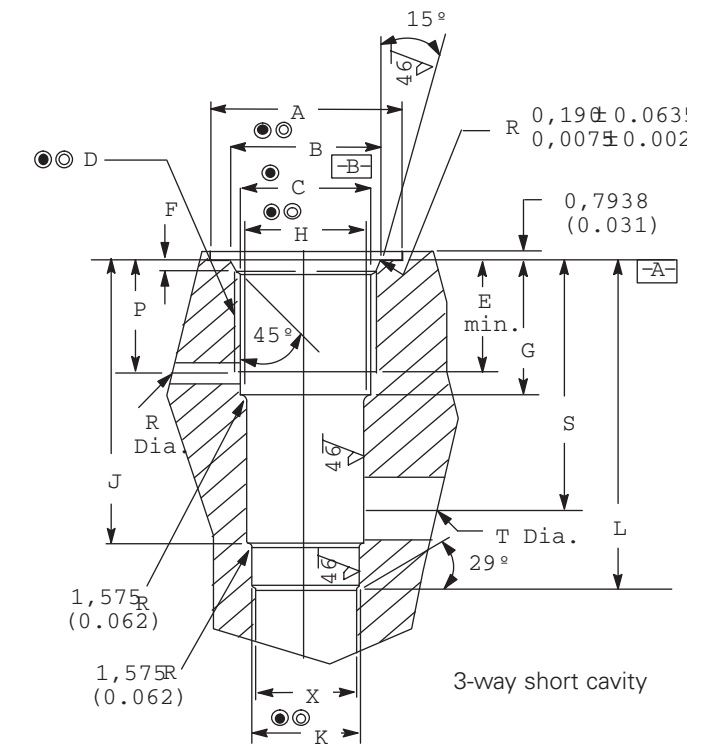
- ⊙ These diameters  $\frac{\text{A}}{\text{B}}$  unless otherwise specified
- ⊙ These diameters  $\frac{\text{A}}{\text{B}}$  unless otherwise specified

CAVITY	A	B	C	D	E	F	G	H	J	K	L
mm (inch)	Spotface	$\pm 0,051$ ( $\pm 0,002$ )	$\pm 0,051$ ( $\pm 0,002$ )	Thread	Full Thread			$\pm 0,0254$ ( $\pm 0,001$ )		$\pm 0,0254$ ( $\pm 0,001$ )	
C-4-3	21,03 (0.828)	12,37 (0.487)	9,80 (0.386)	.4375"—20	9,53 (0.375)	2,36-2,74 (0.093-0.108)	15,49 (0.610)	8,74 (0.344)	30,05 (1.183)	7,95 (0.313)	38,10 (1.500)
C-8-3	30,16 (1.188)	20,65 (0.813)	17,47 (0.688)	.750"—16	12,70 (0.500)	2,54-2,92 (0.100-0.115)	18,23 (0.718)	15,90 (0.626)	33,25 (1.270)	14,30 (0.563)	43,25 (1.703)
C-10-3	30,16 (1.188)	24,00 (0.945)	20,62 (0.812)	.875"—14	15,87 (0.625)	2,54-2,92 (0.100-0.115)	21,59 (0.850)	17,50 (0.689)	38,10 (1.500)	15,90 (0.626)	47,62 (1.875)
C-12-3	38,10 (1.500)	29,15 (1.148)	24,76 (0.975)	1.062"—12	22,22 (0.875)	3,30-3,68 (0.130-0.145)	34,92 (1.375)	23,82 (0.938)	57,78 (2.275)	22,25 (0.876)	69,21 (2.725)
C-16-3	44,45 (1.750)	35,58 (1.401)	31,34 (1.234)	1.312"—12	22,22 (0.875)	3,30-3,68 (0.130-0.145)	34,13 (1.344)	28,62 (1.127)	62,71 (2.469)	27,02 (1.064)	75,39 (2.968)
C-20-3	57,66 (2.270)	43,59 (1.716)	39,12 (1.540)	1.625"—12	20,64 (0.812)	3,35-3,73 (0.132-0.147)	44,45 (1.750)	36,55 (1.439)	85,72 (3.375)	33,38 (1.314)	100,02 (3.938)

