

HI TECMETAL GROUP, INC.

HTG operates three full service heat treating facilities located in Greater Cleveland, Oh. Each company is dedicated to continuous improvements in all facets of its business to provide our customers with the very best in quality processing and heat treating services.

Employee involvement, strategic management, and continual improvements in statistical process controls were an integral part of our operation. In addition to availability to full-service Met-Labs to verify results of processes and materials, we utilize “real time” digital media recorders on all furnace lines.

All three facilities are dedicated to continual improvements in all facets of its business to provide our customers with the very best in quality processing and heat-treating services.

OVERVIEW & DEFINITIONS OF SERVICES OFFERED To demonstrate the broad range of services offered by HTG and to define their meaning and features, refer to the following:

Heat treatment is a method used to alter the physical, and sometimes chemical, properties of a material. The most common application is metallurgical. Heat treatments are also used in the manufacture of many other materials, such as glass. Heat treatment involves the use of heating or chilling, normally to extreme temperatures, to achieve a desired result such as hardening or softening of a material. Heat treatment techniques include annealing, case hardening, precipitation strengthening, tempering and quenching. It is noteworthy that while the term heat treatment applies only to processes where the heating and cooling are done for the specific purpose of altering properties intentionally, heating and cooling often occur as incidental phases of other manufacturing processes such as hot forming or welding.

1. **Annealing:** Heat treatment that makes metals (steel, aluminum, etc.) soft and ductile. Facilitates part shaping, stamping, or machining operations. Removes unwanted stresses and strains. Makes parts more stable.
2. **Atmosphere Heat Treating:** Heat treating done under a controlled, gaseous environment, usually devoid of oxygen. By controlling the gases surrounding the part at high temperatures, the part surface can be protected or enhanced. See, *Neutral Hardening and Carburizing*.
3. **Carburizing:** Steel parts are heated to 1600F– 1750F in a carbon- containing atmosphere, and the carbon atoms are diffused into the surface of the steel making iron nitrides. See, *Case Hardening*.
4. **Case Hardening:** Carburized steel parts are heated to transformation temperature and quenched in oil (or water) to produce a part with a very hard shell or “case”, but with a ductile core.
5. **Carbonitriding:** Steel parts are heated to transformation temperature in a carbon and nitrogen-rich atmosphere to form a hard surface of iron carbides and iron nitrides (after quenching) for resisting sliding wear.
6. **Carbon Restoration:** A carburization process that is designed to bring the surface of a casting or forging back to its original carbon content and to restore the hardenability of the surface.
7. **Cryogenic, Deep Freezing:** Parts are cooled under liquid or gaseous nitrogen to -100F to -300F to remove retained austenite in the steel, or to relieve stresses and make a more homogenous, stable structure.
8. **Fixture Tempering:** Heat treating (usually tempering) done in jigs, under pressure to remove distortion or warpage in parts. Also known as flattening.
9. **Ferritic-Nitro carburizing** THE BENEFITS: High resistance to wear, Excellent scuffing and seizure resistance, Fatigue properties improved by up to 120%, Considerably improved corrosion resistance, Good surface finish, Negligible shape distortion, Predictable growth characteristics, Alloy substitution – Plain carbon steels replacing low alloy steels. These characteristics, alone or in combination, are particularly beneficial for automotive, textile, pump and tooling components. A wide variety of wrought, cast and sintered materials are suitable for treatment after finish machining, including plain carbon steels, cast irons, nitriding steels, and hot work tool steels.
10. **Hardening:** The controlled application and removal of heat (austenitizing, quenching, tempering, freezing) of a metal part to change its physical properties, to enhance part performance or allow further processing.
11. **Hardness Testing:** Quantifying the relative resistance of metal parts to penetration by a probe of a known size with a given force. Measured in Rockwell, Brinell, Knoop or Vickers scales. Related to tensile strength.
12. **Heat Treating:** see specific process description
13. **Induction Hardening and Brazing:** Induction heating allow the targeted heating of an applicable item for applications including surface hardening, melting, brazing and soldering and heating to fit. Iron and its alloys respond best to induction heating, due to their ferromagnetic nature.
14. **Nitriding:** Nitriding is a surface-hardening heat treatment that introduces nitrogen into the surface of steel at a temperature range (500 to 550°C, or 930 to 1020°F), while it is in the ferrite condition. Thus, nitriding is similar to carburizing in that surface composition is altered, but different in that nitrogen is added into ferrite instead of austenite. Because nitriding does not involve heating into the austenite phase field and a subsequent quench to form martensite, nitriding can be accomplished with a minimum of distortion and with excellent dimensional control. **Principal reasons for nitriding:** To obtain high surface hardness, To increase wear

