



Value-Added Thermal-Treatment Solutions

for Demanding Applications



Thermal Treatment: An integral part of our supply chain and service

Supply chain integration. Superior technical service.

Finishing & Value-Add

Thermal Treatment

Bar & Tube Making

Melt

Specially engineered melt for thermal-treat response

Material value. Order quantity flexibility.



Our industry-leading thermal-treatment capabilities provide a diverse range of processing options to meet demanding strength and hardness requirements – regardless of order size. We continue to develop these capabilities and broaden our sophistication in custom thermal-treat offerings so you can rely on innovative product designs and proven quality. With our combination of metallurgical and thermal-treat knowledge, we have set ourselves apart from the competition.

We meet our customers' needs through our value-added steel bars, tubes and billets for challenging applications. Our approach to manufacturing integrates our melting, rolling, piercing and finishing operations, ensuring a complete chemistry and economical solution from start to finish.

We tailor product properties to meet increasing demands from customers with tighter specifications. Benefits of our value-added thermal-treatment capabilities include:

- Precisely controlled hardness and strength properties;
- Improved ductility and toughness;
- Annealing for subsequent forging or machining operations;
- Relieved stresses caused by cold straightening; and
- Development of low-alloy customized grades for unique applications.



Thermal-Treatment Capabilities

We feature seven treatment processes across 20 assets, with more than 50 furnace cycles. These seven processes are anneal, normalize, quench and temper, special quench and temper, spheroidize anneal, stress relieve and temper. These capabilities allow us to offer extremely flexible “recipes” as well as sophisticated material planning and process controls.

Quench and Temper, Special Quench and Temper, Normalize

The austenitizing and quenching process heats steel uniformly to a temperature above the critical range and cools it rapidly, using water, to achieve a desired structure. Then we temper for desired mechanical properties. This treatment helps achieve specific levels of strength and toughness to meet customer requirements.

Special quench and tempering involves longer processing for the most stringent structure and mechanical properties.

In the normalizing process, we heat steel uniformly to a temperature above the critical range, then cool in air to room temperature. This treatment produces a recrystallization and refinement of the grain structure, giving the product uniformity in hardness and structure.

Applications for oil and gas drilling and completion applications often take advantage of these capabilities.

Anneal and Spheroidize Anneal

Annealing is heating uniformly to a temperature within or above the critical range and cooling at a controlled rate to a temperature under the critical range. We use this treatment to produce a definite microstructure, usually one designed for best machinability and ductility. We also use annealing to remove stresses, induce softness and alter toughness or other mechanical properties. Spheroidize anneal uses a long heating cycle to produce carbide microstructures best for machinability and subsequent processing steps. Bearing and industrial and mining components especially benefit from these thermal-treatment capabilities.

Stress Relieve and Temper

Stress relieve helps minimize distortion for machining, while tempering relieves stresses and softens the product prior to cold working. Gears and shafts benefit from these capabilities.





Thermal-Treatment Facilities

Our thermal-treatment facilities provide tailored solutions to meet a wide range of customer needs, allowing us to offer different capabilities to achieve uniformity and production speed. These facilities are our Continuous Thermal Treatment Facility (CTTF), two Induction Thermal Treatment Facilities (ITTF), Quench Temper Facility (QTF) and General Thermal Treatment Facilities (GTTF) – all at our Gambrinus plant in Canton, Ohio.

CTTF: Advanced Processes Produce Uniform Results

The CTTF is one of the world's most advanced quench-and-temper operations. From the austenitizing furnace into the quench station and the tempering furnace to the five-roll straightener, the blend of computer/operator control allows us to customize properties for our customers. This helps us deliver the extraordinary bar and tube quality and uniformity you expect and rely on.

The CTTF features quenching versatility of O.D. quench for bars and thin-walled tubing and our proprietary O.D./I.D. quench process for heavy-walled tubing. Depending on product features and desired mechanical properties, we determine the optimum quench cycle for precise control of as-quenched properties, with minimum distortion.

The CTTF process delivers:

- Constant product rotation for exceptional uniformity;
- Consistent bar and tube straightness;
- Elimination of cold straightening and stress relieving; and
- Flexible size range.

The CTTF accommodates size ranges up to 12.000 inches (304.80 millimeters) in diameter.

- Bars: 2.375-11.000 inches (60.33-279.40 mm) diameter
- Tubes: 2.375-12.000 inches (60.32-304.80 mm) OD
≤ 3.250 inches (82.55 mm) wall
- Lengths: 10-42 feet (3.05-12.80 m)

Investing to Serve Needs of Your Demanding Applications

Consistent innovation makes us an integral part of our customers' success. We continue to develop our facilities, advance our capabilities and broaden our sophistication in thermal-treatment offerings so you can rely on us for innovative product designs and proven performance.

