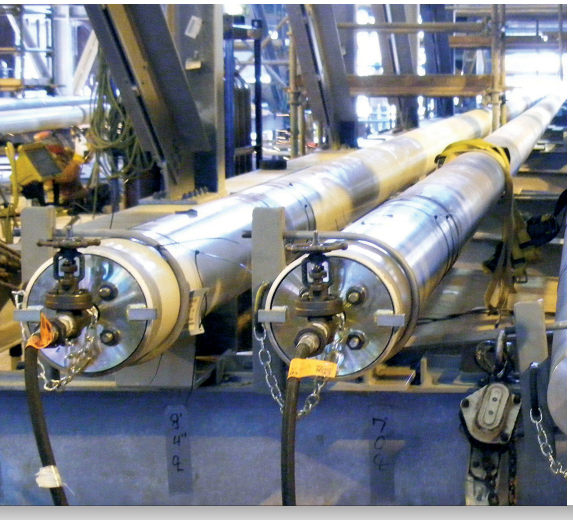
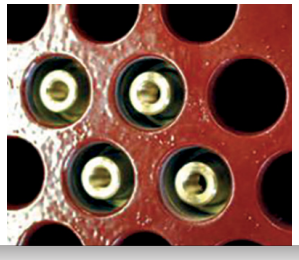
CURTISS-WRIGHT

EST Group





Product Guide

Heat Exchanger Testing & Plugging

Hydrostatic Test & Isolation Plugs

Field Services

CURTISS-WRIGHT

With a proud legacy spanning more than 90 years, Curtiss-Wright is a global innovative company that delivers highly engineered, critical function products and services to the commercial, industrial, defense and energy markets. Building on the heritage of Glenn Curtiss and the Wright brothers, we have a long tradition of providing reliable solutions through trusted customer relationships.

Curtiss-Wright EST Group

Since 1968, Curtiss-Wright EST Group has specialized in the development, and manufacturing of tools and systems that greatly simplify maintenance of shell & tube and air-cooled heat exchangers, as well as test plug systems that expedite in-service inspection of open end pipe, piping systems, tubing and pressure vessels. Our plugging and testing systems have saved customers millions of dollars in maintenance and downtime.

EST Group serves the power generation, upstream oil and gas, refining, petrochemical, fine chemical, pharmaceutical and shipbuilding industries worldwide.

See page 4 for details

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Pop-A-Plug® Tube Plugging System Overview & Qualifications

Our flagship product, Pop-A-Plug Tube Plugs are the industry's leading technology for plugging leaking and/or degraded heat exchanger tubes.

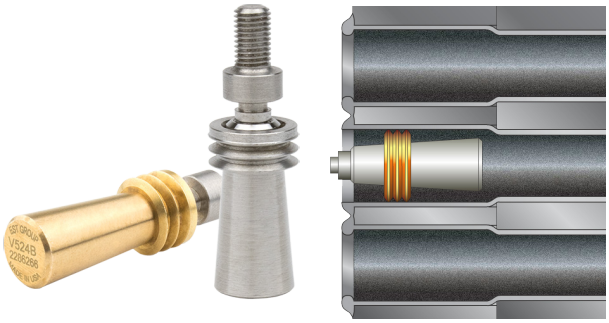
- Eliminates the need for welding in tube plugs
- Identified as a recommended tube plugging method in ASME PCC-2 (Article 312)
- Offers lowest life cycle cost when compared to alternative tube plugging methods
- Engineered solution that will not degrade and leak like rubber or elastomer plugs
- Global industry acceptance as a safe, reliable and easy to install heat exchanger tube plugging method
- Recognized as a best practice repair method by many power, refining, chemical and petrochemical companies worldwide
- Approved by Canada's Technical Standards and Safety Authority (TSSA) and Alberta Boilers Safety Association (ABSA) as a qualified heat exchanger tube plug for Nuclear and non-Nuclear applications. CRN numbers available upon request.
- Used in 100% of North American & French Nuclear Power Plants
- Widely used by US Navy on nuclear class surface ships & submarines
- Available in over 40 different alloys to match heat exchanger tube material to mitigate corrosion and thermal expansion issues
- Large inventory and emergency manufacturing available
- Manufactured to quality assurance programs including: ASME NQA-1-2015, 10 CFR 50 Appx. B and ANSI N45.2
- Nuclear Procurement Issues Corporation (NUPIC) audited and approved company serving the global Nuclear Industry
- Independently reviewed and certified by TUV Rheinland
- ISO 9001:2015 Registered Facility

ISO 9001:2015
registered facility

Heat Exchanger Tube Plugs & Stabilizers

Pop-A-Plug® CPI/Perma Medium Pressure Tube Plugs

Designed as a fast and safe way to seal leaking heat exchanger and condenser tubes. Pop-A-Plug CPI/Perma tube plugs are resistant to thermal cycling and are able to provide a seal that is helium leak tight. Pop-A-Plug CPI/Perma tube plugs install using a controlled force. This protects against damage to tubesheet ligaments and adjacent tubesheet joints, extending the life of your heat exchanger and reducing total operating cost. Operating pressures to 1000 PsiG (68.9 BarG). Tube sizes for 0.472" to 2.067" (11.99mm to 52. 0mm) I.D. tubes. Helium leak tight to 1 x 10^{-6} cc/sec. Larger sizes available. Removable for retubing. Compliant with quality assurance systems including; ANSI N45.2, 10 CFR 50 Appx. B, 10 CFR 21.



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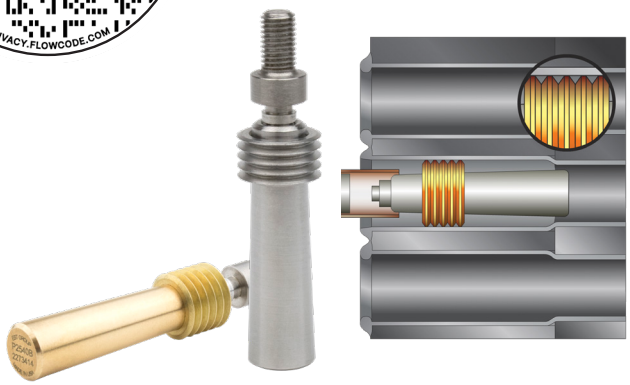
Pop-A-Plug® P2 High Pressure Tube Plugs

A proven long-term performer in thermal and nuclear power generating stations, the Pop-A-Plug P2 tube plug features internally serrated rings designed to maintain a leak tight seal under extreme thermal and pressure cycling. The Pop-A-Plug P2 tube plugging system reduces downtime, eliminates welding and explosives, and will not damage your tubes, tubejoints or tubesheet. Working pressures to 7,000 PsiG (483 BarG). Sizes to fit 0.400" to 1.460" (10.16mm to 37.08mm) tube I.D. Proven helium leak tight to 1 x 10^{-10} cc/sec. Breakaway ensures quick, easy and tightly controlled installation force eliminating damage to tube joints and epoxy coated tubesheets. Larger and smaller sizes available. Pop-A-Plug P2 tube plug sizing lower limit is 0.215" (5.46mm). Removable for retubing. Compliant with quality assurance systems including; ANSI N45.2, 10 CFR 50 Appx. B, 10 CFR 21.



Vibra Proof Condenser Plugs

Expandable metal and elastomer condenser plug, ideal for temporary tube plugging applications. Pressure Rating: 150 PsiG (10.3 BarG) maximum. Size Range: 0.280" to 1.309" (7.11-33.25mm). Standard Materials: 0.28" - 0.47" Stainless Steel with Neoprene seals. 0.50" - 1.28" sizes: Brass with Neoprene seals.

