

Aluminum Tempers

The temper designation follows the alloy designation and is separated from it by a hyphen.

The basic temper designations and subdivisions are as follows:

-F As fabricated: Applies to products which acquire some temper from shaping processes not having special control over the amount of strain-hardening or thermal treatment For wrought products, there are no mechanical property limits.

-O Annealed, recrystallized (wrought products only): Applies to the softest temper of wrought products.

-H Strain-hardened (wrought products only): Applies to products which have their strength increased by strain-hardening with or without supplementary thermal treatments to produce partial softening.

Subdivisions of H Temper: Strain-Hardened

The -H is always followed by two or more digits.

The first digit indicates the specific combination of basic operations, as follows:

H-1 Strain-hardened only: Applies to products which are strain-hardened to obtain the desired mechanical properties without supplementary thermal treatment The number following this designation indicates the degree of strain-hardening.

H-2 Strain-hardened and then partially annealed: Applies to products which are strain-hardened more than the desired final amount and then reduced in strength to the desired level by partial annealing. For alloys that age-soften at room temperature, the -H2 tempers have approximately the same ultimate strength as the corresponding -H3 tempers. For other alloys, the -H2 tempers have approximately the same ultimate strength as the corresponding -H1 tempers and slightly higher elongations. The number following this designation indicates the degree of strain-hardening remaining after the product has been partially annealed.

H-3 Strain-hardened and then stabilized: Applies to products which are strain-hardened and then stabilized by a low temperature heating to slightly lower their strength and increase ductility. This designation applies only to the magnesium-containing alloys which, unless stabilized, gradually age-soften at room temperature. The number following this designation indicates the degree of strain-hardening remaining after the product has been strain-hardened a specific amount and then stabilized.

The second digit indicates strain hardening to the following degrees:

2—Y4 hard

4—1/2 hard

6—V4 hard

8—full hard

9—extra hard

The following three digit -H temper designations have been assigned for wrought products in all alloys:

-H111, -H311 and -H321 apply to products which are strain-hardened less than the amount required for **-H11, -H31 and -H32**, respectively.

-H112 Applies to products which acquire some temper from shaping processes not having special control over the amount of strain-hardening or thermal treatment, but for which there are mechanical property limits or mechanical property testing is required.

W Temper: Solution Heat-Treated

An unstable temper applicable only to alloys which spontaneously age at room temperature after solution heat-treatment This designation is specific only when the period of natural aging is indicated; for example, W 1/2 hour.

Subdivisions of T Temper: Thermally Treated

The -H is always followed by two or more digits.

Numerals 1 through 10 following the T indicate specific sequences of basic treatments, as follows:

T1 Cooled from an elevated temperature shaping process and naturally aged to a substantially stable condition. Applies to products for which the rate of cooling from an elevated temperature shaping process, such as casting or extrusion, is such that their strength is increased by room temperature aging.

T2 Annealed (cast products only). Applies to cast products which are annealed to improve ductility and dimensional stability.

T3 Solution heat-treated and then cold worked. Applies to products which are cold worked to improve strength, or in which the effect of cold work in flattening or straightening is recognized in mechanical property limits.

T4 Solution heat-treated and naturally aged to a substantially stable condition. Applies to products which are not cold worked after solution heat-treatment, or in which the effect of cold work in flattening or straightening may not be recognized in mechanical property limits.

T5 Cooled from an elevated temperature shaping process and then artificially aged. Applies to products which are cooled from an elevated temperature shaping process, such as casting or extrusion, and then artificially aged to improve mechanical properties or dimensional stability or both.

T6 Solution heat-treated and then artificially aged. Applies to products which are not cold worked

after solution heat-treatment, or in which the effect of cold work in flattening or straightening may not be recognized in mechanical property limits.

T7 Solution heat-treated and then stabilized. Applies to products which are stabilized to carry them beyond the point of maximum strength to provide control of some special characteristics.

T8 Solution heat-treated, cold worked, and then artificially aged. Applies to products which are cold worked to improve strength, or in which the effect of cold work in flattening or straightening is recognized in mechanical property limits.

T9 Solution heat-treated, artificially aged, and then cold worked. Applies to products which are cold worked to improve strength.

T10 Cooled from an elevated temperature shaping process. artificially aged and then cold worked. Applies to products which are artificially aged after cooling from an elevated temperature shaping process, such as casting or extrusion, and then cold worked to further improve strength.

The following specific additional digits have been assigned for stress-relieved tempers of wrought products:

Txx51 Stress relieved by stretching. Applies to the following products when stretched the indicated amounts after solution heat-treatment or cooling from an elevated temperature shaping process.

Plate: 1-1/2 to 3% permanent set

Rod, bar, shapes, extruded tube: 1 to 3% permanent set

Drawn tube: 1/2 to 3% permanent set

Applies directly to plate and rolled or cold-finished rod and bar. These products receive no further straightening after stretching.

Applies to extruded rod, bar, shapes and tube and to drawn tube when designated as follows:

Txx 510-Products that receive no further straightening after stretching.

Txx511-Products that may receive minor straightening after stretching to comply with standard tolerances.

Txx52 Stress-relieved by compressing. Applies to products which are stress-relieved by compressing after solution heat-treatment, or cooling from an elevated temperature shaping process to produce a permanent set of 1 to 5 percent.

The following temper designations have been assigned for wrought products heat-treated from O or F temper to demonstrate response to heat-treatment

T42 Solution heat-treated from the O or F temper to demonstrate response to heat-treatment, and naturally aged to a substantially stable condition.

T62 Solution heat-treated from the O or F temper to demonstrate response to heat-treatment and artificially aged.

Temper designations T42 and T62 may also be applied to wrought products heat-treated from any temper by the user when such heat-treatment results in the mechanical properties applicable to these tempers.