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ADOPTION NOTICE
15 August 1990 for
AS 1990
1 January 1990

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Title of Document: Aluminum Alloy Tempers

Date of Specific Issue Adopted: 1 January 1990

Releasing Non-Government Standards Body: SAE

Custodians:
Air Force - 11
Army - MR
Navy - AS

Military Coordinating Activity
Air Force - 11

(Project No: 95GP-0353)

FSC 95GP

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G-01-01

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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE STANDARD

AS1990

Issued: 1-1-90

Submitted for recognition as an American National Standard

ALUMINUM ALLOY TEMPERS

1. PURPOSE:

The purpose of this Aerospace Standard (AS) is to provide a description of the temper nomenclature system for aluminum alloys used in the aerospace industry by combining information from different sources for the benefit of the user.

2. GENERAL:

The tempers used with aluminum alloys as registered with the Aluminum Association provide information regarding the basic operations used for making the property levels for the alloy and temper registered for the product.

This AS provides information as to the general rules used by the Aluminum Association for describing the alloy-temper system (See Section 4). This section is an extraction from ANSI H35.1M. This document also provides a list of alloy and tempers used in aerospace applications. The product form and the basic operations that determine the temper are shown (See Section 5). However, some of these alloy temper combinations are not currently used and may not be readily available.

3. REFERENCES:

For further information on the tempers described in this AS see:

ANSI H35.1M - American National Standard Alloy and Temper Designation Systems for Aluminum

Tempers for Aluminum and Aluminum Alloys Products - Published by the Aluminum Association.

Aluminum Standards and Data - Published by the Aluminum Association.

4. GENERAL RULES DESCRIBING THE ALUMINUM, ALUMINUM ALLOY-TEMPER SYSTEM:

The rules upon which this system is based are established by and can only be modified by ANSI Committee H35.

4.1 Temper Designation System: The temper designation system is used for all forms of wrought and cast aluminum and aluminum alloys except ingot. It is based on the sequences of basic treatments used to produce the various tempers. The temper designation follows the alloy designation, the two being separated by a hyphen. Basic temper designations consist of letters. Subdivisions of the basic tempers, where required, are indicated by one or more digits following the letter. These designate specific sequences of basic treatments, but only operations recognized as significantly influencing the characteristics of the product 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.

4.1.1 Basic Temper Designations: Basic temper designations are as follows:

F As fabricated. Applies to the products of shaping processes in which no special control over thermal conditions or strain-hardening is employed. For wrought products, there are no mechanical property limits.

O Annealed. Applies to wrought products that are annealed to obtain the lowest strength temper, and to cast products that are annealed to improve ductility and dimensional stability. The O may be followed by a digit other than zero.

H Strain-hardened (wrought products only). Applies to products that have their strength increased by strain-hardening, with or without supplementary thermal treatments to produce some reduction in strength. The H is always followed by two or more digits.

W Solution heat-treated. An unstable temper applicable only to alloys that 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 hr.

T Thermally treated to produce stable tempers other than F, O, or H. Applies to products that are thermally treated, with or without supplementary strain-hardening, to produce stable tempers. The T is always followed by one or more digits.

4.2 Subdivisions of Basic Tempers:

4.2.1 Subdivision of H Temper: Strain-Hardened:

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

H1 Strain-hardened only. Applies to products that are strain-hardened to obtain the desired strength without supplementary thermal treatment. The number following this designation indicates the degree of strain-hardening.

H2 Strain-hardened and partially annealed. Applies to products that 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 the same minimum ultimate tensile strength as the corresponding H3 tempers. For other alloys, the H2 tempers have the same minimum ultimate tensile strength as the corresponding H1 tempers and slightly higher elongation. The number following this designation indicates the degree of strain-hardening remaining after the product has been partially annealed.

H3 Strain-hardened and stabilized. Applies to products that 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. The number following this designation indicates the degree of strain-hardening remaining after the stabilization treatment.

