



# AEROSPACE MATERIAL SPECIFICATION

**AMS2631™****REV. G**

Issued 1972-11  
Reaffirmed 2007-02  
Revised 2022-06

Superseding AMS2631F

Ultrasonic Inspection  
Titanium and Titanium Alloy Bar, Billet, and Plate

## RATIONALE

AMS2631G is the result of a limited scope ballot to update Tables 3 and 4.

### 1. SCOPE

#### 1.1 Purpose

This specification covers the procedure for ultrasonic inspection of wrought titanium and titanium alloy products 0.25 inch (6.4 mm) and over in cross-section (thickness) or diameter.

1.1.1 When specifically requested by purchaser, this specification may be used for metals other than titanium.

#### 1.2 Application

This procedure has been used typically for locating internal defects, such as cracks, voids, spongy areas, inclusions, and other structural discontinuities, which may or may not be exposed to the surface, but usage is not limited to such applications.

1.2.1 Testing will normally be accomplished by a procedure utilizing straight beam longitudinal wave inspection with acceptance criteria specified in the Ultrasonic Quality classes as in Table 8 of this specification, but angle beam inspections accomplished by a procedure utilizing either refracted longitudinal or shear wave inspection may be used when agreed upon by purchaser and inspection source.

1.2.2 Round bar and billet may use AMS2628 techniques and equipment for billet over 4.5 inches, using the acceptance criteria of Table 8 of this 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.

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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 +1 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

|          |   |
|----------|---|
| AMS2380  | Approval and Control of Premium-Quality Titanium Alloys                             |
| AMS2628  | Enhanced Ultrasonic Immersion Inspection for Titanium and Other Metal Alloy Billets |
| AMS4928  | Titanium Alloy Bars, Wire, Forgings, Rings, and Drawn Shapes 6Al - 4V Annealed      |
| ARP1917  | Clarification of Terms Used in Aerospace Metals Specifications                      |
| SAE J300 | Engine Oil Viscosity Classification   |

## 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](http://www.astm.org).

|           |   |
|-----------|---|
| ASTM E127 | Fabrication and Control of Flat Bottomed Hole Ultrasonic Standard Reference Blocks  |
| ASTM E317 | Evaluating Performance Characteristics of Ultrasonic Pulse-Echo Testing Systems Without the Use of Electronic Measurement Instruments |

## 2.3 AIA Publications

Available from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 703-358-1000, [www.aia-aerospace.org](http://www.aia-aerospace.org).

|        |  |
|--------|--|
| NAS410 | NAS Certification & Qualification of Nondestructive Test Personnel |
|--------|--|

## 2.4 ANSI Accredited Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

|            |                 |
|------------|-----------------|
| ANSI B46.1 | Surface Texture |
|------------|-----------------|

## 2.5 ASNT Publications

Available from American Society for Nondestructive Testing, P.O. Box 28518, 1711 Arlingate Lane, Columbus, OH 43228-0518, Tel: 800-222-2768 (inside U.S. and Canada) or 614-274-6003 (outside USA), [www.asnt.org](http://www.asnt.org).

|           |   |
|-----------|---|
| SNT-TC-1A | Recommended Practice, Personnel Qualification and Certification in Nondestructive Testing |
|-----------|---|

## 2.6 Airlines for America (A4A) Publications

Available from Airlines for America (A4A), 1301 Pennsylvania Avenue, NW, Suite 1100, Washington, DC 20004, Tel: 202-626-4000, [www.airlines.org](http://www.airlines.org).

|         |  |
|---------|--|
| ATA-105 | Guidelines for Training and Qualifying Personnel in Nondestructive Testing |
|---------|--|

### 3. TECHNICAL REQUIREMENTS

#### 3.1 Qualification

##### 3.1.1 Personnel

Shall be qualified and certified in accordance with NAS410. Alternate procedures, i.e., SNT-TC-1A or ATA-105, may be used if permitted on the purchase order. It is the inspection source's responsibility to ensure that personnel are certified and function within the limits of the applicable specification or procedure.

##### 3.1.2 Facilities

Shall be subject to survey and approval by either the purchaser or a third party that is independent of the purchaser. Reference specifications, procedures, and documentation necessary to verify the qualification of equipment and test personnel shall be available to purchaser, when requested.

##### 3.1.3 Written Procedure

Ultrasonic inspections performed in accordance with this specification shall be detailed in written procedures. Procedures shall identify the type of ultrasonic equipment, method(s) of test, ultrasonic test reference standards, search unit type, style, corrected beam/type focusing and frequency, method of reporting indications, and all other instructions that pertain to the actual test. Procedures shall be detailed sufficiently that another qualified investigator could duplicate the test and obtain equivalent information.

