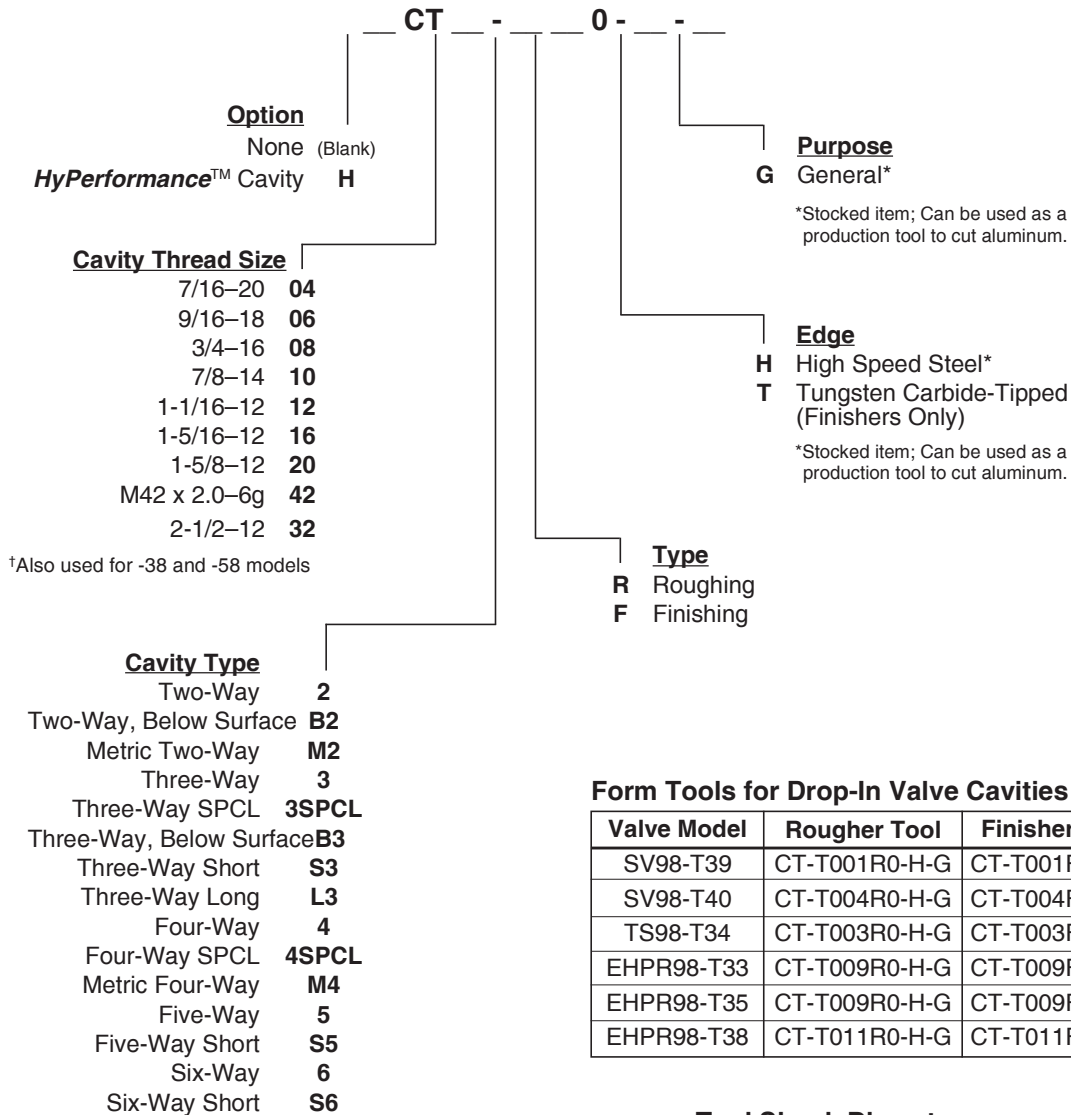


Cavity Form Tools

HydraForce normally stocks standard straight-shanked, tangleless shafts in the sizes indicated. Drawings for standard tools are available upon request. Special tools can be supplied; consult factory for cost and leadtime quotations.

ORDERING INFORMATION



Form Tools for Drop-In Valve Cavities

Valve Model	Rougher Tool	Finisher Tool
SV98-T39	CT-T001R0-H-G	CT-T001F0-T-G
SV98-T40	CT-T004R0-H-G	CT-T004F0-T-G
TS98-T34	CT-T003R0-H-G	CT-T003F0-T-G
EHPR98-T33	CT-T009R0-H-G	CT-T009F0-T-G
EHPR98-T35	CT-T009R0-H-G	CT-T009F0-T-G
EHPR98-T38	CT-T011R0-H-G	CT-T011F0-T-G

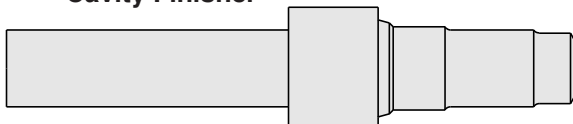
Tool Shank Diameter

Cavity	Rougher	Finisher
08	0.625"	0.750"
10	0.750"	0.750"
12	0.875"	0.750"
16	1.000"	0.750"
20	1.000"	1.000"
M2	1.000"	1.000"
M42	1.000"	1.000"
32	1.500"	1.500"
T001	0.750"	0.750"
T003	0.750"	0.750"
T004	0.750"	0.750"
T009	0.625"	0.625"
T011	0.625"	0.625"

Cavity Rougher

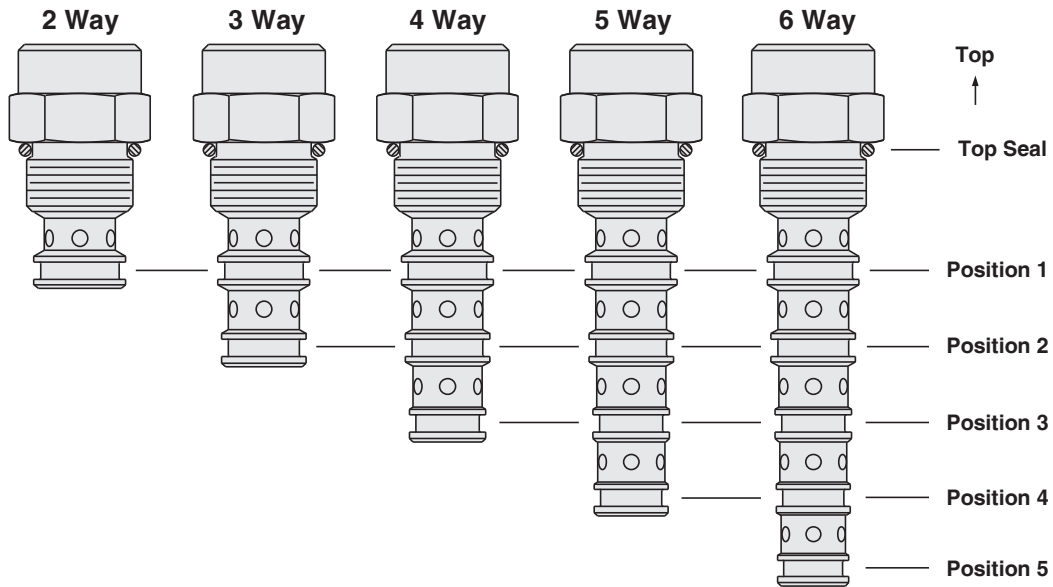


Cavity Finisher



Seal Kit Installation & Ordering Guide

O-RING/BACKUP RING POSITION



STANDARD O-RING SIZES

Cavity Size	Type	Top Seal	Position 1	Position 2	Position 3	Position 4	Position 5
08	2-Way	-908	-012	—	—	—	—
	3-Way	-908	-014	-013	—	—	—
	4-Way	-908	-014	-013	-012	—	—
10	2-Way	-910	-014	—	—	—	—
	3-Way	-910	-015	-014	—	—	—
	3-Way Short	-910	-016	-015	—	—	—
	3-Way Long	-910	-015	-014	—	—	—
	4-Way	-910	-016	-015	-014	—	—
	5-Way	-910	-116	-015	-014	-013	—
	6-Way	-910	-116	-015	-014	-013	-012
6-Way Short	-910	-116	-015	-014	-013	-012	
12	2-Way	-912	-115	—	—	—	—
	2-Way Long	-912	-115	—	—	—	—
	3-Way	-912	-019	-018	—	—	—
	4-Way	-912	-019	-018	-017	—	—
	5-Way Short	-912	-019	-018	-017	-016	—
	6-Way Short	-912	-019	-018	-017	-016	-015
16	2-Way	-916	-119	—	—	—	—
	3-Way Short	-916	-119	-117	—	—	—
	3-Way	-916	-119	-117	—	—	—
	4-Way	-916	-119	-118	-117	—	—
	5-Way Short	-916	-125	-119	-118	-117	—
	6-Way Short	-916	-125	-119	-118	-117	-116
20	3-Way Short	M2.9	-122	-124	—	—	—
42	4-Way Metric	M2.4 x 38.6	-125	M2.4 x 31.6	M2.4 x 29.6	—	—
	6-Way Metric	-131	-125	M2.4 x 31.6	M2.4 x 29.6	M2.9 x 38.6	M2.4 x 27.6
98	3-Way Metric	M1.5 x 21.5	M2.2 x 18.0	M1.6 x 15.1	M1.6 x 14.1	—	—

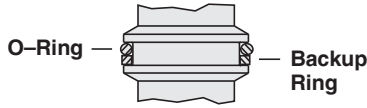
Seal Kit information continued on following page.

Seal Kit Installation & Ordering Guide

O-RING/BACKUP RING INSTALLATION

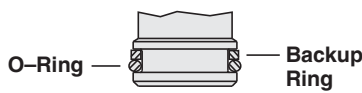
Installation Type T

O-Ring installed toward top of cavity



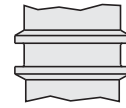
Installation Type B

O-Ring installed toward bottom of cavity



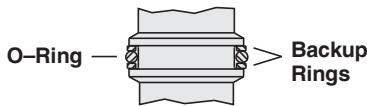
Installation Type X

No seals this location



Installation Type M

O-Ring installed between backups



Installation Type O

O-Ring only; no back-ups



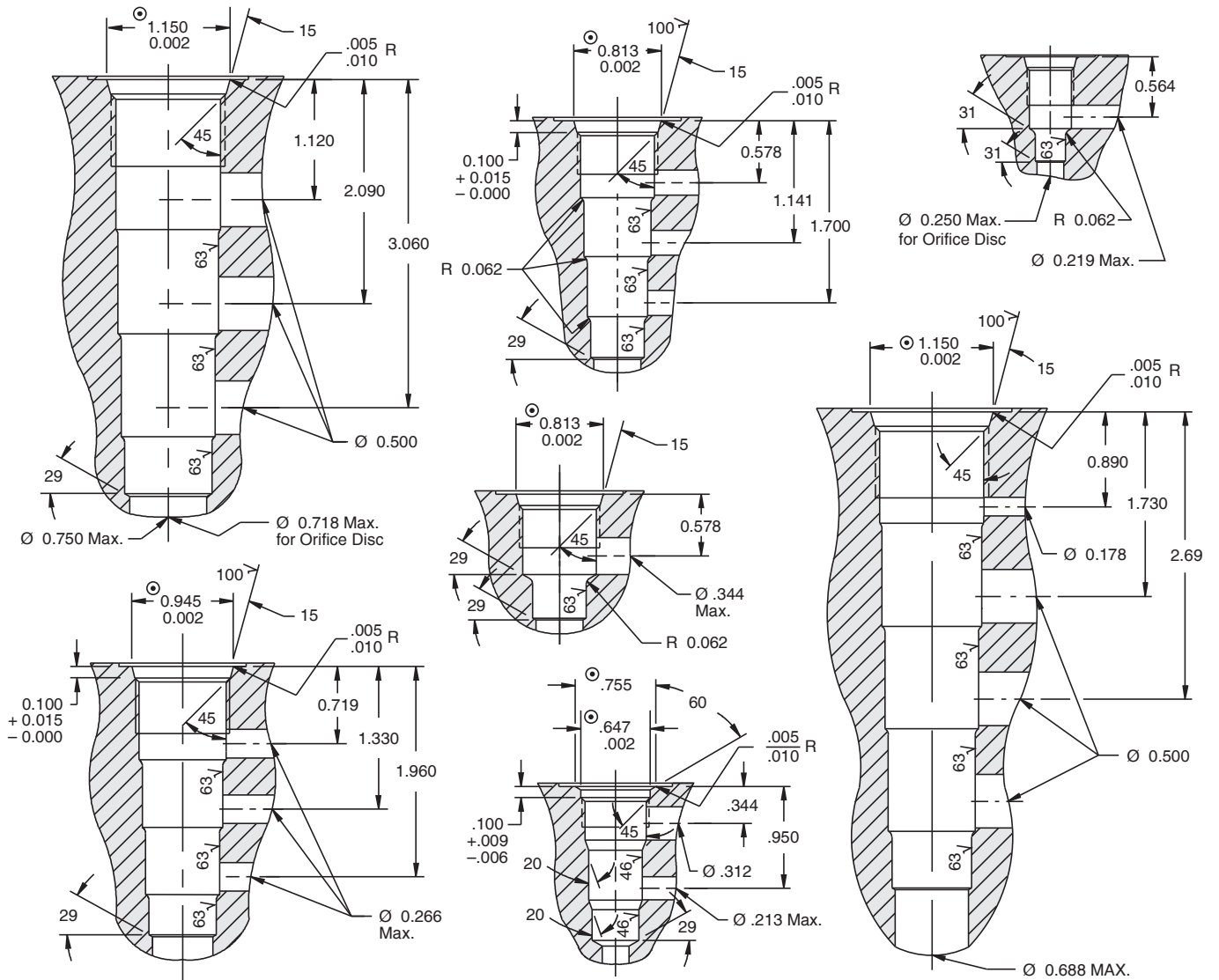
Note: Cartridges which are originally built with polyester elastomer (black) back-up rings, are serviced with single-turn (white) Fluorocarbon back-up rings. This facilitates field installation of the back-up rings, since the original production rings require special tools for installation.

Type "M" back-up rings are 1/2 size single-turn Fluorocarbon rings on all cavities **except** VC12-3, VC12-4, VC16-S3, VC20-S3 and VC98-3.

Temperature Considerations: As per ASTM Standard D2000/SAE J200 Standard **Buna N (N)** seals are designed for applications that operate within the -40°C to 100°C (-40° to 212°F) temperature range. Maximum temperature for optimum seal life is 107°C with reduced life if operated within the 107°C to 120°C range. **Fluorocarbon (V)** seals should be used for applications with an average temperature range between -26°C to 204°C (-15°F to 400°F). **Polyurethane (P)** seals should be used for applications with an average temperature range between 104°C to -54°C (-65°F to 225°F). **PPDI Urethane (U)** seals should be used for applications with an average temperature range between 107°C to -54°C (-65°F to 225°F).

ORDERING INFORMATION

Cavity Thread Size	Cavity Type	Seals	Position 1 Installation Type (Required for 2, 3, 4, 5 & 6-Way Valves)	Position 2 Installation Type (Required for 3, 4, 5 & 6-Way Valves)	Position 3 Installation Type (Required for 4, 5 & 6-Way Valves)	Position 4 Installation Type (Required for 5 & 6-Way Valves)	Position 5 Installation Type (Required for 6-Way Valves Only)
7/16-20	04	2-Way 2	O-Ring toward top of cavity T	O-Ring toward top of cavity T	O-Ring toward top of cavity T	O-Ring toward top of cavity T	O-Ring toward top of cavity T
5/8-18	07	3-Way 3	O-Ring between backups M	O-Ring between backups M	O-Ring between backups M	O-Ring between backups M	O-Ring between backups M
3/4-16	08	3-Way Short S3	O-Ring toward bottom of cavity B	O-Ring toward bottom of cavity B	O-Ring toward bottom of cavity B	O-Ring toward bottom of cavity B	O-Ring toward bottom of cavity B
	38	4-Way 4	O-Ring; no back-ups O	O-Ring; no back-ups O	O-Ring; no back-ups O	O-Ring; no back-ups O	O-Ring; no back-ups O
	58	5-Way 5	No seals this location X	No seals this location X	No seals this location X	No seals this location X	No seals this location X
	78	6-Way 6					
7/8-14	10						
	50						
	70						
	80						
1-1/16-12	12						
	52						
	72						
1-5/16-12	16						
	56						
1-5/8-12	20						
M42 x 2.0	42						



TECHNICAL REFERENCE

Filtration Requirements9.010.1

Cartridge Installation & Torque Values9.020.1

Temperature and Oil Viscosity9.060.1

Equivalents and Conversions9.070.1

04-Size Cavities9.104.1

07-Size Cavities9.107.1

08-Size Cavities9.108.1

10-Size Cavities9.110.1

Drop-in Cavities9.111.1

12-Size Cavities9.112.1

16-Size Cavities9.116.1

20-Size Cavities9.120.1

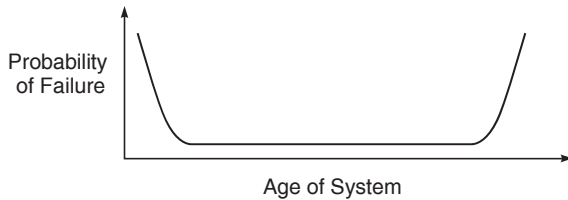
42-Size Cavities9.142.1

Full Warranty Statement9.990.1

Filtration Requirements

HydraForce's experience concurs with data derived from other sources, notably Pall Corporation, that most systems track a "bathtub" curve for failures, with the highest probability occurring at system installation/run-in, following fluid replenishment, and again after the system ages and there has been significant component abrasive wear.

Typical Failure Curve



Best Practices for Avoidance of Initial Start-Up/Run-In Failure

- Hydraulic fluid and components should be cleaned and certified to the appropriate ISO 4406 level prior to installation. Many OEMs have established corporate cleanliness specifications for pre-installed components, which have proven useful in minimizing installation run-in failures.
- System should be flushed with a remote filter cart, where possible. Recommended practice is to use filtration rated at one-third of system filtration specifications. Attempting to flush system using shop air is usually counterproductive, since ambient air may introduce more contaminants than are eliminated.
- High-pressure filtration, non-bypass, high-collapse elements with condition indicators should be used to minimize valve inlet-side contamination.
- O-ring type fittings should be used. Never use tapered (i.e., NPTF) threads or thread sealant. Lubricate connectors with clean system oil. Do not grease.
- Purge all air and water from the system. Difficult-to-prime components (e.g., suction lines, valve wet-tube assemblies, etc.) should be located below the reservoir oil level.
- Protect small orifices with screens or other means to catch the "rocks" often generated at startup.

Best Practices for Proper Maintenance of Mature Hydraulic Systems

- Treat every major rebuilding effort involving significant system intrusion as a "run-in" as described previously.
- Continuous use of high-pressure filtration, non-bypass, high-collapse elements with condition indicators.
- Return line filtration to clean oil of contaminants introduced through lines and actuators. Return line filters with beta ratios over 200 are typically a lower cost way to clean systems, with larger effective filter area and dirt-holding capacity.
- Regular oil analysis to monitor cleanliness and damaging water or air ingress. Studies indicate that up to 20% of component failures in hydraulic systems are the result of corrosion caused by free or dissolved water and/or entrained air.
- Typical 210 bar (3000 psi) valves are designed with clearances (adjusting for concentricity, lap, etc.) of 4 to 10 micron nominal per side diametrical clearances. Abrasive wear will be mostly generated by particles in this size range. According to Pall Corp., 50% of component failures are due to wear induced by abrasion particles at or near this "dynamic clearance".
- Regular inspections of actuator seals, reservoir filler-breathers, and other system entry points.

Minimum Filtration vs. Extended Life Filtration

- HydraForce laboratory and production test stands are installed with filtration capable to 14/13/11, at beta ratios over 200. It is well-established that the proper function and life-expectancy of a typical hydraulic system correlate closely with levels of contamination. With "Extended Life" filtration, as recommended herein, users of HydraForce products may expect to achieve the "million cycle" life, as designed-in to virtually all of our products and validated at the good filtration levels used on our life cycle test stands. To be sure, other factors affect product life, however good filtration is the best method to extend the life of any hydraulic component.
- Failure to provide and maintain required "Minimum Filtration" levels may result in premature malfunction or failure.

Type of System/Valve	Minimum Filtration ISO 4406:1999 SAE J1165 4µm / 6µm / 14µm	Recommended Filtration for Extended Product life 4µm / 6µm / 14µm
High performance systems; high operating pressures at 210 to 350 bar (3000 to 5000 psi); proportional controls, high-cycle applications, etc.	18/16/13	15/13/11
General industrial and mobile equipment operating at pressures to 210 bar (3000 psi); spool-type valves, valves with pilot orifices, etc.	20/18/14	17/15/13

Cartridge Installation & Torque Values



WARNING

READ THIS DOCUMENT BEFORE INSTALLING OR USING HYDRAFORCE PRODUCTS.

IMPROPER SELECTION, IMPROPER USE, USE BY ANYONE OTHER THAN TRAINED USERS HAVING APPROPRIATE TECHNICAL AND MECHANICAL EXPERTISE OR FAILURE OF HYDRAFORCE PRODUCTS OR RELATED ITEMS RESULTING THEREFROM CAN CAUSE DAMAGE TO EQUIPMENT OR PROPERTY, SERIOUS PERSONAL INJURY, OR DEATH.

Before proceeding with cartridge valve installation, please read the SAFETY INFORMATION on page 0.000.1.

Here are some guidelines for installation of HydraForce cartridges, coils, and housings, including tables of torque settings by model number.

CARTRIDGE VALVE INSTALLATION

Step 1

Remove the cartridge from packing and inspect to ensure that no external contaminant is present.

Step 2

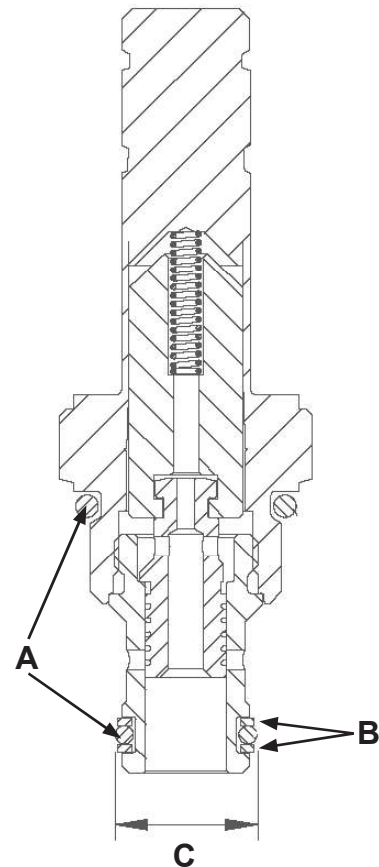
Inspect the O-rings (A) to ensure there is no damage, such as cuts or nicks.

Be sure O-rings and back-up rings (B) are correctly positioned.

NOTE: The O-ring should always be placed toward the higher pressure port or between double back-up rings on bi-directional valves. See page 8.650.1 for O-ring installation.

Check to ensure all back-up rings fit tightly within the O-ring groove. They should not extend farther than the O-rings. **If they are sticking out, squeeze them back into the groove.**

See illustration. All seals should seat in the groove as indicated in figure C.



- A. O-rings
- B. Back-up rings
- C. Seals should not extend past diameter "C"

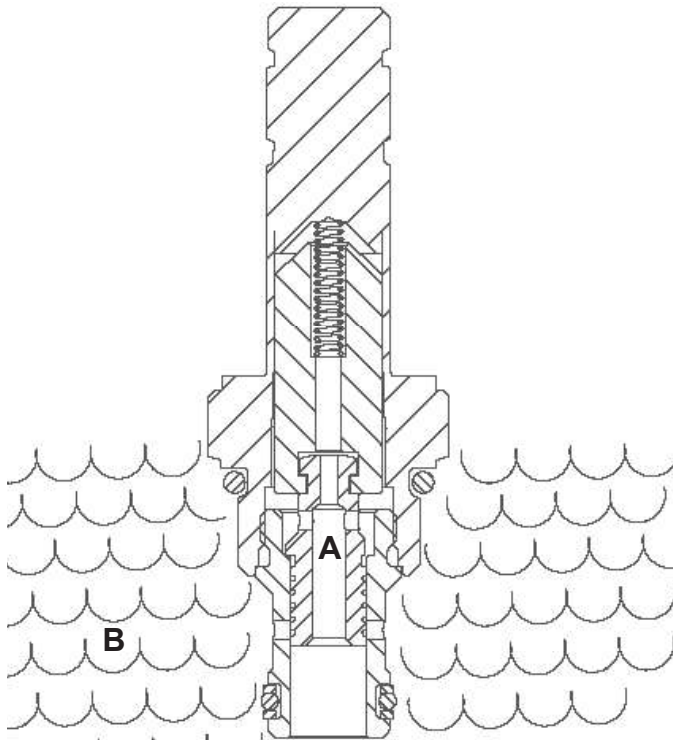
Cartridge Installation & Torque Values

Step 3

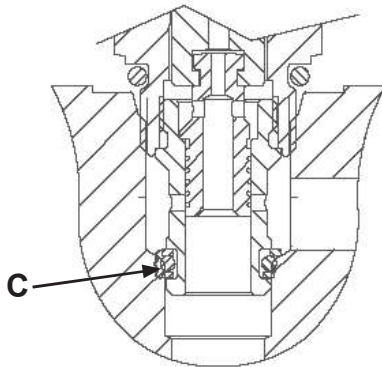
Before installing the cartridge, lubricate all seals (O-rings and back-up rings) with a small amount of the same oil that is used in the application.

To lubricate the seals, immerse the hydraulic portion of the cartridge (A) in oil (B). This will allow the cartridge and seals to easily slide into the cavity.

If the seals are too dry, the back-up rings could spin out of the cage groove (C) and cause seal damage. The diagram shows the location of the O-ring groove (C) and where the back-up ring could extrude.



A. Cartridge (Hydraulic Portion) Immersed
B. Hydraulic Oil

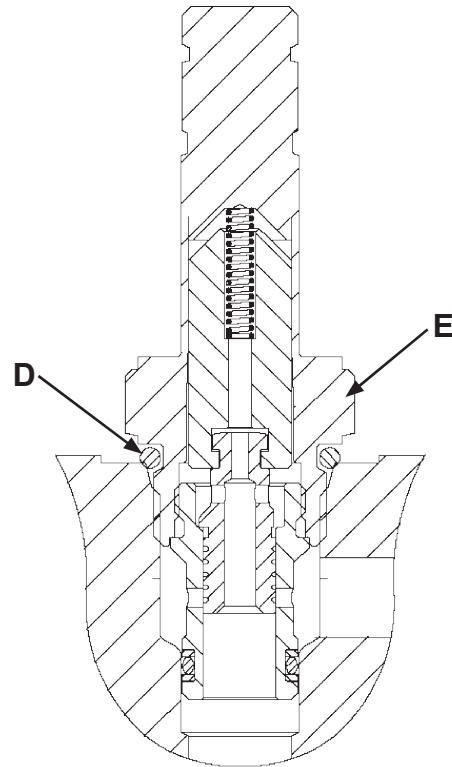


C. Cage Groove (Back-up Ring Could Extrude Here)

Step 4

It is important to install the cartridge (valve) into the cavity correctly. **Insert the cartridge into the cavity and tighten by hand in a clockwise manner.**

You should be able to screw it in with little resistance up to the O-ring (D) and below the hex portion of the valve stem (E). See illustration.



Cartridge Installed in Cavity (Before Tightening)

D. O-ring
E. Hex Portion of Valve Stem

Cartridge Installation & Torque Values

Step 5

Continue to screw in the cartridge with a torque wrench and tighten to the specified torque.

See the Cartridge Installation Torque Table on page 9.020.6. If your valve is not listed, refer to the dimensional drawing on the Catalog page for the specific valve model.

It is important to use the specified torque for each valve to ensure optimal performance of the cartridge.

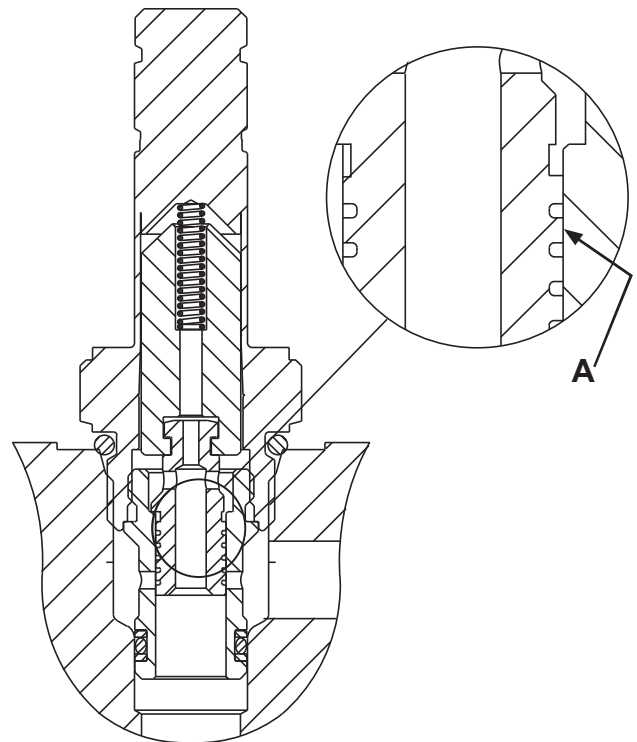
If the valve is tightened above the specified torque value, it may cause the spool or poppet to stick. This occurs because overtightening the cartridge can deform or collapse the inside of the cage, as shown in the diagram at right (A).

COIL INSTALLATION

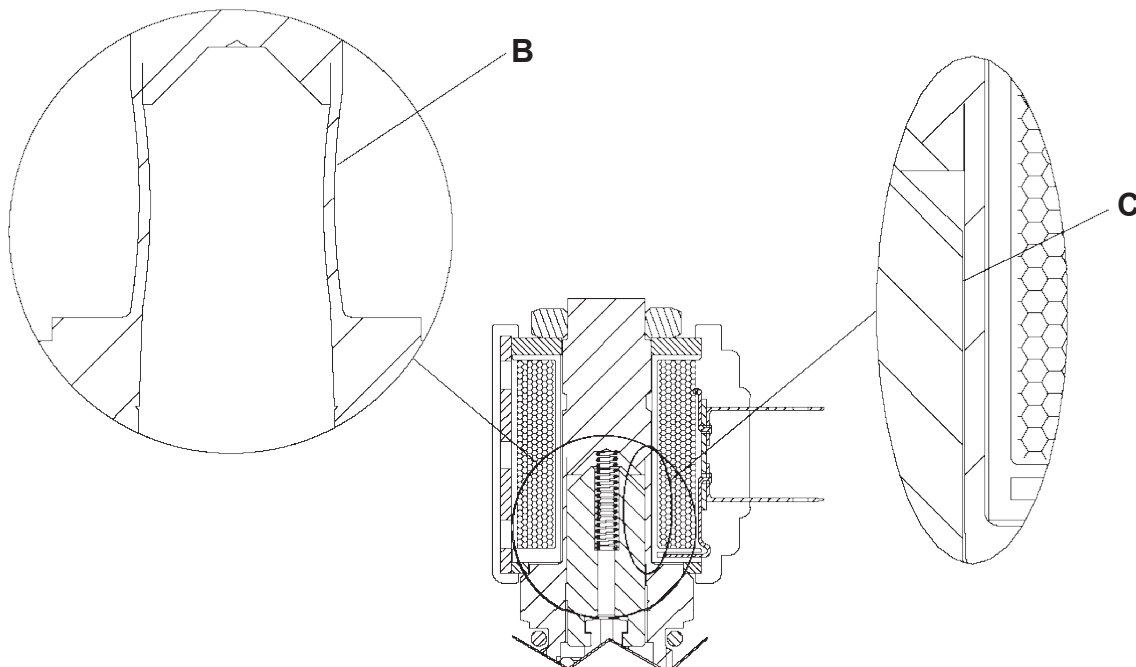
It is important to use the specified torque when tightening the coil nuts. For example, **if the nut is tightened above the specification on the 08, 60, 68, 80 size 2 position actuators, the stainless steel tube could stretch.**

The stretching causes the inside of the tube around the plunger to collapse (B), which could cause the plunger to stick in the energized or de-energized position (C).

This is shown in the diagram below.



Cartridge Installed in Cavity (After Tightening)
A. Spool Could Bind Here



Effects of Over-Tightening the Coil Nut

B. The middle of the tube stretches and collapses inward.

C. When the tube (B) is stretched, it squeezes the plunger (B) here.

Cartridge Installation & Torque Values

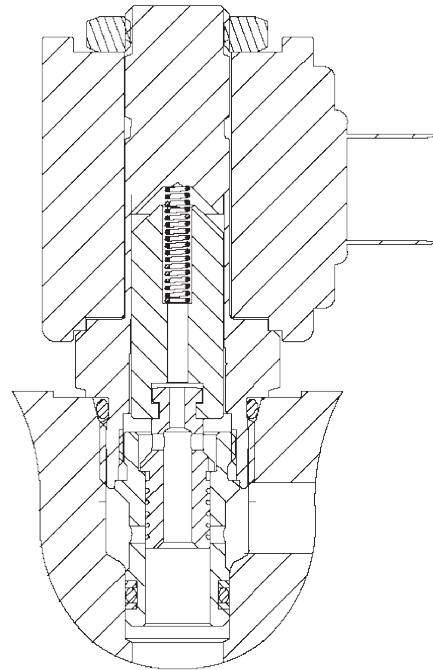
COIL INSTALLATION continued

If the valve uses a single coil, slide the coil over the valve stem. Tighten the coil nut to the specified torque. See the specifications in the Coil Nut Installation Torque Table on page 9.020.6.

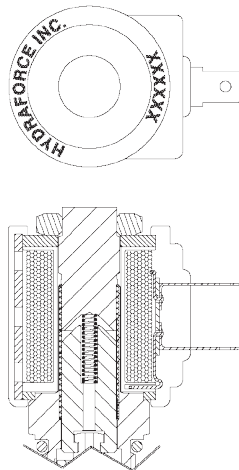
If the valve requires two coils, install them separately. Slide the first coil over the valve stem. Place the washer on top of first coil, then install second coil. Finally, install and tighten the coil nut to the specified torque.

It is important to install coils correctly to ensure they operate as designed. **If a coil is installed upside down, the magnetic flux path will be weak and will not be able to shift the spool or poppet.** See diagram showing correct and incorrect coil installation.

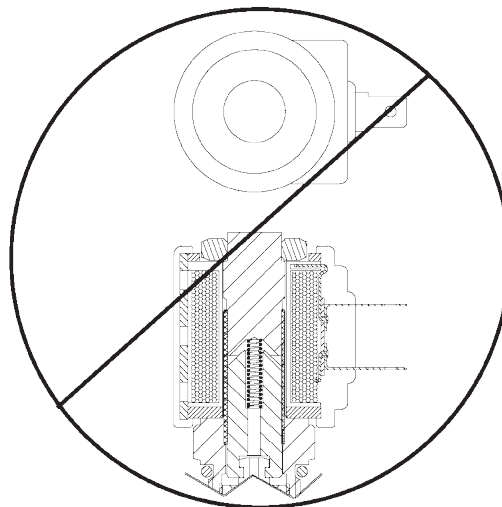
To ensure the coil is right side up, verify that the HydraForce imprint on the coil is facing upward.



