SLOVENSKI STANDARD
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Nadomešča:
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Aluminij in aluminijeve zlitine - Gneteni izdelki - Označevanje stanj

Aluminium and aluminium alloys - Wrought products - Temper designations

Aluminium und Aluminiumlegierungen - Halbzeug - Bezeichnungen der Werkstoffzustände

Aluminium et alliages d'aluminium - Produits corroyés - Désignation des états métallurgiques

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English Version

Aluminium and aluminium alloys - Wrought products - Temper designations

Aluminium et alliages d'aluminium - Produits corroyés - Désignation des états métallurgiques

Aluminium und Aluminiumlegierungen - Halbzeug - Bezeichnungen der Werkstoffzustände

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 515:2017) has been prepared by Technical Committee CEN/TC 132 “Aluminium and aluminium alloys”, 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of an identical text or by endorsement, at the latest by September 2017, and conflicting national standards shall be withdrawn at the latest by September 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 515:1993.

The following modifications were implemented in this new version of EN 515:

— Addition of Clause 2 “Normative references”;

— new definitions and sources in Clause 3;

— new precision in Subclauses 6.1, 7 and 7.3;

— new Table 1 and modification of Table 2;

— improvement of the content of Clause 8.4;

— modification of Figure 1;

— inclusion of new tempers in Table 3: T552, T554, T72, T72510, T72511, T74511, T7452, T7454, T7752, T7754, T7852, T7854, T7952 and T7954;

— modification of new tempers in Table 3: H131, T3510;

— updating Annex A.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard establishes temper designations for all forms of wrought aluminium and aluminium alloys and for continuously cast aluminium and aluminium alloys drawing stock and strip intended to be wrought.

NOTE Some of these temper designations may be subject of patent or patent applications and their listing herein is not to be construed in any way as the granting of a license under such patent right.

Additional temper designations, conforming to this standard, may be standardized with CEN/TC 132 and AECMA/5 provided:

— the temper is used or is available for use by more than one user;

— mechanical property limits are defined;

— the characteristics of the temper are significantly different from those of all other tempers which have the same sequence of basic treatments and for which designations already have been assigned for the same alloy and product;

— the following are also defined if characteristics other than mechanical properties are considered significant:

a) test methods and limits for the characteristics; or

b) the specific practices used to produce the temper.

2 Normative references

Not applicable.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
temper
condition of the metal produced by mechanical and/or thermal processing, typically characterized by a certain structure and specified properties

[SOURCE: EN 12258-1:2012, 3.6.5]

3.2
hot working
forming of a solid metal after preheating

Note 1 to entry: Strain hardening may or may not occur during hot working.

[SOURCE: EN 12258-1:2012, 3.2.3]

3.3
cold working
forming of a solid metal without preheating

Note 1 to entry: Plastic deformation of metal at such temperature and strain-rate that strain-hardening occurs.

[SOURCE: EN 12258-1:2012, 3.2.4]

3.4
strain hardening
modification of a metal structure by cold working resulting in an increase in strength and hardness with loss of ductility

[SOURCE: EN 12258-1:2012, 3.2.11]

3.5
solution heat treatment
heating an alloy to a suitable temperature for sufficient time to allow one or more soluble constituents to enter into solid solution, where they are retained in a supersaturated state after quenching

[SOURCE: EN 12258-1:2012, 3.7.1]

3.6
ageing

treatment of a metal aiming at a change in its properties by precipitation of intermetallic phases from supersaturated solid solution

Note 1 to entry: Ageing can be a treatment at room temperature (natural ageing) or a thermal treatment (artificial ageing).

Note 2 to entry: In North America the term “aging” is used.

[SOURCE: EN 12258-1:2012, 3.7.15]

3.7
annealing
thermal treatment to soften metal by reduction or removal of strain hardening resulting from cold working and/or by coalescing precipitates from the solid solution

[SOURCE: EN 12258-1:2012, 3.6.6]

3.8
heat-treatable alloy
alloy capable of being strengthened by suitable thermal treatment

Note 1 to entry: In addition to cold working, heat-treatable alloys are typically strengthened by precipitation hardening.

