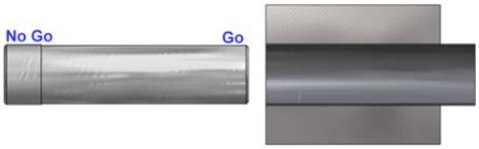
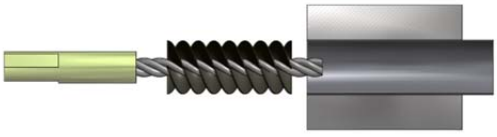
Procedure for Pop-A-Plug® P2 Installation

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.

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.

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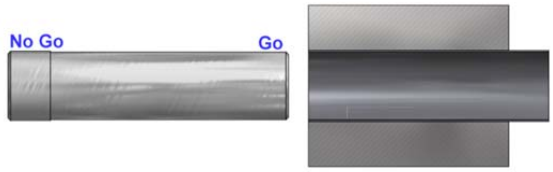
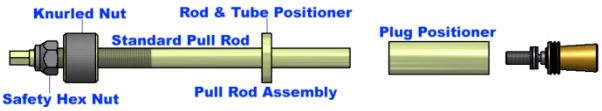
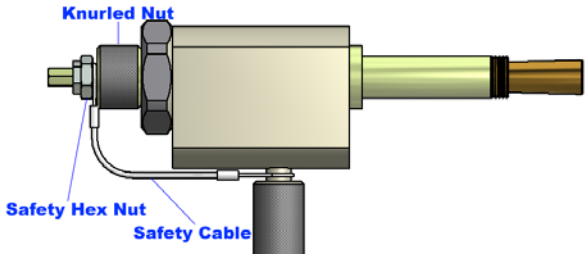
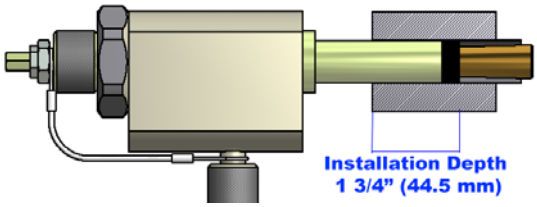
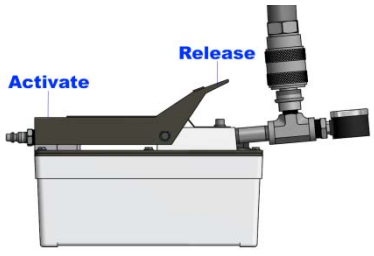
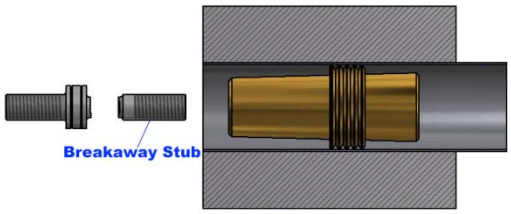
Step/Action	*Additional Action/Information/Result*
5. Carefully inspect tube for scale, pitting or other defects. These conditions must be corrected for plug to seal properly.	A properly brushed tube should have a shiny metallic finish. Deeply pitted tubes may require using larger preparation brushes and plugs.
6. Take a second measurement with Go/No-Go Gage to installation depth.	 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 **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.	 Never stand directly behind Ram. Guide Ram with hands to avoid cocking 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 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.

Step/Action	*Additional Action/Information/Result*
11. 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.

Questions?

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

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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

