

Design and manufacturing plan of a jominy testing device

[Design](#)



The idea of this project is to design a Coming end quench testing machine which will be safe, ease to use, simple to understand, able to be managed by one person If needed, have a clear view of the heat treatment process while In operation, economic, have a low maintenance cost, durable, meets all CE standards and will be suitable for manufacturing. Materials for this thesis was sourced via several means Including Finnish Standards Association SF, world wide web, books and materials on heat treatments as well as one on one conversations with experts In this field.

At the ND of this project, the reader should have a good insight and understanding of the idea behind heat treatments and Coming end quenching test. A major part of this work involved the project drawings using AD software of choice-Pro Engineer wildfire. This required a good knowledge of the programmer and technical drawings as a manual of a step by step process to produce the said machine by means of the drawings in AD and AD formats will be made available.

The general purposes of a heat treatment are to improve the flexibility of soft tissues, remove toxic substance and to uniform the material composition and general quality f a metal piece. Coming test is one of the techniques used to determine the outcome of a heat treatment method. 1. 2 Why heat treatment and what can be heat treated Heat treatment is often associated with increasing the strength of material, but it can also be used to alter certain manufacturing objectives such as improve machining, improve formability and restore ductility after a cold working operation.

Thus it is a manufacturing process that can not only help other manufacturing process, but can also improve product performance by increasing strength or other desirable characteristics. Steels are particularly suitable for heat treatment, since they respond well to heat treatment and the commercial use of steels exceeds that of any other material. Steels are heat treated for one of the following reasons: 1 . Softening 2. Hardening 3. Material Modification. 1. 2. Softening Softening is done to reduce strength or hardness, remove residual stresses, improve toughness, restore ductility, refine grain size or change the electromagnetic properties of the steel restoring ductility or removing residual stresses is a necessary operation when a large amount of cold working is to be reformed, such as in a cold-rolling operation or hardwiring. 1. 2. 2 Hardening Hardening of steels is done to increase the strength and wear properties. One of the prerequisites for hardening is sufficient carbon and alloy content. If there is sufficient Carbon content then the steel can be directly hardened.

Otherwise the surface of the part has to be Carbon enriched using some diffusion to modify properties of materials in addition to hardening and softening. These processes modify the behavior of the steels in a beneficial manner to maximize service life e. G. , stress relieving, or strength properties example cryogenic treatment, r some other desirable properties like spring aging. 1. 3 Basic concept of heat treatment and the procedure Steels are iron-carbon alloys whose characteristics can be influenced by changing the chemical composition (C-content and by adding alloying elements) as well as through heat treatment.

This means that there is a large number of constructional steels which fulfill all requirements. In order to understand the various heat treatments, it is necessary to be familiar with the processes which take place in constructional steel during heating and cooling. The constitutional diagram iron-carbon forms the initial axis for heat treatment. It shows the macrostructure constituents and amounts present in a condition of equilibrium. It can be seen from the constitutional diagram that austenite and, in hyperthyroid steels, austenite and cemented are present at temperatures above the ASK line.

Very slow cooling leads to conditions of equilibrium at room temperature and causes the austenite to convert into other types of macrostructure. Steels with less than 0.8 % carbon content segregate ferrite out of the austenite during cooling and the remaining austenite disintegrates at under CHIC into ferrite. With a carbon content of 0.8 %, ferrite only forms as a mixture of ferrite and cemented. In steels with over 0.8 % carbon content, ferrite and cemented form, whereby the secondary cemented is segregated out at the grain boundaries.

The hardness reached depends on the carbon content of the steel and its heritability whereby the dimensions of the work piece and conditions during heat 4 treatment also play a role. In order to carry out optimum hardening, it is necessary to adhere to the temperatures given and times for holding these as well as to correctly select and handle the hardening medium. The most suitable hardening values are to be achieved through hardening during the

martinets phase. The quenching media are usually water, oil or air, whereby the application depends on the critical cooling speed of the steel.

Steels used for this have low C contents and, depending on the desired core toughness, may be alloyed. For case hardening, depending on the material and shape and size of the work pieces, various types of treatment can be considered which in turn yields the desired result. While surface hardening is used to describe heating of work pieces which are confined to the surface during which the core remains below the hardening temperature and is not hardened at all during quenching. This heating confined to the surface is achieved by gas flames (flame hardening) or inductive heating.

As a result of these types of heating, under corresponding conditions, it is possible to achieve heating to hardening temperature throughout but then these types of heating can no longer be called surface hardening. Special types of surface hardening are case hardening and nitride hardening. Immediately after hardening, the parts are treated at approve. CHIC to relieve stresses. Tempering on the other hand is used to describe heat treatment to achieve high levels of toughness with a particular tensile strength by ordering and subsequently annealing, normally at high temperatures.

The mechanical properties of a tempered steel, in particular its toughness, depend to a large degree on the care taken during the tempering treatment.

