

Issued OCT 1984
Revised DEC 1996
Reaffirmed JAN 2007

Superseding AMS 2759/4A

Heat Treatment
Austenitic Corrosion-Resistant Steel Parts

RATIONALE

This document has been reaffirmed to comply with the SAE 5-year Review policy.

1. SCOPE:

This specification, in conjunction with the general requirements for steel heat treatment covered in AMS 2759, establishes the requirements for annealing, stress relieving, and stabilizing heat treatment of austenitic corrosion-resistant steel parts. Parts are defined in AMS 2759.

1.1 Application:

This specification is applicable to parts made from the following corrosion-resistant steels: 201, 202, 301, 302, 303, 304, 304L, 305, 308, 309, 309C, 310, 314, 316, 316L, 318, 321, 347, and 348 (See Table 1, Note 1).

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2759 Heat Treatment of Steel Parts, General Requirements

ARP1820 Chord Method of Evaluating Surface Microstructural Characteristics

AS4913 Calculation of Soaking Time

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2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A 262 Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
ASTM A 380 Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems
ASTM E 3 Preparation of Metallographic Specimens

3. TECHNICAL REQUIREMENTS:

3.1 Heat Treatment:

Shall conform to AMS 2759 and requirements specified herein.

3.2 Equipment:

Shall conform to AMS 2759. Furnace temperature uniformity requirements for annealing, stress relieving, and stabilizing shall be ± 25 °F (± 14 °C).

3.3 Atmospheres:

Shall be controlled to not contaminate the parts being heat treated. Furnaces used to heat treat other classes of steel using atmospheres, which could contaminate austenitic corrosion-resistant steel parts, such as endothermic, exothermic, carbon-containing nitrogen base, etc, shall have purge cycles (See 8.2) run and then shall be tested to ensure that the surfaces of parts are not contaminated beyond the limits specified in 3.5.1. Materials which could attack or contaminate metal shall not contact parts. Composition and maintenance of salt baths shall be such as to prevent contamination of the parts. Salt baths shall be tested in accordance with AMS2759. Heat treating performed in air shall be in the natural atmosphere of a muffle furnace.

3.3.1 Heating Environment: Parts shall be heat treated in either air or protective atmosphere. Acceptable protective atmospheres include argon, helium, hydrogen, neutral salt, vacuum, and exothermic. Nitrogen and nitrogen-hydrogen blends are permitted below 1425 °F (774°C). Nitrogen and nitrogen-hydrogen blends are permitted at 1425 °F (774 °C) or over only if 0.020inch (0.51 mm) is removed from all surfaces after heat treatment. Nitrogen and nitrogen-hydrogen blends are permitted up to 1925 °F (1052 °C) as a backfill quench for vacuum furnaces. Use of nitrogen from dissociated ammonia is prohibited. For scale-free or discoloration-free parts, an air atmosphere and air cooling should be avoided.

3.3.2 Protective Coatings: A supplemental coating is permitted, to minimize oxidation on finished machined surfaces, when approved by the cognizant engineering organization.

3.4 Procedure:

- 3.4.1 Acid Cleaning: Parts shall be acid cleaned in accordance with ASTM A 380 before thermal treatment following forming with dies made from lead, kirksite, or other low-melting-temperature materials.
- 3.4.2 Soaking: Heating shall be controlled, as described in AMS 2759, such that either the heating medium or the part temperature, as applicable, is maintained at the set temperature shown in Table 1 for the soak time shown in Table 2. Soaking shall commence when all control, indicating, and recording thermocouples reach the specified set temperature or, if load thermocouples as defined in AMS 2759 are used, when the part temperature reaches the minimum of the furnace uniformity at the set temperature.
- 3.4.3 Annealing, Stress Relief, and Dimensional Stabilization: Shall be accomplished by heating, soaking, and cooling as shown in Tables 1 and 2.
- 3.4.4 Heating, stress relieving, or slow cooling of unstabilized grades, except 304L and 316L, between 875 and 1500 °F (468 and 816 °C) is prohibited.
- 3.4.5 Straightening: When approved by the cognizant engineering organization, straightening shall be accomplished at ambient temperature with a post-straightening stress relief as shown in Table 1 or at the stress relieving temperature shown in Table 1 without a subsequent stress relief. For parts subject to excessive warpage, dimensional stabilization may be substituted for stress relief, when approved by the cognizant engineering organization.

