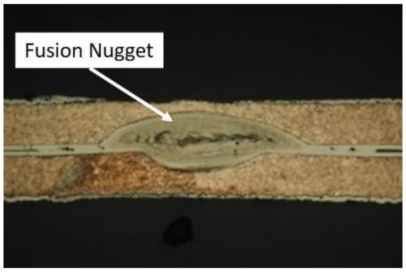
Girish P. Kelkar, Ph.D.
(562) 743-7576
girish@welding-consultant.com
www.welding-consultant.com

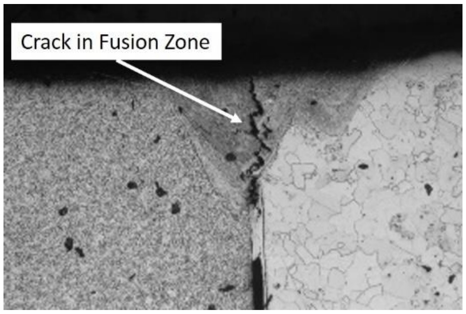
Welding of Ni-Plated Components

Industrial components are often Ni plated for a variety of reasons including appearance, diffusion barrier layer, corrosion protection, and surface hardness. In most applications, the plating process is the final step. However, there are situations where the parts have to be welded after plating which introduces a whole bunch of challenges. To resolve such issues, it is important to step back and first understand the types of plating and their effect on welding. There are two types of plating processes: electroplated Ni and electroless Ni. Electroplated Nickel, as the name implies, is a process that plates a metallic component in an electroplating bath with a Nickel anode. The plating process is controlled to produce Ni plate of required thickness; usually, the plated layer is almost pure Ni. On the other hand, an electroless Ni plating deposits a layer that incorporates a small amount of phosphorous along with Ni; phosphorous can be in the range of 3-15%. Electroless Ni process is able to produce plated layer of uniform thickness even if the component has many small features such sharp steps or blind holes.

For electrical applications where a Cu conductor with Ni plating and gold flash is to be soldered, the Ni plating provides a barrier layer and prevents dissolution of copper into the solder. In situations where higher application temperatures are required, a weld is preferred instead of a solder. To make a weld, the two terminals are typically resistance welded where the nickel layers provide a convenient resistive interlayer and help to focus the welding heat at the interface. For a strong bond, the user may have to push enough energy to melt the nickel layer which then fuses with the copper base form a fusion nugget (see photo below).



Ni plated structural components are commonly made of Ni-plated carbon steels and are chosen as cheaper alternative to stainless steels. When such components are fusion welded as with laser or TIG welding, the user is faced with two problems. First, the Ni layer melts and mixes with the base steel in the fusion zone; the resulting weld nugget no longer has the protective Ni layer and is susceptible to corrosion. The second problem is encountered when welding electroless Ni plating where the phosphorous in the plating reacts with Ni and Fe to form low melting phases that have poor strength. Such phases are segregated to the center of the weld and along grain boundaries, and under suitable stress conditions, can form cracks in the weld. The amount of cracking can be reduced by using a low phosphorous plating; and if possible one should switch to electroplating which is practically pure Ni. However, using electroplated Ni is no sure bet to avoid cracks as can be seen in the weld section shown below. In this particular example, the plating process was not properly controlled and plated Ni layer was full of surface cracks where sulfur compounds from the plating bath had the opportunity to hide. A follow-on weld test by removing the Ni plating layer produced welds without any cracks. Information fed back to the plating vendor led to improved plating quality and defect-free welds.



In both types of Nickel plating processes, the plating vendor may decide to add some pixie dust and try to impress you with making a bright Ni plating. The pixie dust is typically proprietary chemicals that turn a dull matt finish on the Ni plating into a bright shiny surface. Unfortunately, the brighteners added are almost always detrimental to the welding process. This is one situation where the welding engineer would be smart and choose to be dull.

For additional questions or concerns, please contact
Girish P. Kelkar, Ph.D. at 562-743-7576
girish@welding-consultant.com