4.2.1.2 The digit following the designations H1X, H2X, and H3X indicates the degree of strain-hardening. Numeral 8 has been assigned to indicate tempers having an ultimate tensile strength equivalent to that achieved by a cold reduction [temperature during reduction not to exceed 122°F (50°C)] of approximately 75% following a full anneal. Tempers between O (annealed) and 8 are designated by numerals 1 through 7. Material having an ultimate tensile strength about midway between that of the O temper and that of the 8 temper is designated by the numeral 4; about midway between the O and 4 tempers by the numeral 2; and about midway between the 4 and 8 tempers by the numeral 6. Numeral 9 designates tempers whose minimum ultimate tensile strength exceeds that of the 8 temper by 2.0 ksi (10 MPa) or more. For two-digit H tempers with an odd second digit, the standard limits for strength are the arithmetic mean, rounded to the nearest multiple of 1.0 ksi (5 MPa) in conformance with ASTM Recommended Practice E 29, of the standard limits for the adjacent two-digit H tempers with an even second digit.

4.2.1.2.1 For alloys that cannot be cold reduced an amount sufficient to establish an ultimate tensile strength applicable to the HX8 temper (75% cold reduction after full anneal), the HX6 temper tensile strength may be established by a cold reduction of approximately 55% following a full anneal, or the HX4 temper tensile strength may be established by a cold reduction of approximately 35% after a full anneal.

4.2.1.3 The third digit[1], 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. (See Appendix for assigned three-digit H tempers.)

4.2.1.3.1 The minimum ultimate tensile strength of a three-digit H temper must be at least as close to that of the corresponding two-digit H temper as it is to the adjacent two-digit H tempers. Products in the H temper with mechanical properties below H_1 shall be variations of H_1.

4.2.2 Subdivision of T Temper: Thermally Treated:

4.2.2.1 Numerals 1 through 10 following the T indicate specific sequences of basic treatments, as follows:[2]

T1 Cooled from an elevated temperature shaping process and naturally aged to a substantially stable condition. Applies to products that are not cold worked after cooling from an elevated temperature shaping process, or in which the effect of cold work in flattening or straightening may not be recognized in mechanical property limits.

T2 Cooled from an elevated temperature shaping process, cold worked, and naturally aged to a substantially stable condition. Applies to products that are cold worked to improve strength after cooling from an elevated temperature shaping process, or in which the effect of cold work in flattening or straightening is recognized in mechanical property limits.

[1]Numerals 1 through 9 may be arbitrarily assigned as the third digit and registered with The Aluminum Association for an alloy and product to indicate a variation of a two-digit H temper.

[2]A period of natural aging at room temperature may occur between or after the operations listed for the T tempers. Control of this period is exercised when it is metallurgically important.

4.2.2.1 (Continued):

T3 Solution heat-treated[3], cold worked, and naturally aged to a substantially stable condition. Applies to products that are cold worked to improve strength after solution heat-treatment, or in which the effect of cold work in flattening or straightening is recognized in mechanical property limits.

T4 Solution heat-treated[3] and naturally aged to a substantially stable condition. Applies to products that 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 that are not cold worked after cooling from an elevated temperature shaping process, or in which the effect of cold work in flattening or straightening may not be recognized in mechanical property limits.

T6 Solution heat-treated[3] and then artificially aged. Applies to products that 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[3] and overaged/stabilized. Applies to wrought products that are artificially aged after solution heat-treatment to carry them beyond a point of maximum strength to provide control of some significant characteristic.[4] Applies to cast products that are artificially aged after solution heat-treatment to provide dimensional and strength stability.

T8 Solution heat-treated[3], cold worked, and then artificially aged. Applies to products that are cold worked to improve strength, or in which the effect of cold work in flattening or straightening is recognized in mechanical property limits.

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[3]Solution heat-treatment is achieved by heating cast or wrought products to a suitable temperature, holding at that temperature long enough to allow constituents to enter into solid solution and cooling rapidly enough to hold the constituents in solution. Some 6000 series alloys attain the same specified mechanical properties whether furnace solution heat treated or cooled from an elevated temperature shaping process at a rate rapid enough to hold constituents in solution. In such cases the temper designations T3, T4, T6, T7, T8, and T9 are used to apply to either process and are appropriate designations.

[4]For this purpose, characteristic is something other than mechanical properties. The test method and limit used to evaluate material for this characteristic are specified at the time of the temper registration.

4.2.2.1 (Continued):

T9 Solution heat-treated[3], artificially aged, and then cold worked. Applies to products that are cold worked to improve strength.

T10 Cooled from an elevated temperature shaping process, cold worked, and then artificially aged. Applies to products that are cold worked to improve strength, or in which the effect of cold work in flattening or straightening is recognized in mechanical property limits.