CAVITY	P	R	S	T	X
mm (inch)		Max. Dia.		Max. Dia.	Max. Dia.
C-4-3	9,93 (0.391)	6,35 (0.25)	24,61 (0.969)	6,35 (0.25)	
C-8-3	14,68 (0.578)	5,94 (0.234)	28,98 (1.141)	5,94 (0.234)	12,70 (0.500)
C-10-3	18,26 (0.719)	6,35 (0.250)	34,13 (1.344)	6,35 (0.250)	14,27 (0.562)
C-12-3	27,94 (1.100)	12,70 (0.500)	50,80 (2.000)	12,70 (0.500)	20,62 (0.812)
C-16-3	24,60 (0.969)	15,88 (0.625)	53,18 (2.093)	15,88 (0.625)	19,05 (0.750)
C-20-3	30,96 (1.218)	25,40 (1.00)	71,44 (2.812)	25,40 (1.000)	30,16 (1.188)

## C-\*\*-3S Cavity Dimensions

### Dimensions mm (inch)



- ⊙ These diameters  $\frac{\text{A}}{\text{B}}$  unless otherwise specified
- ⊙ These diameters  $\frac{\text{A}}{\text{B}}$  unless otherwise specified

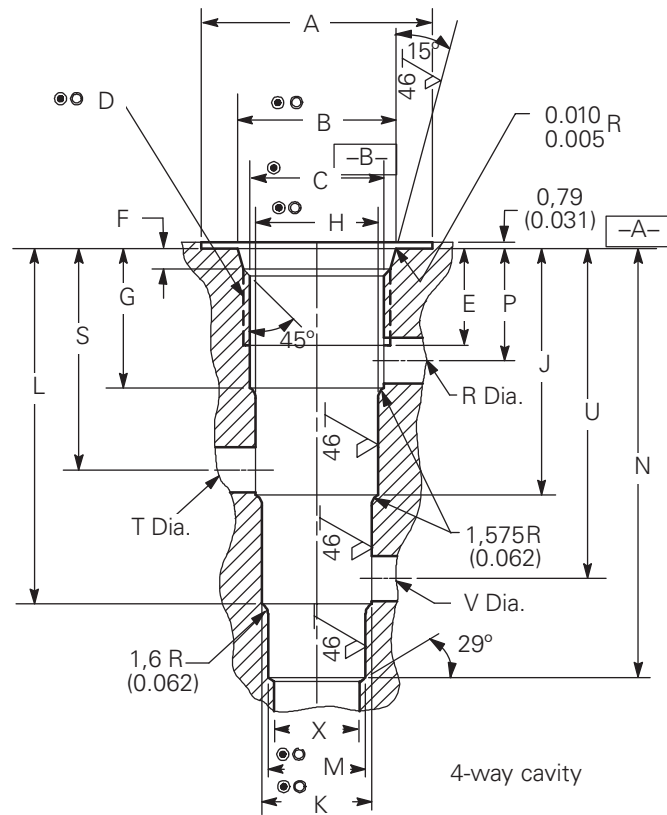
CAVITY	A	B	C	D	E	F	G	H	J	K	L
mm (inch)	Spotface	$+0,0051$ ( $+0,002$ )	$+0,051$ ( $+0,002$ )	Thread	Full Thread			$\pm 0,0254$ ( $\pm 0,001$ )		$\pm 0,0254$ ( $\pm 0,001$ )	
C-10-3S	30,16 (1.188)	24,00 (0.945)	20,62 (0.812)	0.875"—14	14,29 (0.562)	2,54-2,92 (0.100-0.115)	16,51 (0.650)	19,08 (0.751)	38,48 (1.515)	17,50 (0.689)	47,62 (1.875)
C-12-3S	38,10 (1.500)	29,15 (1.148)	24,76 (0.975)	1.062"—12	22,22 (0.875)	3,30-3,68 (0.130-0.145)	25,40 (1.000)	23,82 (0.938)	48,26 (1.900)	22,25 (0.876)	59,69 (2.350)
C-16-3S	44,45 (1.750)	35,58 (1.401)	31,34 (1.234)	1.312"—12	17,46 (0.687)	3,30-3,68 (0.130-0.145)	20,62 (0.812)	28,62 (1.127)	46,02 (1.812)	25,45 (1.002)	55,58 (2.188)
C-20-3S	57,66 (2.270)	43,59 (1.716)	39,12 (1.540)	1.625"—12	20,64 (0.812)	3,35-3,73 (0.132-0.147)	23,82 (0.938)	36,55 (1.439)	64,29 (2.531)	33,38 (1.314)	77,77 (3.062)

