

Technical reference

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



Powering Business Worldwide

Technical reference

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General guidelines for hydraulic integrated circuits (HIC)

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.

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

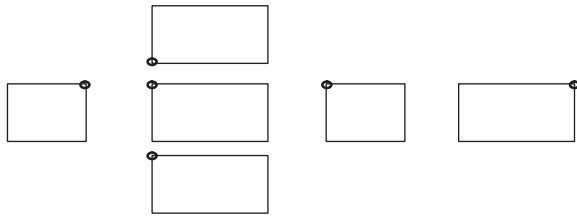
In order to obtain fast turnaround on designs, limit the tooling used to that listed in the standard tooling table. See Preferred Tooling for Machining Manifolds (page M-6).

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.

General guidelines for hydraulic integrated circuits (HIC)

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.

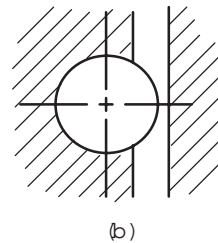
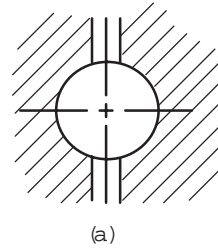
Machining notes

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.



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:

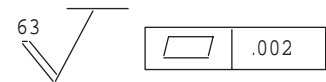
Valve Series	Counterbore	
	Inch	Metric (mm)
8	1.38”	35,0
10	1.38”	35,0
12	1.75”	44,5
16	2.00”	50,8
20	2.56”	65,0

Use of expander plugs and zero leak gold sae o-ring plugs

On small HIC 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 anodized, unless otherwise specified. Aluminum manifolds where the internally grounded coil is used should not be anodized. Prototypes are supplied without surface treatment.

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

General guidelines for hydraulic integrated circuits (HIC)

Wall thickness

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.

Warning

Failure to follow the recommended wall thicknesses may lead to manifold failure.

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.

Creating bill of material – BOM

Develop a BOM that includes quantity, model codes, part numbers and descriptions of the HIC. 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.

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	12,70
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	2.5 x 4.5	4 x 4
2 x 3	3 x 3	4 x 4.5
2 x 4	3 x 3.5	4 x 5
2 x 5	3 x 4	4 x 6
2 x 6	3 x 4.5	4.5 x 4.5
2.5 x 2.5	3 x 5	5 x 5
2.5 x 3	3.5 x 3.5	5 x 6
2.5 x 3.5	3.5 x 4	5.5 x 5.5
2.5 x 4	3.5 x 4.5	6 x 6

Preferred tooling for machining of custom manifolds

Preferred tooling for machining manifolds

Spot drill	Jobber length drill	Screw machine length drill	
Size	Size	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	Reamer size	Reamer size	Slot cutter	Ball end mill	End mill	
C-4-2	C-12-3S	7/16"	.1285"	5mm	#3 T	9/32"	1/2"
C-4-3	C-12-4	13/32"	.485"	7mm	#5 T	11/32"	3/8"
C-8-2	C-16-2	1/2"	.562" (flat bottom)	8mm	C-12-2UT		7/16"
C-8-3	C-16-2 (undersized)	17/32"	.6255" (flat bottom)	9mm	#6 T		13/32"
C-8-4	C-16-3	43/64"	1.1255" (flat bottom)	10mm			13/16"
C2-8-2	C-16-3S	39/64"	1.437" (flat bottom)	12mm			7/8"
C-10-2	C-16-4	1-3/32"		14mm			15/16"
C-10-2 (undersized)	C-20-2	1-13/32"		16mm			1"
C-10-3	C-20-2 (undersized)						1-13/16"
C10-3S	C-20-3						1-3/8"
C-10-4	C-20-3S						1-1/2"
C-12-2	C-20-4						2"
C-12-3							2.562"

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

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

SC-4-2-75
SC-4-2-88

Counter sink

2" x 90
2" x 5"
1/4" x 90

Drill

1/4" x 90

Center drill

#5

Press tap

#6-32 X
#10-24 X
1/4"-20 X

Tap

1/4"-20
5/16"-18
5/16"-24
3/8"-16
3/8"-24
7/16"-14
7/16"-20
1/2"-13
1/2"-20
9/16"-18

5/8"-11
5/8"-18
3/4"-16
7/8"-14
1"-14
1-1/16"-12
1-3/16"-12
1-5/16"-12
1-5/8"-12
1-7/8"-12

1/8"-28 BSPP
1/4"-19 BSPP
3/8"-19 BSPP
1/2"-14 BSPP
3/4"-14 BSPP
1"-11 BSPP
1/16"-27 NPTF
1/8"-27 NPTF
1/4"-18 NPTF
3/8"-14 NPTF

1/2"-14 NPTF
3/4"-14 NPTF
1"-11 1/2 NPTF
M10 x 1.5 Metric
M10 x 1.25 Metric

Pulley tap

1/4" - 20
5/16" - 24
7/16" - 20
9/16" - 18
3/4" - 16

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

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 not 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)	

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Port information

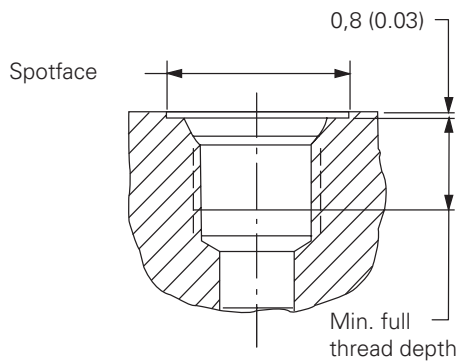
SAE and BSPP Ports

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)

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

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.

Dash No.	Nominal tubing	Millimeter	Thread size	J full	K	
	O.D.d	mm (inch)	SAE J475 ISO R725 inch	Thd depth min.	+0.4 –0.0 mm	(+0.015 –0.000) (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)

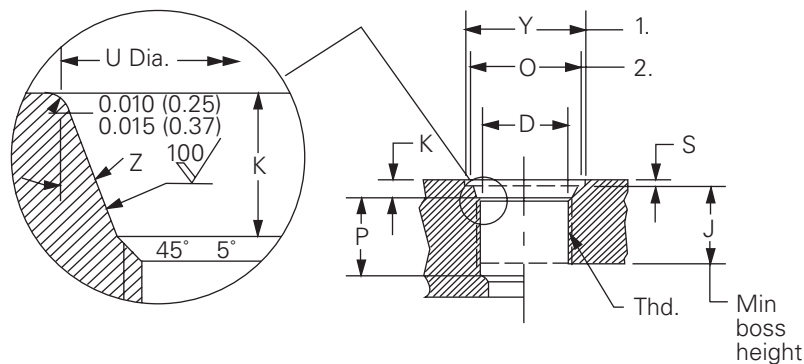
a Diameter U shall be concentric with thread pitch diameter within 0.0005 in. (0.13mm) FIR, and shall be free from longitudinal and spiral tool marks. Annular tool marks up to 100 mu in. max. are allowed.

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.	O		P ^c	S ^b	U Dia. ^a		Y	Z
	Min. mm	Dia. inch	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



Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

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
2-Way			
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
3-Way			
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
3-Way short			
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
4-Way			
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
5-Way short			
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
C-20-5S	Steel	RT-20-5-S-8356	02-187307

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

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
2-Way			
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
3-Way			
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
3-Way short			
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
4-Way			
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
.5-Way short			
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

Tool size	RPM	IPM
C-10-2	600	4
C-10-3	600	4
C-10-4	600	4
C-16-2	600	4
C-16-3	600	4
C-16-4	500	3
C-20-2	500	3
C-20-3	500	3
C-20-3S	500	3
C-20-4	500	3

Bridgeport / lagun type machines

Tool size	RPM	IPM
C-10-2	800-1000	5-6
C-10-3	800-1000	5-6
C-10-4	800-1000	5-6
C-16-2	800-1000	5-6
C-16-3	800-1000	5-6
C-16-3S	250	2 1/2
C-16-4	250	2 1/2
C-20-2	250	2 1/2
C-20-3	250	2 1/2
C-20-3S	250	2 1/2
C-20-	250	2 1/2

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

C-**-2(P)

Dimensions

mm (inch)

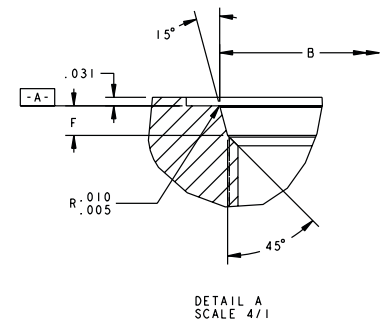
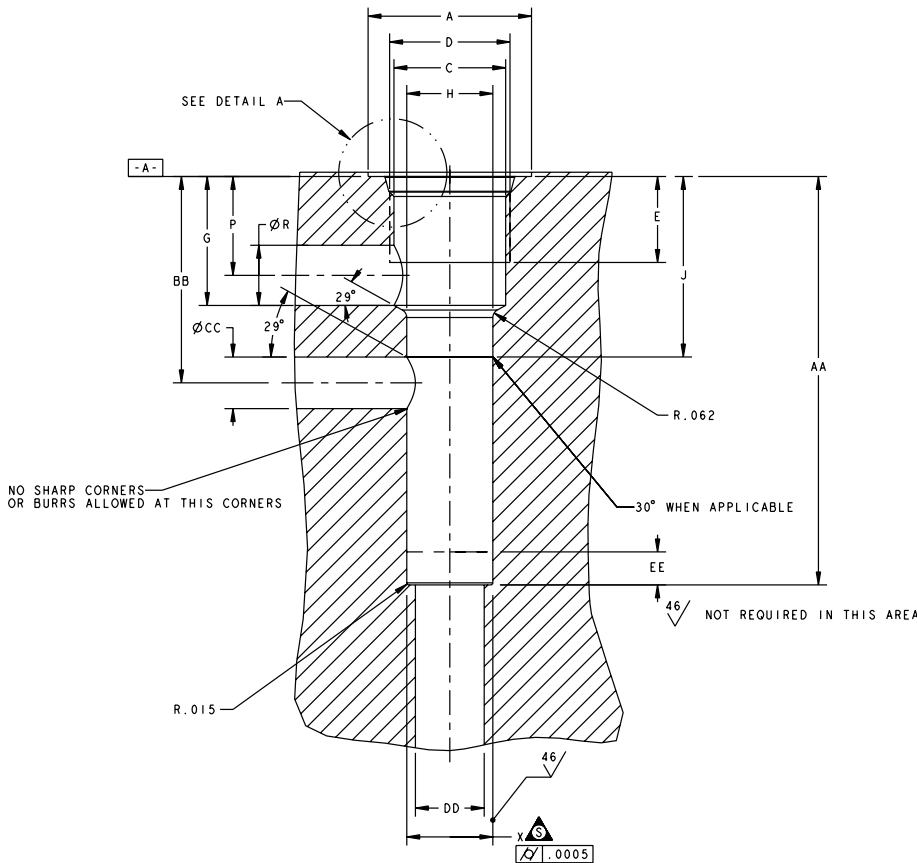
Cavity bores can be machined accurately in aluminum or steel. The necessary UNF, or UN threads may be machined using standard small tools, possibly already in your machine shop or from a local tool supplier.

Either you, our customer, or Eaton can design and

manufacture customized manifolds or housings dedicated to individual applications. We call the resulting valve packages Hydraulic Integrated Circuits (HIC). Cartridges selected for your application can be accommodated in one or more HICs, according to your requirements.

