

Vocabulary of heat treatment terms for ferrous products

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National foreword

This British Standard has been prepared under the direction of the Iron and Steel Standards Policy Committee and is the English language version of EN 10052:1993, *Vocabulary of heat treatment terms for ferrous products*, published by the European Committee for Standardization (CEN). It supersedes BS 6562-1:1985 which is withdrawn.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 28, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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English version

Vocabulary of heat treatment terms for ferrous products

Vocabulaire du traitement thermique des
produits ferreux

Begriffe der Wärmebehandlung von
Eisenwerkstoffen

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Foreword

This European Standard has been prepared by the Technical Committee ECISS/TC 21, Vocabulary of heat treatment terms, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 1994, and conflicting national standards shall be withdrawn at the latest by April 1994.

According to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

NOTE This European Standard contains different references to definitions and different statements in notes in each language version because of different terms used in national terminology.

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1 Scope

The purpose of this European Standard is:

1.1 To define the terms in the ferrous products heat treatment vocabulary.

These terms are divided into a main part (**3.2**) and a complementary section (**3.3**)

- the main part gives an alphabetical list of the terms with their definitions and, where appropriate, comments. Definitions of foreign terms for which the language in question has no equivalents are given at the end of the main part under their reference number;
- the complementary section comprises the definitions of terms necessary to understand the main part.

NOTE The comments are printed in italics in order to differentiate them from the definitions.

Any term defined in the main part of this European Standard and used elsewhere in a definition or a comment is printed in capital letters.

The reference numbers given with each term are identical in all the versions and correspond to the French alphabetical order. In order to avoid any confusion, the numbers of the terms in the annex are preceded by the letter A. Clause **3.1** gives the terms in numerical order.

1.2 To facilitate translations using the tables of equivalent terms.

Table 1 gives the equivalent French and German terms for the English terms in the alphabetical list.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate place in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EU 23-71, *End quench hardenability test for steel (Jominy test)*.

EU 103-71, *Micrographic determination of the ferritic or austenitic grain size of steels*.

EU 104-70, *Determination of the decarburization depth of unalloyed and low alloy structural steels*.

EU 105-71, *Determination and verification of the effective case depth after carburizing*.

EU 108-72, *Round steel wire rod for cold formed nuts and bolts — Dimensions and tolerances*.

EU 114-72, *Determination of resistance to intergranular corrosion of austenitic stainless steels. Corrosion test in a sulphate medium (Monypenny — Strauss test)*.

EU 116-72, *Determination of the effective case depth after surface hardening*.

EN 10020, *Definition and classification of grades of steel*.

EN 10083-1, *Quenched and tempered steels — Part 1: Technical conditions for special steel*.

EN 10083-2, *Quenched and tempered steels — Part 2: Unalloyed quality steels*.

prEN 10083-3, *Quenched and tempered steels — Part 3: Technical delivery conditions for boron steels*.

3 Terms

3.1 List of terms in numerical order

1	Carbon activity
2	Softening
3	Grain refining
4	Aluminizing
5	Endothermic atmosphere
6	Exothermic atmosphere
7	Ausforming
8	Austenitizing
9	Auto-tempering
10	Self-quenching
11	Blueing
12	Boriding
13	Burning
14	Blackening
15	Maximum achievable hardness
16	Carbonitriding
17	Carburizing
18	Blank carburizing
19	Boost-diffuse carburizing
20	Heating
21	Heating curve
22	Heating time
23	Heating function
24	Heating schedule
25	Heating rate
26	Chromizing
27	Carbon mass transfer coefficient
28	Compound layer
29	Diffusion zone
30	Quench hardened layer