Pop-A-Plug® Tube Stabilizers

Stabilize weakened or fractured heat exchanger and condenser tubes. Unique Pop-A-Plug anchoring system eliminates cable or rod migration, ensuring fractured/deteriorated tubes are securely supported until retubing or sleeving can be performed, mitigating risk of damage to adjacent tubes. Ideal for any type of shell and tube heat exchanger from high pressure feedwater heaters to surface condensers. Sizes to fit tubes ranging from 0.501" to 0.960" I.D. (12.73 - 24.38mm). Available in either rod or cable type configuration. Available in any length.

Installation & Removal Tools

Pop-A-Plug® Battery-Operated Smart Ram 640T

Smart Ram 640T allows operators to quickly perform heat exchanger tube repairs without significant setup or breakdown time. Self-contained battery-operated hydraulic unit provides reliable installation of heat exchanger tube plugs. Long-lasting 18v/3.0Ah Lithium-ion battery allows for cordless operation in remote and close quarters environments without the need for electric or plant air connection.

CONVENIENCE REDEFINED

Features

- Ideal for remote or confined spaces
- Self-contained battery-operated unit - no shop air or electric required
- Long-lasting 3.0Ah Li-Ion Battery
- Install up to 500 tube plugs on fully charged battery
- Eliminates tripping hazards
- Install with Breakaway or Pull-to-Pressure methods
- Integrated high accuracy pressure transducer
- Info display with multi-user preset capabilities
- Weighs 5lbs (2.3kg)

Tube I.D. Range

CPI /Perma Plugs: 0.472 - 1.336" (11.99 - 33.93mm)
P2 Plugs: 0.400 - 1.180" (10.19 - 29.99mm)

Plug Size Range / Capacity

CPI /Perma Plugs: V-471 thru V-1212
P2 Plugs: P2-400 thru P2-1160

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Installation & Removal Tools

Pop-A-Plug® System Ram Packages

There is no better way to install Pop-A-Plug Tube Plugs than with our hydraulic installation equipment. Our Ram Packages are designed to hydraulically install Pop-A-Plug Tube Plugs quickly and safely. Rams are compact and easy to use. Ram Packages include a hydraulic ram, pump, pressure gauge, high pressure hose and storage cases. All provide a controlled, repeatable installation force and requires no welding for plug installation. Rams operate on shop air supply - 40 to 125 PsiG (2.7 to 8.6 BarG).

- All provide a controlled, repeatable installation force
- No welding required for plug installation

PAP6600 Ram Package

Tube I.D. Range
CPI /Perma Plugs: 0.472 - 1.336" (11.99 - 33.93mm)
P2 Plugs: 0.400 - 1.180" (10.19 - 29.99mm)

Plug Size Range / Capacity
CPI /Perma Plugs: V-471 thru V-1212
P2 Plugs: P2-400 thru P2-1160

PAP123RK Ram Package

Tube I.D. Range
CPI /Perma Plugs: 0.472 - 2.067" (11.99 - 52.50mm)
P2 Plugs: 0.400 - 2.020" (10.19 - 51.31mm)

Plug Size Range / Capacity
CPI /Perma Plugs: V-471 thru V-1944
P2 Plugs: P2-400 thru P2-2000

PAP3600 Close Quarters Ram

Compact design for installing Pop-A-Plug Tube Plugs with minimal clearance around the tube end. Ideal for tubes in the outermost row of closed head feedwater heaters or for tubes adjacent to a pass partition or divider plate.

Tube I.D. Range
CPI /Perma Plugs: 0.472 - 0.810" (11.99 - 20.57mm)
P2 Plugs: 0.400 - 0.880" (10.19 - 22.37mm)

Plug Size Range / Capacity
CPI /Perma Plugs: V-471 thru V-735
P2 Plugs: P2-400 thru P2-860

Pop-A-Plug® Manual Installation Tool (MIT)

Provides fast, reliable installation in situations where air or electricity are not available. Each MIT comes complete with a Pull Rod and Positioner to install the size and style Pop-A-Plug Tube Plug identified in the tool's model number. By interchanging pull rods and plug positioners, the MIT body can be used to install P2 plugs up to 1.160" (29.46mm) and CPI/Perma plugs up to 1.149" (29.18mm). The MIT can be used with manual wrenches or sockets, as well as with electric or pneumatic impact wrenches.

Installation & Removal Tools

Pop-A-Plug® Pull Rod Assemblies

EST Group maintains a significant inventory of Pull Rod Assemblies, Channel Head assemblies and extensions for both near end and through-the-tube plugging in Shell and Tube Heat Exchangers and Air Cooled Heat Exchangers.

Pull Rod Assemblies for Air Cooled Heat Exchangers (ACHE)

EST Group offers a line of Pull Rod assemblies, Channel Head assemblies and extensions for the preparation and plugging of all types of Air Cooled Heat Exchangers. These tools eliminate the need for hammer in or welded plugs that can damage the tube and/or tubesheet and cause unexpected ejections.

Pull Rods, Go/No-Go Gages, Reamers and Brushes are all available with extension rods to easily reach the tubesheet through the plug header to do the repairs in minutes instead of hours.

One Rev Tube Cutter

Ideal for piercing tubes prior to tube plugging. Capable of cutting ferrous & non-ferrous tubes commonly found in heat exchangers, boilers, & condensers. No special drives required, use with hand wrench or ratchet. Adjustable for tubesheet thickness from 1" to 6" (25.4mm - 152.4 mm), longer tools available in 10" increments. **Size Range:** 0.5"-2" (12.7mm - 50.8 mm)

Tapered Reamers

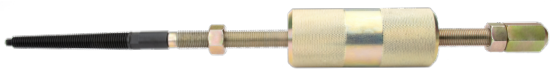
Needed when weld droop obstructs a tube opening and prevents proper measurement of tube I.D. Tapered design allows for precise removal of weld droop or other obstructions when fitted into a hand-held power drill. Offered in various sizes for use with Pop-A-Plug CPI/Perma and Pop-A-Plug P2 tube plugs.

Tube Preparation Brushes

Our brushes deliver fast and consistent tube preparation. Tube preparation brushes size and round the tube end, quickly remove surface defects that can cause leaks and provide a roughened surface. This improves the Pop-A-Plug Tube Plug's pressure holding capability and leak tight integrity.

Pop-A-Plug® Removal Tool (PRT)

Quickly and easily remove installed Pop-A-Plug Tube Plugs with the dual functioning Removal Tool. The PRT features a nose piece that threads into the pin of an installed plug, enabling you to drive the pin from the ring. The tool retains the pin while a serrated spear grabs the ring's I.D. An integral slide hammer pulls out the ring and pin in one operation. Also available in extended models for Pop-A-Plug Air Cooled Heat Exchanger tube plugging systems.



Heat Exchanger Tube Testing Equipment & Turnaround Job Boxes

G-160 Tube Testing Tool

Rapidly detect tube leaks while providing a safer working environment for plant personnel. Innovative patented gripper design provides increased operator safety. Uses standard compressed air supply - 40 to 125 PsiG (2.7 to 8.5 BarG).

Test tube I.D. sizes from 0.28" to 1.81" (7.1mm to 46.0).

Features

- Ergonomic design with push button activated air injection valve
- Patented gripper design requires less operator force
- Corrosion resistant powder coated finish
- Lightweight aluminum construction
- Fully protected gauges
- Impact-resistant case
- Integrated gripper design available
- Analog and digital gauges available

G-250 Vacuum Tube Testing Tool

Designed to quickly seal off and evacuate individual heat exchanger tubes to test for leakage. Test heat exchanger tubes ranging from 0.28" to 1.45" (7.1 to 36.8mm). High strength aluminum alloy construction reduces fatigue associated with heavier testing equipment. Each G-250 set weighs less than 2.5 lbs. (1.1kg).

Optional Seal sets available to test tubes to 2.50" (63.5mm). Replacement Seal & Washer sets, Channel Head Extensions and Digital Pressure Gauges also available. Uses standard compressed air supply – 40 to 125 PsiG (2.7 to 8.5 BarG).

