

**AEROSPACE
MATERIAL
SPECIFICATION**

SAE AMS-QQ-A-250/11A

Issued 1997-08
Cancelled 2008-07

Superseding AMS-QQ-A-250/11

Aluminum Alloy 6061, Plate and Sheet

UNS A96061

RATIONALE

AMS-QQ-A-250/11 has been designated Cancelled and Superseded because equivalent technical requirements are provided by other specifications.

CANCELLATION NOTICE

This specification has been declared "CANCELLED" by the Aerospace Materials Division, SAE, as of July 2008 and has been superseded by the specifications listed below. The requirements of the latest issue of the specifications listed below shall be fulfilled whenever reference is made to the cancelled AMS-QQ-A-250/11. By this action, this document will remain listed in the Numerical Section of the Index of Aerospace Material Specifications, noting that it has been superseded by the specifications listed below.

Cancelled specifications are available from SAE.

Product	Superseding Specification
Temper O	AMS 4025, Aluminum Alloy, Sheet and Plate, 1.0Mg 0.60Si 0.28Cu 0.20Cr (6061-0) Annealed
Temper T4, T42, T451	AMS 4026, Aluminum Alloy, Sheet and Plate, 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061; -T4 Sheet, -T451, Solution Heat Treated and Naturally Aged
Temper T6, T62, T651	AMS 4027, Aluminum Alloy, Sheet and Plate 1.0Mg 0.60Si 0.28Cu 0.20Cr (6061; -T6 Sheet, -T651 Plate) Solution and Precipitation Heat Treated
Temper F	AMS 4025, Aluminum Alloy, Sheet and Plate, 1.0Mg 0.60Si 0.28Cu 0.20Cr (6061-0) Annealed, or AMS 4026, Aluminum Alloy, Sheet and Plate, 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061; -T4 Sheet, -T451, Solution Heat Treated and Naturally Aged, or AMS 4027, Aluminum Alloy, Sheet and Plate 1.0Mg 0.60Si 0.28Cu 0.20Cr (6061; -T6 Sheet, -T651 Plate) Solution and Precipitation Heat Treated
For Non-Aerospace Applications, Tempers F, O, T4, T42, T451, T6, T62, T651	ASTM B 209, Aluminum and Aluminum-Alloy Sheet and Plate – <i>designating alloy 6061 and applicable temper</i>

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NOTICE

This document has been taken directly from Federal Specification QQ-A-250/11F and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards.

The original Federal Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, (b) the use of the existing government specification or standard format, and (c) the exclusion of any qualified product list (QPL) sections.

The complete requirements for procuring 6061 aluminum alloy plate and sheet described herein shall consist of this document and the latest issue of AMS-QQ-A-250.

1. SCOPE AND CLASSIFICATION:

1.1 Scope:

This specification covers the specific requirements for 6061 aluminum alloy plate and sheet.

1.2 Classification:

- 1.2.1 Tempers: The plate and sheet are classified in one of the following tempers as specified (See 6.3): O, T4, T6, T42, T62, T451, T651, or F temper. Definitions of these tempers are specified in AMS-QQ-A-250.

2. APPLICABLE DOCUMENTS:

See AMS-QQ-A-250.

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3. REQUIREMENTS:

3.1 Chemical Composition:

The chemical composition shall conform to the requirements specified in Table I.

TABLE I. Chemical Composition 1/

Element	Percent	
	Minimum	Maximum
Magnesium	0.80	1.20
Silicon	0.40	0.80
Copper	0.15	0.40
Chromium	0.04	0.35
Iron	-	0.70
Titanium	-	0.15
Manganese	-	0.15
Zinc	-	0.25
Other Elements, each	-	0.05
Other Elements, total	-	0.15
Aluminum	Remainder	

1/ Analysis shall routinely be made only for the elements specifically mentioned in Table I. If, however, the presence of other elements is indicated or suspected in amounts greater than the specified limits, further analysis shall be made to determine that these elements are not present in excess of specified limits.

3.2 Mechanical Properties:

3.2.1 Mechanical Properties of Material as Supplied: The mechanical properties perpendicular to the direction of final rolling, except for material under 9 inches in width, shall conform to the requirements of Table II for the temper specified. For material under 9 inches in width, the mechanical properties parallel to the direction of final rolling shall conform to the requirements of Table II for temper specified.

TABLE II. Mechanical Properties (See 6.5)

