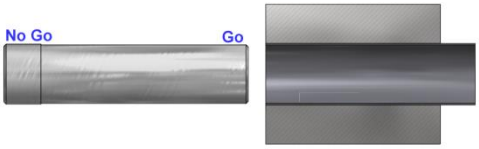
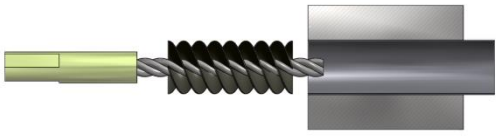
Procedure for Pop-A-Plug® CPI/Perma™ Near End Installation

WARNING

- ⚠ Pop-A-Plug CPI/Perma 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 CPI/Perma can be installed directly into the tubesheet.
- ⚠ Installed Pop-A-Plug CPI/Perma plugs 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 CPI/Perma Pin with a hammer or heavy object.
- ⚠ Failure to remove weld droop prior to installing the Pop-A-Plug CPI/Perma plug 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 CPI/Perma plug which will either leak initially or later.

Use the procedure outlined below to properly prep the tube ID and perform a near end installation with Pop-A-Plug CPI/Perma plugs.

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.	 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. 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.	
3. Take initial tube ID measurement with Go/No-Go Gage.	 Small end of gage should fit in tube to installation depth and large end should not.
4. Select the smallest of the Tube Preparation Brushes furnished in the Brush Kit that interferes with the tube ID. 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.	 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.

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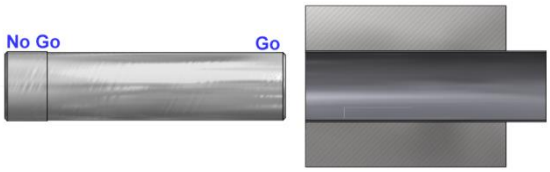
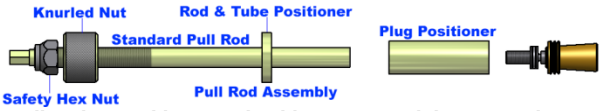
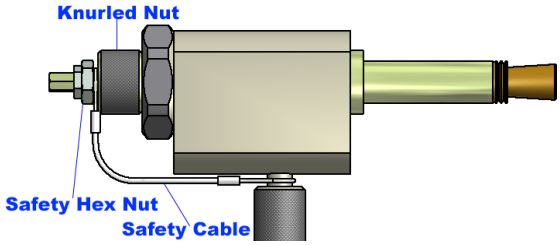
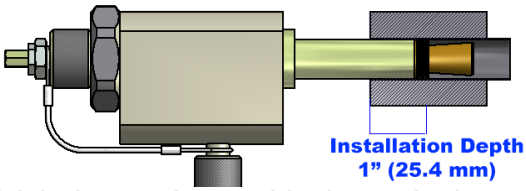
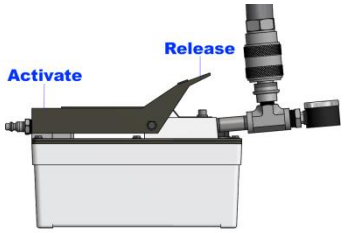
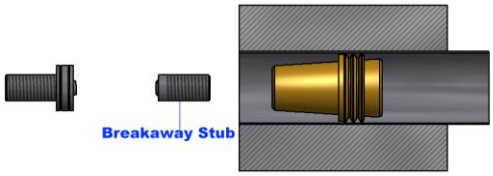
Step/Action	*Additional Action/Information/Result*
6. Take a second measurement with Go/No-Go Gage to installation depth.	 Brushing may remove enough tube material to require the next larger size gage and Pop-A-Plug.
7. Thread the Pop-A-Plug size that matches the correct Go/No-Go Gage size onto the appropriate Pull Rod Assembly (See stamping on parts or table on reverse side for part numbers).	 All arrows on Pull Rod Assembly parts should point toward the Pop-A-Plug.
8. 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.
9. Insert Pop-A-Plug into prepared tube to **1" (25.4 mm)** installation depth. If the thickness of the tubesheet or the expanded length of the tube cannot accommodate a **1" (25.4 mm)** installation depth, install the plug as deep as possible while keeping the Pop-A-Plug positioned within the tubesheet.	 Never stand directly behind Ram. Guide Ram with hands to avoid cocking Pop-A-Plug.
10. 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 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 Customer Service, or your local representative for assistance.
11. After Pop-A-Plug installation, remove the Breakaway stub from the installed Pop-A-Plug by turning counter-clockwise.	

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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 Plug Removal Tool and repeat procedure using next larger Tube Preparation Brush and Pop-A-Plug size.

Questions?

Contact EST Group Customer Service at any of the following locations with questions.

