**Procedure for Pop-A-Plug® P2 Installation**

**WARNING**

- Pop-A-Plug P2 plugs must be installed in the heat exchanger tube section where the tube has been expanded into the tubesheet. In cases where the heat exchanger tube has been removed, the Pop-A-Plug P2 can be installed directly into the tubesheet.
- Installed Pop-A-Plug P2s should not project beyond the tubesheet face unless on the perimeter or in a thin tubesheet. In cases where the pin of an installed plug extends beyond the tubesheet, extra caution must be taken to ensure the pin is not struck by another object.
- Remove tube sleeves or shields prior to tube preparation and plugging.
- Never hit the Pop-A-Plug P2 Pin with a hammer or heavy object.
- Failure to remove weld droop prior to installing the Pop-A-Plug P2 will result in a false reading with the Go/No Go Gage. This false Go/No Go Gage reading will direct the user to install an undersized Pop-A-Plug P2 plug which will either leak initially or later.

Use the procedure outlined below to properly prep the heat exchanger tube ID and install Pop-A-Plug P2 plugs.

<table>
<thead>
<tr>
<th>Step/Action</th>
<th>Additional Action/Information/Result</th>
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</table>
| 1. If tube is welded to sheet, remove any weld droop protruding into the tube ID with a Tapered Reamer. Removing weld droop is a fairly quick step and should only take 15 – 30 seconds to remove. Only remove the weld droop (burr) projecting into the tube ID. | ![Figure 1A – Standard Near End Install](image1) A straight reamer should never be used. Extended Tapered reamers are available for Air Cooled Heat Exchanger (ACHE or Pin-Fan) applications. Install tapered reamer in a variable speed drill and lightly lubricate. The small end of tapered reamer should fit into tube ID and large end should not. For Air Cooled Heat Exchanger (ACHE) applications, choose a reamer with an extension long enough to reach the tubesheet through the header box. The reamer should be operated in the following manner:  
  - Keep reamer axis parallel to tube axis and lightly squeeze the trigger on the drill to a low rpm in short intervals.  
  - Use slight forward pressure. If too much pressure is used the reamer may catch.  
  - Never force the reamer into the tube ID. |
| 2. Service permitting, puncture both ends of the tube to be plugged just beyond the tubesheet to minimize the potential of trapped pressure. | ![Figure 1B – ACHE Near End Install](image2) |

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### Step/Action

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<tr>
<td>3.</td>
<td>Take initial tube ID measurement with Go/No-Go Gage. For ACHE applications, install the Threaded Go/No-Go Gage onto the Gage Extension Rod and take initial tube ID measurement with Go/No-Go Gage.</td>
</tr>
<tr>
<td><img src="image1" alt="Figure 3A" /> Gaging Standard Near End Install</td>
<td><img src="image2" alt="Figure 3B" /> Gaging ACHE Install</td>
</tr>
<tr>
<td>4.</td>
<td>Select the smallest of the Tube Preparation Brushes furnished in the Brush Kit that interferes with the tube ID. For ACHE applications, the brush will need to be threaded onto the appropriate length Extension. Operate the brush with a power drill for at least 30 seconds (5 seconds for 90/10 Cu/Ni and Brass tubes) back and forth from the tube opening to the installation depth evenly to prevent a tapered condition. If as a result of uneven brushing the tube entrance is smaller, the installed plug may be undersized and leak.</td>
</tr>
<tr>
<td><img src="image3" alt="Figure 4A" /> Brushing Standard Near End Install</td>
<td><img src="image4" alt="Figure 4B" /> Brushing ACHE Install</td>
</tr>
<tr>
<td>5.</td>
<td>Carefully inspect tube for scale, pitting or other defects. These conditions must be corrected for plug to seal properly.</td>
</tr>
<tr>
<td>6.</td>
<td>Take a second measurement with Go/No-Go Gage to installation depth. For ACHE applications, the Extension will again be required to reach the tubesheet.</td>
</tr>
<tr>
<td><img src="image5" alt="Figure 6A" /> Second Gaging, near End Install</td>
<td><img src="image6" alt="Figure 6B" /> Second Gaging, ACHE Install</td>
</tr>
<tr>
<td><strong>Note:</strong> If No-Go (larger) end of gage fits into tube to installation depth, the next larger plug size is needed.</td>
<td>Brushing may remove enough tube material to require the next larger size gage and Pop-A-Plug. This step confirms original plug size choice is still valid.</td>
</tr>
<tr>
<td>7.</td>
<td>Assemble the Hydraulic Ram Package to be used.</td>
</tr>
<tr>
<td><img src="image7" alt="Figure 6C" /> Second Gaging, ACHE Install</td>
<td><strong>•</strong> See DC4042 for detailed Hydraulic Ram Package Assembly instructions.</td>
</tr>
</tbody>
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<td>8. Thread the Pop-A-Plug size that matches the correct Go/No-Go Gage size onto the appropriate Pull Rod Assembly. (See Documents DC4002 for CPI Application Data, and DC1066 for Installation Equipment.)</td>
<td>All arrows on Pull Rod Assembly parts should point toward the Pop-A-Plug. Channel head pull rod assemblies are to be used for ACHE applications, to acquire sufficient length to reach tubesheet through the header box.</td>
</tr>
<tr>
<td>10. Insert Pop-A-Plug into prepared tube to 1 3/8” (44.5 mm) installation depth. If the thickness of the tubesheet or the expanded length of the tube cannot accommodate a 1 3/8” (44.5 mm) installation depth, install the plug as deep as possible while keeping the Pop-A-Plug positioned within the tubesheet. For ACHE Applications, it will be necessary to guide the pull rod assembly with the plug threaded into the tube from through the plug sheet. Thus, it is advised to set the Stand-Off Ring a measured distance to achieve an appropriate Installation Depth. Typically, this will be the 1 3/8” (44.5 mm) Installation Depth added to the header box depth.</td>
<td>Failure to correctly seat and tighten hydraulic fittings will cause ram piston to lock in extended position after activation.</td>
</tr>
</tbody>
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Note: Weeping during hydro test indicates small surface imperfections in the tube that are difficult to see. A large leak indicates a surface imperfection in the tube such as scarring from a drill used to remove a sleeve or tapered pin that should have been seen in step 5. In either case, remove Pop-A-Plug using EST Group Pop-A-Plug Removal Tool and repeat procedure using next larger Tube Preparation Brush and Pop-A-Plug size.

