

1. Purpose:

- 1.1. This procedure is for installation of Farmington Engineering Cv Plugs into holes in metal manifolds and other fluid products. These expansion plugs are designed to fit into holes with a diameter tolerance of $-0/+004$ " ($-0/+0.1$ mm). Machining to this tolerance is accomplished with a simple drilling operation. Secondary reaming is not recommended. Cv Plugs have a one piece design for fast, easy installation.

2. Procedure Overview:

- 2.1. Installation is accomplished by simply pressing the steel ball into the Cv Plugs, causing the plug to expand, so that its lands and grooves press into the surrounding hole material.

3. Equipment Required:

- 3.1. Standard drill with a 118° point.
- 3.2. Desired size Cv Plugs.
- 3.3. Farmington Engineering hand installation tool for the specific Cv Plugs size. For automated assembly the air hammer tool is required. See Figure 1 and Table A.
- 3.4. Pneumatic air hammer for automatic installations. The Farmington Engineering air hammer tools have a 0.401 " diameter shank that is designed to fit most of the standard pneumatic tools. Farmington Engineering offers pneumatic hammer tools for sale.
- 3.5. Work table with heavy surface to resist impact and reduce noise level.

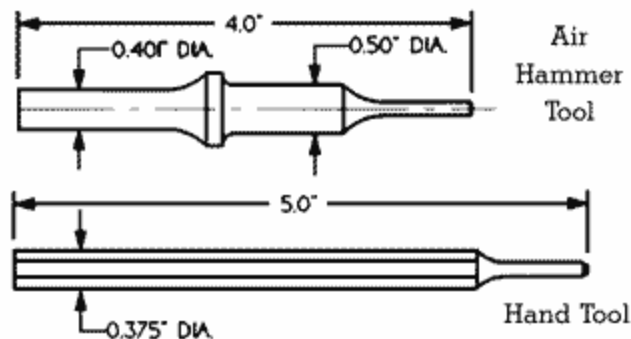


FIGURE 1

4. Hole Preparation:

- 4.1. On a general note, the holes drilled with a standard drill with 118° point should be adequate. The "as drilled" surface finish provides for better plug retention and higher proof pressure than does a reamed surface finish.
- 4.2. Visually inspect the installation hole for proper depth, support shoulder and diameter; and verify that it is free of cutting oils, grease and machining chips.

5. Hand Installation:

- 5.1. Place the one piece Cv Plugs assembly into the installation hole so that it contacts the shoulder at the bottom of the hole. The plug must be flush with or any distance below the surface of the part. See Figure 2.

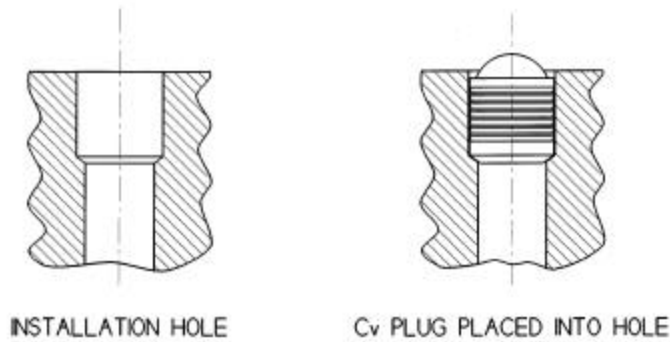


FIGURE 2

- 5.2. Using the proper Farmington Engineering hand tool from Table A, press the ball into the plug. The ball should be pressed to a flush or a slightly below flush condition. The ball depth tolerance is $+0/-0.010$ " ($+0/-0.25$ mm).
- 5.3. Caution should be used to avoid overdriving the ball into the plug. See Figure 3.

