

Aluminium Alloys are supplied in a very wide range of tempers with two principal groups:

**Non-heat treatable alloys** - Alloys whose strength/mechanical properties are achieved by cold working (rolling, extruding, etc.). Sometimes called work hardening alloys, Temper is denoted by letter H.

**Heat treatable alloys** - Alloys whose strength/mechanical properties are achieved by heat treatment followed by cooling and natural or artificial ageing. Temper denoted by letter T.

## HEAT-TREATABLE ALLOYS

**Solution heat treating** - The process of heating aluminium at prescribed temperature for a prescribed time and then cooling rapidly usually by quenching in water.

**Natural ageing (T1, T2, T3, T4)** - The process which occurs spontaneously at ordinary temperature until the metal reaches a stable condition. This hardens the metal after solution heat treatment.

**Artificial ageing (T5, T6, T9)** - The process of heating for a prescribed period (2-30 hours) at a prescribed low temperature (100-200°C) until the metal reaches a stable condition. This hardens/increases strength after solution heat treating quicker than natural ageing and to a greater level.

## NON HEAT-TREATABLE ALLOYS

**Work hardening (H14)** - General term for processes which increase strength of aluminium and reduce the ductility, (e.g. rolling, drawing, pressing, stamping). Sometimes called strain-hardening.

**Partial annealing (H24)** - A heating process which reduces strength and increases ductility of aluminium after work hardening. Sometimes called temper let-down.

**Stabilising (H34)** - A low temperature thermal treatment or heat introduced during manufacture which stabilises the mechanical properties. This process usually improves ductility and is only applied to those alloys which, unless stabilised, gradually age-soften at room temperature, (i.e. non-heat treatable range.) The purpose of stabilising is to relieve the residual internal stress in the metal. Mainly used for 5000 series alloys.

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## REVISION HISTORY

Datasheet Updated	13 November 2018
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Please note that the 'Datasheet Update' date shown above is no guarantee of accuracy or whether the datasheet is up to date.

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### Non-Heat Treatable Alloy Designations

Term	Description
H1X	Work hardened
H2X	Work hardened and partially annealed
H3X	Work hardened and stabilized by low temperature treatment
H4X	Work hardened and stoved
HX2	Quarter-Hard
HX4	Half-Hard
HX6	Three-quarter Hard
HX8	Fully Hardened

### Temper Codes for Plate

Code	Description
H111	Some work hardening imparted by shaping processes but less than required for H11 temper
H112	Alloys that have some tempering from shaping but no special control over the amount of strain-hardening or thermal treatment. Some strength limits apply.
H321	Strain hardened less than required for a controlled H32 temper.
H323	A version of H32 that has been specially fabricated to provide acceptable resistance to stress corrosion cracking.
H34	Stabilised, Half Hard - A low temperature thermal treatment or heat introduced during manufacture which stabilises the mechanical properties and relieves residual internal stress, usually improves ductility. Only applied to alloys which, unless stabilised, gradually age-soften at room temperature.
H343	H34 specially fabricated to provide acceptable resistance to stress corrosion cracking.
H115	Armour plate.
H116	Special corrosion-resistant temper.

### Full List of Temper Codes

Code	Description
F	As Fabricated (no property limits specified)
O	Fully Annealed, Soft
H111	<i>see adjacent table</i>
H112	<i>see adjacent table</i>
H115	Armour Plate
H116	Special corrosion resistant temper
H12	Work hardened to quarter hard, not annealed after rolling
H14	Work hardened to half hard, not annealed after rolling
H16	Work hardened to three-quarter hard, not annealed after rolling
H18	Work hardened to fully hard, not annealed after rolling
H19	Work hardened to Extra Hard, not annealed after rolling
H24	Work hardened then partially annealed to half hard
H26	Work hardened then partially annealed to three-quarter hard
H28	Work hardened then partially annealed to fully hard
H32	Work hardened then stabilised by low-temperature heat treatment to quarter hard
H321	<i>see adjacent table</i>
H323	<i>see adjacent table</i>
H34	<i>see adjacent table</i>
H343	<i>see adjacent table</i>
H36	Work hardened then stabilised by low-temperature heat treatment to three-quarter hard
H38	Work hardened then stabilised by low-temperature heat treatment to fully hard
O	Fully Annealed, Soft

**Full List of Temper Codes *continued***

T1	Cooled from an elevated temperature and naturally aged
T2	Cooled from an elevated temperature, cold worked and naturally aged
T3	Solution heat treated, cold worked and naturally aged
T351	Solution heat treated then stress relieved by stretching - Equivalent to T4 condition
T352	Solution heat treated, stress relieved by compressing to produce a permanent set of 1% to -5% then naturally aged
T3510	Solution heat treated and stress-relieved by stretching - Equivalent to T4 condition
T3511	Solution heat treated and stress-relieved by stretching - Equivalent to T4 condition
T36	Solution heat treated then cold worked by a reduction of 6%
T361	Solution heat treated then stress relieved by stretching.
T4	Solution heat treated and naturally aged to a substantially stable condition
T42	Solution heat treated and naturally aged to a substantially stable condition
T451	Solution heat treated then stress relieved by stretching - Equivalent to T4
T4510	Solution heat treated and stress-relieved by stretching - Equivalent to T4 condition
T4511	Solution heat treated and stress-relieved by stretching - Equivalent to T4 condition
T5	Cooled from an elevated temperature shaping process and artificially aged
T6	Solution heat treated and artificially aged
T62	Solution heat treated then artificially aged by the user

T651	Solution heat treated, stress relieved by stretching then artificially aged
T6510	Solution heat treated and stress-relieved by stretching then artificially aged with no straightening after aging - Equivalent to T4 condition
T6511	Solution heat treated and stress-relieved by stretching then artificially aged with minor straightening after aging - Equivalent to T4 condition
T7	Solution heat treated then stabilised
T72	Solution heat treated then specially artificially aged for resistance to stress corrosion
T73	Solution heat treated then specially artificially aged for resistance to stress corrosion
T7351	Solution heat treatment then specially artificially aged for resistance to stress corrosion
T8	Solution heat treated, cold worked then artificially aged
T81	Solution heat treated, cold worked then artificially aged
T851	Solution heat treated then stress relieved by stretching then artificially aged
T8510	Solution heat treated, stress-relieved by stretching then artificially aged
T8511	Solution heat treated, stress-relieved by stretching then artificially aged
T9	Solution heat treated, artificially aged and cold worked
T10	Cooled from an elevated temperature, artificially aged then cold worked