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	A REF.	B REF.	C REF.	D REF.	E REF.	F REF.	G REF.	H REF.
C-8-2P	1.188	0.813	0.688	0.750	0.500	0.108	0.750	0.501
C-10-2P	1.188	0.945	0.812	0.875	0.625	0.108	0.937	0.626
C-12-2P	1.500	1.148	0.975	1.063	0.875	0.138	1.375	0.938
C-16-2P	1.750	1.401	1.234	1.313	0.875	0.138	1.344	1.127
C-20-2P	2.270	1.716	1.540	1.625	0.813	0.140	1.750	1.439

J REF.	P REF.	R REF.	X	AA	BB	CC	DD	EE
1.188	0.578	0.344	0.501/0.502	2.295	1.328	0.344	0.312	0.24
1.312	0.719	0.438	0.625/0.626	2.969	1.500	0.375	0.500	0.26
1.825	1.100	0.500	0.937/0.9385	3.220	2.000	0.500	0.750	0.24
1.844	0.969	0.750	1.125/1.1265	4.219	2.219	0.750	0.875	0.50
2.312	1.219	1.000	1.437/1.438	5.094	2.844	1.000	1.063	0.63

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

Dimensions

mm (inch)

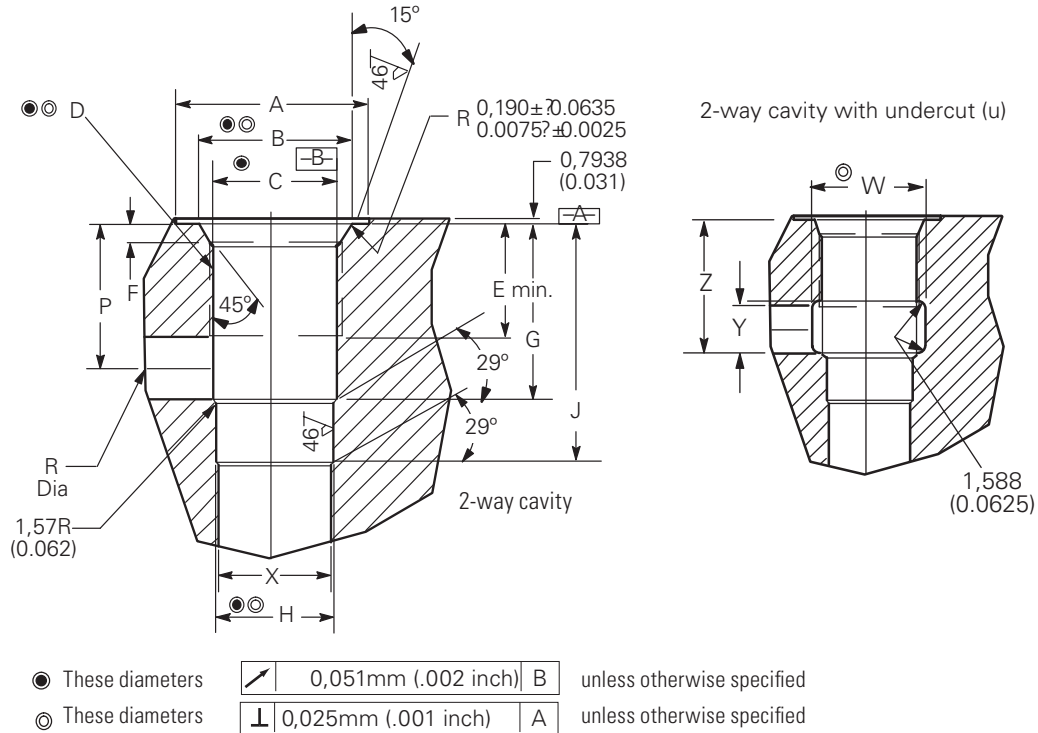
Cavity bores can be machined accurately in aluminum or steel. The necessary UNF, or UN threads may be machined using standard small tools, possibly already in your machine shop or from a local tool supplier.

Either you, our customer, or Eaton can design and

manufacture customized manifolds or housings dedicated to individual applications. We call the resulting valve packages Hydraulic Integrated Circuits (HIC). Cartridges selected for your application can be accommodated in one or more HICs, according to your requirements.

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)

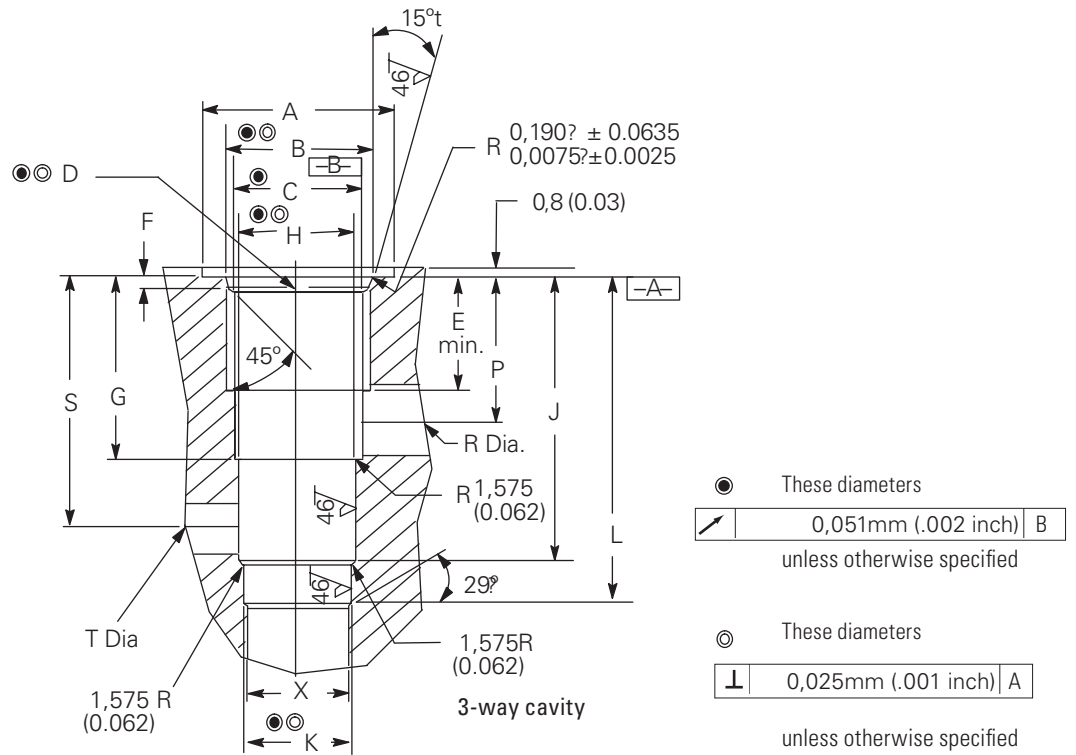


Cavity	A	B	C	D	E	F	G	H	J	P	R	X
mm (inch)	Spotface	+0,051 (±0.002)	±0,051 (±0.002)	Thread	Full thread			±0,0254 (±0.001)		Max. Dia.	Max. Dia.	
C-4-2	21,03 (0.828)	12,37 (0.487)	9,80 (0.386)	.4375"—20	9,53 (0.375)	2,36-2,74 (0.093-0.108)	15,49 (0.610)	8,74 (0.344)	23,37 (0.920)	9,93 (0.391)	6,35 (0.250)	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
mm (inch)			
C-12-2U (only)	30,82 (1.214)	12,70 (0.500)	34,29 (1.350)

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

C-**-3 Cavity dimensions



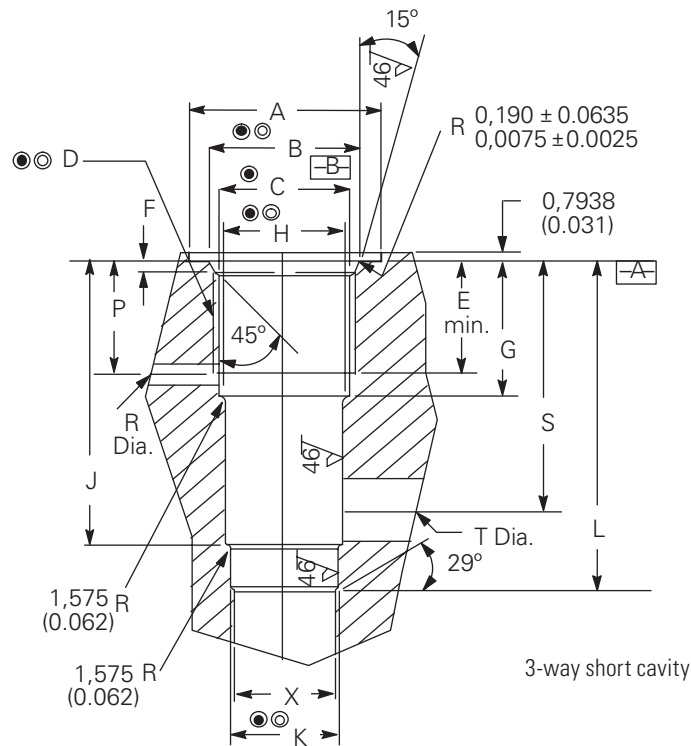
Cavity	A	B	C	D	E	F	G	H
	Spotface	±0,051 (±0.002)	±0,051 (±0.002)	Thread	Full thread			(±0,0254) (±0.001)
mm (inch)								
C-4-3	21,03 (0.828)	12,37 (0.487)	9,80 (0.386)	.4375"—20	9,53 (0.375)	2,36-2,74 (0.093-0.108)	15,49 (0.610)	8,74 (0.344)
C-8-3	30,16 (1.188)	20,65 (0.813)	17,47 (0.688)	.750"—16	12,70 (0.500)	2,54-2,92 (0.100-0.115)	18,23 (0.718)	15,90 (0.626)
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)
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)
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)
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)

Cavity	J	K	L	P	R	S	T	X
		(±0,0254) (±0.001)			Max. Dia.		Max. Dia.	Max. Dia.
mm (inch)								
C-4-3	30,05 (1.183)	7,95 (0.313)	38,10 (1.500)	9,93 (0.391)	6,35 (0.25)	24,61 (0.969)	6,35 (0.25)	7,14 (0.281)
C-8-3	33,25 (1.270)	14,30 (0.563)	43,25 (1.703)	14,68 (0.578)	5,94 (0.234)	28,98 (1.141)	5,94 (0.234)	12,70 (0.500)
C-10-3	38,10 (1.500)	15,90 (0.626)	47,62 (1.875)	18,26 (0.719)	6,35 (0.250)	34,13 (1.344)	6,35 (0.250)	14,27 (0.562)
C-12-3	57,78 (2.275)	22,25 (0.876)	69,21 (2.725)	27,94 (1.100)	12,70 (0.500)	50,80 (2.000)	12,70 (0.500)	20,62 (0.812)
C-16-3	62,71 (2.469)	27,02 (1.064)	75,39 (2.968)	24,60 (0.969)	15,88 (0.625)	53,18 (2.093)	15,88 (0.625)	19,05 (0.750)
C-20-3	85,72 (3.375)	33,38 (1.314)	100,02 (3.938)	30,96 (1.218)	25,40 (1.00)	71,44 (2.812)	25,40 (1.000)	30,16 (1.188)

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

Dimensions

mm (inch)



- ⊙ These diameters

↗	0,051mm (.002 inch)	B
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 unless otherwise specified
- ⊙ These diameters

⊥	0,025mm (.001 inch)	A
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 unless otherwise specified

Cavity	A	B	C	D	E	F	G	H
mm (inch)	Spotfac	±0,051 (±0.002)	±0,051 (±0.002)	Thread	Full thread			±0,0254 (±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)
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)
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)
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)