#### 3.2 Equipment

##### 3.2.1 Basic Ultrasonic Test Instrument

Shall be capable of producing, receiving, and displaying high-frequency electrical pulses at the required frequencies and energy levels. The ultrasonic instrument shall be of the pulse-echo type capable of operating at 2.25 through 10 MHz except as permitted in 3.2.2.2. Gates, distance-amplitude correction systems, and other electronic aids to ultrasonic testing and interpretation shall be used as required. An alarm system, a recorder, or an auto-stop device, or combination of these, may be used.

##### 3.2.1.1 Instrument Linearity

The instrument performance characteristics shall be evaluated in accordance with ASTM E317 or original manufacturer's requirements with acceptance in accordance with Table 1.

**Table 1 - Acceptance for instrument characteristics**

| Instrument Characteristics                   | Acceptance  |
|--|---|
| Upper linearity limit, percent of full scale | ≥95   |
| Lower linearity limit, percent of full scale | ≤10   |
| Vertical linearity, percent of full scale    | ≤5  |
| Horizontal linearity, percent of full scale  | ≤2  |
| Gain or attenuator (sensitivity) accuracy    | ±2 dB per 20 dB of control range and within ±10% of the reference amplitude for each increment. |

##### 3.2.2 Ultrasonic Search Units

Shall be capable of transmitting and receiving ultrasonic vibrations at the frequency and energy levels specified below. The frequency used shall be the highest practical ultrasonic frequency which will provide the required penetration, resolution, and signal to noise.

### 3.2.2.1 Search Unit Dimensions and Styles

For both contact and immersion tests with either longitudinal or shear mode, the choice of transducer dimension, style, focusing characteristics, type, etc., is dependent on the test and the approved test procedure. In general, for immersion testing, flat-faced or corrected-beam transducers with diameters 3/8 through 1 inch (9.5 through 25.4 mm) or rectangular units with a maximum area of 1 square inch (6.5 cm<sup>2</sup>) are acceptable. Contact units with a maximum area of 1 square inch (6.5 cm<sup>2</sup>) with 1/2 inch (12.7 mm) minimum to 1-1/8 inch (28.5 mm) maximum dimensions are acceptable for longitudinal testing, while 1 square inch (6.5 cm<sup>2</sup>) or 1 by 1/2 inch (25.4 by 12.7 mm) transducers are acceptable for shear testing. Use of a paint brush, liquid delay, special size, or other special transducer is acceptable when agreed upon by purchaser and inspection source.

3.2.2.2 Shall be the highest practical frequency which will provide the penetration and resolution required. Frequencies lower than 2.25 MHz for longitudinal inspections or 1.0 MHz for shear inspections shall not be used unless agreed upon by purchaser and inspection source.

### 3.2.3 Phased Array Search Units

A virtual probe is defined as a group of individual array elements, pulsed simultaneously or at phasing intervals to generate a larger acoustic aperture.

3.2.3.1 The virtual probe dimensions (sum length of elements pulsed to form a single beam) shall meet the dimensions defined in 3.2.2.1.

3.2.3.2 Virtual probes within a linear array shall meet the requirements for minimum index in both the scan and index directions.

3.2.3.3 There shall be no more than one dead element in a virtual probe and the array shall not have two adjacent dead elements.

3.2.3.4 All virtual probes in the array shall exhibit an amplitude response within 10% of the mean amplitude.

### 3.2.4 Voltage Regulator

If fluctuations in line voltage cause variations exceeding  $\pm 5\%$  in a signal with an amplitude equal to the upper linearity limit of the instrument, a voltage regulator shall be used on the power source; this requirement does not apply to battery-powered units.

### 3.2.5 Couplant

#### 3.2.5.1 Immersion Method

For inspection by the immersion method, clean tap water shall be used as the couplant material; rust inhibitors, wetting agents, or both, may be added. The water shall be free of visible air bubbles which could interfere with the ultrasonic test.

#### 3.2.5.2 Contact Method

For inspection by the contact method, couplants that may be used include SAE 30 motor oil in accordance with SAE J300, cellulose gum, or other couplant materials, as long as they do not damage the material under inspection. Neoprene or urethane rubber sheet or similar material may be used between the transducer and the product being tested to prevent excessive transducer wear provided adequate compensation for its use is made.

### 3.2.6 Longitudinal Reference Standards

Shall be fabricated from AMS4928 titanium alloy or from other titanium alloy acoustically similar to the alloy to be tested. The procedures established in ASTM E127 are recommended for manufacturing ultrasonic reference blocks with flat bottom holes (FBH) for straight beam testing.