

# Complete Aluminum Extrusion Temper Guide

Temper	Definition
F	As fabricated (no mechanical property limits specified).
0	Annealed - products achieving the required annealed properties after hot forming processes may be designated as O temper.
01	Thermally treated at approximately the same time and temperature required for solution treatment and slow cooled to room temperature (formerly designated as T41).
02	Thermomechanically processed to enhance formability, such as required for super-plastic forming (SPF).
03	Homogenized.
H12	Strain-hardened - 1/4 hard.
H14	Strain-hardened - 1/2 hard.
H16	Strain-hardened - 3/4 hard.
H18	Strain-hardened - 4/4 hard (fully hardened).
H19	Strain-hardened - extra hard.
Hxx4	Applies to embossed or patterned sheet or strip, fabricated from the corresponding Hxx temper.
Hxx5	Strain-hardened - applies to welded tubes.
H111	Annealed and slightly strain-hardened (less than H11) during subsequent operations such as stretching or levelling.
H112	Slightly strain-hardened from working at an elevated temperature from a limited amount of cold work (mechanical property limits specified).
H116	Applies to aluminum-magnesium alloys with a magnesium content of 4% or more and for which mechanical property limits and exfoliation corrosion resistance are specified.
H22	Strain-hardened and partially annealed - 1/4 hard.
H24	Strain-hardened and partially annealed - 1/2 hard.
H26	Strain-hardened and partially annealed - 3/4 hard.
H28	Strain-hardened and partially annealed - 4/4 hard (fully hardened).
H32	Strain-hardened and stabilized - 1/4 hard.
H34	Strain-hardened and stabilized - 1/2 hard.
H36	Strain-hardened and stabilized - 3/4 hard.
H38	Strain-hardened and stabilized - 4/4 hard (fully hardened).
H42	Strain-hardened and painted or lacquered - 1/4 hard.
H44	Strain-hardened and painted or lacquered - 1/2 hard.
H46	Strain-hardened and painted or lacquered - 3/4 hard.
H48	Strain-hardened and painted or lacquered - 4/4 hard (fully hardened).

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W	Solution heat-treated (unstable temper). The period of natural ageing (W2h..) may also be specified.
W51	Solution heat-treated (unstable temper) and stress-relieved by controlled stretching (permanent set 0.5% to 3% for sheet, 1.5% to 3% for plate, 1% to 3% for hand or ring forging and rolled ring). The products receive no further straightening after stretching.
W510	Solution heat-treated (unstable temper) and stress-relieved by controlled stretching (permanent set 1% to 3% for extruded rod, bar, shapes and tube, 0.5% to 3% for drawn tube). The products receive no further straightening after stretching.
W511	Same as W510 except minor straightening is allowed after stretching to comply with standard tolerances.
W52	Solution heat-treated (unstable temper) and stress-relieved by compressing to produce a permanent set of 1- 5%.
W54	Solution heat-treated (unstable temper) and stress-relieved by restricting cold in the finish die (die forging).
T1	Cooled from an elevated temperature shaping process and naturally aged.
T2	Cooled from an elevated temperature shaping process, cold worked and naturally aged.
T3	Solution heat-treated, cold worked and naturally aged.
T31	Solution heat-treated, cold worked approximately 1% and naturally aged.
T351	Solution heat-treated, stress-relieved by controlled stretching (permanent set 0.5% to 3% for sheet, 1.5% to 3% for plate, 1% to 3% for rolled or cold-finished rod and bar, 1% to 5% for hand or ring forging and rolled ring) and naturally aged. The products receive no further straightening after
T3510	Solution heat-treated, stress-relieved by controlled stretching (permanent set 1% to 3% for extruded rod, bar, shapes and tube, 0.5% to 3% for drawn tube) and naturally aged. The products receive no further straightening after stretching.
T3511	Same as T3510 except that minor straightening is allowed after stretching to comply with standard tolerances.
T354	Solution heat-treated stress-relieved by restricting cold in the finish die and naturally aged.
T36	Solution heat-treated, cold worked approximately 6% and naturally aged.
T37	Solution heat-treated, cold worked approximately 7% and naturally aged.
T39	Solution heat-treated and cold worked to an appropriate degree to achieve the specified mechanical properties. Cold work may be carried out before or after natural ageing.
T4	Solution heat-treated and naturally aged.
T42	Solution heat-treated and naturally aged. Applies to test material heat-treated from annealed or F temper or to products heat-treated from any temper by the user.
T451	Solution heat-treated, stress-relieved by controlled stretching (permanent set 0.5% to 3% for sheet, 1.5% to 3% for plate, 1% to 3% for rolled or cold-finished rod and bar, 1% to 5% for hand or ring forging and rolled ring) and naturally aged. The products receive no further straightening after stretching.