Pop-a-Plug P2 Kit	Plug Size	Tube I.D. Min. (in)	Tube I.D. Max. (in)	Tube I.D. Min. (mm)	Tube I.D. Max. (mm)
P2-400-Q	0.400	0.401	0.420	10.19	10.68
P2-420-Q	0.420	0.421	0.440	10.69	11.19
P2-440-Q	0.440	0.441	0.460	11.20	11.70
P2-460-Q	0.460	0.461	0.480	11.71	12.21
P2-480-Q	0.480	0.481	0.500	12.22	12.72
P2-500-Q	0.500	0.501	0.520	12.73	13.22
P2-520-Q	0.520	0.521	0.540	13.23	13.73
P2-540-Q	0.540	0.541	0.560	13.74	14.24
P2-560-Q	0.560	0.561	0.580	14.25	14.75
P2-580-Q	0.580	0.581	0.600	14.76	15.26
P2-600-Q	0.600	0.601	0.620	15.27	15.76
P2-620-Q	0.620	0.621	0.640	15.77	16.27
P2-640-Q	0.640	0.641	0.660	16.28	16.78
P2-660-Q	0.660	0.661	0.680	16.79	17.29
P2-680-Q	0.680	0.681	0.700	17.30	17.80
P2-700-Q	0.700	0.701	0.720	17.81	18.30
P2-720-Q	0.720	0.721	0.740	18.31	18.81
P2-740-Q	0.740	0.741	0.760	18.82	19.32
P2-760-Q	0.760	0.761	0.780	19.33	19.83
P2-780-Q	0.780	0.781	0.800	19.84	20.34
P2-800-Q	0.800	0.801	0.820	20.35	20.84
P2-820-Q	0.820	0.821	0.840	20.85	21.35
P2-840-Q	0.840	0.841	0.860	21.36	21.86
P2-860-Q	0.860	0.861	0.880	21.87	22.37
P2-880-Q	0.880	0.881	0.900	22.38	22.88
P2-900-Q	0.900	0.901	0.920	22.89	23.38
P2-920-Q	0.920	0.921	0.940	23.39	23.89
P2-940-Q	0.940	0.941	0.960	23.90	24.40
P2-960-Q	0.960	0.961	0.980	24.41	24.91
P2-980-Q	0.980	0.981	1.000	24.92	25.42
P2-1000-Q	1000	1001	1020	25.43	25.92
P2-1020-Q	1020	1021	1040	25.93	26.43
P2-1040-Q	1040	1041	1060	26.44	26.94
P2-1060-Q	1060	1061	1080	26.95	27.45
P2-1080-Q	1080	1081	1.100	27.46	27.96
P2-1100-Q	1.100	1.101	1.120	27.97	28.46
P2-1120-Q	1.120	1.121	1.140	28.47	28.97
P2-1140-Q	1.140	1.141	1.160	28.98	29.48
P2-1160-Q	1.160	1.161	1.180	29.49	29.99
P2-1180-Q	1.180	1.181	1.200	30.00	30.50
P2-1200-Q	1200	1201	1220	30.51	3100
P2-1220-Q	1220	1221	1240	3101	3151
P2-1240-Q	1240	1241	1260	3152	32.02
P2-1260-Q	1260	1261	1280	32.03	32.53
P2-1280-Q	1280	1281	1300	32.54	33.04
P2-1300-Q	1300	1301	1320	33.05	33.54
P2-1320-Q	1320	1321	1340	33.55	34.05
P2-1340-Q	1340	1341	1360	34.06	34.56
P2-1360-Q	1360	1361	1380	34.57	35.07
P2-1380-Q	1380	1381	1400	35.08	35.58
P2-1400-Q	1400	1401	1420	35.59	36.08
P2-1420-Q	1420	1421	1440	36.09	36.59
P2-1440-Q	1440	1441	1460	36.60	37.10
P2-1460-Q	1460	1461	1480	37.11	37.61
P2-1480-Q	1480	1481	1500	37.62	38.12
P2-1500-Q	1500	1501	1520	38.13	38.62
P2-1520-Q	1520	1521	1540	38.63	39.13
P2-1540-Q	1540	1541	1560	39.14	39.64
P2-1560-Q	1560	1561	1580	39.65	40.15
P2-1580-Q	1580	1581	1600	40.16	40.66
P2-1600-Q	1600	1601	1620	40.67	41.16
P2-1620-Q	1620	1621	1640	41.17	41.67
P2-1640-Q	1640	1641	1660	4168	42.18
P2-1660-Q	1660	1661	1680	42.19	42.69
P2-1680-Q	1680	1681	1700	42.70	43.20
P2-1700-Q	1700	1701	1720	43.21	43.70
P2-1720-Q	1720	1721	1740	43.71	44.21
P2-1740-Q	1740	1741	1760	44.22	44.72
P2-1760-Q	1760	1761	1780	44.73	45.23
P2-1780-Q	1780	1781	1800	45.24	45.74
P2-1800-Q	1800	1801	1820	45.75	46.24
P2-1820-Q	1820	1821	1840	46.25	46.75
P2-1840-Q	1840	1841	1860	46.76	47.26
P2-1860-Q	1860	1861	1880	47.27	47.77
P2-1880-Q	1880	1881	1900	47.78	48.28
P2-1900-Q	1900	1901	1920	48.29	48.78
P2-1920-Q	1920	1921	1940	48.79	49.29
P2-1940-Q	1940	1941	1960	49.30	49.80
P2-1960-Q	1960	1961	1980	49.81	50.31
P2-1980-Q	1980	1981	2.000	50.32	50.82

