CR-TEC Engineering Inc.

Process Specification PS182
TEC-Plug Installation & Removal Procedure

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1. **Purpose:**
   - This procedure is for installation of TEC-Plugs to seal holes in metal manifolds and other fluid products. The 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 neither necessary nor recommended. TEC-Plugs have a one piece design for fast, easy installation.

2. **Procedure Overview:**
   - Installation is accomplished by simply pressing the steel ball into the TEC-Plug, causing the plug to expand, so that its lands and grooves press into the surrounding hole material.

3. **Equipment Required:**
   - Standard drill with a 118^{o} point.
   - Desired size TEC-Plugs.
   - CR-TEC Engineering hand installation tool for the specific TEC-Plug size. For automated assembly the air hammer tool is available. See Figure 1 and Table A.
   - Pneumatic air hammer for automatic installations. The CR-TEC Engineering air hammer tools have a 0.401" diameter shank that is designed to fit most of the standard brands.
   - Work table with heavy surface to resist impact and reduce noise level.

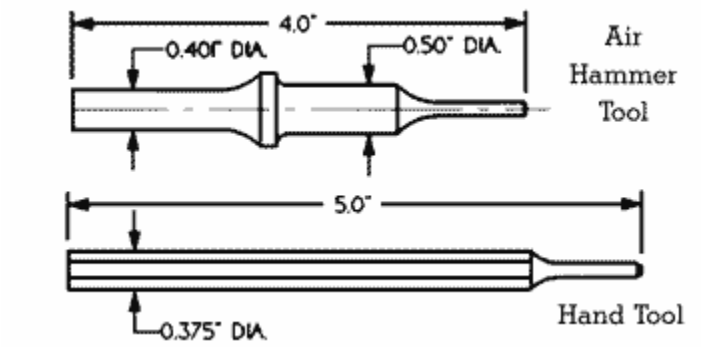
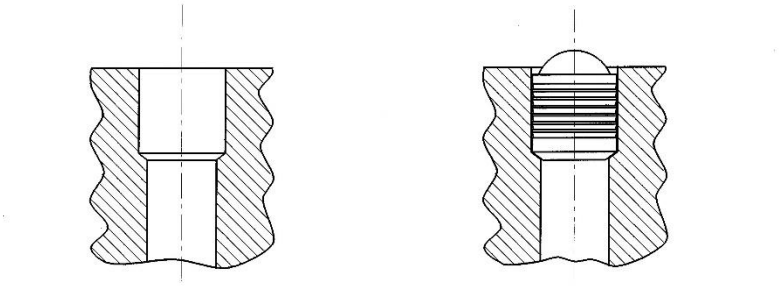


FIGURE 1

4. **Hole Preparation:**
   - On a general note, the holes drilled with a standard drill with 118^{o} point should be adequate. The "as drilled" surface finish provides for better plug retention and higher proof pressure than does a reamed surface finish.
   - 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.

Hand Installation:

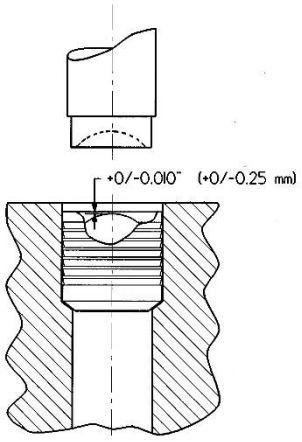
- Place the one piece TEC-Plug assembly into the installation hole so that it contacts the shoulder at the bottom of the hole. The plug must be flush with or any distance below the surface of the part. See Figure 2.



INSTALLATION HOLE TEC-PLUG PLACED INTO HOLE

FIGURE 2

- Using the proper CR-TEC hand tool from Table A, press the ball fully 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).
- Caution should be used to avoid overdriving the ball into the plug. See Figure 3.



BALL PRESSED INTO TEC-PLUG – NOTE THE POSITION
OF THE BALL RELATIVE TO THE TOP OF THE PLUG

FIGURE 3

- 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.

- Installation force estimates for specific TEC-Plug and hole material combinations are available. Contact CR-TEC for further information.
- TEC-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.

5. Automatic Installation:

- Place the one piece TEC-Plug 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.
- Select the proper CR-TEC air hammer tool from Table A and install into the pneumatic air hammer.
- Set the shop air pressure to the midpoint of the range recommended in Table A.
- Firmly hold the air hammer tool against the TEC-Plug, and activate a 1 to 2 second operation.
- A change in sound will indicate that the tool has completed the installation.
- Verify that the ball flushness is within tolerance.
- Adjust air pressure to operator preference.