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T4510	Solution heat-treated, stress-relieved by controlled stretching (permanent set 1% to 3% for extruded rod, bar shapes and tube, 0.5% to 3% for drawn tube) and naturally aged. The products receive no further straightening after stretching.
T4511	Same as T4510 except that minor straightening is allowed after stretching to comply with standard tolerances.
T452	Solution heat-treated, stress-relieved by compressing to produce a permanent set of 1% to 5% and naturally aged.
T454	Solution heat-treated, stress-relieved by restricting cold in the finish die and naturally aged.
T5	Cooled from an elevated temperature shaping process and then artificially aged.
T51	Cooled from an elevated temperature shaping process and then artificially aged in underageing conditions to improve formability.
T56	Cooled from an elevated temperature shaping process and then artificially aged - mechanical property level higher than T5 achieved through special control of the process (6000 series alloys).
T6	Solution heat-treated and then artificially aged.
T61	Solution heat-treated and then artificially aged in underageing conditions to improve formability.
T6151	Solution heat-treated, stress-relieved by controlled stretching (permanent set 0.5% to 3% for sheet, 1.5% to 3% for plate) and then artificially aged in underageing conditions to improve formability. The products receive no further straightening after stretching.
T62	Solution heat-treated and then artificially aged. Applies to test material heat-treated from annealed or F temper or to products heat-treated from any temper by the user.
T64	Solution heat-treated and then artificially aged in underageing conditions (between T6 and T61) to improve formability.
T651	Solution heat-treated, stress-relieved by controlled stretching (permanent set 0.5% to 3% for sheet, 1.5% to 3% for plate, 1% to 3% for rolled or cold-finished rod and bar, 1% to 5% for hand or ring forging and rolled ring) and then artificially aged. The products receive no further straightening after stretching.
T6510	Solution heat-treated, stress-relieved by controlled stretching (permanent set 1% to 3% for extruded rod, bar, shapes and tube, 0.5% to 3% for drawn tube) and then artificially aged. The products receive no further straightening after stretching.
T6511	Same as T6510 except that minor straightening is allowed after stretching to comply with standard tolerances.
T652	Solution heat-treated, stress-relieved by compressing to produce a permanent set of 1% to 5% and then artificially aged.
T654	Solution heat-treated, stress-relieved by restricting cold in the finish die and then artificially aged.
T66	Solution heat-treated and then artificially aged - mechanical property level higher than T6 achieved through special control of the process (6000 series alloys).
T7	Solution heat-treated and then artificially overaged.
T73	Solution heat-treated and then artificially overaged in order to achieve the best stress corrosion resistance.