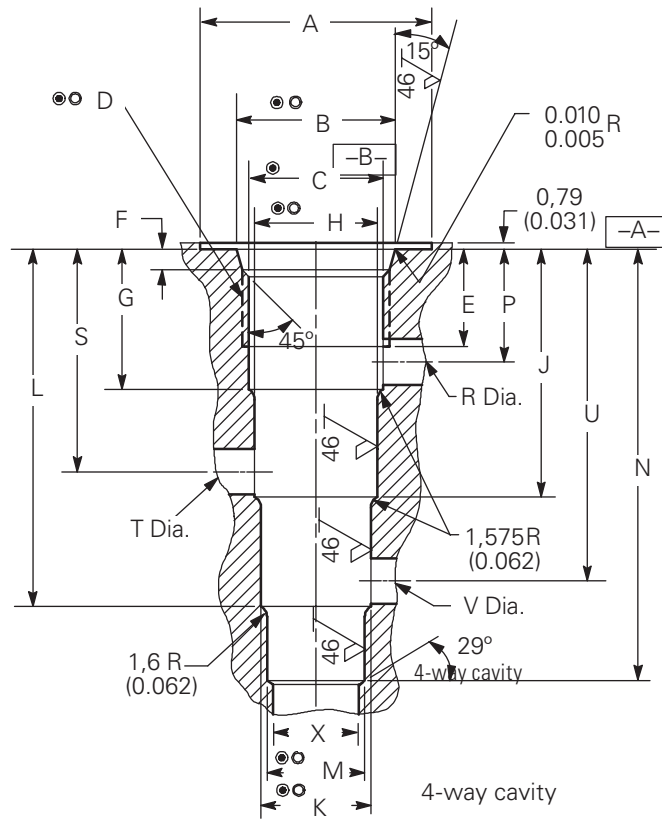
Cavity	J	K	L	P	R	S	T	X
mm (inch)		±0,0254 (±0.001)	Max. Dia.				Max. Dia.	Max. Dia.
C-10-3S	38,48 (1.515)	17,50 (0.689)	47,62 (1.875)	14,29 (0.562)	3,18 30,96 (0.125)	13,49 (1.218)	15,88 (0.531)	(0.625)
C-12-3S	48,26 (1.900)	22,25 (0.876)	59,69 (2.350)	22,22 (0.875)	4,82 41,27 (0.190)	12,70 (1.625)	20,62 (0.500)	(0.812)
C-16-3S	46,02 (1.812)	25,45 (1.002)	55,58 (2.188)	16,67 (0.656)	6,35 37,31 (0.250)	15,88 (1.468)	19,05 (0.625)	(0.750)
C-20-3S	64,29 (2.531)	33,38 (1.314)	77,77 (3.062)	19,84 (0.781)	6,35 50,00 (0.250)	25,40 (1.968)	30,16 (1.000)	(1.188)

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

C-**-4 Cavity dimensions

Dimensions

mm (inch)



⊙ These diameters

0,051mm (.002 inch) B
unless otherwise specified

⊙ These diameters

0,025mm (.001 inch) A
unless otherwise specified


Cavity	A	B	C	D	E	F	G	H	J	K
mm (inch)	Spotface	±0,051 (±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)

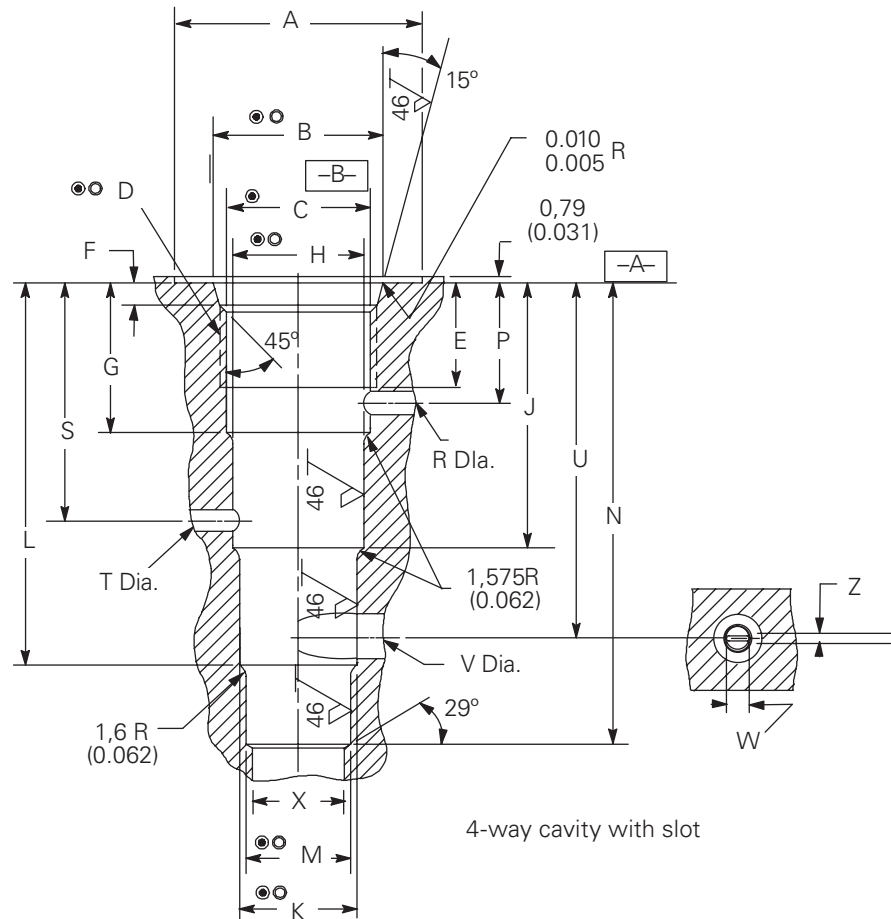
Cavity	L	M	N	P	R	S	T	U	V	X
mm (inch)		±0,0254 (±0.001)			Max. Dia.		Max. Dia.			Max. Dia.
C-8-4	46,48 (1.830)	12,72 (0.501)	56,13 (2.210)	14,68 (0.578)	5,94 (0.234)	28,98 (1.141)	5,94 (0.234)	43,25 (1.703)	5,94 (0.234)	11,13 (0.438)
C-10-4	53,98 (2.125)	15,90 (0.626)	63,50 (2.500)	18,26 (0.718)	6,35 (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)

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.


Dimensions

mm (inch)


 For use with VCB1-10/12 Cartridge Only



● These diameters

 0,051mm (.002 inch) B unless otherwise specified

◎ These diameters

 0,025mm (.001 inch) A unless otherwise specified

Cavity	A	B	C	D	E	F	G	H	J	K
	Spotface	±0,051 (±0.002)	±0,051 (±0.002)	Thread	Full thread			(±0,0254) (±0.001)		±0,0254 (±0.001)
mm (inch)										
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)

Cavity	L	M	N	P	R	S	T	U	V	X
		±0,0254 (±0.001)			Max. Dia.		Max. Dia.			Max. Dia.
mm (inch)										
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)

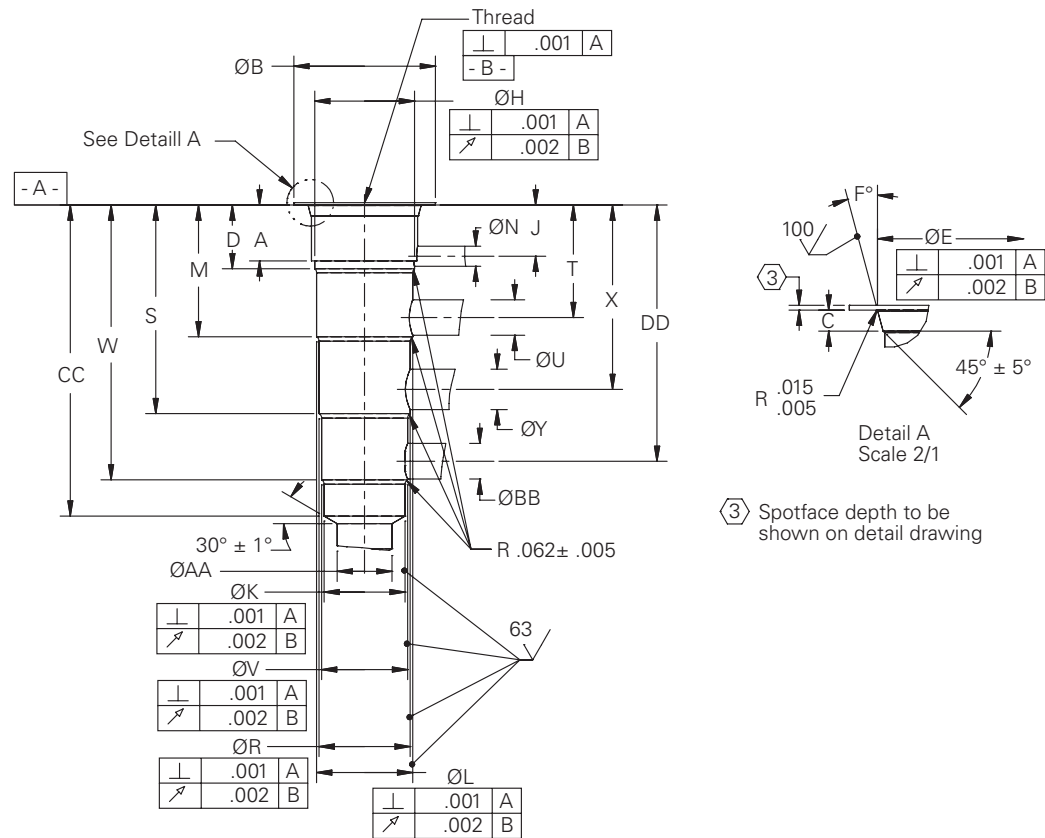
Cavity	Thread	W	Z
mm (inch)			
C-10-4U	All	15,9 (0.625)	ø 6,3 (0.25)
C-12-4U	SAE12	22,4 (0.88)	ø 12,6 (0.50)
	1/2" BSPP	17,5 (0.68)	

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

C-**-5S CavityDimensions

Dimensions

mm (inch)



③ Spotface depth to be shown on detail drawing

Cavity	Thread	A	B	C	D	E	F	H	K	L	M	N
		±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	0.75"—16	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)	3,81 (0.150)
C-10-5S	0.875"—12	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)	6,76 (0.266)
C-12-5S	1.0625"—12	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)	4,78 (0.188)
C-16-5S	1.3125"—12	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)	6,35 (0.250)
C-20-5S	1.625"—12	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)	6,35 (0.250)

Cavity	J	R	S	U	T	V	W	Y	X	AA	BB	CC	DD
	±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	±0.13 Max	±0.13 (±0.005)	±0.005)
C-8-5S	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	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	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	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	16,00 (0.630)	36,55 (1.439)	70,10 (2.760)	36,83 (0.562)	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)