CAVITY	P	R	S	T	X
mm (inch)		Max. Dia.		Max. Dia.	Max. Dia.
C-10-3S	14,29 (0.562)	3,18 (0.125)	30,96 (1.218)	13,49 (0.531)	15,88 (0.625)
C-12-3S	22,22 (0.875)	4,82 (0.190)	41,27 (1.625)	12,70 (0.500)	20,62 (0.812)
C-16-3S	16,67 (0.656)	6,35 (0.250)	37,31 (1.468)	15,88 (0.625)	19,05 (0.750)
C-20-3S	19,84 (0.781)	6,35 (0.250)	50,00 (1.968)	25,40 (1.000)	30,16 (1.188)



# C-\*\*-4 Cavity Dimensions

**Dimensions**  
mm (inch)



● These diameters  $\frac{\text{mm}}{1000}$  (0.002 inch) B unless otherwise specified  
 ◎ These diameters  $\frac{\text{mm}}{1000}$  (0.001 inch) A unless otherwise specified

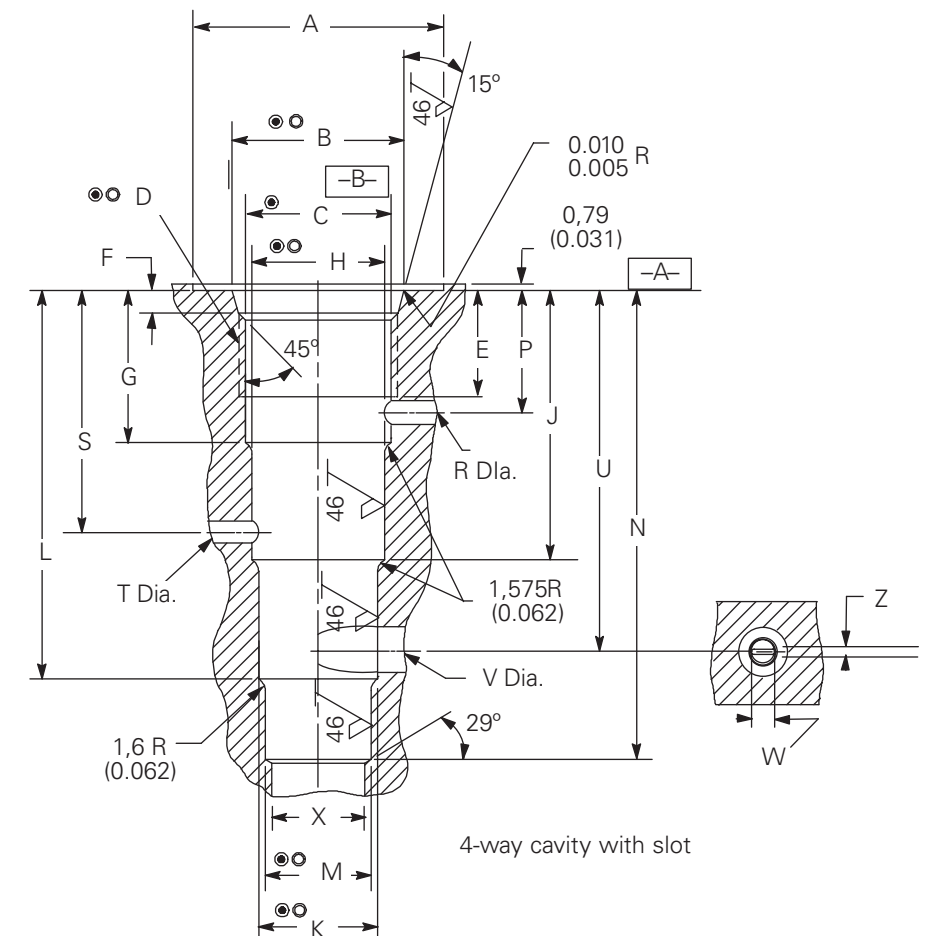
CAVITY	A	B	C	D	E	F	G	H	J	K
mm (inch)	Spotface	+0,0051 (+0.002)	+0,051 (+0.002)	Thread	Full Thread			±0,0254 (±0.001)		±0,0254 (±0.001)
C-8-4	30,16 (1.188)	20,65 (0.813)	17,47 (0.688)	0.750"—16	12,70 (0.500)	2,54-2,92 (0.100-0.115)	18,24 (0.718)	15,90 (0.626)	32,26 (1.270)	14,30 (0.563)
C-10-4	30,16 (1.188)	24,00 (0.945)	20,62 (0.812)	0.875"—14	15,88 (0.625)	2,54-2,92 (0.100-0.115)	22,22 (0.875)	19,08 (0.751)	38,10 (1.500)	17,50 (0.689)
C-12-4	38,10 (1.500)	29,15 (1.148)	24,76 (0.975)	1.062"—12	22,22 (0.875)	3,30-3,68 (0.130-0.145)	34,92 (1.375)	23,82 (0.938)	57,78 (2.275)	22,25 (0.876)
C-16-4	44,45 (1.750)	35,58 (1.401)	31,34 (1.234)	1.312"—12	22,22 (0.875)	3,30-3,68 (0.130-0.145)	34,14 (1.344)	28,62 (1.127)	62,71 (2.469)	27,02 (1.064)
C-20-4	57,66 (2.270)	43,59 (1.716)	39,12 (1.540)	1.625"—12	20,64 (0.812)	3,35-3,73 (0.132-0.147)	44,45 (1.750)	36,55 (1.439)	85,72 (3.375)	33,38 (1.314)