In summer 2014, we announced plans to open an Advanced Quench-and-Temper Facility (AQTF) at our Gambrinus plant to produce more value-added steel for customers' demanding applications. This \$40 million investment improves our technical capabilities and is foundational to our ability to grow some of our unique and sophisticated product lines to meet those needs. Additional continuous heat-treat capabilities will provide the flexibility to create more customized steels.

The facility, which we expect to be fully operational by the end of 2016, will have capacity for 50,000 process tons annually of 4-inch (101.6 mm) to 13-inch (330.2 mm) bars and tubes. The AQTF will be larger than each of our three existing thermal-treatment facilities.

This added thermal-treat capacity will especially benefit intensive horizontal and offshore drilling and completion activities. The AQTF will serve applications at increased drilling depths and footage with deeper, larger bore well designs.



ITTF: Maximum Control Equals Easier Customization

Our heat-treated steel bars and tubes suit jobs of any size. The ITTF supports customization with highly precise, consistent temperature controls. Such control and efficiency helps ensure that all jobs – even those for small quantities – meet exacting specifications. We manage the entire process, from melt through thermal treatment, so you get the quality you expect. That means our clean steel with exceptional uniformity, straightness and hardness.

Our ability to rotate the steel during the treatment process enables exceptional uniformity and straightness. Our heat-treated steel fulfills stringent mechanical and hardness requirements due to the ITTF's combination of consistent temperatures, faster rotational speeds, controlled quenching and uniform tempering.

The ITTF completely finishes the steel, including normalization, quenching and tempering, and process stress relieving or tempering.

The ITTF induction-heating process means:

- Ideal processing for small and large jobs;
- Shorter turnaround times; and
- Elimination of cold straightening and stress relieving.



Our second ITTF operation is an all-induction line capable of processing a wider range of O.D. bars and tubes. The facility employs a unique V-shaped roll design that allows product to remain exceptionally straight. The piece-tracking system gathers key parameters at all points of processing.

The ITTF accommodates size ranges up to 8.000 inches (203.20 millimeters) in diameter.

Operations we perform in the second ITTF operation include normalize, stress relief and temper.

- Bars: 1.000-8.000 inches (25.40-203.20 mm) diameter
- Tubes: 2.000-8.000 inches (50.80-203.20 mm) OD <= 3.000 inches (50.80 mm) wall
- Lengths: 12-40 feet (3.66-12.19 m)



QTF: Combining Strength with Efficiency

A deep technical knowledge of manufacturing processes led us to build a specialized QTF operation, where we efficiently process both bar and tubular orders. Our streamlined quench-and-temper operation produces customized product quickly and reliably.

With precise temperature control, we can adjust our processes to meet customized product requirements. This helps us achieve the best possible results.

The QTF process provides:

- Induction pre-heating results in quick processing times;
- Continuous piece tracking to gather data throughout all stages of processing; and
- Modified quench-and-roll design – along with specially designed cooling table – so product remains exceptionally straight without the need for post-straighten operation.

The QTF accommodates size ranges up to 9.000 inches (228.60 millimeters) in diameter.

- Bars: 4.000-9.000 inches (101.60-228.60 mm) diameter
- Tubes: 4.000-9.000 inches (101.60-228.60 mm) OD <= 3.000 inches (76.20 mm) wall
- Lengths: 12-40 feet (3.66-12.19 m)



GTTF: Specially Formulating Heating, Cooling Cycles

Our GTTF thermal-treatment assets include 10 car-bottom type furnaces, five roller-hearth type furnaces and one tunnel-hearth furnace. We perform all seven treatment processes at the GTTF.

Car Furnaces

- Bars: 1.000-13.000 inches (25.40-330.20 mm) diameter
- Tubes: 2.000-13.000 inches (50.80-330.20 mm) OD <= 3.000 inches (76.20 mm) wall
- Lengths: 9-50 feet (2.74-15.24 m)

Roller Furnaces

- Bars: 1.000-12.000 inches (25.40-304.80 mm) diameter
- Tubes: 2.000-13.000 inches (50.80-330.20 mm) OD <= 3.000 inches (76.20 mm) wall
- Lengths: 9-40 feet (2.74-12.19 m)

Tunnel Furnaces

- Bars: 2.000-12.000 inches (50.80- 304.80 mm) diameter
- Tubes: 2.000-13.000 inches (50.80-330.20 mm) OD <= 3.000 inches (76.20 mm) wall
- Lengths: 9-40 feet (2.74-12.19 m)



Answering Customers' Toughest Challenges

We customize every product and service we deliver to meet customers' specific needs. Our focus is on improving performance by addressing the toughest challenges, whether that requires a special bar quality (SBQ) steel bar or seamless mechanical tube, a value-added component, honing, drilling or thermal-treatment services or a supply chain solution.

Our engineers are experts in materials, processing and applications, so we can work closely with each customer to deliver flexible solutions related to our products as well as their applications and supply chains. We believe few others in our industry can consistently deliver this kind of breadth, customization and responsiveness.



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