Cartridge with Single Coil Installed



Correct Coil Installation



Incorrect Coil Installation

HOUSINGS

Step 1

Verify correct plumbing of housing by referring to specific product catalog pages for port logic.

Step 2

Inspect cavity for burrs or other machining irregularities which could damage O-rings during installation.

If separation from the mounting surface is required, refer to page 8.250.1 for panel mount spacer plates.

Cartridge Installation & Torque Values

Cartridge Installation Torque

Listed in alpha-numeric order by valve model number - refer to Catalog if your valve's torque setting is not listed here. Source: EGN111170

Model	Ft-lbs	Nm	Model	Ft-lbs	Nm	Model	Ft-lbs	Nm
BV10	24-26	32.6-35.4	EV10	24-26	32.6-35.4	MD10	24-26	32.6-35.4
CB10	24-26	32.6-35.4	EV12	33-37	44.7-50.2	MP08	19-21	25.8-28.5
CP42-M4X	65-75	88.4-102	EV16	46-54	63.4-73.2	MP10	24-26	32.6-35.4
CR08	19-21	25.8-28.5	EV20	65-75	88.1-101.7	MP58	20	27.4
CR10	24-26	32.6-35.4	EV58-34	19-21	25.8-28.5	MR10	24-26	32.6-35.4
CV04-20	12-14	16.3-19	FC08	19-21	25.8-28.5	MV08	19-21	25.8-28.5
CV04-B20	4-5	5.4-6.8	FC10	24-26	32.6-35.4	NV08	19-21	25.8-28.5
CV06	7-8	9.5-10.8	FC12	33-37	44.7-50.2	NV10	24-26	32.6-35.4
CV08	19-21	25.8-28.5	FD10	24-26	32.6-35.4	NV12	33-37	44.7-50.2
CV10	24-26	32.6-35.4	FD12	33-37	44.7-50.2	PC08	19-21	25.8-28.5
CV12	33-37	44.7-50.2	FD16	46-54	63.4-73.2	PC10	24-26	32.6-35.4
CV16	46-54	63.4-73.2	FD50	46-54	63.4-73.2	PD10	24-26	32.6-35.4
CV42	110-130	150-177	FD52	73-77	99-104.4	PD12	33-37	44.7-50.2
CV50-20	24-26	32.6-35.4	FD56	98-101.7	133-138	PD16	46-54	63.4-73.2
DC08	19-21	25.8-28.5	FR08	19-21	25.8-28.5	PD42	65-75	88.1-101.7
DC10	24-26	32.6-35.4	FR10	24-26	32.6-35.4	PE12	33-37	44.7-50.2
EC08	19-21	25.8-28.5	FR12	33-37	44.7-50.2	PE16	46-54	63.4-73.2
EC10	24-26	32.6-35.4	FR16-20F	98-101.7	133-138	PE42-S67X	65-75	88.1-101.7
EC12-30, -32, -34, -35, -40	33-37	44.7-50.2	FR16-30F	46-54	63.4-73.2	PR08	19-21	25.8-28.5
EC12-42, -43	73-77	99-104.4	FR50-20F, -23, -28	33-37	44.7-50.2	PR10	24-26	32.6-35.4
EC16-32, -34, -40	46-54	63.4-73.2	F56-44, -45	98-102	133-138	PR12	33-37	44.7-50.2
EC16-42, -43	98-101.7	132.8-138.3	FRRV10	24-26	32.6-35.4	PR50	24-26	32.6-35.4
EC42-M40, -M42, -M43	65-75	88.1-101.7	FRRV12	33-37	44.7-50.2	PR58	24-26	32.5 - 35.3
EC50	33-37	44.7-50.2	HCV16-20	195-205	265-278	PRES50-30	50-55	67.8-74.6
ED56-42, -43	98-102	132.8-138.2	HCV42-M20			PS08-30	19-21	25.8-28.5
ECR16	46-54	63.4-73.2	Aluminum	220-230	298-311	PS10	24-26	32.6-35.4
EHPR01-33	11-12	14.9-16.3	Ductile Iron	290-300	394-420	PS50	25	33.9
EHPR08	19-21	25.8-28.5	HEC32-43	490-510	665-690	PV08	19-21	25.8-28.5
EHPR98	0.9-1.1	1.2-1.5	HEP16-S35	195-205	265-278	PV16	46-54	63.4-73.2
EP08	19-21	25.8-28.5	HP10	24-26	32.6-35.4	PV42	65-75	88.1-101.7
EP10	24-26	32.6-35.4	HP16	46-54	63.4-73.2	PV70	24-26	32.6-35.4
EP12	33-37	44.7-50.2	HPD16-S5	220-230	298-311	PV72	33-37	44.7-50.2
EP16	46-54	63.4-73.2	HS10	24-26	32.6-35.4	PV76	46-54	63.4-73.2
EP20	65-75	88.1-101.7	HS50-42, -43	24-26	32.5-35.4	RV08	19-21	25.8-28.5
EPFR16	46-54	63.4-73.2	HS52-42, -43	33-37	44.7-50.2	RV10	24-26	32.6-35.4
EPFR20	65-75	88.1-101.7	HSP16-20	190-210	258-285	RV12	33-37	44.7-50.2
EPFR50-S35	24-26	32.6-35.4	HSV10	75-85	101.7-115	RV16	46-54	63.4-73.2
EPFR52-S35	33-37	44.7-50.2	KS10	24-26	32.6-35.4	RV50	24-26	32.6-35.4
EPFR58-35	19-20	25.8-28.5	LS04-B30	4-5	5.4-6.8	RV52	33-37	44.7-50.2
ER10	24-26	32.6-35.4	LS08-30	19-21	25.8-28.5	RV56	46-54	63.4-73.2
ER12	33-37	44.7-50.2	LS10	24-26	32.6-35.4	RV58	19-21	25.8-28.5
			LS50	24-26	32.6-35.4	RVCV56	147-153	199.3-207.4

Continued on next page ...

Cartridge Installation & Torque Values

Cartridge Installation Torque

Listed in alpha-numeric order by valve model number - refer to Catalog if your valve's torque setting is not listed here. Source: ECN111170

Model	Ft-lbs	Nm	Model	Ft-lbs	Nm	Model	Ft-lbs	Nm
BV10	24-26	32.6-35.4	EV10	24-26	32.6-35.4	MD10	24-26	32.6-35.4
CB10	24-26	32.6-35.4	EV12	33-37	44.7-50.2	MP08	19-21	25.8-28.5
CP42-M4X	65-75	88.4-102	EV16	46-54	63.4-73.2	MP10	24-26	32.6-35.4
CR08	19-21	25.8-28.5	EV20	65-75	88.1-101.7	MP58	20	27.4
CR10	24-26	32.6-35.4	EV58-34	19-21	25.8-28.5	MR10	24-26	32.6-35.4
CV04-20	12-14	16.3-19	FC08	19-21	25.8-28.5	MV08	19-21	25.8-28.5
CV04-B20	4-5	5.4-6.8	FC10	24-26	32.6-35.4	NV08	19-21	25.8-28.5
CV06	7-8	9.5-10.8	FC12	33-37	44.7-50.2	NV10	24-26	32.6-35.4
CV08	19-21	25.8-28.5	FD10	24-26	32.6-35.4	NV12	33-37	44.7-50.2
CV10	24-26	32.6-35.4	FD12	33-37	44.7-50.2	PC08	19-21	25.8-28.5
CV12	33-37	44.7-50.2	FD16	46-54	63.4-73.2	PC10	24-26	32.6-35.4
CV16	46-54	63.4-73.2	FD50	46-54	63.4-73.2	PD10	24-26	32.6-35.4
CV42	110-130	150-177	FD52	73-77	99-104.4	PD12	33-37	44.7-50.2
CV50-20	24-26	32.6-35.4	FD56	98-101.7	133-138	PD16	46-54	63.4-73.2
DC08	19-21	25.8-28.5	FR08	19-21	25.8-28.5	PD42	65-75	88.1-101.7
DC10	24-26	32.6-35.4	FR10	24-26	32.6-35.4	PE12	33-37	44.7-50.2
EC08	19-21	25.8-28.5	FR12	33-37	44.7-50.2	PE16	46-54	63.4-73.2
EC10	24-26	32.6-35.4	FR16-20F	98-101.7	133-138	PE42-S67X	65-75	88.1-101.7
EC12-30, -32, -34, -35, -40	33-37	44.7-50.2	FR16-30F	46-54	63.4-73.2	PR08	19-21	25.8-28.5
EC12-42, -43	73-77	99-104.4	FR50-20F, -23, -28	33-37	44.7-50.2	PR10	24-26	32.6-35.4
EC16-32, -34, -40	46-54	63.4-73.2	F56-44, -45	98-102	133-138	PR12	33-37	44.7-50.2
EC16-42, -43	98-101.7	132.8-138.3	FRRV10	24-26	32.6-35.4	PR50	24-26	32.6-35.4
EC42-M40, -M42, -M43	65-75	88.1-101.7	FRRV12	33-37	44.7-50.2	PR58	24-26	32.5 - 35.3
EC50	33-37	44.7-50.2	HCV16-20	195-205	265-278	PRES50-30	50-55	67.8-74.6
ED56-42, -43	98-102	132.8-138.2	HCV42-M20			PS08-30	19-21	25.8-28.5
ECR16	46-54	63.4-73.2	Aluminum	220-230	298-311	PS10	24-26	32.6-35.4
EHPR01-33	11-12	14.9-16.3	Ductile Iron	290-300	394-420	PS50	25	33.9
EHPR08	19-21	25.8-28.5	HEC32-43	490-510	665-690	PV08	19-21	25.8-28.5
EHPR98	0.9-1.1	1.2-1.5	HEP16-S35	195-205	265-278	PV16	46-54	63.4-73.2
EP08	19-21	25.8-28.5	HP10	24-26	32.6-35.4	PV42	65-75	88.1-101.7
EP10	24-26	32.6-35.4	HP16	46-54	63.4-73.2	PV70	24-26	32.6-35.4
EP12	33-37	44.7-50.2	HPD16-S5	220-230	298-311	PV72	33-37	44.7-50.2
EP16	46-54	63.4-73.2	HS10	24-26	32.6-35.4	PV76	46-54	63.4-73.2
EP20	65-75	88.1-101.7	HS50-42, -43	24-26	32.5-35.4	RV08	19-21	25.8-28.5
EPFR16	46-54	63.4-73.2	HS52-42, -43	33-37	44.7-50.2	RV10	24-26	32.6-35.4
EPFR20	65-75	88.1-101.7	HSP16-20	190-210	258-285	RV12	33-37	44.7-50.2
EPFR50-S35	24-26	32.6-35.4	HSV10	75-85	101.7-115	RV16	46-54	63.4-73.2
EPFR52-S35	33-37	44.7-50.2	KS10	24-26	32.6-35.4	RV50	24-26	32.6-35.4
EPFR58-35	19-20	25.8-28.5	LS04-B30	4-5	5.4-6.8	RV52	33-37	44.7-50.2
ER10	24-26	32.6-35.4	LS08-30	19-21	25.8-28.5	RV56	46-54	63.4-73.2
ER12	33-37	44.7-50.2	LS10	24-26	32.6-35.4	RV58	19-21	25.8-28.5
			LS50	24-26	32.6-35.4	RVCV56	147-153	199.3-207.4

Continued on next page . . .

Cartridge Installation & Torque Values

Continued from previous page.

Cartridge Installation Torque					
Model	Ft-lbs	Nm	Model	Ft-lbs	Nm
RVD50	47-53	63.7-71.9	SV58	19-21	25.8-28.5
SF08	19-21	25.8-28.5	SV80-61	24-26	32.6-35.4
SF20-22, -23	65-75	88.4-101.7	SV88-20	19-21	25.8-28.5
SL08	19-21	25.8-28.5	SV98	2-3	3-4
SP08-20, -21, -22, -24, -25, -46R, -47C, CL, D, DL	19-21	25.8-28.5	SVCL10-30, -32	33-37	44.7-50.2
SP08-57D	25-30	33.9-40.7	SVCV08	19-21	25.8-28.5
SP08-58D	19-21	25.8-28.5	SVCV12	33-37	44.7-50.2
SP10-20, -21, -24	33-37	44.7-50.2	SVRV10	24-26	32.7-35.4
SP10-46R, -47C&D, -57C&D, -58C&D	24-26	32.6-35.4	SVRV12	33-37	44.7-50.2
SP12	33-37	44.7-50.2	SV80	24-26	32.6-35.4
SP16	46-54	63.4-73.2	SV98	19-21	25.8-28.5
SPCL10	24-26	32.7-35.4	TR04-B20	4-5	5.4-6.8
SPCL16	46-54	63.4-73.2	TS08	19-21	25.8-28.5
SV07	19-21	25.8-28.5	TS10	24-26	34-36.7
SV08	19-21	25.8-28.5	TS12	33-37	44.7-50.2
SV10	24-26	32.7-35.4	TS38-20, -21	19-21	25.8-28.5
SV12-20, -21, -22 -23, -28, -29	33-37	44.7-50.2	TS58-20	24-26	32.6-35.4
SV12-24, -25, -31 -33, -34, -40, -41, -42, -60	52-60	70.7-81.3	TS80-30	24-25	32.6-33.9
SV16	46-54	63.4-73.2	TS90	25-27	34-36.7
SV20	65-75	88.1-101.7	TS98-30, -31	24-25	32.6-33.9
SV38	19-21	25.8-28.5	UP10	25-27	34-37
			ZL70	24-27	32.6-36.7
			ZL72	33-37	44.7-50.2
			ZL76	46-54	63.4-73.2

Drop-In Valves Mounting Screw Torque		
Model	Ft-lbs	Nm
SV98-T39, T40	2.2-3	3-4
TS98-T34	2.2-3	3-4
EHPR98-T33, T35, T38	0.9-1.1	1.2-1.5

Coil Nut Installation Torque		
Model	Ft-lbs	Nm
EHPR01, 08-33	5-7	6.8-9.5
CR08, CR10	5-7	6.8-9.5
FC10, FC12	5-7	6.8-9.5
FR10, FR12	5-7	6.8-9.5
KS10	5-7	6.8-9.5
NV08, NV10, NV12	5-7	6.8-9.5
PR08, PR10, PR50	5-7	6.8-9.5
PS08, PS10, PS50	5-7	6.8-9.5
PV08	5-7	6.8-9.5
PV70, PV72	10-12	13.6-16.3
RV	5-7	6.8-9.5
SF08, SL08	4-5	5.4-6.8
SV07-31	4-5	5.4-6.8
SV08, SV80, SV98	4-5	5.4-6.8
SV08-W, SV80-W, SV98-W with D-coil	5	6.8
SV08, SV80, SV98 with E-coil	4-5	5.4-6.8
SV10, SV16, SV38, SV58 with D-coil	5-7	6.8-9.5
SV10W, SV16W, SV38W, SV58W	9-10	12.2-13.6
SV10, SV16, SV38, SV58, w/E-Coil	5-7	6.8-9.5
SV12-20, -21, -22 -23 w/D-Coil	5-7	6.8-9.5
SV12-20W, -21W -22W, -23W	7-10	9.5-13.6
SV12-20, -21, -22 -23 w/E-coil	7-10	9.5-13.6
SV12-24, -25, -3x, -4x	7-10	9.5-13.6
SV20-22, S38, S38M S39, S39P	4-5	5.4-6.8
TS08-20, -27	4-5	5.4-6.8
TS10, 12-26, 36	5-7	6.8-9.5
TS10, 12-27	4-5	5.4-6.8
TS38, 58-20	5-7	6.8-9.5
TS38-58-21	4-5	5.4-6.8
TS80, 98-30	5-7	6.8-9.5
TS90-98-31	5-7	6.8-9.5
UP10-30	5-7	6.8-9.5
ZL72	10-12	13.6-16.3

Temperature Considerations

Temperature and oil viscosity can affect valve performance. Here are some considerations:

Temperature and Viscosity

The temperature rating given for each cartridge should be considered a storage temperature range. In general, when the hydraulic system is operating at low temperatures the oil is higher viscosity and valve response may be slower than in warm oil conditions. Conversely, when the system is operating at extremely high temperatures the oil is lower viscosity and the viscous damping action will be reduced. This can result in valve instability and system noise.

Shifting in Low Temperatures

Some electrically-operated valves may not shift fully when the system voltage is below the nominal level in low-temperature, high-viscosity conditions. Please consult the factory for application assistance if you know your hydraulic system will be operating at either end of the temperature extreme.

Seal Choices

As per ASTM Standard D2000/SAE J200 Standard Buna N (standard) seals are designed for applications that operate within the -40°C to 100°C (-40° to 212°F) temperature range. Maximum temperature for optimum seal life is 107°C with reduced life if operated within the 107°C to 120°C range. Fluorocarbon (V) seals should be used for applications with an average temperature range between -26°C to 204°C (-15°F to 400°F). Polyurethane (P) seals should be used for applications with an average temperature range between -54°C to 104°C (-65°F to 225°F).

Equivalent Values & U.S./Metric Conversions

LENGTH

- 1 micron (μ) = 0.00004 inch (in.)
- 1 millimeter (mm) = 0.039 in.
- 1 centimeter (cm) = 0.3937 in.
- 1 decimeter (dm) = 0.3281 foot (ft.)
- 1 meter (m) = 39.37 in.
= 3.281 ft.
= 1.0937 yards (yds.)

AREA - SQUARE

- 1 square millimeter = 0.00155 square inch (sq. in.)
- 1 square centimeter = 0.155 sq. in.
- 1 square decimeter = 15.5 sq. in.
= 0.10764 square feet (sq. ft.)

AREA - CUBIC

- 1 cubic centimeter = 0.061 cubic inch (in.³)
= 0.0002642 U.S. liquid gallons
- 1 cubic decimeter = 61.023 in.³

LIQUID MEASURE

- 1 milliliter (ml) = 0.0338176 ounce (oz.)
- 1 deciliter (dl) = 3.381 oz.
- 1 liter (l) = 1.0569 quarts (qt.)
= 0.26417 gallon (gal.)
- 1 drop = 0.05 cubic centimeter (cc)
= 0.00169 oz.

WEIGHT

- 1 gram (g) = 0.0353 ounce (oz.)
- 1 kilogram (kg.) = 2.2046 pounds (lb.)
- 1 metric ton = 0.9842 U.S. ton

TEMPERATURE

- $^{\circ}\text{Celsius} = 5/9 (^{\circ}\text{Fahrenheit} - 32)$

FLOW - LIQUID

- 1 liter/minute (lpm) = 0.2642 U.S. gallon/minute (gpm)

FORCE

- 1 Newton (N) = 0.225 pound (lb.)

FREQUENCY

- 1 cycle/second (cps) = 1 Hertz (H)

ABSOLUTE VISCOSITY

- 1 centipoise (@ 0.9 specific gravity) = 5.35 SUS

POWER

- 1 kilowatt (kw) = 1.34 horsepower (HP)
- 1 horsepower (HP) = 33,000 foot-pounds (ft. lbs.)/minute
= 550 foot-pounds (ft. lbs.)/second
= 42.4 BTU/minute
= 746 watts

PRESSURE

- 1 bar = 14.5 pounds per square inch (psi) —
above atmospheric
= 33.8 foot water column
= 42 foot oil column
= 29.92 inches of mercury (in. Hg)
- 1 millimeter of mercury (mm Hg) = 0.03937 in. Hg —
below atmospheric
- 1 psi = 2.0416 in. Hg
= 27.71 in. water
- 1 foot column of water = 0.433 psi
- 1 foot column of oil = 0.390 psi

TORQUE

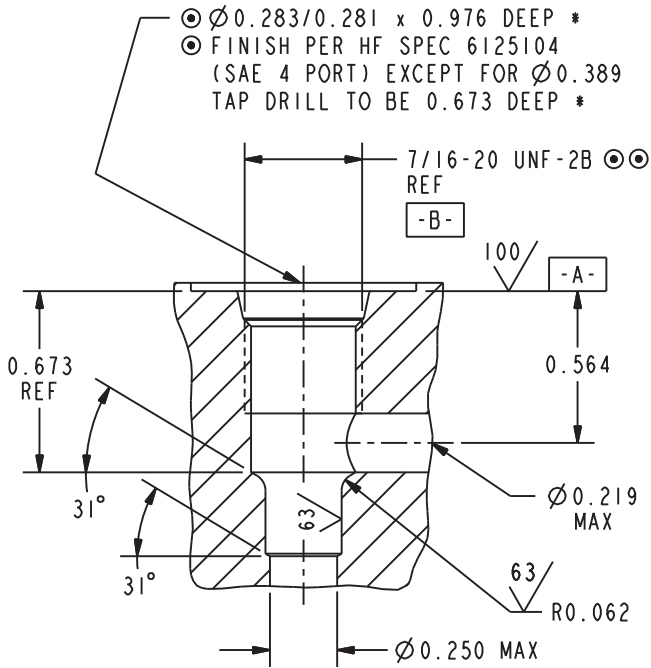
- 1 Newton-meter (Nm) = 0.7375621ft-lbs \approx 0.738
(Machinery's handbooks)
- 1 Newton-meter (Nm) = 8.8507542 lbs-in \approx 8.85 (x12in)

VELOCITY

- 1 meter per second (m/s) = 3.28 feet/second (fps)

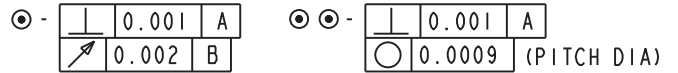
Series 04 Cartridge Cavities

VC04-2



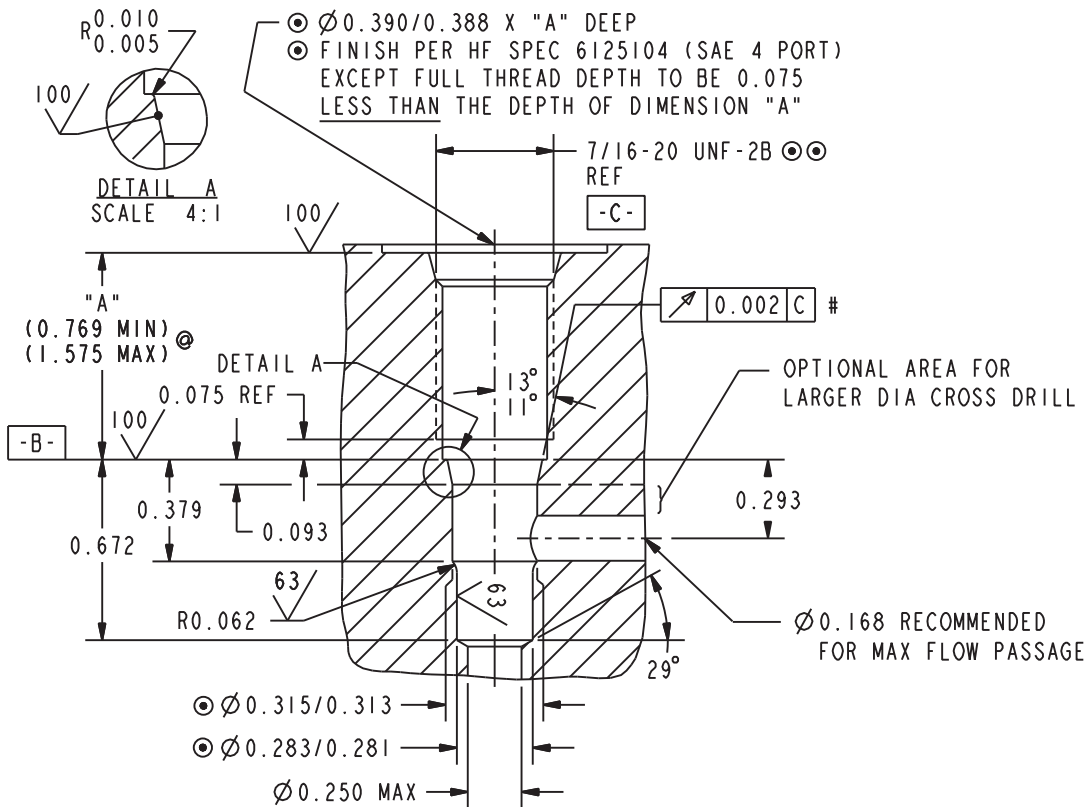
NOTES:

- FEATURES (EXCEPT FOR PILOT DRILL, CROSS DRILL AND SAE 4 PORT) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.



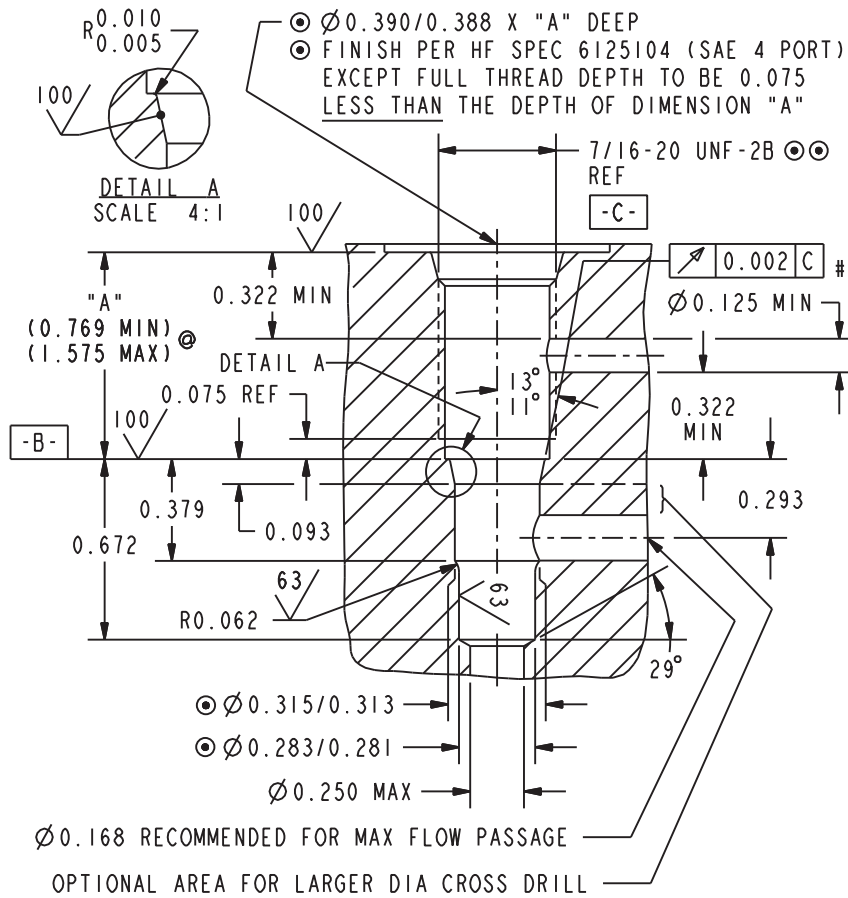
- * - DEPTHS ARE FROM DATUM -A- .
- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

VC04-B2



Series 04 Cartridge Cavities

VC04-B3



NOTES:

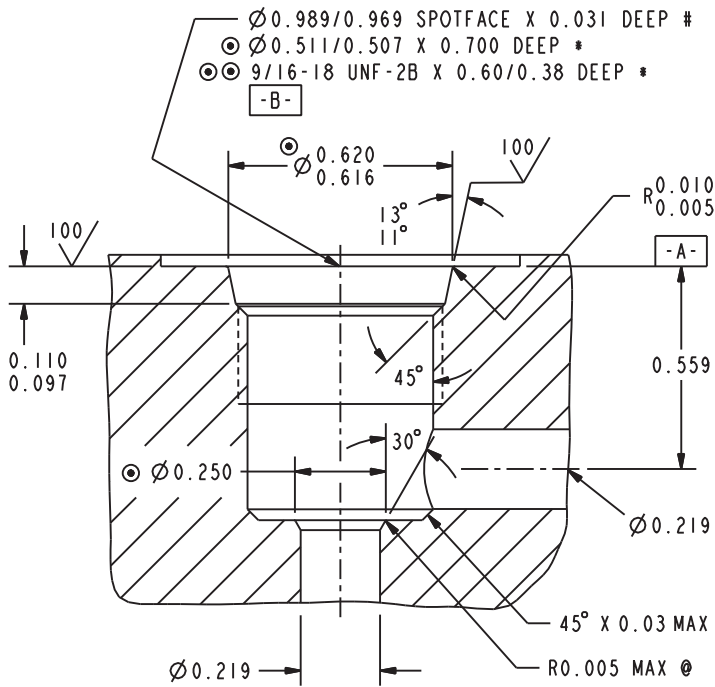
- THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL, CROSS DRILLS AND SAE 4 PORT) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.



- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.
- \odot - WITH HF FORM TOOLS AND USING 0.020/0.010 SPOTFACE DEPTH.
- # - THIS SURFACE IS A VALVE SEAT, IT MUST BE FREE OF NICKS AND TOOL MARKS.

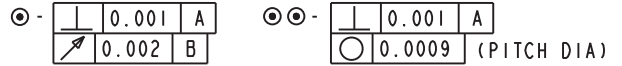
Series 06 Cartridge Cavities

VC06-1



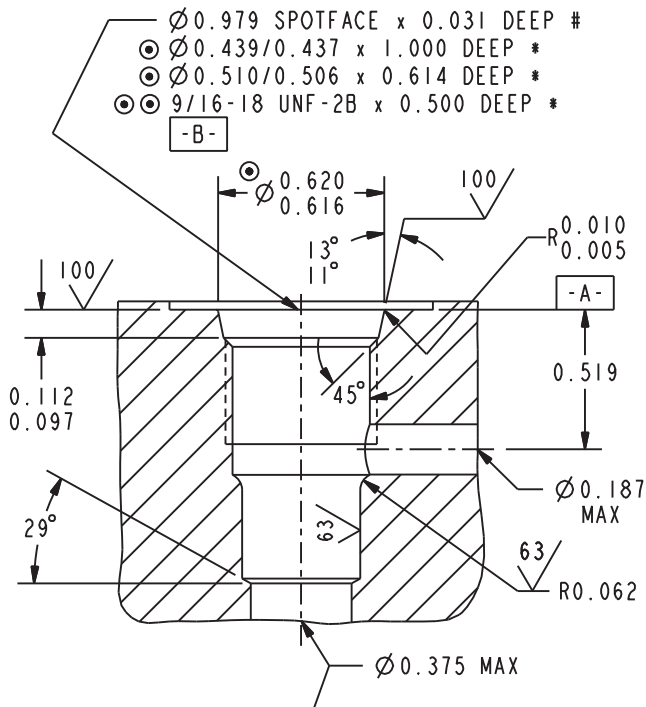
VC06-1

NOTES:



- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.
- @ - THIS SURFACE IS A VALVE SEAT. IT MUST BE FREE OF NICKS AND TOOL MARKS.

VC06-2



NOTE: CAVITY VARIATION 'A' **
 MINIMUM PILOT DRILL $\varnothing 0.375$ TO
 MINIMUM DEPTH OF 1.10 FROM DATUM -A-

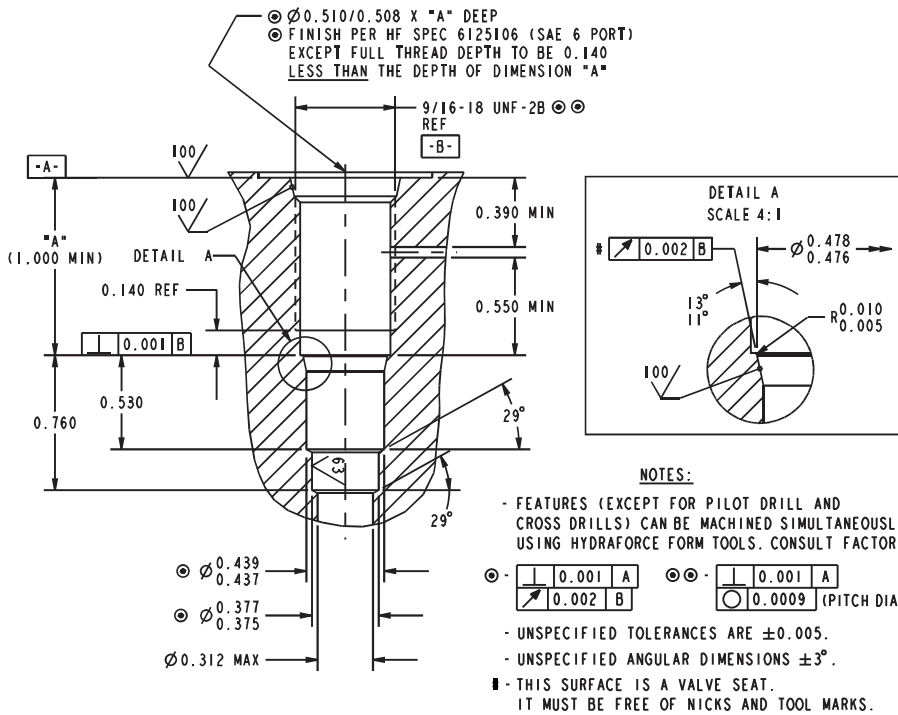
VC06-2

NOTES:

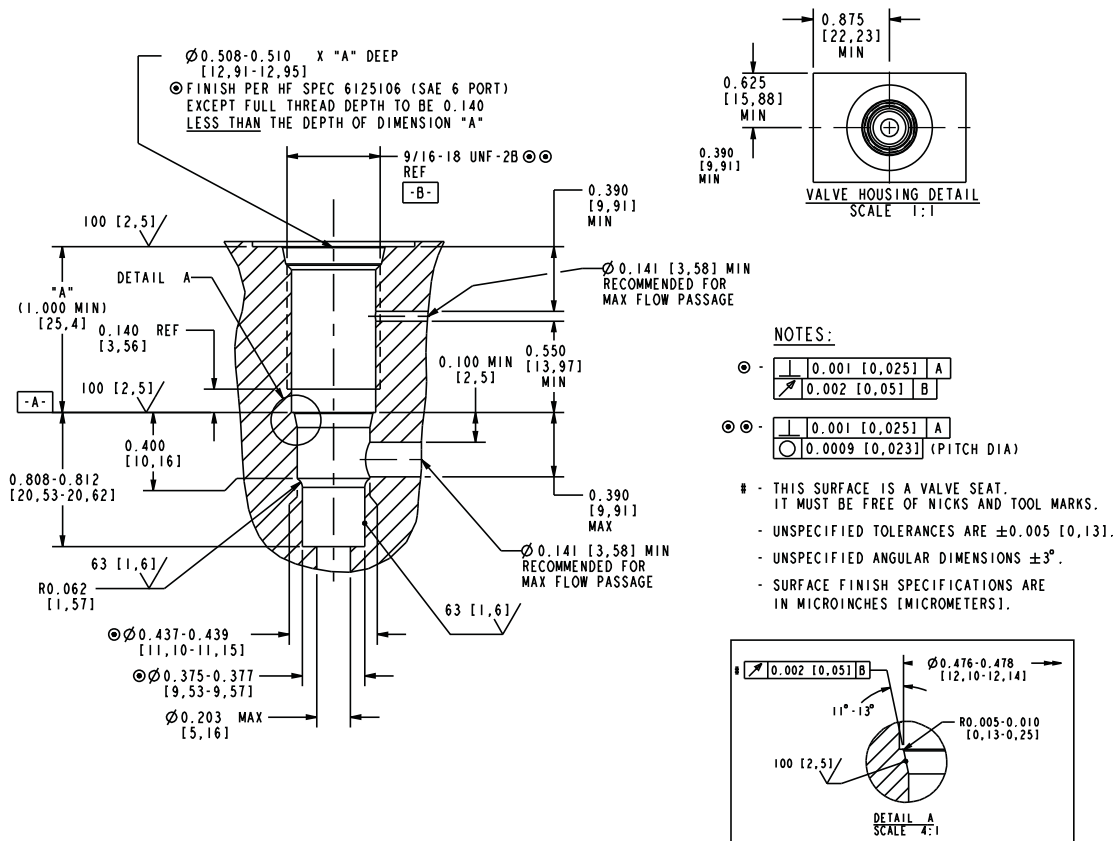
- FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.
- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.
- ** - FEATURES OF VARIATION 'A' ARE ONLY REQUIRED IF NOTED ON A SPECIFIC PRODUCT CATALOG PAGE.

