

Nickel Alloy, Corrosion and Heat-Resistant, Seamless Tubing
72Ni - 15.5Cr - 0.95Cb (Nb) - 2.5Ti - 0.70Al - 7.0Fe
Vacuum Melted
Solution Heat Treated, Precipitation Hardenable to 170 ksi (1172 MPa) Tensile Strength
(Composition similar to UNS N07750)

RATIONALE

AMS5583E is a Five Year Review and update of this specification.

1. SCOPE

1.1 Form

This specification covers a precipitation hardenable corrosion and heat-resistant nickel alloy in the form of seamless tubing.

1.2 Application

This tubing has been used typically for fluid lines requiring high strength up to 1300 °F (704 °C) and oxidation resistance up to 1800 °F (982 °C), but usage is not limited to such applications. Parts may be formed and then heat treated to improve strength at elevated temperatures.

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.

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2.1 SAE Publications

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

| | |
|---------|---|
| AMS2263 | Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Tubing |
| AMS2269 | Chemical Check Analysis Limits, Nickel, Nickel Alloys, and Cobalt Alloys |
| AMS2371 | Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock |
| AMS2634 | Ultrasonic Inspection, Thin Wall Metal Tubing |
| AMS2750 | Pyrometry |
| AMS2807 | Identification, Carbon and Low-Alloy Steels, Corrosion and Heat-Resistant Steels and Alloys, Sheet, Strip, Plate, and Aircraft Tubing |

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 E 8/E 8M | Tension Testing of Metallic Materials |
| ASTM E 18 | Rockwell Hardness of Metallic Materials |
| ASTM E 112 | Determining Average Grain Size |
| ASTM E 354 | Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys |
| ASTM E 426 | Electromagnetic (Eddy-Current) Examination of Seamless and Welded Tubular Products, Titanium, Austenitic Stainless Steel and Similar Alloys |
| ASTM E 1417 | Liquid Penetrant Testing |

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 354, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - COMPOSITION

| Element | min | max |
|---------------------|-------|-------|
| Carbon | -- | 0.08 |
| Manganese | -- | 0.35 |
| Silicon | -- | 0.35 |
| Phosphorus | -- | 0.015 |
| Sulfur | -- | 0.010 |
| Chromium | 14.00 | 17.00 |
| Nickel | 70.00 | -- |
| Columbium (Niobium) | 0.70 | 1.20 |
| Titanium | 2.25 | 2.75 |
| Aluminum | 0.40 | 1.00 |
| Iron | 5.00 | 9.00 |
| Cobalt (3.1.1) | -- | 1.00 |
| Tantalum | -- | 0.05 |
| Copper | -- | 0.50 |

3.1.1 Determination not required for lot acceptance.

3.1.2 Check Analysis

Composition variations shall meet the applicable requirements of AMS2269.

3.2 Melting Practice

Alloy shall be multiple melted using consumable electrode practice in the remelt cycle. If consumable electrode remelting is not performed in vacuum, electrodes which have been produced by vacuum induction melting shall be used for remelting.

3.3 Condition

Solution heat treated, and unless solution heat treatment is performed in an atmosphere yielding a bright finish, pickled as required.

3.4 Heat Treatment

Tubing shall be solution heat treated by heating to a temperature not lower than 1800 °F (982 °C), holding at the selected temperature within ± 25 °F (± 14 °C) for a time commensurate with cross-sectional thickness, and cooling at a rate equivalent to an air cool or faster. Pyrometry shall be in accordance with AMS2750.

3.5 Fabrication

Tubing shall be produced by a seamless and drawn process. Any surface finishing operation applied to remove objectionable pits and blemishes shall be performed prior to solution heat treatment. Only light polishing to improve external surface appearance is permitted after solution heat treatment.

3.6 Properties

Tubing shall conform to the following requirements:

3.6.1 As Solution Heat Treated

3.6.1.1 Tensile Properties

Shall be as shown in Table 2, determined in accordance with ASTM E 8/E 8M.

