

CONNECTICUT STATE DEPARTMENT OF EDUCATION

Division of Instruction

Hartford

SHOP THEORY FOR THE MACHINE TRADES

SUBJECT: Metallurgy of Iron and Steel

SESSION 12.

OBJECTIVE: Other Specialized Heat Treatments

METHOD: Answer questions by referring to the hand book, Conference,
and Final Tests

REFERENCE: Machinery's Hand Book

STUDENT ASSIGNMENT: On a separate sheet of paper, answer the following
questions. You may use your hand book.

I. Gas Carburizing (H.B., p.1649)

1. What common gases are used?
2. How is the correct atmosphere about the work maintained?
3. Are there any limits to the size or shape of the work that can be carburized by this method?

II. Flame Hardening (H.B., p.1650)

4. What types of work are hardened by this process?
5. Describe briefly the general method.
6. What method of flame hardening is used on large, circular work?
7. Describe briefly the progressive method of flame hardening.

III. Induction Hardening (H.B., pp.1651-3)

8. What classes of work are hardened by this method?
9. How long a time is required for heating?
10. What is the cycle range of the current used?
11. What is the relation between frequency of cycle and depth of penetration?
12. Name three methods of quenching used with induction hardening.

IV. Deep Freezing (H.B., pp.1666-70)

13. How long a time of refrigeration is the equivalent of six months of aging at room temperature?
14. Give the three steps in stabilizing precision gages.

V. Heat Treatment of High Speed Steels (H.B., pp.1660-3)

15. Give the main steps and corresponding temperatures used in hardening H.S.S.
16. Give the main steps and temperatures for drawing H.S.S.
17. Give the main steps and temperature for annealing H.S.S.

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SHOP THEORY FOR THE MACHINE TRADES

Name of Student _____ Date _____

Instructor _____ Grade _____

COMPLETION TEST - Semi-Final

(To cover lessons 7 to 12, inclusive. To be used at the option of the instructor, for the purpose of checking grades. Use of notes by the student is permissible)

INSTRUCTIONS TO THE STUDENT: Write in each blank space the single word that, in your opinion, best completes the statement.

1. Heat treatments vary very greatly with _____ of the steels.
2. A formula for specialized heat treatment of alloy steels is furnished by the _____.
3. Molten lead baths have a temperature range of from _____ degrees to _____ degrees.
4. Water or brine quenching is used only for _____ steels.
5. In a _____ type of gas or oil fired furnace, the products of combustion are kept away from the work.
6. A _____ pyrometer keeps a time and temperature record of the oven or bath in which the work is being heated.
7. The Rockwell hardness tester measures the _____ of a steel ball or diamond point into the surface to be tested.
8. _____ tables are used to get equivalent Rockwell and Brinell hardness numbers.
9. Red-hardness is a quality of _____ steel.
10. The _____ speed must be faster than the _____ speed if any hardening is to be accomplished.
11. Timbre depends upon the _____ size.
12. _____ is used in the salt bath when a thin case is desired.

Completion Test - Semi-Final (Continued)

13. _____ timbre steel is less liable to crack when hardened.
14. The free iron in fully annealed steel is called _____.
15. Iron carbide (Fe_3C), when present in annealed steel is called _____.
16. Iron and carbon, as combined to make steel, belong to type _____ alloy.
17. Pearlite is a laminated mechanical mixture of _____ and _____.
18. As a carbon steel is heated up for hardening, transformation to austenite begins at a point called the _____ critical.
19. Carbon steel with _____% carbon is called eutectoid steel.
20. The normalizing temperature is usually about 100° _____ than the annealing temperature.
21. A piece of carbon steel, to be fully annealed, must be cooled very _____.
22. The point of fastest transformation time on the Bain S-curve is called the _____ of the curve.
23. Steel that is austempered does not require the usual _____ operation.
24. Spherodizing makes the steel easier to _____.
25. Deep freezing for a few hours accomplishes the equivalent of six _____ of aging at normal temperatures.

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SUBJECT: Metallurgy of Iron and Steel

FINAL TEST

(Questions to be answered by students
without reference to notes or texts)

INSTRUCTIONS TO STUDENTS: Underscore the words that correctly complete
the sentences.