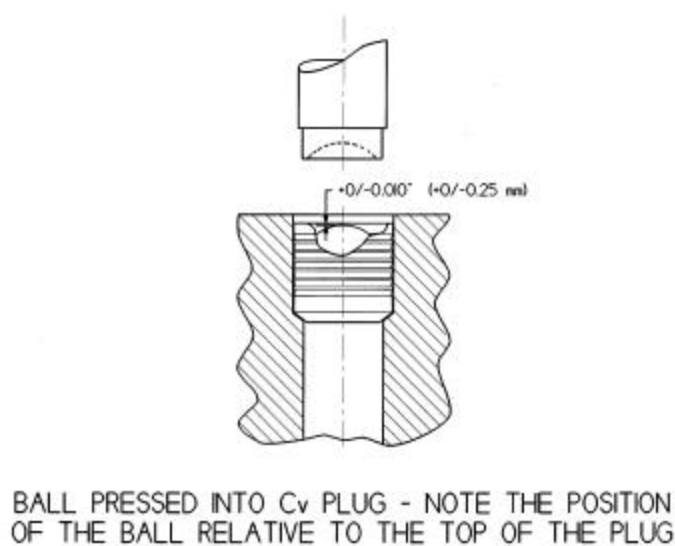


FIGURE 3

- 5.4. Pressing the ball into the plug can be accomplished by using the hand installation tool in combination with a hand held hammer, manual arbor press or pneumatic/hydraulic press. When using a hammer a few sharp blows are more effective than numerous small blows.
- 5.5. Installation force estimates for specific Cv Plugs and hole material combinations are available. Contact Farmington Engineering for further information.
- 5.6. Cv Plugs provide for a reliable and consistent proof pressure performance, however, periodic checks of proof pressure should be made to verify that installation is correctly accomplished.

6. Automatic Installation:

- 6.1. Place the one piece Cv Plugs assembly into the hole so that it bottoms on the shoulder at the bottom of the hole. The plug must be flush or below the surface of the part.
- 6.2. Select the proper Farmington Engineering air hammer tool from Table A, and install into the pneumatic air hammer.
- 6.3. Set the shop air pressure to the midpoint of the range recommended in Tables A and B.
- 6.4. Firmly hold the air hammer tool against the Cv Plugs, and activate a 1 to 2 second operation.
- 6.5. A noticeable change in sound will indicate that the tool has completed the installation.
- 6.6. Verify that the ball flushness is within tolerance.
- 6.7. Adjust air pressure to operator preference.

7. Cv Plugs Removal:

- 7.1. Cv Plugs may be removed by simple machining, with ordinary shop tools. The hardness of the 440C and bearing steel balls is controlled by heat treating to Rockwell 38C to 47C, specifically to allow removal. The hardness of the 302 and 316 stainless balls is naturally low to allow for removal.
- 7.2. The removal procedure involves drilling and tapping the steel ball expander to remove the expansion plug.

8. Required Removal Equipment:

- 8.1. See recommended drills and taps sizes in Tables C and D.
- 8.2. Standard bolts with striker.



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9. Removal Procedure:

- 9.1. Drill and tap threads into the steel ball.
- 9.2. Thread a standard bolt with striker into the steel ball and pull the ball from the Cv Plugs.
- 9.3. Drill and tap threads into the I.D. of the Cv Plugs.
- 9.4. Use a standard bolt with striker to pull the plug from the hole.
- 9.5. Check the installation hole tolerances before installing a new Cv Plugs.

10. Further Technical Assistance :

Contact Farmington Engineering technical assistance via e-mail or phone for specific questions:

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English Cv Plugs Installation Tools and Recommended Settings

	Cv Plugs Diameter	Hand Tool Part Number	Air Hammer Tool Part Number	Air Hammer Pressure*	
				PSIG	BAR
English Standard Length	.156"	CVTS040	CVTS040AH	25	1.7
	.187"	CVTS045	CVTS045AH	30	2.1
	.218"	CVTS050	CVTS050AH	35	2.4
	.250"	CVTS060	CVTS060AH	35	2.4
	.281"	CVTS070	CVTS070AH	40	2.8
	.312"	CVTS080	CVTS080AH	40	2.8
	.343"	CVTS090	CVTS090AH	45	3.1
	.375"	CVTS095	CVTS095AH	45	3.1
	.406"	CVTS100	CVTS100AH	45	3.1
	.437"	CVTS110	CVTS110AH	50	3.4
	.468"	CVTS120	CVTS120AH	50	3.4
	.562"	CVTS140	CVTS140AH	55	3.8
	.625"	CVTS160	CVTS160AH	55	3.8
	.687"	CVTS180	CVTS180AH	60	4.1
	.750"	CVTS190	CVTS190AH	65	4.5
0.875	CVTS220	CVTS220AH	70	4.8	
English Short Length	.093"	CVTS024	---	---	---
	.125"	CVTS030	CVTS030AH	25	1.7
	.156"	CVTS044	CVTS044AH	25	1.7
	0.187	CVTS045	CVTS045AH	30	2.1
	.218"	CVTS050	CVTS050AH	35	2.4
	.250"	CVTS060	CVTS060AH	35	2.4
	.281"	CVTS074	CVTS074AH	40	2.8
	.312"	CVTS080	CVTS080AH	40	2.8
	.343"	CVTS099	CVTS090AH	45	3.1
	.406"	CVTS100	CVTS100AH	45	3.1

* Air hammer air pressures represented here are recommended for use with steel Cv Plugs.