- In USA and Canada: tel: 800-355-7044 or 215-721-1100, e-mail: est-info@curtisswright.com
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- On the Internet at: http://estgroup.cwfc.com

EST Group provides a complete range of repair products, services, and replacement parts covering the life cycle of heat exchangers and condensers; additionally EST Group provides products and services to facilitate pressure testing pipe, piping systems, pressure vessels, and their components. Visit EST Group on the Internet at http://estgroup.cwfc.com.

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.

Table 2: Plug Sizing

		Tube I.D. (see Note 5)						Tube I.D. (see Note 5)			
		Min	Max	Min	Max			Min	Max	Min	Max
Pop-A-Plug CPI/Perma Kit	Plug Size	(in)		(mm)		Pop-A-Plug CPI/Perma Kit	Plug Size	(in)		(mm)	
V-471-Q	.471	0.472	0.515	11.99	13.08	V-919-Q	.919	.920	1.019	23.37	25.88
V-491-Q	.491	0.492	0.540	12.50	13.72	V-962-Q	.962	.963	1.027	24.46	26.09
V-512-Q	.512	0.513	0.562	13.03	14.27	V-979-Q	.979	.980	1.079	24.89	27.41
V-524-Q	.524	0.525	0.585	13.34	14.86	V-1024-Q	1.024	1.025	1.088	26.04	27.64
V-555-Q	.555	0.556	0.616	14.12	15.65	V-1054-Q	1.054	1.055	1.154	26.80	29.31
V-584-Q	.584	0.585	0.649	14.86	16.48	V-1087-Q	1.087	1.088	1.152	27.64	29.26
V-621-Q	.621	0.622	0.689	15.80	17.50	V-1103-Q	1.103	1.104	1.203	28.04	30.56
V-649-Q	.649	0.650	0.713	16.51	18.11	V-1149-Q	1.149	1.150	1.213	29.21	30.81
V-670-Q	.670	0.671	0.740	17.04	18.80	V-1171-Q	1.171	1.172	1.270	29.77	32.26

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		Tube I.D. (see Note 5)			
		Min	Max	Min	Max
Pop-A-Plug CPI/Perma Kit	Plug Size	(in)		(mm)	
V-712-Q	.712	0.713	0.777	18.11	19.74
V-735-Q	.735	0.736	0.810	18.69	20.57
V-774-Q	.774	0.775	0.838	19.69	21.29
V-804-Q	.804	0.805	0.890	20.45	22.61
V-837-Q	.837	0.838	0.902	21.29	22.91
V-853-Q	.853	0.854	0.949	21.69	24.10
V-899-Q	.899	0.900	0.963	22.86	24.46

		Tube I.D. (see Note 5)			
		Min	Max	Min	Max
Pop-A-Plug CPI/Perma Kit	Plug Size	(in)		(mm)	
V-1212-Q	1.212	1.213	1.336	30.81	33.93
V-1334-Q	1.334	1.335	1.458	33.91	37.03
V-1456-Q	1.456	1.457	1.579	37.01	40.11
V-1578-Q	1.578	1.579	1.701	40.11	43.21
V-1700-Q	1.700	1.701	1.823	43.21	46.30
V-1822-Q	1.822	1.823	1.945	46.30	49.40
V-1944-Q	1.944	1.945	2.067	49.40	52.50

Pop-a-Plug CPI/Perma kits contain (10) plugs, a Tube Preparation Brush Kit and a Go/No-Go Gage. EST Group recommends one Tube Preparation Brush Kit for every two Pop-A-Plug CPI/Perma Kits. Brushes are marked with size on swage. Ensure correct size brush is chosen before brushing. The suffix "Q" in the Pop-A-Plug CPI/Perma kit part number is the Pop-A-Plug CPI/Perma material designator. Please replace "Q" with one of the following:

B = Brass	M = Monel	D=Duplex 2205 Stainless	NI=Nickel 200	A = 4142 Alloy
C = Carbon Steel	S = 316 Stainless	F22=F22 Alloy	NI2=Nickel 201	I=Inconel 600
H=70/30 Copper Nickel	E = 304 Stainless	F11=F11 Alloy Steel	P=430 Stainless	X=AL6Xn
N = 90/10 Copper Nickel	T = Titanium	Y=Incoloy 825	K=410 Stainless	ZC=Zirconium

Additional materials are readily available to meet your tube plugging needs.

To minimize effects of corrosion and thermal expansion, the Pop-A-Plug material should closely match the heat exchanger tube material. Contact EST Group if materials other than those listed above are needed.