[SOURCE: EN 12258-1:2012, 2.2.8]

3.9
non heat-treatable alloy
alloy which is not strengthened by thermal treatment

Note 1 to entry: Non-heat-treatable alloys are only strengthened by hot or cold working.

[SOURCE: EN 12258-1:2012, 2.2.9]

3.10
stress relieving
reduction of internal residual stresses by thermal or mechanical means

[SOURCE: EN 12258-1:2012, 3.2.8]

4 Basis of codification

4.1 The temper designations are based on the sequences of basic treatments used to produce the various tempers. Property (mechanical or physical) limits apply to individual alloy-temper-product combinations.

4.2 The temper designation follows the alloy designation; these are separated by a hyphen.

4.3 Basic temper designations consists of letters. If subdivisions of the basic tempers are required, these are indicated by one or more digits following the letter of the basic temper. These digits relate to a specific sequence of basic treatments, but only those treatments or operations recognized as significantly influencing the products characteristics are indicated.

Should some other variation of the same sequence of basic operations be applied to the same alloy, resulting in different characteristics, then additional digits are added to the designation.

5 Basic temper designations

5.1 F – as fabricated

This designation applies to the products of shaping processes in which no special control over thermal conditions or strain hardening is applied. For this temper, there are no mechanical property limits specified.

5.2 O - Annealed

This designation applies to products which are annealed to obtain the lowest strength temper. The O may be followed by a digit other than zero[1].

5.3 H – Strain-hardened

This designation applies to products subjected to the application of cold work after annealing (or after hot forming), or to a combination of cold work and partial annealing or stabilizing, in order to secure the specified mechanical properties. The letter H is always followed by at least two digits, the first indicating the specific combination of basic operations and the second indicating the degree of strain hardening. A third digit indicates the variation of a two digits temper and it is used when mechanical properties, or others characteristics, differ from those of the two digits H temper to which it is added.

[1] Products achieving the required annealed properties after hot forming processes may be designated as O temper.

5.4 W – Solution heat-treated

This designation describes an unstable temper. It applies only to alloys which spontaneously age at room temperature after solution heat-treatment. This designation is specific only when the period of natural ageing is indicated; for example W 1/2 h.

5.5 T - Thermally treated to produce stable tempers other than F, O or H (for heat-treatable alloys only)

This designation applies to products which are thermally treated, with or without supplementary strain-hardening, to produce stable tempers. The T is always followed by one or more digits indicating the specific sequence of treatments.

6 Subdivision of O (annealed) temper designations

6.1 O1 – High temperature annealed and slow cooled[2]

This designation applies to wrought products which are thermally treated at approximately the same time and temperature required for solution heat-treatment and slow cooled to room temperature, in order to generate the correct ultrasonic response and / or provide dimensional stability. It is applicable to products which are to be machined prior to solution heat treatment by the user. Mechanical property limits are not specified.

6.2 O_2 – Thermo-mechanically processed

This designation applies to wrought products subjected to a special thermo-mechanical treatment. It is applicable to products which are to be super-plastically formed prior to solution heat treatment by the user.

6.3 O3 – Homogenized

This designation applies to continuously cast drawing stock or strip, which are subjected to a high temperature soaking treatment to eliminate or reduce segregations, thus improving subsequent formability and or response to solution heat-treatment.

7 Subdivision of H (strain-hardened) temper designations

Subdivisions are made according to the basic operations described in 5.3 and the final degree of strain hardening, as follows:

7.1 First digit after H:

The first digit following the letter H indicates the specific combination of basic operations as follows:

— H1x Strain hardened only

These designations apply to products which are strain-hardened to obtain the desired strength without supplementary thermal treatment.

[2] Formerly designated as T41.

