AEROSPACE MATERIAL SPECIFICATION

AMS2770™	REV. R
Issued 1974-06 Revised 2020-08 Superseding AMS2770P	

Heat Treatment of Wrought Aluminum Alloy Parts

RATIONALE

AMS2770R adds back alloy 2004, revises Temperature Uniformity Test Recovery Requirements, Calibration of Refractometers, Method B, and Parts and Aging of 2219 (Table 7).

NOTICE

ORDERING INFORMATION: The following information shall be provided to the heat-treating processor by the purchaser. Purchase order and/or purchaser supplied documents shall specify not less than the following:

- AMS2770R
- Quantity of parts
- Part number or part identity
- Material (alloy) designation of parts, including mill heat/lot number
- Heat treating operations required, including:
  - Heat treat condition, as delivered
  - Final heat treatment condition required
- Processing variables not defined in or different from AMS2770 requirements, such as:
  - Processing temperatures, times, and other parameters
  - Part type
  - Allowance for straightening
  - Post straightening thermal operations requirements
  - Any pre-cleaning and post-cleaning requirements
  - Post heat treatment corrosion protection requirements
  - Any restriction to options allowed within this specification (e.g., salt bath only, polymer quenchant only)

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724 776 4970 (outside USA)

SAE WEB ADDRESS:

For more information on this standard, visit
ds/content/AMS2770R

1. SCOPE

1.1 Purpose

This specification specifies the engineering requirements for heat treatment, by part fabricators (users) or their vendors or subcontractors, of parts (see 8.6.1). It also covers heat treatment by warehouses or distributors converting raw material from one temper to another temper (see 1.3 and 8.5). It covers the following aluminum alloys:

1100, 2004, 2014, 2017, 2024, 2098, 2117, 2124, 2195, 2219, 2224, 3003, 5052, 6013, 6061, 6063, 6066, 6951, 7049, 7050, 7075, 7149, 7178, 7249, and 7475.

1.1.1 This specification may be used for heat treatment of parts made from other alloys provided the temperatures, temperature uniformity tolerances, times, and quenchants are specified or approved by the cognizant engineering organization (see 8.6.7).

1.2 Castings and parts made from castings shall be heat treated in accordance with AMS2771.

1.3 Temper Conversion

When a warehouse, distributor, or similar organization converts raw material to a different temper, it shall be heat treated and tested to the requirements of this specification. The marking, testing, and reporting requirements shall also be in accordance with AMS2772 and the raw material specification.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2658	Hardness and Conductivity Inspection of Wrought Aluminum Alloy Parts
AMS2750	Pyrometry
AMS2771	Heat Treatment of Aluminum Alloy Castings
AMS2772	Heat Treatment of Aluminum Alloy Raw Materials
AMS3025	Polyalkalene Glycol Heat Treat Quenchant
ARP1917	Clarification of Terms Used in Aerospace Metals Specification
ARP1962	Training and Approval of Heat-Treating Personnel

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D445	Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

2.3 ANSI Accredited Publications

Copies of these documents are available online at http://webstore.ansi.org/.

ANSI H35.1/H35.1M Alloy and Temper Designation Systems for Aluminum

3. TECHNICAL REQUIREMENTS

3.1 Equipment

3.1.1 Pyrometry

Shall be in accordance with AMS2750. Furnaces shall have a minimum of Type D instrumentation.

3.1.1.1 Solution heat treating and O1 (formerly T411) temper furnaces shall be a minimum of Class 2.

3.1.1.2 AMS2750 furnace classifications for aging shall be as follows:

3.1.1.2.1 Aging ovens operating at or below 300 °F (149 °C) shall be a minimum of Class 2.

3.1.1.2.2 For alloys 7049, 7149, 7249, and 7050, aging ovens or aging furnaces operating above 300 °F shall be a minimum of Class 1.

3.1.1.2.3 For aging all other alloys, all ovens or furnaces operating above 300 °F (149 °C) shall be a minimum of Class 2.