Table 3: Installation Equipment

Installation Equipment Small Ram					Installation Equipment Large Ram				
Pop-A-Plug CPI/Perma Size	Plug Positioner	Pull Rod Assembly	Channel Head Pull Rod Assembly (see Note 1)	Tube Preparation Brush Kit	Pop-A-Plug CPI/Perma Size	Plug Positioner	Pull Rod Assembly	Channel Head Pull Rod Assembly (see Note 1)	Tube Preparation Brush Kit
.471	P-471	PA-471	CPA-471-YY	BSH-471-(HT)	1.334	P-1334	PA-1334-L	CPA-1334-L-YY	BSH-1334-(NY)
.491	P-491	PA-491	CPA-491-YY	BSH-491-(HT)	1.456	P-1456	PA-1456-L	CPA-1456-L-YY	BSH-1456-(NY)
.512	P-512	PA-512	CPA-512-YY	BSH-512-(HT)	1.578	P-1578	PA-1578-L	CPA-1578-L-YY	BSH-1578-(NY)
.524	P-524	PA-524	CPA-524-YY	BSH-524-(HT)	1.700	P-1700	PA-1700-L	CPA-1700-L-YY	BSHV-1700-(NY)
.555	P-555	PA-555	CPA-555-YY	BSH-555-(HT)	1.822	P-1822	PA-1822-L	CPA-1822-L-YY	BSH-1822-(NY)
.584	P-584	PA-584	CPA-584-YY	BSH-584-(HT)	1.944	P-1944	PA-1944-L	CPA-1944-L-YY	BSH-1944-(NY)
.621	P-621	PA-621	CPA-621-YY	BSH-621-(HT)					
.649	P-649	PA-649	CPA-649-YY	BSH-649-(HT)					
.670	P-670	PA-670	CPA-670-YY	BSH-670-(HT)					
.712	P-712	PA-712	CPA-712-YY	BSH-712-(HT)					
.735	P-735	PA-735	CPA-735-YY	BSH-735-(HT)					
.774	P-774	PA-774	CPA-774-YY	BSH-774-(HT)					
.804	P-804	PA-804	CPA-804-YY	BSH-804-(HT)					
.837	P-837	PA-837	CPA-837-YY	BSH-837-(HT)					
.853	P-853	PA-853	CPA-853-YY	BSH-853-(HT)					
.899	P-899	PA-899	CPA-899-YY	BSH-899-(HT)					
.919	P-919	PA-919	CPA-919-YY	BSH-919-(HT)					
.962	P-962	PA-962	CPA-962-YY	BSH-962-(HT)					
.979	P-979	PA-979	CPA-979-YY	BSH-979-(HT)					
1.024	P-1024	PA-1024	CPA-1024-YY	BSH-1024-(NY)					
1.054	P-1054	PA-1054	CPA-1054-YY	BSH-1054-(NY)					
1.087	P-1087	PA-1087	CPA-1087-YY	BSH-1087-(NY)					
1.103	P-1103	PA-1103	CPA-1103-YY	BSH-1103-(NY)					
1.149	P-1149	PA-1149	CPA-1149-YY	BSH-1149-(NY)					
1.171	P-1171	PA-1171	CPA-1171-YY	BSH-1171-(NY)					
1.212	P-1212	PA-1212	CPA-1212-YY	BSH-1212-(NY)					

NOTES:

1. The extended length of the Channel Head Assembly allows the installer to properly position the plug without having to reach or lean into heat exchangers with channel barrels or divider plates. The suffix YY signifies the length, in feet, of the Channel Head Extension. These parts are available in 1, 2, 3, 4 and 6 foot lengths. Replace YY with 01, 02, etc. for respective Channel Head Extension size required.
2. Tube Preparation Brush Kits are required for tube preparation with all POP-A-PLUG®CPI/Perma plugs. EST Group recommends one Tube Preparation Brush Kit for every two Pop-A-Plug CPI/Perma Kits. Brushes are marked with size on swage. Ensure correct size brush is chosen before brushing. The part number suffix "HT" is used to denote the most aggressive brushes for carbon steel and stainless steel (hard alloys) applications; no suffix is used for brass, CuNi 90/10 (soft alloys). See DC 1225 for other material recommendations. The part number suffix "NY" is used to denote the nylon coated brushes for all materials. For Utility applications, (1) brush kit per order plus (1) additional brush kit per each (5) plug kits ordered is recommended. For Petro/Chem applications, (2) brush kits per order plus (2) additional brush kits per each (5) plug kits ordered are recommended.
3. EST can provide a brush lubricant / spark inhibitor, which will reduce the potential of sparking during all brushing and reaming, P/N: BSH-LUBE.
4. If tube is not expanded into the tubesheet the maximum tube ID limit is reduced by 0.020"(0.51mm). See DC1222 for tube ID ranges of Titanium plugs. Tube ID ranges for Titanium Pop-A-Plug CPI/Perma plugs differ from standard materials.

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