G-650 Vacuum Joint Testing Tool

Quickly test expanded tube-to-tubesheet joints for leakage. Ideal for heat exchanger manufacturers or companies performing retubing operations. The G-650 Tool seals the tube I.D. and the tubesheet face, then evacuates the tube end at the joint. A loss of vacuum indicates a leaky tube joint. Interchangeable manifolds and Seal & Washer sets allow the G-650 Tool to test tube-to-tubesheet joints on .375" to 1.25" (9.5mm to 31.8mm) O.D. tubes. The larger G-650A Vacuum Joint Testing Tool will accommodate tube O.D. sizes from 1.5" to 2.5" (38.1 - 63.5mm).

G-650 Tools are not suitable for testing excessively belled/flared tube ends or tubes with welded tube-to-tubesheet joints. Digital pressure gauges also available. Uses standard compressed air supply - 40 to 125 PsiG (2.7 to 8.5 BarG).

Turnaround Job Boxes

Perfect for anyone planning a large test & repair project who needs to have all their Pop-A-Plug Tube Plugs and Installation tools in one place. Turnaround Job Boxes are easily transported by fork truck or pallet jack. All-steel construction. Can be securely locked to prevent theft of tools, plugs and other equipment.

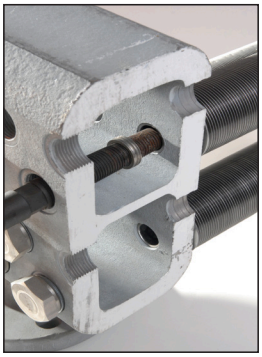
Field Notes

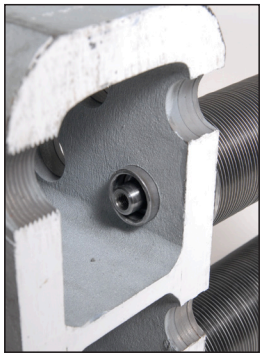
Pop-A-Plug® Tube Plugging System for Air-Cooled Heat Exchangers

Curtiss Wright EST Group offers a solution to simplify testing, maintenance and repair of Air-Cooled Heat Exchangers. Pop-A-Plug Tube Plugging System and G-Series Tube Testing equipment provide easy-to-use tools for leak-testing and installing permanent but removable plugs into leaking tubes. These tools are designed to test and plug tubes through the plug sheet, directly accessing the tubesheet. Testing and installation can be done in minutes, not the hours previously needed to perform repairs. Pop-A-Plug Tube Plugs are rated up to 7000 PsiG (480 BarG), and are available in a variety of materials to match your tube material, I.D. and pressure.

Reported results using the Pop-A-Plug Tube Plugging System:

20 tubes were plugged and exchanger was back in operation in 1 hour using the Pop-A-Plug System versus 18-26 hours of downtime using hammer and welded plugs.





- Average installation time: 2 minutes per plug
- No weld permits required
- No expert welders required
- No damage to plug sheet threads
- Plugs can be removed when re-tubing is required

Change Out Old Elastomeric Plugs, Minimize Plant Downtime

In power generating stations, any forced outage is costly, especially at the peak of the generating season. All plants that support the base load of energy need to do everything possible to maximize uptime. As an example of costs associated with unplanned outages, a coal-fired generation plant incurred almost $10.9 million in losses due to almost 1369 hours (over 8 weeks) of downtime due to process water contamination. Causes for the failures were varied but one of the single largest (34%), was due to the failure of previously installed rubber condenser plugs!

These outages call for the proactive change out of old rubber/elastomer tube plugs to Pop-A-Plug Tube Plugs for reliable, and permanent sealing of leaking and degraded tube plugs. Pop-A-Plug Tube Plugs are proven to provide the lowest lifecycle cost for all types of plug systems used in heat exchanger maintenance. Pop-A-Plug Tube Plug kits are readily from a large inventory with 24/7 emergency service available for any unplanned outage that may arise – anywhere. EST Group also offers outage job box kits for large plants needing a variety of plugs for their condenser systems.

GripTight® Hydrostatic Pressure Testing & Isolation Plugs

Safe, Effective Solutions for Rapid Pipe Testing and Repairs

EST Group offers a complete line of Hydrostatic Pressure Test and Pipeline Isolation Plugs for pressure testing pipework, pipelines and pressure vessels. GripTight® Test Plugs – for high pressure hydrostatic testing of open-end pipe, piping systems, tubing and pressure vessels. Safe and effective at working pressures to 15000 PsiG (1034 BarG). Pipe O.D. and ID sealing solutions available. GripTight® Isolation Plugs – positively isolate pipe end hot work from potentially explosive upstream vapors; then weld and test the flange to pipe connection all with one tool.

- Test Open End Pipes, Pipelines, Tubes and Pressure Vessels
- Perform Flange-To-Pipe Weld Testing
- Isolate and Test Pipe Connections
- Facilitates testing in accordance with ASME PCC-2 and ASME Boiler and Pressure Vessel Codes

GripTight MAX® Plug

Significantly increase the range of pipe materials that can be tested at higher pressures.

Highly effective for testing high pressure steam systems, high alloy hardened pipe materials, and down hole/well-head piping. Also effective for testing non-metallic materials including Fiberglass Reinforced Plastic (FRP) and Glass Reinforced Epoxy (GRE).

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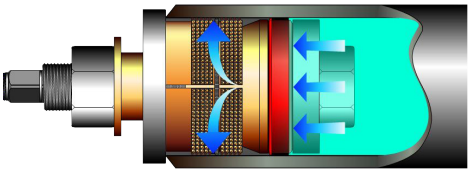
Features & Benefits

- Test pressures up to 15000 PsiG (1034 BarG)
- Size range 3/8" to 48" (DN10 - DN1200)
- Safe & reliable testing at higher pressures
- Saves up to 85% in testing time vs. welded-on end cap testing procedures
- Patented dual-serrated gripper design provides more gripping points on inside pipe surfaces

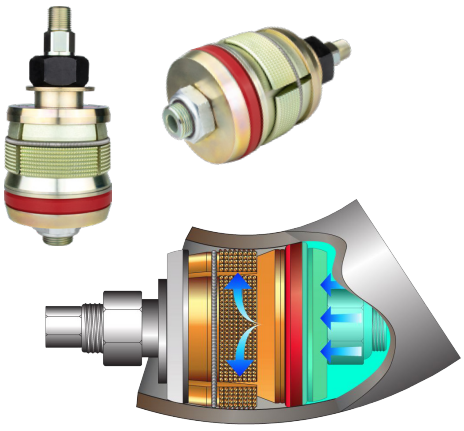


GripTight® Elbow Plug

Designed for testing long radius elbows. Our patented dual-serrated GripTight MAX grippers give this unique plug design pressure holding capabilities to 3350 PsiG (231 BarG) – providing a safe and effective solution for pipe spools and piping systems terminating in long radius elbows.