(Denis S. , 1984) 1. 4. 7 Teenier treatment Teenier treatment is a salt bath process especially developed from soft intruding. As a nitrogen carrier, a KEN/CON salt bath with air cooling is used. Then cooled in water or air,

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depending on the material and shape. (GAG, 201 la. (Wasteland Mechanical Testing & Research, 2012)) 6 2. 1 COMING END QUENCHING TEST IN HEAT TREATMENTS The concept of Coming test

The Coming end-quench test is the measure of the heritability of steel, which is a measure of the capacity of the steel to harden in depth under a given set of conditions. (Wasteland Mechanical Testing & Research, 2012). Knowledge about the heritability of steels is necessary to select the appropriate combination of alloy steel and heat treatment to minimize thermal stresses and distortion in manufacturing components of different sizes. The Coming end-quench test is the standard method for measuring the heritability of steels.

This describes the ability of the steel to be hardened in depth by quenching. Heritability depends on the chemical composition of the steel and also be can affected by prior processing conditions, such as the systematizing temperature. It not only is necessary to understand the basic information provided from the test, but also to understand how the information obtained from the Coming test can be used to understand the effects of alloying in steels and the steel macrostructure. (Industrial heating, 2012.). 2.

Connection of Coming test to real the world and working materials Heat treatment is an indispensable step in the manufacture of steel products, as canonical properties such as hardness, static, and dynamic strength and toughness are selectively controlled by deliberate manipulation of the chemical and metallurgical structure of a component. However, apart from the desired effects, the heat treatment process can be accompanied by

unwanted effects such as component distortion, high material hardness, low material strength, a lack of toughness which can lead to crack formation and inadequate hardness depth, which can lead to fatigue failure.

Therefore, success or failure of heat treatment not only affects manufacturing costs but also determines product quality and reliability. Heat treatment must therefore be taken into account during development and design, and it has to be controlled in the manufacturing process. Part designers and heat treatment practitioners are looking for process feasibility, a specific macrostructure fitting to the in-service requirements, minimum part distortion, and proper distribution of residual stresses.

Due to this pending need, Coming test in introduced heat treatments Coming test of heat treatments can be achieved in two ways- the simulation based design or the practical approach. Information will give in details on the practical approach as that is the idea behind this project, however is expedient to shed some light on the simulation based design approach. SLEWED is one of the tools possible for such approach. 7 It is finite element software which permits for not only Coming tests to be carried out but all other heat treatment processes to be achieved taking all significant physical effects into account.

Thus, the part designer/heat treatment practitioner can have a deliberate influence on minimizing manufacturing costs and optimizing product reliability and quality. The Coming test is implemented as a predefined, ready-to-run emulation project in SLEWED. The user defines the chemical composition of the steel, and the computation of the Coming test is done

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automatically. With the aid of SLEWED heat treatments processes on actual parts is done and it provide answers to these basic questions: ; Is the selected heat treatment process feasible? Is the selected steel feasible? ; Is the selected quenching media suitable? ; Is the process window safe against process tolerances? ; Is the part hard where it should be hard? ; Is there any crack risk occurring during the process? ; Are the obtained distortions acceptable? Are the residual compressive stresses high enough and well positioned? (Which Sites, April, 2008), (Herald Prosper, 2008) 2. 4 The aim of Coming test is to ensure that the right heritability is achieved as already stated or to have a record of the current heritability data.

So without success being achieved here in, a good success will not have being achieved to some degree. Below are two insightful diagrams which we shall discuss more on shortly. FIGURE 2 Above: quench test of a 0. AWT% carbon steel: (a) Undeterred martinets; (b) Ferrite and pearlier. Pearlier, the darker constituent, is a eutectic mixture of rite and iron carbide. The Coming end-quench test measures the heritability of steel; that is, the ability of martinets at a given depth below the surface when cooled under a given condition from high temperature.

A quench and temper heat treatment uses this phase transformation to harden steels. Tempering the martinets macrostructure imparts a good combination of strength and toughness to the steel. Without tempering, martinets is hard, but brittle. To select steel for a component that will be heat treated, it is important to know its heritability. Both alloying and macrostructure effect the heritability, allowing the correct steel and

quenching rate to be selected. Prior processing of the steel also affects the macrostructure and should also be considered.

Hardening of steels can be understood by considering that on cooling from high temperature, the austenite phase of the steel can transform to either martinites (Fig. AAA) or a mixture of ferrite and pearlier (Fig. B). The ferrite/pearlier reaction involves diffusion, which takes time. However, the martinites transformation does not involve diffusion and essentially is instantaneous. These two reactions are nominative, and martinites is obtained if the cooling rate is fast enough to avoid the slower formation of ferrite and pearlier.

In alloyed steels, the ferrite/ pearlier reaction is further slowed down, which allows martinites to be obtained using slower cooling rates. Transformation to another possible phase (finite) can be understood in a similar way.

Heritability describes the capacity of the steel to harden in depth under a given set of conditions. For example, a steel of a high heritability can transform to a high fraction of martinites to depths of several millimeters under relatively slow cooling, such as an oil quench.

By comparison, a steel of low heritability may only form a high fraction of martinites to a depth of less than a millimeters, even under quite rapid cooling, such as water quench. Steels having high heritability are required to make large high-strength components, such as large extruder screws for injection molding of polymers, pistons for rock breakers, mine-shaft supports, aircraft undercarriages, as well as for small, high-precision

components, such as die-casting molds, drills and presses for stamping coins.