4.2.2.2 Additional digits[5], the first of which shall not be zero, may be added to designations T1 through T10 to indicate a variation in treatment that significantly alters the characteristics of the product. (See Appendix for specific additional digits for T tempers.)

4.3 Variations of O Temper: Annealed:

4.3.1 A digit following the O, when used, indicates a product in the annealed condition having special characteristics. As the O temper is not part of the strain-hardened (H) series, variations of O temper shall not apply to products that are strain-hardened after annealing and in which the effect of strain-hardening is recognized in the mechanical properties or other characteristics.

5. LIST OF ALLOY-TEMPERS OF INTEREST TO THE AEROSPACE INDUSTRY:

5.1 General: The following listing provides information as to the metallurgical process a particular alloy and temper receives beginning with solution heat treatment. The list is not intended to be a description of the registration or of the application for which the alloy-temper was designed. This information can be obtained through the Aluminum Association or an interested supplier.

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[3]See footnote 3 on page 5.

[5]Additional digits may be arbitrarily assigned and registered with the Aluminum Association for an alloy and product to indicate a variation of tempers T1 through T10 (See footnote 1). Variations in treatment that do not alter the characteristics of the product are considered alternate treatments for which additional digits are not assigned.

5.2 Castings: Codes are as follows:

AA - Artificial age
SHT - Solution heat treat
NA - Natural age
AO - Overaged
M - Indicates the primary process variable modified to develop the characteristics associated with the temper variation. The significance of the numbers contained in the temper designation is not defined beyond what is shown in Section 4.

Alloy-Temper		Process Used to Obtain Temper
201.0	T4	SHT-NA
A201.0	T7	SHT-AO
A205.0	T7	SHT-AO
206.0	T4	SHT-NA
	T7	SHT-AO
	T4	SHT-NA
	T71	$SHT-AO_M$
222.0	T4	SHT-NA
	T61	SHT-AA
242.0	F	As Cast
	T4	SHT-NA
	T571	F Temper and AA
	T61	SHT (quench by air blast) - AA
243.0	T41	SHT-NA
	T61	SHT-AA
295.0	T4	SHT-NA
	T62	SHT-AA
296.0	T4	SHT-NA
	T6	SHT-AA
319.0	T4	SHT-NA
	T6	SHT-AA
354.0	T41	SHT-NA
	T61	SHT-AA
355.0	T4	SHT-NA
	T51	F-AA
	T6	SHT-AA
	T71	SHT-AO
C355.0	T4	SHT-NA
	T6	SHT-AA
	T61	$SHT-AA_M$
	T71	SHT-AO
356.0	F	As Cast
	T51	F-AA
	T6	SHT-AA
A356.0	T4	SHT-NA
	T6	SHT-AA
	T61	$SHT-AA_M$
	T51	F-AA

5.2 (Continued):

Alloy-Temper		Process Used to Obtain Temper
357.0	T4	SHT-NA
	T6	SHT-AA
	T61	SHT-AA_M
A357.0	T6	SHT-AA
358.0	T4	SHT-NA
	T6	SHT-AA
	T60	SHT-Controlled delay - AA
359.0	T4	SHT-NA
	T61	SHT-AA
	T62	SHT-AA (less than for T61)
520.0	T4	SHT-(Controlled cool in hot H_2O or oil)
712.0	F	As Cast
	T1	SHT (Cooled from Casting) - NA
	T5	T1-AA
850.0	F	As Cast
	T5	F-AA

