

MIL-T-5421B  
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MILITARY SPECIFICATION

TUBES, PITOT, ELECTRICALLY HEATED, AIRCRAFT

This specification is mandatory for use by all Departments and Agencies of the Department of Defense

1. SCOPE

1.1 This specification covers all types of two-wire electrically heated pitot tubes identified as follows:

Type I Rated Voltage -24-Volt, Direct Current  
AN5811-1 "L" Shaped, Inverted  
AN5812-1 "L" Shaped  
AN5813-1 Straight

Type II Rated Voltage-115-Volt, 400-Hz, Single-Phase  
Alternating Current  
AN5811-2 "L" Shaped, Inverted  
AN5812-2 "L" Shaped  
AN5813-2 Straight

\* 2. APPLICABLE DOCUMENTS

\* 2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

Federal

PPP-B-636 Box, Fiberboard

Military

MIL-P-116 Preservation, Methods of  
MIL-D-1000 Drawing, Engineering and Associated List

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MIL-S-7742 Screw Threads, Standard, Optimum Selected Series,  
General Specification for  
MIL-A-8625 Anodic Coatings, for Aluminum and Aluminum Alloys

STANDARDSFederal

FED-STD-151 Metal, Test Methods

Military

MIL-STD-129 Marking for Shipment and Storage  
MIL-STD-143 Specification and Standard Order of Precedence for  
the Selection of  
MS35207 Screw, Machine-Pan Head, Cross-Recessed, Carbon Steel,  
Cadmium Plated, UNF-2A  
MS35338 Washer, Lock, Split, Helical, Medium Series

Air Force - Navy Aeronautical

AN786 Coupling-Airspeed Tube Union (Brazing)  
AN3115 Receptacle-Airspeed Tube Electrical  
AN5811 Tube-Pitot, Electrically Heated, "L" Shaped Inverted  
AN5812 Tube-Pitot, Electrically Heated, "L" Shaped  
AN5813 Tube-Pitot, Electrically Heated

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

## 3. REQUIREMENTS

\* 3.1 First article. This specification provides for first article testing.

3.2 Materials. Materials shall be as specified herein. Materials which are not specifically designated shall be of the best commercial quality and suitable for the purpose intended.

3.2.1 Metals. Metals shall be corrosion-resistant unless protected to resist corrosion during normal service life.

3.2.2 Nonmagnetic materials. Nonmagnetic materials shall be used for all parts of the tube, except where magnetic materials are essential.

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3.2.3 Selection of materials. Specifications and standards for all materials, parts, and Government certification and approval of processes and equipment, which are not specifically designated herein and which are necessary for the execution of this specification, shall be selected in accordance with MIL-STD-143, except as provided in the following paragraph.

3.2.3.1 Standard parts. MS or AN standard parts shall be used wherever they are suitable for the purpose, and shall be identified on the drawing by their part numbers. Commercial utility parts such as screws, bolts, nuts, cotter pins, etc., may be used, provided they possess suitable properties and are replaceable by the MS or AN standard parts without alteration, and provided the corresponding standard part numbers are referenced in the parts list and, if practicable, on the contractor's drawings. In the event there is no suitable corresponding standard part in effect on date of invitation for bids, commercial parts may be used provided they conform to all requirements of this specification.

3.3 Design and construction. The design of the tubes shall conform to AN5811, AN5812, or AN5813, as specified. The tubes shall be so constructed that no parts will work loose in service. They shall be built to withstand the normal strains of jars, vibrations, and such other conditions as are incident to shipping, storage, installation, and service without failure.

3.3.1 Finish. Protective coatings and finishes which will crack, chip, or scale during normal service life or due to extremes of atmospheric conditions shall not be used.

3.3.1.1 The outside of the tube shall be finished with a durable dull color acceptable to the procuring service.

3.3.1.2 Aluminum-alloy parts shall be covered with an anodic film conforming to MIL-A-8625.

3.3.2 Screw threads. Machine screw threads greater than 0.060 inch in diameter shall be in accordance with MIL-S-7742.

3.3.3 Drainage. The tube shall be so designed that when ice on the tube is melted under flight conditions, the water resulting therefrom shall drain from the tube and not be conducted into the impact pressure line where it may freeze.