Series 06 Cartridge Cavities

VC06-B2

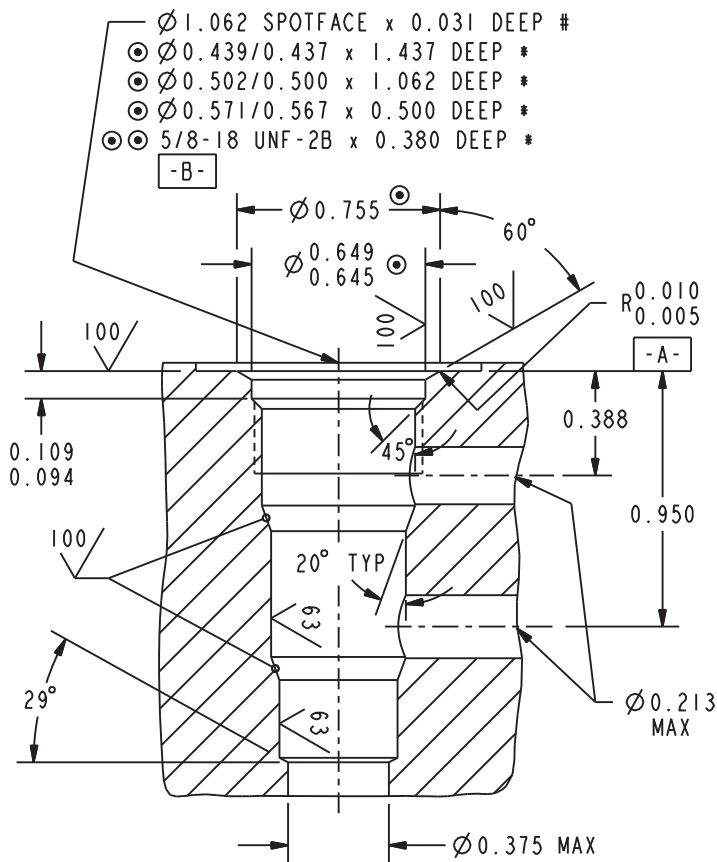


HVC06-B3



Series 07 Cartridge Cavities

VC07-3



NOTES:

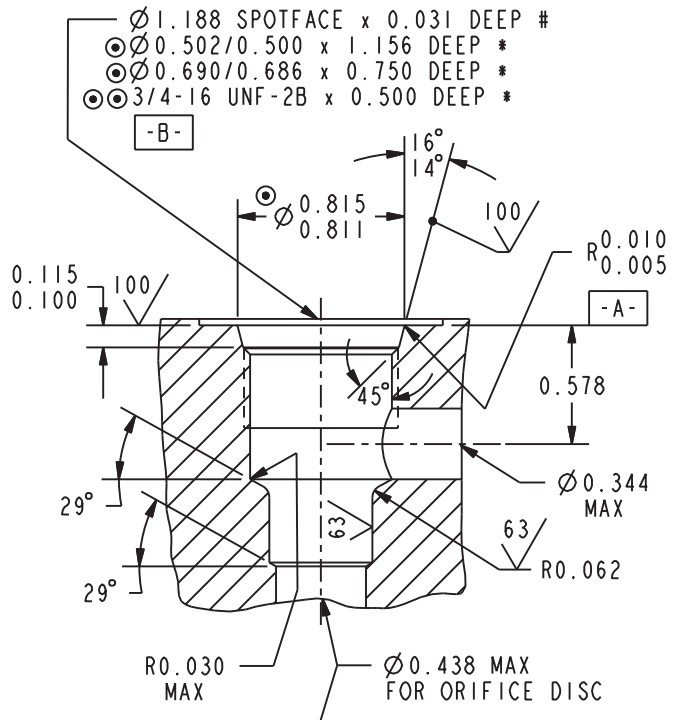
- THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

\odot -	0.001	A	$\odot \odot$ -	0.001	A
	0.002	B		0.0009	(PITCH DIA)

- * - DEPTHS ARE FROM DATUM **-A-** .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

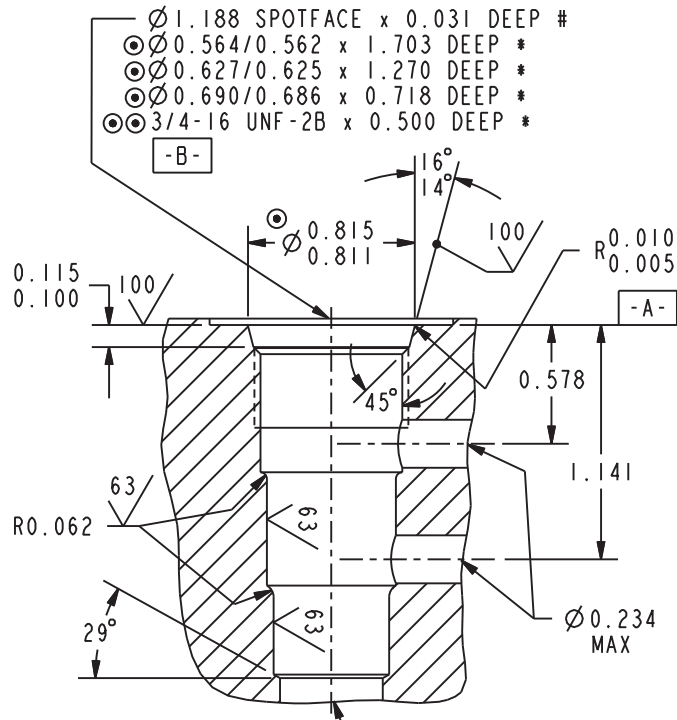
Series 08 Cartridge Cavities

VC08-2



NOTE:
 CAVITY VARIATION 'A' **
 PILOT DRILL $\varnothing 0.469$ MIN.
 REQUIRED TO MIN. DEPTH
 OF 1.32 FROM SPOTFACE

VC08-3



NOTE:
 CAVITY VARIATION 'A' **
 PILOT DRILL $\varnothing 0.500$ MIN
 REQUIRED TO MIN. DEPTH
 OF 1.81 FROM SPOTFACE

NOTES:

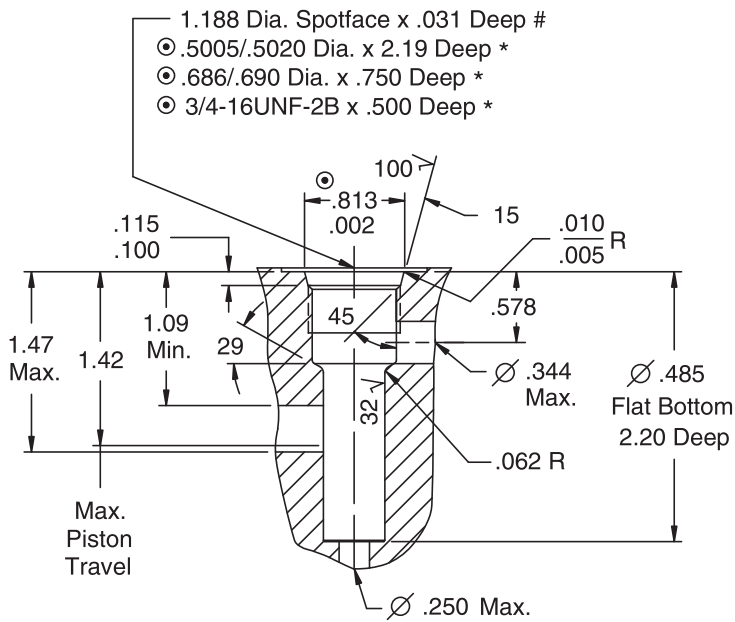
- THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

\odot	$\frac{\perp}{\nearrow}$	0.001	A	$\odot \odot$	$\frac{\perp}{\circ}$	0.001	A
	$\frac{\perp}{\nearrow}$	0.002	B		$\frac{\perp}{\circ}$	0.0009	(PITCH DIA)

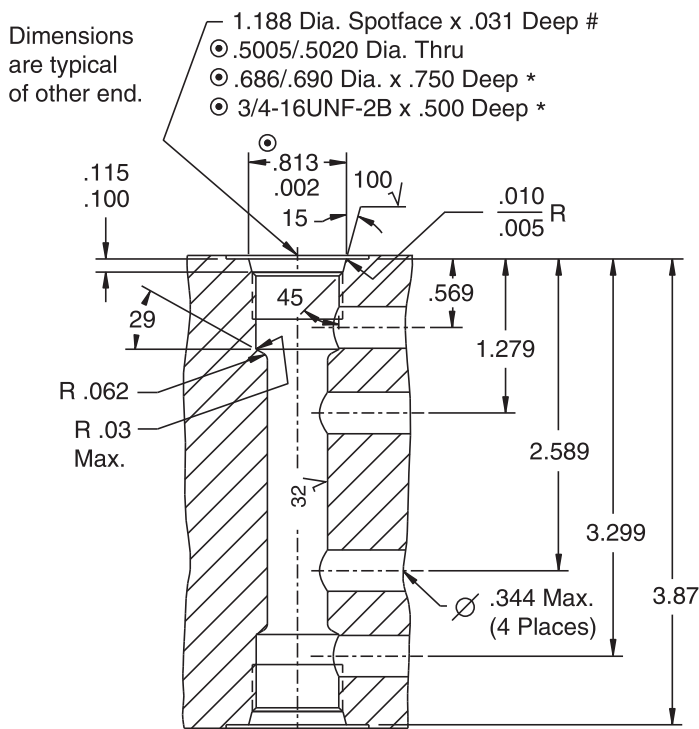
- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.
- ** - FEATURES OF VARIATION 'A' ARE ONLY REQUIRED IF NOTED ON A SPECIFIC PRODUCT CATALOG PAGE.

Series 08 Cartridge Cavities

VC08-PCV



VC08-DCV



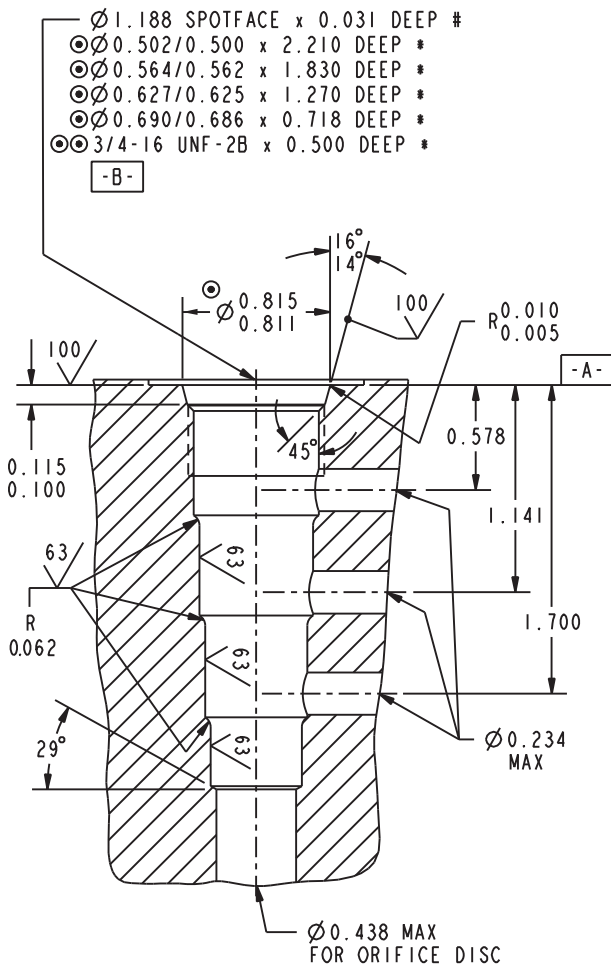
Notes:

- ◎ 1. These Diameters to be Concentric within .002 T.I.R. and Perpendicular to Spotface within .001 T.I.R.
- * 2. Depths are from Spotface.
- 3. Unspecified Tolerances are .005.
- # 4. Unless Otherwise Specified on Machining Drawing
- 5. All Dimensions shown in inches unless otherwise noted.

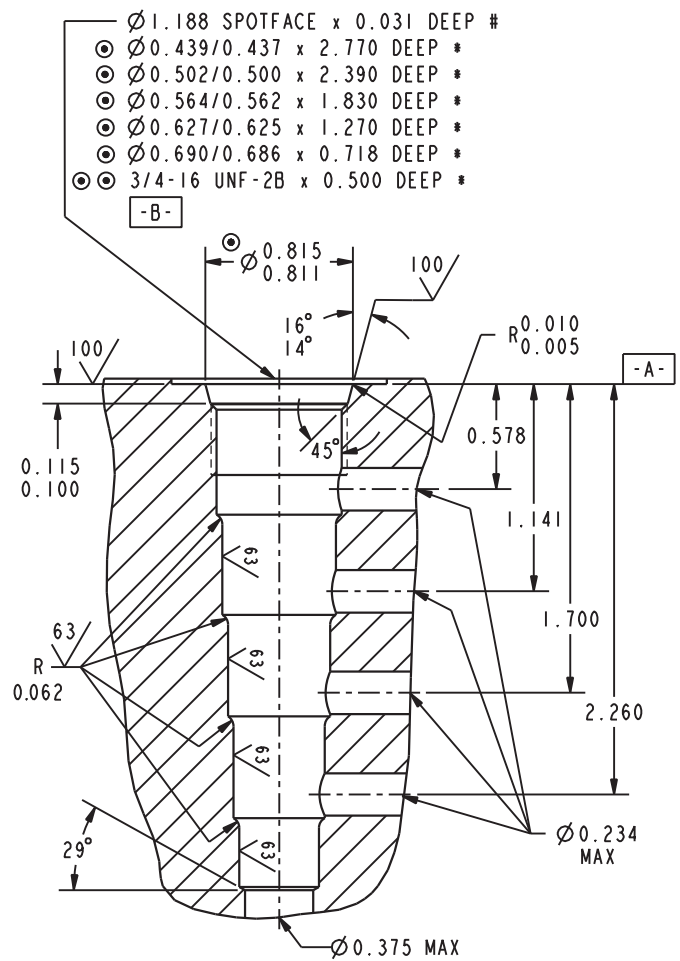
Cavity features (except for pilot drill and cross drills) can be machined simultaneously using HydraForce form tools. Consult factory.

Series 08 Cartridge Cavities

VC08-4



VC08-5



NOTES:

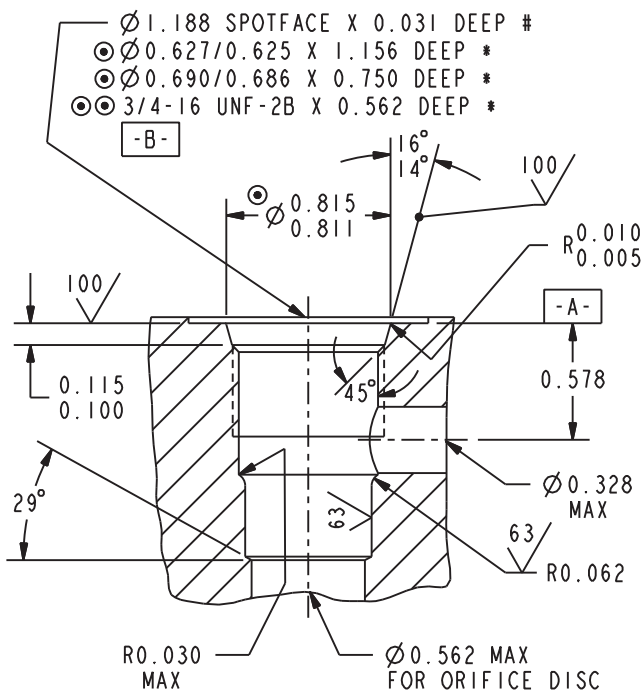
- THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

\odot - <table border="1"> <tr><td>0.001</td><td>A</td></tr> <tr><td>0.002</td><td>B</td></tr> </table>	0.001	A	0.002	B	$\odot \odot$ - <table border="1"> <tr><td>0.001</td><td>A</td></tr> <tr><td>0.0009</td><td>(PITCH DIA)</td></tr> </table>	0.001	A	0.0009	(PITCH DIA)
	0.001	A							
0.002	B								
0.001	A								
0.0009	(PITCH DIA)								

- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

Series 09 Cartridge Cavities

VC09-2



NOTES:

- THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.



- * - DEPTHS ARE FROM DATUM **-A-** .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

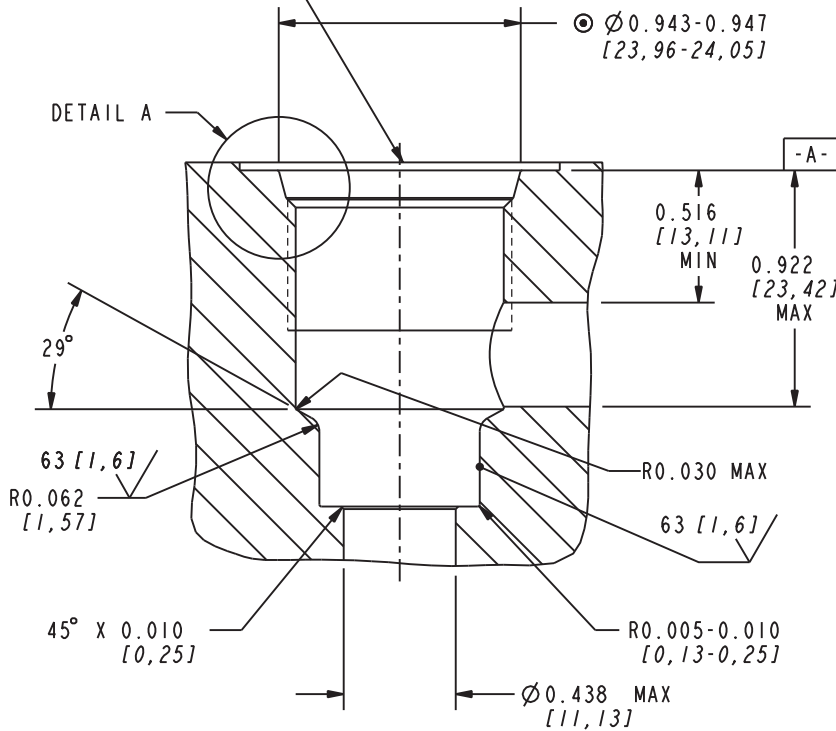
Series 10 Cartridge Cavities

HVC10-2

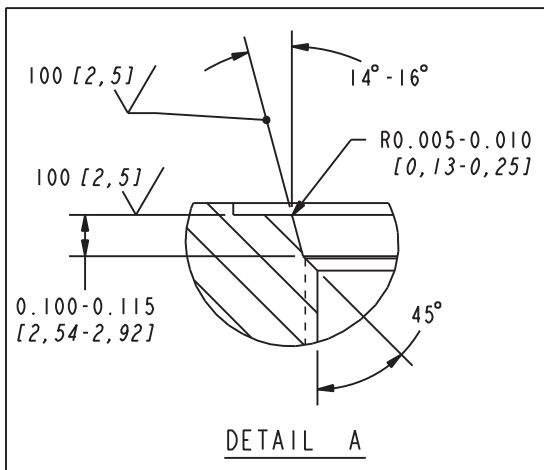
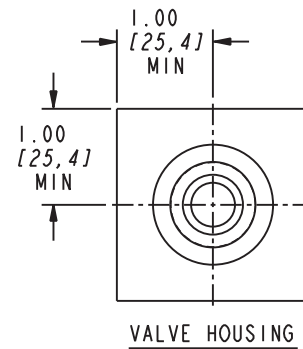
- Ø1.250 [31,75] SPOTFACE X 0.031 [0,79] DEEP #
- ⊙ Ø0.625-0.627 [15,88-15,92] X 1.310-1.314 [33,28-33,37] DEEP *
- ⊙ Ø0.810-0.814 [20,58-20,67] X 0.932 [23,67] DEEP *
- ⊙⊙ 7/8-14 UNF-2B X 0.625 [15,88] DEEP *

-B-

CAVITY TOOLS:
 7540650 - ROUGH
 7540660 - FINISH WITH
 TUNGSTEN
 INSERTS



INCH
 MILLIMETRE



NOTES:

- ⊙ -

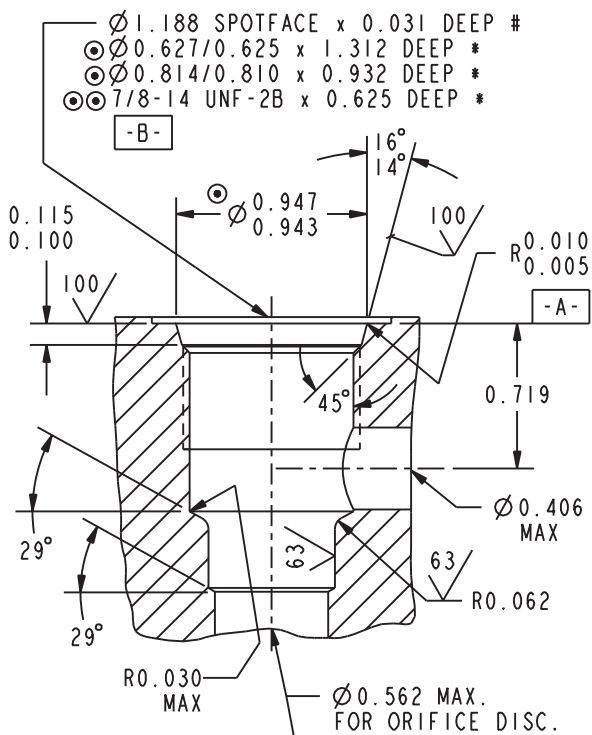
	0.001 [0,025]	A
	0.002 [0,05]	B
- ⊙⊙ -

	0.001 [0,025]	A
	0.0009 [0,023]	(PITCH DIA)

- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ±0.005 [0,13].
- UNSPECIFIED ANGULAR DIMENSIONS ±3° .
- SURFACE FINISH SPECIFICATIONS ARE IN MICROINCHES [MICROMETERS].

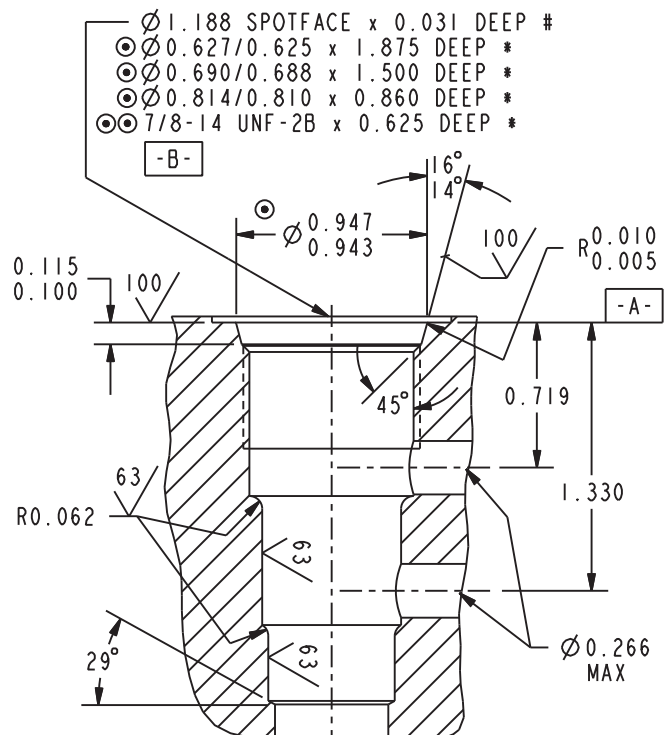
Series 10 Cartridge Cavities

VC10-2



NOTE:
CAVITY VARIATION 'A'***
PILOT DRILL $\varnothing 0.562$ MIN.
REQUIRED TO MIN. DEPTH
OF 1.50 FROM SPOTFACE

VC10-3



NOTE:
CAVITY VARIATION 'A'***
PILOT DRILL $\varnothing 0.562$ MIN.
REQUIRED TO MIN. DEPTH
OF 2.06 FROM SPOTFACE

NOTE:
CAVITY VARIATION 'B'***
PILOT DRILL $\varnothing 0.600$ MIN.
0.615 MAX. REQUIRED
TO MIN. DEPTH OF 2.63
FROM SPOTFACE

NOTES:

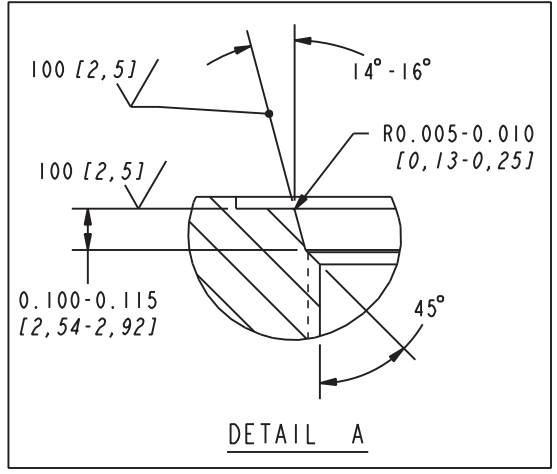
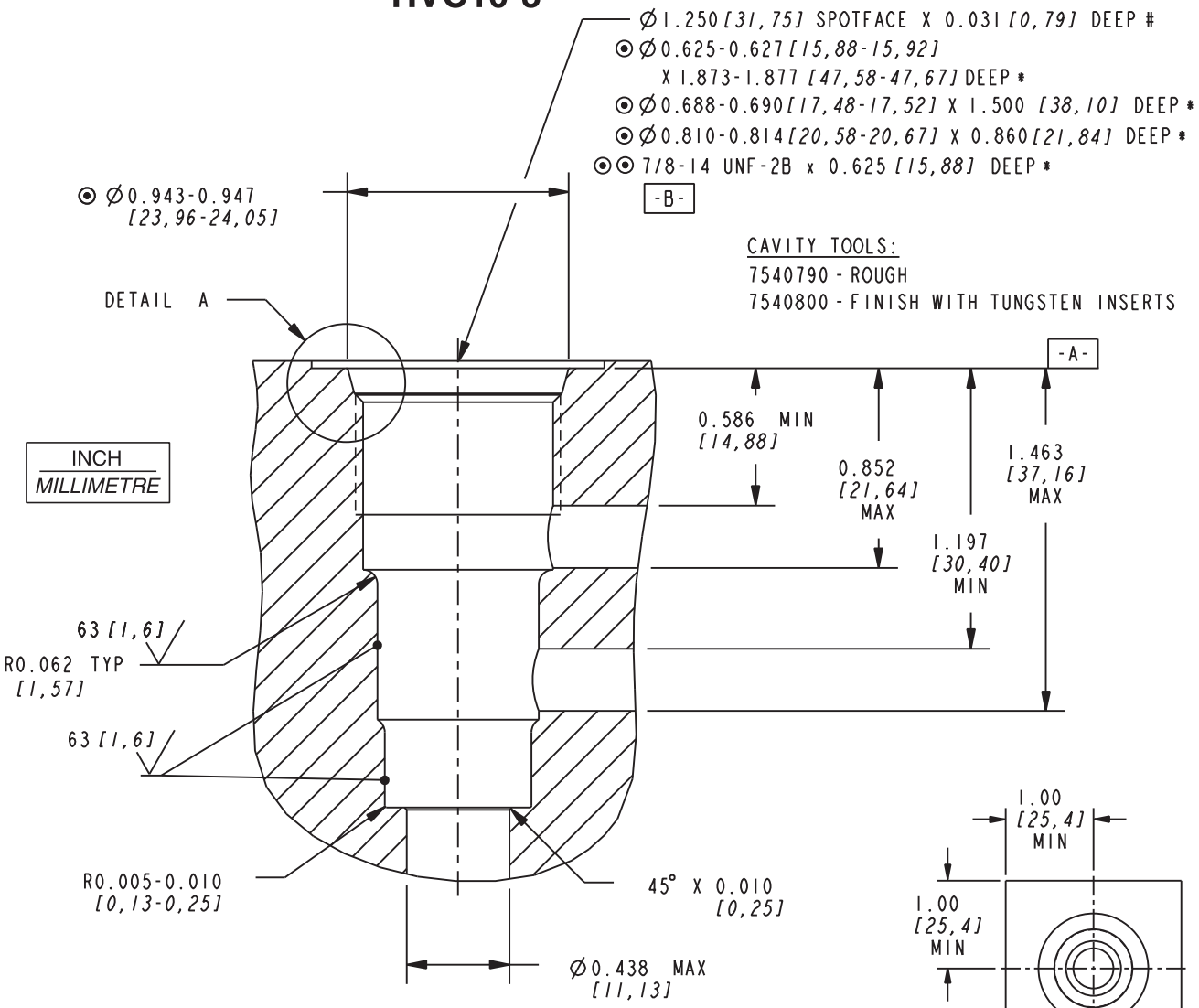
- THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

⊙		0.001	A	⊙ ⊙		0.001	A
		0.002	B			0.0009	(PITCH DIA)

- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.
- ** - FEATURES OF VARIATIONS ARE ONLY REQUIRED IF NOTED ON A SPECIFIC PRODUCT CATALOG PAGE.

Series 10 Cartridge Cavities

HVC10-3



NOTES:

- \odot -

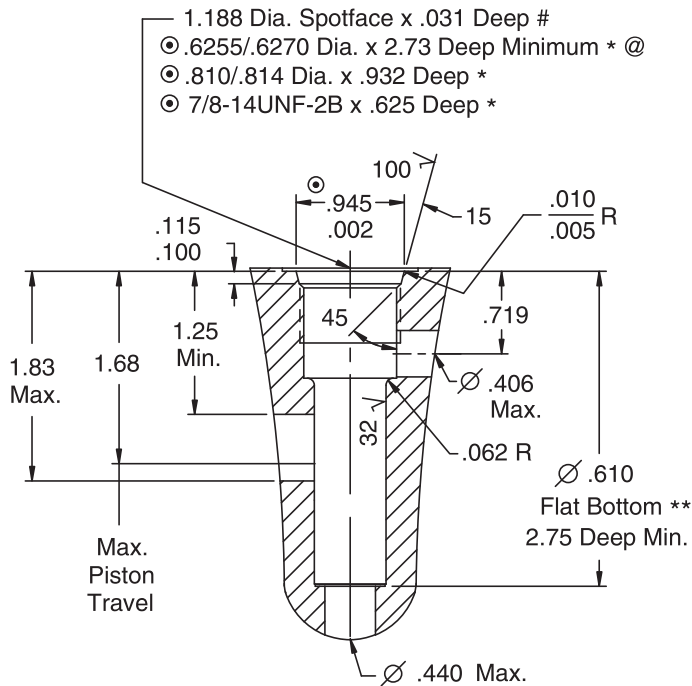
	0.001 [0,025]	A
↗	0.002 [0,05]	B
- $\odot \odot$ -

	0.001 [0,025]	A
	0.0009 [0,023]	(PITCH DIA)

- * - DEPTHS ARE FROM DATUM **-A-**.
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 [0,13].
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.
- SURFACE FINISH SPECIFICATIONS ARE IN MICROINCHES [MICROMETERS].

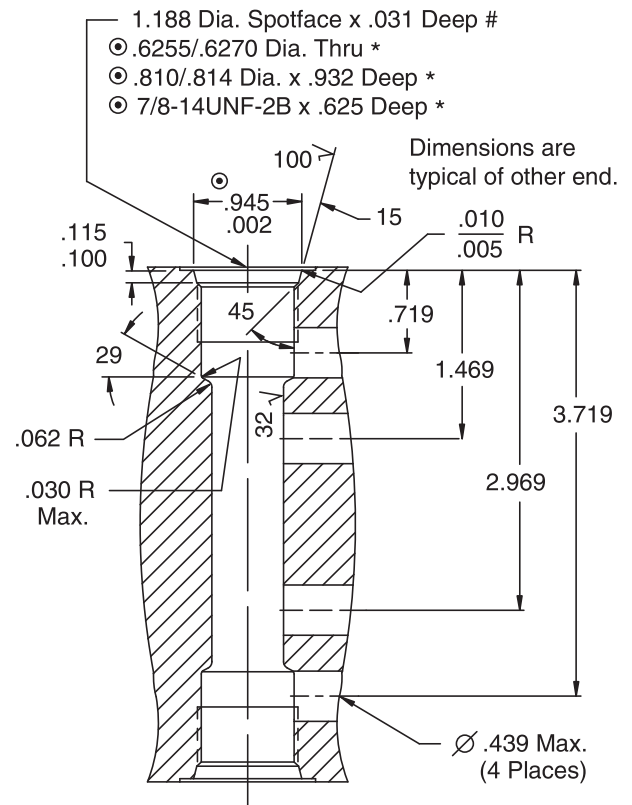
Series 10 Cartridge Cavities

VC10-PCV



** Flat Bottom Dia. is used as the PCV Piston stop.
 Alternate stop can be up to .025 inch deeper.

VC10-DCV

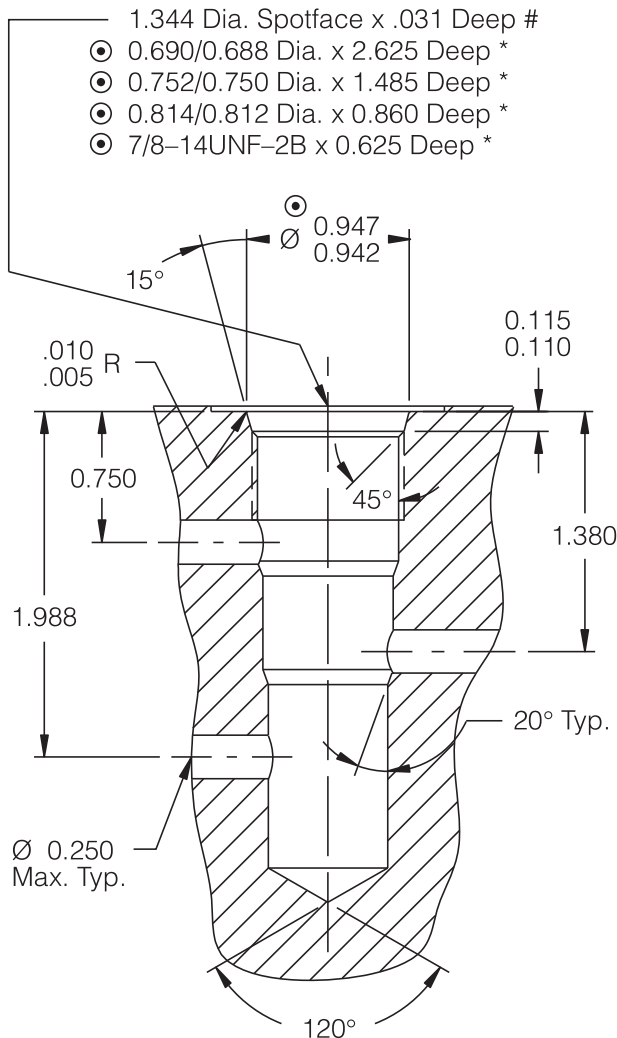


These features (except for pilot drill & cross drills) can be machined simultaneously with a form tool.