1. The object in giving this course is to
 - a. make metallurgists of the students
 - b. equip the students to do heat treating
 - c. give the students a useful background for understanding
 - d. give the students a chance to sleep inclass

2. The process of transforming iron ore into pig iron is principally a process of
 - a. oxidation
 - b. corrosion
 - c. combustion
 - d. reduction

3. Pig iron is a product of the
 - a. the Bessemer converter
 - b. foundry cupola
 - c. blast furnace
 - d. open hearth furnace

4. Stock for use in automatic screw machines is quite likely to be
 - a. drill rod
 - b. cold rolled steel
 - c. acid Bessemer steel
 - d. high speed steel

5. _____ and _____ are generally classed as impurities in steel and are seldom added as alloys.
 - a. manganese
 - b. molybdenum
 - c. carbon
 - d. cobalt
 - e. sulphur
 - f. silicon
 - g. phosphorous
 - h. columbium

Metallurgy of Iron and Steel - Final Test - (Continued)

6. The electric furnace, for making tool steels,
 - a. has largely supplanted the crucible furnace
 - b. is practically obsolete
 - c. is too expensive for general use

7. The ways of a cast iron Monarch engine lathe bed are hardened by the _____ process.
 - a. cyanide
 - b. flame hardening
 - c. deep freezing
 - d. induction hardening

8. Excessive grain growth is controlled
 - a. at the mill
 - b. by annealing
 - c. by temperature controls
 - d. by a neutralizing atmosphere

9. Work that has been heated to an excessive temperature should be
 - a. cooled to its critical point and quenched
 - b. immediately quenched
 - c. preheated and then soaked
 - d. annealed and reheated

10. A brine bath for quenching carbon steel is superior to fresh water because
 - a. it is faster quenching
 - b. no bubbles of gas form on the surface of the work
 - c. deeper hardness penetration results
 - d. there is less tendency for decarburization

11. After steel has been hardened, it must be tempered or drawn because
 - a. it is too brittle to use as a tool
 - b. it is not yet hard enough
 - c. it is necessary to prevent warping
 - d. it keeps its shape better

12. Case hardening is performed when
 - a. deep penetration is required
 - b. a tough center and a hard surface are required
 - c. extra hardness for cutting is required
 - d. a high tensile strength is required

13. The preheating high speed steels before subjecting them to the hardening temperature is done to
 - a. restore the original internal structure
 - b. keep the work from burning
 - c. prevent the formation of internal stresses
 - d. prevent excessive decarburization

Metallurgy of Iron and Steel - Final Test --(Continued)

14. Full annealing of carbon steel is accomplished by heating and soaking above the lower critical point and cooling in
 - a. water or brine
 - b. air
 - c. a bath of molten salts
 - d. the furnace or oven
 - e. a lead bath

15. The principal reason for normalizing is to
 - a. soften the steel for machining
 - b. reduce the grain size
 - c. relieve internal stresses
 - d. restore the original internal structure of the steel

16. The scale formed on work that is not packed when carburized is caused by
 - a. slow cooling
 - b. too high temperature
 - c. oxidation
 - d. chemical action of the quenching medium

17. Machinability of a piece of steel depends, more than on anything else, upon
 - a. relative hardness
 - b. character of the chip
 - c. grain structure
 - d. number of hard spots of soft spots

18. 12% to 20% of tungsten, plus 4% of chromium, added to carbon steel as alloys improve very much its
 - a. wear resistance
 - b. machinability
 - c. strength
 - d. ability to cut when hot

19. A typical drawing specification for .78% carbon steel could be
 - a. "heat to deep purple and quench"
 - b. "soak for 20 minutes at 900° and quench"
 - c. "draw for two hours at 300°"
 - d. "draw for fifteen minutes at 300°"

20. The _____ temperature for carbon steels is fairly uniform at from 1325° to 1340°
 - a. lower critical
 - b. upper critical
 - c. hardening
 - d. normalizing

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Metallurgy of Iron and Steel

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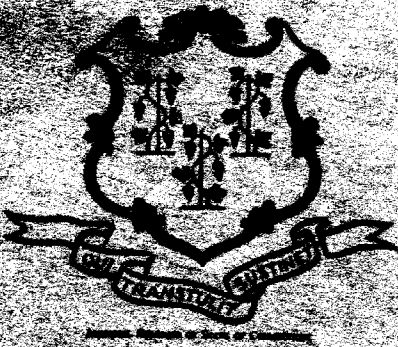
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METALLURGY OF IRON AND STEEL



SESSIONS 1-12