Features & Benefits

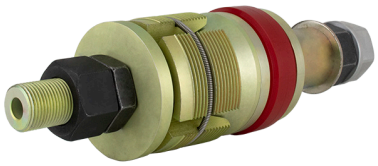
- Test pressures up to 3350 PsiG (231 BarG)
- Size range 2" to 48" (DN50-DN1200)
- Orientation Free Installation - no need to align with elbow - easier operation
- Patented dual-serrated gripper design
- Fits most long radius elbow
- Saves up to 85% in testing time vs. welded end cap/pup testing procedures

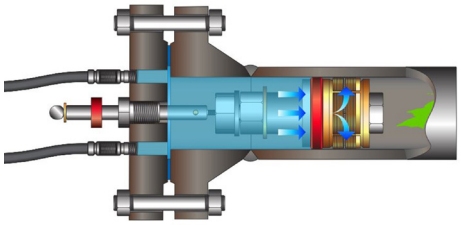


Pressure Test Plugs

GripTight® Reverse Pressure Plug

Pressure test flange-to-pipe welds with full radial, hoop and axial stresses – equivalent to the stresses that would be produced when using a blind to pressurize the entire piping system. Pressure testing can effectively verify the weld integrity providing the user confidence the flange and weld will properly function when placed into service. ASME PCC-2 (Article 503) Type I testing device. *Custom sizes available upon request. Standard Seal Material: Urethane*



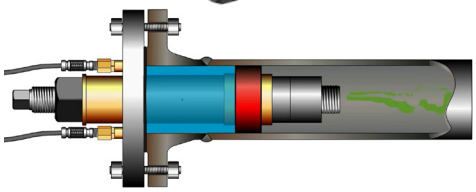


Size Range
2" to 48" NPS (DN50 - DN1200)
Custom sizes available upon request

Test Pressure
2250 PsiG (155.1 BarG)

High Lift Flange Weld Plug

Monitor upstream conditions, isolate and purge weld area, perform hot work, and hydro test the weld joint with one easy-to-use tool. No blind flanging upstream, no vacuum truck for evacuating the line, and no X-raying. Each test requires a minimum amount of water, no need to fill the entire line. Use less water and minimize your environmental impact. High Lift seal design provides improved seal-to-pipe clearance. Operating pressures to ANSI B16.5 requirements. Flange classes 150 to 600 lb. All flange types. ASME PCC-2 (Article 503) Type III testing device. *Custom sizes available upon request. Standard Seal Material: Urethane*



Size Range
3/8" to 48" NPS (DN10 to DN1200)
Custom sizes available upon request

Test Pressure

150#	450 PsiG	(31.0 BarG)
300#	1125 PsiG	(77.6 BarG)
600#	2250 PsiG	(155.1 BarG)

GripTight® PE Plug

Designed for testing of polyethylene pipe (LDPE, MDPE, & HDPE). Working pressure varies by plug size, SDR, and material grade. Testing can be performed on an installed pipe or while it is still on the spool. Aluminum/Steel constructions with Urethane Seal. Plug sizes to cover 9 to 17 SDR applications in either HDPE or MDPE pipe - other sizes available. *Standard Seal Material: Urethane with Fluoroelastomer and Nitrile/Buna-N O-rings*

Size Range
2", 3", 4", 6" and 8" (DN50 to DN200)

Test Pressure
Up to 375 PsiG (25.8 BarG) Max
Varies by plug size, SDR, and material grade

O.D. GripTight® Plug

Uses self-gripping, self-sealing design and reliable dual seal mechanism to provide unparalleled speed and safety in hydro-testing. The GripTight design grips and seals along the pipe O.D. Since pipe O.D.'s are constant, one O.D. plug often replaces several different sizes of I.D. sealing plugs providing an economic advantage and lower inventory. *Standard Seal Material: Urethane with Fluoroelastomer O-ring*

Size Range
1/4" to 4" ANSI pipe sizes (DN8 to DN100) &
1/2" to 3½" (12.7mm to 88.9mm) O.D. tube sizes

Test Pressure
Up to 5000 PsiG (344.7 BarG)

Socket Weld (SQS) Plug

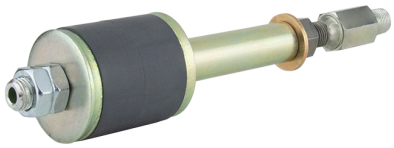
SQS Test Plugs are designed to facilitate testing socket weld fittings and couplings. During installation, grippers expand within the socket holding the plug in position while the seal element expands and seals off the bore of the fitting. Designed for ASTM A105 3000 lb carbon steel socket weld fittings. *Custom sizes available upon request. Standard Seal Material: Urethane*

Size Range
1/2" to 2" NPS (DN15 to DN50)

Test Pressure
Up to 5000 PsiG (344.7 BarG)
depending on plug size

Bolt Type Plug

Designed for simple and reliable testing of pipe and tubing. Bolt Type plugs feature a neoprene seal – the only part of the plug that comes in contact with the tube I.D. Simply install into the open end of the pipe or tube and tighten the large compression nut to expand the seal element; then begin testing. *Standard Seal Material: Neoprene*

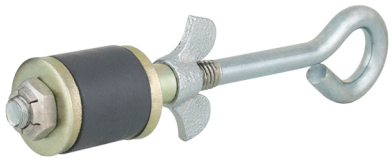


Size Range
0.28" to 10.5" (7.11 to 266.7mm)

Test Pressure
Up to 250 PsiG (17.2 BarG)
depending on plug size

Economy Plug

Simple and reliable testing of pipe and tubing. Economy plugs feature a neoprene seal - the only part of the plug that comes in contact with the tube I.D. Simply install the Economy test plug into the open end of a pipe and/or tube, and tighten to expand the seal. Begin pressure testing. *Standard Seal Material: Neoprene*



Size Range
3/8" to 4" (11.2 to 101.6mm)

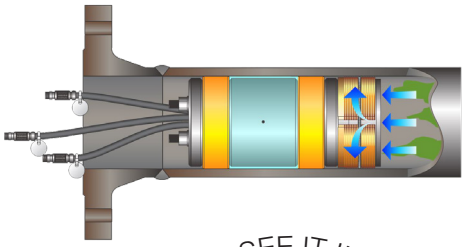
Test Pressure
Up to 35 PsiG (2.4 BarG)
depending on plug size

Pipe Isolation Plugs

GripTight® Isolation Plug

GripTight Isolation Plugs integrate a Double Block and Bleed Test Plug with GripTight grippers. The upstream port allows operators to positively isolate and monitor potentially explosive vapors during hot work. The dual port design allows water to be introduced to the section between the seals through the fill port while air is simultaneously evacuated through the vent port, creating a positive pressure barrier between the hot work and residual upstream gases. After hot work is complete, the plug can be repositioned to hydrotest the new weld connection.

GripTight grippers improve the operational safety minimizing the risk of accidental plug blowout/expulsion due to improper use or unexpected upstream pressure in the line. As upstream pressure increases, GripTight grippers use the pressure to grip and seal more securely against the pipe's I.D. ASME PCC-2 (Article 503) Type IV testing device. *Standard Seal Material: Urethane*

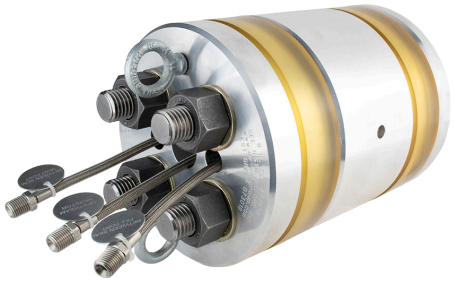


Size Range
3/4" to 48" NPS (DN20 to DN1200)
Custom sizes available upon request

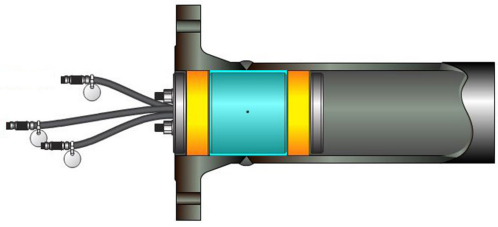
Test Pressure
Up to 2250 PsiG (155.1 BarG) between the seals
1500 PsiG (103 BarG) upstream

Double Block and Bleed Plug

Double Block and Bleed Isolation Plug utilizes a safe and effective three port design. The upstream port allows operators to positively isolate and monitor potentially explosive vapors during hot work. The dual port design allows water to be introduced to the section between the seals through the fill port while air is simultaneously evacuated through the vent port, creating a positive pressure barrier between the hot work and residual upstream gases. After hot work is complete, plug can be repositioned to hydrotest new weld connections.