Pop-a-Plug P2 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 P2 Kits. Brushes are marked with size on swage. Ensure correct size brush is chosen before brushing. The suffix "Q" in the Pop-A-Plug P2 kit part number is the Pop-A-Plug material designator. Please replace "Q" with one of the following:

- B = Brass
- C = Carbon Steel
- H=70/30 Copper Nickel
- N = 90/10 Copper Nickel
- M = Monel
- S = 316 Stainless
- E = 304 Stainless
- T = Titanium
- D=Duplex 2205 Stainless
- F22=F22 Alloy
- F11=F11 Alloy Steel
- Y=Incoloy 825
- NI=Nickel 200
- NI2=Nickel 201
- P=430 Stailnless
- K=410 Stainless
- A = 4142 Alloy
- I=Inconel 600
- X=AL6Xn
- 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 P2 Size	Plug Positioner	Pull Rod Assembly	Channel Head Pull Rod Assembly	Pop-A-Plug P2 Size	Plug Positioner	Pull Rod Assembly	Channel Head Pull Rod Assembly
.400-.440	PP-400-440	PRA-400-440	CHA-400-440-LL	.400-.440	PP-400-440	LPRA-400-440	LCHA-400-440-LL
.460-.480	PP-460-500	PRA-460-500	CHA-460-500-LL	.460-.480	PP-460-500	LPRA-460-500	LCHA-460-500-LL
.500-.580	PP-520-580	PRA-520-580	CHA-520-580-LL	.500-.580	PP-520-580	LPRA-520-580	LCHA-520-580-LL
.600-.680	PP-600-680	PRA-600-680	CHA-600-680-LL	.600-.680	PP-600-680	LPRA-600-680	LCHA-600-680-LL
.700-.780	PP-700-780	PRA-700-780	CHA-700-780-LL	.700-.780	PP-700-780	LPRA-700-780	LCHA-700-780-LL
.800-.860	PP-800-860	PRA-800-860	CHA-800-860-LL	.800-.860	PP-800-860	LPRA-800-860	LCHA-800-860-LL
.880-.960	PP-880-960	PRA-880-960	CHA-880-960-LL	.880-.960	PP-880-960	LPRA-880-960	LCHA-880-960-LL
.980-1.060	PP-980-1060	PRA-980-1060	CHA-980-1060-LL	.980-1.060	PP-980-1060	LPRA-980-1060	LCHA-980-1060-LL
1.080-1.160	PP-1080-1160	PRA-1080-1160	CHA-1080-1160-LL	1.080-1.160	PP-1080-1160	LPRA-1080-1160	LCHA-1080-1160-LL
				1.180-1.240	PP-1180-1240	LPRA-1180-1240	LCHA-1180-1240-LL
				1.260-1.340	PP-1260-1340	LPRA-1260-1340	LCHA-1260-1340-LL
				1.360-1.440	PP-1360-1440	LPRA-1360-1440	LCHA-1360-1440-LL
				1.460-1.540	PP-1460-1540	LPRA-1460-1540	LCHA-1460-1540-LL
				1.560-1.640	PP-1560-1640	LPRA-1560-1640	LCHA-1560-1640-LL
				1.660-1.740	PP-1660-1740	LPRA-1660-1740	LCHA-1660-1740-LL
				1.760-1.840	PP-1760-1840	LPRA-1760-1840	LCHA-1760-1840-LL
				1.860-1.940	PP-1860-1940	LPRA-1860-1940	LCHA-1860-1940-LL
				1.960-2.000	PP-1960-2000	LPRA-1960-2000	LCHA-1960-2000-LL

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