TABLE A

Metric Cv Plugs Installation Tools and Recommended Settings

	Cv Plugs Diameter	Hand Tool Part Number	Air Hammer Tool Part Number	Air Hammer Pressure*	
				PSIG	BAR
Metric	3 mm	CVTS030	CVTS030AH	25	1.7
	4 mm	CVTS040	CVTS040AH	25	1.7
	5 mm	CVTS050	CVTS050AH	30	2.1
	6 mm	CVTS060	CVTS060AH	35	2.4
	7 mm	CVTS070	CVTS070AH	40	2.8
	8 mm	CVTS080	CVTS080AH	40	2.8
	9 mm	CVTS090	CVTS090AH	45	3.1
	10 mm	CVTS100	CVTS100AH	45	3.1
	12 mm	CVTS120	CVTS120AH	50	3.4
	14 mm	CVTS140	CVTS140AH	55	3.8
	16 mm	CVTS160	CVTS160AH	55	3.8
	18 mm	CVTS180	CVTS180AH	60	4.1
	20 mm	CVTS200	CVTS200AH	65	4.5
	22 mm	CVTS220	CVTS220AH	70	4.8

* Air hammer air pressures represented here are recommended for use with steel Cv Plugs.

TABLE B

Recommended Drills and Taps for English Cv Plugs Removal

	Cv Plugs Diameter	Ball Drill	Ball Tap	Cv Plugs Drill	Cv Plugs Tap
English Standard Length	.156"	42	4-40	42.00	4-40
	.187"	42	4-40	42.00	4-40
	.218"	7/64"	6-32	7/64"	6-32
	.250"	28	8-32	28.00	8-32
	.281"	28	8-32	28.00	8-32
	.312"	20	10-32	20.00	10-32
	.343"	20	10-32	20.00	10-32
	.375"	13/64"	1/4-20	13/64"	1/4-20
	.406"	13/64"	1/4-20	13/64"	1/4-20
	.437"	13/64"	1/4-20	13/64"	1/4-20
	.468"	13/64"	1/4-20	13/64"	1/4-20
	.562"	J	5/16-24	J	5/16-24
	.625"	J	5/16-24	J	5/16-24
	.750"	J	5/16-24	J	5/16-24
.875"	J	5/16-24	J	5/16-24	
English Short Length	.125"	49	2-56	49	2-56
	.156"	49	2-56	49	2-56
	.187"	42	4-40	42	4-40
	.218"	42	4-40	42	4-40
	.250"	7/64"	6-32	7/64"	6-32
	.281"	7/64"	6-32	7/64"	6-32
	.312"	20	10-32	20	10-32
	.343"	20	10-32	20	10-32
	.406"	13/64"	1/4-20	13/64"	1/4-20

Table C

Recommended Drill and Taps for Metric Cv Plugs Removal

Metric Drills and Tap	Cv Plugs Diameter	Ball Drill	Ball Tap	Cv Plugs Drill m	Cv Plugs Tap
	3 mm	1.75 mm	M2.2 x .45	1.75 mm	M2.2 x .45
	4 mm	2.1mm	M2.5 x .45	2.6 mm	M3 x .50
	5 mm	2.1mm	M2.5 x .45	2.6 mm	M3 x .50
	6 mm	3mm	M3.5 x .60	4.5 mm	M5 x .80
	7 mm	3 mm	M3.5 x .60	5.5 mm	M6 x .50
	8 mm	4.5 mm	M5 x .80	6.5 mm	M7 x .75
	9 mm	4.5 mm	M5 x .80	7.5 mm	M8 x 1.00
	10 mm	6.3 mm	M7 x .75	8 mm	M9 x 1.00
	12 mm	6.3 mm	M7 x .75	10.5 mm	M11 x 1.00
	14 mm	7.4 mm	M8 x .75	7.4 mm	M8 x .75
	16 mm	7.4 mm	M8 x .75	7.4 mm	M8 x .75
	18 mm	7.4 mm	M8 x .75	7.4 mm	M8 x .75
	20 mm	7.4 mm	M8 x .75	7.4 mm	M8 x .75
22 mm	7.4 mm	M8 x .75	7.4 mm	M8 x .75	

English Drills and Taps	3 mm	49	2-56	49	2-56
	4 mm	42	4-40	42	4-40
	5 mm	42	4-40	42	4-40
	6 mm	7/64"	6-32	7/64"	6-32
	7 mm	28	8-32	28	8-32
	8 mm	20	10-32	20	10-32
	9 mm	20	10-32	20	10-32
	10 mm	13/64"	1/4-20	13/64"	1/4-20
	12 mm	13/64"	1/4-20	13/64"	1/4-20
	14 mm	J	5/16-24	J	5/16-24
	16 mm	J	5/16-24	J	5/16-24
	18 mm	J	5/16-24	J	5/16-24
	20 mm	J	5/16-24	J	5/16-24
	22 mm	J	5/16-24	J	5/16-24

Table D