31	Carbon profile	76	Solution treatment
32	Tempering curve	77	Heating-up time
33	Cyaniding	78	Nitrocarburizing
34	Thermal cycle	79	Nitriding
35	Decarburization	80	Blank nitriding
36	Decarburizing	81	Two-stage nitriding
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46	Impulse hardening	91	Effective case depth after carburizing
47	Induction hardening	92	Depth of decarburization
48	Local hardening	93	Depth of hardening
49	Precipitation hardening	94	Effective case depth after surface hardening
50	Precipitation hardening treatment	95	Depth of nitriding
51	Single quench hardening treatment	96	Carbon restoration
52	Quench hardening	97	Recrystallizing
53	Through-hardening	98	Annealing
54	Surface hardening treatment	99	Bright annealing
55	Quench hardening treatment	100	Full annealing
56	Direct hardening treatment	101	Soft annealing
57	Double quench hardening treatment	102	Inter-critical annealing
58	Secondary hardening	103	Isothermal annealing
59	Floor-to-floor time	104	Sub-critical annealing
60	Normalizing forming	105	Cooling
61	Temper embrittlement	106	Cooling curve
62	Spheroidization	107	Cooling time
63	Spheroidizing	108	Cooling function
64	Graphitization	109	Cooling conditions
65	Graphitizing	110	Cooling schedule
66	Grain coarsening	111	Cooling rate
67	Homogenizing	112	Critical cooling function
68	Solution annealing	113	Critical cooling rate
69	Impulse heating	114	Stress relieving
70	Isoforming	115	Recovery
71	Jominy test	116	Tempering
72	Soaking	117	Sherardizing
73	Malleablizing	118	Siliconizing
74	Maraging	119	Stabilizing
75	Medium	120	Stabilization of retained austenite
		121	Sulphidizing

3.2 Main part

ageing treatment – 40 –

HEAT TREATMENT applied to a ferrous product after SOLUTION TREATMENT to bring its properties to the required level.

It consists of HEATING to and SOAKING at one or more specified temperatures, followed by cooling appropriately.

NOTE In English, a treatment carried out after SOLUTION TREATMENT but before the final AGEING TREATMENT and at an intermediate temperature is called Austenite conditioning or Primary hardening

aluminizing – 4 –

THERMOCHEMICAL TREATMENT which is applied to a ferrous product with the object of producing surface enrichment in aluminium.

NOTE In English, the term calorizing was formerly used to designate this treatment.

annealing – 98 –

HEAT TREATMENT consisting of HEATING and SOAKING at a suitable temperature followed by COOLING under conditions such that, after return to ambient temperature, the metal will be in a structural state closer to that of equilibrium.

As this definition is very general, it is advisable to use an expression specifying the aim of the treatment (see definitions 96 to 101).

NOTE In English, the term “box annealing” is used when the annealing is carried out in a sealed container to minimize oxidation.

atmosphere see MEDIUM – 75 –

ausforming – 7 –

THERMOMECHANICAL TREATMENT of a ferrous product which consists of plastically deforming the metastable austenite before subjecting it to the martensitic and/or bainitic transformation.

austempering – 137 –

HEAT TREATMENT involving AUSTENITIZATION followed by STEP QUENCHING, at a rate fast enough to avoid the formation of ferrite or pearlite, to a temperature above M_s and SOAKING to ensure partial or total transformation of the austenite to bainite.

The final COOLING to ambient temperature is not at any specific rate.

austenite conditioning See AGEING TREATMENT – 40 –

austenitizing – 8 –

OPERATION during which the ferrous product is brought to a temperature such that the structure becomes austenitic.

If this transformation is incomplete, the austenitization is termed partial.

austenitizing temperature – 125 –

Highest temperature at which the ferrous product is held during austenitization.

auto-tempering – 9 –

Spontaneous TEMPERING undergone by martensite during QUENCHING.

NOTE In English, the term “self-tempering” is also used to designate this phenomenon.

baking – 38 –

HEAT TREATMENT permitting the release of hydrogen occluded in a ferrous product without modifying its structure.

This treatment is generally carried out following an electrolytic plating or pickling or welding operation.

blacking – 14 –

OPERATION carried out in an oxidizing MEDIUM at a temperature such that the polished surface of a ferrous product becomes covered with a thin, continuous, adherent film of dark-coloured oxide.

blank carburizing – 18 –

Simulation treatment which consists of reproducing the THERMAL CYCLE of CARBURIZING without the carburizing MEDIUM.

This treatment makes it possible to assess the metallurgical consequences of the THERMAL CYCLE of CARBURIZING.

blank nitriding – 80 –

Simulation treatment which consists of reproducing the THERMAL CYCLE of NITRIDING without the nitriding MEDIUM.

This treatment makes it possible to assess the metallurgical consequences of the THERMAL CYCLE of NITRIDING.

blue brittleness see TEMPER EMBRITTLEMENT – 61 –

blueing – 11 –

OPERATION carried out in an oxidizing MEDIUM at a temperature such that the polished surface of a ferrous product becomes covered with a thin, continuous, adherent film of blue-coloured oxide.