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

Valve	Cavity	Page number
1CE120, 1CEB120, 4CK120, 5CK120	A877	M-21
1CLLR100	A878	M-21
1DR2, 1DR30, 3CA20, 3CP2 S207, S217 (A, H), PDR21A	A879	M-21
1DS30, 1DS100, 1PS100, 1PSC100, 1UPS100, 1PA100	A880	M-21
1AR100, 1ARC100, 1UAR100, 1GR30, 1GR100	A881	M-22
1SB10	A893	M-22
1LR300	A1126	M-22
1PUL200	A3145	M-23
1VR100, 1UL60	A3146	M-23
S229, PPD2 2A	A3531	M-23
1SB304	A5302	M-23
1CE30, 1CER30, 1CEB30, 1CEL30 4CK30, 5CK30, 1PSC30	A6610	M-24
PFR2 4A, PFR21H	A6701	M-24
1CEBD120, 1CPBD120	A6726	M-24
1CE300, 1CEB300, 4CK300, 5CK300	A6935	M-25
2CFRC60, 2CR80	A7447	M-25
1PUL60	A12088	M-26
1CEBD90, 1CPBD90	A12196	M-26
1CE90, 1CEB90, 1CER90, 1CEL90, 4CK(D)90	A12336	M-26
1HP7, 1CLLR50	A12370	M-26
S520(H), S521(H), S525, S526	A12743	M-27
S541, S542, 2CFD50, 4CKKT50	A12744	M-27
1CEBD300, 1CPBD300	A13098	M-27
LE402, 3CA300	A13245	M-28
1VR200, 1PA200, 1PS200	A16102	M-28
1SH10	A16927	M-28

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

Cartridge cavities

Index

Valve	Cavity	Page number
1CE140, 1CER140, 1CEL140	A20081	M-28
1CPBD30	A20530	M-29
1RDS702	A21145	M-29
LEV402	A21773	M-29
1CE20	A22903	M-29
1GR60	CVA-20-01-0	M-30
1DS60, 1PS60	CVA-22-06-0	M-30
2CFP60	CVA-27-04-0	M-30
2CFD200	CVB-42-04-0	M-31
1SH60	C-I-M18-3	M-31

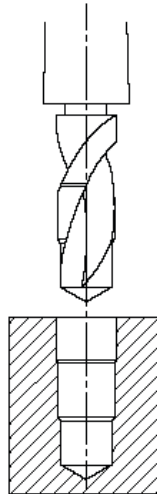
Our cavities have been designed to achieve standardization based on each thread size to reduce the amount of tooling required to cover the valve range. All new designs of cartridge are made to fit the ISO recommendations for

standard cavities. The diagram below shows the sequence of tooling using tools specified in the following pages.

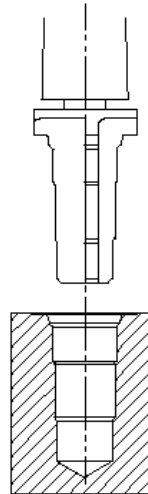
Note: a pilot drill may be required before the form drill.

Great care must be taken to ensure that the tools are inserted along the same machining axis to maintain correct concentricities, hence bodies should not be moved between operations.

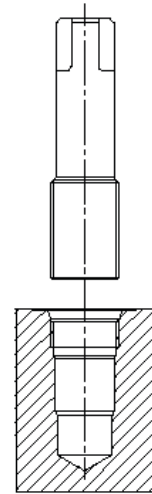
Operation 1 form drill



Operation 2 form reamer



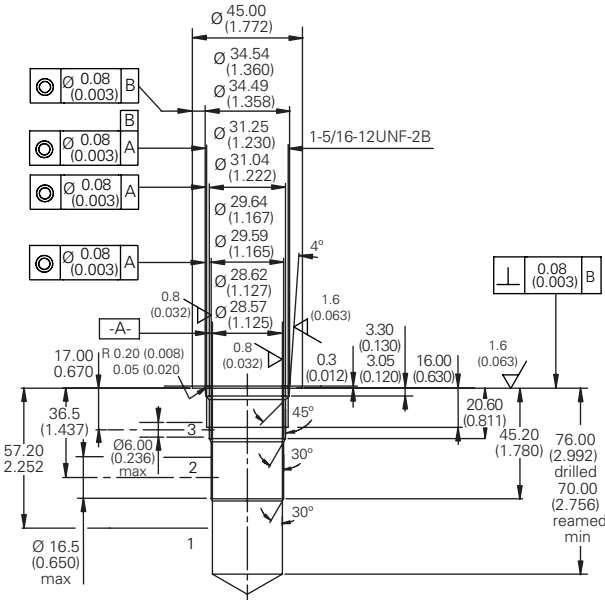
Operation 3 plug tap



Cavity A877

Cavity tools

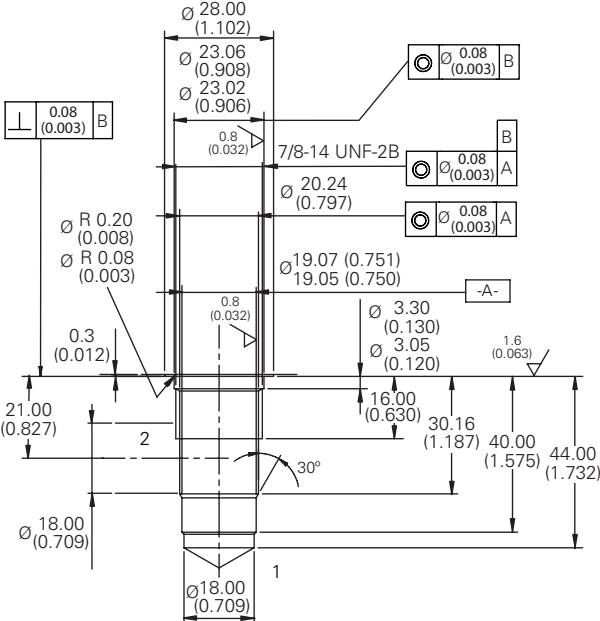
- Form Drill A1161
- Form Reamer A1162
- Plug Tap 1 5/16-12 UNF



Cavity A878

Cavity tools

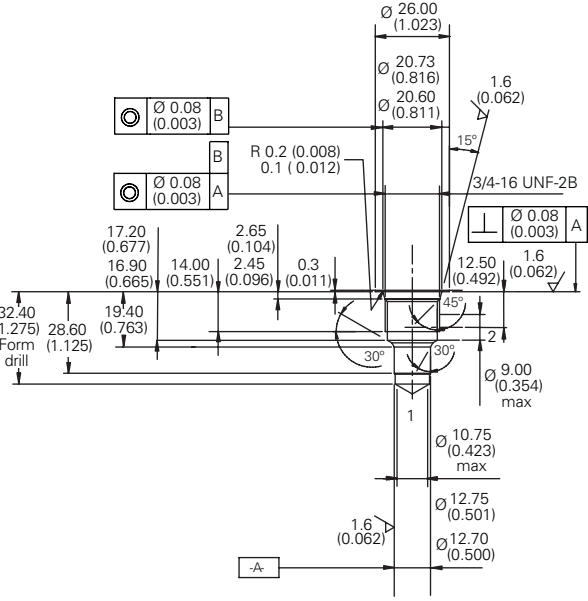
- Form Drill A885
- Form Reamer A1173
- Plug Tap 7/8-14 UNF



Cavity A879

Cavity tools

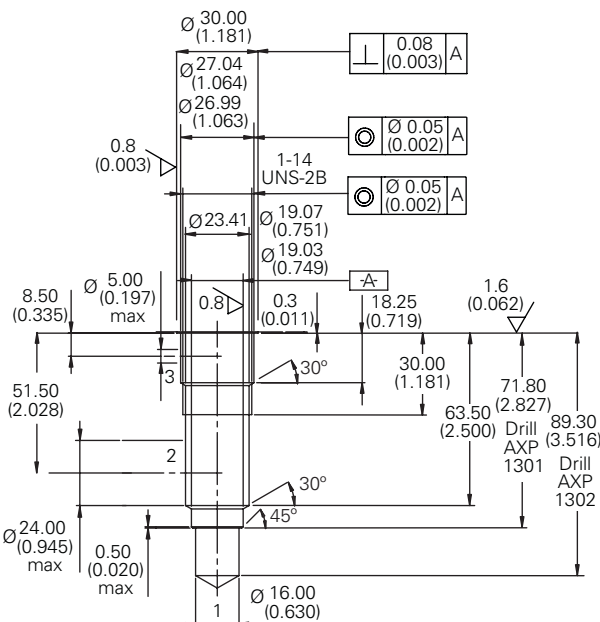
- Form Drill A1040
- Form Reamer A1041
- Plug Tap 3/4-16 UNF



Cavity A880

Cavity tools

- Form Drill A1302
- Form Reamer A1303
- Plug Tap 1-14 UNS



Note: These cavity dimensions are for installation purposes only.

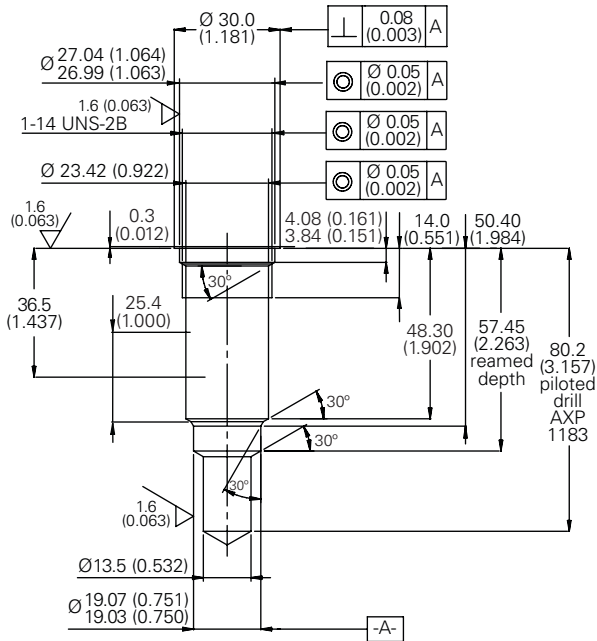
Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

Cartridge cavities

Cavity A881

Cavity tools

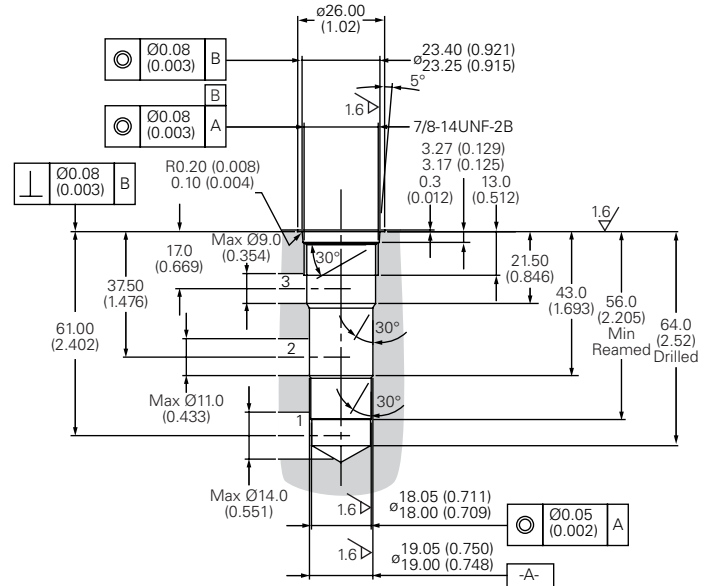
Form Drill	A1183
Form Reamer	A1036
Plug Tap	1 -14 UNF



