

Plymouth Feedwater Heater Tubing

FOR THE POWER GENERATION INDUSTRY



PLYMOUTH



FEEDWATER HEATER TUBING

THE CHOICE OF UTILITY ENGINEERS AND FABRICATORS

Products and Service Around the Globe

With economic progress and the desire for growth fueling the power generation market, finding a supplier to fulfill feedwater heater tubing needs with the highest value, regardless of geographic location, is critical to planning and productivity. That is why it makes good business sense to partner with the industry leader.

Plymouth Tube is committed to its mission of *providing products and services that meet or exceed our customers' expectations*. Continuous improvement is fostered throughout Plymouth Tube's operation by Manufacturing Excellence — which empowers teams to create an organization that is effective, flexible, productive and powerful in producing products within the markets we serve. Our customers around the world rely on the superior quality, strength and precision of our feedwater heater and pressure tubes to ensure power plant safety, performance and reliability over decades of service.



Plymouth's stainless steel feedwater heater tubes are used in more than 70% of all U.S. feedwater heater applications.



Plymouth Tube Company's facility in West Monroe, Louisiana has led in the production of stainless steel feedwater heater and pressure tubing for nearly five decades. These high quality tubes are used in fossil fuel and nuclear electric power plants and in balance of plant heat exchangers. A privately held, family-owned business founded in 1924, Plymouth was the first tube company to produce stainless steel feedwater heater tubes. Since 1967, we have supplied over 325-million feet (98-million meters) of welded and seamless stainless steel feedwater heater tubes to electric utility companies and feedwater heater fabricators, such as BHEL, Foster Wheeler, Hydro Dyne, MHI, SPEC, TEI and Yuba Heat Transfer. In addition, Plymouth Tube serves the world's leading architectural and engineering (A&E) firms and engineering, procurement and constructors (EPCS), including Bechtel, Fluor, Foster Wheeler, Sargent & Lundy, and Stone & Webster.



POWER GENERATION TUBING

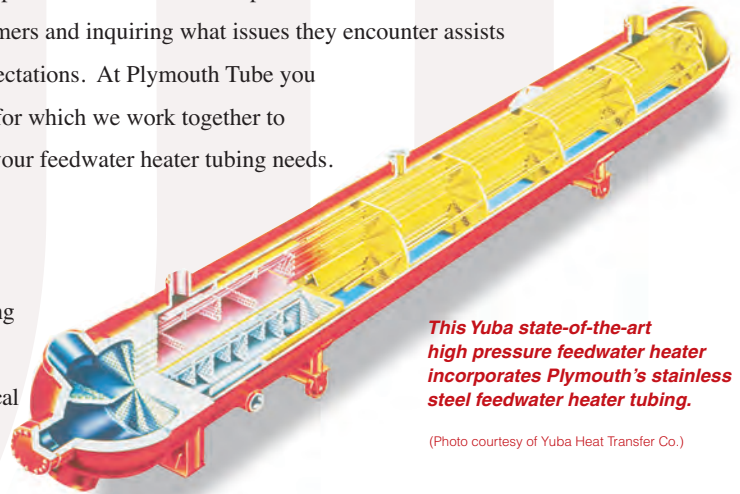


Your Energy Solution Specialist

Whether your application requires seamless, welded and cold drawn or welded and bead forged austenitic or ferritic stainless steel tubing, you can always count on consistent, high quality tubing manufactured by our plant specialists at Plymouth Tube Company. Innovation and continuous improvement of our manufacturing processes are some of the main drivers that differentiate us from other manufacturers. We implement the theory of lean manufacturing and routinely work to improve our processes with Kaizen inspired events. We also realize that by getting to know our customers and inquiring what issues they encounter assists us to produce tubing that exceeds expectations. At Plymouth Tube you are more than a customer, you are a partner for which we work together to engage ideas for efficient and productive solutions for your feedwater heater tubing needs.

Value Added Processes Assure Quality

All of our tubing is gas tungsten arc welded and cold worked, using cold drawing, bead rolling or bead forging techniques to provide superior dimensional consistency, uniformity of mechanical properties, and optimal corrosion resistance.



This Yuba state-of-the-art high pressure feedwater heater incorporates Plymouth's stainless steel feedwater heater tubing.

(Photo courtesy of Yuba Heat Transfer Co.)



Since 1967, our tubing is manufactured utilizing the experience of processing to capture tighter tolerances, dimensional consistency and corrosion resistance for overall quality.



Tubing is heat treated in our bright annealing furnace to provide superior surface finish by eliminating scaling and surface imperfections.



Tubing quality and consistency is of utmost importance. Manufacturing processes are closely monitored to ensure tubing is always supplied in the exceptional manner that is expected from Plymouth Tube Co.