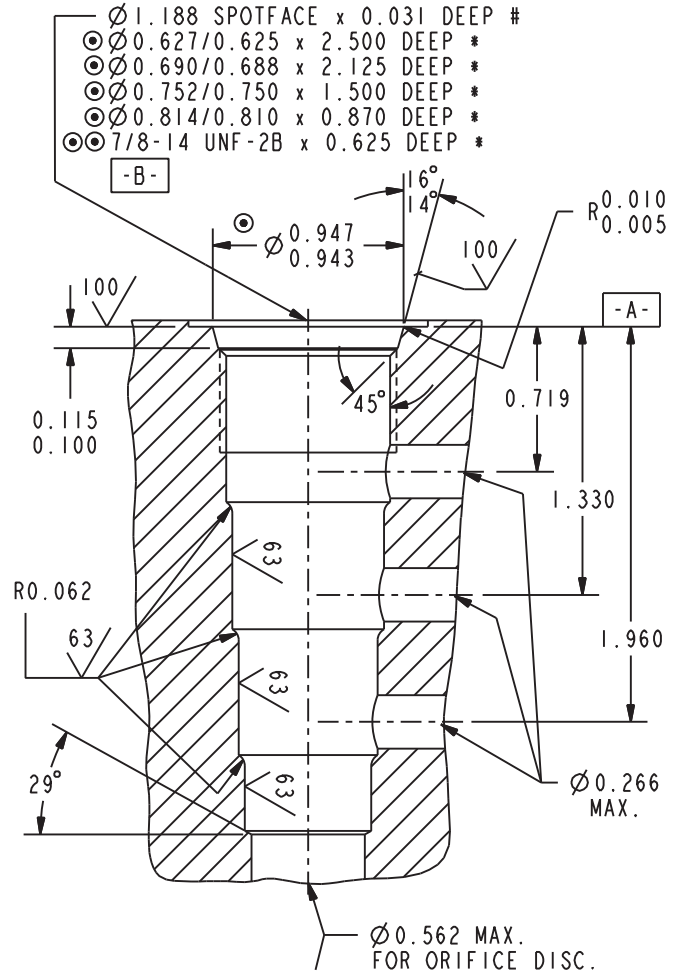
- ◎ — These diameters to be concentric within 0.002 T.I.R. and perpendicular to spotface within 0.001 T.I.R.
- * — Depths are from spotface.
- # — Unless otherwise specified on machining drawing
 Unspecified tolerances are ± 0.005 .
- @ — Flat bottom diameter is used as PCV piston stop. If alternate stop or if 0.626 diameter is deeper than min. shown above, then the piston stop must be within 0.025" max. of the depth of the 0.626 diameter.

Series 10 Cartridge Cavities

VC98-3



VC10-4



NOTE:
 CAVITY VARIATION 'A' **
 PILOT DRILL Ø 0.562 MAX.
 REQUIRED TO MIN. DEPTH
 OF 2.69 FROM SPOTFACE

The above features (except for pilot drill & cross drills) can be machined simultaneously with a form tool.

All machined cavity surfaces $46\sqrt{\quad}$ maximum.

◎ — These diameters to be concentric within 0.002 T.I.R. and perpendicular to spotface within 0.001 T.I.R.

* — Depths are from spotface.

— Unless otherwise specified on machining drawing.

Unspecified tolerances are ± 0.005 .

NOTES:

THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

◎		0.001	A	◎◎		0.001	A
	/	0.002	B		○	0.0009	(PITCH DIA)

* - DEPTHS ARE FROM DATUM -A- .

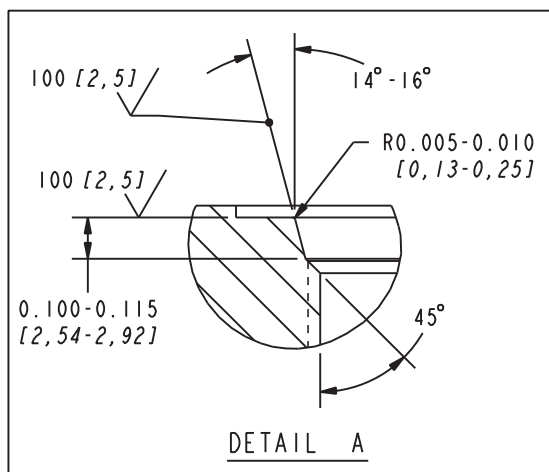
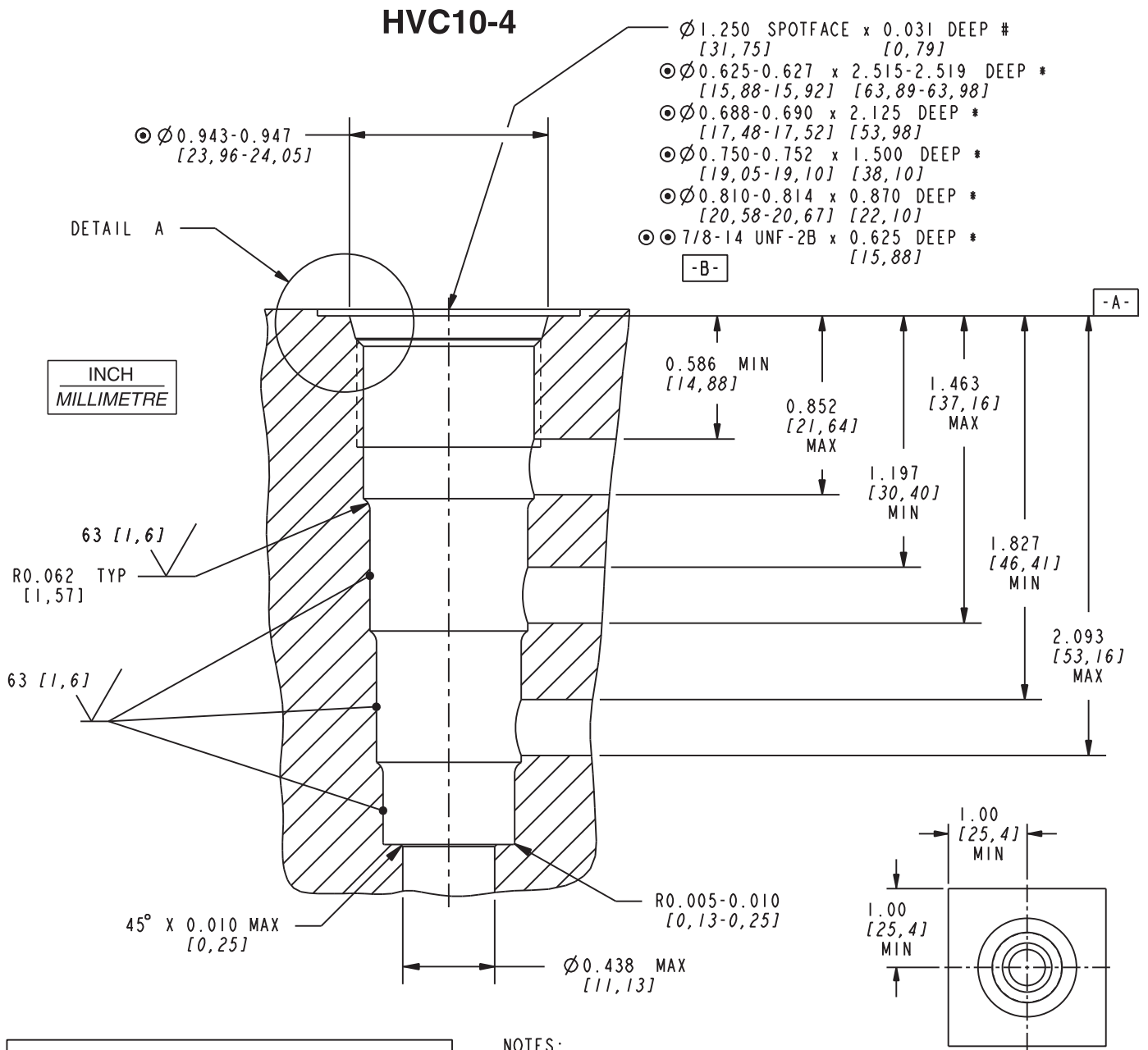
- UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.

- UNSPECIFIED TOLERANCES ARE ± 0.005 .

- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

** - FEATURES OF VARIATION 'A' ARE ONLY REQUIRED IF NOTED ON A SPECIFIC PRODUCT CATALOG PAGE.

Series 10 Cartridge Cavities



NOTES:

\odot -	<table border="1"><tr><td>0.001</td><td>[0,025]</td><td>A</td></tr><tr><td>0.002</td><td>[0,05]</td><td>B</td></tr></table>	0.001	[0,025]	A	0.002	[0,05]	B
0.001	[0,025]	A					
0.002	[0,05]	B					
$\odot \odot$ -	<table border="1"><tr><td>0.001</td><td>[0,025]</td><td>A</td></tr><tr><td>0.0009</td><td>[0,023]</td><td>(PITCH DIA)</td></tr></table>	0.001	[0,025]	A	0.0009	[0,023]	(PITCH DIA)
0.001	[0,025]	A					
0.0009	[0,023]	(PITCH DIA)					

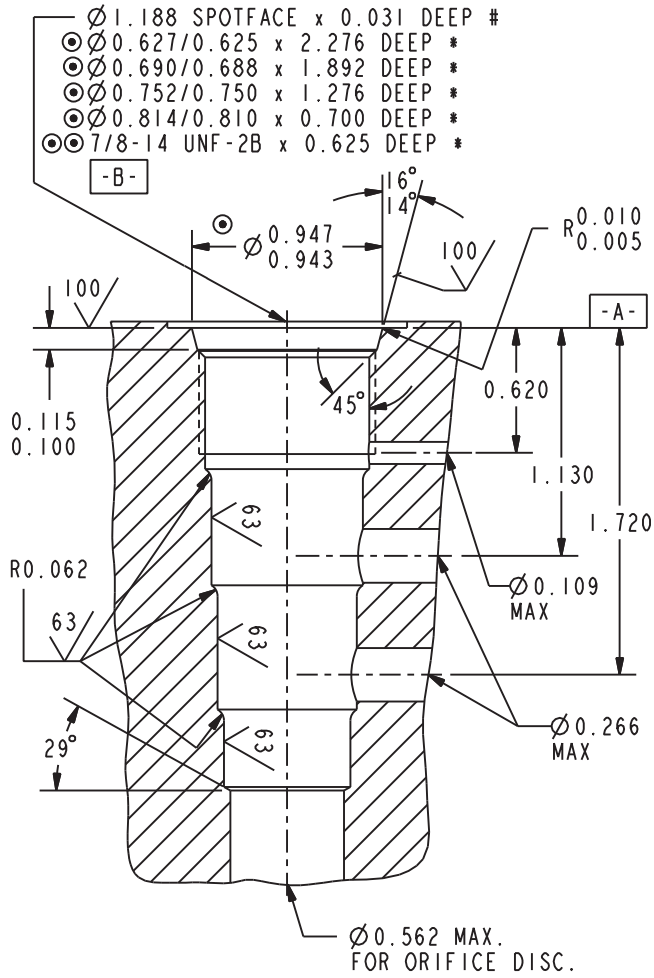
- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 [0,13].
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.
- SURFACE FINISH SPECIFICATIONS ARE IN MICROINCHES [MICROMETERS].

VALVE HOUSING

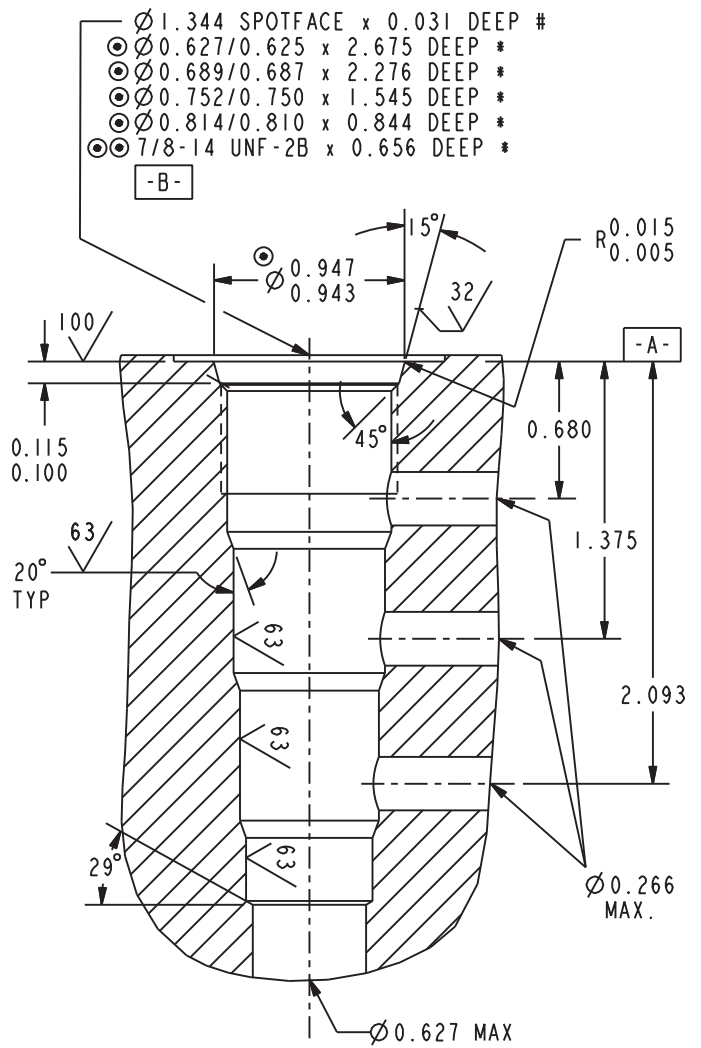
CAVITY TOOLS:
 7540810 - ROUGH
 7540820 - FINISH
 WITH TUNGSTEN INSERTS

Series 10 Cartridge Cavities

VC10-S4



VC10-L4



NOTES:

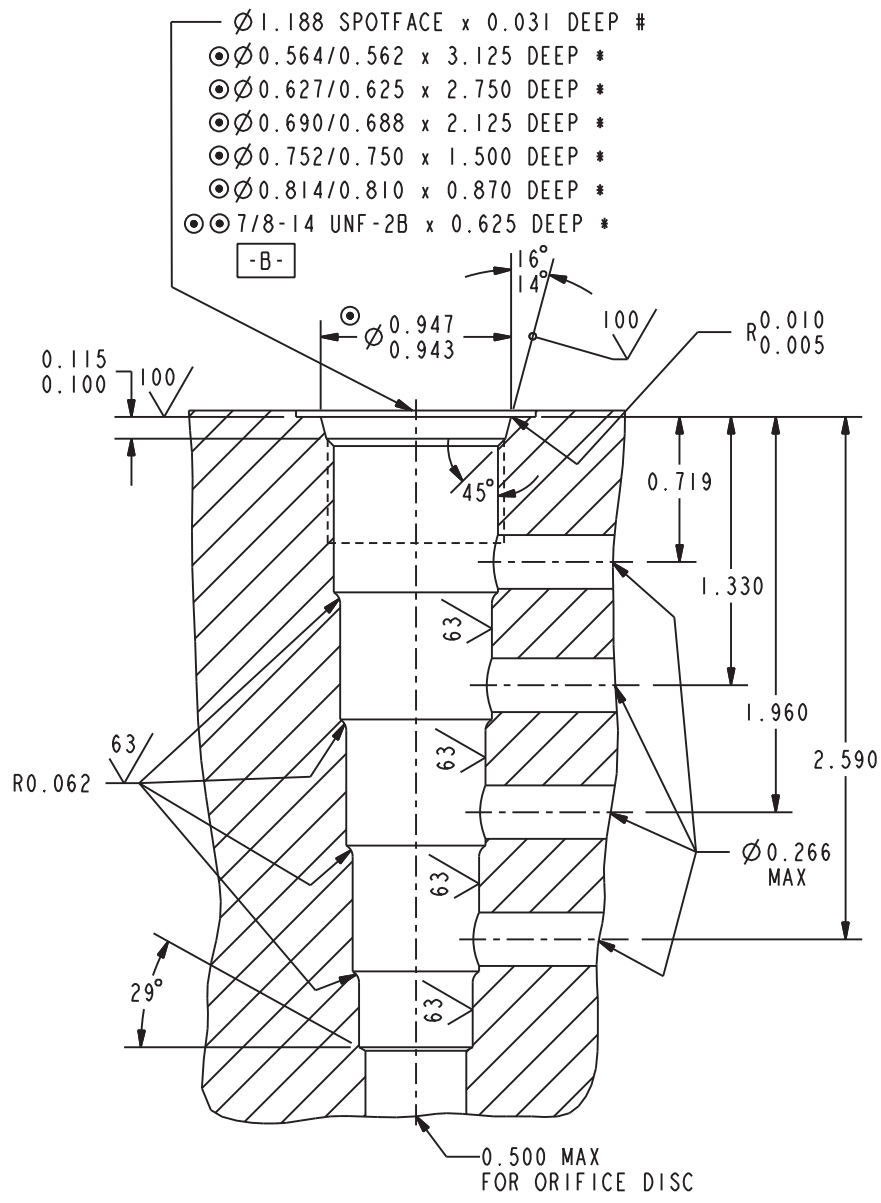
THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

\odot	$\frac{0.001}{0.002}$	A	$\odot \odot$	$\frac{0.001}{0.0009}$	A
		B			(PITCH DIA)

- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

Series 10 Cartridge Cavities

VC10-5



NOTES: - THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

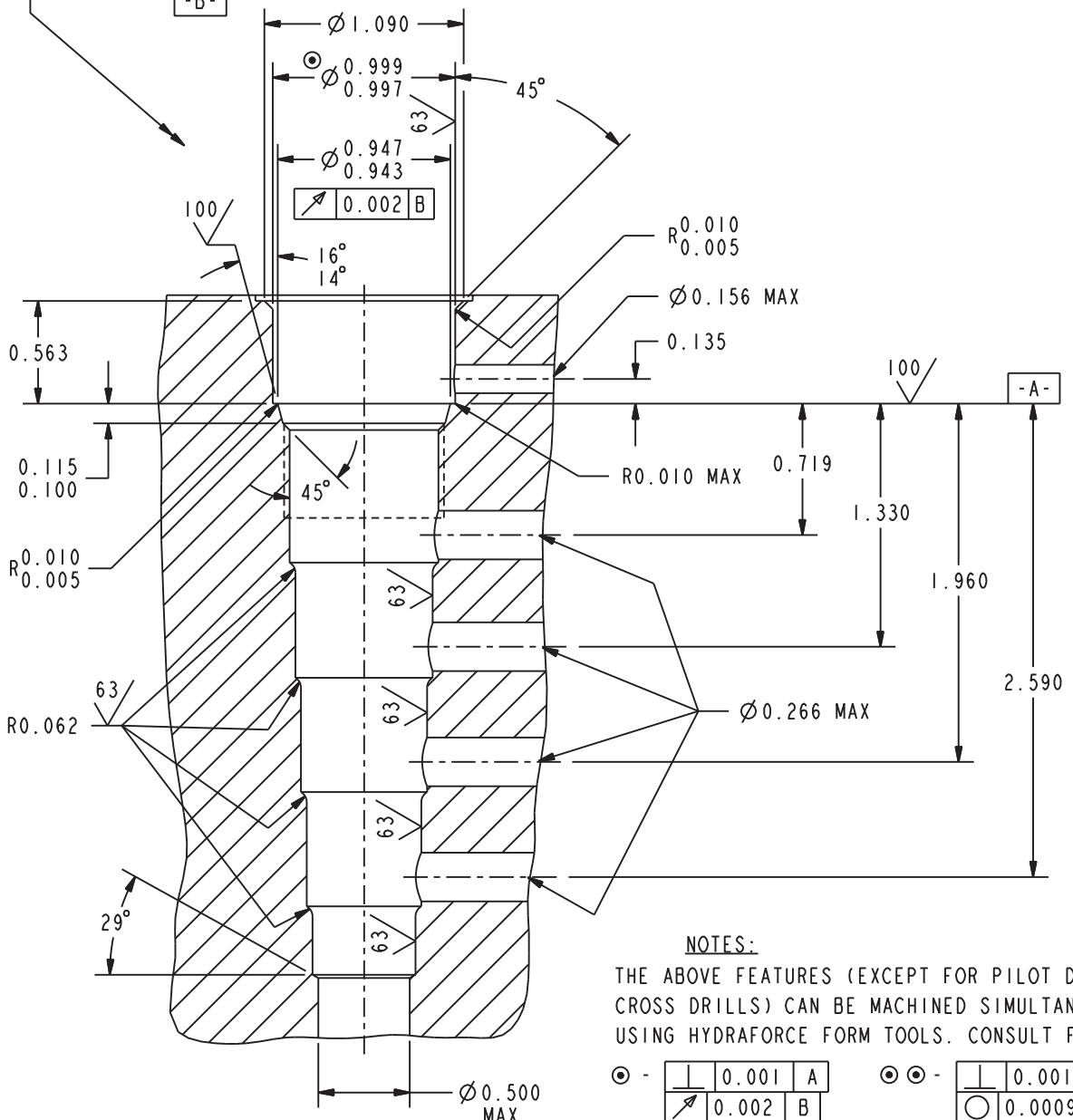
\odot	\perp	0.001	A	$\odot \odot$	\perp	0.001	A
	∇	0.002	B		\bigcirc	0.0009	(PITCH DIA)

- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

Series 10 Cartridge Cavities

VC10-S6

- Ø 1.188 SPOTFACE x 0.031 DEEP #
 - ⊙ Ø 0.564/0.562 x 3.125 DEEP *
 - ⊙ Ø 0.627/0.625 x 2.750 DEEP *
 - ⊙ Ø 0.690/0.688 x 2.125 DEEP *
 - ⊙ Ø 0.752/0.750 x 1.500 DEEP *
 - ⊙ Ø 0.814/0.810 x 0.870 DEEP *
 - ⊙⊙ 7/8-14 UNF-2B x 0.625 DEEP *
- B-



NOTES:

THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

- ⊙ -

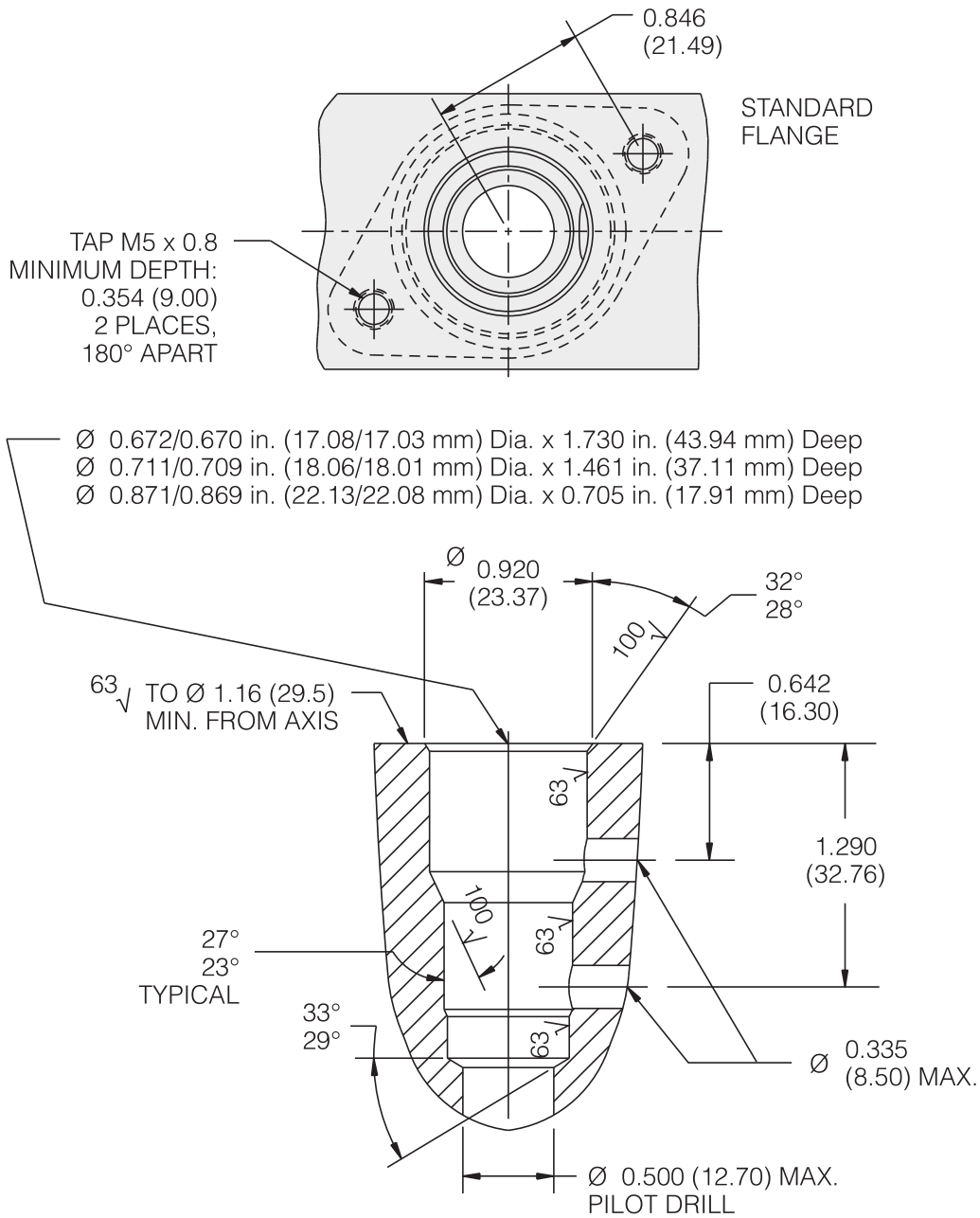
	0.001	A
	0.002	B
- ⊙⊙ -

	0.001	A
	0.0009	(PITCH DIA)

- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ±0.005.
- UNSPECIFIED ANGULAR DIMENSIONS ±3°.

Drop-in Cartridge Cavities

VC-T001



INCH (MILLIMETER)

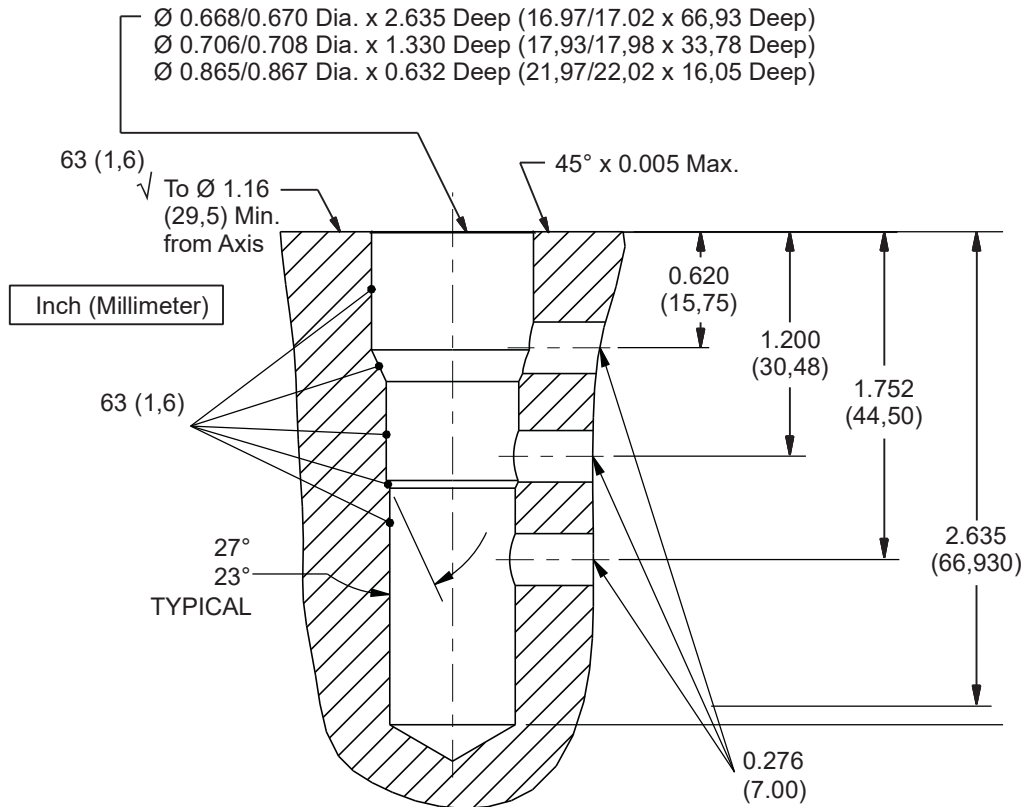
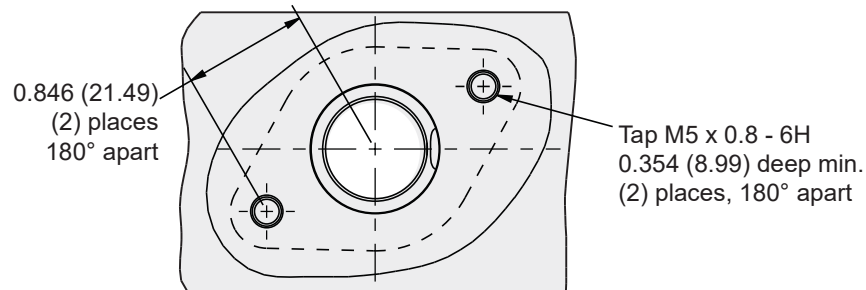
The above features (except for pilot drill & cross drills) can be machined simultaneously with a form tool.

All diameters, with exception of 0.500 in. (12.7 mm) Pilot Drill to be concentric within 0.002 in. (0.05 mm) T.I.R. and perpendicular to face within 0.002 in. (0.05 mm) T.I.R.

Unspecified tolerances are ±0.005 in. (0.13 mm).

Drop-in Cartridge Cavities

VC-T003



The above features (except for pilot drill and cross drills) can be machined simultaneously with a form tool.

Cavity Tools: Rough: 7540210; Finish: 7540230;
Finish with Tungsten Carbide Inserts: 7540220

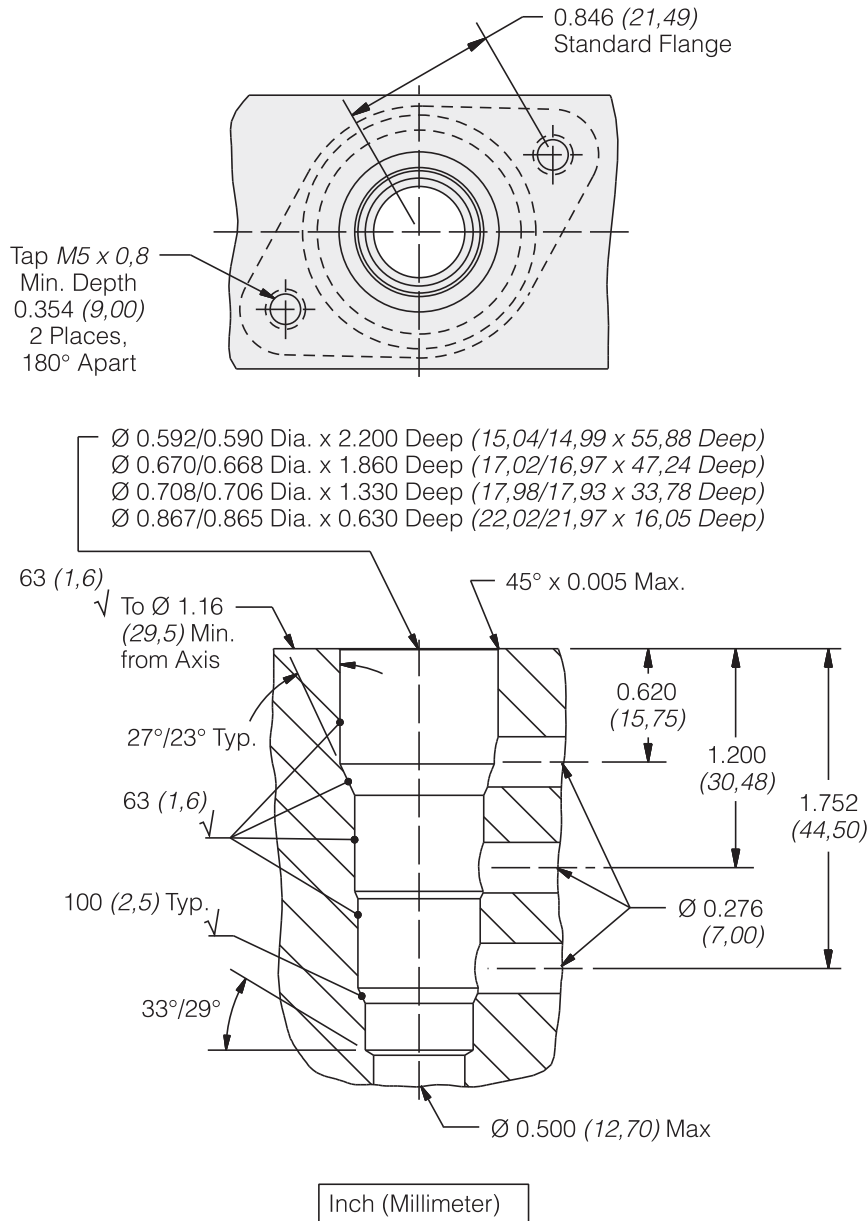
These diameters, with exception of Ø 0.500 (12,70) Pilot Drill, to be concentric within 0.002 (0,05) T.I.R. and perpendicular to spotface within 0.002 (0,05).

Unspecified tolerances are ±0.005 (0,13).

Surface finish specifications are in Microinches (Micrometers).

Drop-in Cartridge Cavities

VC-T004



The above features (except for pilot drill and cross drills) can be machined simultaneously with a form tool.

Cavity Tools: Rough: 7540150; Finish: 7540170;
Finish with Tungsten Carbide Inserts: 7540160

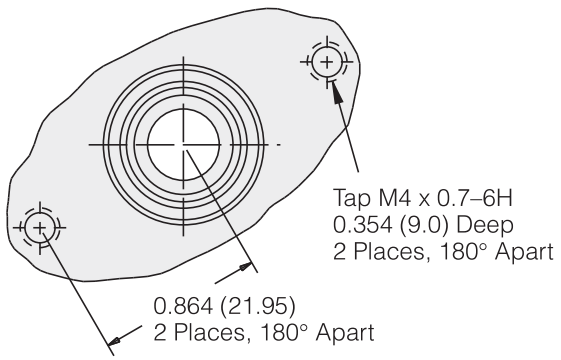
These diameters, with exception of $\varnothing 0.500$ (12,70) Pilot Drill, to be concentric within 0.002 (0,05) T.I.R. and perpendicular to spotface within 0.002 (0,05).

Unspecified tolerances are ± 0.005 (0,13).