Cavity A893

Cavity tools

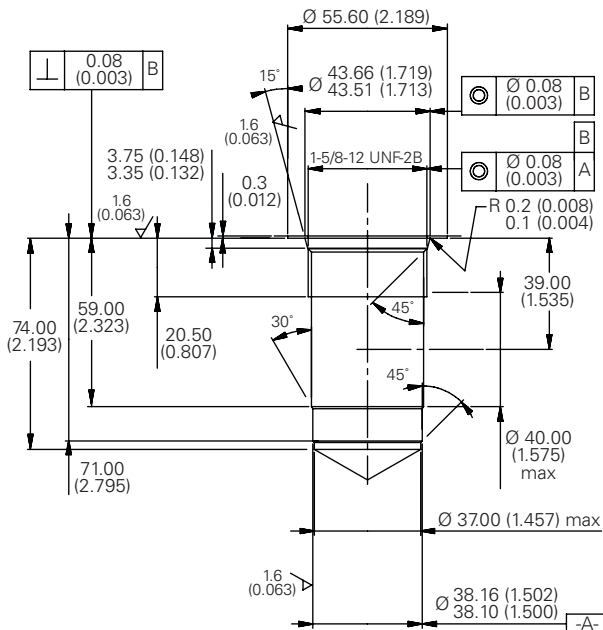
Form Drill	A894
Form Reamer	AT491
Plug Tap	7/8-14 UNF



Cavity A1126

Cavity tools

Form Drill	AT422
Form Reamer	AT488
Plug Tap	1 5/8-12 UNF



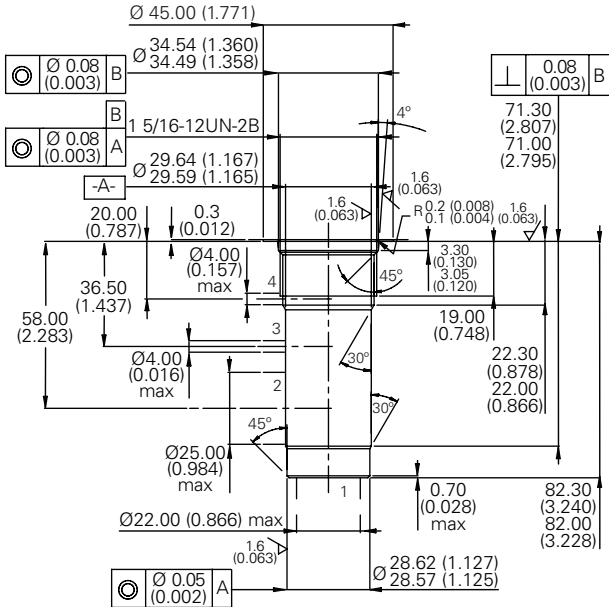
Note: These cavity dimensions are for installation purposes only.

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

Cavity A3145

Cavity tools

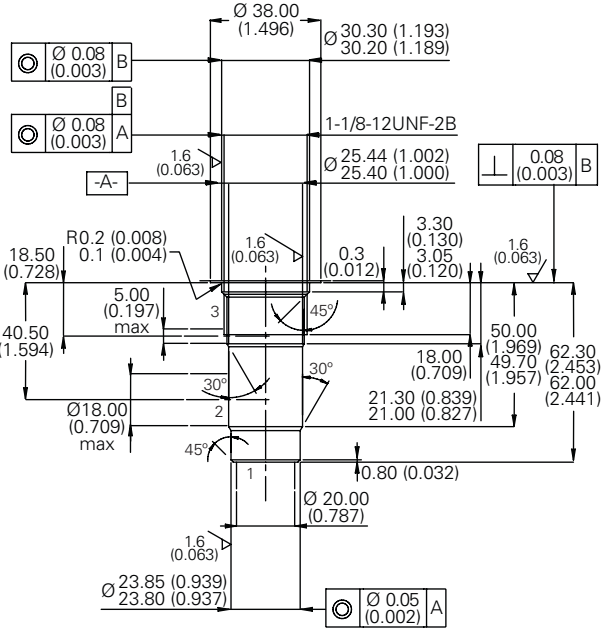
- Form Drill A3226
- Form Reamer A3227
- Plug Tap 1 5/16-12 UN



Cavity A3146

Cavity tools

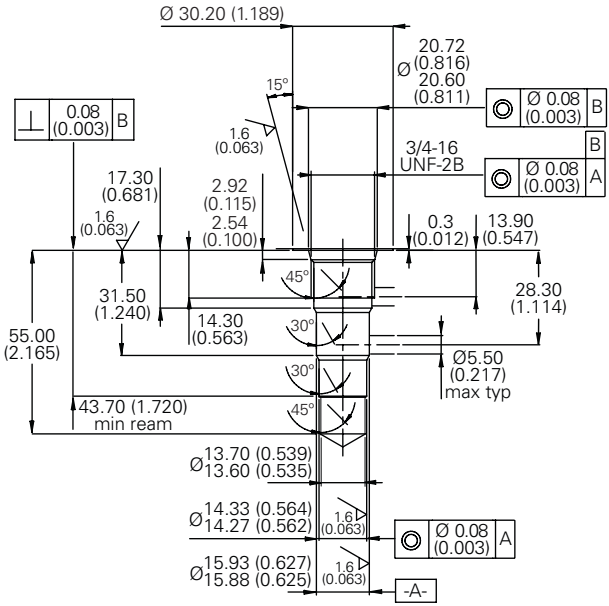
- Form Drill A3315
- Form Reamer A3316
- Plug Tap 1 1/8-12 UNF



Cavity A3531

Cavity tools

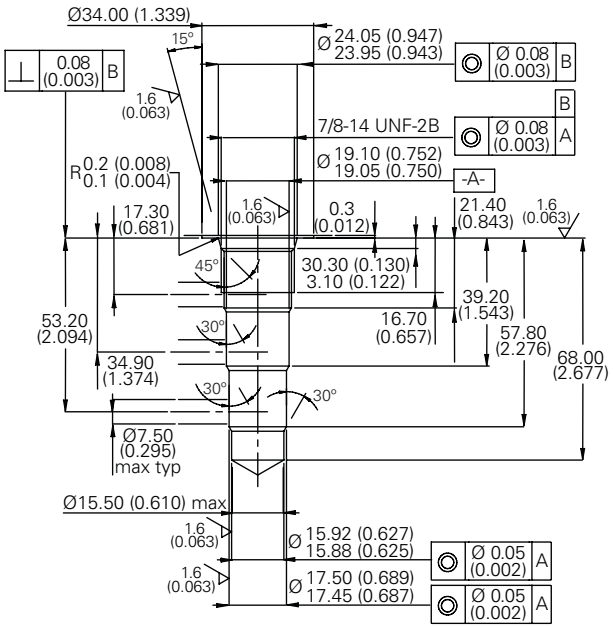
- Form Drill A3538
- Form Reamer A3539
- Plug Tap 3/4-16 UNF



Cavity A5302

Cavity tools

- Form Drill A5668
- Form Reamer A5669
- Plug Tap 7/8-14 UNF



Note: These cavity dimensions are for installation purposes only.

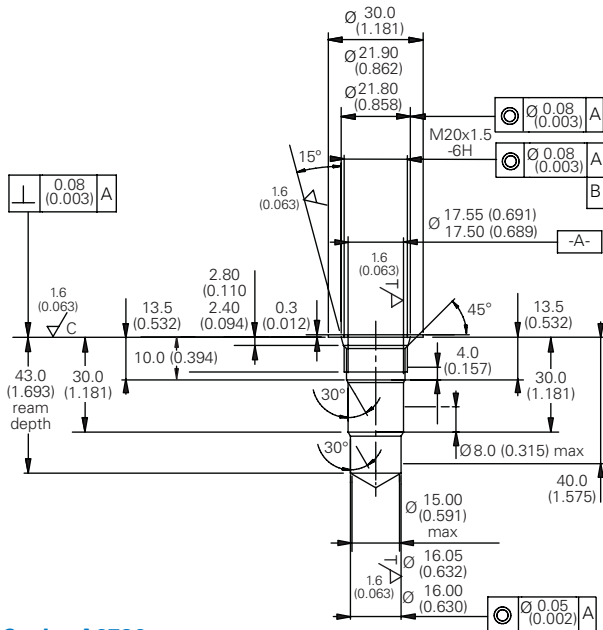
Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

Cartridge cavities

Cavity A6610

Cavity tools

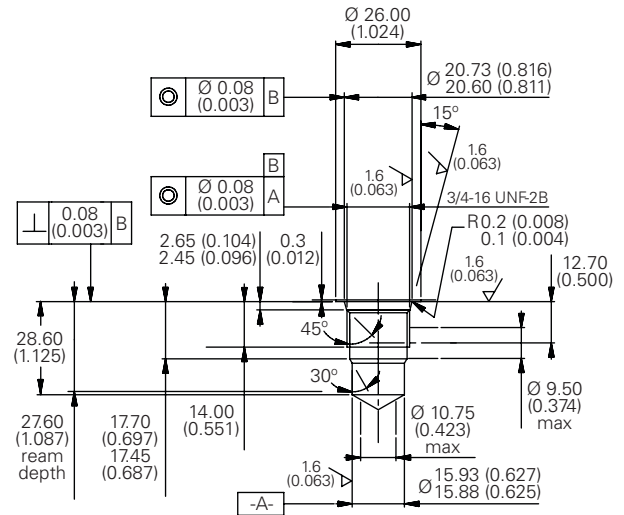
Form Drill	AT447
Form Reamer	AT448
Plug Tap	M20 x 1.5



Cavity A6701

Cavity tools

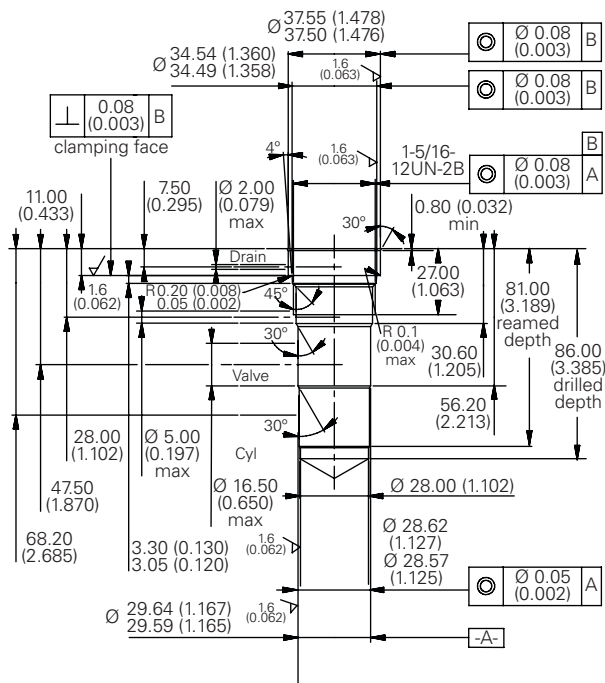
Form Drill	AT482
Form Reamer	AT483
Plug Tap	3/4-16 UNF



Cavity A6726

Cavity tools

Form Drill	A6933
Form Reamer	A6934
Plug Tap	1 5/16-12 UNF



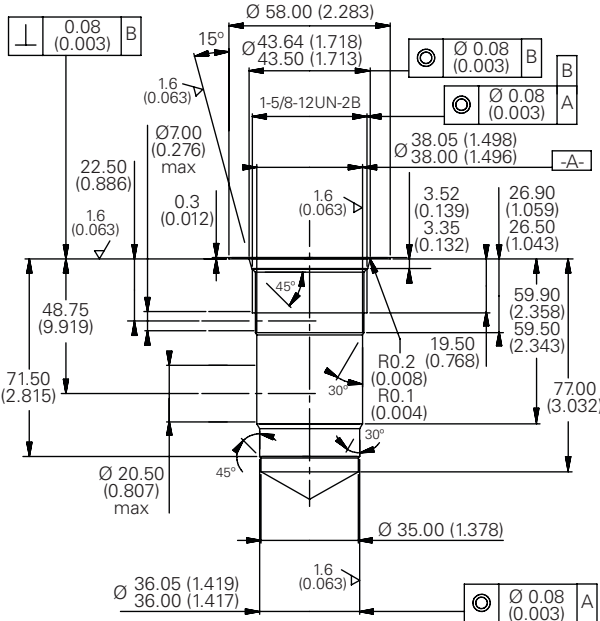
Note: These cavity dimensions are for installation purposes only.