6. Cv Plug Removal:

- TEC-Plugs are easily 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.
- The removal procedure involves drilling and tapping the steel ball expander to remove the expansion plug.

7. Required Removal Equipment:

- Drills and taps in the sizes recommended in Table B.
- Standard bolts with striker.

8. Removal Procedure:

- Drill and tap threads into the steel ball.
- Thread a standard bolt with striker into the steel ball and pull the ball from the TEC Plug.
- Drill and tap threads into the I.D. of the TEC-Plug.
- Use a standard bolt with striker to pull the plug from the hole.
- Check the installation hole tolerances before installing a new TEC-Plug.

9. Further Technical Assistance:

10.1 Contact CR-TEC for technical assistance via email or telephone for specific questions: Telephone 203-318-9500 or info@crtec.com

TEC-Plug Installation Tools and Recommended Settings				
TEC-Plug Diameter	**Hand Tool Part Number**	**Air Hammer Tool Part Number**	**Air Hammer Pressure***	
English Sizes			**PSIG**	**BAR**
.156"	TEC-HT-040	---	25	1.7
.187"	TEC-HT-050	TEC-AH-050	30	2.1
.218"	TEC-HT-050	TEC-AH-050	35	2.4
.250"	TEC-HT-060	TEC-AH-060	35	2.4
.281"	TEC-HT-070	TEC-AH-070	40	2.8
.312"	TEC-HT-080	TEC-AH-080	40	2.8
.343"	TEC-HT-090	TEC-AH-090	45	3.1
.375"	TEC-HT-090	TEC-AH-090	45	3.1
.406"	TEC-HT-100	TEC-AH-100	45	3.1
.437"	TEC-HT-110	TEC-AH-110	50	3.4
.468"	TEC-HT-120	TEC-AH-120	50	3.4
.562"	TEC-HT-140	TEC-AH-140	55	3.8
English Sizes – Short				
.125"	TEC-HT-030	---	25	1.7
.156"	TEC-HT-040	---	25	1.7
.187	TEC-HT-050	TEC-AH-050	30	2.1
.218"	TEC-HT-050	TEC-AH-050	35	2.4
.250"	TEC-HT-060	TEC-AH-060	35	2.4
.281"	TEC-HT-070	TEC-AH-070	40	2.8
.312"	TEC-HT-080	TEC-AH-080	40	2.8
.343"	TEC-HT-090	TEC-AH-090	45	3.1
.406"	TEC-HT-100	TEC-AH-100	45	3.1
Metric Sizes				
3 mm	TEC-HT-030	---	25	1.7
4 mm	TEC-HT-040	---	25	1.7
5 mm	TEC-HT-050	TEC-AH-050	30	2.1
6 mm	TEC-HT-060	TEC-AH-060	35	2.4
7 mm	TEC-HT-070	TEC-AH-070	40	2.8
8 mm	TEC-HT-080	TEC-AH-080	40	2.8
9 mm	TEC-HT-090	TEC-AH-090	45	3.1
10 mm	TEC-HT-100	TEC-AH-100	45	3.1
12 mm	TEC-HT-120	TEC-AH-120	50	3.4
14 mm	TEC-HT-140	TEC-AH-140	55	3.8
16 mm	TEC-HT-160	TEC-AH-160	55	3.8
18 mm	TEC-HT-180	TEC-AH-180	60	4.1
20 mm	TEC-HT-200	TEC-AH-200	65	4.5
22 mm	TEC-HT-220	TEC-AH-220	70	4.8

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

TABLE A

Recommended Drills and Taps for TEC-Plug Removal					
	TEC-Plug Size	**Ball Drill**	**Ball Tap**	**TEC-Plug Drill**	**TEC Plug-Tap**
English Standard Length	.156"	42	4-40	42	4-40
	.187"	42	4-40	42	4-40
	.218"	7/64"	6-32	7/64"	6-32
	.250"	28	8-32	28	8-32
	.281"	28	8-32	28	8-32
	.312"	20	10-32	20	10-32
	.343"	20	10-32	20	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
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
Metric Size	**TEC-Plug Size**	**Ball Drill**	**Ball Tap**	**TEC-Plug Drill**	**TEC-Plug Tap**
	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 B