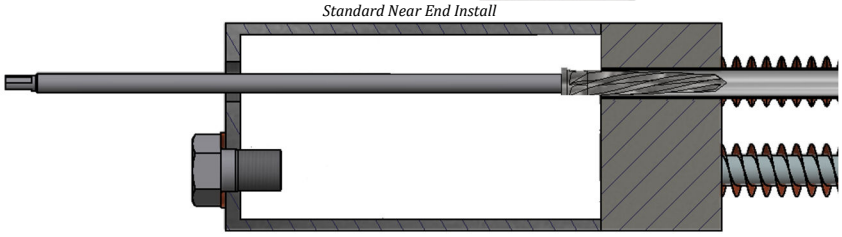
Procedure for Pop-A-Plug® P2 Installation

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.

Step/Action	*Additional Action/Information/Result*
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. **Note** A straight reamer should never be used. Extended Tapered reamers are available for Air Cooled Heat Exchanger (ACHE or Fin-Fan) applications.	 *Standard Near End Install*  *ACHE Near End Install* 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.	

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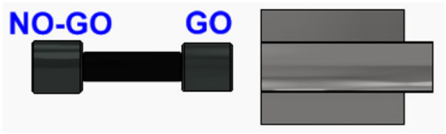
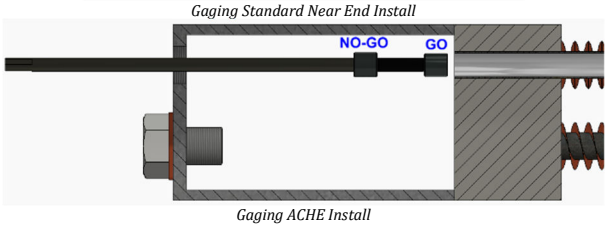
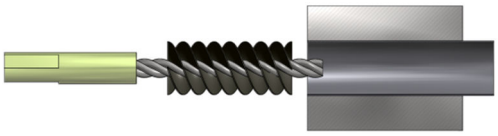
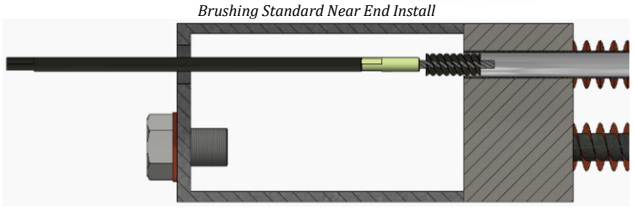
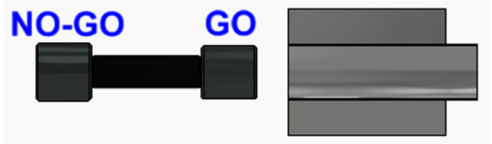
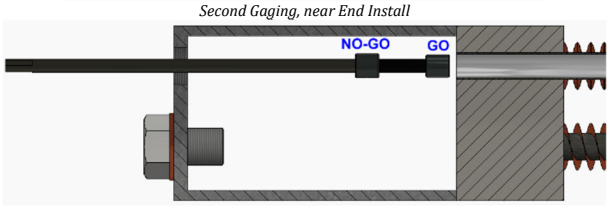
Step/Action	*Additional Action/Information/Result*
3. Take initial tube ID measurement with Go/No-Go Gage. For ACHE applications, install the Threaded Go/No-Go Gage onto the Gage Extension Rod and take initial tube ID measurement with Go/No-Go Gage.	 *Gaging Standard Near End Install*  *Gaging ACHE Install* Small end of gage should fit in tube to installation depth and large end should not. For ACHE applications, choose an Extension long enough to reach the tube opening in the tubesheet through the header box. Using an adjacent plug hole as a spotting port or measuring the header box depth and the extension rod to confirm Go/No-Go measurements is helpful.
4. 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.	 *Brushing Standard Near End Install*  *Brushing ACHE Install* Do not use an oversized brush, force the brush into the tube, or bend the stem. These actions may break the stem and cause deep grooves in the tube. Do not reverse drill because bristles will fall out. A Brush lubricant/Spark inhibitor Lube-A-Tube is available from the factory if required. This should be used when brushing stainless steel tubes or brush may wear out quickly. Brush lubricant / Spark inhibitor should be cleaned from tube before plugging.
5. Carefully inspect tube for scale, pitting or other defects. These conditions must be corrected for plug to seal properly.	A properly brushed tube should have a shiny metallic finish. Deeply pitted tubes may require using larger preparation brushes and plugs.
6. 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. ***Note:*** If No-Go (larger) end of gage fits into tube to installation depth, the next larger plug size is needed.	 *Second Gaging, near End Install*  *Second Gaging, ACHE Install* 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.
7. Assemble the Hydraulic Ram Package to be used. If using a Curtiss-Wright Smart Ram®, skip to step 13.	See DC4042 for detailed Hydraulic Ram Package Assembly instructions.