3.1.1.3 Annealing and stress relieving furnaces shall be a minimum of Class 5.

3.1.2 Furnaces

3.1.2.1 Heating Media

Shall be air, molten salt bath, oil bath, or fluidized bed. The products of combustion and other materials that could contaminate parts shall not come into contact with parts during solution heat treating, annealing or stress relieving. Electrical heating elements and radiant tubes shall be shielded to prevent parts from being exposed to direct radiation. Shield construction and placement shall be such as to prevent parts from being exposed to re-radiation of heat from electrical elements or radiant tubes. Composition and maintenance of salt baths and fluidized beds shall be such as to prevent attack of the parts.

3.1.2.2 Temperature Uniformity Test Recovery Requirements (see 8.6.9)

For all solution heat treat and aging furnaces, the lag time between recovery of the first test thermocouple and the last test thermocouple to within 10 °F (6 °C) or 5 °F (3 °C), as applicable, of the set temperature during furnace uniformity tests shall not exceed the following:

3.1.2.2.1 Furnaces Tested without a Load

20 minutes.

3.1.2.2.2 Furnaces Tested with a Load

40 minutes.

3.1.2.3 Furnaces Used for Alclad Material

Heat input of furnaces used for solution heat treating of parts made from Alclad product shall be sufficient to ensure conformance to 3.3.4.

3.1.3 Racks and Fixtures

Shall be constructed so as to preclude entrapment of water, molten salt and/or water/polymer solutions and shall not be made of materials that will interact with or diffuse into the aluminum materials at the heat treating temperature.

3.1.4 Quenching Equipment

3.1.4.1 Equipment shall be provided for quenching in water, and/or water/polymer solutions, and for measuring quenchant temperature. Provisions shall be made for mechanical or hydraulic agitation of the quenching medium and/or agitation of the parts and for heating and cooling of the quenchant, as necessary to conform to 3.4.2 and 3.4.3. Air agitation shall not be used.

3.1.4.2 Quench tanks shall be located in proximity to solution heat treating furnaces so that the quench delay requirements of Table 5 can be met.

3.1.4.3 The quenchant volume shall be sufficient to prevent the quench tank temperature from rising more than permitted in 3.4.3 during quenching with a maximum load.

3.1.5 Refrigeration Equipment

Refrigerators, dry ice boxes, or liquid baths, combinations or alternative methods approved by the cognizant engineering organization shall be provided for cold storage of parts when retention of the as-quenched (AQ) temper is required. Instrumentation for refrigerators, dry ice boxes, and liquid baths shall be in accordance with AMS2750.

3.2 General Procedures

3.2.1 Parts requiring a heat treatment to produce a final “T” temper shall be solution heat treated (including quenching), refrigerated when necessary, and aged when required, as specified herein (see 8.6.1). Heat treatment shall be performed only on entire parts, never on a portion or section of a part.

3.2.2 Cleaning

Prior to solution heat treating or annealing, parts shall be clean and visually free of contaminants such as dirt, metal residues, lubricants, and solvent residues. Residue from heating and quenching media shall be removed from parts after any heat treatment step.

3.2.3 Racking and Spacing

3.2.3.1 Parts, except rivets and other small parts (see 3.2.3.2), shall be racked or supported to permit free access of the heating and quenching media to all surfaces of parts in all portions of the load.

3.2.3.1.1 Solution Heat Treating

Parts, 0.250 inch (6.35 mm) and under in nominal thickness, shall be separated by not less than 1 inch (25 mm). Thicker parts shall be separated by at least 1 inch (25 mm) plus the part thickness. (Complex parts and parts of large plan form (see 8.8.12) may require greater separation.)

3.2.3.1.2 Aging, Annealing, and Stress Relieving

Parts shall be separated by not less than 1 inch (25 mm), except thin parts may be nested, provided thickness of nested stacks does not exceed 1 inch (25 mm) and stacks are at least 1 inch (25 mm) apart.

3.2.3.2 Rivets and Other Small Parts

May be heated and soaked in baskets or in continuous furnaces. Arrangement in baskets may be either orderly or random. Parts may touch but shall not be nested in a manner that prevents free access of the quench media to most surfaces. Maximum thickness of layers of rivets or parts in baskets or on a moving belt, and minimum space between layers, shall be 2 inches (51 mm).