Durable aluminum/steel construction makes this tool lightweight and easy to maneuver. The volume of water required for testing is so small that testing can be accomplished using a simple hand pump, easily facilitating testing in remote areas of facilities. Multi-schedule capability. ASME PCC-2 (Article 503) Type IV testing device. *Standard Seal Material: Urethane*



Size Range
3/4" to 48" NPS (DN20 to DN1200)
Custom sizes available upon request

Test Pressure
Up to 2250 PsiG (155.1 BarG) between the seals
10 PsiG (0.7 BarG) upstream

Hydrostatic Test Pumps

P Series Hand Pump

A self-contained and portable hand pump for testing tubes, pipes and pressure vessels. It is integrated into a 5 gallon (19 liters) attached reservoir which is easily refilled. Pump is hand operated, eliminating the need for compressed air. Pressure output can be adjusted to either 1000 PsiG (68.9 BarG), 2000 PsiG (137.9 BarG) or 3000 PsiG (207 BarG) for the appropriate application. It has a silicone-filled gauge for all weather use and minimal moving parts for durability and longevity. High pressure bleed valve and hose with swivel fitting included.

P Series

Ideal for hydro testing heat exchanger tubes, pipe and pressure vessels in the field or in the shop. Available in two output pressures, 2,500 or 10,000 PsiG (172 or 689 BarG). All wetted parts are stainless steel. Easy to read 4" (100 mm) diameter pressure gauge. Completely enclosed in a lockable aluminum tool box. Supplied with 10ft (3.1 m) high pressure hose with quick couplings for air and water inlet connections.

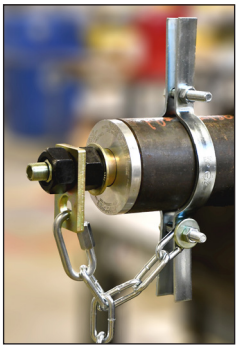
Blue Max

Suitable for all hydrostatic testing applications. Available in a number of output pressures ranging from 1,000 to 10,000 PsiG (69 to 689 BarG). Higher pressures available. All wetted parts are stainless steel. Blue Max 3 features an easy to read 4" diameter (100 mm) pressure gauge. Supplied with mating quick connect couplings for air inlet, water inlet and high pressure outlet connections. Enclosed cabinet provides safe & quiet operation, and protects components from damage.

Accessories & Safety Devices

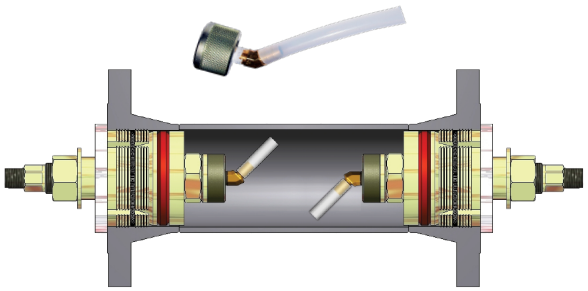
Plug Safety Gags

Designed to prevent damage which may occur due to incorrectly installed plugs ejecting from the pipe during pressurization. Gags are designed to quickly fasten to pipe O.D. and plug inlet.



GripTight® Vent Assembly

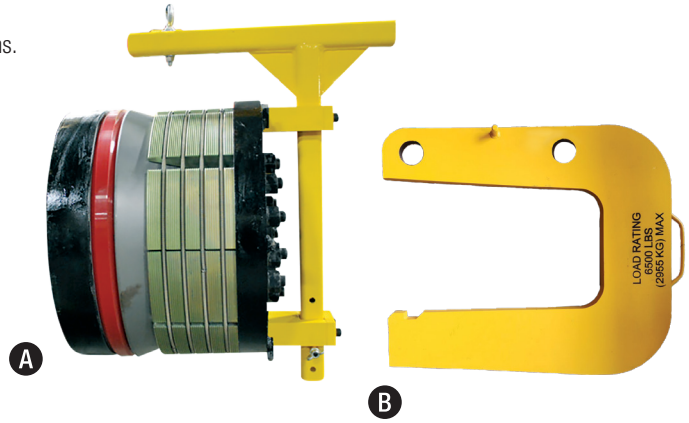
Safely fill and drain pipes during hydrostatic testing. Vents are installed with tubes at high and low points in the area being tested in order to fill with test medium and displace air/gases in the pipe being tested.



Test Plug Lifting Arms

Designed to maneuver larger test plugs securely with cranes, forklifts, or other lifting mechanisms. Provides greater stability and operator safety during installations.

Style	Size Ranges	Max. Capacity
A	10”-24” (DN250-DN600)	10”-24” - 1,500lbs. (680.4kg)
B	26”-36” (DN650-DN900)	26”-36” - 3,500lbs. (1,587.6kg)
B	38”-48” (DN950-DN1200)	38”-48” - 6,500lbs. (2,948.4kg)



Pipe Test Toolkit

Combined with your choice of GripTight Test Plug, GripTight MAX Test Plug or other EST Group Test and Isolation Plugs, the Pipe Test Tool kit is all you need to hydrostatically test your flange welds and other joint connections. All that’s needed is the water!

Field Services & Product Training

Expert Technical Support 24 / 7 / 365

With industry wide reduction in plant maintenance personnel, it is more important than ever to work with a skilled and experienced provider of heat exchanger and hydrostatic testing services. From inspection to repair services, when you work with EST Group, you know the job will be done right.

EST Group Field Services provide a complete range of on-site services for your shell and tube heat exchangers, condensers, air cooled heat exchangers and oil coolers. We also provide hydrostatic testing services for pipe, piping systems, and flange connections. Our trained technicians have the experience and know-how to handle the most demanding jobs, safely, competently and on-time.

Join our growing list of satisfied customers in the power generation, chemical, petrochemical, oil refining, pharmaceutical, industrial gas, shipbuilding, and boiler manufacturing industries.

Services

- Pop-A-Plug Tube Plugging
- Tube Testing & Tube Joint Testing
- Tube Sleeving & Lining
- Tube Cleaning
- Tube Sample Removal
- Visual Tube Inspection
- Hydrostatic Testing
  - GripTight full line testing
  - GripTight Elbow testing
  - GripTight Reverse Pressure flange weld testing
  - Double Block and Bleed Isolation
  - GripTight Isolation weld testing with back pressure isolation
- Field Supervision & Technical Support

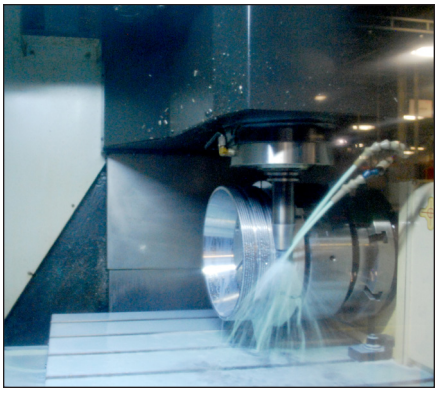
Product Training

- Certified Training Program
- Pop-A-Plug Installation Training
- Test Plug Operation and Plug Maintenance Training

Manufacturing

Serving industry for over 50 years, EST Group is equipped to handle any type of machining in a wide range of materials. Our state-of-the-art equipment gives us the flexibility to work with virtually any component material our customers' specifications require.

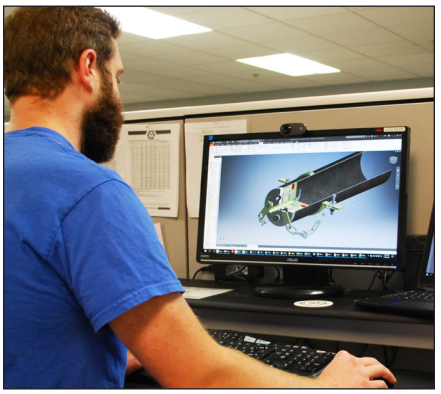
Our manufacturing floor is fully equipped with a variety of CNC lathes including Swiss-type, CNC mills, 4 & 5 axis, conventional turret, and secondary operation machines, laser engravers and other equipment that was specifically developed to improve quality of our products and efficiency of manufacturing processes.