CAVITY	L	M	N	P	R	S	T	U	V	X
mm (inch)		±0,0254 (±0.001)			Max.Dia.		Max.Dia.			Max.Dia.
C-8-4	46,48 (1.830)	12,72 (0.501)	56,13 (2.210)	14,68 (0.578)	5,94 (0.234)	28,98 (1.141)	5,94 (0.234)	43,25 (1.703)	5,94 (0.234)	11,13 (0.438)
C-10-4	53,98 (2.125)	15,90 (0.626)	63,50 (2.500)	18,26 (0.718)	6,35 (0.250)	34,13 (1.343)	6,35 (0.250)	50,00 (1.968)	6,35 (0.250)	14,29 (0.562)
C-12-4	80,64 (3.175)	20,65 (0.813)	92,07 (3.625)	27,94 (1.100)	12,70 (0.500)	50,80 (2.000)	12,70 (0.500)	73,66 (2.900)	12,70 (0.500)	19,05 (0.750)
C-16-4	91,29 (3.594)	25,45 (1.002)	103,99 (4.094)	24,60 (0.968)	15,88 (0.625)	53,16 (2.093)	15,88 (0.625)	81,76 (3.218)	15,88 (0.625)	19,05 (0.750)
C-20-4	127,00 (5.000)	31,78 (1.251)	141,27 (5.562)	30,96 (1.218)	25,40 (1.000)	71,44 (2.812)	25,40 (1.000)	112,71 (4.437)	25,40 (1.000)	30,16 (1.188)

# C-\*\*-4U Cavity Dimensions

For use with  
VCB1-10/12  
Cartridge Only

**Dimensions**  
mm (inch)



● These diameters  $\frac{\text{mm}}{1000}$  (0.002 inch) B unless otherwise specified  
 ◎ These diameters  $\frac{\text{mm}}{1000}$  (0.001 inch) A unless otherwise specified

CAVITY	A	B	C	D	E	F	G	H	J	K
mm (inch)	Spotface	+0,0051 (+0.002)	+0,051 (+0.002)	Thread	Full Thread			±0,0254 (±0.001)		±0,0254 (±0.001)
C-10-4U	30,16 (1.188)	24,00 (0.945)	20,62 (0.812)	0.875"—14	15,88 (0.625)	2,54-2,92 (0.100-0.115)	22,22 (0.875)	19,08 (0.751)	38,10 (1.500)	17,50 (0.689)
C-12-4U	38,10 (1.500)	29,15 (1.148)	24,76 (0.975)	1.062"—12	22,22 (0.875)	3,30-3,68 (0.130-0.145)	34,91 (1.375)	23,81 (0.938)	57,77 (2.275)	22,24 (0.876)

