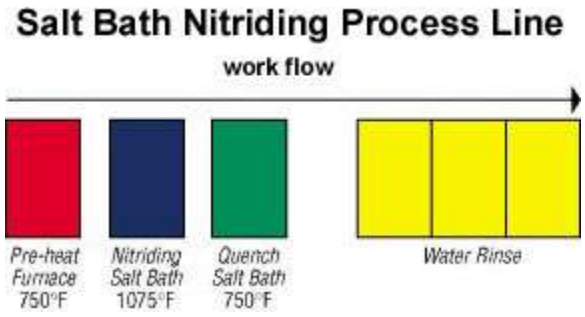
Salt Bath Nitriding and QPQ
AMS 2753

Nitriding is a heat treating process that allows nitrogen onto the surface of a metal to create a case hardened surface.

Salt bath nitriding, alse referred to as liquid salt bath ferritic nitrocarburizing is a surface treatment for most ferrous metal components and is designed to improve certain engineering properties to enhance wear resistance, lubricity, fatigue strength and corrosion resistance. The nitriding process will also lower the coefficient of friction.

Salt Bath Processes

Salt bath nitriding is a thermochemical process in which nitrogen and carbon are diffused simultaneously into the surface of the material. The high concentration of nitrogen chemically combines with iron and other nitride forming elements to produce an outer layer of epsilon iron nitride (Fe_3N) which is thin, hard and ductile.



This layer is also known as the compound zone which has increased surface hardness to enhance anti-galling characteristics and lowers the coefficient of friction. This compound zone also functions as a solid film lubricant by providing a non-metallic interface between mating surfaces. Nitrogen of lower concentration continues to diffuse below the compound zone and forms a solid solution with the base metal iron. This zone is referred to as the diffusion zone and is noted for its improvement in fatigue strength.

Heating Comparison

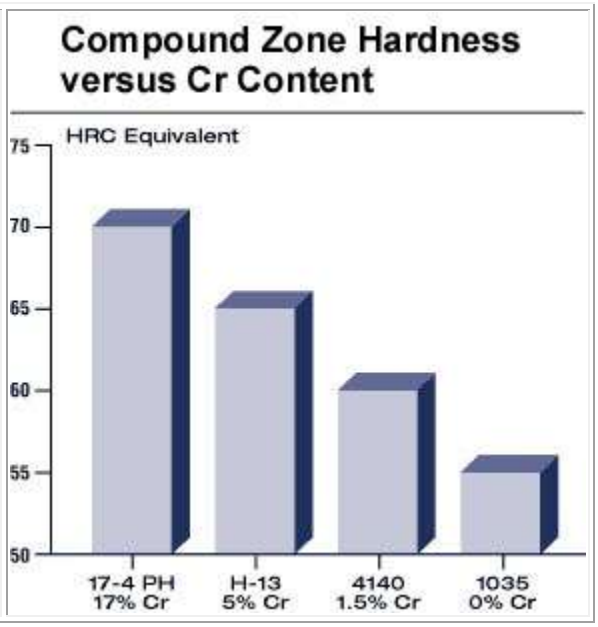
In comparison to conventional heat treating, salt bath nitriding has a low operating temperature typically of 1075°F (580°C). At this temperature, distortion is minimized and components can be completed through the final machining and heat treatment stages prior to the salt bath nitriding process. The process, besides being an alternative to conventional heat treating, is an option to consider for the replacement of other types of nitriding and certain deposition coatings (i.e., chrome and nickel plating).

Material Selection

Material selection affects surface hardness and depth of hardness. Typically the surface hardness of low to medium carbon steels and certain alloys ranges from 550-700 HV with depths of .0002" to .0008" depending on the cycle time. The surface hardness of stainless steels generally is 840 HV or greater at a depth of .0002" to .0015". Depending on material type, the continuation of nitrogen penetration in the diffusion zone occurs to a depth of between .003" to .040" at a descending gradient of hardness.

Materials Commonly Salt Bath Nitrided

- **Low to medium carbon steel**
- **Alloy steel**
- **Stainless steel**
- **Cast iron**
- **Tool and die steel**



Implementations

Let Us Help You Improve Your...

- Wear Resistance
- Running properties

- Abrasion resistance
- Anti-galling
- Lubricity
- Coefficient of friction
- Fatigue strength
- Corrosion resistance (except stainless steel)
- Material costs (low alloys versus high alloys)
- Alternatives to expensive plating processes

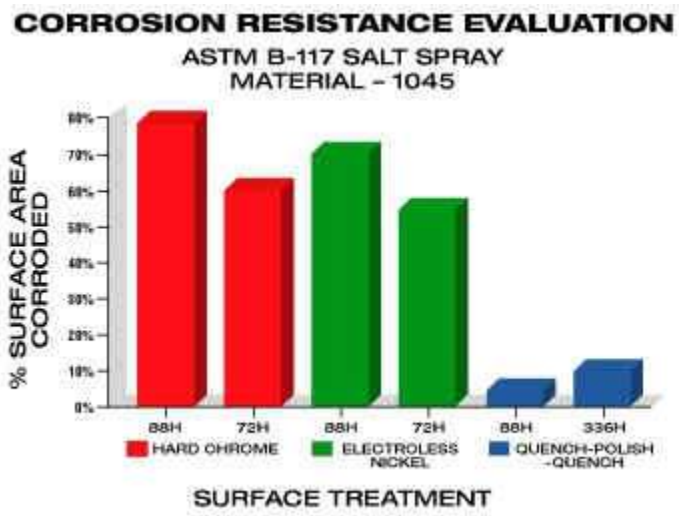
SALT BATH NITRIDING

At 1075° F the Salt Bath Nitride process is a Thermo Chemical treatment that improves wear resistance and corrosion resistance of ferrous metals with little or no dimensional change.

- Hardness 52-58 HRc
- Meets AMS 2753 Specifications
- Improves fatigue strength
- Exceptional lubricity
- Low coefficient of friction
- Improved wear resistance
- Improved corrosion resistance
- Resistance to weld splatter
- Holds dimensional requirements with little or no distortion
- Nice matt black color
- Metal treatment (not a coating)

Corrosion Resistance

The salt bath nitriding process consist of preheating, nitriding, quenching and water rinses. A supplemental process to improve corrosion resistance is called Quench-Polish-Quench (QPQ) known as **QUENCH - POLISH - QUENCH** is offered by Houston Unlimited, Inc. This process involves ferrous components that have been salt bath nitrited. The parts are then mechanically polished to achieve a comparable original finish, reimmersed into the salt quench bath, water rinsed and oiled. The product of this quench-polish-quench process is a layer of iron oxide on the surface that enhances the corrosion resistance for non-stainless steels and promotes an appealing, black, cosmetic finish.



The advantages of salt nitriding are:

- Quick processing time - usually in the order of 4 hours or so to achieve
- Simple operation - heat the salt and workpieces to temperature and submerge until the duration has transpired

The disadvantages are:

- The salts used are highly toxic - Disposal of salts are controlled by stringent environmental laws in western countries and has increased the costs involved in using salt baths. This is one of the most significant reasons the process has fallen out of favor in the last decade or so.
- Only one process possible with a particular salt type - since the nitrogen potential is set by the salt, only one type of process is possible