Some Additional Ways That Plymouth Adds Value Include:

- Bright annealing or annealed and pickled processes to eliminate scaling and improve surface finish. Depending on your grade choice we will utilize the most effective treatment to provide exceptional tubing.
- Plymouth's proprietary process provides better than the Electric Power Research Institute (EPRI) recommended requirements of residual hoop stress offering our maximum of 3 ksi (20.7 MPa). This proactive approach minimizes residual hoop stress levels that can lead to stress corrosion cracking.
- U-Bend stress relief to provide a residual hoop stress of less than 8 ksi average (55.2 MPa) — the lowest in the industry.
- Tube weld is thoroughly bead worked or cold drawn.
- High energy cleaning for reduced risk of carbide precipitation and stress corrosion cracking.
- Cold drawing for superior characteristics compared to as-welded and sized or welded and bead worked tubing. Call us if you need tubing that has the performance edge.
- Subjected to more strenuous NDT Eddy Current testing per A-688 S1 or S2, versus industry standard of A-1016 only.
- Use of welded stainless steel versus carbon steel for high-pressure, feedwater heater applications may be your best value over the system life. Call to discuss value analysis.

<http://www.plymouth.com>



CONSISTENT QUALITY TUBING

Quality Control and Quality Assurance Tests Ensure Performance and Reliability

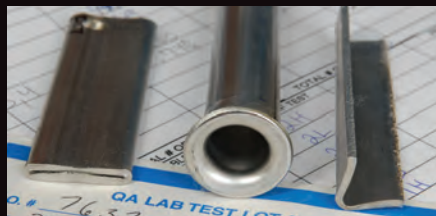
Our comprehensive on site laboratory testing capabilities include eddy current, ultrasonic, air under water, hydrostatic, liquid penetrant, flatten, flare, flange, reverse bend, reverse flatten, tensile, hardness, various corrosion, residual chloride, straight and U-bend residual stress testing. Additional product testing includes:

- **S-2 Commercial in-line eddy current testing** is Plymouth's standard for all heavy wall tubing, 2.11 mm (0.083 inches) or greater to detect the smallest discontinuities. SA 688 S1 eddy current testing is standard for lower pressure, lighter wall tubing.
- **In-line laser micrometer monitoring** assures OD dimensional conformance to specifications over the length of the tube.
- **Hydrostatic pressure testing** using high-purity demineralized water (less than 1 ppm chloride) ensures a chloride free tube.
- **Residual stress measurement** ensures customer specifications have been met. Pioneered by Plymouth, the blind-hole strain gauge method of measuring stress in the U-Bend has become an industry standard recommended by Electric Power Research Institute (EPRI).

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Dimensional measurement using laser micrometer.



Flattening, Flange and Reverse Bend mechanical tests are conducted to qualify our tubing to the specification required as well as to Plymouth Tube Co. quality standards.



U-Bend tubing during the stress relieving process. Our XtraLowStress tubing offers the lowest possible residual stress in the industry.



XtraLowStress (XLS®)

The choice of utility engineers and fabricators.

In the intense heat and pressure of feedwater heaters, XtraLowStress quality tubing is the choice many engineers and fabricators have come to depend on. With the enormous investments involved, failure is not an option. XLS offers the lowest possible residual stress with less than 3 ksi (20.7 MPa) in the straight portions and less than 8 ksi (55.2 MPa) in the U-bends. Our XLS feedwater heater tubing is thoroughly cold drawn or cold worked and put through the more strenuous S2 NDT Eddy Current testing. XLS surpasses all industry standards for feedwater heater tubing making it the strongest most reliable tubing on the market.



ASTM A and ASME SA			OD Range		Wall Thickness ¹		Max. Length		U-Bend
Specifications	Grades		mm	Inches	mm	Inches	m	ft.	Radius
FEEDWATER HEATER TUBING			<i>Welded:</i>				<i>U-Bend²</i>		
A 688/A 688 M & A 803/A 803 M <i>Welded Stainless Steel Feedwater Heater Tubes</i> <i>U-Bending Available</i>	TP304	TP316	12.70	0.50	0.89 AW	0.035 AW	39.62	130	1.5 x tube OD up to 1219 mm (48 in.)
	TP304L	TP316L	<i>to</i>	<i>to</i>	<i>to</i>	<i>to</i>	<i>Straight Leg³</i>		
	TP304LN	TP316LN	25.40	1.00	3.40 AW	0.134 AW	18.00	60	
	AL6XN	TP321							
	TP439								
PRESSURE TUBING			<i>Seamless:</i>				<i>U-Bend²</i>		
A 213/A 213 M <i>Seamless Austenitic</i> <i>U-Bending Available</i>	TP304	TP316	12.70	0.50	0.89 AW	0.035 AW	39.62	130	1.5 x tube OD up to 1219 mm (48 in.)
	TP304L	TP316L	<i>to</i>	<i>to</i>	<i>to</i>	<i>to</i>	<i>Straight Leg³</i>		
	TP304N	TP316N	31.75	1.25	2.77 MW	0.11 MW	18.00	60	
	TP304LN	TP316LN							
	TP321								