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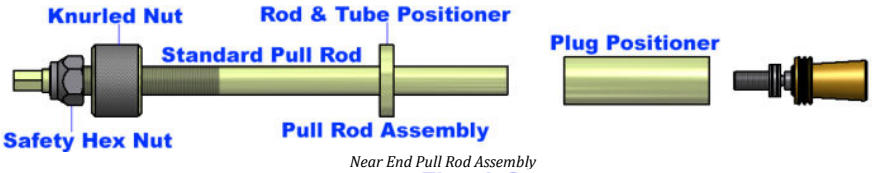
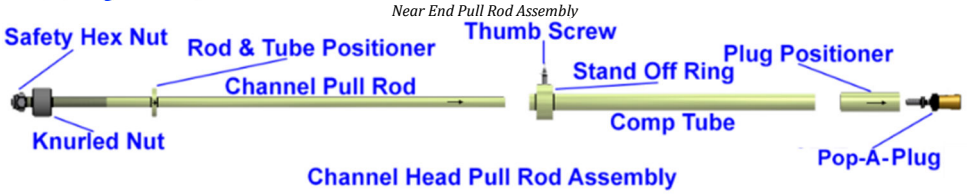
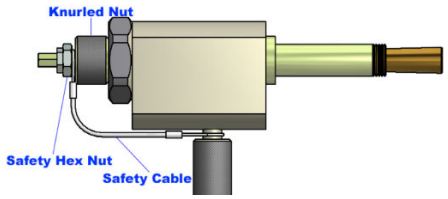
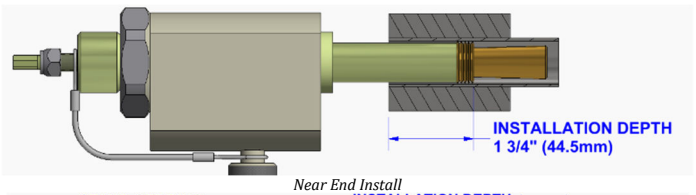
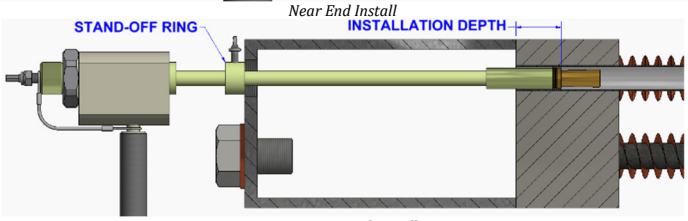
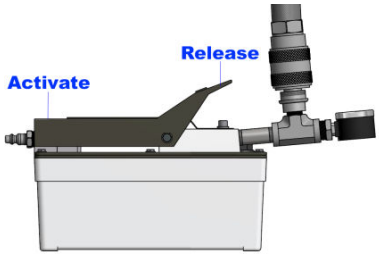
Step/Action	*Additional Action/Information/Result*
8. Thread the Pop-A-Plug size that matches the correct Go/No-Go Gage size onto the appropriate Pull Rod Assembly. (See Documents DC4002 for CPI Application Data, and DC1066 for Installation Equipment.)	All arrows on Pull Rod Assembly parts should point 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.