Engineering

Our Engineering team is devoted to providing innovative, precise, and cost-effective solutions to our customers. Extensive knowledge of applications and equipment within the industries we serve, allow our products and services to improve our customers' project scope through reduction in time and cost, while maintaining consistent dependability and a safer work environment.

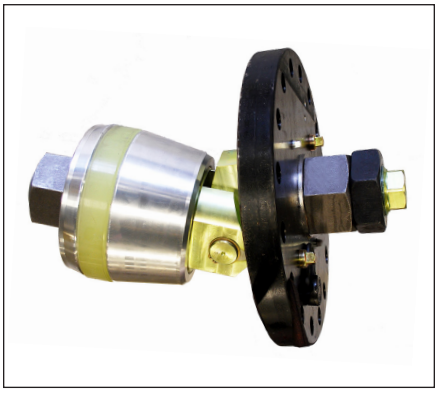
Our team continuously utilizes new techniques and technology to improve the quality of our products and influence the industry in a positive way. Precision engineering and expert application support make EST Group the best choice for solving complex pipe testing and isolation challenges.



Custom Products

EST Group has a long-standing reputation as a leader, and quality manufacturer of heat exchanger tube plugging and pressure testing pipe equipment. While we maintain a large inventory of Pop-A-Plug Tube Plugs and GripTight Test Plugs for a variety of applications, our custom products are what truly set us apart from our competition.

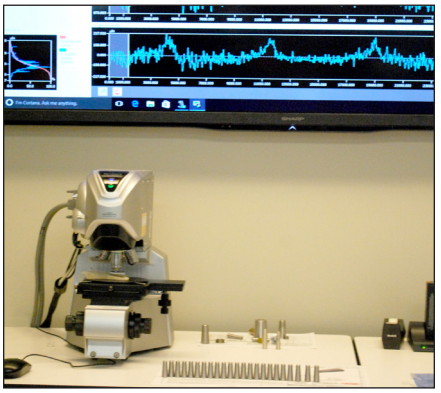
Thorough knowledge of applications across the industries we serve allow our team of Application Engineers to work closely with our customers to design products to suit their every need, while providing high-level service and support to see projects through to completion.



Quality Assurance

EST Group's QA team is focused on continuous improvement and reducing waste at every level within our organization. This ensures that our customers get the best solution to their problem in a timely fashion.

Our Quality Program is integrated into each element of our operation – manufacturing, supply chain, engineering, and sales. Each process is audited and reviewed to ensure our products exceed the demand of our customers.



Common Pipe Sizing Chart - English & Metric Sizing (inches / mm)

PIPE SIZE	DN	PIPE O.D.	SCH 5S	SCH 10S	SCH 10	SCH 20	SCH 30	STD	SCH 40	SCH 60	XS	SCH 80	SCH 100	SCH 120	SCH 140	SCH 160	XXS
1/8”	6	0.405 (10.29)		0.307 (7.80)				0.269 (6.83)	0.269 (6.83)		0.215 (5.46)	0.215 (5.46)					
1/4”	8	0.540 (13.72)		0.410 (10.41)				0.364 (9.25)	0.364 (9.25)		0.302 (7.67)	0.302 (7.67)					
3/8”	10	0.675 (17.15)		0.545 (13.84)				0.493 (12.52)	0.493 (12.52)		0.423 (10.74)	0.423 (10.74)					
1/2”	15	0.840 (21.34)	0.710 (18.03)	0.674 (17.12)				0.622 (15.80)	0.622 (15.80)		0.546 (13.87)	0.546 (13.87)				0.464 (11.79)	0.252 (6.40)
3/4”	20	1.050 (26.67)	0.920 (23.37)	0.884 (22.45)				0.824 (20.93)	0.824 (20.93)		0.742 (18.85)	0.742 (18.85)				0.612 (15.54)	0.434 (11.02)
1”	25	1.315 (33.40)	1.185 (30.10)	1.097 (27.86)				1.049 (26.64)	1.049 (26.64)		0.957 (24.31)	0.957 (24.31)				0.815 (20.70)	0.599 (15.21)
1-1/4”	32	1.660 (42.16)	1.530 (38.86)	1.442 (36.63)				1.380 (35.05)	1.380 (35.05)		1.278 (32.46)	1.278 (32.46)				1.160 (29.46)	0.896 (22.76)
1-1/2”	40	1.900 (48.26)	1.770 (44.96)	1.682 (42.72)				1.610 (40.89)	1.610 (40.89)		1.500 (38.10)	1.500 (38.10)				1.338 (33.99)	1.100 (27.94)
2”	50	2.375 (60.33)	2.245 (57.02)	2.157 (54.79)				2.067 (52.50)	2.067 (52.50)		1.939 (49.25)	1.939 (49.25)				1.689 (42.90)	1.503 (38.18)
2-1/2”	65	2.875 (73.03)	2.709 (68.81)	2.635 (66.93)				2.469 (62.71)	2.469 (62.71)		2.323 (59.00)	2.323 (59.00)				2.125 (53.98)	1.771 (44.98)
3”	80	3.500 (88.90)	3.334 (84.68)	3.260 (82.80)				3.068 (77.93)	3.068 (77.93)		2.900 (73.66)	2.900 (73.66)				2.626 (66.70)	2.300 (58.42)
3-1/2”	90	4.000 (101.60)	3.834 (97.38)	3.760 (95.50)				3.548 (90.12)	3.548 (90.12)		3.364 (85.45)	3.364 (85.45)					
4”	100	4.500 (114.30)	4.334 (110.08)	4.260 (108.20)				4.026 (102.26)	4.026 (102.26)		3.826 (97.18)	3.826(97.18)		3.626 (92.10)		3.438 (87.33)	3.152 (80.06)
5”	125	5.563 (141.30)	5.345 (135.76)	5.295 (134.49)				5.047 (128.19)	5.047 (128.19)		4.813 (122.25)	4.813 (122.25)		4.563 (115.90)		4.313 (109.55)	4.063 (103.20)
6”	150	6.625 (168.28)	6.407 (162.74)	6.357 (161.47)				6.065 (154.05)	6.065 (154.05)		5.761 (146.33)	5.761 (146.33)		5.501 (139.73)		5.189 (131.80)	4.897 (124.38)
8”	200	8.625 (219.08)	8.407 (213.54)	8.329 (211.56)		8.125 (206.38)	8.071 (205.00)	7.981 (202.72)	7.981 (202.72)	7.813 (198.45)	7.625 (193.68)	7.625 (193.68)	7.437 (188.90)	7.189 (182.60)	7.001 (177.83)	6.813 (173.05)	6.875 (174.63)
10”	250	10.750 (273.05)	10.482 (266.24)	10.420 (264.67)		10.250 (260.35)	10.136 (257.45)	10.020 (254.51)	10.020 (254.51)	9.750 (247.65)	9.750 (247.65)	9.564 (242.93)	9.312 (236.52)	9.064 (230.23)	8.750 (222.25)	8.500 (215.90)	8.750 (222.25
12”	300	12.750 (323.85)	12.438 (315.93)	12.390 (314.71)		12.250 (311.15)	12.090 (307.09)	12.000 (304.80)	11.938 (303.23)	11.626 (295.30)	11.750 (298.45)	11.376 (288.95)	11.062 (280.97)	10.750 (273.05)	10.500 (266.70)	10.126 (257.20)	10.750 (273.05)
14”	350	14.000 (355.60)	13.688 (347.68)	13.624 (346.05)	13.500 (342.90)	13.376 (339.75)	13.250 (336.55)	13.250 (336.55)	13.124 (333.35)	12.812 (325.42)	13.000 (330.20)	12.500 (317.50)	12.124 (307.95)	11.812 (300.02)	11.500 (292.10)	11.188 (284.18)	
16”	400	16.000 (406.40)	15.670 (398.02)	15.624 (396.85)	15.500 (393.70)	15.376 (390.55)	15.250 (387.35)	15.250 (387.35)	15.000 (381.00)	14.688 (373.08)	15.000 (381.00)	14.312 (363.52)	13.938 (354.03)	13.562 (344.47)	13.124 (333.35)	12.812 (325.42)	
18”	450	18.000 (457.20)	17.670 (448.82)	17.624 (447.65)	17.500 (444.50)	17.376 (441.35)	17.124 (434.95)	17.250 (438.15)	16.876 (428.65)	16.500 (419.10)	17.000 (431.80)	16.124 (409.55)	15.688 (398.48)	15.250 (387.35)	14.876 (377.85)	14.438 (366.73)	
20”	500	20.000 (508.00)	19.625 (498.48)	19.564 (496.93)	19.500 (495.30)	19.250 (488.95)	19.000 (482.60)	19.250 (488.95)	18.812 (477.82)	18.376 (466.75)	19.000 (482.60)	17.938 (455.63)	17.438 (442.93)	17.000 (431.80)	16.500 (419.10)	16.062 (407.97)	
22”	550	22.000 (558.80)	21.625 (549.28)	21.564 (547.73)	21.500 (546.10)	21.250 (539.75)	21.000 (533.40)	21.250 (539.75)		20.250 (514.35)	21.000 (533.40)	19.750 (501.65)	19.250 (488.95)	18.750 (476.25)	18.250 (463.55)	17.750 (450.85)	
24”	600	24.000 (609.60)	23.564 (598.53)	23.500 (596.90	23.500 (596.90)	23.250 (590.55)	22.876 (581.05)	23.250 (590.55)	22.624 (574.65)	22.062 (560.37)	23.000 (584.20)	21.564 (547.73)	20.938 (531.83)	20.376 (517.55)	19.876 (504.85)	19.312 (490.52)	
26”	650	26.000 (660.40)			25.376 (644.55)	25.000 (635.00)		25.250 (641.35)			25.000 (635.00)						
28”	700	28.000 (711.20)			27.376 (695.35)	27.000 (685.80)	26.750 (679.45)	27.250 (692.15)			27.000 (685.80)						
30”	750	30.000 (762.00)	29.500 (749.30)	29.376 (746.15)	29.376 (746.15)	29.000 (736.60)	28.750 (730.25)	29.250 (742.95)			29.000 (736.60)						
32”	800	32.000 (812.80)			31.376 (796.95)	31.000 (787.40)	30.750 (781.05)	31.250 (793.75)	30.624 (777.85)		31.000 (787.40)						
34”	850	34.000 (863.60)			33.376 (847.75)	33.000 (838.20)	32.750 (831.85)	33.250 (844.55)	32.624 (828.65)		33.000 (838.20)						
36”	900	36.000 (914.40)			35.376 (898.55)	35.000 (889.00)	34.750 (882.65)	35.250 (895.35)	34.500 (876.30)		35.000 (889.00)						
42”	1000	42.000 (1066.8)						41.250 (1047.75)			41.000 (1041.40)						
48”	1200	48.000 (1219.2)						47.250 (1200.15)			47.000 (1193.8)						