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

Cavity A6935

Cavity tools

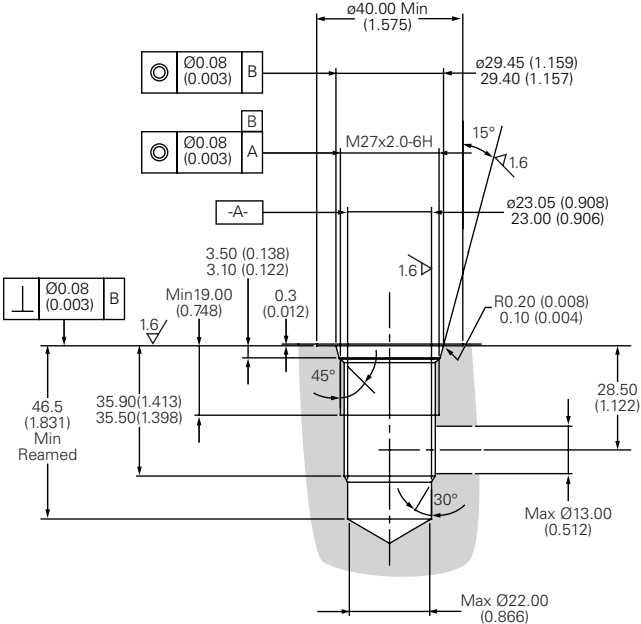
- Form Drill AT501
- Form Reamer AT502
- Plug Tap 1 5/8-12 UN



Cavity A7447

Cavity tools

- Form Drill A8115
- Form Reamer A8117
- Plug Tap M27 X 2



Note: These cavity dimensions are for installation purposes only.

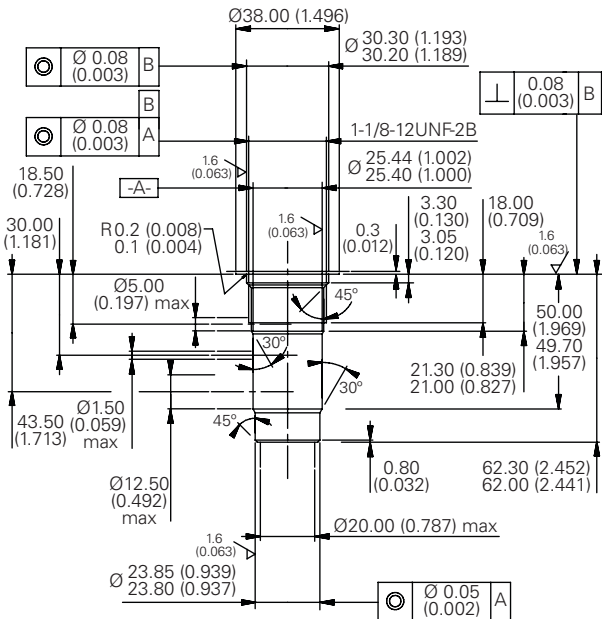
Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

Cartridge cavities

Cavity A12088

Cavity tools

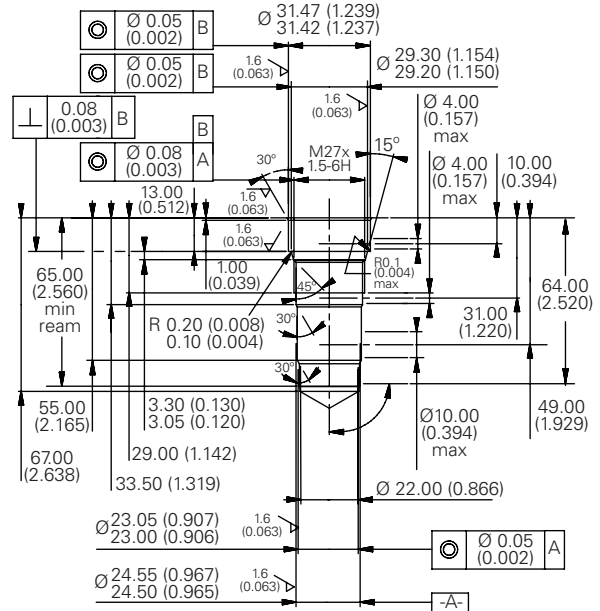
Form Drill	A3315
Form Reamer	A3316
Plug Tap	1 1/8-12 UNF



Cavity A12196

Cavity tools

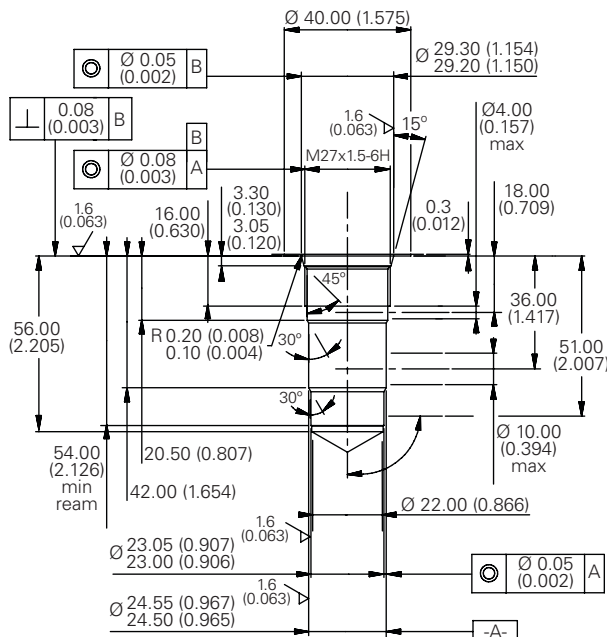
Form Drill	A12197
Form Reamer	A12198
Plug Tap	M27 X 1.5



Cavity A12336

Cavity tools

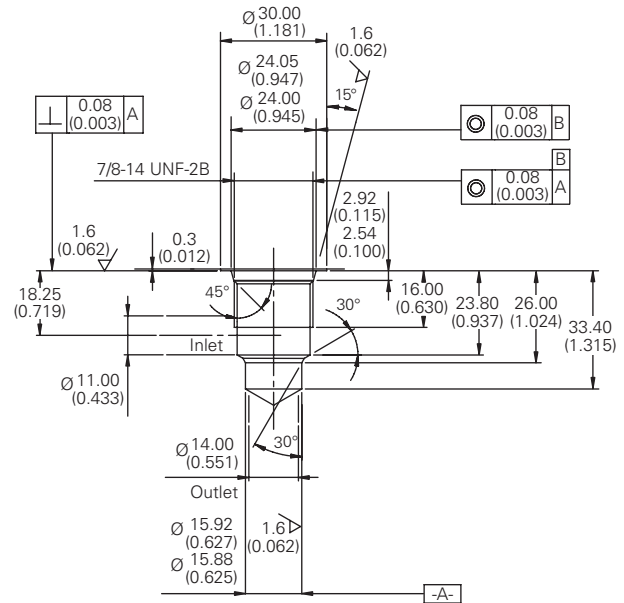
Form Drill	A12337
Form Reamer	A12338
Plug Tap	M27 X 1.5



Cavity A12370

Cavity tools

Form Drill	A12439
Form Reamer	A12440
Plug Tap	7/8-14 UNF



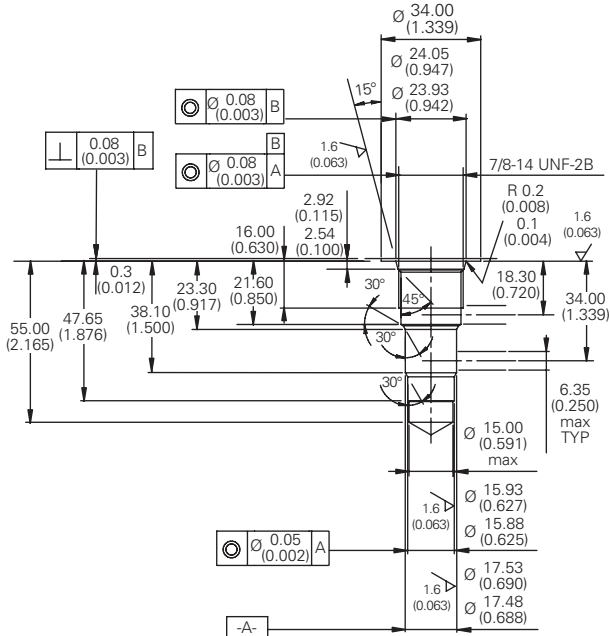
Note: These cavity dimensions are for installation purposes only.

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

Cavity A12743

Cavity tools

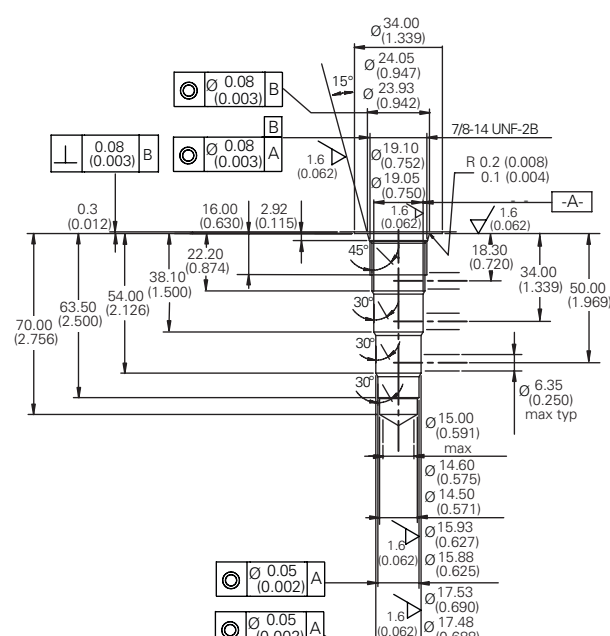
- Form Drill A12802
- Form Reamer A12803
- Plug Tap 7/8"-14 UNF



Cavity A12744

Cavity tools

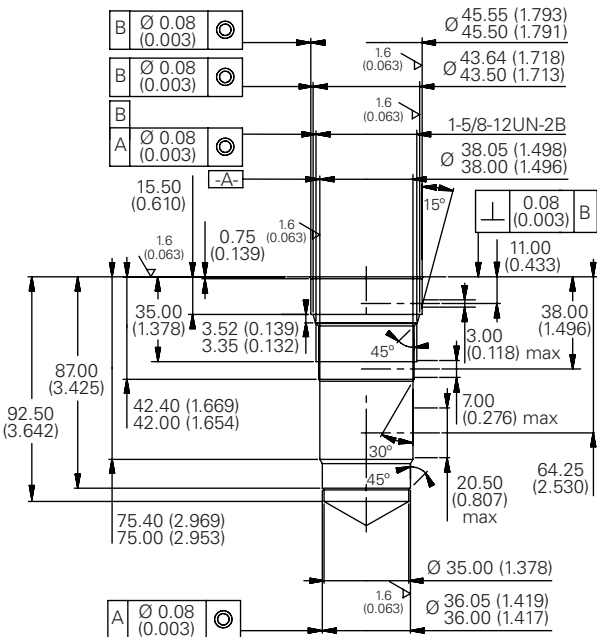
- Form Drill A12804
- Form Reamer A12805
- Plug Tap 7/8"-14 UNF



Cavity A13098

Cavity tools

- Form Drill A13099
- Form Reamer A13100
- Plug Tap 1 5/8"-12 UN



Note: These cavity dimensions are for installation purposes only.