5.3 Wrought Alloys: (See Codes at the end of Table):

Alloy-Temper	Product Form: S	P	TD	TE	E	RCF	BCF	WCF	R	F_H	F_D	RR	F	Process Used to Obtain Temper
1100 – H14	x	x	x			x		x	x					CW approximately 1/2 hard
H18	x		x					x						CW approximately full hard
2004 – T6	x													SHT–AA
2011 – T3			x			x	x	x						SHT–CW–NA
T4						x	x							SHT–NA
T451						x	x							SHT–SR_S–NA
T4511			x			x								SHT–SR_S–NA (Minor straightening after SR_S allowed)
T8			x			x	x	x						SHT–CW–AA
2014 – T3	x													SHT–CW–NA
T4	x		x	x	x	x	x	x			x			SHT–NA
T42	x	x	x	x	x	x	x	x						Not available from producer–see A2.2
T451		x				x	x							SHT–SR_S–NA
T4510				x	x									SHT–SR_S–NA
T4511				x	x									SHT–SR_S–NA (Minor straightening after SR_S allowed)
T6	x		x	x	x	x	x	x		x	x	x		SHT–AA
T61										x	x			SHT (Quenched in boiling water) – AA
T62	x	x	x	x	x	x	x	x						Not available from producer–see A2.2
T611										x	x			SHT (Quenched in hot water) – AA
T651		x				x	x							SHT–SR_S–AA
T652										x		x		SHT–SR_C–AA
T6510				x	x									SHT–SR_S–AA
T6511				x	x									SHT–SR_S–AA (Minor straightening after SR_S allowed)
2017 – H13						x		x						CW approximately 1/4 to 1/2 hard
T4						x	x	x	x					SHT–NA
T42						x	x	x						Not available from producer–see A2.2
T451						x	x							SHT–SR_S–NA
2018 – T61											x			SHT (Quenched in boiling water) – AA
T71											x			SHT (Quenched in boiling water) – AO

5.3 (Continued):

Alloy-Temper	Product Form: S	P	TD	TE	E	RCF	BCF	WCF	R	F_H	F_D	RR	F	Process Used to Obtain Temper
2024 – H13						×		×						CW approximately 1/4 to 1/2 hard
T3	×		×	×	×	×	×	×					×	SHT–CW–NA
T351		×				×	×							SHT–SR_S–NA
T3510				×	×									SHT–SR_S–NA
T3511				×	×									SHT–SR_S–NA (Minor straightening after SR_S allowed)
T36								×						SHT–CW (Approximately 6%) – NA
T361	×	×												SHT–CW (Approximately 6%) – NA
T4	×					×	×	×	×					SHT–NA
T42	×	×	×	×	×	×	×	×	×					Not available from producer–see A2.2
T6						×	×	×						SHT–AA
T62	×	×				×	×	×						Not available from producer–see A2.2
T81			×										×	SHT–CW–AA
T84			×											SHT–CW (Approximately 4%) – AA
T851		×				×	×							SHT–SR_S–AA
T8510				×	×									SHT–SR_S–AA
T8511				×	×									SHT–SR_S–AA (Minor straightening after SR_S allowed)
T861	×	×												SHT–CW (Approximately 6%) – AA
2025 – T6												×		SHT–AA
2048 – T851		×												SHT–SR_S–AA
2117 – H13						×		×						CW Approximately 1/4 to 1/2 hard
H15						×		×						CW Approximately 1/2 to 3/4 hard
T4									×					SHT–NA
2124 – T351		×												SHT–SR_S–NA
T851		×												SHT–SR_S–AA
2218 – T61											×			SHT (Quenched in boiling water) – AA
T71											×			SHT (Quenched in boiling water) – A0
2219 – T31	×		×	×	×									SHT–CW–NA
T351		×										×		SHT–SR_S–NA
T3510				×	×									SHT–SR_S–NA
T3511				×	×									SHT–SR_S–NA (Minor CW after SR_S allowed)

5.3 (Continued):

Alloy-Temper	S	P	TD	TE	E	RCF	BCF	WCF	R	F_H	F_D	RR	F	Process Used to Obtain Temper
2219 (Continued)														
T37	x	x												SHT-CW (Approximately 8%) - NA
T6									x	x	x	x		SHT-AA
T62	x	x		x	x									Not available from producer-see A2.2
T71										x	x			SHT (Quenched in boiling water) - AO
T81	x			x	x									SHT-CW-AA
T851		x				x	x					x		SHT-SR_S-AA
T8510				x	x									SHT-SR_S-AA
T8511				x	x									SHT-SR_S-AA (Minor straightening after SR_S allowed)
T852										x		x		SHT-SR_C-AA
T87	x	x												SHT-CW (Approximately 8%) - AA
2224 - T3510					x									SHT-SR_S-NA
T3511					x									SHT-SR_S-NA (Minor straightening after stretch allowed)
2324 - T39		x												SHT-CW (Approximately 11%) - SR_S
2519 - T87		x												SHT-CW
2618 - T61										x	x	x		SHT (Quenched in boiling water) - AA
T71										x	x			SHT (Quenched in boiling water) - AO
3003 - H14	x	x	x			x		x	x					Cold worked approximately 1/2 hard
H18	x		x					x						Cold worked approximately full hard
4032 - T6											x			SHT-AA
5052 - H32	x	x	x			x		x	x					Cold worked approximately 1/4 hard - stabilized
H34	x	x	x					x						Cold worked approximately 1/2 hard - stabilized
H191													x	Cold worked more than H18 temper
5056 - H191													x	Cold worked more than H18 temper

