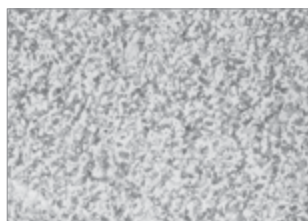


## HEAT TREATMENT

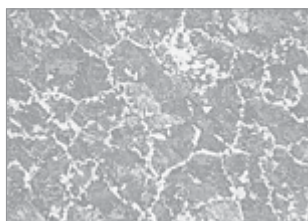
The heat treatment of steel is an ancient art and science that dates back to the Iron Age. Today, it has been refined to a sophisticated science. It is now possible to greatly enhance the strength, ductility, and resilience of steel through a properly controlled heat treatment process. The 'as forged' fitting results in variability that is detrimental in applications that require toughness. Normalizing, spheroidized annealing, and quench and tempering are heat treat processes. Proper heat treatment eliminates the risk of cooling variation at the forging process. This is true of all steels regardless of material grades.

Crosby heat treats all fittings that are load bearing components and minimizes risk by the effective heat treatment of fittings. We do not take shortcuts for the sake of cutting cost. A non-heat treated product compromises the performance ability of that product.

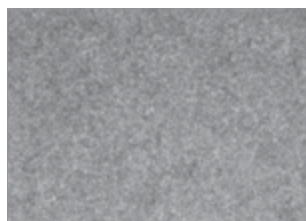
### Microstructures for various heat treatment processes



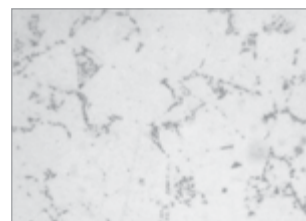
AS FORGED



NORMALIZED



QUENCHED & TEMPERED



COLD TUFF®

### QUENCHED & TEMPERED

Quenching and tempering of steel has been found to be the heat treatment best suited to fully develop the strength and enhance the grain flow of carbon and alloy forgings.

The quenched and tempered product will deform before ultimate failure, thus giving warning.

The quenching process is rapid cooling in water or oil, after heating, to form a strong but brittle structure. The tempering process is the reheating of the steel to obtain the desired strength while increasing the ductility and toughness.

Quench and tempering provides the consistency of performance needed by all critical applications, especially overhead lifting.

#### Questions to ask your rigging provider

*Are load-bearing fittings heat treated, and what type of heat treatment is used?*

*What products do they quench and temper, and are their products exposed to high-stress quenched and temper?*

*If not, why are they willing to accept inferior impact toughness properties of non-quenched and tempered products?*

Some supply critical fittings in 'as forged' or 'as cast' condition, and many normalize their forgings but do not quench and temper.

#### Why choose Crosby

Crosby fittings are exposed to high stress applications, designed as load-bearing elements, and are quenched and tempered.

The Crosby Quenched & Tempered process is the most consistent method of assuring that every fitting performs as needed, especially in overhead lifting.



### MATERIAL CONTROL

The proper heat treatment of forged fittings depends on the appropriate selection of materials and use of heat treat procedures. Fine grained, special bar forging quality steel of specific cleanliness requirements and guaranteed hardenability in the appropriate grades must be used.

Proper selection of steel is not enough, however. The control and management of these steels, from purchase through the entire manufacturing process, is essential to assure that the proper results are attained in the designated product. This control should utilize a production traceability program.

#### Questions to ask your rigging provider

*Do they have an identification code forged into the product that traces material back to verified certification?*

*Are all heat records maintained by the traceability code?*

Most do not provide traceability of material.

#### Why choose Crosby

Crosby uses the Product Identification Code (PIC) for material control, from receipt and verification of steel throughout the entire manufacturing process.

Crosby can provide certified material analysis for each production lot.

### ULTIMATE STRENGTH, DUCTILITY, IMPACT & FATIGUE PROPERTIES

The mechanical properties of steel when a load is very rapidly applied is known as its *impact strength*. Forged fittings must be able to have impact strengths that match the requirements of their application, especially in cold temperatures. The ability of a steel to withstand repeated applications of a load is measured by fatigue testing. The proper heat treatment of forgings, which includes quenching and tempering, can develop these properties to their desired level in a consistent and reliable manner. The ability to perform when overloaded is known as *ductility*.

#### Question to ask your rigging provider

*Are the products designed and manufactured with considerations for strength, fatigue, impact, and ductility?*

Some do not utilize materials that have good impact and fatigue properties.

#### Why choose Crosby

Crosby's product line benefits from the selection of steel and the heat treatment process that allows for superior strength, ductility, impact, and fatigue performance. The product deforms if overloaded, giving warning before ultimate failure. All of these properties are essential if the product is to perform time after time. They are also important to assure that the inspection criteria set forth by ANSI will effectively monitor the ability of the fitting to continue in service.

### Heat treatment process by product group

**Shackles** – Pins and bows are Quenched and Tempered  
**Eye Hooks** – Quenched and Tempered  
**Shank Hooks** – Quenched and Tempered  
**Master Links** – Quenched and Tempered  
**Hoist Rings** – Quenched and Tempered  
**Swivels** – Quenched and Tempered  
**Turnbuckles** – All ends are Q&T or Normalized bodies Normalized

**Pad Eyes** – Quenched and Tempered  
**Eye Bolts** – Quenched and Tempered  
**Load Binders** – Quenched and Tempered  
**Swage Sockets** – Spheroidized Annealed  
**Swage Sleeves** – Cold Tuff®  
**Spelter Sockets** – Normalized