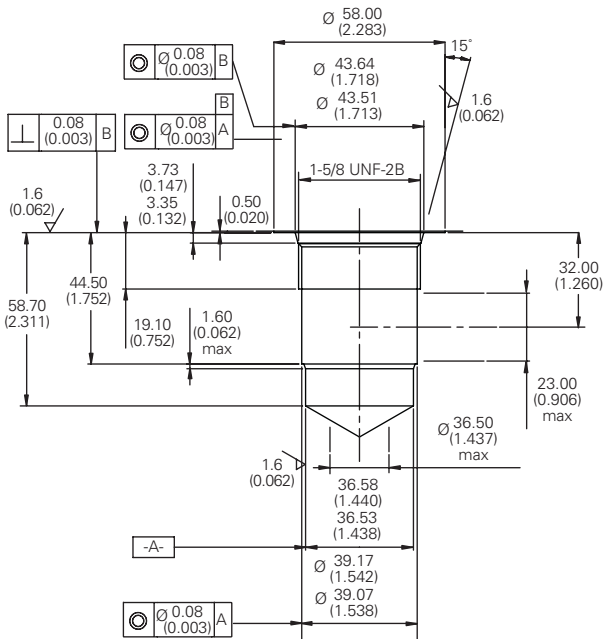
Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

Cartridge cavities

Cavity A13245

Cavity tools

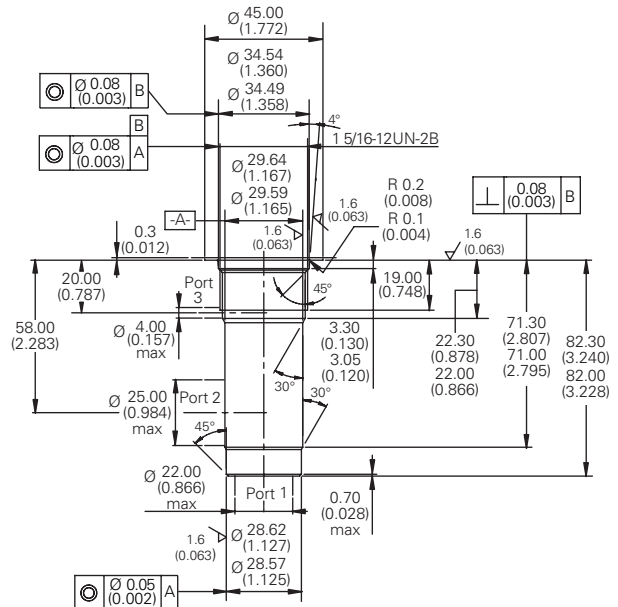
Form Drill	A13246
Form Reamer	A13247
Plug Tap	1 5/8"-12UNF-2B



Cavity A16102

Cavity tools

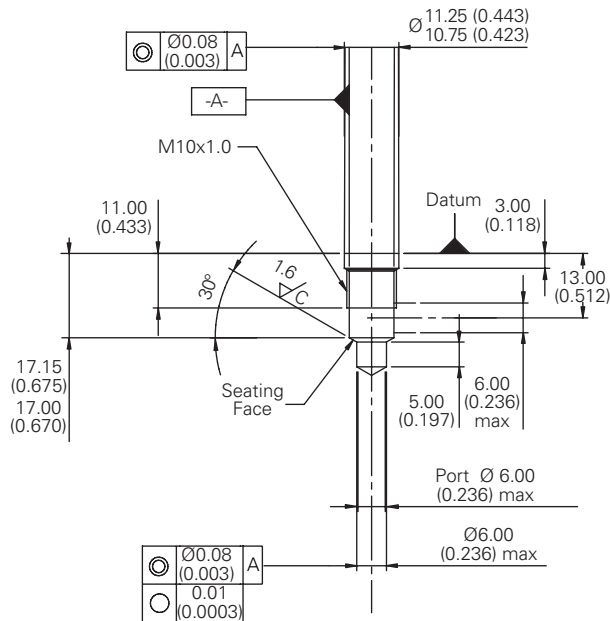
Form Drill	A3226
Form Reamer	A3227
Plug Tap	1 5/16-12UNF-2B



Cavity A16927

Cavity tools

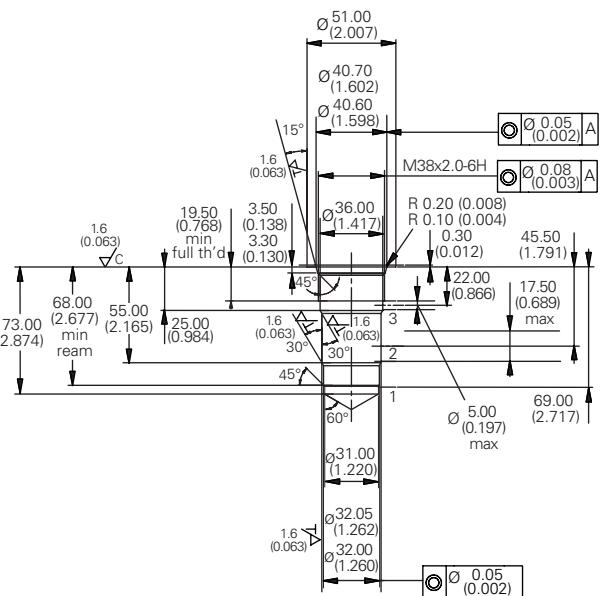
Form Reamer	AT1097
Plug Tap	M10 x 1.0



Cavity A20081

Cavity tools

Form Drill	AT2369/1
Form Reamer	AT2369/2
Plug Tap	M38 x 2-6H



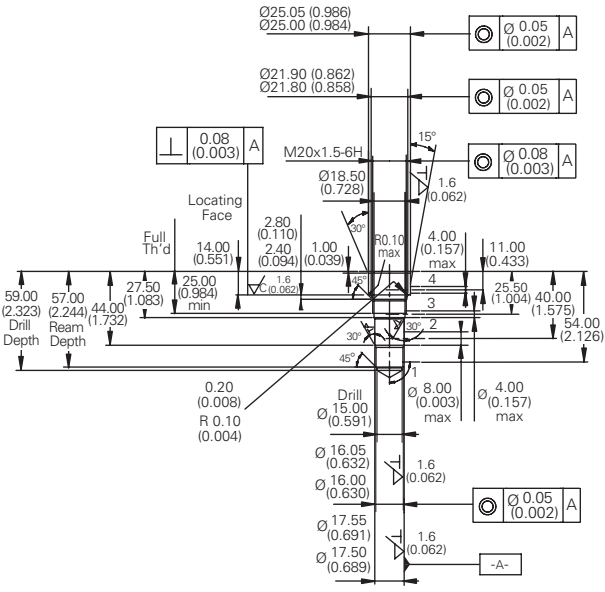
Note: These cavity dimensions are for installation purposes only.

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

Cavity A20530

Cavity tools

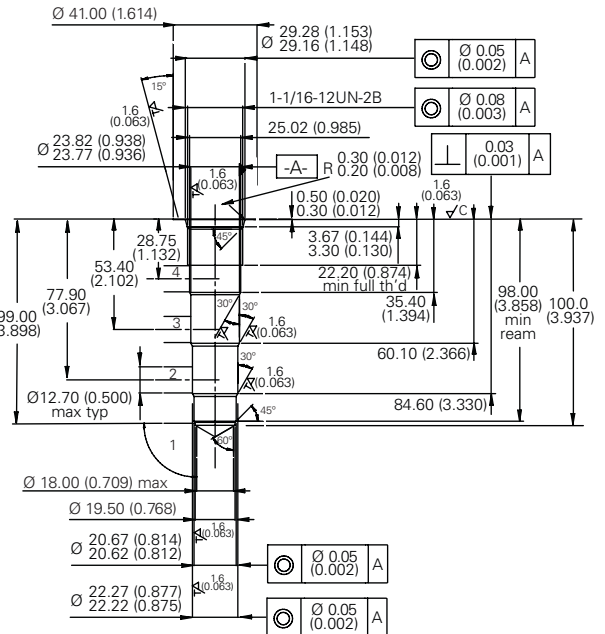
Form Drill AT2573
 Form Reamer AT2574
 Plug Tap M20 x 1.5 6H



Cavity A21145

Cavity tools

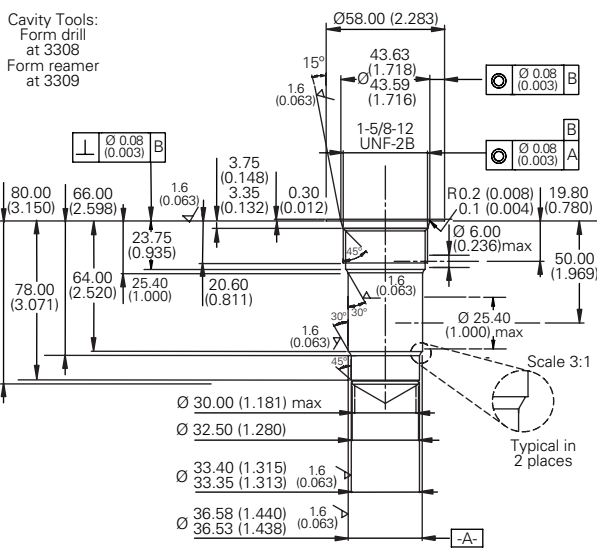
Form Drill AT2962
 Form Reamer AT2963
 Plug Tap 1 1/16 12 UN - 2B



Cavity A21773

Cavity tools

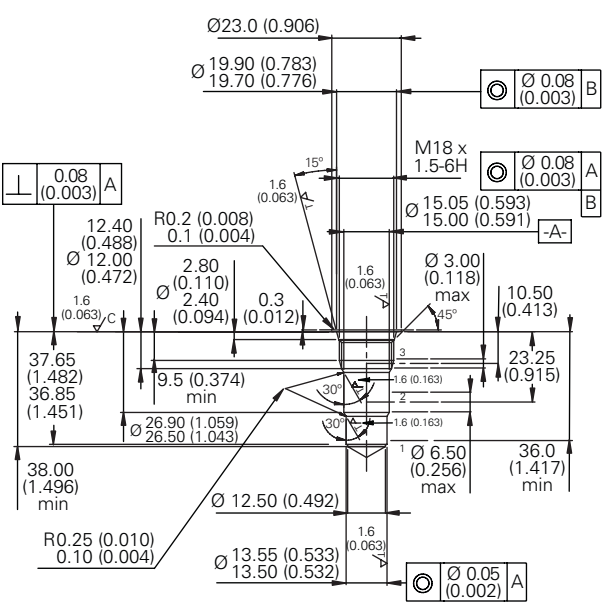
Form Drill AT3308
 Form Reamer AT3309
 Plug Tap 1 5/8"-12UNF-2B



Cavity A22903

Cavity tools

Form Drill AT3616
 Form Reamer AT3617
 Plug Tap M18x1.5-6H



Note: These cavity dimensions are for installation purposes only.

