

A Simplified Guide to Heat Treating Tool Steels

When we consider that the greater overall costs of most tools and dies are incurred prior to heat treatment and further that proper heat treatment is critical to the successful application of tooling, this so-called "hardening" process is placed in it's proper perspective of importance. While there are a number of specialized procedures which can be employed in the heat treatment of tool steels, the purpose of this discussion is to review the basic heat treating process, it's steps and terms, and perhaps offer some helpful hints along the way.

The Heat Treating Process

The process consists of:

- A) PREHEATING the Annealed tool, typically at 1250 degrees F.
- B) AUSTENITIZING (Soaking at High Heat).
- C) QUENCHING – Quench to Hard Brittle (Martensite) condition.
- D) TEMPERING (Drawing to desired hardness).

Annealing

Tool steels are furnished in the annealed condition which is the soft, machineable and necessary condition for proper heat treat response. The exceptions to this are the prehardened steels such as P-20, Brake Die, Holder Block and Maxel Tooling Plate which are furnished at 28/32 HRC and used at that hardness.

Tool steels should always be annealed prior to re-hardening and annealed steels should be re-annealed after welding. Unlike hardening which requires a quench after soaking at the hardening temperature, the essence of annealing is very slow cooling from the annealing temperature. By way of example, A2 tool steel is annealed by heating to 1550 degrees F, soaking for two hours at temperature, furnace cooling 50 degrees F per hour to below 1200 degrees F followed by air cooling. Some shops anneal late in the day after all other heat treating has been finished by simply soaking the part to be annealed at the proper annealing temperature and then turning the furnace off. The next morning the part is fully annealed and ready for handling.

Preheating

Preheating plays no part in the actual hardening reaction and is often considered an unnecessary step. However, preheating performs at least one major function, it minimizes thermal shock, thus reducing the danger of excessive distortion, warping or cracking. As a matter of fact, intricate tools and particularly high speed steels, are often preheated in two steps: one below the transformation temperature and the second right at the transformation temperature. Preheating does not require "soaking" but the tool should be equalized at the preheat temperature. Remember, always bring your tools up with the furnace to the preheating temperature.

Austenitizing (High Heat)

Austenitizing depends upon time and temperature, thus the common term, soak at high heat. Of the two, temperature is the most critical. Never exceed the high heat range for the grade. Excessive temperature will cause erratic results. Classic symptoms of overheating are low as-quenched hardnesses and, depending upon the alloy content, shrinkage and loss of magnetic properties. Soaking time should always be after the steel has caught up with the furnace temperature. With the exception of high speed steels, a rule of thumb for soak time is one half hour per inch of thickness with a forty-five minute minimum and if in doubt over how long to soak a tool, soak it longer – never less. High speed steels are essentially equalized with the furnace temperature as opposed to soaking due to the fact that the high heat range is so close to the melting point. Essentially, high speed steels are equalized at the austenitizing (High Heat) temperature in minutes of furnace time, never soaked.

Tool Steel Heat Treating Guide

Michael Seilmaier



Tool Steel Heat Treating Guide:

Heat Treater's Guide Harry Chandler, 1994-12-31 This edition is a complete revision and contains a great deal of new subject matter including information on ferrous powder metallurgy cast irons ultra high strength steels furnace atmospheres quenching processes SPC and computer technology Data on over 135 additional irons and steels have been added to the previously covered 280 alloys Tool Steels, 5th Edition George Adam Roberts, Richard Kennedy, G. Krauss, 1998 **The Tool Steel Guide** James A. Szumera, 2003 For tool designers tool and die makers machinists and apprentices Szumera presents specification heat treatments applications for all types of die and mold steels and suggestions on how to prepare steels for machining and heat treatment He does not provide a bibliography Annotation c Boo Heat Treatment William E. Bryson, 2015-06-03 This book focuses on heat treating by ASM SME and AISI standards The manual has been created for use in student education as well as to guide professionals who has been heat treating their entire lives It is written without the typical metallurgical jargon This book will serve as a training manual from day one in learning how to heat treat a metal and then also serve as a day to day reference for a lifetime This manual zeros in on the popular tool steels alloy steels heat treatable stainless steels case hardening steels and more It deals with these metals with up to date usage and processing recipes What is different with this manual from all the others is that it doesn't just deal with the heat treatment process it also covers the continuation of the hardening process with cryogenics Yes it is written to help those who may want a thorough understanding of what goes on in the process of heat treating and how to do it better However it also shows how proper heat and cryogenic processing can save your company money Making money through longer life tooling decarb free and stress relief all while learning how to create a better finer grain structure This manual shows the reader that hardness is only an indication of hardness and that the real money savings is in the fine grained structure This manual is written for toolmakers engineers heat treaters procurement management personnel and anyone else who is involved in metals Metals are affected by the entire thermal scale from 2400 F down to 320 F That is the complete range of thermally treated metals and that is what this manual covers **The Tool Engineer**, 1941 Iron Age and Hardware, Iron and Industrial Reporter, 1919 *Essential Guide to Metals and Manufacturing* Krishan Katyal, 2019-04-30 This book is intended for new owners engineers technicians purchasing agents chief operating officers finance managers quality control managers sales managers or other employees who want to learn and grow in metal manufacturing business The book covers the following 1 Basic metals their selection major producers and suppliers websites 2 Manufacturing processes such as forgings castings steel fabrication sheet metal fabrication and stampings and their equipment suppliers websites 3 Machining and finishing processes and equipment suppliers websites 4 Automation equipment information and websites of their suppliers 5 Information about engineering drawings and quality control 6 Lists of sources of trade magazines technical books that will provide more information on each subject discussed in the book *Iron Age*, 1919 **Tool and Manufacturing**

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American Machinist & Automated Manufacturing ,1924 *Transactions of the American Society for Steel Treating* American Society for Steel Treating,1923 **Heat Treatment, Selection, and Application of Tool Steels** William E. Bryson,2005 In a few short years this has become the established reference for tool makers heat treaters and engineers seeking step by step recipes for properly heat treating a wide range of tool steels plus practical information about machinability shock resistance wear and extending tool life Now the completely revised and expanded Second Edition of the best selling Heat Treatment Selection and Application of Tool Steels is available It has been extensively updated and includes the following significant new additions an entirely new chapter on the popular powdered tool steel CPM 10V a thorough new section on carburizing thoroughly describes the process and its benefits the section on cryogenic treatment has been completely rewritten to describe the theory and process and a comprehensive glossary of related terms has been added As in the first edition valuable tables of properties attributed qualities and shortcomings of popular tool steels are also included

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