5.3 (Continued):

Alloy-Temper	Product Form: S	P	TD	TE	E	RCF	BCF	WCF	R	F_H	F_D	RR	F	Process Used to Obtain Temper
5083 - H111				x	x					x	x			Some cold work introduced after an anneal
H112		x		x	x					x	x			Some strain hardening when working at an elevated temp.
H321	x	x												Cold worked approximately 1/4 hard - stabilized
H323	x													Cold worked approximately 1/4 hard - stabilized
H343	x													Cold worked approximately 1/2 hard - stabilized
5086 - H32	x	x												Cold worked approximately 1/4 hard - stabilized
H34	x	x												Cold worked approximately 1/2 hard - stabilized
H111					x									Cold worked approximately 1/2 hard - stabilized
H112					x									Some cold work introduced after an anneal
5454 - H32	x	x												Some strain hardening when working at an elevated temp.
H34	x	x												Cold worked approximately 1/4 hard - stabilized
H111					x									Cold worked approximately 1/2 hard - stabilized
H112					x									Some cold work introduced after an anneal
5456 - H112	x	x												Some strain hardening when working at an elevated temp.
H321	x	x												Some strain hardening when working at an elevated temp.
H111					x									Cold worked approximately 1/4 hard - stabilized
H112					x									Some strain hardening when working at an elevated temp.
6013 - T4	x													SHT-NA
T42	x													Not available from producer-see A2.2
T6	x													SHT-AA
T62	x													Not available from producer-see A2.2
6061 - H13						x		x						Cold worked approximately 1/4 to 1/2 hard
T4	x		x	x	x	x	x	x						SHT-NA
T42	x	x	x	x	x	x	x	x						Not available from producer-see A2.2
T451		x				x	x							SHT-SR_S-NA
T4510				x	x									SHT-SR_S
T4511				x	x									SHT-SR_S-NA (Minor straightening after SR_S allowed)
T6	x		x	x	x	x	x	x	x	x	x	x		SHT-AA
T62	x	x	x	x	x	x	x	x						Not available from producer-see A2.2
T651		x				x	x							SHT-SR_S-AA
T652										x		x		SHT-SR_C-AA
T6510				x	x									SHT-SR_S-AA

5.3 (Continued):

Alloy-Temper	Product Form S	P	TD	TE	E	RCF	BCF	WCF	R	F_H	F_D	RR	F	Process Used to Obtain Temper
6061 – (Continued)														
T6511				x	x									SHT–SR_S–AA (Minor straightening after SR_S allowed)
T89								x						SHT–CW_M–AA
T913								x						SHT–AA_M–CW
T94								x						SHT–AA_M–CW
6063 – T4			x	x	x									SHT–NA
T42			x	x	x									Not available from producer–see A2.2
T6			x	x	x									SHT–AA
T62			x	x	x									Not available from producer–see A2.2
T83			x											SHT–CW_M–AA
T831			x											SHT–CW_M–AA
T832			x											SHT–CW_M–AA
T837			x											SHT–CW_M–AA
6066 – T4			x	x	x									SHT–NA
T42			x	x	x									Not available from producer–see A2.2
T4510				x	x									SHT–SR_S–NA
T4511				x	x									SHT–SR_S–NA (Minor straightening after SR_S allowed)
T6			x	x	x						x			SHT–AA
T62			x	x	x									Not available from producer–see A2.2
T6510				x	x									SHT–SR_S–AA
T6511				x	x									SHT–SR_S–AA (Minor straightening after SR_S allowed)
6151 – T6											x	x		SHT–AA
6951 – T6	x				x									SHT–AA
7001 – T6				x	x									SHT–AA
T62				x	x									Not available from producer–see A2.2
T6510				x	x									SHT–SR_S–AA
T6511				x	x									SHT–SR_S–AA (Minor straightening after SR_S allowed)

5.3 (Continued):