resistance, To improve fatigue life, To improve corrosion resistance, To obtain a surface that is resistant to the softening effect of heat at temperatures up to the nitriding temperature.

15. **Nitrotec:** The process works to achieve the same result as the salt bath process, except gaseous mixtures are used to diffuse the nitrogen and carbon into the work piece.
16. **Metal Testing, Metallographic:** Determining the microstructure of steel or other metallic parts to predict or to assure their physical properties, e.g., tensile strength, ductility, hardness. Done on a polished sample under a microscope.
17. **Metallurgical:** Advice on selection and treatment of steel alloys and other metals (aluminum, copper, bronze, brass, stainless steel) to optimize part performance in a given application and to minimize part costs.
18. **Normalizing:** A heat treat process to bring the microstructure into a condition that facilitates subsequent processes by making the part more homogenous in structure. Usually done on castings or forgings.
19. **Neutral Hardening:** Heat treating done in an oxygen-free environment that is chemically neutral to the surface of the steel. Endothermic atmosphere or nitrogen blankets are used.
20. **Precision Gas Carburizing:** A gaseous carburizing process where the gas mixtures, time and temperatures are all controlled continuously throughout the process through digital controls and oxygen probes.
21. **Quenching:** The rapid, but controlled, cooling (in air, inert gas, oil or water) of hot metal parts to produce a desired change in the microstructure of the material..
22. **Selective Hardening:** Heat treating processes that harden only one area of a part. Also may mean a physical barrier (copper plate or stop-off) is applied to prevent carburization and hardening of an area of the part.
23. **Solution Treating:** A heat treating process that prepares the material for subsequent low temperature precipitation hardening by artificial aging. Allows "soft" parts to be finished to size before the aging process.
24. **Spheroidize Annealing:** A "softening" of steel by heating and then cooling very slowly to provide a metallurgical structure that looks like "spheres" or "balls." Allows the metal to be stamped or formed more easily.
25. **Steel Hardening:** See, *Hardening*.
26. **Straightening:** A post-heat treat process to bring shafts, blades, or other parts into tolerance for straightness.
27. **Stress Relieving:** A heat treating process (usually below 1250F) to remove welding, cold working or other internal strains to avoid part movement during later heat treatment or machining.
28. **Tempering:** After the hardening process parts are usually very hard, but too brittle to use reliably. Tempering is a subsequent heating process to lower the hardness and to increase ductility.
29. **Testing:** Metallurgical: See, *Metal Testing*.
30. **Thermal Processing:** See, *Heat Treating*.
31. **Vacuum Heat Treating:** Heat treating done on parts inside a vessel that has had most of the ambient air removed before heat-up. Since there is no oxygen present, the parts come out "bright."

HEAT TREATING SERVICES

Atmosphere Processing

- Atmosphere Annealing
- Atmosphere Carbonitriding
- Atmosphere Carbon Restoration
- Atmosphere Carburizing
- Atmosphere Normalizing
- Quench & Temper

Vacuum Process

- Heat treat tool steels
- Heat treat stainless steels
- Vacuum Age Hardening
- Vacuum Braze
- Vacuum Full Anneal
- Vacuum Normalizing
- Vacuum Solution Anneal
- Vacuum Temper

Tempering

- Age Hardening
- Anneal for Machining
- Full Anneal
- Post Weld Heat Treating (Code Stress Relieve)
- Regular Temper
- Stress Relieve
- Temper Anne

