West Special Fasteners Ltd.

Duplex and Super Duplex – Ensuring your fastener is correct

When purchasing anything, you always want to ensure you get exactly what you ordered. With fasteners, this is no different and is becoming more and more critical in the high end markets of Oil & Gas, Petrochemical and Offshore bolting.

In the past 5 years, the use of Duplex and Super Duplex has increased dramatically in the fastener industry. Raw materials are readily available, in a good range of sizes and competitively priced. These factors have encouraged a number of companies to get involved with these materials, meaning competition is fierce. However, Duplex materials are complicated and, if not handled right at every stage, can give end users major problems.

The main reasons these problems occur is when a product, such as a Hexagon Bolt, Socket Capscrews or Hexagon nut is produced by hot forging. The hot forging process is either performed incorrectly, the heat treatment load is not done and tested to a repeatable and approved procedure, or sometimes products are not even heat treated at all.

Imagine this scenario; You have 2 hexagon bolts that have been hot forged and machined, that look exactly the same, from 2 different suppliers. All the material certificates conform to the required standard and a PMI check of each fastener shows both are the correct grade. However, only one supplier hasn't carried out the hot forging and heat treatment process correctly. The only way you could now fully tell the difference is by carrying out a full metallurgical analysis on the finished products.

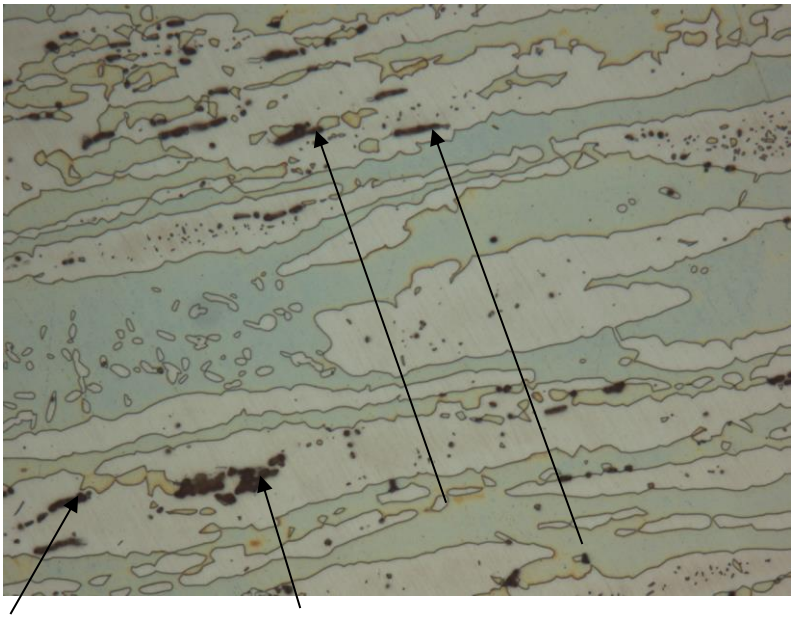
Duplex materials have an austenite and ferrite balance, which gives a better corrosion resistance (stress and pitting), plus a higher strength than standard austenitic stainless steels (A2/A4). However, when hot forged or heat treated incorrectly, this balance can be altered and these increased capabilities are altered or completely taken away. There are also detrimental phases that can be formed, such as Sigma and Chi, should the material not be handled correctly. These phases can greatly reduce corrosion resistance and the strength performance expected of Duplex and Super Duplex.

After the hot forging of these materials, there should always be a solution treatment take place. This solution treatment process is a vital part of ensuring the material is returned to the original, intended condition it was designed for. As with any process as vital as this, the load must be treated at the correct time and temperature, followed by rapid water quenching. If the products are loaded inaccurately, heated at wrong times / temperatures or quenched incorrectly, you will have defective products.

West Special Fasteners Ltd.

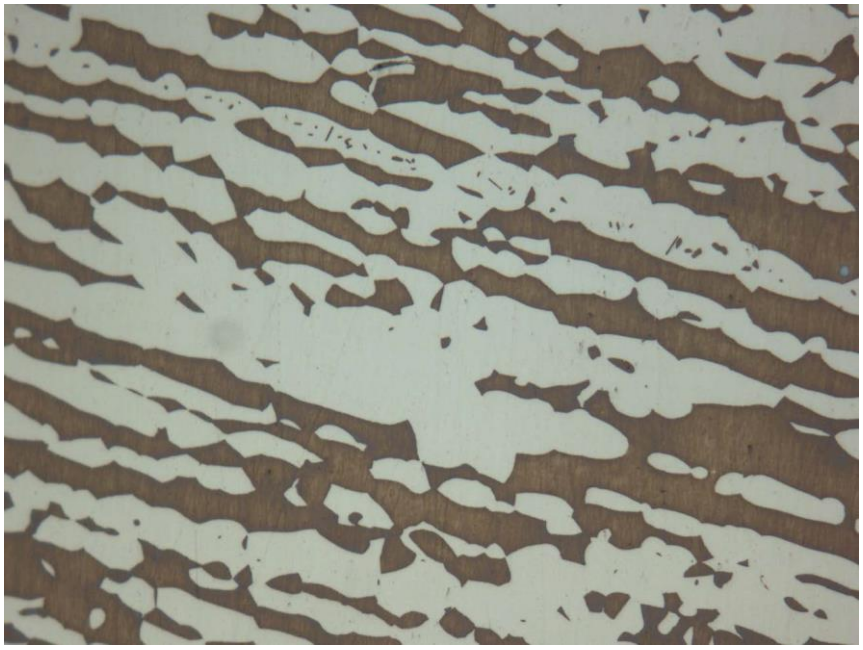
Once heat treatment has been completed, the only way that you can ensure it has been done correctly is by carrying out specific tests on the load. These tests check the structure of the material, ensuring that the balance of austenite and ferrite is back at the correct levels, plus the detrimental phases have not occurred. These tests are carried out by fully independent, UKAS approved test houses. Below, you will see examples of both bad and good results on a heat treatment load:

Bad



These dark patches within the microstructure (taken at x500) are signs of “Sigma Phase”,which is detrimental to Super Duplex

Good



The above microstructure, taken at the same magnification, is free of sigma phase and any other detrimental aspects to Super Duplex

Duplex and Super Duplex are both expected to be added to ISO 3506 at its next revision. This will no doubt encourage a further increase in suppliers that manufacture in these materials. However, not all manufacturers will have the experience and knowledge to supply hot forged products as well as West Special Fasteners. James Hawkins, one of our Directors, sits on the ISO 3506 Revision Committee for the UK, and has offered his 20 plus years of experience of forging Super Duplex from the trials in the early 90's, to the development of the processes used today by the top producers of Super Duplex bolting today. The company has supplied proven technical data, to the committee, from real world projects, using fasteners produced in Super Duplex by West Special Fasteners.

West Special Fasteners have recently been awarded approval for the hot forging of Super Duplex by a major end user in the Oil & Gas market, ExxonMobil. Not only is this approval a major success story for our company, but shows understanding of the materials we are regularly asked to supply. This, along with high level of integrity, transparency and knowledge, ensure that West Special Fasteners are supplying the right product. Not only in these grades, but exotic materials such as Inconel, Hastelloy, Titanium and many others.

To some people it is just a bolt and a nut, but to West Special Fasteners, it's a nut and a bolt that will do the job it was designed for!

Article Published in Fast Magazine BVAA Valve User and BSSA Online. Article by Tim Wilson.