Alloy-Temper	Product Form: S	P	TD	TE	E	RCF	BCF	WCF	R	F_H	F_D	RR	F	Process Used to Obtain Temper
7010 – T7351		×												SHT-SR_S-AO (More than – T73651 temper)
T7451		×												SHT-SR_S-AO (More than – T7651 temper)
T7651		×												SHT-SR_S-AO
7049 – T73										×	×			SHT-AO
T7351		×												SHT-SR_S-AO
T7352										×				SHT-SR_C-AO
T73511				×	×									SHT-SR_S-AO (Minor straightening after SR_S allowed)
*T74											×			SHT-AO (Less than for T73 temper)
T76511				×	×									SHT-SR_S-AO (Minor straightening after SR_S allowed)
7050 – H13						×		×						Cold worked approximately 1/4 to 1/2 hard
T7									×					SHT-SR_S-AO
T73510					×									SHT-SR_S-AO
T73511				×	×									SHT-SR_S-AO (Minor straightening after SR_S allowed)
*T74										×	×			SHT-AO
*T7451		×										×		SHT-SR_S-AO
*T74510					×									SHT-SR_S-AO
*T74511				×	×									SHT-SR_S-AO (Minor straightening after SR_S allowed)
*T7452										×	×	×		SHT-SR_C-AO
*T7454											×			SHT-$SR_{(S\&C)}$-AO
T7651		×												SHT-SR_S-AO
T76510					×									SHT-SR_S-AO
T76511				×	×									SHT-SR_S-AO (Minor straightening after SR_S allowed)
7075 – H13						×		×						Cold worked approximately 1/4 to 1/2 hard
T6	×		×	×	×	×	×	×	×	×	×	×		SHT-AA
T62	×	×	×	×	×	×	×	×						Not available from producer-see A2.2
T651		×				×	×					×		SHT-SR_S-AA
T6510				×	×									SHT-SR_S-AA
T6511				×	×									SHT-SR_S-AA (Minor straightening after SR_S allowed)
T652										×				SHT-SR_C-AA
T73	×		×	×	×	×	×	×	×	×	×			SHT-AO
T7351		×				×	×					×		SHT-SR_S-AO
T73510				×	×									SHT-SR_S-AO
T73511				×	×									SHT-SR_S-AO (Minor straightening after SR_S allowed)

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5.3 (Continued):

Alloy-Temper	Product Form S	P	TD	TE	E	RCF	BCF	WCF	R	F_H	F_D	RR	F	Process Used to Obtain Temper
7075 - (Continued)														
T7352										x	x			$SHT-SR_C-AO$
*T74										x	x			SHT-AO
*T7452										x		x		$SHT-SR_C-AO$
T76	x				x									SHT-AO (Less than T73 temper)
T7651		x												$SHT-SR_S-AO$
T76510					x									$SHT-SR_S-AO$
T76511					x									$SHT-SR_S-AO$ (Minor straightening after SR_S allowed)
7090 - T73511					x									$SHT-SR_S-AO$ (Minor straightening after stretch allowed)
7091 - T73511					x									$SHT-SR_S-AO$ (Minor straightening after stretch allowed)
7149 - T73										x	x			SHT-AO
T73511				x	x									$SHT-SR_S-AO$ (Minor straightening after SR_S allowed)
7150 - T651		x												$SHT-SR_S-AA$
T6151		x												$SHT-SR_S-AA_M$
T6510					x									$SHT-SR_S-AA$
T6511					x									$SHT-SR_S-AA$ (Minor straightening after SR_S allowed)
T61510					x									$SHT-SR_S-AA_M$
T61511					x									$SHT-SR_S-AA_M$ (Minor straightening after SR_S allowed)
T7751		x			x									$SHT-SR_S-AA_M$
T77511				x										$SHT-SR_S-AA_M$ (Minor straightening after SR_S allowed)
7175 - T6	x													SHT-AA
T62		x												Not available from producer-see A2.2
T651		x												$SHT-SR_S-AA$
T66											x			$SHT-AA_M$
T73	x													SHT-AO
T7351		x												$SHT-SR_S-AO$
T73511					x									$SHT-SR_S-AO$ (Minor straightening after SR_S allowed)
*T74										x	x			SHT-AO
*T7452										x	x			$SHT-SR_C-AO$
*T7454											x			$SHT-SR_{(S\&C)}-AO$
T76	x													SHT-AO
T7651		x												$SHT-SR_S-AO$