Near End Pull Rod Assembly



ACHE Pull Rod Assembly

9. Remove Safety Hex Nut and Knurled Nut and insert Pull Rod Assembly into Hydraulic Ram. Thread Knurled Nut onto Pull Rod removing all slack in assembly. Secure Safety Cable on Pull Rod and thread Safety Hex Nut onto Pull Rod.	 Failure to correctly seat and tighten hydraulic fittings will cause ram piston to lock in extended position after activation.
10. Insert Pop-A-Plug into prepared tube to **1¾" (44.5 mm)** installation depth. If the thickness of the tubesheet or the expanded length of the tube cannot accommodate a **1¾" (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 1¾"(44.5mm) Installation Depth added to the header box depth.	 *Near End Install*  *ACHE Near End Install* Never stand directly behind Ram. Guide Ram with hands to avoid cocking plug.
11. Depress Hydraulic Pump pedal, Hydraulic Ram will stroke.	 If plug does not "POP" and PsiG exceeds 7000 PsiG (483 BarG) on gage, STOP. Depress front of Hydraulic Pump pedal and Hydraulic Ram will retract. If the ring has not contacted the tube ID and the Pop-A-Plug can be removed from the tube on this first stroke you may have an UNDERSIZED PLUG. Otherwise tighten knurled nut and depress pump pedal. If plug does not "POP", on second stroke an UNDERSIZED PLUG has been installed, stop and contact EST Group Customer Service, or your local representative for assistance.

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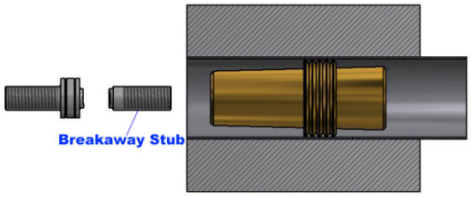
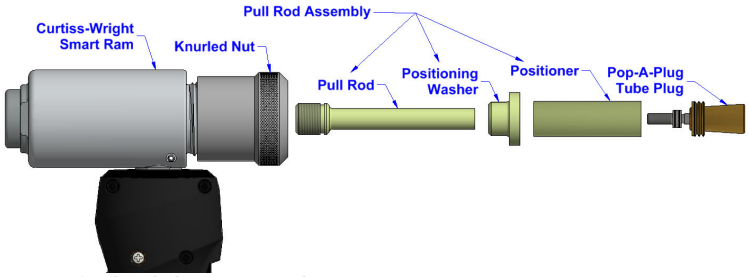
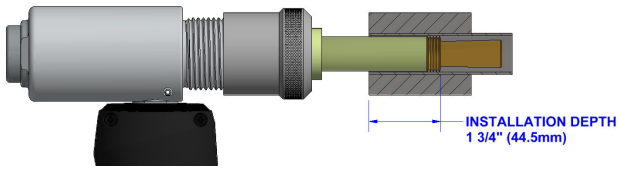
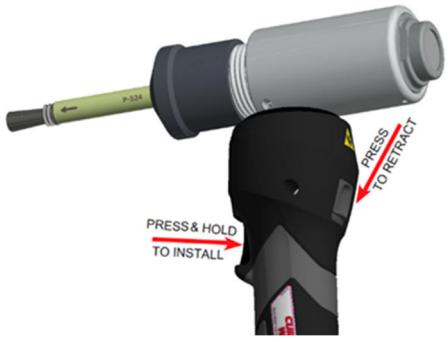
Step/Action	*Additional Action/Information/Result*
12. After Pop-A-Plug installation, remove the Breakaway stub from the installed Pop-A-Plug by turning counter-clockwise.	

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.

For installation using the **Curtiss-Wright Smart Ram**, perform steps 1 through 6 above and complete procedure using the steps outlined below. See DC1230 for detailed Curtiss-Wright Smart Ram instructions.

