Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

# AEROSPACE MATERIAL SPECIFICATION

AMS 4977

Issued 11-1-69
Revised

## TITANIUM ALLOY BARS AND WIRE
## 11.5Mo - 6.0Zr - 4.5Sn
## Solution Heat Treated

1. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

2. APPLICATION: Primarily for parts requiring high strength-to-weight ratio up to 700 F (371 C), where cold formability is desirable or necessary. Suitable for aircraft fasteners and for aerospace structures requiring deep hardenability.

3. COMPOSITION:

| | min | max | |
|---|---|---|---|
| Molybdenum | 10.00 | 13.00 | |
| Zirconium | 4.50 | 7.50 | |
| Tin | 3.75 | 5.25 | |
| Iron | -- | 0.35 | |
| Oxygen | -- | 0.18 | |
| Hydrogen | -- | 0.0200 | (200 ppm) |
| Carbon | -- | 0.10 | |
| Nitrogen | -- | 0.05 | (500 ppm) |
| Other elements, total (1) | -- | 0.40 | |
| Titanium | remainder | | |

(1) Determination not required for routine acceptance.

3.1 Check Analysis: Composition variations shall meet the requirements of the latest issue of AMS 2249.

4. CONDITION: Unless otherwise ordered, the product shall be supplied in the following condition:

4.1 Bar: Hot finished, with or without subsequent cold reduction, solution heat treated, straightened, and descaled.

4.2 Wire: Hot finished, with or without subsequent cold reduction, solution heat treated, and descaled.

5. TECHNICAL REQUIREMENTS:

5.1 Solution Heat Treatment: The product shall be solution heat treated by heating to a temperature within the range 1275 - 1350 F (690.6 - 732.2 C), holding at the selected temperature within ± 25 F (± 14 C) for 15 min., and quenching in water.

5.2 Properties as Solution Heat Treated:

5.2.1 Tensile Properties: These properties apply when the rate of strain is maintained at 0.003 - 0.007 in. per in. per min. through the yield strength, and then is increased so as to produce failure in approximately one additional minute. When a dispute occurs between purchaser and vendor over the yield strength values, a referee test shall be performed on a test machine having a strain rate pacer, using a rate of 0.005 in. per in. per min. through the yield strength and a minimum cross head speed of 0.10 in. per min. above the yield strength.

| Nominal Diameter or Distance Between Parallel Sides Inches | Tensile Strength psi, min | Yield Strength at 0.2% Offset psi, min | Elongation % in 2 in or 4D, min | Reduction of Area (round specimens) %, min |
|---|---|---|---|---|
| Up to 1.625, incl | 110,000 | 90,000 | 15 | 50 |
| Over 1.625 to 3.000, incl | 100,000 | 90,000 | 15 | 50 |

5.2.1.1 Tensile properties for sizes over 3.000 in. in diameter or distance between parallel sides shall be as agreed upon by purchaser and vendor.

5.2.2 Hardness: The product should have hardness not higher than Rockwell C 30 or equivalent but shall not be rejected on the basis of hardness if the tensile property requirements are met.

5.3 Properties after Precipitation Heat Treatment: Material shall conform to the following requirements after being heated to 1050 - 1100 F (565.6 - 593.3 C), held at heat for not less than 2 hr, cooled in air, and descaled. Precipitation heat treatment shall precede final machining of specimens.

5.3.1 Tensile Properties: These properties apply to bars and wire up to 1.625 in., incl, in diameter or distance between parallel sides and when the rate of strain is maintained at 0.003 - 0.007 in. per in. per min. through the yield strength and then is increased so as to produce failure in approximately one additional minute. When a dispute occurs between purchaser and vendor over the yield strength values, a referee test shall be performed on a machine having a strain rate pacer, using a rate of 0.005 in. per in. per min. through the yield strength and a minimum cross head speed of 0.10 in. per min. above the yield strength.

| | |
|---|---|
| Tensile Strength, psi | 135,000 min |
| Yield Strength at 0.2% Offset, psi | 130,000 min |
| Elongation, % in 2 in. or 4D | 12 min |
| Reduction of Area (round specimens), % | 40 min |

5.3.1.1 Tensile property requirements for sizes over 1.625 in. in diameter or distance between parallel sides shall be as agreed upon by purchaser and vendor.

5.3.2 Hardness: The product should have hardness of Rockwell 30 - 38 or equivalent but shall not be rejected on the basis of hardness if the tensile property requirements are met.

6. QUALITY: Unless otherwise specified, material shall be produced by multiple melting using consumable electrode practice; at least one of the melting cycles shall be under vacuum. The product shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts.

7. TOLERANCES: Unless otherwise specified, tolerances for bars and wire shall conform to all applicable requirements of the latest issue of AMS 2241. Tolerances for sizes not covered by AMS 2241 shall be as agreed upon by purchaser and vendor.

8. REPORTS:

8.1 Unless otherwise specified, the vendor of the product shall furnish with each shipment three copies of a report of the results of tests for chemical composition of each heat in the shipment and the results of tests on each lot to determine conformance to the hydrogen and technical requirements of this specification. A lot is defined as all material of the same nominal size from the same heat processed at the same time. This report shall include the purchase order number, heat number, material specification number, size, and quantity from each heat.