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\*3.3.4 Heating element. The tubes shall be electrically heated. The heating element placed in the nose of the tube shall have a minimum rating of 120 watts at rated voltage with the outer shell of the tube immersed in a water-ice mixture at a temperature of approximately 0°C (32°F).

3.3.5 Electrical circuit. The electrical circuit of the tube shall be of the two-wire type and shall be provided with an AN3115-1 snap type receptacle.

3.3.6 Sleeve assembly. The sleeve assembly shown on Drawing AN5813 shall be furnished as a part of each AN5813 tube.

3.3.7 Shipping caps. The threads of coupling AN786-1, and the total pressure opening shall be suitably protected by a slip-on cap of nonstrategic material.

3.4 Interchangeability. All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation and performance. Changes in manufacturer's part numbers shall be governed by the drawing number requirements of MIL-D-1000.

3.5 Performance. The tubes shall satisfy the performance requirements specified in Section 4 when subjected to the applicable tests.

3.6 Identification of product. The following information shall be etched, engraved, or stamped on each tube in a location that will not interfere with proper operation of the tube.

Name of Tube (as shown on the AN drawing)  
 Rated Voltage  
 AN Part No.  
 Stock No.  
 Manufacturer's Part No.  
 Contract or Order No.  
 Manufacturer's Name or Trade-Mark  
 U. S. Property

3.6.1 The word "TOP" shall be etched, engraved, or stamped on the tube in the location shown on the AN drawing.

### 3.7 Installation.

3.7.1 Installation instructions. Unless otherwise specified, the contractor shall furnish with each tube, one printed copy of instructions, with illustrations and diagrams, if necessary, covering the installation of the tube. Prior to printing, two copies shall be furnished to the Procuring Service for approval.

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Whenever possible, the instructions shall be arranged to require only one sheet of paper, either 8-1/2 by 11 inches or 17 by 11 inches.

3.7.2 Mounting screws. The contractor shall furnish four MS35207-226 mounting screws and four MS35338-41 lockwashers for installing the assembly.

3.7.3 Envelope. An envelope containing the installation instructions (when required), mounting screws, and lockwashers shall be furnished with each tube. The following information shall be printed on the face of the envelope:

**"IMPORTANT**

This envelope contains installation instructions and mounting screws."

3.8 Workmanship. Workmanship shall be in accordance with the best practice for high quality aircraft instruments.

**4. QUALITY ASSURANCE PROVISIONS**

\*4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

\*4.2 Classification of tests. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.3).
- b. Quality conformance inspection (see 4.4).

\*4.3 First article inspection.

\*4.3.1 First article sample. The sample shall consist of three tubes of each part number specified in the contract or order, representative of the production equipment. The samples shall be identified with the manufacturers part number and such other information as required by the procuring activity.

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\*4.3.2 First article tests. First article tests of tubes shall consist of all the tests specified under Quality Conformance Inspection and, in addition, the tests described in the following paragraphs.

\*4.3.2.1 Error at zero angle of attack. The tube shall be mounted in a wind tunnel in line with the air flow and tested separately for impact pressures at speeds of 50 to 600 knots, inclusive, in increments of 50 knots. This test shall be made by comparison with the results obtained under similar conditions with a standard tube. The error in indicated airspeed obtained shall in no case exceed 1.0 knot. A 'standard tube' is a pitot tube with a known accuracy and calibration.

4.3.2.2 Error at various angles of attack. The tube shall be tested at 150 knots for impact pressure at angles of attack varying by 2-degree increments from +14 degrees to -10 degrees. The indicated airspeed at any of the test intervals shall not differ from the indicated airspeed, at zero pitch, by more than 1.0 knot.

4.3.2.3 Corrosion due to salt spray. The tube, complete with the sleeve (AN5813 only), and electrical receptacle attached, shall be exposed to salt spray in accordance with FED-STD-151 for a period of 50 hours. No excessive corrosion or damage to any part of the tube shall result from this test.

4.3.2.4 De-icing. The tube shall be tested in an icing wind tunnel at an indicated tunnel speed of 100 knots, and an ambient temperature of  $-15^{\circ}\text{C}$   $-5^{\circ}\text{C}$  ( $+5^{\circ}\text{F}$   $19^{\circ}\text{F}$ ). The nose of the tube shall be coated with an ice cap approximately 1/4 inch thick, and then the applicable voltage, as listed below, shall be applied.