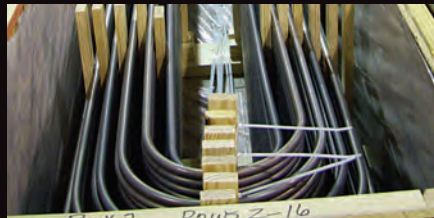
Contact Plymouth Tube for dimensions outside the listed ranges

Plymouth Tube was involved in developing the original ASTM A-688 standard specification for welded austenitic stainless steel feedwater heater tubes and continues to be actively involved with the ASTM, ASME and HEI.

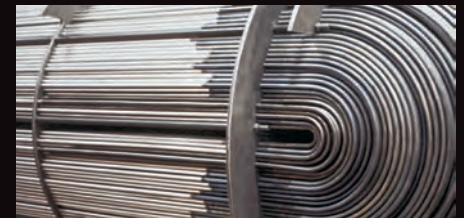
¹AW = Average Wall, MW = Minimum Wall
Upon request, we can provide 0.71 mm (0.028 inch) MW.
²Maximum developed length of U-Bent tube from end to end, or max. length of a straight tube.
³Maximum length of one straight leg portion of a U-Bent tube.



To ensure clean and dry tubing, tubing is handled by gloved technicians with the process of blowing felt plugs through the inside diameter of each tube.



Custom made boxing is used for packaging u-bend tubing for consistent protection during export and domestic transit.



Top companies have come to expect and rely on quality XtraLowStress tubing for their Feedwater Heater needs. —Photo courtesy of Hydro Dyne Inc.

Cleaning, Finishing, Packaging

The tubing is cut to length, end finished, cleaned and air dried. Felt plugs are blown through the tube’s inside diameter to confirm that it is clean and dry. Our U-Bent feedwater heater tubes and pressure tubes are carefully packaged and secured in sturdy wooden crates to prevent damage during shipping.

Custom packaging is available upon request.

Quality Assurance

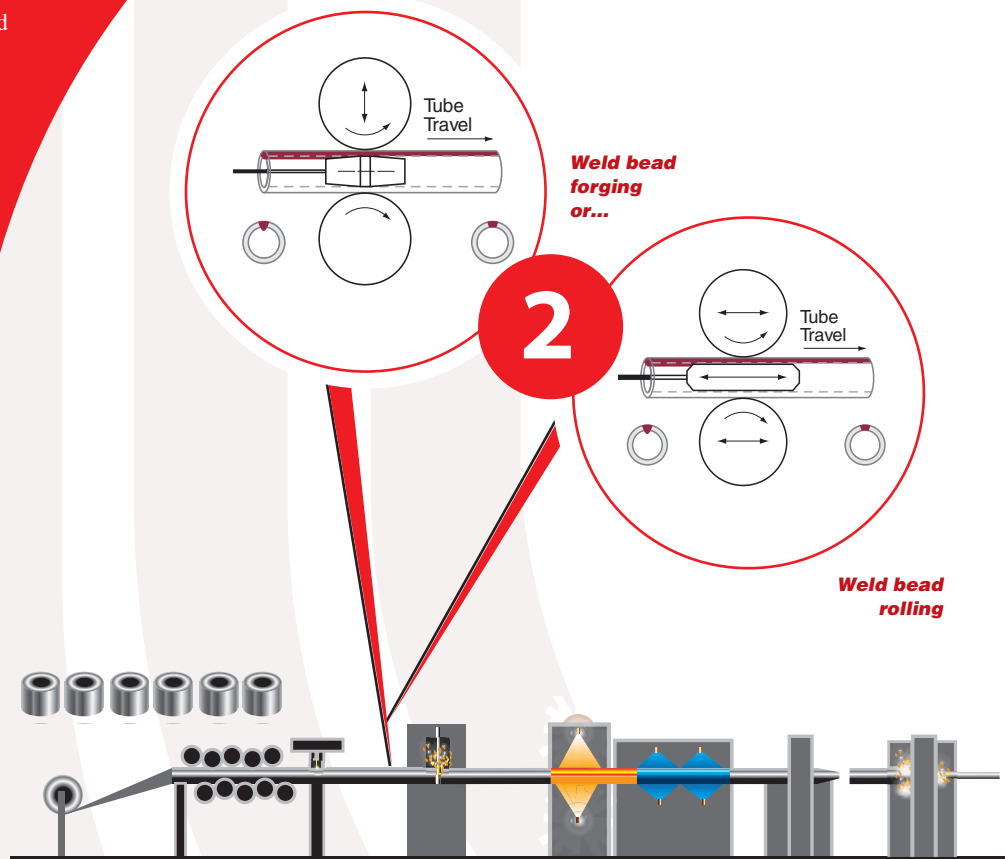
Thorough quality control processes ensure that every order meets all specified quality and performance standards. Plymouth's West Monroe mill is ISO 9001 and PED certified and carefully monitors each process, providing traceability of every tube from raw material to finished product.