Table 1: Operator Troubleshooting Guide

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imperfections such as pitting, gouges or scratches still exist within the tube ID after brushing.</td>
<td>Deep imperfections can exist from normal heat exchanger operation or maintenance work.</td>
<td>Continue brushing with Tube Preparation Brush until little or no resistance is encountered. If imperfections still exist, move up to the next Pop-A-Plug size and repeat tube preparation steps.</td>
</tr>
<tr>
<td>Plug Positioner flares or becomes stuck on installed plug. Breakaway fractures or side opposite the undercut. (Normally the Breakaway fractures at the undercut) Pop-A-Plug does not “POP” after second stroke of hydraulic ram.</td>
<td>Undersized Pop-A-Plug The Pop-A-Plug was installed beyond the thickness of the tubesheet Heat Exchanger tube is not expanded (rolled or similar) into the tubesheet.</td>
<td>Gage or measure tube ID at location where Pop-A-Plug will be installed. Refer to heat exchanger datasheet to determine tubesheet thickness. Install Pop-A-Plug within the tubesheet length. Roller expand heat exchanger tube at Pop-A-Plug installation depth otherwise contact EST for assistance.</td>
</tr>
<tr>
<td>Go/No-Go Gage indicates proper Pop-A-Plug size, but problems related to an undersized Pop-A-Plug occur.</td>
<td>Weld droop has not been removed. Heat exchanger tube is only “soft rolled” for a short distance and is expanded to a larger tube ID beyond the “soft roll” length.</td>
<td>Remove weld droop using tapered reamer. Using Tube Preparation Brush, enlarge the heat exchanger tube so that the tube entrance and “soft roll” area has same ID as at the Pop-A-Plug installation depth.</td>
</tr>
<tr>
<td>Hydraulic Ram is stuck in extended position and will not retract.</td>
<td>Mating quick connects between Hydraulic Ram and hose between Hydraulic Pump and hose are not fully engaged and tightened. Piston within Hydraulic Ram has been damaged.</td>
<td>Using gripping pliers turn locking collar on female quick connect to further engage connection. Continue tightening until Hydraulic Ram retracts. Return Hydraulic Ram to EST for repair.</td>
</tr>
<tr>
<td>Stem of Tube Preparation Brush fractures</td>
<td>Brush size is too large The brush was forced or advanced too quickly.</td>
<td>Gage the heat exchanger tube using Go/No-Go Gage and select corresponding brush size. Slowly feed the Tube Preparation Brush into the heat exchanger tube if significant resistance is encountered.</td>
</tr>
<tr>
<td>Bristles fall out of Tube Preparation Brush</td>
<td>The brush was run counter-clockwise in the drill.</td>
<td>Obtain a new brush and operate brush clockwise.</td>
</tr>
<tr>
<td>Inadequate space to get plug into tube when using the standard Hydraulic Ram with Full Rod Assembly.</td>
<td></td>
<td>Use EST’s Close Quarter Ram for Pop-A-Plug installation.</td>
</tr>
</tbody>
</table>