NOTE In English, the term steam treatment is used when the process is carried out in superheated water vapour.

boriding – 12 –

THERMOCHEMICAL TREATMENT which is applied to a ferrous product with the aim of producing a surface layer of boride.

NOTE The medium in which boriding takes place should be specified, for example, pack boriding, paste boriding, etc.

boost-diffuse carburizing – 19 –

CARBURIZING carried out in two or more successive stages with different carbon potentials.

box annealing see ANNEALING – 98 –

bright annealing – 99 –

ANNEALING carried out in a MEDIUM that allows the original metallic surface finish to be maintained by preventing oxidation of the metal.

burning – 13 –

Irreversible change in the structure and properties brought about by the onset of fusion at the grain boundaries.

calorizing see ALUMINIZING – 4 –**carbon activity** – 1 –

Ratio of the vapour pressure of carbon in a given state (for example in austenite of specific carbon concentration) to the vapour pressure of pure carbon (graphite), as a reference state, at the same temperature.

carbon mass transfer coefficient – 27 –

Mass of carbon transferred from the carburizing MEDIUM into the steel, per unit surface area per second for a unit difference between the CARBON POTENTIAL, and actual surface carbon content.

carbon potential – 87 –

Carbon content at the surface of a specimen of pure iron in equilibrium with the CARBURIZING MEDIUM considered and under the conditions specified.

carbon profile – 31 –

Carbon content as a function of distance from the surface.

carbon restoration – 96 –

THERMOCHEMICAL TREATMENT intended to restore the carbon content of the surface layer, decarburized during an earlier treatment.

carbonitriding – 16 –

THERMOCHEMICAL TREATMENT which is applied to a ferrous product heated to a temperature above A_{c1} , to obtain a surface enrichment in carbon and nitrogen, which are in solid solution in the austenite.

Generally, this OPERATION is followed immediately by QUENCH HARDENING.

NOTE 1 The MEDIUM in which CARBONITRIDING takes place shall be specified, for example gas, salt bath, etc.

NOTE 2 CARBONITRIDING carried out in a bath of molten salts containing cyanides is called CYANIDING.

carburizing – 17 –

THERMOCHEMICAL TREATMENT which is applied to a ferrous product in the austenitic state, to obtain a surface enrichment in carbon, which is in solid solution in the austenite.

The carburized ferrous product undergoes QUENCH HARDENING (immediately or later).

NOTE The MEDIUM in which CARBURIZING takes place shall be specified, for example gas, pack, etc.

case depth – 90 –

Distance between the surface of a ferrous product and a limit characterizing the thickness of the layer enriched in carbon. This limit should be specified.

Example: For the total CASE DEPTH, this limit will correspond to the carbon content of the unaltered base metal.

NOTE In English the term CASE DEPTH is used for any CASE HARDENING or SURFACE HARDENING process.

case hardening – 141 –

Treatment consisting of CARBURIZING or CARBONITRIDING followed by QUENCH HARDENING.

NOTE In English, NITRIDING, NITROCARBURIZING, etc., are also considered to be CASE HARDENING processes.

cementation see THERMOCHEMICAL TREATMENT – 131 –**chromizing** – 26 –

THERMOCHEMICAL TREATMENT which is applied to a ferrous product in order to obtain surface enrichment in chromium.

The surface layer can consist of practically pure chromium (on low-carbon steels) or of chromium carbide (on high-carbon steels).

compound layer – 28 –

Surface layer formed during a THERMOCHEMICAL TREATMENT and made up of the chemical compounds formed by the element(s) introduced during the treatment and certain elements from the base metal.

For example, the layer of nitride formed during NITRIDING, the layer of boride formed during BORIDING, the layer of chromium carbide formed during the CHROMIZING of high carbon steel.

NOTE In English the term “white layer” is improperly used to designate this layer on nitrided and nitrocarburized ferrous product.

continuous-cooling-transformation diagram (CCT diagram) – 43 –

Set of curves drawn in a semi-logarithmic coordinate system with logarithmic time/temperature coordinates and which define for each COOLING FUNCTION, the temperature at which the austenite begins and ends its transformation.

In general a complementary curve joins the points corresponding to the temperatures at which the proportion of phase transformed reaches 50 %. Information is also given about the transformation products and their proportions.

Finally, the hardness measured after return to ambient temperature is shown for each of the COOLING CURVES.

NOTE CCT diagrams may also be obtained for a given cooling period.

cooling – 105 –

Reduction of the temperature of a ferrous product.