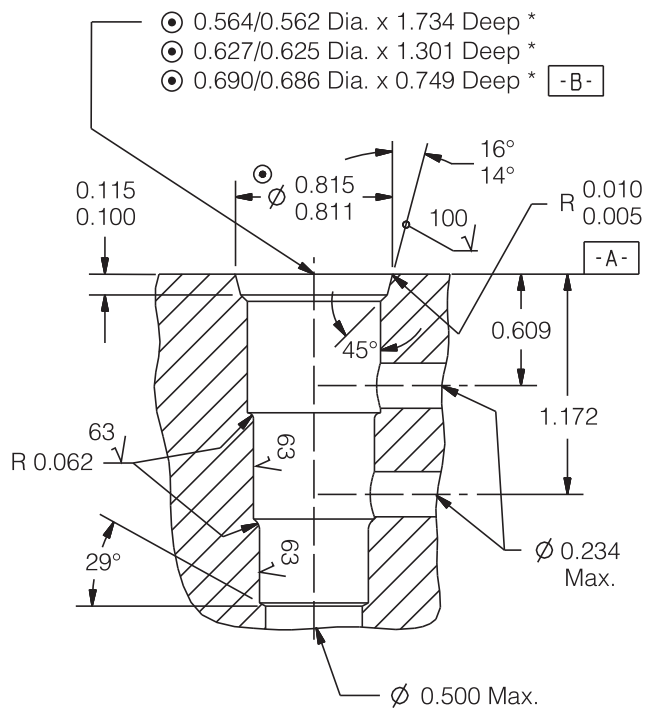
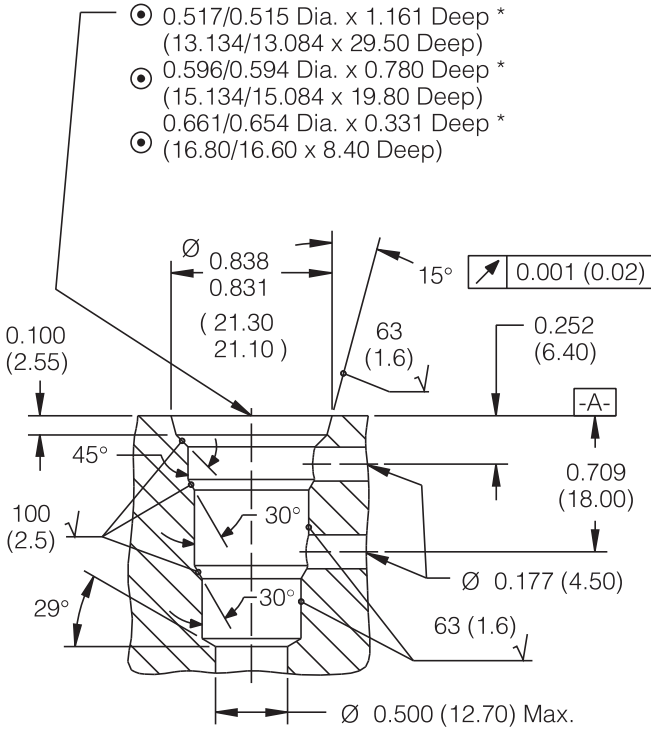
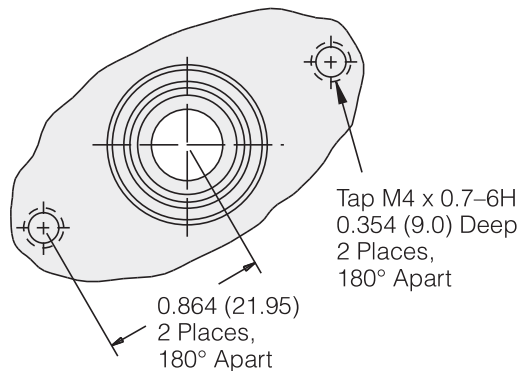
Surface finish specifications are in Microinches (Micrometers).

Drop-in Cartridge Cavities

VC-T009



VC-T011



Inch (Millimeter)

The above features (except for pilot drill and cross drills) can be machined simultaneously with a form tool.

Cavity Tools: Rough: 7540420; Finish: 7540430; Finish with Tungsten Carbide Inserts: 7540435

⊙ — These diameters to be concentric within 0.002 T.I.R. and perpendicular to spotface within 0.001 T.I.R.

* — Depths are from datum [-A-]

Unspecified tolerances are ±0.005

*		0.002	B
		0.001	A

* — Depths are from datum [-A-]

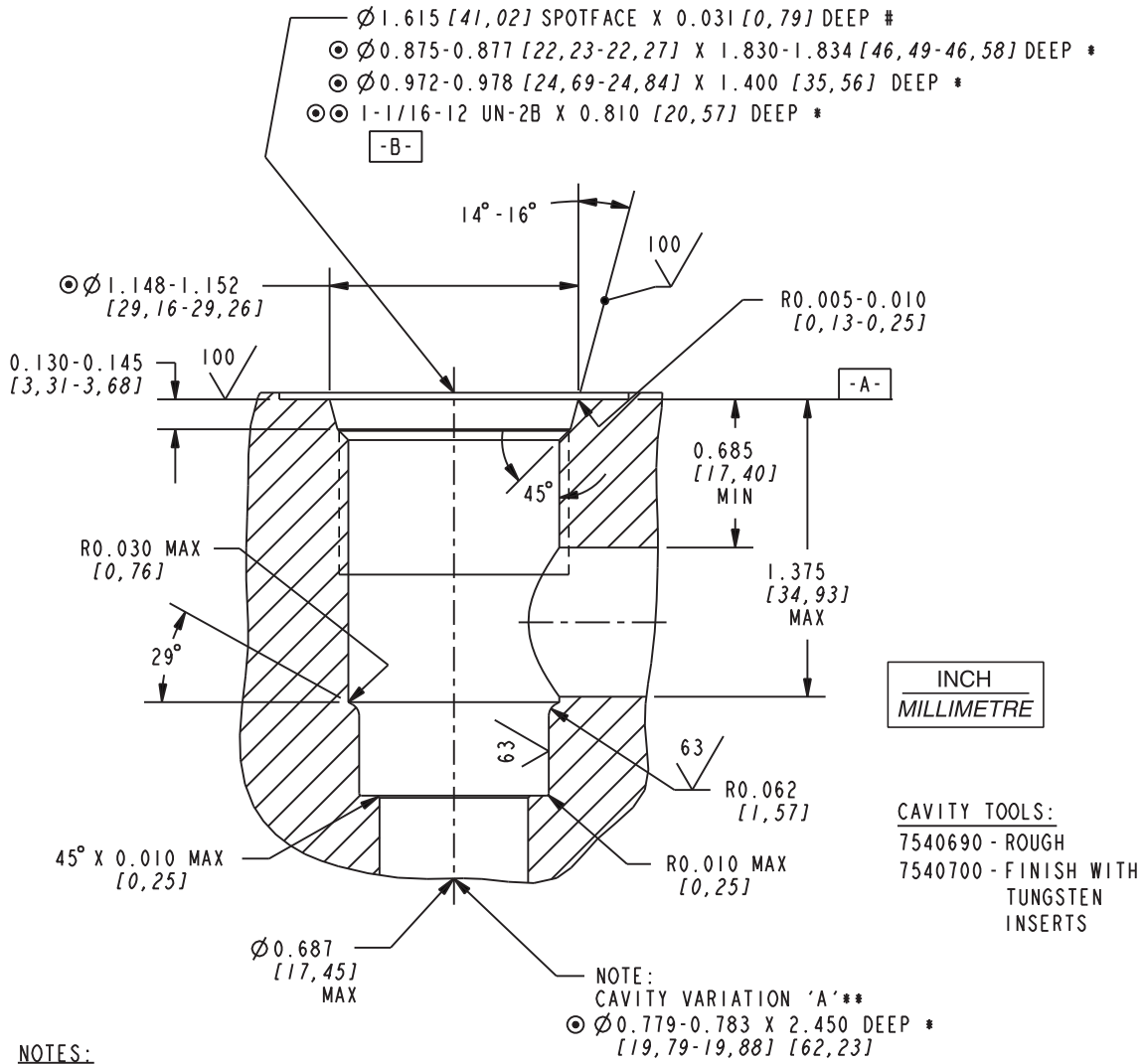
Unspecified tolerances are ±0.005

Unspecified angular dimensions are ±3°

Inch (Millimeter)

Series 12 Cartridge Cavities

HVC12-2



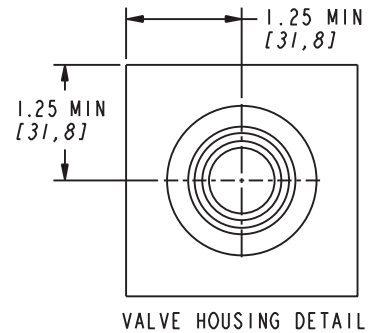
NOTES:

- \odot -

	0.001 [0,025]	A
↗	0.002 [0,05]	B
- $\odot \odot$ -

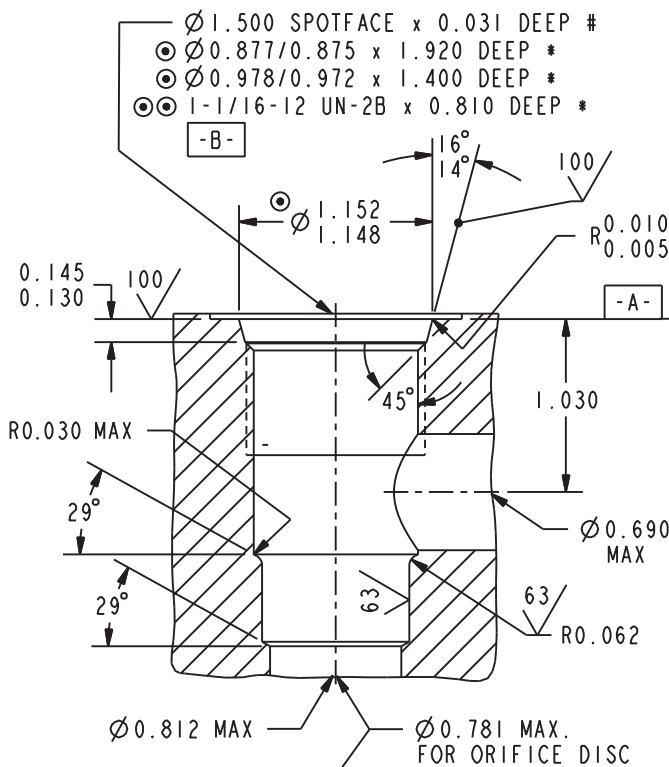
	0.001 [0,025]	A
○	0.0009 [0,023]	(PITCH DIA)

- * - DEPTHS ARE FROM DATUM **-A-**.
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 [0,13].
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.
- SURFACE FINISH SPECIFICATIONS ARE IN MICROINCHES [MICROMETERS].



Series 12 Cartridge Cavities

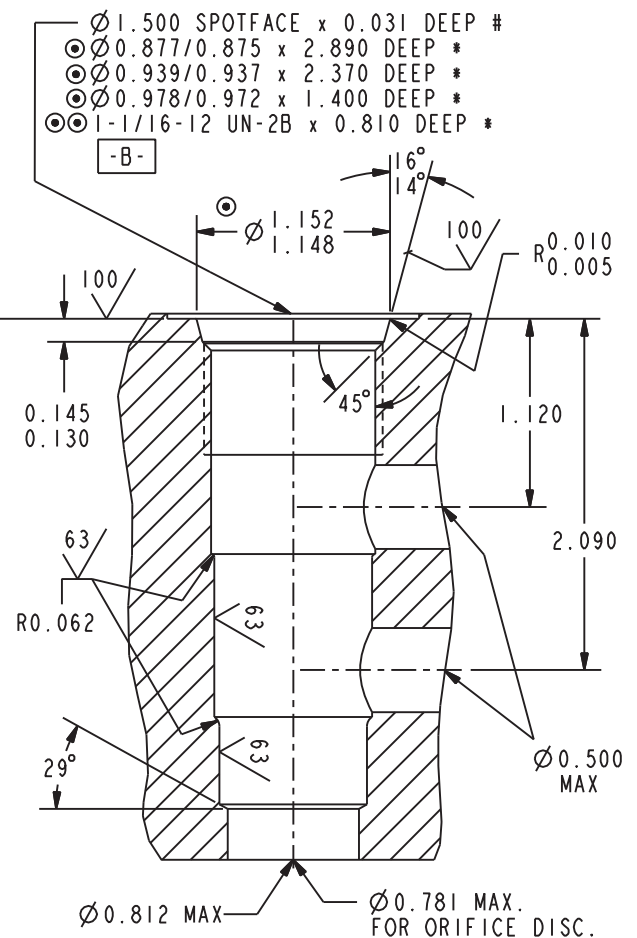
VC12-2



NOTE:
CAVITY VARIATION 'A'***
MIN. PILOT DRILL $\varnothing 0.750$
REQUIRED TO MIN. DEPTH
OF 2.14 FROM SPOTFACE

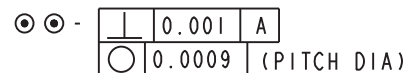
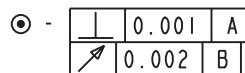
NOTE:
CAVITY VARIATION 'B'***
PILOT DRILL $\varnothing 0.812$
REQUIRED TO MIN. DEPTH
OF 2.45 FROM SPOTFACE

VC12-3



NOTES:

- THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.



* - DEPTHS ARE FROM DATUM **-A-** .

- UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.

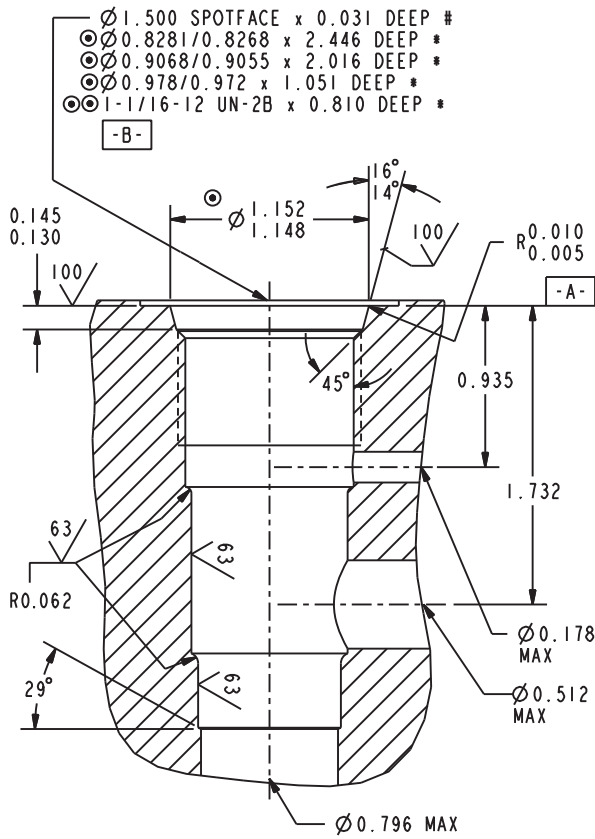
- UNSPECIFIED TOLERANCES ARE ± 0.005 .

- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

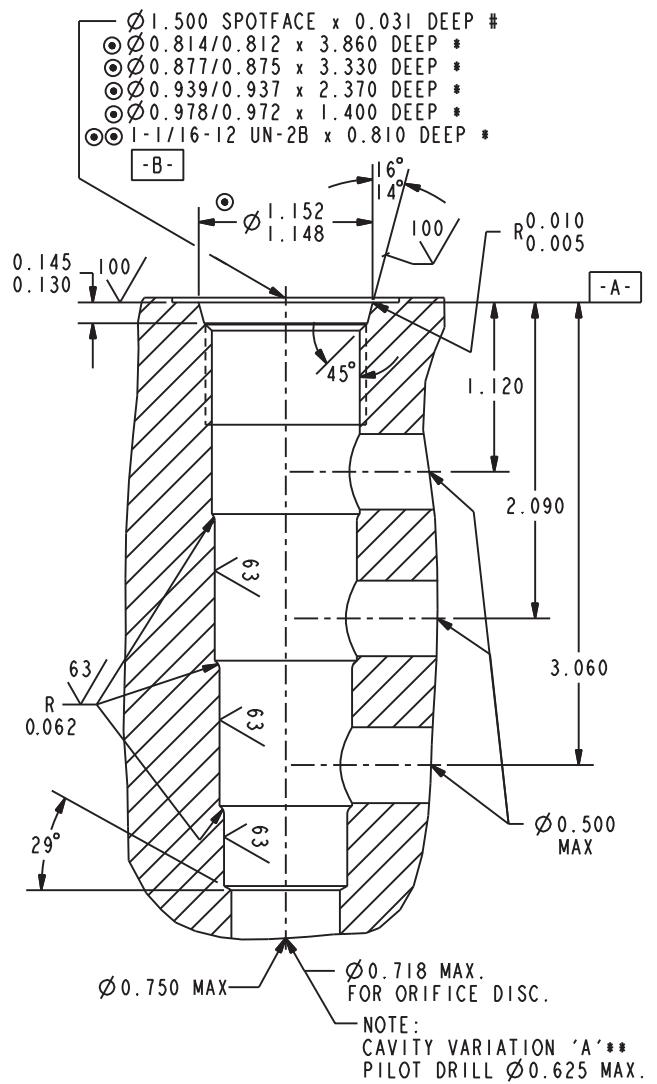
*** - FEATURES OF VARIATION 'A' AND 'B' ARE ONLY REQUIRED IF NOTED ON A SPECIFIC PRODUCT CATALOG PAGE.

Series 12 Cartridge Cavities

VC12-S3



VC12-4



NOTES: - THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

\odot	$\frac{0.001}{0.002}$	A	$\odot \odot$	$\frac{0.001}{0.0009}$	A	(PITCH DIA)
---------	-----------------------	---	---------------	------------------------	---	-------------

* - DEPTHS ARE FROM DATUM -A- .

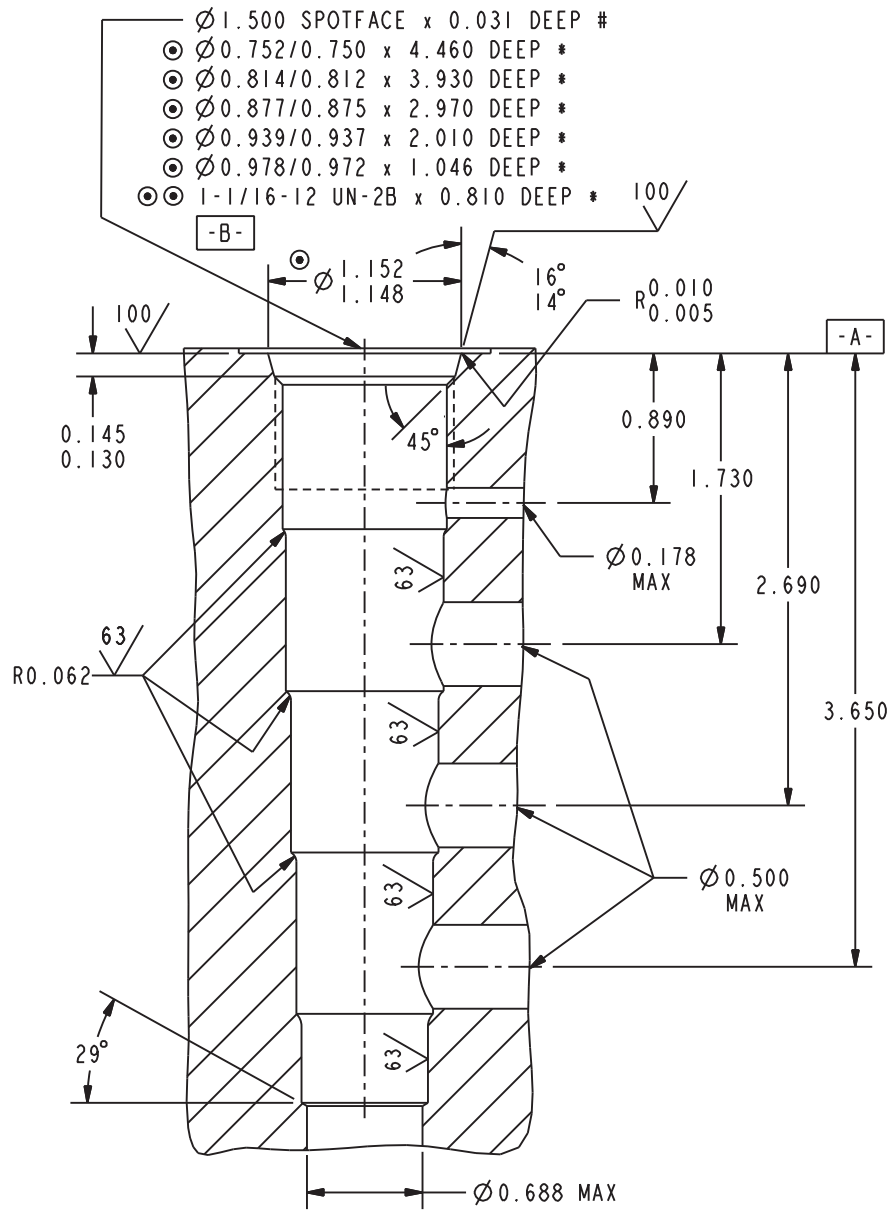
- UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.

- UNSPECIFIED TOLERANCES ARE ± 0.005 . - UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

** - FEATURES OF VARIATION 'A' ARE ONLY REQUIRED IF NOTED ON A SPECIFIC PRODUCT CATALOG PAGE.

Series 12 Cartridge Cavities

VC12-S5



NOTES: - THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

\odot -

	0.001	A
↗	0.002	B

 $\odot\odot$ -

	0.001	A
○	0.0009	(PITCH DIA)

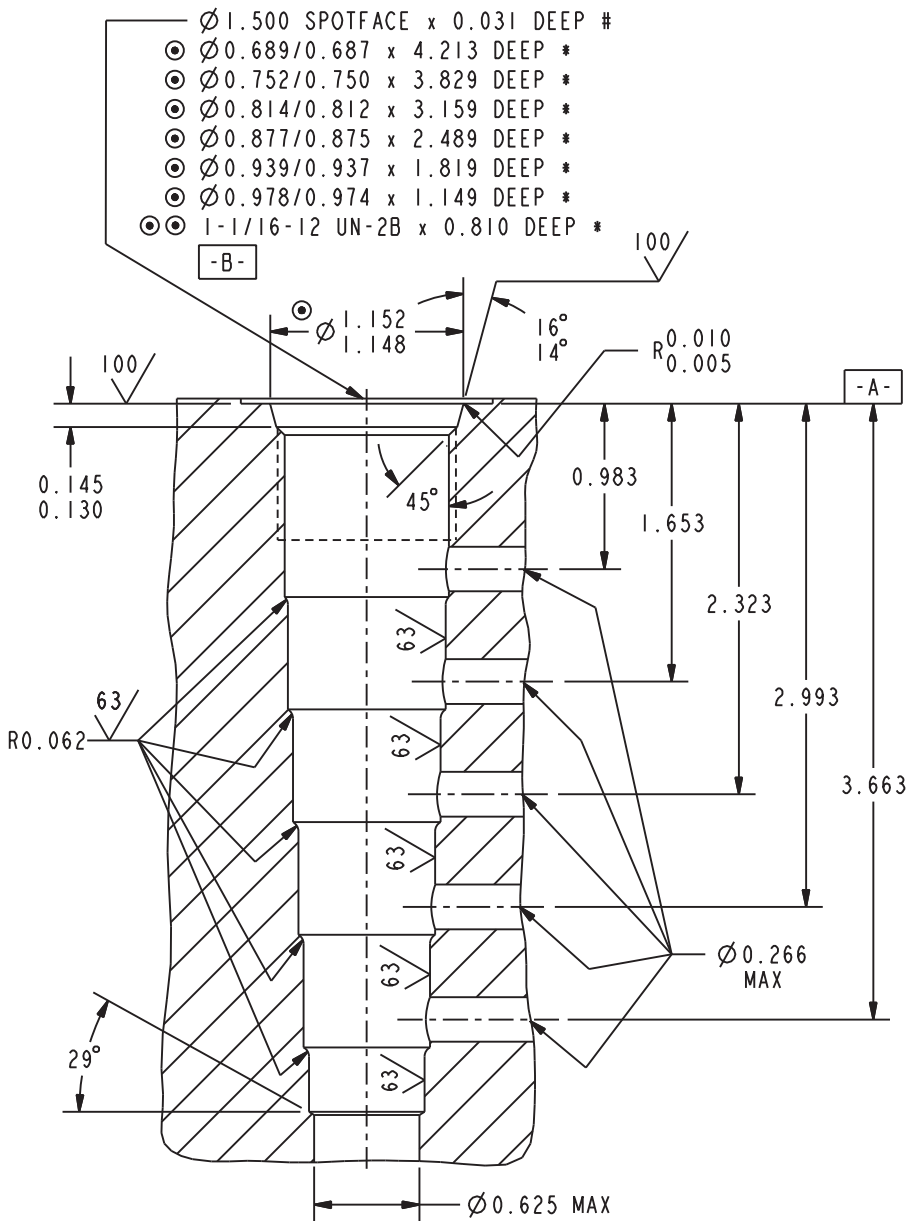
* - DEPTHS ARE FROM DATUM **-A-** .

- UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.

- UNSPECIFIED TOLERANCES ARE ± 0.005 . - UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

Series 12 Cartridge Cavities

VC12-6



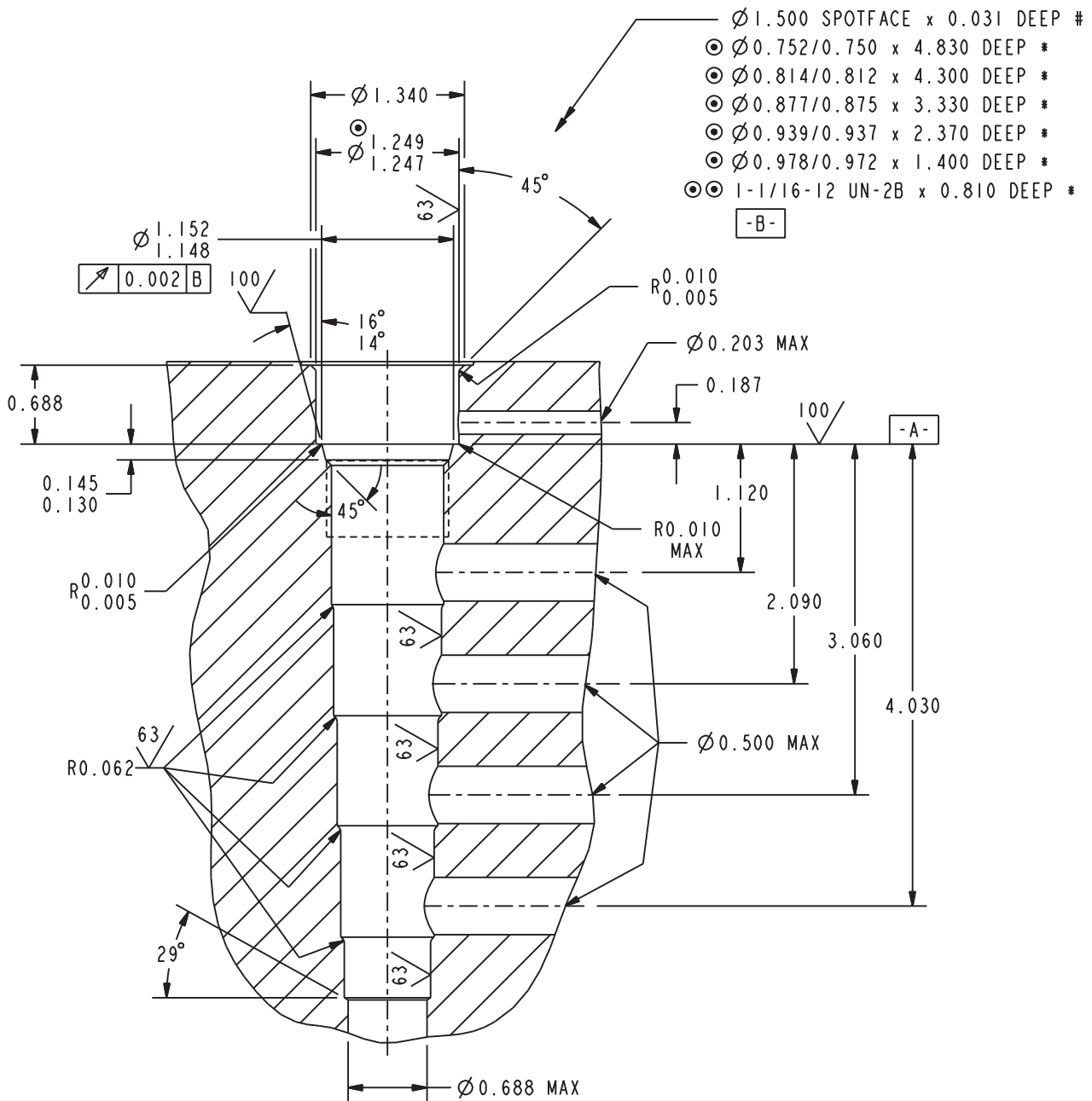
NOTES: - THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

\odot	\perp	0.001	A	$\odot \odot$	\perp	0.001	A
	∇	0.002	B		\bigcirc	0.0009	(PITCH DIA)

- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 . - UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

Series 12 Cartridge Cavities

VC12-S6



NOTES: - THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

⊙ -

⊥	0.001	A
↗	0.002	B

 ⊙⊙ -

⊥	0.001	A
○	0.0009	(PITCH DIA)

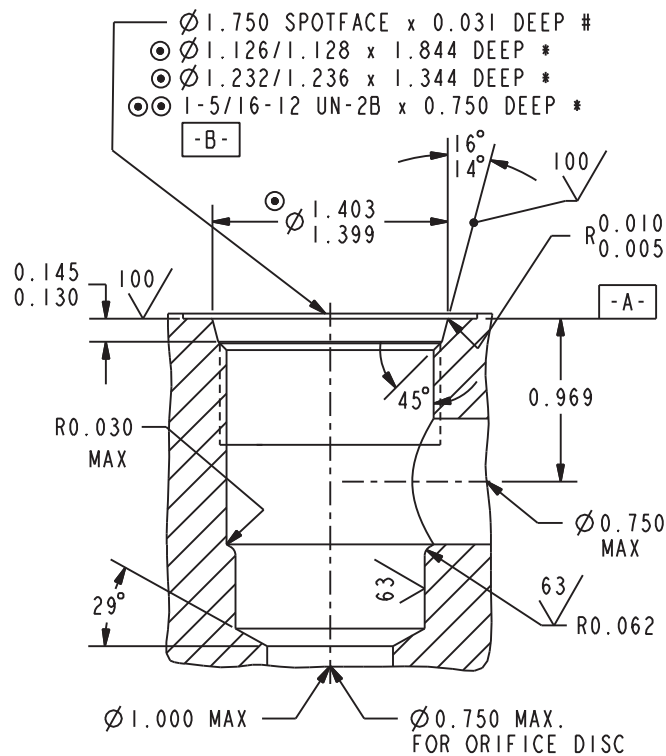
* - DEPTHS ARE FROM DATUM -A- .

- UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.

- UNSPECIFIED TOLERANCES ARE ±0.005. - UNSPECIFIED ANGULAR DIMENSIONS ±3°.

Series 16 Cartridge Cavities

VC16-2



NOTES:

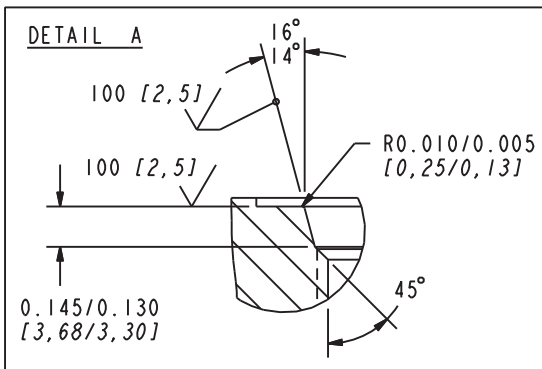
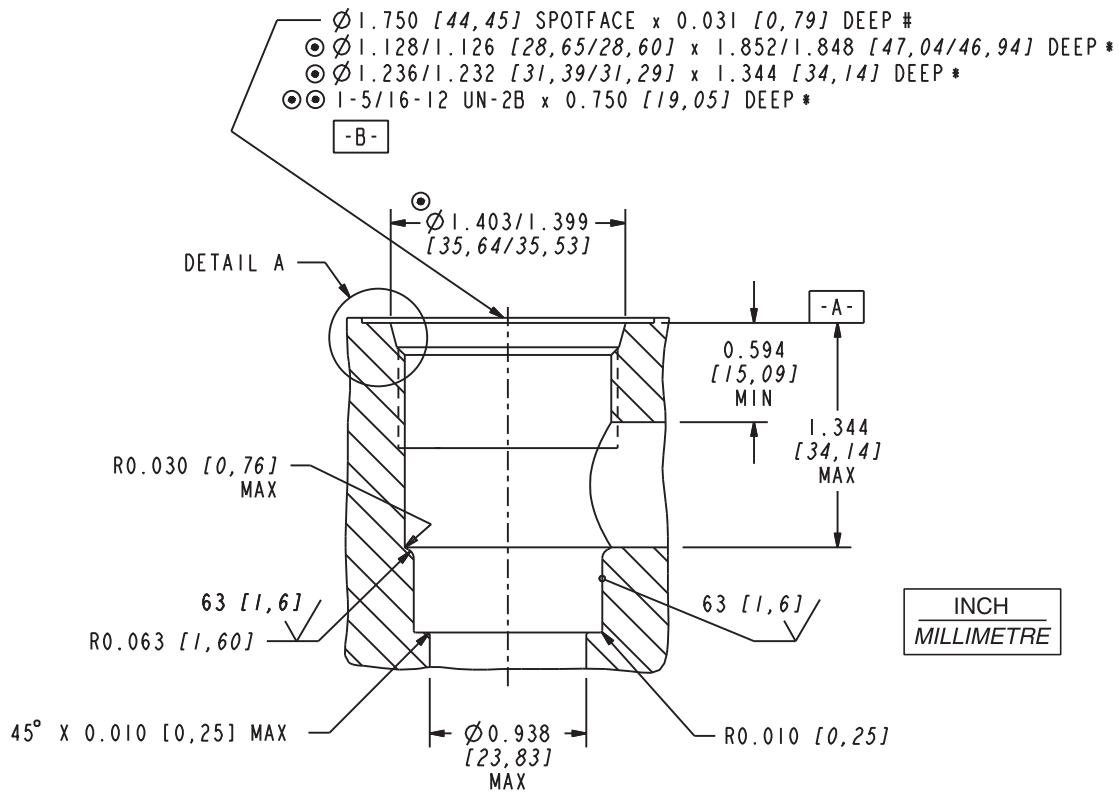
- THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.



- * - DEPTHS ARE FROM DATUM **-A-**.
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ±0.005.
- UNSPECIFIED ANGULAR DIMENSIONS ±3°.