For Type I tubes - 22-volt, Direct Current

For Type II tubes - 105-volt, 400 Hz, Single-Phase, AC

The time required to clear the ice-cap after the above voltage is applied shall not exceed 2 minutes.

4.3.2.5 Cold resistance. The tube shall be subjected to a temperature of  $-35^{\circ}\text{C}$  ( $-35^{\circ}\text{F}$ ) for 48 hours. There shall be no evidence of damage. At the option of the Procuring Activity, any or all of the tests shall be conducted after this test.

4.3.2.6 High pressure leakage. The impact pressure opening and drain holes shall be sealed and a test manometer connected to the impact connection. A pressure of 80 inches of mercury shall be applied. During a 1-minute period the pressure shall not drop below 79.80 inches of mercury.

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\* 4.4 Quality conformance inspection. Quality conformance inspection shall consist of individual tests and sampling tests.

4.4.1 Individual tests. Each tube submitted for acceptance under contract shall be subjected to the following tests. In addition, each tube shall be subject to any other test specified herein which the inspector considers necessary to determine conformance with the requirements of this specification.

4.4.1.1 Examination of product. Each tube shall be carefully examined to determine conformance with the requirements of this specification not covered by applicable tests.

4.4.1.2 Leakage. The impact pressure opening and drain holes shall be sealed and a test manometer connected to the impact connection. A pressure of 30 inches of mercury shall be applied. During a 1-minute period, the pressure shall not drop below 29.95 inches of mercury.

4.4.1.3 Electrical circuit. At an ambient temperature from 20° to 30°C (68° to 86°F), rated voltage shall be applied across the terminals of the tube for a period of 2 minutes. After the 2-minute period, the power shall be 80 watts, +20 or -5 percent.

4.4.1.4 High potential. The tube shall be subjected to a high potential test with the following voltage, at commercial frequency, applied between each terminal and the case for a period of 60 seconds:

<u>Tube Type</u>	<u>Sea Level</u>	<u>50,000 Feet Altitude</u>
I	550 v. rms	110 v. rms
II	1250 v. rms	500 v. rms

No damage to the wiring or insulation shall result from this test.

4.4.2 Sampling tests. Five tubes, selected by the inspector at random from each 500 tubes, or less, of each lot which have passed the required individual tests shall be subjected to the following tests. A lot shall consist of all the tubes of the same part number which are submitted for acceptance under the same contract or order.

4.4.2.1 Vibration. The tubes shall be subjected to vibration such that a point on the tip of the tube will oscillate 1/4 inch. The test shall be conducted for a period of 3 hours which shall consist of 1-hour periods at 1,000, 2,000 and 3,000 cycles per minute. Type I tubes shall be operated on 30 volts direct current, and type II tubes shall be operated on 120 volts, 400 hz, alternating current continuously during this test. Ambient temperature shall be 20° to 30°C (68° to 86°F). No leaks or failure of any kind shall result from this test.



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**4.4.2.2 Power consumption.** Each tube shall be supported vertically, fully immersed in a water-ice mixture at a temperature of approximately 0°C (32°F) within 1/4 inch of the mounting surface and shall be allowed to remain there for a period of 10 minutes. The electrical connector pins shall then be connected through a test circuit containing a 7-ampere fuse for type I tubes, or a 2-ampere fuse for type II tubes, to a source of rated voltage. The initial current surge shall not cause the fuse to fail. After the specified potential has been applied for a period of 5 minutes, the power shall be measured and shall be 120 watts, +25%, -0%.

**4.4.2.3 Endurance.** Type I tubes shall be operated on 30 volts direct current, and type II tubes shall be operated on 120-volts, 400 hz, single-phase alternating current, continuously for 5 hours. There shall be no damage of any kind except discoloration, which will not affect corrosion resistance. This test may be combined with the vibration test by extending the period of power application to 5 hours. Ambient temperature shall be 20° to 30°C (68° to 86°F).