Step/Action	*Additional Action/Information/Result*
13. Thread Knurled Nut onto external threads of Smart Ram. Do not tighten. Fully thread Pull Rod into the Curtiss-Wright Smart Ram Piston, hand tight. Place the Positioning Washer over the Pull Rod into the Knurled Nut with the arrow facing away from the Knurled Nut. Place the Positioner over the Pull Rod with the arrow facing away from the Positioning Washer.	 See DC1230 for detailed Curtiss-Wright Smart Ram instructions.
14. Thread the Pop-A-Plug size that matches the correct Go/No-Go Gage size onto the appropriate Smart Ram Pull Rod Assembly. Unthread Knurled Nut to remove all slack form the system; finger tighten.	
15. Insert Pop-A-Plug into prepared tube to **1¾" (44.5 mm)** installation depth. If the thickness of the tubesheet or the expanded length of the tube cannot accommodate a **1¾" (44.5 mm)** installation depth, install the plug as deep as possible while keeping the Pop-A-Plug positioned within the tubesheet.	 Guide Smart Ram with hands to avoid cocking Pop-A-Plug. See DC1232 for instructions for ACHE applications using the Curtiss-Wright Smart Ram.
16. Squeeze Smart Ram trigger and begin installation of plug.	

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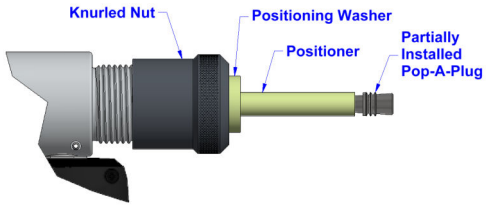
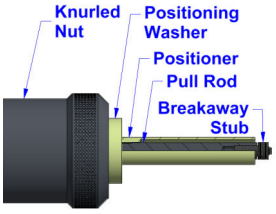
Step/Action	*Additional Action/Information/Result*
17. Occasionally, a Pop-A-Plug Tube Plug may not be fully installed after a single full stroke of the SR. If required, a second stroke can be completed. Manually retract the SR Piston if it has not done so automatically. All tension in the Pull Rod should be fully relieved, and the Positioner should be able to move freely on the Pull Rod. Unthread Knurled Nut two full turns to partially remove slack in the Pull Rod assembly. Proceed with Pop-A-Plug installation.	 If the plug is engaged within the inside of the tube, make sure the Smart Ram is carefully supported during this procedure to prevent the plug from being cocked or moved or unintentionally breaking the Breakaway.
18. After Pop-A-Plug installation, remove the Breakaway stub from the installed Pop-A-Plug by turning counter-clockwise. Remove Breakaway Stud from Pull Rod by fully threading the Knurled Nut onto the Smart Ram Cylinder, pushing the Positioner against the Positioning Washer to expose the Breakaway Stub, and unthreading the Breakaway Stub from the Pull Rod by turning the Stub counterclockwise.	

Table 1: Operator Troubleshooting Guide

Problem	Cause	Solution
Imperfections such as pitting, gouges or scratches still exist within the tube ID after brushing.	Deep imperfections can exist from normal heat exchanger operation or maintenance work.	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.
Plug Positioner flares or becomes stuck on installed plug. Breakaway fractures on side opposite the undercut. (Normally the Breakaway fractures at the undercut) Pop-A-Plug does not "POP" after second stroke of hydraulic ram.	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.	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.
Go/No-Go Gage indicates proper Pop-A-Plug size, but problems related to an undersized Pop-A-Plug occur.	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.	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.
Hydraulic Ram is stuck in extended position and will not retract.	Mating quick connects between Hydraulic Ram and hose or between Hydraulic Pump and hose are not fully engaged and tightened. Piston within Hydraulic Ram has been damaged	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.
Stem of Tube Preparation Brush fractures	Brush size is too large The brush was forced or advanced too quickly	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.
Bristles fall out of Tube Preparation Brush	The brush was run counter-clockwise in the drill.	Obtain a new brush and operate brush clockwise.
Inadequate space to get plug into tube when using the standard Hydraulic Ram with Pull Rod Assembly.		Use EST's Close Quarter Ram for Pop-A-Plug installation.

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