— H2x Strain-hardened and partially annealed

These designations apply to products which are strain-hardened more than the desired final amount and then reduced in strength to the desired final level by partial annealing. For alloys that age-soften at room temperature, the H2x tempers have the same minimum ultimate tensile strength as the corresponding H3x tempers. For other alloys, the H2x tempers have the same minimum ultimate tensile strength as the corresponding H1x tempers and slightly higher elongation.

— H3x Strain-hardened and stabilized

These designations apply to products which are strain-hardened and whose mechanical properties are stabilized either by a low temperature thermal treatment or as a result of heat introduced during fabrication. Stabilization usually improves ductility. This designation is applicable only to those alloys which, unless stabilized, gradually age-soften at room temperature.

— H4x Strain-hardened and lacquered or painted.

These designations apply to products which are strain-hardened and which may be subjected to some partial annealing during the thermal curing which follows the painting or lacquering operation.

7.2 Second digit after H:

The second digit following the letter H indicates the final degree of strain hardening, as identified by the minimum value of the ultimate tensile strength.

— Numeral 8 has been assigned to the hardest tempers normally produced. The minimum tensile strength of tempers Hx8 may be determined from Table 1 and is based on the minimum tensile strength of the alloy in the annealed temper.

— Tempers between O (annealed) and Hx8 are designated by numerals 1 to 7.

a) Numeral 2 designates tempers whose ultimate tensile strength is approximately midway between that of the O temper and that of the Hx4 temper.

b) Numeral 4 designates tempers whose ultimate tensile strength is approximately midway between that of the O temper and that of the Hx8 temper.

c) Numeral 6 designates tempers whose ultimate tensile strength is approximately midway between that of the Hx4 temper and that of the Hx8 temper.

d) Numeral 1, 3, 5 and 7 designate, similarly, tempers intermediate between those defined above.

— Numeral 9 designates tempers whose ultimate tensile strength exceeds that of the Hx8 temper by 10 MPa or more.

— The ultimate tensile strength of intermediate tempers, determined as described above, when not ending in 0 or 5, shall be rounded to the next higher 0 or 5.

Table 1 — Determination of Hx8 minimum tensile strength

Minimum tensile strength in annealed temper MPa	Increase in tensile strength to Hx8 temper MPa
up to 40	55
45 to 60	65
65 to 80	75
85 to 100	85
105 to 120	90
125 to 160	95
165 to 200	100
205 to 240	105
245 to 280	110
285 to 320	115
325 and over	120

7.3 Third digit after H:

The third digit, when used, indicates a variation of a two digit temper. It is used when the degree of control of temper or the mechanical properties or both differ from, but are close to that (or those) for the two digit H temper designation to which it is added, or when some other characteristic is significantly affected.

The following three digit H temper designations have been assigned:

— Hx11: applies to products which incur sufficient strain-hardening after the final anneal that they fail to qualify as annealed but not so much or so consistent an amount of strain hardening that they qualify as Hx1.

— H112: Applies to products which may acquire some strain hardening from working at an elevated temperature or from a limited amount of cold work, and for which there are mechanical property limits.

— H116: applies to products, made of those alloys of the 5xxx group in which the magnesium content is 3 % nominal or more. These products are strain hardened at the last operation to specified stable tensile property limits, and to meet specified levels of corrosion resistance in accelerated-type corrosion test. Corrosion tests include inter-granular and exfoliation test. This temper is suitable for continuous service at temperatures not greater than 65 °C.

— H321: applies to products, made of those alloys of the 5xxx group in which the magnesium content is 3 % nominal or more. These products are thermally stabilized at the last operation to specified stable tensile property limits, and to meet specified levels of corrosion resistance in accelerated-type corrosion test. Corrosion tests include inter-granular and exfoliation test. This temper is suitable for continuous service at temperatures not greater than 65 °C.

— H1x8: Applies to products manufactured from alloys in the 5xxx series group, for which the magnesium content is 3 % nominal or more. These products are strain hardened at the last operation to specified stable tensile property limits, and are capable of meeting specified levels of corrosion resistance in accelerated type corrosion tests after a thermal treatment that is intended to demonstrate improved