CAVITY	L	M	N	P	R	S	T	U	V	X
mm (inch)		±0,0254 (±0.001)			Max.Dia.		Max.Dia.			Max.Dia.
C-10-4U	53,98 (2.125)	15,90 (0.626)	63,50 (2.500)	19,83 (0.781)	3,17 (0.125)	10,31 (0.406)	3,17 (0.125)	51,58 (2.031)	6,35 (0.250)	14,29 (0.562)
C-12-4U	80,61 (3.175)	20,64 (0.813)	92,04 (3.625)	27,93 (1.100)	12,70 (0.500)	50,78 (2.000)	12,70 (0.500)	73,63 (2.900)	12,70 (0.500)	19,04 (0.750)

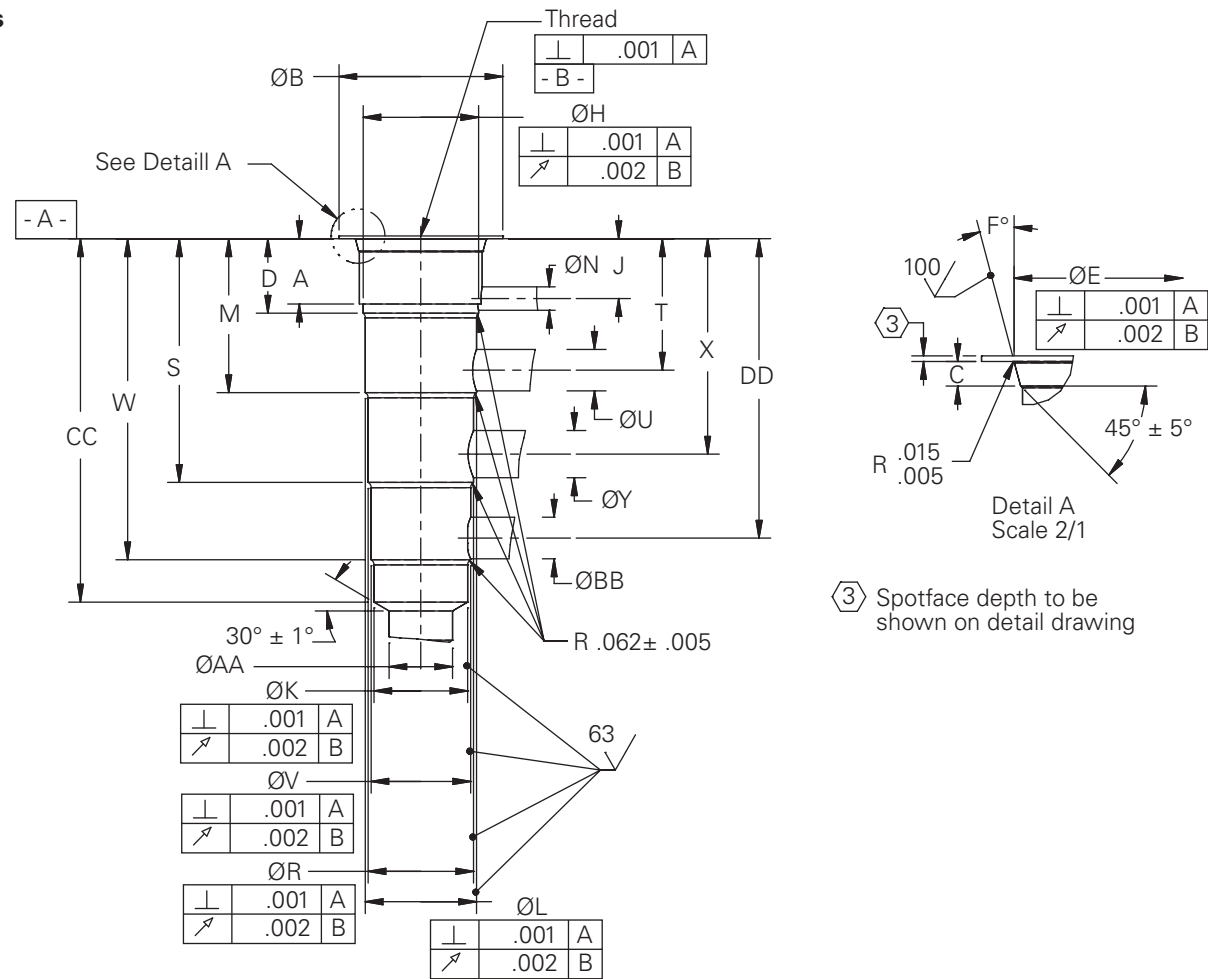
CAVITY	THREAD	W	Z
mm (inch)			
C-10-4U	All	15,9 (0.625)	ø 6,3 (0.25)
C-12-4U	SAE12 1/2" BSPP	22,4 (0.88) 17,5 (0.68)	ø 12,6 (0.50)