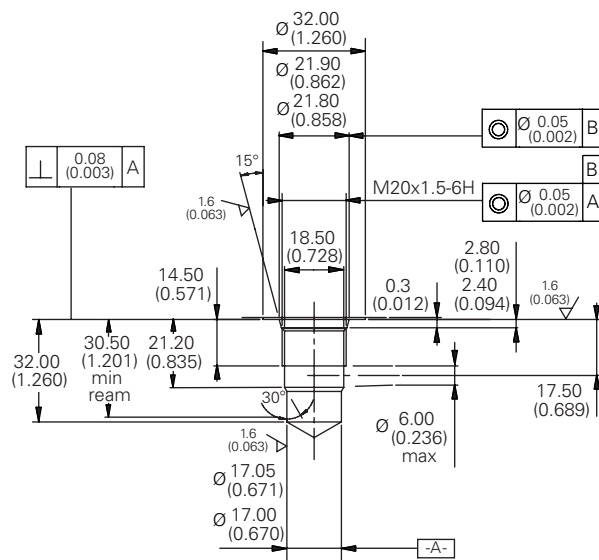
Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

Cartridge cavities

Cavity CVA-20-01-0

Cavity tools

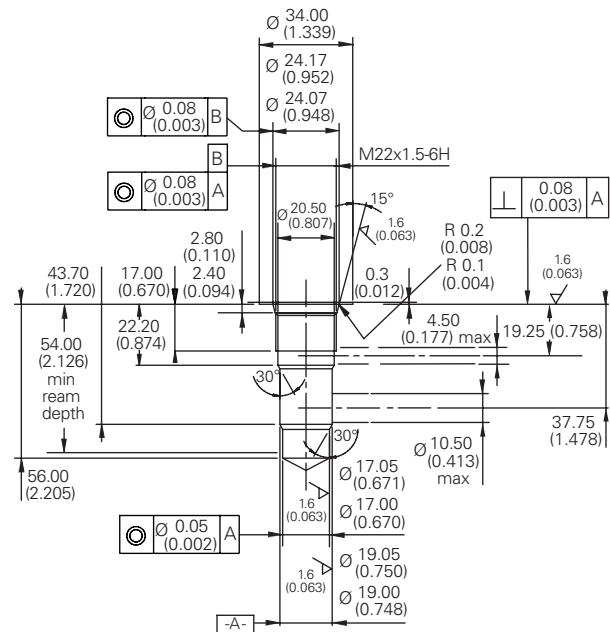
Form Drill	A8961
Form Reamer	A8962
Plug Tap	M20 X 1.5



Cavity CVA-22-06-0

Cavity tools

Form Drill	A8966
Form Reamer	A8967
Plug Tap	M22 X 1.5

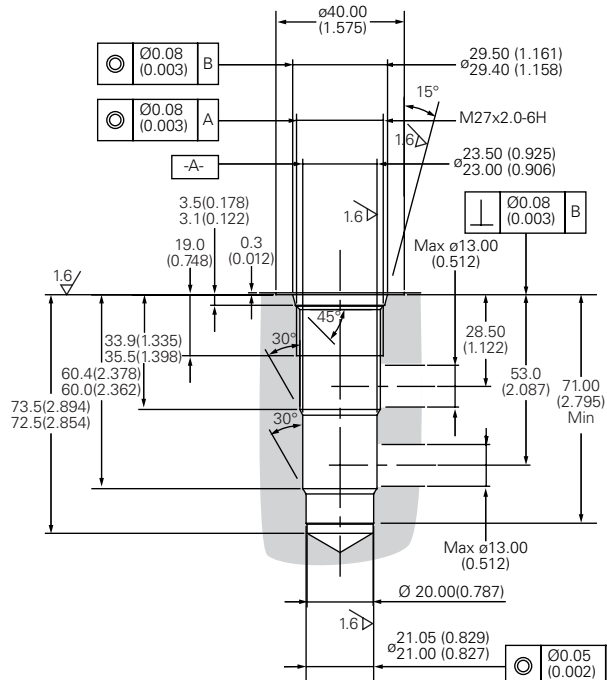


Notes: These cavity dimensions are for installation purposes only.

Cavity CVA-27-04-0

Cavity tools

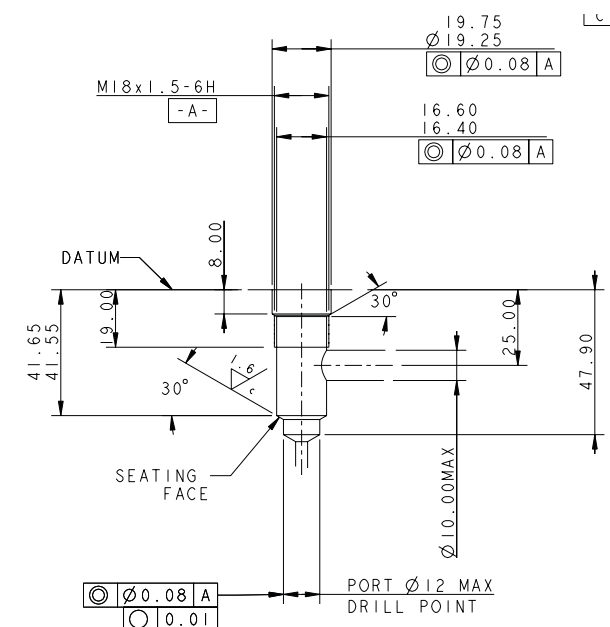
Form Drill	A12784
Form Reamer	A496
Plug Tap	M27 X 2



Cavity C-I-M18-3

Cavity tools

Form Drill	---
Form Reamer	---
Plug Tap	---

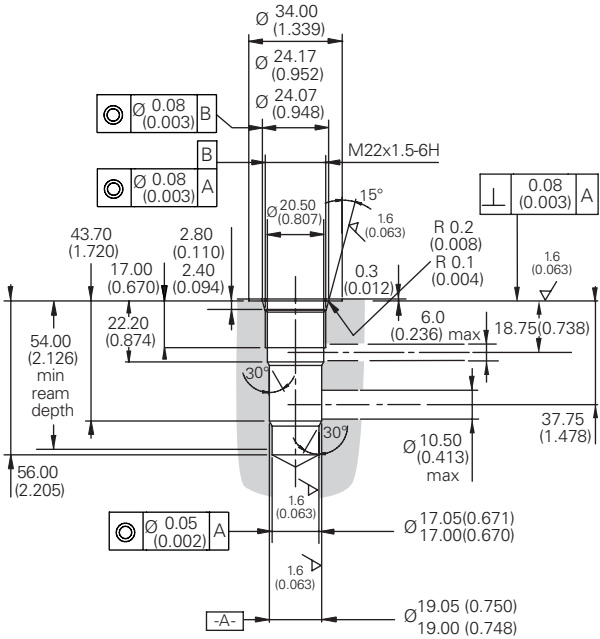


Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

Cavity CVB- 22- 06- 0

Cavity tools

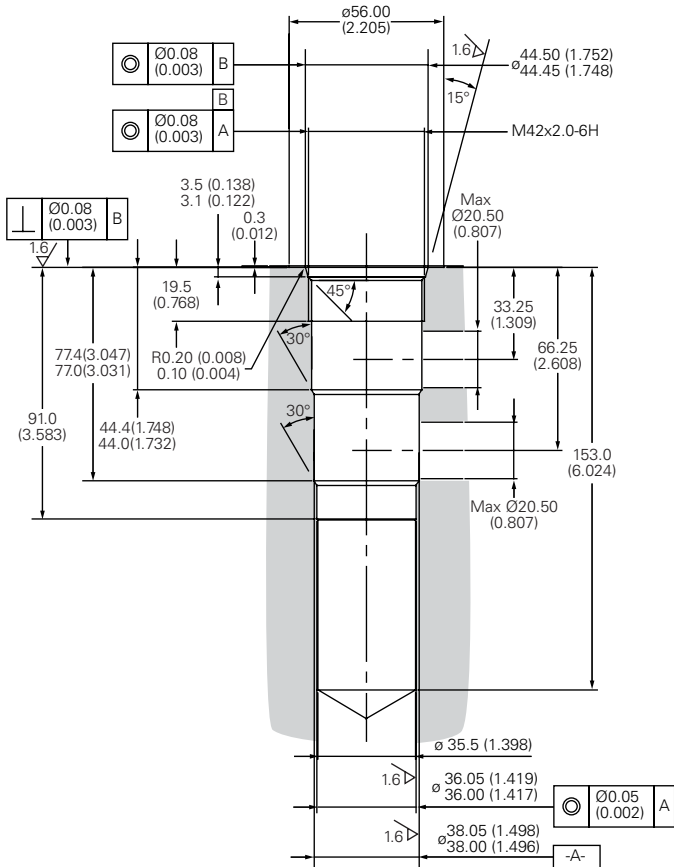
- Form Drill A8966
- Form Reamer A8967
- Plug Tap M22 X 1.5



CVB- 42- 04- 0

Cavity tools

- Form Drill BT499
- Form Reamer AT498
- Plug Tap M42 X 2



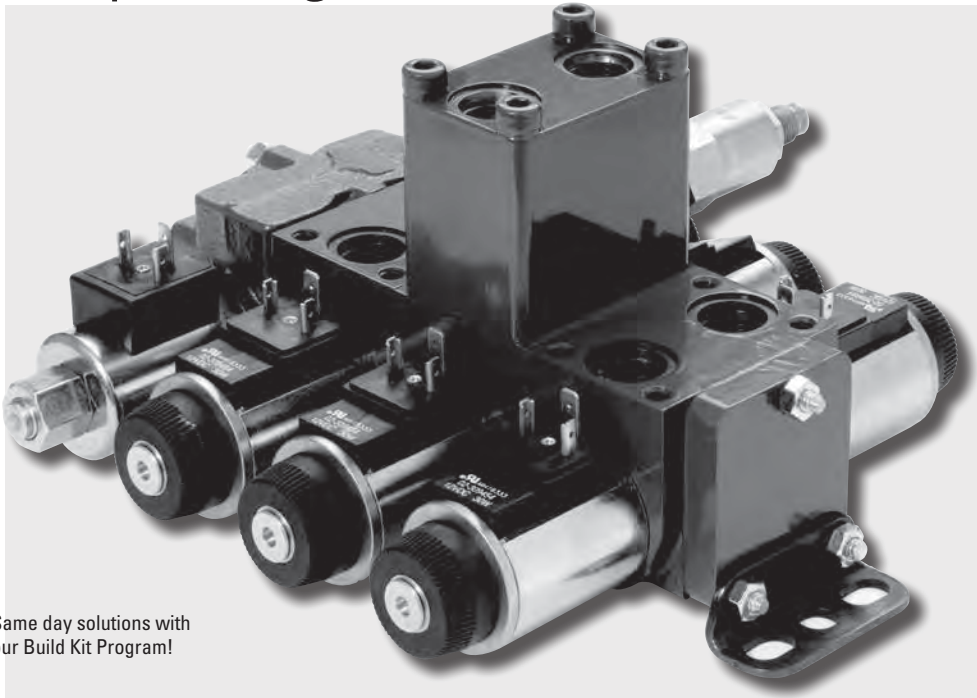
Note: These cavity dimensions are for installation purposes only.

Where measurements are critical request certified drawings. We reserve the right to change specifications without notice.

TC Cavity

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Sectional Design for Multiple Configurations



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MDG Mobile Valve

Eaton's MDG mobile directional control valve uses a modular, versatile design based on our proven Vickers® DG4V3 design.

Eaton® MDG valves, truly designed for mobile applications, offer the traditional benefits of a stackable mobile valve and provide further value as circuit options for mobile manifold

systems. This same versatility and flexibility applies to system applications, making it your best value for customized, multi-functional circuits.

For more information, contact your local Eaton distributor, call us at 800-547-7805 or visit us on the web at: www.eaton.com/hydraulics.