Induction Processes

- Induction Annealing
- Induction Hardening
- Induction Tempering
- Sandblasting
- Masking

Testing

- Lab Testing
- Micro Hardness Testing
- Metallurgist P.E. On Staff

Our mission at HTG is to provide the highest quality heat treating services to our customers. To achieve this we maintain a high degree of commitment and respect to both our customers and our employees. When you call HTG you will be greeted by someone who is proud of what they do and who will be truly interested in what they can do to help you. No matter what you need, technical assistance, a quotation, scheduling a pick-up, or even a question about paperwork, we will be eager to assist you.

For additional information on HTG, please go to www.htg.cc



Figure 1 Dual station Induction Hardening

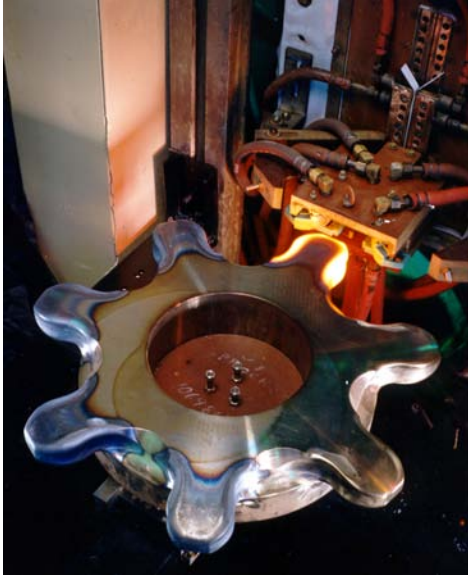


Figure 2 Gear Hardening by Induction



Figure 3 Braking Lever: assembled brazed and heat treated



Figure 4 10 Bar Tool Treater

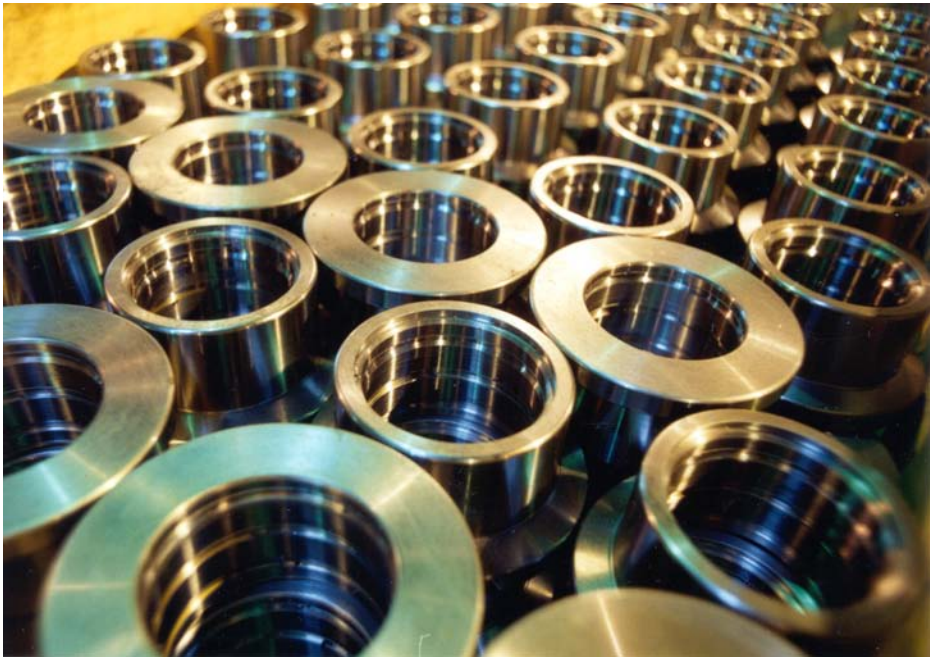


Figure 5 Quench & Temper



Figure 6 Nitrotec Treatment



Figure 7 HTG Materials Lab