Approximate Tube Inside Diameters Before & After Roller Expansion (Inches)

Tube Inside Diameters As Manufactured														
Wall Thickness		Tube O.D.												
BWG	Decimal	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	2
8	0.165	0.045	0.170	0.295	0.420	0.545	0.670	0.795	0.920	1.045	1.170	1.295	1.420	1.670
9	0.148	0.079	0.204	0.329	0.454	0.579	0.704	0.829	0.954	1.079	1.204	1.329	1.454	1.704
10	0.134	0.107	0.232	0.357	0.482	0.607	0.732	0.857	0.982	1.107	1.232	1.357	1.482	1.732
11	0.120	0.135	0.260	0.385	0.510	0.635	0.760	0.885	1.010	1.135	1.260	1.385	1.510	1.760
12	0.109	0.157	0.282	0.407	0.532	0.657	0.782	0.907	1.032	1.157	1.282	1.407	1.532	1.782
13	0.095	0.185	0.310	0.435	0.560	0.685	0.810	0.935	1.060	1.185	1.310	1.435	1.560	1.810
14	0.083	0.209	0.334	0.459	0.584	0.709	0.834	0.959	1.084	1.209	1.334	1.459	1.584	1.834
15	0.072	0.231	0.356	0.481	0.606	0.731	0.856	0.981	1.106	1.231	1.356	1.481	1.606	1.856
16	0.065	0.245	0.370	0.495	0.620	0.745	0.870	0.995	1.120	1.245	1.370	1.495	1.620	1.870
17	0.058	0.259	0.384	0.509	0.634	0.759	0.884	1.009	1.134	1.259	1.384	1.509	1.634	1.884
18	0.049	0.277	0.402	0.527	0.652	0.777	0.902	1.027	1.152	1.277	1.402	1.527	1.652	1.902
19	0.042	0.291	0.416	0.541	0.666	0.791	0.916	1.041	1.166	1.291	1.416	1.541	1.666	1.916
20	0.035	0.305	0.430	0.555	0.680	0.805	0.930	1.055	1.180	1.305	1.430	1.555	1.680	1.930
21	0.032	0.311	0.436	0.561	0.686	0.811	0.936	1.061	1.186	1.311	1.436	1.561	1.686	1.936
22	0.028	0.319	0.444	0.569	0.694	0.819	0.944	1.069	1.194	1.319	1.444	1.569	1.694	1.944
23	0.025	0.325	0.450	0.575	0.700	0.825	0.950	1.075	1.200	1.325	1.450	1.575	1.700	1.950
24	0.022	0.331	0.456	0.581	0.706	0.831	0.956	1.081	1.206	1.331	1.456	1.581	1.706	1.956

Tube Inside Diameters After Roller Expansion														
Wall Thickness		Tube O.D.												
BWG	Decimal	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	2
8	0.165	0.078	0.203	0.328	0.453	0.578	0.703	0.828	0.953	1.078	1.203	1.328	1.453	1.703
9	0.148	0.109	0.234	0.359	0.484	0.609	0.734	0.859	0.984	1.109	1.234	1.359	1.484	1.734
10	0.134	0.134	0.259	0.384	0.509	0.634	0.759	0.884	1.009	1.134	1.259	1.384	1.509	1.759
11	0.120	0.159	0.284	0.409	0.534	0.659	0.784	0.909	1.034	1.159	1.284	1.409	1.534	1.784
12	0.109	0.179	0.304	0.429	0.554	0.679	0.804	0.929	1.054	1.179	1.304	1.429	1.554	1.804
13	0.095	0.204	0.329	0.454	0.579	0.704	0.829	0.954	1.079	1.204	1.329	1.454	1.579	1.829
14	0.083	0.226	0.351	0.476	0.601	0.726	0.851	0.976	1.101	1.226	1.351	1.476	1.601	1.851
15	0.072	0.245	0.370	0.495	0.620	0.745	0.870	0.995	1.120	1.245	1.370	1.495	1.620	1.870
16	0.065	0.258	0.383	0.508	0.633	0.758	0.883	1.008	1.133	1.258	1.383	1.508	1.633	1.883
17	0.058	0.271	0.396	0.521	0.646	0.771	0.896	1.021	1.146	1.271	1.396	1.521	1.646	1.896
18	0.049	0.287	0.412	0.537	0.662	0.787	0.912	1.037	1.162	1.287	1.412	1.537	1.662	1.912
19	0.042	0.299	0.424	0.549	0.674	0.799	0.924	1.049	1.174	1.299	1.424	1.549	1.674	1.924
20	0.035	0.312	0.437	0.562	0.687	0.812	0.937	1.062	1.187	1.312	1.437	1.562	1.687	1.937
21	0.032	0.317	0.442	0.567	0.692	0.817	0.942	1.067	1.192	1.317	1.442	1.567	1.692	1.942
22	0.028	0.325	0.450	0.575	0.700	0.825	0.950	1.075	1.200	1.325	1.450	1.575	1.700	1.950
23	0.025	0.330	0.455	0.580	0.705	0.830	0.955	1.080	1.205	1.330	1.455	1.580	1.705	1.955
24	0.022	0.335	0.460	0.585	0.710	0.835	0.960	1.085	1.210	1.335	1.460	1.585	1.710	1.960