Temper	Thickness Inches	Tensile Strength minimum ksi	Yield Strength at 0.2 percent Offset or at extension in- dicated		Elongation in 2 in. or 4 times D <u>1/</u> ; <u>2/</u> minimum percent
			minimum ksi	Extension under load inch/inch	
O	0.006 to 0.007, incl	22.0 <u>3/</u>	12.0 <u>3/</u>	0.0032	10
	over 0.007 to 0.009, incl	22.0 <u>3/</u>	12.0 <u>3/</u>	0.0032	12
	over 0.009 to 0.020, incl	22.0 <u>3/</u>	12.0 <u>3/</u>	0.0032	14
	over 0.020 to 0.128, incl	22.0 <u>3/</u>	12.0 <u>3/</u>	0.0032	16
	over 0.128 to 0.499, incl	22.0 <u>3/</u>	12.0 <u>3/</u>	0.0032	18
	0.500 to 1.00, incl	22.0 <u>3/</u>	-	-	18
	over 1.00 to 3.00, incl	22.0 <u>3/</u>	-	-	16
T4	0.006 to 0.007, incl	30.0	16.0	0.0036	10
	over 0.007 to 0.009, incl	30.0	16.0	0.0036	12
	over 0.009 to 0.020, incl	30.0	16.0	0.0036	14
	over 0.020 to 0.249, incl	30.0	16.0	0.0036	16
T42 <u>4/</u>	0.006 to 0.007, incl	30.0	14.0	0.0034	10
	over 0.007 to 0.009, incl	30.0	14.0	0.0034	12
	over 0.009 to 0.020, incl	30.0	14.0	0.0034	14
	over 0.020 to 0.249, incl	30.0	14.0	0.0034	16
	0.250 to 1.00, incl	30.0	14.0	0.0034	18
	over 1.000 to 3.000, incl	30.0	14.0	0.0034	16
T451 <u>6/</u>	0.250 to 1.00 incl	30.0	16.0	0.0036	18
	over 1.000 to 3.000, incl	30.0	16.0	0.0036	16
T6 and T62 <u>4/</u>	0.006 to 0.007, incl	42.0	35.0	0.0055	4
	over 0.007 to 0.009, incl	42.0	35.0	0.0055	6
	over 0.009 to 0.020, incl	42.0	35.0	0.0055	8
	over 0.020 to 0.249, incl	42.0	35.0	0.0055	10
T651 <u>6/</u> and T62 <u>4/</u>	0.250 to 0.499, incl	42.0	35.0	0.0055	10
	0.500 to 1.000, incl	42.0	35.0	0.0055	9
	over 1.000 to 2.000, incl	42.0	35.0	0.0055	8
	over 2.000 to 3.000, incl	42.0	35.0	0.0055	6
	over 3.000 to 4.000, incl	42.0	35.0	0.0055	6

TABLE II. Mechanical Properties (See 6.5) (Continued)

Temper	Thickness Inches	Tensile Strength minimum ksi	Yield Strength at 0.2 percent Offset or at extension in- dicated		Elongation in 2 in. or 4 times D <u>1</u> / <u>2</u> / minimum percent
			minimum ksi	Extension under load inch/inch	
T651	over 4.000 to 6.000, incl	40.0	35.0	0.0055	6
F	All	<u>5</u> / <u>3</u>	<u>5</u> / <u>3</u>	<u>5</u> / <u>3</u>	<u>5</u> / <u>3</u>

1/ Specimen diameter.

2/ Not required for material 1/2 inch or less width.

3/ Maximum.

4/ Material in the T42 or T62 temper is not available from material producers.

5/ No requirements.

6/ Tempers T451 and T651 are available in plate only.

- 3.2.2 Mechanical Properties After Heat Treatment: In addition to conforming to the requirements of 3.2.1, material in the tempers identified in the following paragraphs shall, after having been heat-treated to other tempers also identified therein, have properties conforming to those specified in Table II, as applicable.
- 3.2.2.1 Material in the Annealed (O) and As-Fabricated (F) Tempers: Material in the O or F tempers without the subsequent imposition of cold working or forming operations shall, after proper solution heat treatment and natural aging, develop the properties specified in Table II for the T42 temper. When specified (See 6.3), material in the O and F tempers, without the subsequent imposition of cold working or forming operations, shall, after proper solution treatment and artificial aging, develop the properties specified in Table II for the T62 temper.
- 3.2.2.2 Material in the T4, T6, T451, and T651 Tempers: When specified (See 6.3), material in the T4, T6, T451, and T651 tempers shall, without the subsequent imposition of cold working or forming operations, and after proper solution heat treatment and natural aging, develop the properties specified in Table II for the T42 temper.
- 3.2.2.3 Material in the T4 and T451 Tempers: When specified (See 6.3), material in the T4 and T451 tempers shall, after proper artificial aging, develop the properties specified in Table II for the T6 and T651 tempers, respectively.
- 3.2.2.4 Material in the T42 Temper: When specified (See 6.3), material in the T42 temper shall, after proper artificial aging, develop the properties specified in Table II for the T62 temper.

- 3.2.3 Bend Test: Bend specimens, taken from the material, shall be capable of withstanding, without cracking, the bend test specified in AMS-QQ-A-250. The values for bend factors N are given in Table III.

TABLE III. Bend Factor N Values

Thickness (inch)	Tempers		
	O	T4 and T42	T6 and T62
0.006 to 0.020, incl.	0	2	2
over 0.020 to 0.036, incl.	1	3	3
over 0.036 to 0.064, incl.	1	3	4
over 0.064 to 0.128, incl.	1	3	5
over 0.128 to 0.249, incl.	2	3	6
0.250 to 0.499, incl.	3	4	7

3.3 Marking:

When specified (See 6.3), in addition to the marking required in AMS-QQ-A-250, metal in the T6 and T651 tempers shall be identified by an inspection lot number marked in at least one location on each piece.

4. QUALITY ASSURANCE PROVISIONS:

See AMS-QQ-A-250 and as follows:

4.1 Heat Treatment:

- 4.1.1 Aging Period Before Testing: Specimens in the T4, T42, and T451 tempers will not be required to be tested within 4 days after completion of the solution heat treatment. If, within this period, the manufacturer elects to test specimens, which thereupon fail to meet the requirements, he can discard these initial test results and test additional specimens selected after four days of aging. These specimens shall be selected from the same location in the production lot or sample as those tested previously.

4.2 Mechanical Tests After Heat Treatment:

- 4.2.1 Number of Tests After Heat Treatment: From material in the annealed (O) and as-fabricated (F) tempers, an additional number of specimens, equal to those required by AMS-QQ-A-250, shall be taken and tested after solution heat treatment to determine compliance with 3.2.2.