3.5 Properties:

- 3.5.1 Surface Contamination: When any surface of a part is not machined after heat treatment, the protective atmosphere or backfill medium in furnaces, for heating parts above 1350°F (732°C), shall be controlled not to produce carburization or nitriding (See 3.5.1.1), and intergranular oxidation shall not exceed 0.0007inch (0.018 mm). Parts heat treated in salt baths shall be free of residual salts.
- 3.5.1.1 Unless specifically informed that the parts will be machined all over, the heat treating processor shall process the parts as though some surfaces will not have subsequent metal removal and, therefore, shall heat treat parts using controlled atmosphere which will conform to the surface contamination requirements. Unless specified, controlled atmosphere is not required for parts with only raw material surfaces, except those made from sheet or strip.
- 3.5.1.2 Furnaces used exclusively to heat treat parts which will have all contamination removed shall not require testing.
- 3.5.2 Carbide Precipitation: When using other means of cooling in accordance with Table 1, Note 2, no carbide precipitation is permitted.

3.6 Test Methods:

Shall be in accordance with AMS 2759 and as follows:

- 3.6.1 Surface Contamination: Testing shall be by metallurgical examination at 500X magnification of etched specimens prepared in accordance with ASTM E 3. The chord method in ARP1820 may be used to enhance this examination.
- 3.6.2 Carbide Precipitation: Shall be determined in accordance with ASTM A 262.

4. QUALITY ASSURANCE PROVISIONS:

The responsibility for inspection, classification of tests, sampling, approval, entries, records, and reports shall be in accordance with AMS 2759 and as specified in 4.1 and 4.2.

4.1 Classification of Tests:

The classification of acceptance, periodic, and preproduction tests shall be as specified in AMS 2759 and as specified in 4.1.1 and 4.1.2.

- 4.1.1 Periodic Tests: Surface contamination (3.5.1) is a periodic test and shall be performed for each piece of equipment after the purging of atmospheres whenever the equipment has been used previously to heat treat using atmospheres such as endothermic, exothermic, carbon-containing nitrogen base, etc, which could contaminate austenitic corrosion-resistant steel parts.
- 4.1.2 Preproduction Tests: Surface contamination (3.5.1) is a preproduction test and shall be performed prior to any production heat treating for each piece of equipment and type of atmosphere to be used in each furnace. Additionally, tests to determine conformance to the requirements for carbide precipitation shall be performed prior to any production heat treatment for each piece of equipment and each alternate means of cooling.

4.2 Sampling:

Shall be in accordance with AMS 2759 and as follows:

- 4.2.1 Surface Contamination Testing: One or more samples shall be processed.

5. PREPARATION FOR DELIVERY:

See AMS 2759.

6. ACKNOWLEDGMENT:

See AMS 2759.

7. REJECTIONS:

See AMS 2759.

8. NOTES:

Shall be in accordance with 8.1, 8.2, and AMS 2759.

8.1 This is an editorial revision to correct publication errors in the "A" (September 1996) issue. A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the original (October 1984) issue of this specification. An (R) symbol to the left of the document title indicates a complete revision of the specification, including technical revisions. Change bars and (R) are not used in original publications, nor in specifications that contain editorial changes only.

8.2 Purge Cycles:

Effective purge cycles can be run to remove contamination from refractory furnace linings using inert gases with small amounts of reducing agents.

PREPARED UNDER THE JURISDICTION OF AMS COMMITTEE "F" AND AMEC