INFORMATION FROM OUR HEAT TREATMENT WORKSHOP!

Nitrocarburizing + post-oxidation (“Nitro black”)

Heat treatment: Nitrocarburizing + post-oxidation (“Nitro black”), see below

Surface hardness: approx. 600 HV

Nitriding depth: Fz approx. 20 µm, nitriding depth DNC approx. 0.2 mm. DNC defined as min 400 HV

General:

The material-technical basis of the process is nitrocarburizing + post-oxidation. More than 100 trademarks for essentially the same process exist with only small differences from trademark to trademark. Such trademarks are also called Corr-I-dur, Nitrocarburizing, Blacknite etc. The processes are sometimes dipped in oil to enhance the black coloration.

Purpose:

Nitrocarburizing + post-oxidation has the purpose of introducing nitrogen and carbon into the material surface while a protective oxide film is formed. This process is primarily intended to improve wear resistance in the surface layer and increase fatigue strength.

Advantages:

Nitrocarburizing + post-oxidation is based on the same principles as nitrocarburizing, i.e. a nitriding process that hardens the steel surface without any phase transformation taking place, which could otherwise result in dimensional changes. In the nitrocarburizing process, a gas is also added which causes oxidation of the surface, resulting in a visible black coloration. The color may, however, vary somewhat depending on the type of steel. This complete oxidation provides very good corrosion protection for e.g. quenched and tempered steels or tool steels that otherwise lack corrosion resistance. The process also increases resistance to wear, scratching, adhesion and abrasion as well as improving fatigue strength. The process, like gas nitriding, gives rise to a compound layer on the surface (Fz) and a diffusion zone, but where the compound layer is not as brittle as in gas nitriding.

Limitations:

Nitrocarburizing takes place at approximately 570 degrees, which can have negative effects on the steel if it is already hardened and has been exposed to a temperature above the nitriding temperature. The surface oxide is very thin, usually 1–3 µm, which means that the surface should not or cannot be machined after nitrocarburizing + post-oxidation.

Base material:

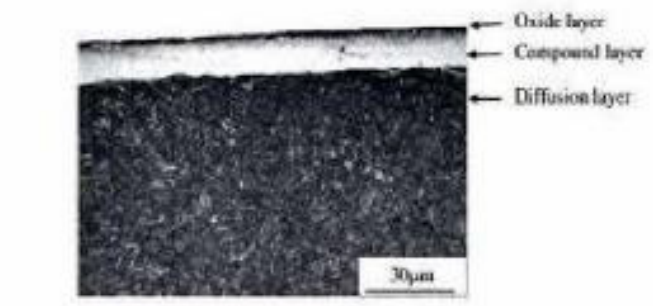
In principle, all materials can be nitrocarburized and post-oxidized, except stainless steels, high-alloy tool steels and sintered steels. Higher alloy content gives a higher surface hardness, but slightly less case depth, in the same way as with other nitriding processes.

Principle:

The process is based on the same principles as nitrocarburizing, but an oxidation gas, most often nitrous oxide (N2O), is added. The oxidation is carried out for a short time at approximately 450–550 °C. The iron oxide that is formed should preferably be magnetite (Fe3O4), which has the same composition as LKAB's ore or rust. However, the oxide is so dense that it does not allow oxygen to pass through for continued corrosion.

Procedure:

The material is handled in the same way as in nitrocarburizing, but at the end of the heating step the temperature is lowered and nitrous oxide is added so that the oxidation process can take place.

Control:

The surface hardness should be verified with HV measurement due to the thin layers. Drawings should state the thickness of the compound layer and the case depth. For the steel to be considered nitrocarburized, the surface layer hardness should be at least 400 HV or 50 HV higher than the hardness of the base material.