Series 16 Cartridge Cavities

HVC16-2



NOTES:

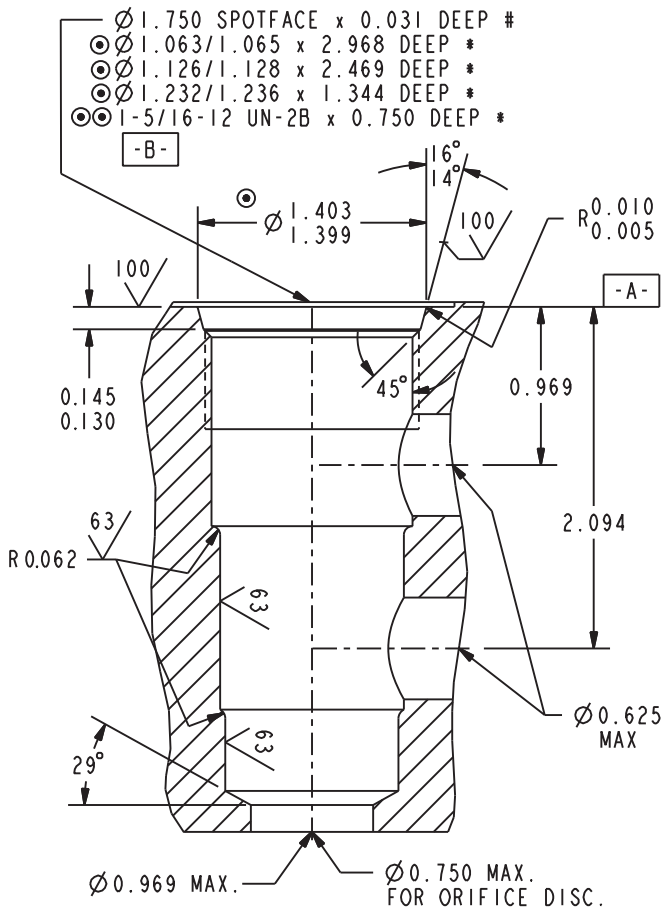
- \odot -

		0.001 [0,025]	A
		0.002 [0,05]	B
- $\odot \odot$ -

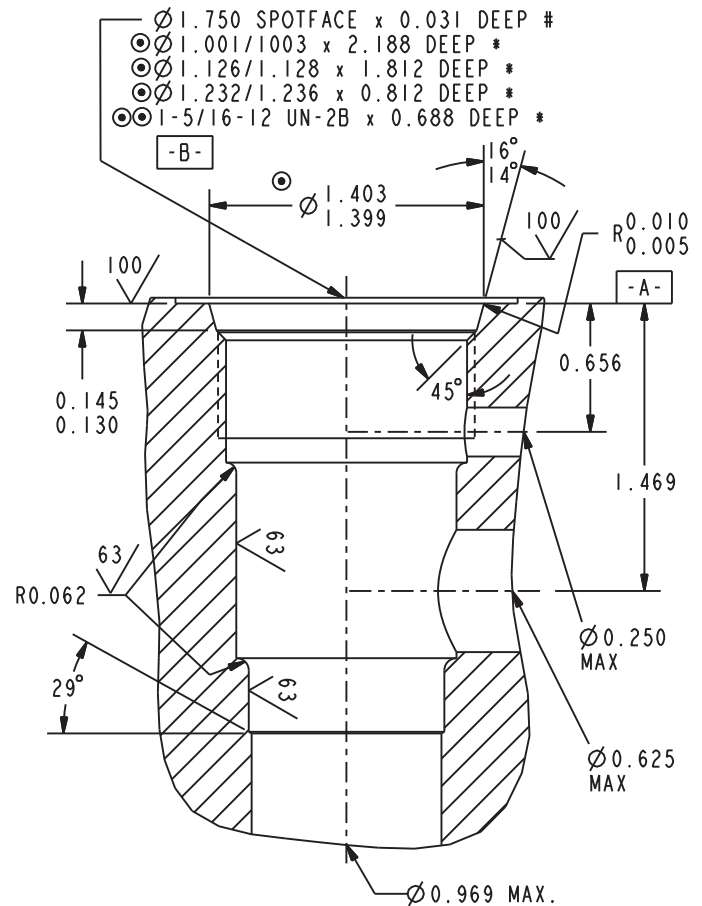
		0.001 [0,025]	A
		0.0009 [0,023]	(PITCH DIA)
- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 [0,13].
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.
- SURFACE FINISH SPECIFICATIONS ARE IN MICROINCHES [MICROMETERS].

Series 16 Cartridge Cavities

VC16-3



VC16-S3



NOTES:

- THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.



- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

NOTES:

- THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.



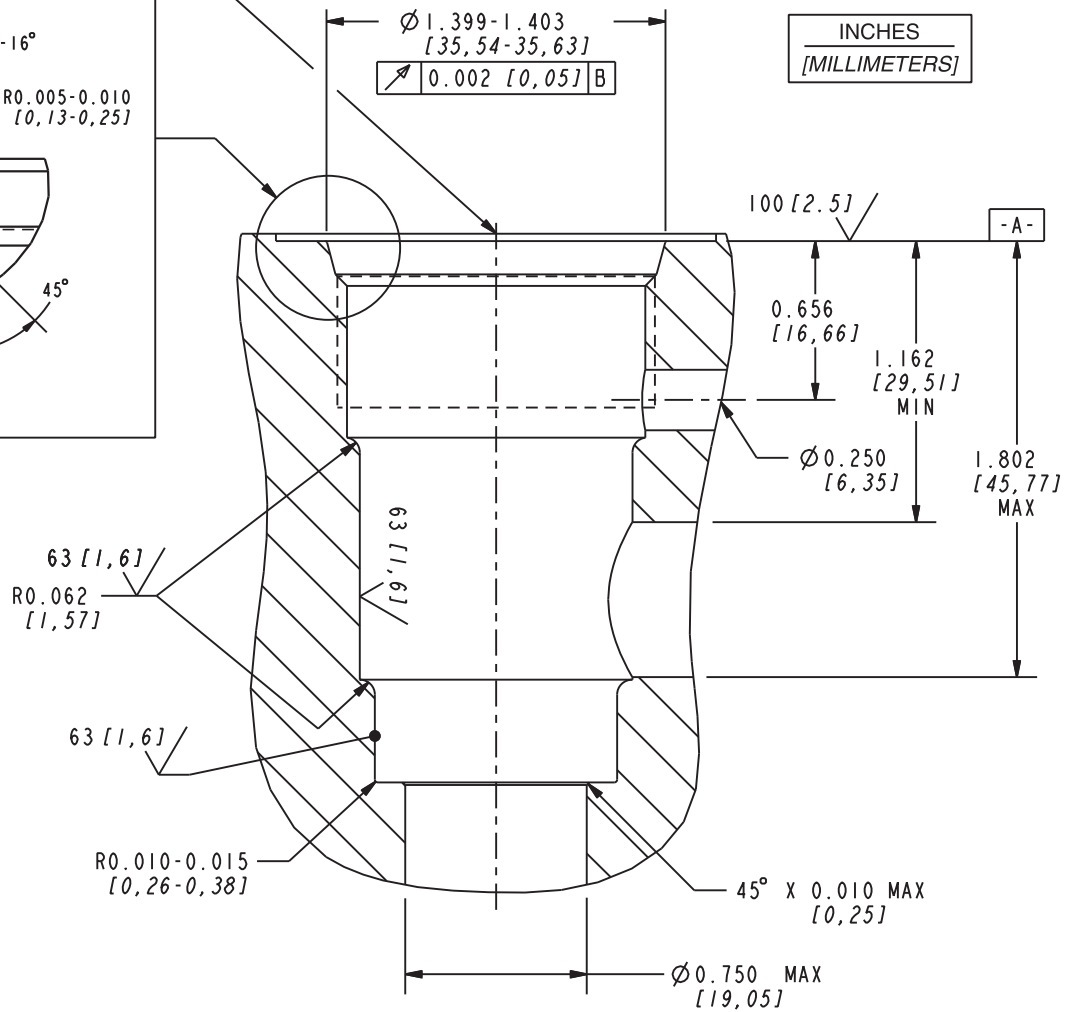
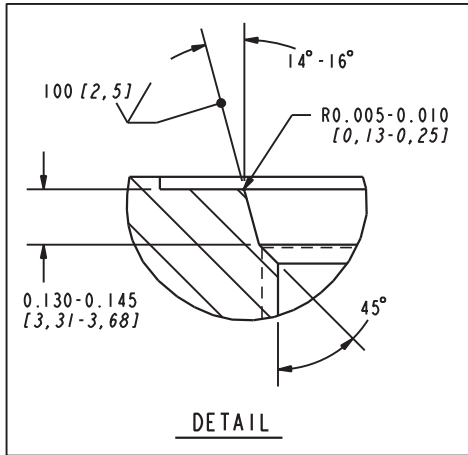
- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

Series 16 Cartridge Cavities

HVC16-S3

- Ø 1.820 [46,23] SPOTFACE X 0.031 [0,79] DEEP #
- ⊙ Ø 1.001-1.003 [25,43-25,47] X 2.236-2.240 [56,80-56,89] DEEP *
- ⊙ Ø 1.126-1.128 [28,61-28,65] X 1.812 [46,02] DEEP *
- ⊙ Ø 1.232-1.236 [31,30-31,39] X 0.812 [20,62] DEEP *
- ⊙⊙ 1-5/16-12 UN-2B X 0.688 [17,48] DEEP *

-B-



NOTES:

- ⊙ -

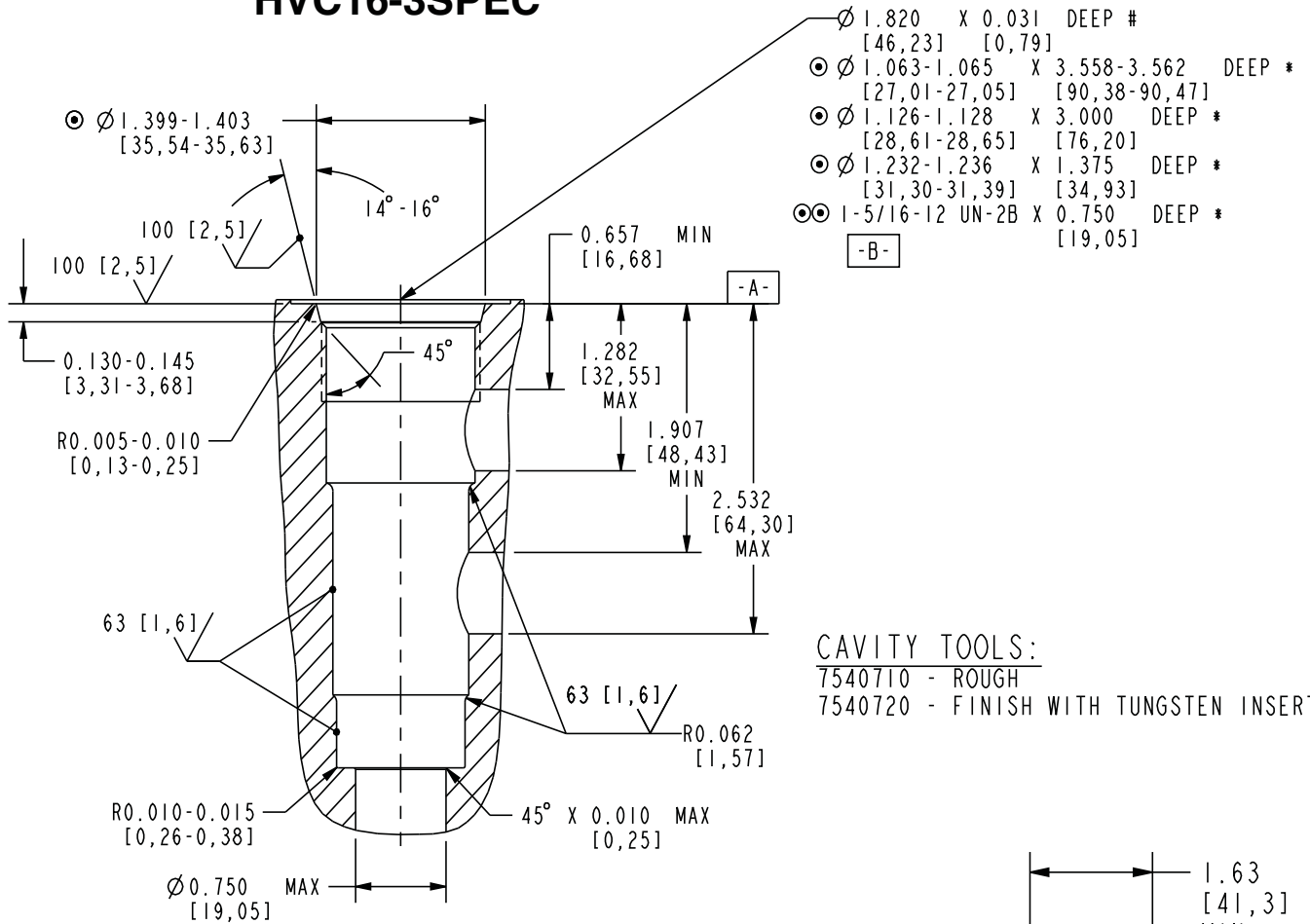
	0.001 [0,025]	A
/	0.002 [0,05]	B
- ⊙⊙ -

	0.001 [0,025]	A
○	0.0009 [0,023]	(PITCH DIA)

- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ±0.005 [0,13] .
- UNSPECIFIED ANGULAR DIMENSIONS ±3° .
- SURFACE FINISH SPECIFICATIONS ARE IN MICROINCHES [MICROMETERS] .

Series 16 Cartridge Cavities

HVC16-3SPEC



- $\varnothing 1.820$ X 0.031 DEEP # [46,23] [0,79]
- $\varnothing 1.063-1.065$ X 3.558-3.562 DEEP * [27,01-27,05] [90,38-90,47]
- $\varnothing 1.126-1.128$ X 3.000 DEEP * [28,61-28,65] [76,20]
- $\varnothing 1.232-1.236$ X 1.375 DEEP * [31,30-31,39] [34,93]
- $\varnothing 1-5/16-12$ UN-2B X 0.750 DEEP * [19,05]

CAVITY TOOLS:
 7540710 - ROUGH
 7540720 - FINISH WITH TUNGSTEN INSERTS

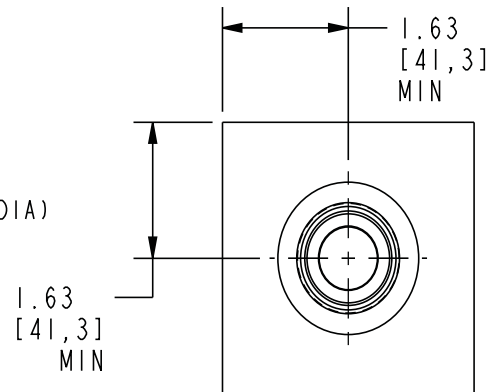
NOTES:

- \varnothing -

	0.001 [0,025]	A
	0.002 [0,05]	B
- $\varnothing \varnothing$ -

	0.001 [0,025]	A
	0.0009 [0,023]	(PITCH DIA)

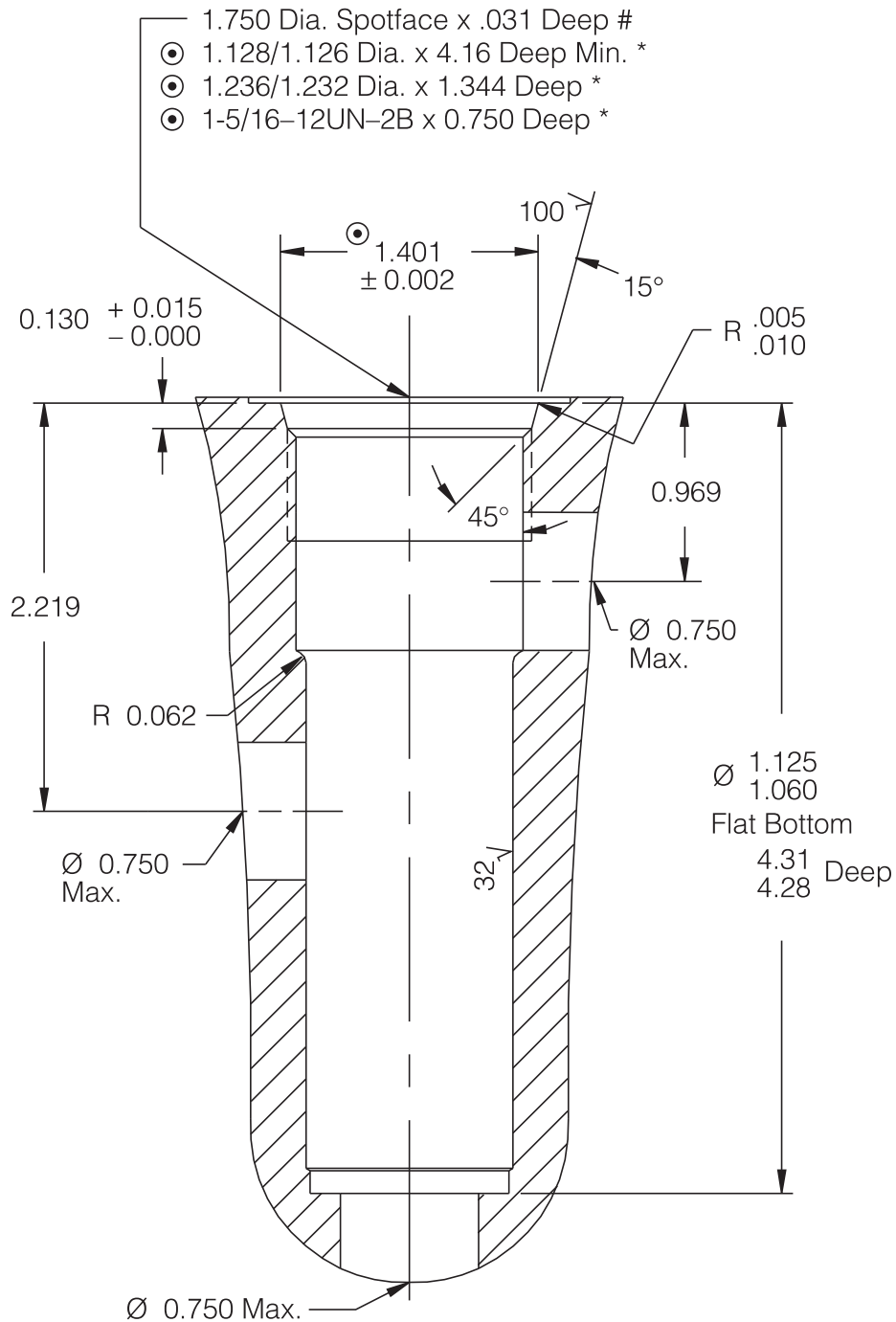
- * - DEPTHS ARE FROM DATUM **-A-**.
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 [0,13].
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.
- SURFACE FINISH SPECIFICATIONS ARE IN MICROINCHES [MICROMETERS].



VALVE HOUSING DETAIL
 SCALE 1:2

Series 16 Cartridge Cavities

VC16-PCV



The above features (except for pilot drill & cross drills) can be machined simultaneously with a form tool.

◎ — These diameters to be concentric within 0.002 T.I.R. and perpendicular to spotface within 0.001 T.I.R.

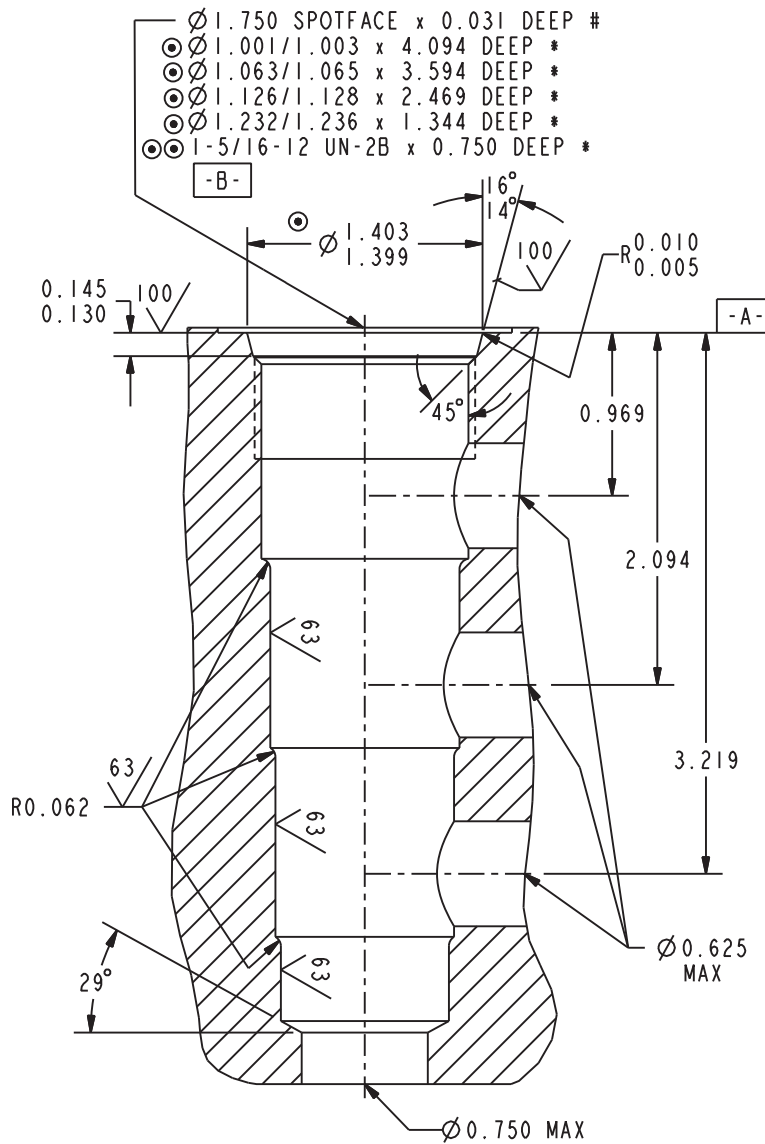
* — Depths are from spotface.

— Unless otherwise specified on machining drawing

Unspecified tolerances are ±0.005.

Series 16 Cartridge Cavities

VC16-4



NOTES:

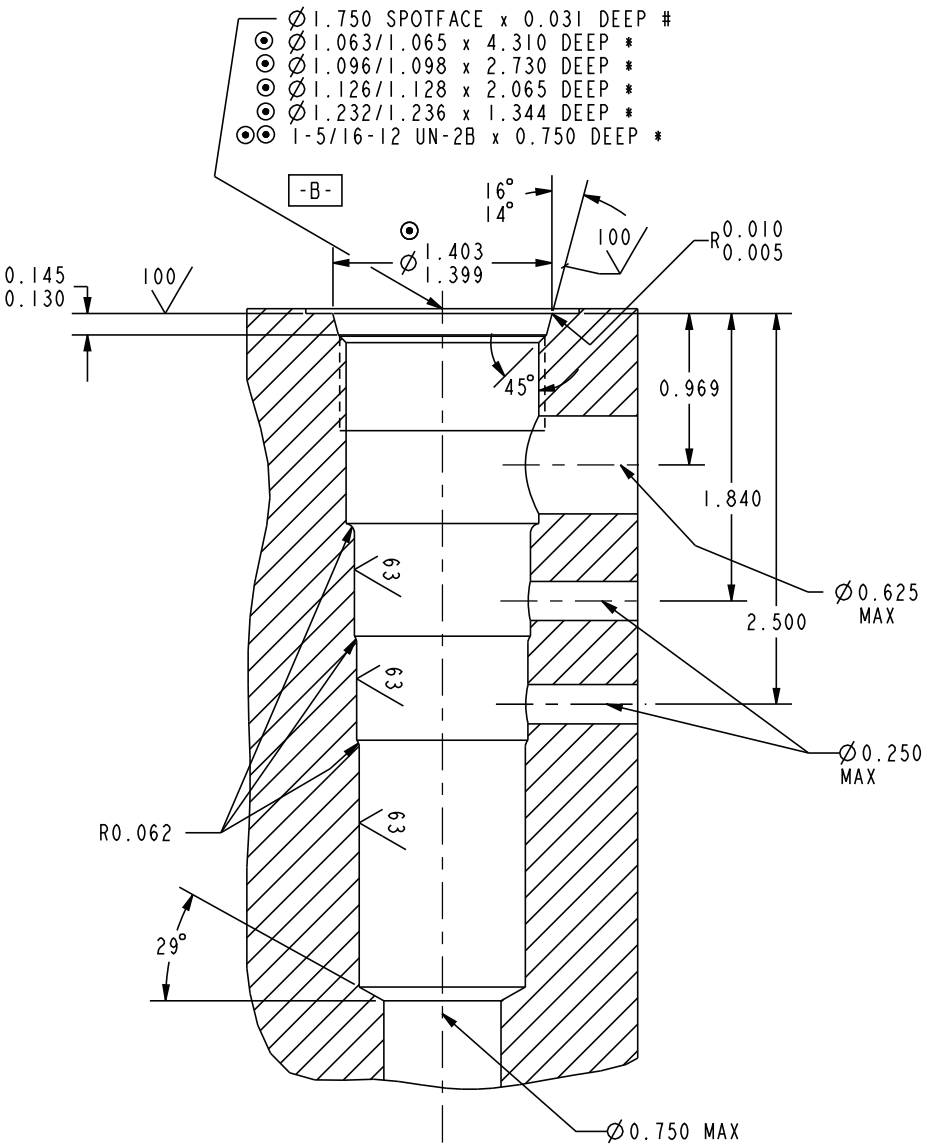
- THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

⊙		0.001	A	⊙ ⊙		0.001	A
		↗	0.002			B	○

- * - DEPTHS ARE FROM DATUM **-A-** .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ±0.005.
- UNSPECIFIED ANGULAR DIMENSIONS ±3°.

Series 16 Cartridge Cavities

VC16-4SPCL



NOTES:

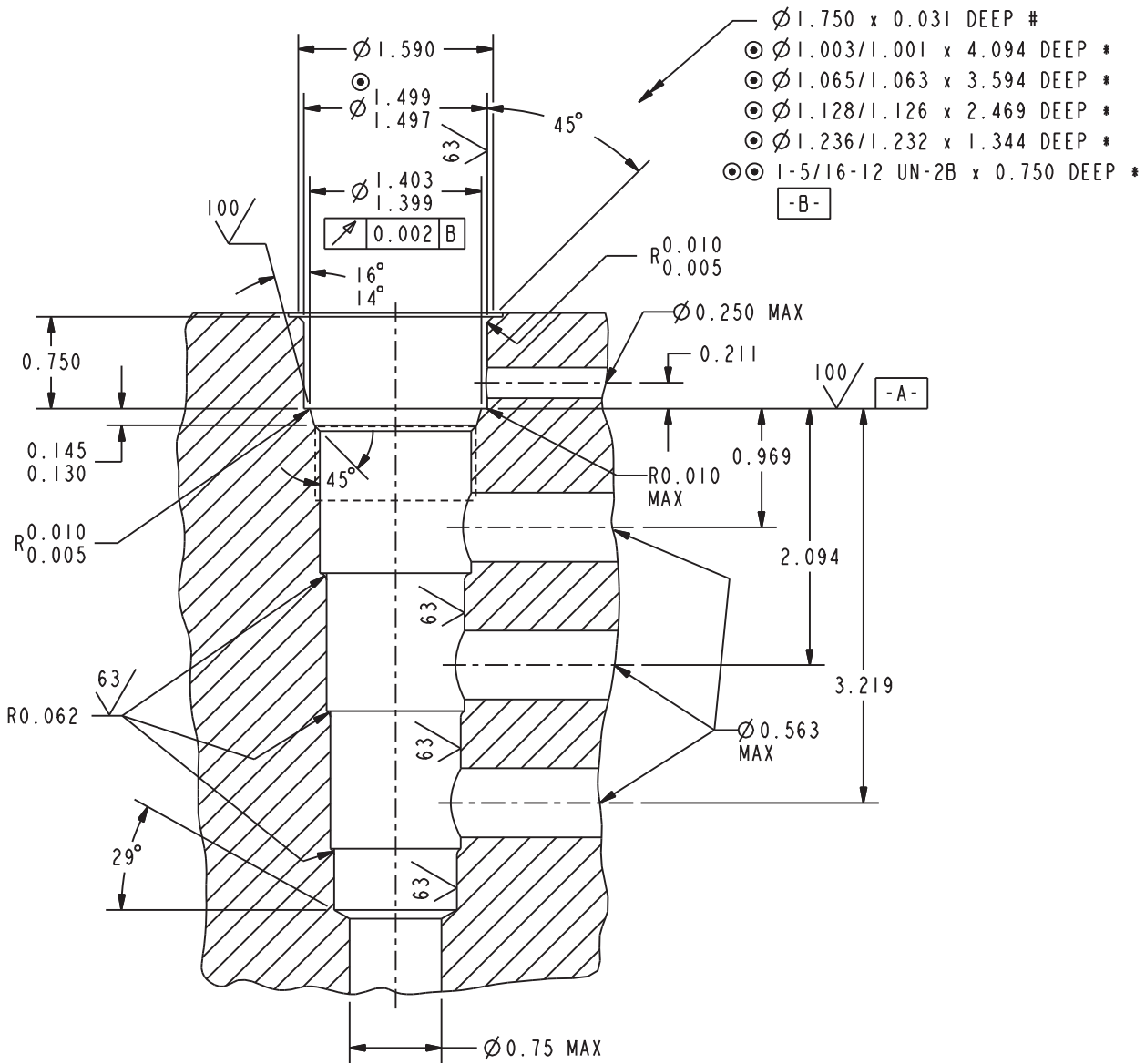
- THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

\odot -	0.001	A	$\odot\odot$ -	0.001	A
		0.002		B	

- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

Series 16 Cartridge Cavities

VC16-S5



NOTES: - THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

\odot -

\perp	0.001	A
∇	0.002	B

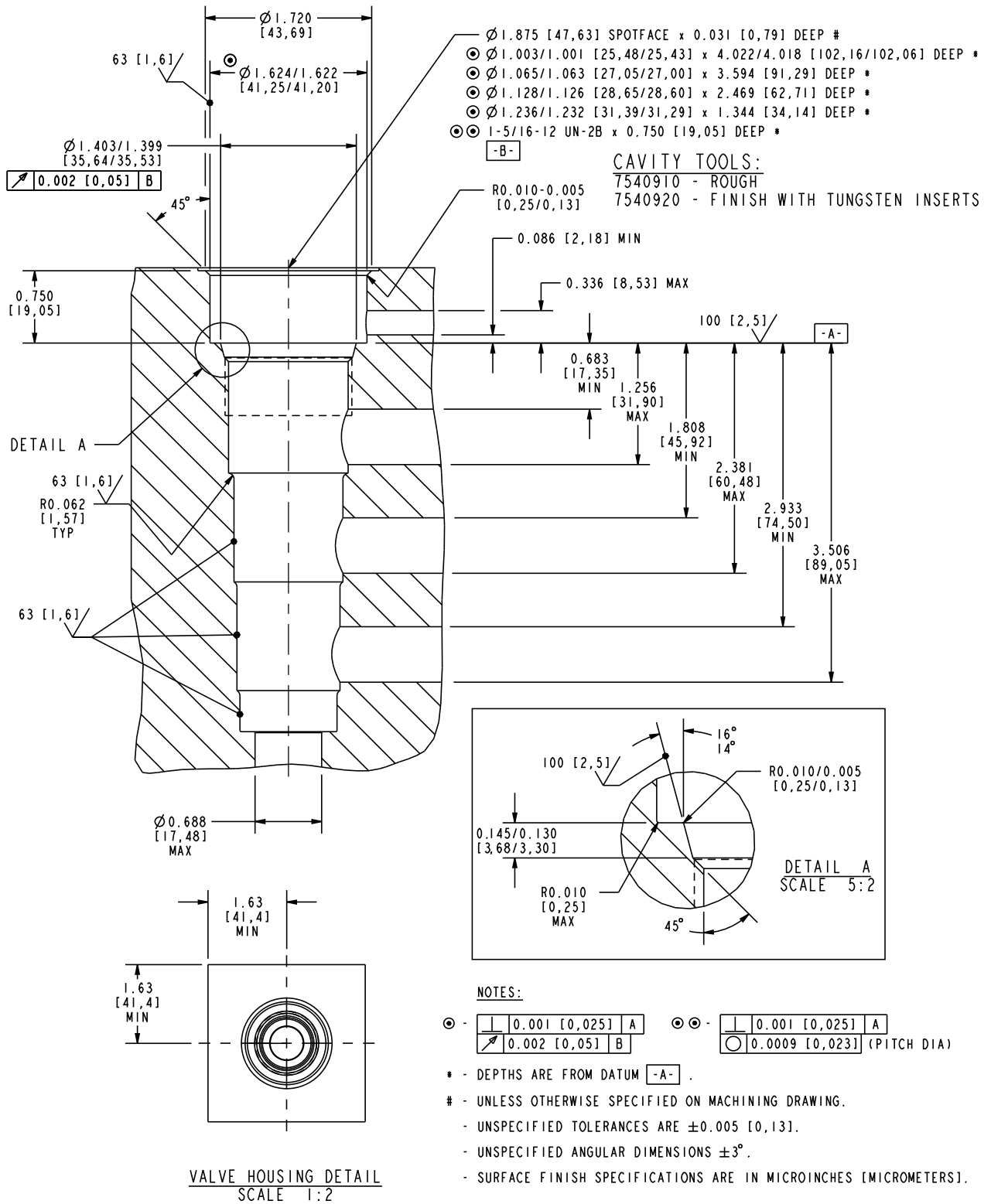
 $\odot \odot$ -

\perp	0.001	A
\bigcirc	0.0009	(PITCH DIA)

- * - DEPTHS ARE FROM DATUM $-A-$.
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 . - UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