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T732	Solution heat-treated and then artificially overaged in order to achieve the best stress corrosion resistance. Applies to test material heat-treated from annealed or F temper or to products heat-treated from any temper by the user.
T7351	Solution heat-treated, stress-relieved by controlled stretching (permanent set 0.5% to 3% for sheet, 1.5% to 3% for plate, 1% to 3% for rolled or cold-finished rod and bar, 1% to 5% for hand or ring forging and rolled ring) and then artificially overaged in order to achieve the best stress corrosion resistance. The products receive no further straightening after stretching.
T73510	Solution heat-treated, stress-relieved by controlled stretching (permanent set 1% to 3% for extruded rod, bar, shapes and tube, 0.5% to 3% for drawn tube) and then artificially overaged in order to achieve the best stress corrosion resistance. The products receive no further straightening after stretching.
T73511	Same as T73510 except that minor straightening is allowed after stretching to comply with standard tolerances.
T7352	Solution heat-treated, stress-relieved by compressing to produce a permanent set of 1% to 5% and then artificially overaged in order to achieve the best stress corrosion resistance.
T7354	Solution heat-treated, stress-relieved by restricting cold in the finish die and then artificially overaged in order to achieve the best stress corrosion resistance.
T74	Solution heat-treated and then artificially overaged (between T73 and T76).
T7451	Solution heat-treated, stress-relieved by controlled stretching (permanent set 0.5% to 3% for sheet, 1.5% to 3% for plate, 1% to 3% for rolled or cold-finished rod and bar, 1% to 5% for hand or ring forging and rolled ring) and then artificially overaged (between T73 and T76). The products receive no further straightening after stretching.
T74510	Solution heat-treated, stress-relieved by controlled stretching (permanent set 1% to 3% for extruded rod, bar shapes and tube 0.5% to 3% for drawn tube) and then artificially overaged (between T73 and T76). The products receive no further straightening after stretching.
T74511	Same as T74510 except that minor straightening is allowed after stretching to comply with standard tolerances.
T7452	Solution heat-treated, stress-relieved by compressing to produce a permanent set of 1% to 5% and then artificially overaged (between T73 and T76).
T7454	Solution heat-treated, stress-relieved by restricting cold in the finish die and then artificially overaged (between T73 and
T76	Solution heat-treated and then artificially overaged in order to achieve a good exfoliation corrosion resistance.
T761	Solution heat-treated and then artificially overaged in order to achieve a good exfoliation corrosion resistance. (applies to 7475 sheet and strip).
T762	Solution heat-treated and then artificially overaged in order to achieve a good exfoliation corrosion resistance. Applies to test material heat-treated from annealed or F temper or to products heat-treated from any temper by the user.
T7651	Solution heat-treated, stress-relieved by controlled stretching (permanent set 0.5% to 3% for sheet, 1.5% to 3% for plate, 1% to 3% for rolled or cold-finished rod and bar, 1% to 5% for hand or ring forging and rolled ring) and then artificially overaged in order to achieve a good exfoliation corrosion resistance. The products receive no further straightening after

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T76510	Solution heat-treated, stress-relieved by controlled stretching (permanent set 1% to 3% for extruded rod, bar, shapes and tube, 0.5% to 3% for drawn tube) and then artificially overaged in order to achieve a good exfoliation corrosion resistance. The products receive no further straightening after stretching.
T76511	Same as T76510 except that minor straightening is allowed after stretching to comply with standard tolerances.
T7452	Solution heat-treated, stress-relieved by compressing to produce a permanent set of 1% to 5% and then artificially overaged in order to achieve a good exfoliation corrosion resistance.
T7454	Solution heat-treated, stress-relieved by restricting in the finish die and then artificially overaged in order to achieve a good exfoliation corrosion resistance.
T79	Solution heat-treated and then artificially overaged (very limited overageing).
T79510	Solution heat-treated, stress-relieved by controlled stretching (permanent set 1% to 3% for extruded rod, bar, shapes and tube, 0.5% to 3% for drawn tube) and then artificially overaged (very limited overageing). The products receive no further straightening after stretching.
T8	Solution heat-treated, cold worked and then artificially aged.
T82	Solution heat-treated by the user, controlled stretched with a minimum permanent set of 2% and then artificially aged (alloy 8090).
T832	Solution heat-treated, cold worked a controlled specific amount and then artificially aged (applies to 6063 drawn tube).
T841	Solution heat-treated, cold worked and then artificially underaged (sheet and strip in alloys 2091 and 8090).
T851	Solution heat-treated, stress-relieved by controlled stretching (permanent set 1% to 3% for sheet, 1.5% to 3% for plate, 1% to 3% for rolled or cold-finished rod and bar, 1% to 5% for hand or ring forging and rolled ring) and then artificially aged. The products receive no further straightening after stretching.
T8510	Solution heat-treated, stress-relieved by controlled stretching (permanent set 1% to 3% for extruded rod, bar, profiles and tube, 0.5% to 3% for drawn tube) and then artificially aged. The products receive no further straightening after stretching.
T8511	Same as T8510 except for minor straightening is allowed after stretching to comply with standard tolerances.
T852	Solution heat-treated, stress-relieved by compressing to produce a permanent set of 1% to 5% and then artificially aged.
T854	Solution heat-treated, stress-relieved by restricting cold in the finish die and then artificially aged.
T86	Solution heat-treated, cold worked approximately 6% and then artificially aged.
T87	Solution heat-treated, cold worked approximately 7% and then artificially aged.
T89	Solution heat-treated, cold worked to an appropriate degree to achieve the specified mechanical properties and then artificially aged.
T9	Solution heat-treated, artificially aged and then cold worked.