**4.4.2.4 Heat conductivity.** One liter of tap water shall be placed in a glass beaker, and the heated part of the tube shall be supported vertically with the nose immersed in the water to a depth of 1-1/2 inches. With the tube and water at approximately room temperature, rated voltage shall be applied after first noting the water temperature with a standard thermometer. During this test the water shall be stirred gently to assure uniform temperature throughout; and the thermometer shall be properly suspended approximately 1-1/4 inches from the surface of the tube under test. Fifteen minutes after the voltage has been applied, the temperature of the water shall have risen not less than 8°C (14.4°F).

**4.4.2.5 Weight.** The tube shall be weighed without the AN3115 electrical assembly and without the mounting screws and lockwashers, MS35207 and MS35338, respectively, AN5813 tubes shall be weighed with the sleeve assembly installed. The weight shall not exceed 1.0 pound.

**4.4.2.6 Magnetic property.** The tube shall be held in various positions on an East-West line and 5 lines from the center of a free magnet, approximately 1-1/2 inches long, in a magnetic field with a horizontal intensity of 0.18 ± 0.01 gauss. (An aircraft compass with the compensating magnets removed therefrom may be used as the free magnet for this test). The test shall be made first with no voltage applied to the tube and then shall be repeated with the tube operated on rated voltage. The deflection of the compass shall be not greater than 5 degrees.

**4.4.3 Rejection and retest.**



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4.4.3.1 The individual tubes failing to meet their respective tests shall be rejected.

4.4.3.2 When tests are specified on a quantity of tubes that are selected as representative of a certain lot, and one or more of this number fails to meet the requirements, additional tubes of the lot represented shall be tested immediately to determine the cause of failure. Individual performance tests shall not be interrupted, unless the defect is of such a nature that it will seriously affect the performance or safe use of the tube. When the cause of the failure has been determined, the contractor shall incorporate the changes necessary to correct the defects in the remaining tubes of the order.

4.4.3.3 Rejected tubes either shall be replaced with other tubes or shall be reworked to correct the defects, after which all specified tests shall be repeated.

4.4.3.4 Rejected tubes shall not be resubmitted for inspection without furnishing full particulars concerning previous rejection and measures taken to overcome the defects.

4.4.4 Accepted tubes shall be stamped with the official acceptance stamp.

\* 4.5 Inspection of preservation and packaging. Inspection and testing of preservation and packaging shall be accomplished in accordance with the requirements of section 5 or the documents specified therein.

### 5. PREPARATION FOR DELIVERY

#### \* 5.1 Packaging.

\* 5.1.1 Level A. Tubes shall be packaged in accordance with Method 1A of MIL-P-116, without the use of contact preservative, one each in a container conforming to PPP-B-636, weather-resistant class.

\* 5.1.2 Level C. Tubes shall be provided sufficient protection against physical and mechanical damage to assure safe delivery, without degradation of the item reliability, from the supply source to the first receiving activity for immediate use.

#### \* 5.2 Packing.

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\*5.2.1 Level A. Tubes packaged as specified in 5.1.1 shall be packed in shipping containers conforming to PPP-B-636, weather-resistant class. Insofar as practicable, exterior containers shall be of uniform shape and size and of minimum cube and tare consistent with the protection required.

\*5.2.2 Level B. Tubes packaged as specified in 5.1.1 shall be packed in domestic class exterior containers conforming to PPP-B-636. Other requirements as specified in 5.2.1 shall apply.

\*5.2.3 Level C. Packing which affords adequate protection against damage during direct domestic shipment from the supply source to the first receiving activity for immediate use. This level shall conform to applicable carrier rules and regulations and may be the suppliers commercial practice, provided the latter meets the requirements of this level.

\*5.3 Marking of shipments. Interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129.

6 NOTES

6.1 Intended use. The tubes covered by this specification are intended for use on aircraft to provide an accurate source of impact pressure for use with airspeed indicators under service conditions of airspeeds up to 650 knots and at temperatures to  $-65^{\circ}\text{C}$  ( $-85^{\circ}\text{F}$ ).

\*6.2 Ordering data. Procurement documents shall specify the following:

- a. The AN part number of the tube desired.
- b. Required levels of packaging and packing.

6.3 Definitions. The term "rated voltage" as used in this specification is defined as follows:

For Type I Tubes - 24-Volt, Direct Current

For Type II Tubes - 115-Volt, 400-Hz, Single-Phase, Alternating Current

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NOTE: The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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