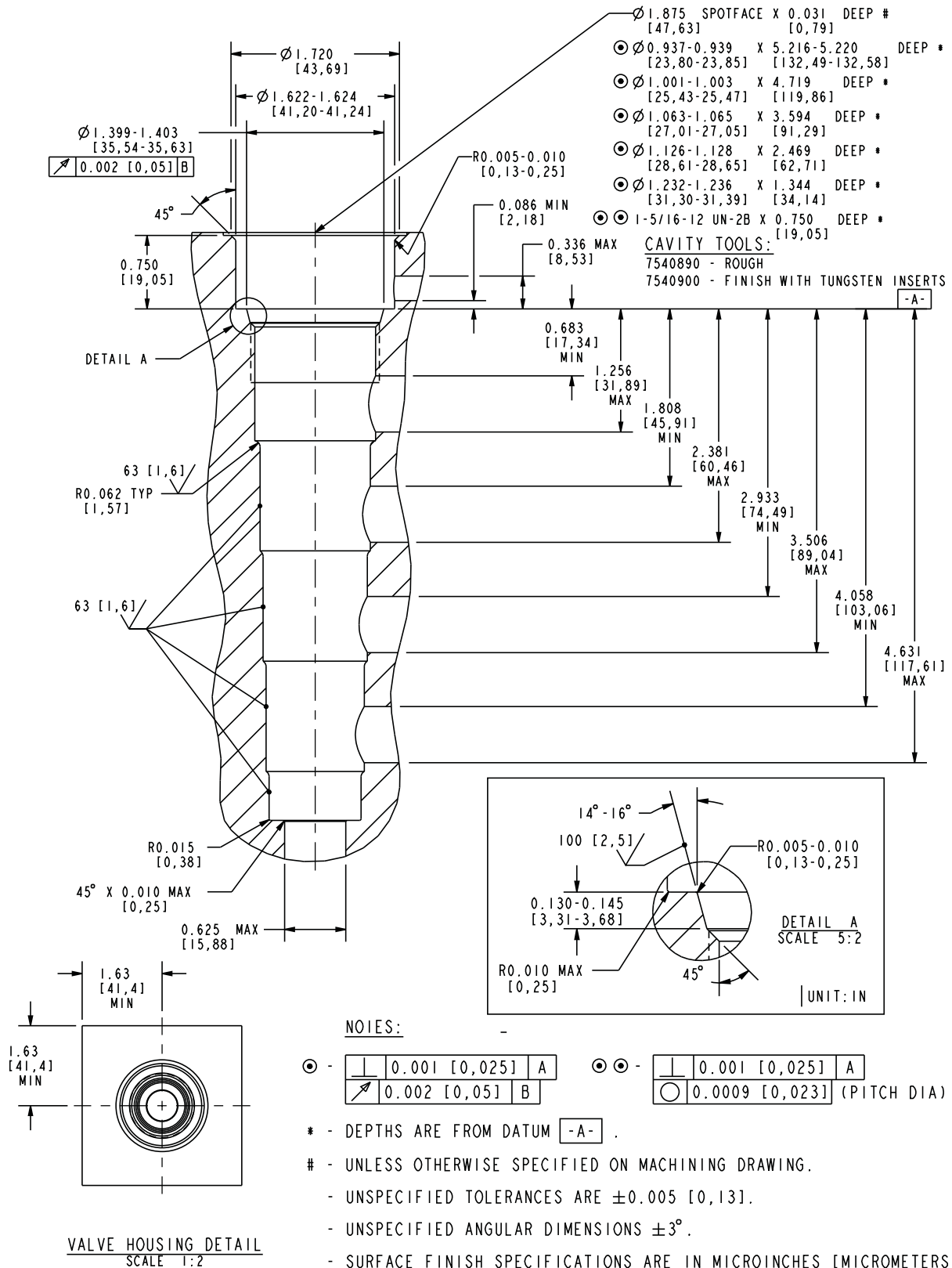
Series 16 Cartridge Cavities

HVC16-S5



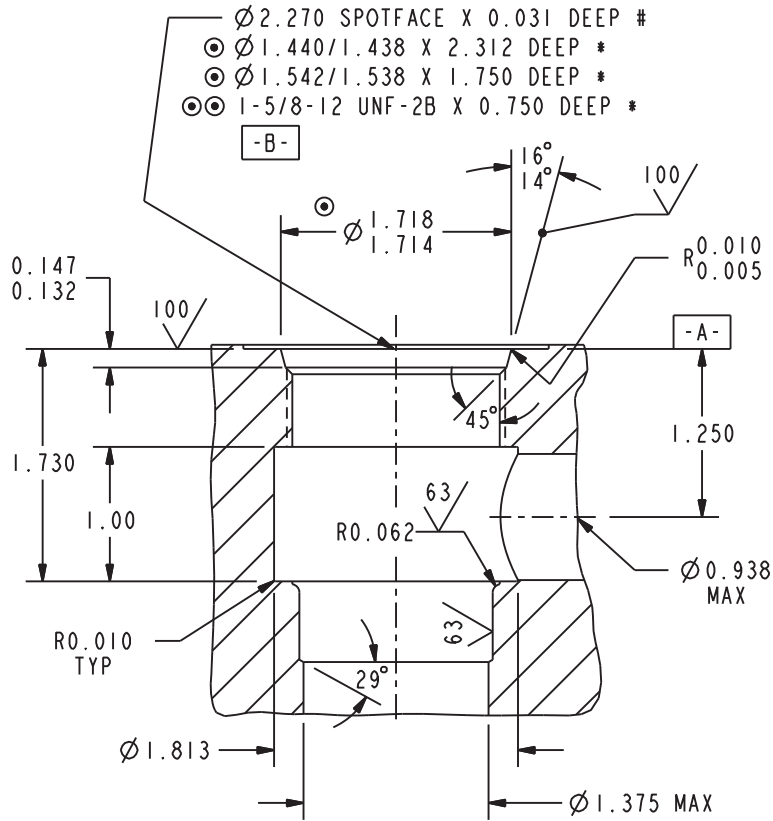
Series 16 Cartridge Cavities

HVC16-S6



Series 20 Cartridge Cavities

VC20-2



NOTES:

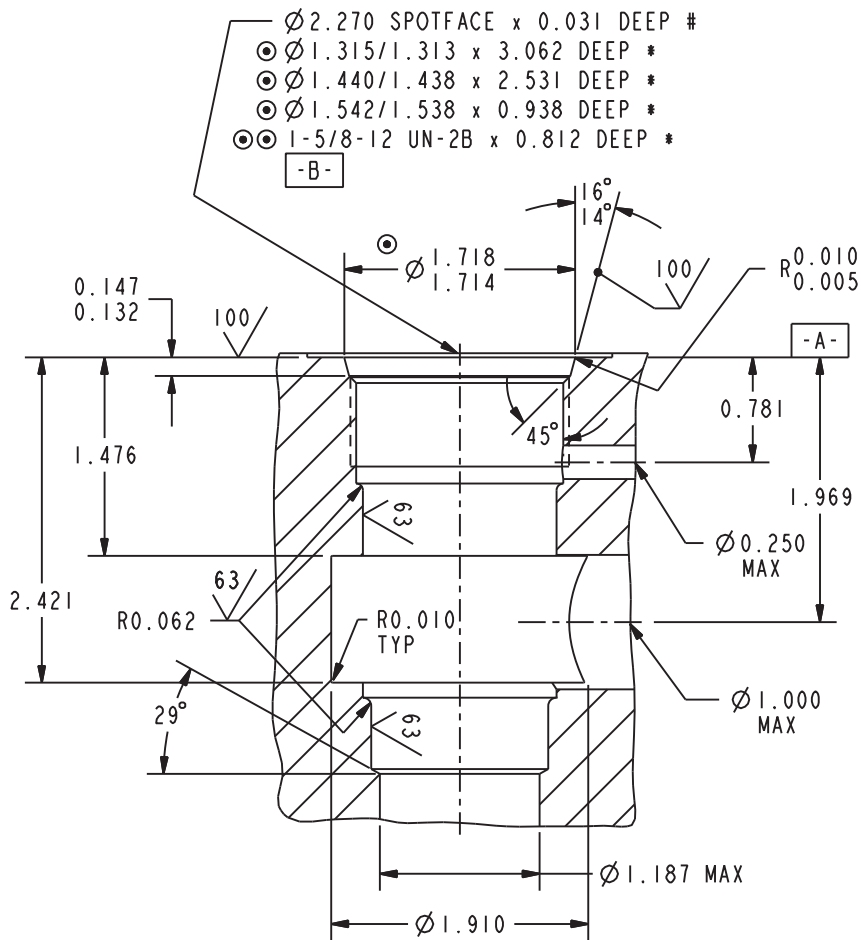
- THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL, CROSS DRILLS AND $\varnothing 1.813$ UNDERCUT) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

\odot	\perp	0.001	A	$\odot \odot$	\perp	0.001	A
	∇	0.002	B		\bigcirc	0.0009	(PITCH DIA)

- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.
- ALL MACHINED SURFACES $\sqrt{125}$ UNLESS OTHERWISE SPECIFIED.

Series 20 Cartridge Cavities

VC20-S3 – Variation “A”



NOTES:

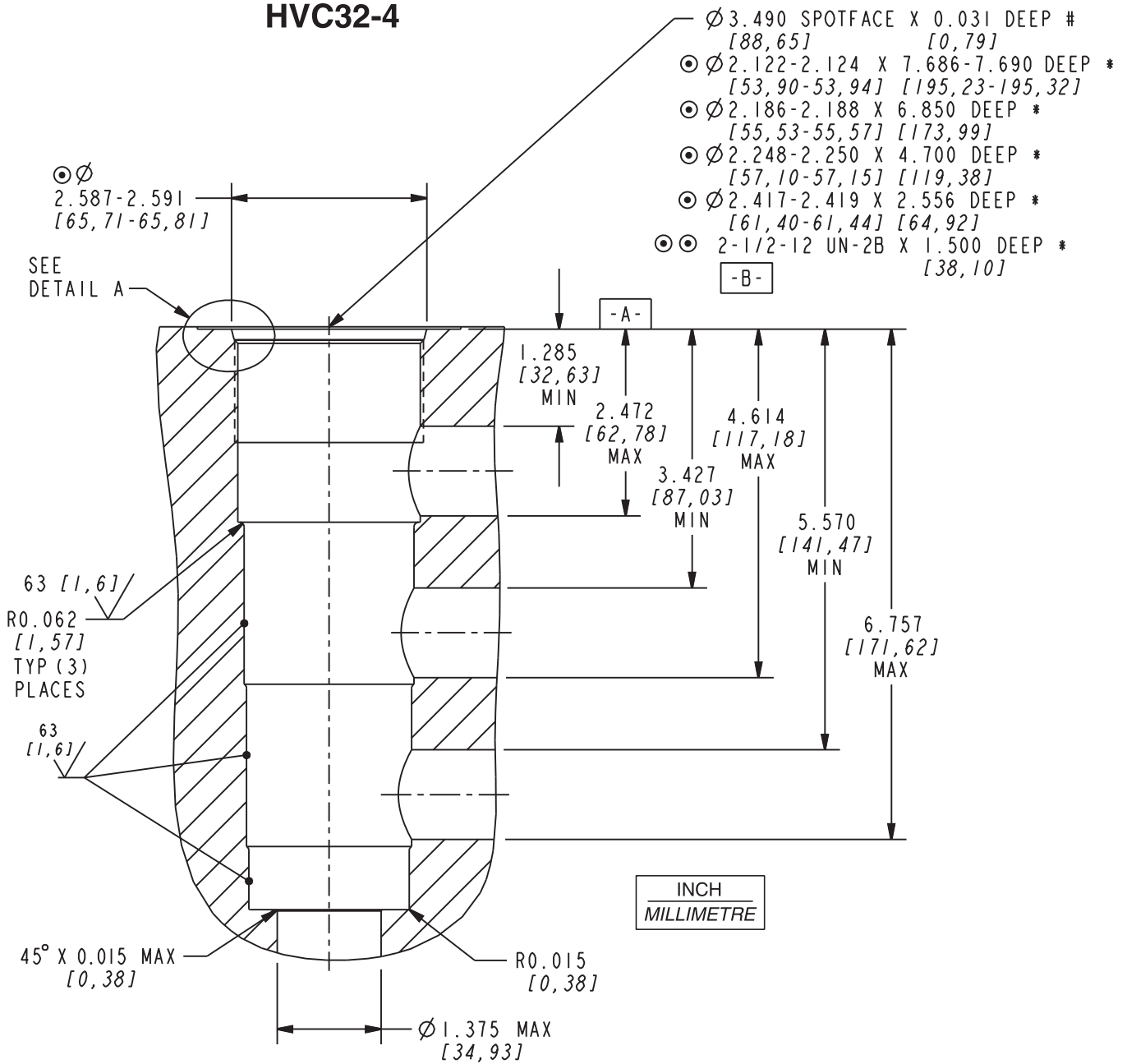
- THE ABOVE FEATURES (EXCEPT FOR PILOT DRILL AND CROSS DRILLS) CAN BE MACHINED SIMULTANEOUSLY USING HYDRAFORCE FORM TOOLS. CONSULT FACTORY.

\odot -	0.001	A	$\odot \odot$ -	0.001	A
	0.002	B		0.0009	(PITCH DIA)

- * - DEPTHS ARE FROM DATUM **-A-** .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 .
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.

Series 32 Cartridge Cavities

HVC32-4



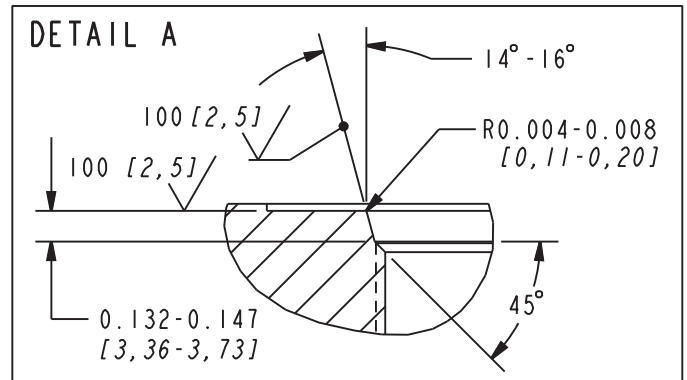
\odot -

\perp	0.001 [0,025]	A
∇	0.002 [0,05]	B

$\odot \odot$ -

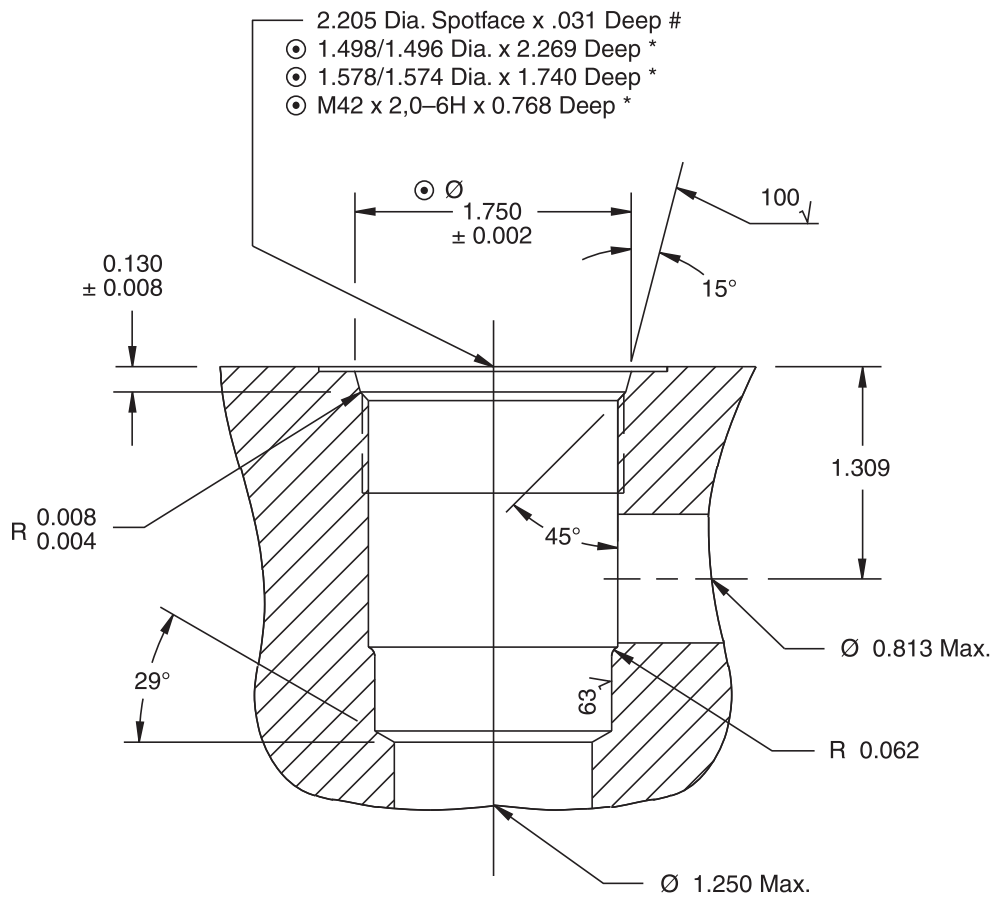
\perp	0.001 [0,025]	A
\bigcirc	0.0009 [0,023]	(PITCH DIA)

- * - DEPTHS ARE FROM DATUM -A- .
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
- UNSPECIFIED TOLERANCES ARE ± 0.005 [0,13].
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$.
- SURFACE FINISH SPECIFICATIONS ARE IN MICROINCHES [MICROMETERS].



Series 42 Cartridge Cavities

VC42-M2



The above features (except for pilot drill & cross drills) can be machined simultaneously with a form tool.

◎ — These diameters to be concentric within 0.002 T.I.R. and perpendicular to spotface within 0.001 T.I.R.

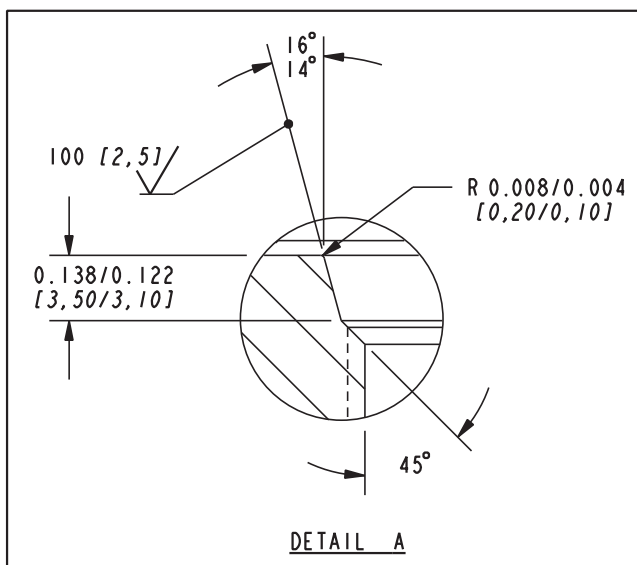
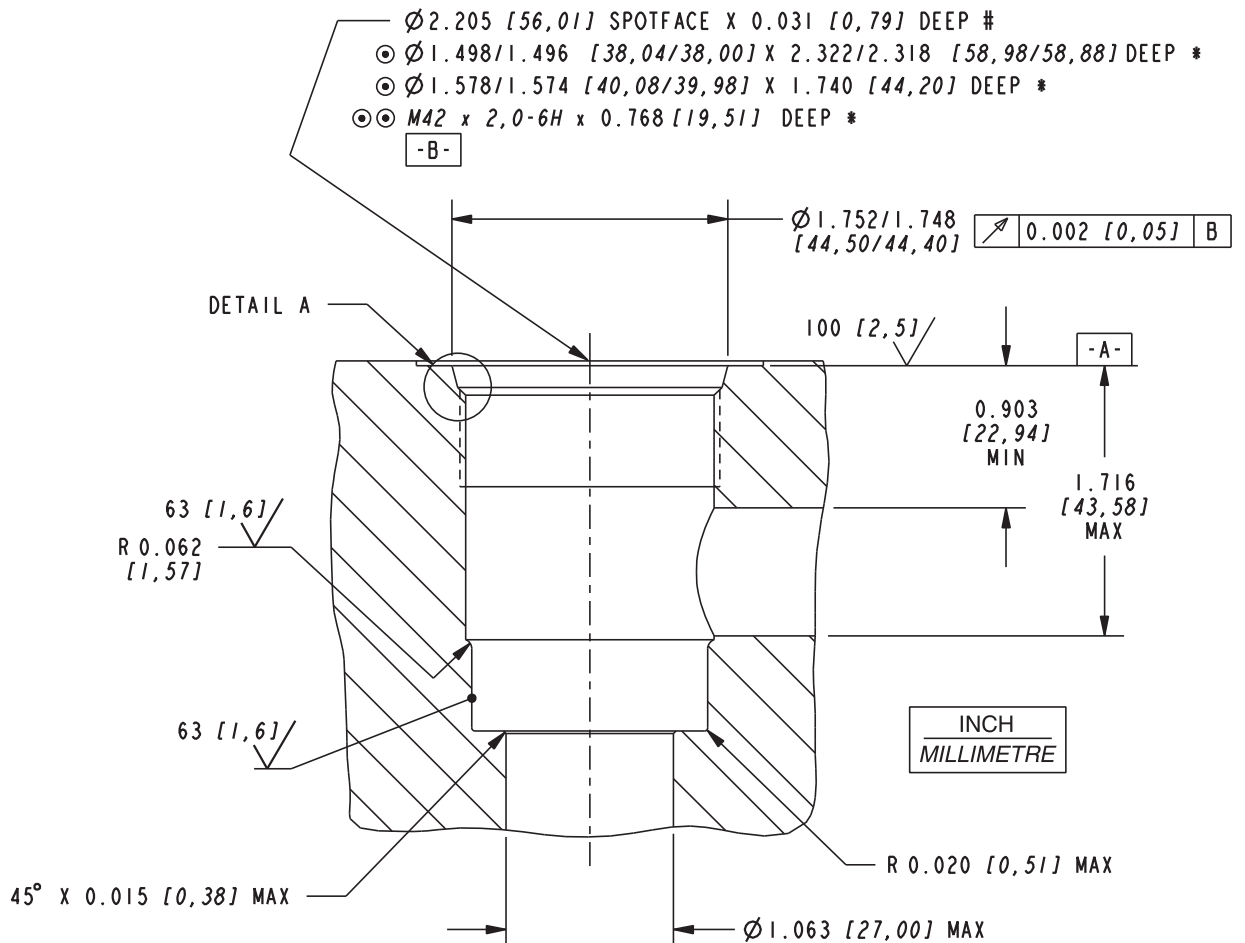
* — Depths are from spotface.

— Unless otherwise specified on machining drawing

Unspecified tolerances are ±0.005.

Series 42 Cartridge Cavities

HVC42-M2



- \odot -

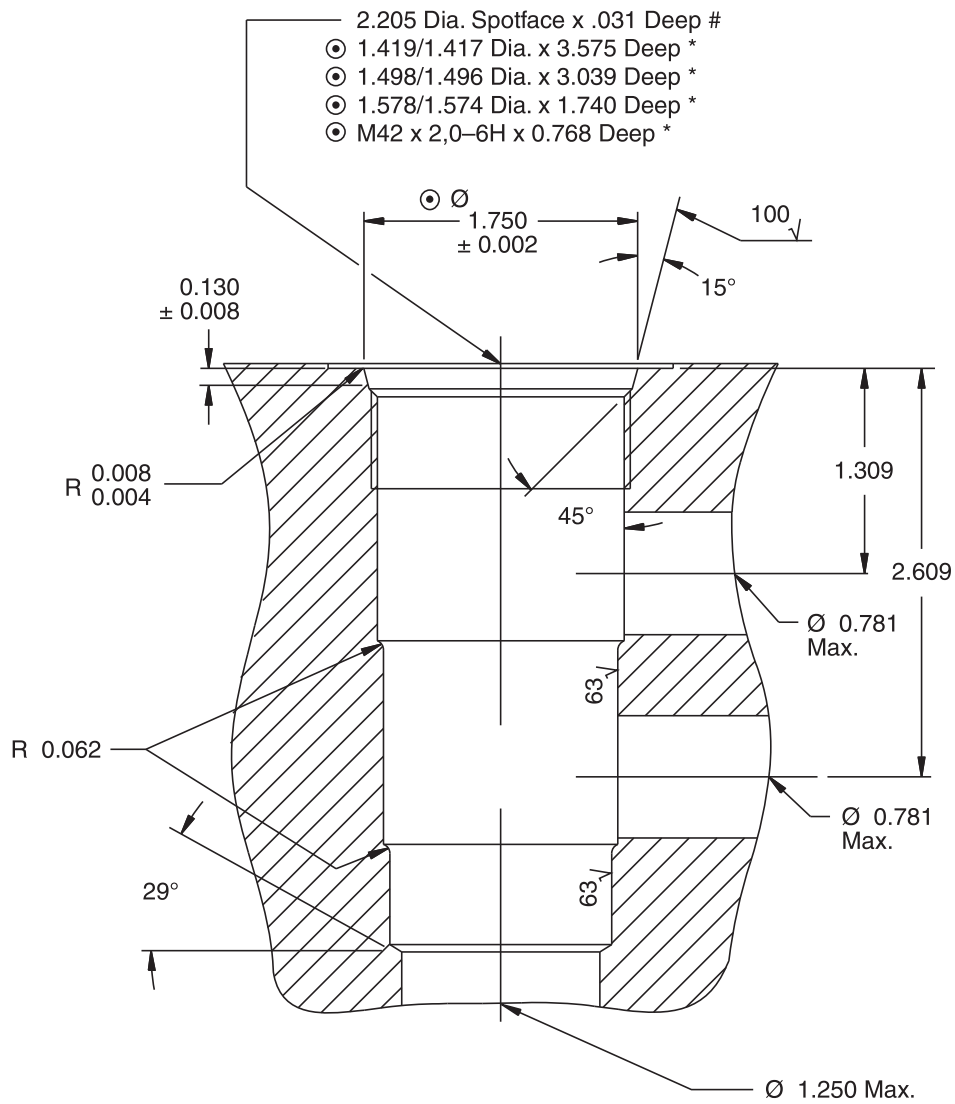
$\sqrt{\quad}$	0.001 [0,025]	A
$\sqrt{\quad}$	0.002 [0,05]	B
- $\odot \odot$ -

$\sqrt{\quad}$	0.001 [0,025]	A
\bigcirc	0.0009 [0,023]	(PITCH DIA)

- * - DEPTHS ARE FROM DATUM **-A-**
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING
- UNSPECIFIED TOLERANCES ARE ± 0.005 [0,13]
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$
- SURFACE FINISH SPECIFICATIONS ARE IN MICROINCHES [MICROMETERS]

Series 42 Cartridge Cavities

VC42-M3

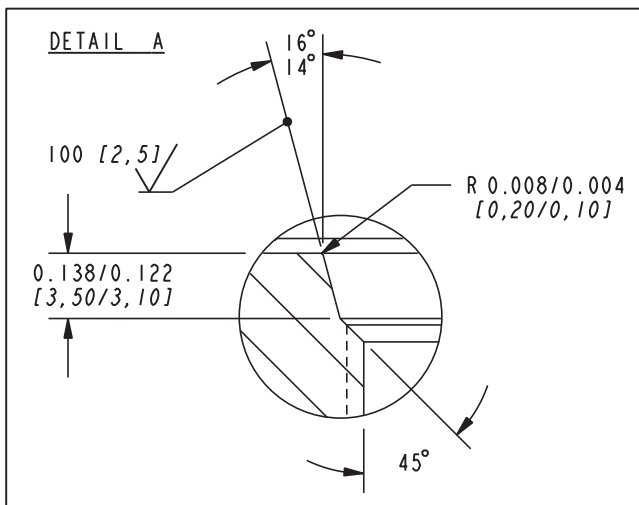
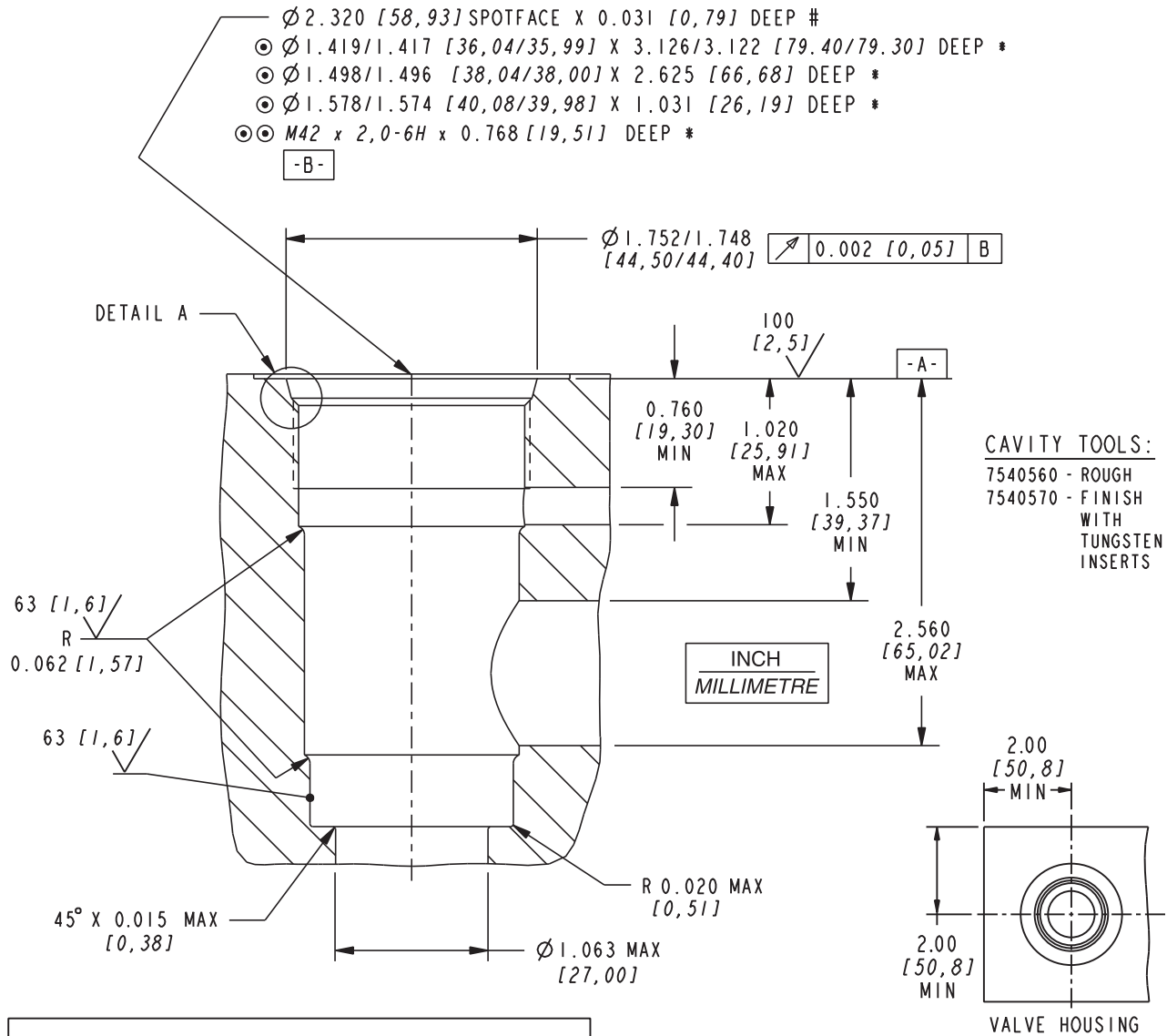


The above features (except for pilot drill & cross drills) can be machined simultaneously with a form tool.
 ◎ — These diameters to be concentric within 0.002 T.I.R. and perpendicular to spotface within 0.001 T.I.R.
 * — Depths are from spotface.
 # — Unless otherwise specified on machining drawing

Unspecified tolerances are ±0.005.

Series 42 Cartridge Cavities

HVC42-S3

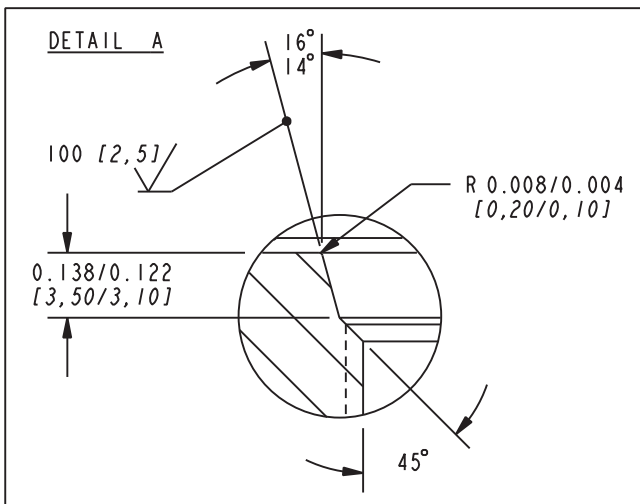
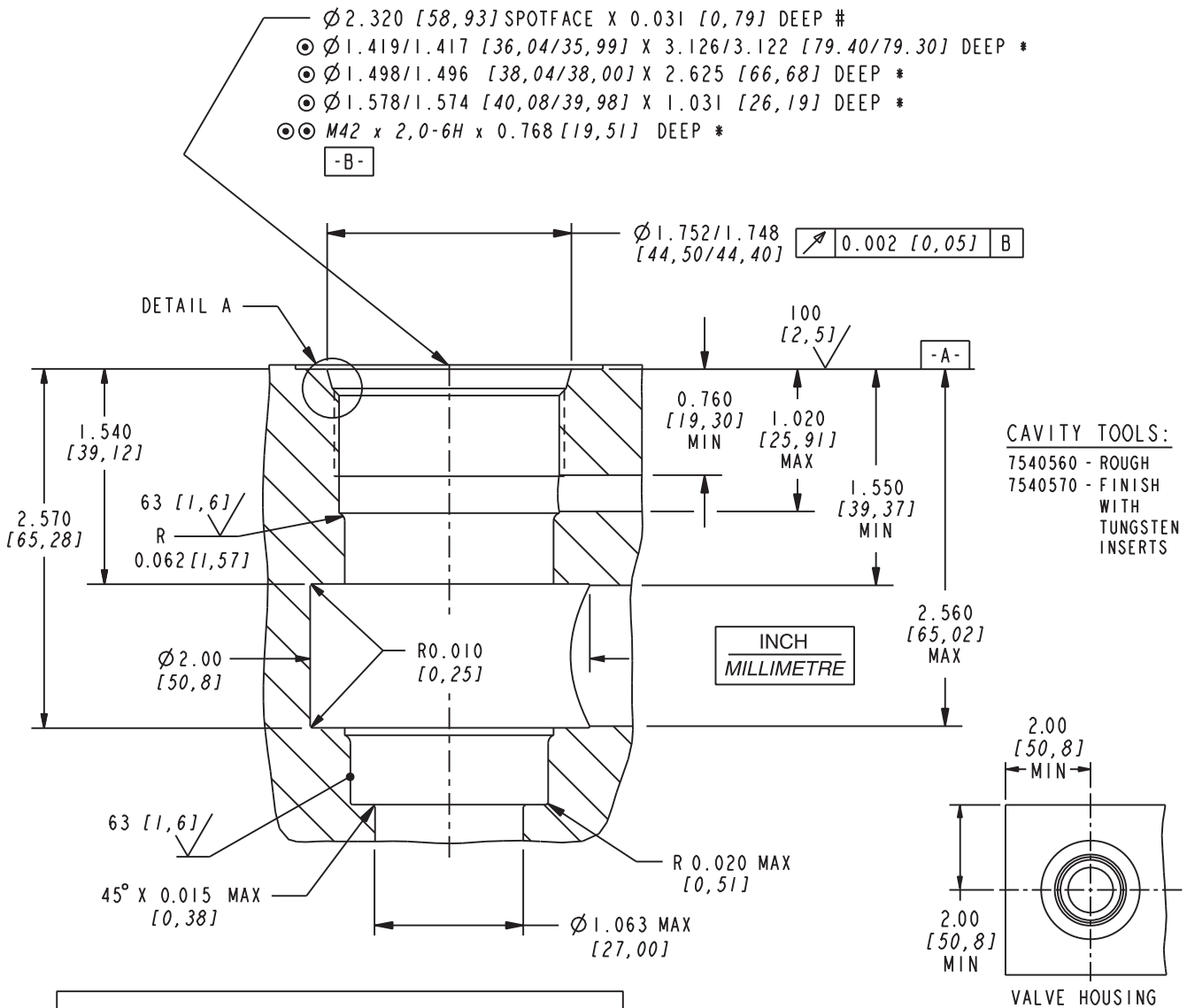


- \odot - $\sqrt{0.001}$ [0,025] A
 $\sqrt{0.002}$ [0,05] B
- $\odot \odot$ - $\sqrt{0.001}$ [0,025] A
 $\bigcirc 0.0009$ [0,023] (PITCH DIA)

- * - DEPTHS ARE FROM DATUM -A-
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING
- UNSPECIFIED TOLERANCES ARE ± 0.005 [0,13]
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$
- SURFACE FINISH SPECIFICATIONS ARE IN MICROINCHES [MICROMETERS]

Series 42 Cartridge Cavities

HVC42-S3A



- \odot -

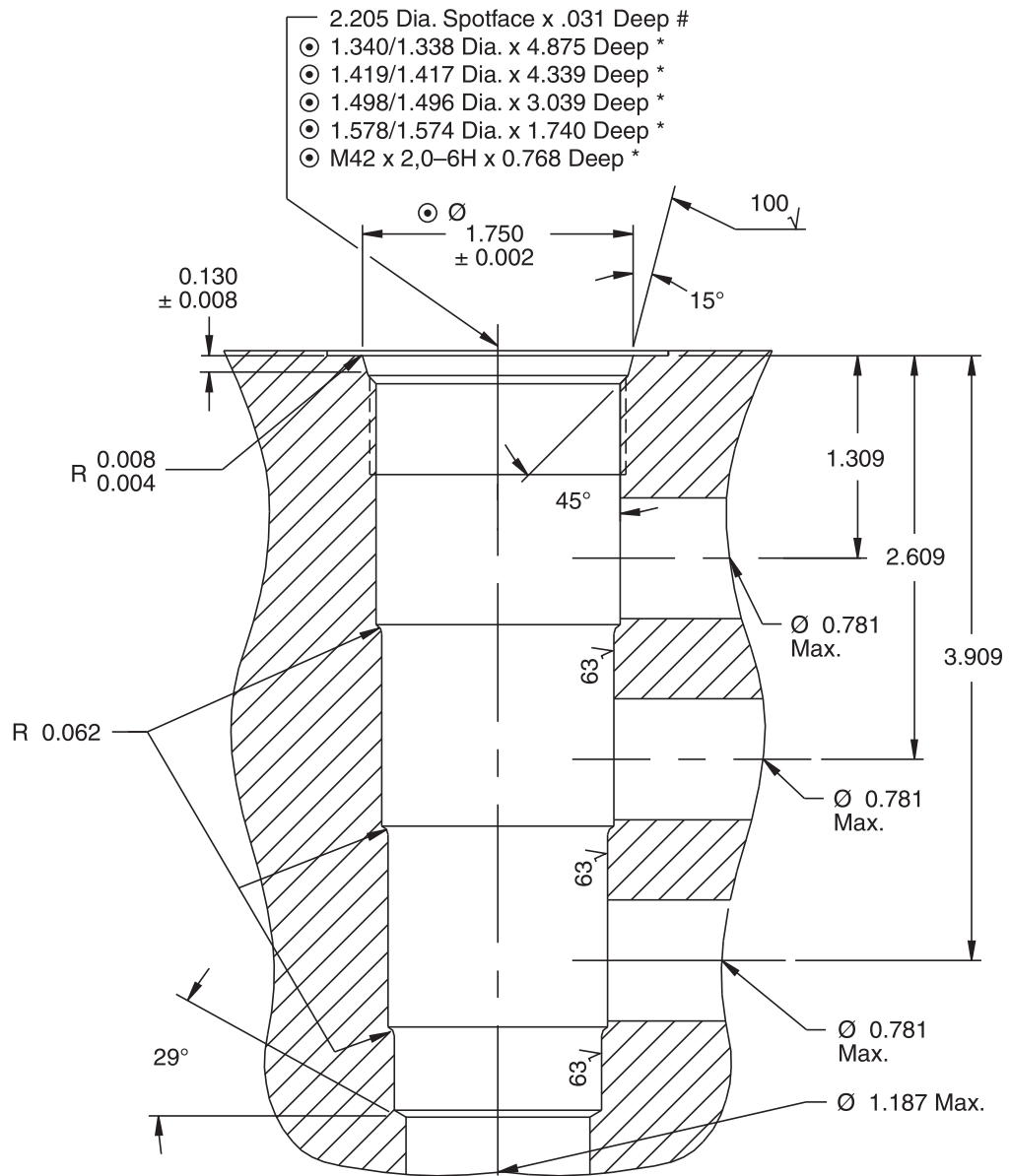
0.001	[0,025]	A
0.002	[0,05]	B
- $\odot \odot$ -

0.001	[0,025]	A
0.0009	[0,023]	(PITCH DIA)

- * - DEPTHS ARE FROM DATUM -A-
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING
- UNSPECIFIED TOLERANCES ARE ± 0.005 [0,13]
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$
- SURFACE FINISH SPECIFICATIONS ARE IN MICROINCHES [MICROMETERS]

Series 42 Cartridge Cavities

VC42-M4



The above features (except for pilot drill & cross drills) can be machined simultaneously with a form tool.