# C-\*\*-5S

## Cavity Dimensions

### Dimensions

mm (inch)



CAVITY	A	B	C	D	E	F	H	K	L	M
	±0,13 (±0.005)	±0,13 (±0.005)	+0,38 (+0.005) (-0.0)	±0,13 (±0.005)	±0,05 (±0.002)	±1°	Min Max	±0,03 (±0.001)	±0,03 (±0.001)	±0,13 (±0.005)
C-8-5S	12,70 (0.500)	30,16 (1.188)	2,54 (0.100)	14,48 (0.570)	20,65 (0.813)	15	17,42 - 17,52 (0.686-0.690)	11,13 (0.438)	15,90 (0.626)	29,51 (1.162)
C-10-5S	15,88 (0.625)	30,16 (1.188)	2,54 (0.100)	22,09 (0.870)	24,00 (0.945)	15	20,57 - 20,67 (0.810-0.814)	14,30 (0.563)	19,08 (0.751)	38,10 (1.500)
C-12-5S	17,53 (0.690)	38,10 (1.500)	2,54 (0.100)	19,79 (0.779)	29,21 (1.150)	15	24,69 - 24,79 (0.972-0.976)	19,08 (0.751)	23,83 (0.938)	38,84 (1.529)
C-16-5S	17,53 (0.690)	44,45 (1.750)	3,30 (0.130)	20,02 (0.788)	35,59 (1.401)	15	31,29 - 31,39 (1.232-1.236)	25,45 (1.002)	30,20 (1.189)	41,40 (1.630)
C-20-5S	17,53 (0.690)	57,66 (2.270)	3,35 (0.132)	20,02 (0.788)	43,59 (1.716)	15	39,12 - 39,29 (1.543-1.547)	33,38 (1.314)	38,16 (1.502)	44,45 (1.750)

CAVITY	N	J	R	S	U	T	V	W	Y	X	AA	BB	CC	DD
	Max	±0,13 (±0.005)	±0,03 (±0.001)	±0,13 (±0.005)	Max	±0,13 (±0.005)	±0,03 (±0.001)	±0,13 (±0.005)	Max	±0,13 (±0.005)	Max	Max	±0,13 (±0.005)	±0,13 (±0.005)
C-8-5S	3,81 (0.150)	12,19 (0.480)	14,30 (0.563)	43,79 (1.724)	5,94 (0.234)	26,41 (1.040)	12,72 (0.501)	58,04 (2.285)	5,94 (0.234)	40,64 (1.600)	9,91 (0.390)	5,94 (0.234)	66,80 (2.630)	54,86 (2.160)
C-10-5S	6,76 (0.266)	18,26 (0.719)	17,50 (0.689)	53,98 (2.125)	6,75 (0.266)	33,78 (1.330)	15,90 (0.626)	69,85 (2.750)	6,76 (0.266)	49,78 (1.960)	13,00 (0.512)	6,76 (0.266)	79,38 (3.125)	65,79 (2.590)
C-12-5S	4,78 (0.188)	15,88 (0.625)	22,25 (0.876)	59,44 (2.340)	9,53 (0.375)	33,32 (1.312)	20,65 (0.813)	78,51 (3.091)	11,13 (0.438)	53,19 (2.094)	17,45 (0.687)	9,53 (0.375)	88,14 (3.470)	73,03 (2.875)
C-16-5S	6,35 (0.250)	16,08 (0.633)	28,63 (1.127)	65,56 (2.581)	11,18 (0.440)	35,36 (1.392)	27,03 (1.064)	86,33 (3.399)	12,70 (0.500)	57,94 (2.281)	19,05 (0.750)	11,18 (0.440)	97,69 (3.846)	80,52 (3.170)
C-20-5S	6,35 (0.250)	16,00 (0.630)	36,55 (1.439)	70,10 (2.760)	36,83 (1.450)	36,83 (1.450)	34,98 (1.377)	94,23 (3.710)	15,09 (0.594)	61,47 (2.420)	25,40 (1.000)	14,22 (0.560)	106,69 (4.200)	86,61 (3.410)