TABLE 2 - SOLUTION HEAT TREATED TENSILE PROPERTIES

| Property | Value |
|---|-------------------|
| Tensile Strength, maximum | 140 ksi (965 MPa) |
| Yield Strength at 0.2% Offset, maximum | 80 ksi (552 MPa) |
| Elongation in 2 inches (50.8 mm) or 4D, minimum | |
| Strip Specimen | 30% |
| Full Tube | 35% |

3.6.1.2 Average Grain Size

Shall be ASTM No. 5 or finer, determined in accordance with ASTM E 112.

3.6.1.3 Flarability

Specimens as in 4.3.1 from tubing 0.188 to 2.000 inches (4.78 to 50.80 mm), inclusive, in nominal OD shall withstand flaring at room temperature, without formation of cracks or other visible defects, by being forced axially with steady pressure over a hardened and polished tapered steel pin having a 74-degree included angle to produce a flare having a permanent expanded OD not less than 1.20 times the original nominal OD.

3.6.2 Response to Precipitation Heat Treatment

Tubing shall have the following properties after being precipitation heat treated by heating to 1350 °F ± 25 (732 °C ± 14), holding at heat for not less than 8 hours, cooling at a rate of 100 °F (56 °C) degrees per hour to 1150 °F ± 25 (621 °C ± 14), holding at 1150 °F ± 25 (621 °C ± 14) for 8 hours ± 0.5, and cooling at a rate equivalent to cooling in air. Instead of the 100 °F (56 °C) degrees per hour cooling rate to 1150 °F ± 25 (621 °C ± 14), tubing may be furnace cooled at any rate provided the time at 1150 °F ± 25 (621 °C ± 14) is adjusted to give a total precipitation heat treatment time of not less than 18 hours.

3.6.2.1 Tensile Properties

Shall be as shown in Table 3, determined in accordance with ASTM E 8/E 8M.

TABLE 3 - MINIMUM TENSILE PROPERTIES AFTER PRECIPITATION HEAT TREATMENT

| Property | Value |
|--|--------------------|
| Tensile Strength | 170 ksi (1172 MPa) |
| Yield Strength at 0.2% Offset | 115 ksi (793 MPa) |
| Elongation in 2 inches (50.8 mm) or 4D | |
| Strip Specimen | 12% |
| Full Tube | 15% |

3.6.2.2 Hardness

Should be not lower than 30 HRC, or equivalent (See 8.2), determined in accordance with ASTM E 18. Tubing shall not be rejected on the basis of hardness if the tensile property requirements of 3.5.2.1 are acceptable, determined on specimens taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness.

3.7 Quality

Tubing, as received by purchaser, shall be uniform in quality and condition and shall have a finish conforming to the best practice for high quality aircraft tubing. It shall be smooth and free from grease, oil and other foreign matter, heavy scale or oxide, burrs, seams, tears, grooves, laminations, slivers, pits, and other imperfections detrimental to usage of the tubing. Surface imperfections such as handling marks, straightening marks, light mandrel and die marks, shallow pits, and scale pattern will not be considered injurious if the imperfections are removable within the tolerances specified for wall thickness but removal of such imperfections is not required.

3.7.1 When specified by purchaser (See 8.5), tubing shall be subjected to fluorescent penetrant inspection in accordance with ASTM E 1417, to ultrasonic inspection in accordance with AMS2634, to electromagnetic (eddy-current) inspection in accordance with ASTM E 426, or to any combination thereof. Tubing shall meet the requirements of acceptance criteria established by the cognizant engineering organization.

3.8 Tolerances

Shall conform to all applicable requirements of AMS2263.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The vendor of tubing shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the tubing conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (3.1), tensile properties (3.6.1.1) response to precipitation heat treatment (3.6.2.1), average grain size (3.6.1.2), hardness (3.6.2.2), nondestructive inspection when specified (3.7.1), and tolerances (3.8) are acceptance tests and shall be performed on each heat or lot as applicable.