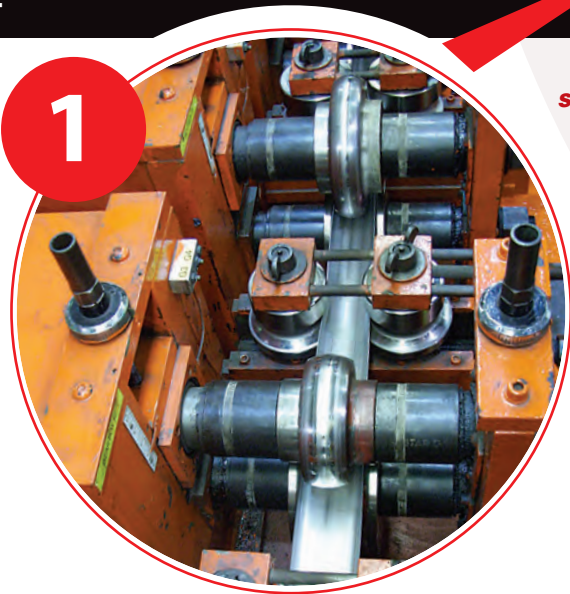
In addition to feedwater heater tubing, Plymouth Tube also manufactures high-precision pressure, mechanical and general purpose tubing — seamless, welded and cold drawn or welded and bead forged. Available in stainless steel and nickel alloys, the tubing is well suited to a wide range of industrial applications.

Many of the world's leading chemical and pharmaceutical companies, as well as original equipment manufacturers in the automotive, aerospace and other industries, turn to Plymouth for all of their tubing needs.

As the technology leader, Plymouth is able to provide superior quality products through state-of-the-art manufacturing processes and testing capabilities. Our skilled technicians and engineers have the technical knowledge to help customers analyze their tubing requirements and find effective solutions.



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Stainless steel strip is roll formed to produce tubing in as-welded, bead forged or bead rolled condition tube rounds for cold drawing.



Tubes are bright annealed, then rapidly cooled in a controlled atmosphere roller hearth furnace to ensure corrosion resistance.



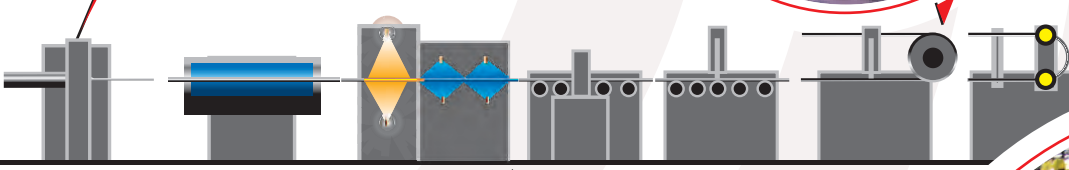
4

Cold drawn-over-mandrel tubing allows precision OD and wall thickness to customer specifications. Each drawbench has its own in-line ultrasonic tube cleaner.



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U-Bend
Plymouth's processes provide stress levels lower than EPRI recommendations.



5

Closed container shipping for overseas deliveries is made possible by our optional unitized crating and stacking of U-tube orders.



5

In-line eddy current testing detects flaws in the tubing. Our use of the A688 S-2 Commercial eddy current test for heavy wall tube exceeds the industry standard.

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Front and back cover photos courtesy of South Texas Project Nuclear.

**Leading companies specify
Plymouth Tube Co. XtraLowStress Tubing...**



Photo Courtesy of Hydro Dyne Inc.



Photo Courtesy of TEI International

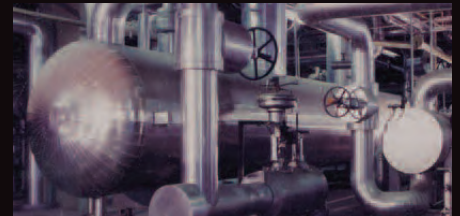


Photo Courtesy of Yuba Heat Transfer LLC.



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