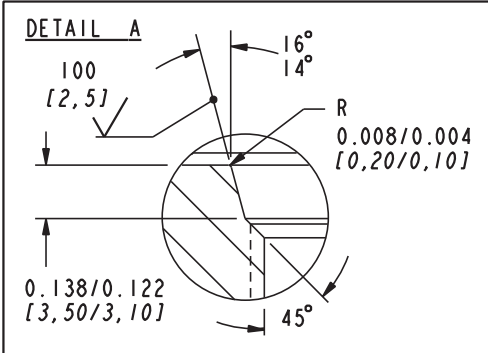
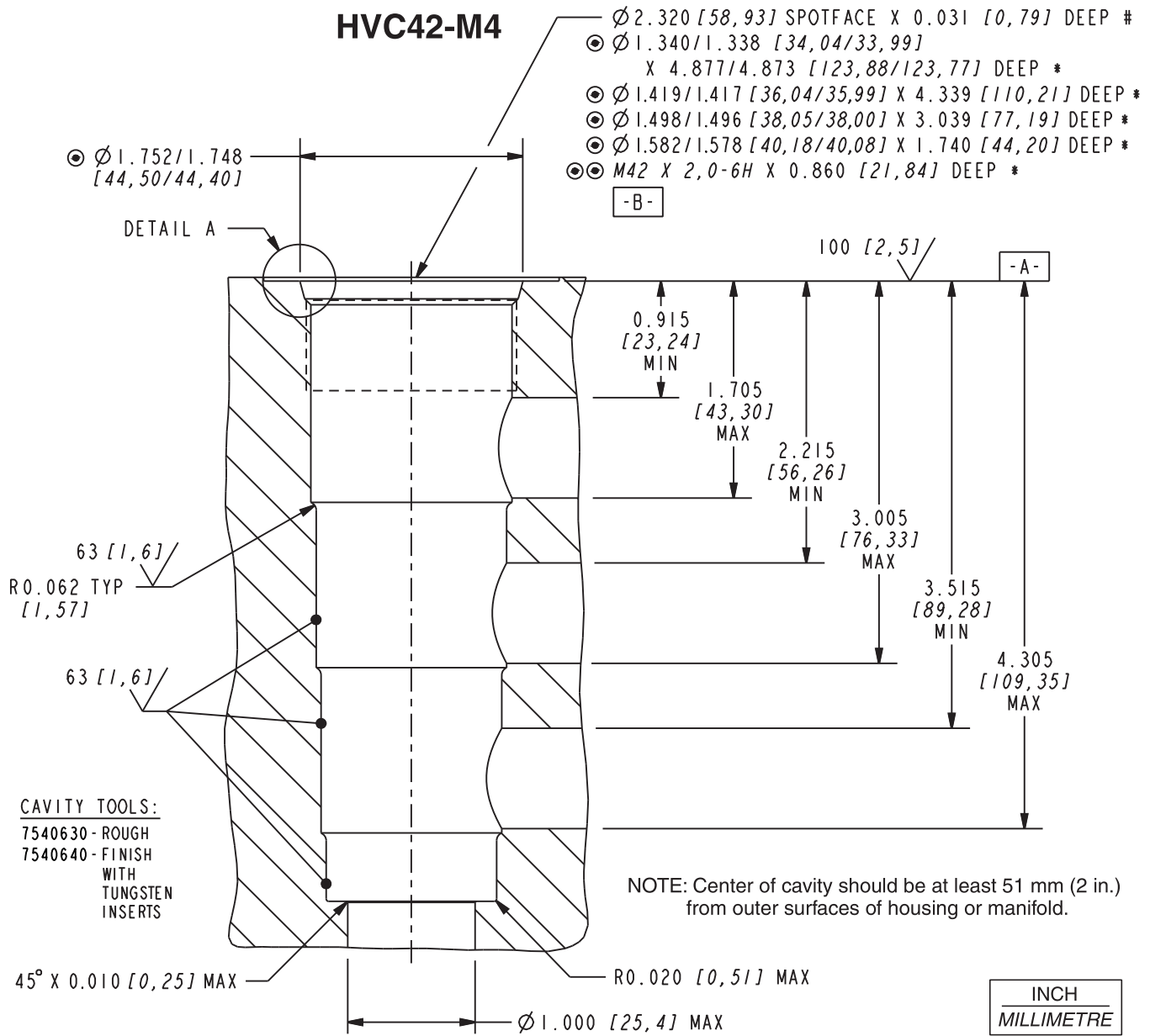
⊙ — These diameters to be concentric within 0.002 T.I.R. and perpendicular to spotface within 0.001 T.I.R.

* — Depths are from spotface.

— Unless otherwise specified on machining drawing

Unspecified tolerances are ±0.005.

Series 42 Cartridge Cavities



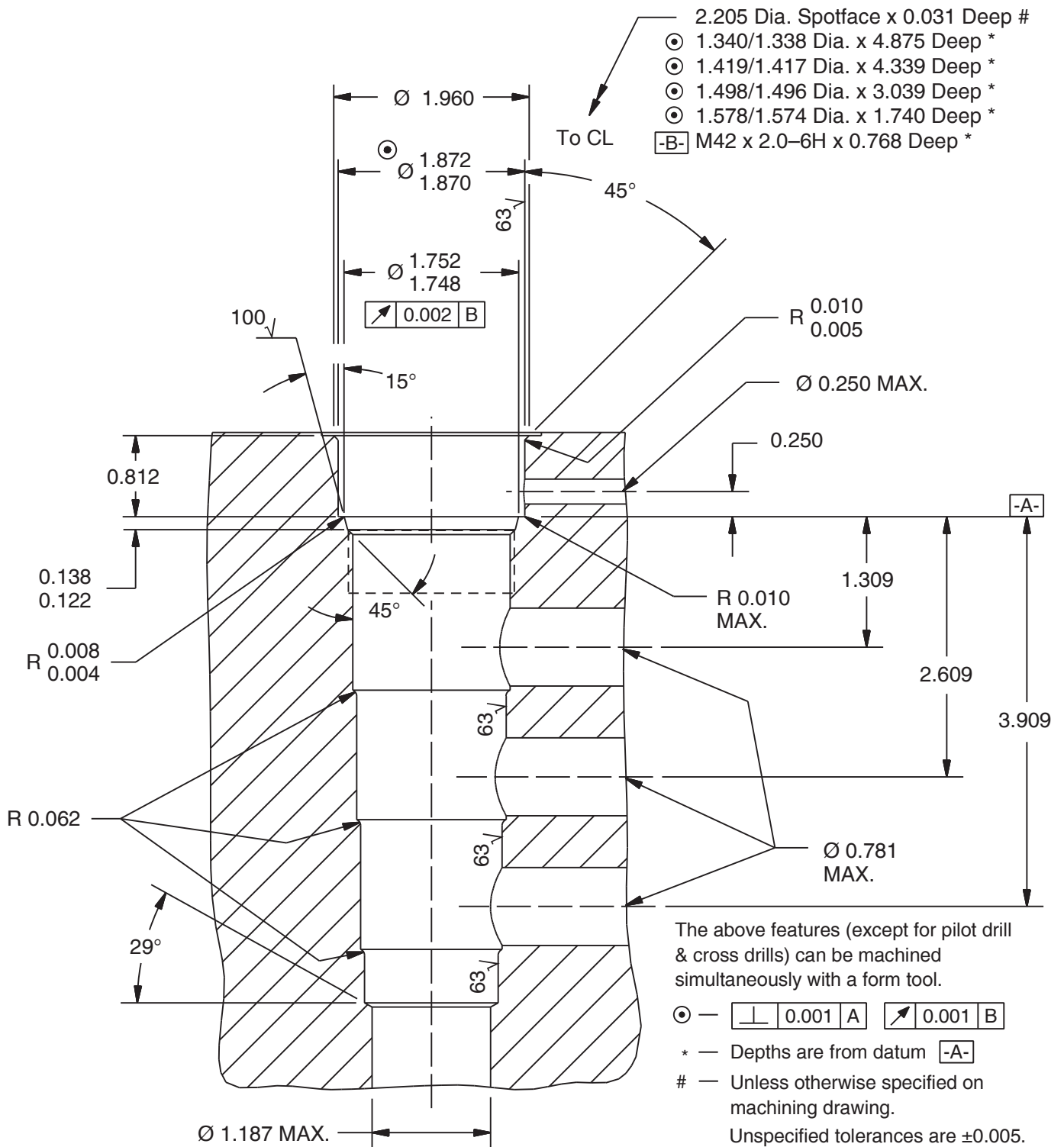
- \odot -

\perp	0.001 [0,025]	A
∇	0.002 [0,05]	B
- $\odot \odot$ -

\perp	0.001 [0,025]	A
\bigcirc	0.0009 [0,023]	(PITCH DIA)
- * - DEPTHS ARE FROM DATUM **-A-**
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING
- UNSPECIFIED TOLERANCES ARE $\pm 0.005 [0,13]$
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$
- SURFACE FINISH SPECIFICATIONS ARE IN MICROINCHES [MICROMETERS]
- ** - CAVITY VARIATION 'A': PILOT DRILL $\varnothing 0.922 [23,42]$ REQUIRED TO MINIMUM DEPTH OF 6.290 [159,77] FROM DATUM A ONLY IF NOTED ON SPECIFIC PRODUCT CATALOG PAGE.

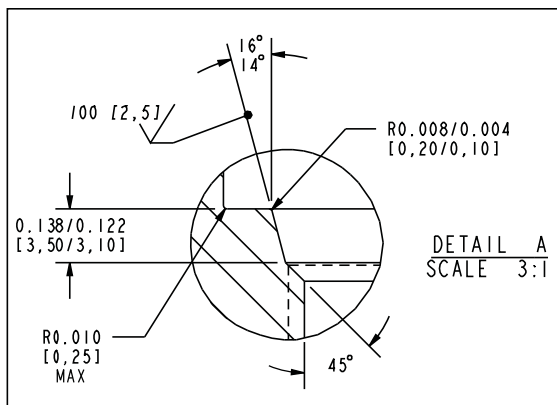
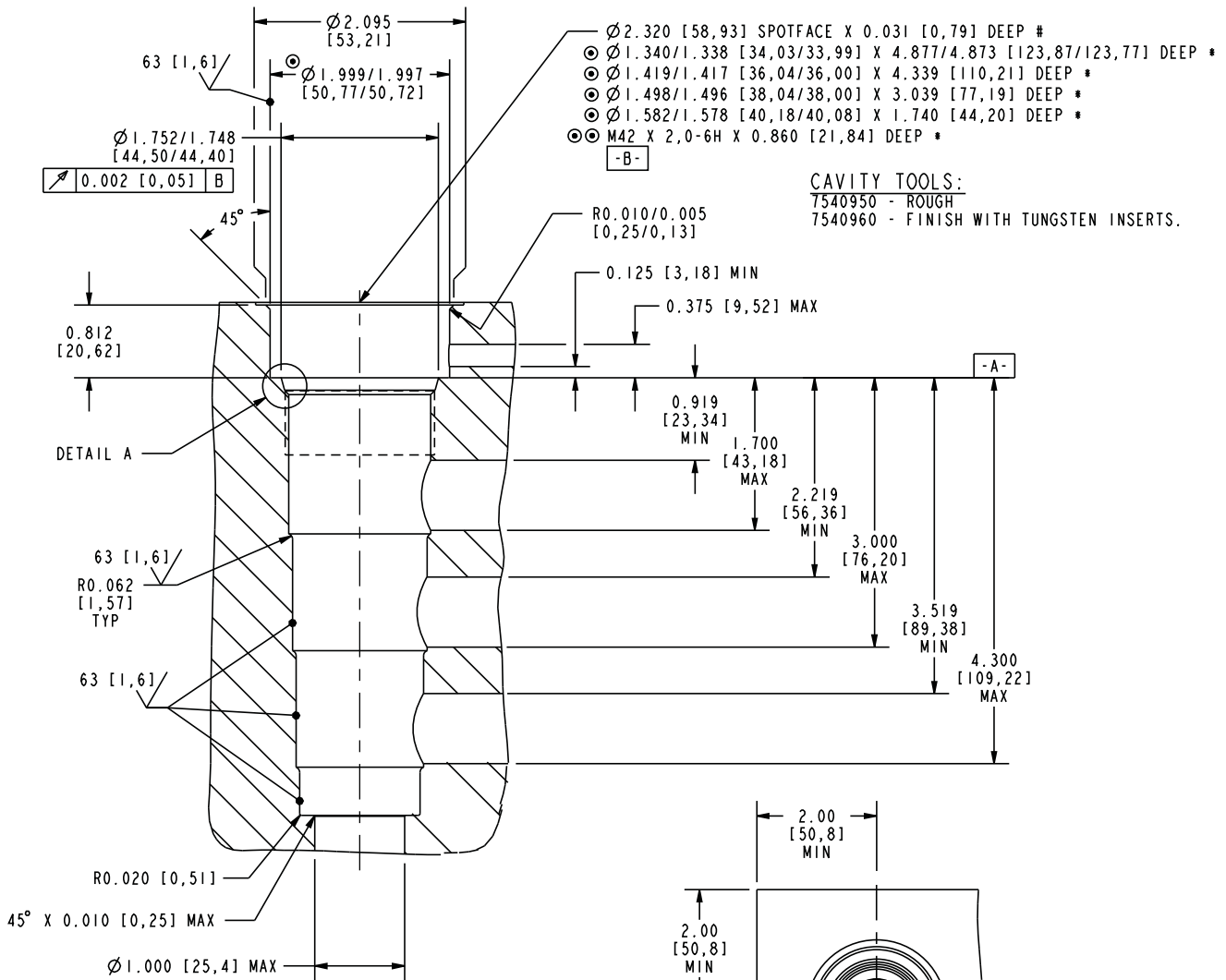
Series 42 Cartridge Cavities

VC42-S5



Series 42 Cartridge Cavities

HVC42-S5



- NOTES:
- ⊙ -

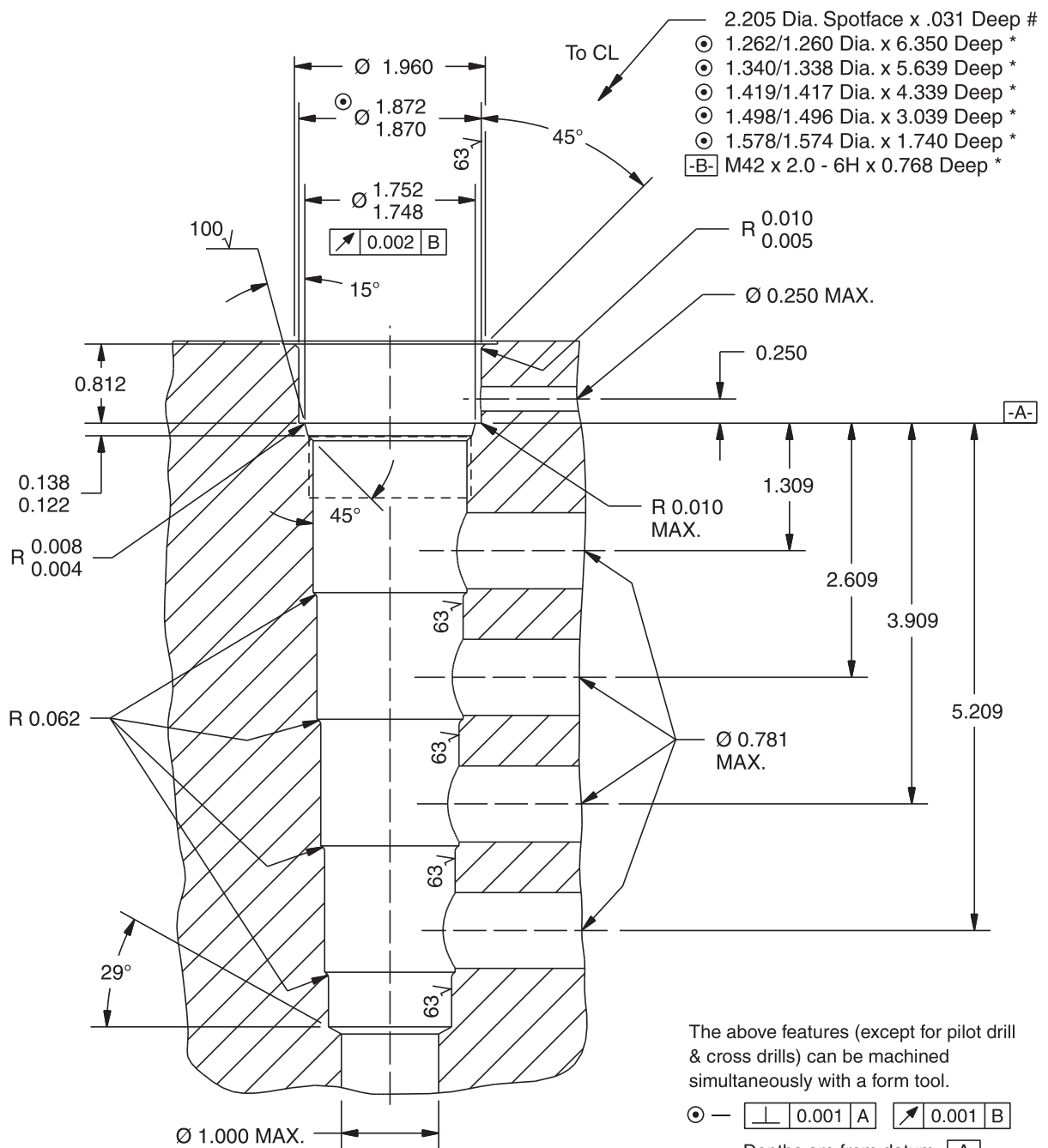
0.001	[0,025]	A
0.002	[0,05]	B

 ⊙ ⊙ -

0.001	[0,025]	A
0.0009	[0,023]	(PITCH DIA)
 - * - DEPTHS ARE FROM DATUM -A- .
 - # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING.
 - UNSPECIFIED TOLERANCES ARE ±0.005 [0,13].
 - UNSPECIFIED ANGULAR DIMENSIONS ±3°.
 - SURFACE FINISH SPECIFICATIONS ARE IN MICRONS [MICROMETERS].

Series 42 Cartridge Cavities

VC42-S6



- 2.205 Dia. Spotface x .031 Deep #
- \odot 1.262/1.260 Dia. x 6.350 Deep *
- \odot 1.340/1.338 Dia. x 5.639 Deep *
- \odot 1.419/1.417 Dia. x 4.339 Deep *
- \odot 1.498/1.496 Dia. x 3.039 Deep *
- \odot 1.578/1.574 Dia. x 1.740 Deep *
- \square -B- M42 x 2.0 - 6H x 0.768 Deep *

The above features (except for pilot drill & cross drills) can be machined simultaneously with a form tool.

\odot — $\perp 0.001$ A $\nearrow 0.001$ B

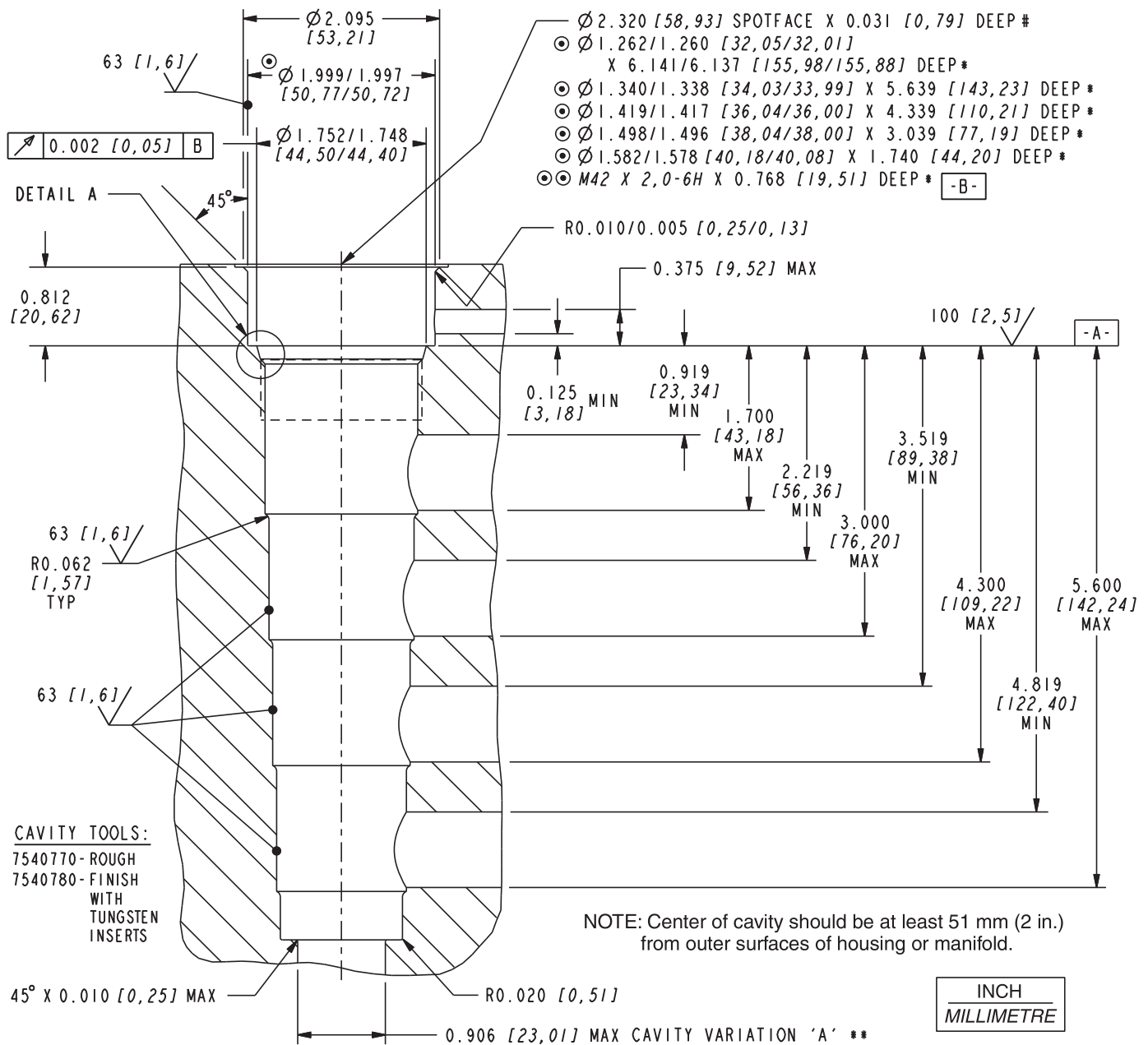
* — Depths are from datum -A-

— Unless otherwise specified on machining drawing.

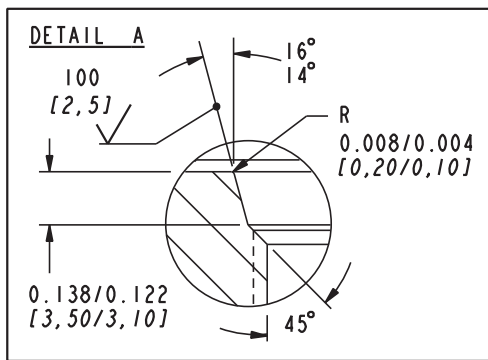
Unspecified tolerances are ± 0.005 .

Series 42 Cartridge Cavities

HVC42-S6



- ◎ $\varnothing 2.320$ [58, 93] SPOTFACE X 0.031 [0, 79] DEEP #
- ◎ $\varnothing 1.262/1.260$ [32, 05/32, 01] X 6.141/6.137 [155, 98/155, 88] DEEP*
- ◎ $\varnothing 1.340/1.338$ [34, 03/33, 99] X 5.639 [143, 23] DEEP*
- ◎ $\varnothing 1.419/1.417$ [36, 04/36, 00] X 4.339 [110, 21] DEEP*
- ◎ $\varnothing 1.498/1.496$ [38, 04/38, 00] X 3.039 [77, 19] DEEP*
- ◎ $\varnothing 1.582/1.578$ [40, 18/40, 08] X 1.740 [44, 20] DEEP*
- ◎◎ M42 X 2,0-6H X 0.768 [19, 51] DEEP* -B-



- ◎ - $\frac{0.001 [0, 025] A}{0.002 [0, 05] B}$
- ◎◎ - $\frac{0.001 [0, 025] A}{0.0009 [0, 023] (PITCH DIA)}$

- * - DEPTHS ARE FROM DATUM -A-
- # - UNLESS OTHERWISE SPECIFIED ON MACHINING DRAWING
- UNSPECIFIED TOLERANCES ARE ± 0.005 [0, 13]
- UNSPECIFIED ANGULAR DIMENSIONS $\pm 3^\circ$
- SURFACE FINISH SPECIFICATIONS ARE IN MICROINCHES [MICROMETERS]
- ** - CAVITY VARIATION 'A': PILOT DRILL $\varnothing 0.922$ [23, 42] REQUIRED TO MINIMUM DEPTH OF 6.290 [159, 77] FROM DATUM A ONLY IF NOTED ON SPECIFIC PRODUCT CATALOG PAGE.

Warranty Information

NOTICE

The data and application materials contained herein are furnished for information only and are believed to be reliable. We cannot assume responsibility for test results achieved by others, over whose test methods and equipment we have no control. It is the user's responsibility to test to determine suitability for the user's purpose and to

adopt such precautions as may be advisable for the protection of property and persons against hazards that may be involved in the handling and use of the product. Because our products are being continuously improved, data contained herein is subject to change without notice.

FIVE YEAR WARRANTY

HydraForce, Inc. warrants to the original purchaser of its products that the products are free from defects in workmanship and material, when operated under normal conditions and in accordance with accepted HydraForce and/or industry recommended practices. HydraForce, Inc. makes no warranty to those defined as consumers in the Magnuson-Moss Warranty - Federal Trade Commission Act. This warranty extends only to the original non-consumer purchaser of the product and is not transferrable.

This warranty shall be in effect for a period of 60 months from the starting date of services, but not to exceed 65 months from the date of manufacture as indicated by the date code stamping.

NOTE: THIS WARRANTY SPECIFICALLY EXCLUDES CARTRIDGE SEALS DUE TO O-RING SHELF LIFE LIMITATIONS. FURTHER, THIS WARRANTY EXCLUDES PRODUCTS NOT OF HYDRAFORCE'S MANUFACTURE WHICH MAY BE INCLUDED AS ADJUNCTIVE PRODUCTS IN MANIFOLDS OR SYSTEMS. THESE PRODUCTS SPECIFICALLY INCLUDE, BUT ARE NOT LIMITED TO, OTHER MANUFACTURERS' CARTRIDGE VALVES, SUBBASE-TYPE VALVES, ELECTRONIC CONNECTORS, SENSORS, CONTROLS, FITTINGS AND FILTERS. WHERE THESE PRODUCTS CARRY ORIGINAL MANUFACTURERS' WARRANTIES, THE WARRANTY PASSES THROUGH HYDRAFORCE TO THE ORIGINAL USER AS PROVIDED WITHIN THE ORIGINAL MANUFACTURER'S WARRANTY. CONSULT FACTORY.

To be eligible for warranty consideration, all product items must be covered by acceptable documentation and received at the HydraForce, Inc. factory within (3) months of the date of claim according to the requirements of the HydraForce Returned Goods Policy, as revised, which is considered to be part of this warranty.

This warranty shall not apply to products which, in the sole judgment of HydraForce, Inc., have been inadequately maintained or shelf-preserved, subjected to contamination, negligent handling, improper installation, tampering or unauthorized dis-assembly.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE AND OF ANY OTHER OBLIGATIONS OR LIABILITY ON THE PART OF HYDRAFORCE, INC.

The purchaser is solely responsible for determining suitability for use. HydraForce, Inc. neither assumes nor authorizes any other person to assume for it any liability in connection with a new product.

HYDRAFORCE, INC. SHALL NOT BE LIABLE, UNDER ANY CIRCUMSTANCES, FOR ANY LOSS OF PROFITS OR ANY OTHER CONTINGENT, CONSEQUENTIAL, OR SPECIAL DAMAGES. SPECIFICALLY, HYDRAFORCE, INC. SHALL NOT BE RESPONSIBLE FOR THE COST OF REMOVAL OF THE PRODUCT, DAMAGES DUE TO REMOVAL, OR ANY OTHER COSTS INCURRED IN SHIPPING THE PRODUCT TO AND FROM THE PLANT OF MANUFACTURE, OR INCURRED IN THE INSTALLATION OF THE REPAIRED OR REPLACED PRODUCT.

Liability under this warranty is limited to the repair or replacement, at HydraForce, Inc. option, of the products determined to be defective upon examination and to be within the warranty period. This warranty policy does not provide for a refund or credit for defective material. Repaired or replacement product items shall be covered by the terms of this warranty on a pro-rated time basis, which reduces the warranty period by the amount of time the original product was in service.

APPLICATION APPROVALS / LIMITATIONS

It is increasingly common for OEM machinery manufacturers to require of their suppliers that they participate in product design throughout the various stages of development. This is a positive outcome of concurrent design strategies and one in which, if properly executed, should result in more robust machinery, with higher long-term customer satisfaction. As a supplier, HydraForce is committed to supporting our customers in their efforts to make better machines through proper application of our products.

Engineering of machines is a quantitative process. While "soft" issues like operator comfort may be legitimately addressed in QFD exercises and marketing proposals, successful implementation of operation concept requires the listing of "hard" measurements and specifications. Only against comprehensive real numbers and supporting test data, therefore, can an engineer determine whether a product is appropriate for use in an application.

HydraForce stands ready to offer limited approval for an "application" (only) to the extent that the machine developer embodies the "application" with "hard" specifications, typically delivered in written form on engineering drawings, or other documentation. Viewing of machine operation, durability goals, joint participation in FMEA exercises, and OEM supplying applicable Industry Standards information are viewed by HydraForce as extremely useful in the development of a machine specification. However, it is our policy, herein, that any information or other aspect of intended machine operation not transferred to written specification is ineligible for "application approval." Limited application approvals may be authorized only be HydraForce's V.P. Engineering, Engineering Manager, or the company President, and must be in writing.

HydraForce products have been successfully applied in a wide variety of commercial applications and are designed to generally conform to common industrial and mobile performance practices.

HOWEVER, HYDRAFORCE SPECIFICALLY PROHIBITS ANY DISTRIBUTOR, CUSTOMER, OR OTHER THIRD PARTY FROM APPLYING HYDRAFORCE PRODUCTS IN THE FOLLOWING APPLICATIONS, WITHOUT OBTAINING HYDRAFORCE ENGINEERING DEPARTMENT APPROVAL:

- Explosive or hazardous environments
- On-highway or railway vehicles carrying passengers
- Aircraft or aerospace vehicles
- Ordnance equipment
- Nuclear facility equipment
- Life-saving or support equipment
- Amusement Rides
- Non-oil-based hydraulic fluids
- Braking systems in on-highway vehicles

Questions regarding acceptance of applications should be directed to HydraForce Factory Engineering personnel. Acceptance must be obtained in writing and does not constitute suitability for use, which is the sole decision of the machine manufacturer, based on qualification testing of the device.