NOTE: TUBE INSIDE DIAMETERS AFTER ROLLER EXPANSION ARE ESTIMATED ASSUMING A 10% WALL THICKNESS LOSS, FORMULA = [(O.D. - 2 * (WT * 0.9)]

Approximate Tube Inside Diameters Before & After Roller Expansion (mm)

Tube Inside Diameters As Manufactured

Wall Thickness		Tube O.D.														
BWG	Decimal	9.53	12.70	15.88	19.05	22.23	25.40	28.58	31.75	34.93	38.10	41.28	44.45	50.80	57.15	63.50
8	4.19	1.14	4.32	7.49	10.67	13.84	17.02	20.19	23.37	26.54	29.72	32.89	36.07	42.42	48.77	55.12
9	3.76	2.01	5.18	8.36	11.53	14.71	17.88	21.06	24.23	27.41	30.58	33.76	36.93	43.28	49.63	55.98
10	3.40	2.72	5.89	9.07	12.24	15.42	18.59	21.77	24.94	28.12	31.29	34.47	37.64	43.99	50.34	56.69
11	3.05	3.43	6.60	9.78	12.95	16.13	19.30	22.48	25.65	28.83	32.00	35.18	38.35	44.70	51.05	57.40
12	2.77	3.99	7.16	10.34	13.51	16.69	19.86	23.04	26.21	29.39	32.56	35.74	38.91	45.26	51.61	57.96
13	2.41	4.70	7.87	11.05	14.22	17.40	20.57	23.75	26.92	30.10	33.27	36.45	39.62	45.97	52.32	58.67
14	2.11	5.31	8.48	11.66	14.83	18.01	21.18	24.36	27.53	30.71	33.88	37.06	40.23	46.58	52.93	59.28
15	1.83	5.87	9.04	12.22	15.39	18.57	21.74	24.92	28.09	31.27	34.44	37.62	40.79	47.14	53.49	59.84
16	1.65	6.22	9.40	12.57	15.75	18.92	22.10	25.27	28.45	31.62	34.80	37.97	41.15	47.50	53.85	60.20
17	1.47	6.58	9.75	12.93	16.10	19.28	22.45	25.63	28.80	31.98	35.15	38.33	41.50	47.85	54.20	60.55
18	1.25	7.04	10.21	13.39	16.56	19.74	22.91	26.09	29.26	32.44	35.61	38.79	41.96	48.31	54.66	61.01
19	1.07	7.39	10.57	13.74	16.92	20.09	23.27	26.44	29.62	32.79	35.97	39.14	42.32	48.67	55.02	61.37
20	0.89	7.75	10.92	14.10	17.27	20.45	23.62	26.80	29.97	33.15	36.32	39.50	42.67	49.02	55.37	61.72
21	0.81	7.90	11.07	14.25	17.42	20.60	23.77	26.95	30.12	33.30	36.47	39.65	42.82	49.17	55.52	61.87
22	0.71	8.10	11.28	14.45	17.63	20.80	23.98	27.15	30.33	33.50	36.68	39.85	43.03	49.38	55.73	62.08
23	0.64	8.26	11.43	14.61	17.78	20.96	24.13	27.31	30.48	33.66	36.83	40.01	43.18	49.53	55.88	62.23
24	0.56	8.41	11.58	14.76	17.93	21.11	24.28	27.46	30.63	33.81	36.98	40.16	43.33	49.68	56.03	62.38

Tube Inside Diameters After Roller Expansion

Wall Thickness		Tube O.D.														
BWG	Decimal	9.53	12.70	15.88	19.05	22.23	25.40	28.58	31.75	34.93	38.10	41.28	44.45	50.80	57.15	63.50
8	4.19	1.98	5.16	8.33	11.51	14.68	17.86	21.03	24.21	27.38	30.56	33.73	36.91	43.26	49.61	55.96
9	3.76	2.76	5.93	9.11	12.28	15.46	18.63	21.81	24.98	28.16	31.33	34.51	37.68	44.03	50.38	56.73
10	3.40	3.40	6.57	9.75	12.92	16.10	19.27	22.45	25.62	28.80	31.97	35.15	38.32	44.67	51.02	57.37
11	3.05	4.04	7.21	10.39	13.56	16.74	19.91	23.09	26.26	29.44	32.61	35.79	38.96	45.31	51.66	58.01
12	2.77	4.54	7.72	10.89	14.07	17.24	20.42	23.59	26.77	29.94	33.12	36.29	39.47	45.82	52.17	58.52
13	2.41	5.18	8.36	11.53	14.71	17.88	21.06	24.23	27.41	30.58	33.76	36.93	40.11	46.46	52.81	59.16
14	2.11	5.73	8.91	12.08	15.26	18.43	21.61	24.78	27.96	31.13	34.31	37.48	40.66	47.01	53.36	59.71
15	1.83	6.23	9.41	12.58	15.76	18.93	22.11	25.28	28.46	31.63	34.81	37.98	41.16	47.51	53.86	60.21
16	1.65	6.55	9.73	12.90	16.08	19.25	22.43	25.60	28.78	31.95	35.13	38.30	41.48	47.83	54.18	60.53
17	1.47	6.87	10.05	13.22	16.40	19.57	22.75	25.92	29.10	32.27	35.45	38.62	41.80	48.15	54.50	60.85
18	1.25	7.28	10.46	13.63	16.81	19.98	23.16	26.33	29.51	32.68	35.86	39.03	42.21	48.56	54.91	61.26
19	1.07	7.60	10.78	13.95	17.13	20.30	23.48	26.65	29.83	33.00	36.18	39.35	42.53	48.88	55.23	61.58
20	0.89	7.92	11.10	14.27	17.45	20.62	23.80	26.97	30.15	33.32	36.50	39.67	42.85	49.20	55.55	61.90
21	0.81	8.06	11.24	14.41	17.59	20.76	23.94	27.11	30.29	33.46	36.64	39.81	42.99	49.34	55.69	62.04
22	0.71	8.25	11.42	14.60	17.77	20.95	24.12	27.30	30.47	33.65	36.82	40.00	43.17	49.52	55.87	62.22
23	0.64	8.38	11.56	14.73	17.91	21.08	24.26	27.43	30.61	33.78	36.96	40.13	43.31	49.66	56.01	62.36
24	0.56	8.52	11.69	14.87	18.04	21.22	24.39	27.57	30.74	33.92	37.09	40.27	43.44	49.79	56.14	62.49

NOTE: TUBE INSIDE DIAMETERS AFTER ROLLER EXPANSION ARE ESTIMATED ASSUMING A 10% WALL THICKNESS LOSS, FORMULA = [(O.D. - 2 * (WT * 0.9)]

Notes

Contact Information

North, Central & South America

EST Group
2701 Township Line Road
Hatfield, PA 19440 USA

P +1.215.721.1100 **I** +1.800.355.7044
F +1.215.721.1101
est-info@curtisswright.com

Europe, Middle East, Africa (EMEA)

EST Group B.V.
Hoorn 312a, 2404 HL Alphen aan den Rijn
The Netherlands

P +31.172.418841
F +31.172.418849
est-emea@curtisswright.com

China

P +86.400.636.5077
est-china@curtisswright.cn

Singapore

P +65.3158.5052
est-asia@curtisswright.com

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Product animations, instructions, and detailed technical information are available on our website: **www.cw-estgroup.com**