

Heat treatment of ferrous materials

Notation to indicate heat treatment processes

DIN
17014
Part 3

Wärmebehandlung von Eisenwerkstoffen; Kurzangabe von Wärmebehandlungen

1 Scope and field of application

This standard specifies a notation system to indicate the details (e.g. temperature, time) of heat treatment processes. This system is intended to abbreviate the otherwise lengthy description of heat treatment processes, and may be used, for example, in production documentation and in publications.

The system is so structured that it is possible to elaborate and clarify heat treatment processes as necessary, an ordinary typewriter keyboard being sufficient to print the symbols involved.

2 Notation system elements

The following details on heat treatment may be given in abbreviated or symbolic form:

- heat treatment equipment;
- heat treatment medium;
- rate of heating and cooling;
- heat treatment temperature;
- holding periods;
- intervals between heat treatment steps;
- symbols to indicate subsequent steps;
- other information.

3 Symbols and their meaning

3.1 Slash (/) or arrow (→)

A slash shall be used to separate heat treatment steps, the following step being carried out after a specific duration. An arrow pointing to the right may be used instead of a slash.

3.2 Plus sign (+)

A plus sign shall be used to separate heat treatment steps, the following step being carried out after an unspecified duration. It shall also be used to indicate that ambient temperature is to be reached after completion of the preceding step.

3.3 Minus sign (−)

A minus sign shall be placed before a temperature that is below zero. Temperatures at or above zero and those given in degrees Kelvin do not require the use of a preceding symbol.

3.4 Parentheses ()

Parentheses are usually put around whole words used for explanatory purposes and any symbols from other notation systems.

Note. Inside parentheses, the slash may be used as a simple divider, and the plus sign to indicate amounts or additions.

4 Indication of temperatures, durations and thermal cycles

4.1 Temperatures shall be given in either degrees Celsius (°C) or degrees Kelvin (K). Temperature differences shall be given in K.

4.2 Durations shall be given in s (seconds), min (minutes), h (hours) or d (days).

4.3 Where it is relevant that a certain temperature be held for a specific length of time, this duration shall follow the temperature. Unless otherwise stated, times given represent holding times.

4.4 The initial and final temperature of any heat treatment process is usually ambient temperature and need not be given separately for every step.

4.5 Any change in temperature (e.g. holding, heating or cooling to a certain temperature) shall be given.

4.6 Where the rate at which a temperature change occurs is of relevance, this shall be given in K/h (degrees Kelvin per hour).

5 Examples and explanations of symbols to indicate heat treatment processes

880 °C, 30 min/oil

Heated to 880 °C, held for 30 minutes, quenched in oil, then cooled to ambient temperature (e.g. hardening).

880 °C, 30 min/oil + 550 °C, 1 h/air

Heated to 880 °C, held for 30 minutes, quenched in oil, then cooled to ambient temperature. After an unspecified duration, heated to 550 °C, held one hour, then cooled in air to ambient temperature (e.g. quenching and tempering).

880 °C, 30 min/oil/air RT, 6 h/550 °C, 1 h/air

Heated to 880 °C, held for 30 minutes, quenched in oil, cooled in air to ambient temperature, held at ambient temperature for six hours, heated to 550 °C, held for one hour, then cooled in air to ambient temperature.

880 °C, 30 min/salt bath: 200 °C, 20 min/air

Heated to 880 °C, held for 30 minutes, immersed for 20 minutes in a salt bath having a temperature of 200 °C, then cooled in air to ambient temperature.

880 °C, 30 min/(≤30 s) oil + 550 °C, 1 h/air

Heated to 880 °C, held for 30 minutes and, within 30 seconds after the end of the holding period, quenched in oil, then cooled to ambient temperature. After an unspecified duration, heated to 550 °C, held for one hour, then cooled in air to ambient temperature.

880 °C, 30 min/salt bath: 350 °C, 3 h/air

Heated to 880 °C, held for 30 minutes, quenched in a salt bath having a temperature of 350 °C, held there for three hours, then cooled in air to ambient temperature (e.g. austenitizing, transforming to bainite).

880 °C, 30 min/oven: 20 K/h, 400 °C/680 °C, 2 h/air

Heated to 880 °C, held for 30 minutes, cooled to 400 °C in an oven at a rate of 20 K/h, heated to 680 °C, held for two hours, then cooled in air to ambient temperature (e.g. austenitizing, transforming to pearlite).

Carburizing gas, 930 °C, 4 h/retort oven: 850 °C, 40 min/oil: 65 °C/air + 180 °C, 30 min/air

Heated to 930 °C, with a carburizing gas, held for four hours, cooled to 850 °C in a retort oven and held there for 40 minutes. Quenched in oil at a temperature of 65 °C, then cooled in air to ambient temperature. After an unspecified duration, heated to 180 °C, held for 30 minutes, then cooled in air to ambient temperature (e.g. case hardening, annealing).

Carburizing powder, 930 °C, 4 h/air (box annealing) + 870 °C, 40 min/salt bath: 200 °C/air + 810 °C, 40 min/oil (type XYZ)/air

Heated to 930 °C, with a carburizing powder, held for four hours, then, with the products left in the box, cooled in air to ambient temperature. After an unspecified duration, heated to 870 °C, held for 40 minutes, quenched in a salt bath having a temperature of 200 °C, then cooled in air to ambient temperature. After an unspecified duration, heated to 810 °C, held for 40

minutes, quenched in oil of type XYZ, then cooled in air to ambient temperature (e.g. double hardening).

Air, 400 °C, 30 min/salt bath, 850 °C/salt bath, 1050 °C, 200 s/salt bath, 1220 °C, 200 s/salt bath: 550 °C, 5 min/air + 560 °C, 90 min/air + 560 °C, 90 min/air

Heated in air to 400 °C, held for 30 minutes, further heated in a salt bath to 850 °C, then to 1050 °C, held for 200 seconds, further heated in a salt bath to 1220 °C, held for 200 seconds, quenched in a salt bath having a temperature of 550 °C, held for five minutes, then cooled in air to ambient temperature. After an unspecified duration, heated to 560 °C, held for 90 minutes, then cooled in air to ambient temperature. After an unspecified duration, repetition of the whole process (e.g. multi-step preheating, hardening, double annealing of high speed steel).

900 °C, 20 min/water spray cooling to 400 °C/salt bath: 400 °C, 5 min/air

Heated to 900 °C, held for 20 minutes, cooled with water spray to 400 °C, immersed in a salt bath having a temperature of 400 °C, held there for five minutes, then cooled in air to ambient temperature.

860 °C, 20 min/oil/−50 °C/air

Heated to 860 °C, held for 20 minutes, quenched in oil, cooled to −50 °C, then warmed in air to ambient temperature.

Furnace: 70 K/h, 700 °C, 4 h/furnace: 50 K/h, 300 °C/air
Heated to 700 °C in a furnace at a rate of 70 K/h, held for four hours, cooled to 300 °C in a furnace at a rate of 50 K/h, then cooled in air to ambient temperature.