

INCH-POUND
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MIL-DTL-5421D  
5 April 2011  
SUPERSEDING  
MIL-DTL-5421C  
13 July 2007

## DETAIL SPECIFICATION

### TUBES, PITOT, ELECTRICALLY HEATED, AIRCRAFT

Inactive for new design after 5 May 1999.
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This specification is approved for use by all departments and agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope. This specification covers all types of two-wire electrically heated pitot tubes for use with airspeed indicators.

1.2 Classification. The pitot tubes are of the following styles and rated voltages (see 6.2):

1.2.1 Style. The styles of pitot tubes are as follows:

AN5811	-	"L" shaped, inverted
AN5812	-	"L" shaped
SAE AS5813	-	Straight

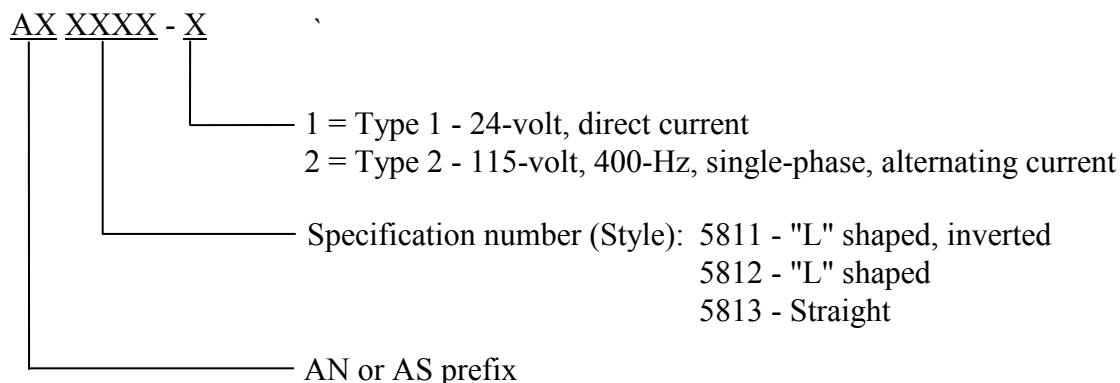
1.2.2 Rated voltage. The rated voltage of the pitot tubes are as follows:

Type 1	-	24-volt, direct current
Type 2	-	115-volt, 400-Hz, single phase, alternating current

Comments, suggestions, or questions on this document should be addressed to Defense Logistics Agency Aviation VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297-5616 or e-mailed to <a href="mailto:STDZNMGT@dla.mil">STDZNMGT@dla.mil</a> . Since contact information can change, you may want to verify the currency of this address information using the ASSIST database at <a href="https://assist.daps.dla.mil">https://assist.daps.dla.mil</a> .
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1.3 Part or identifying number (PIN). The PIN to be used for pitot tubes acquired to this specification is created as follows:



## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of the documents cited in sections 3 and 4 of this specification, whether or not they are listed.

### 2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

#### DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-S-7742	- Screw Threads, Standard, Optimum Selected Series: General Specification for.
MIL-A-8625	- Anodic Coatings for Aluminum and Aluminum Alloys.
AN3115	- Receptacle - Airspeed Tube Electrical.
AN5811	- Tube, Pitot, Electrically Heated, "L" Shaped, Inverted.
AN5812	- Tube, Pitot, Electrically Heated, "L" Shaped.

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## DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-31000 - Technical Data Packages.

(Copies of these documents are available online at <https://assist.daps.dla.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

## AEROSPACE INDUSTRIES ASSOCIATION (AIA)

NASM35207 - Screw, Machine-Pan Head, Cross Recessed, Carbon Steel, Cadmium Plated, UNF-2A (IN./MM).  
 NASM35338 - Washer, Lock-Spring, Helical, Regular (Medium) Series.

(Copies of these documents are available online at <http://www.aia-aerospace.org/> or from Aerospace industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209.)

## ASTM INTERNATIONAL

ASTM B 117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

(Copies of these documents are available online at <http://www.astm.org/> or from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.)

## SAE INTERNATIONAL

SAE AS5813 - Tube - Pitot, Electrically Heated.

(Copies of these documents are available online at <http://www.sae.org/> or from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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## 3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.3.

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

3.3.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements and promotes economically advantageous life cycle costs.

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

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

3.4 Standard parts. MS or AN standard parts shall be used wherever they are suitable for the purpose. They shall be identified on the drawing by their parts numbers. Commercial utility parts such as screws, bolts, nuts, and cotter pins 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 parts numbers are referenced in the parts list and, if practicable, on the contractors drawings. In the event there is no suitable corresponding standard part in effect on the date of invitation for bids, commercial parts may be used provided they conform to all requirements of this specification.

3.5 Design and construction. The design of the tubes shall conform to AN5811, AN5812, and SAE AS5813 as specified. The tubes shall be constructed so that no parts will work loose in service. The tubes 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.

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

3.5.1.1 Tube exterior. The tube exterior shall be finished with a durable dull color acceptable to the procuring activity.

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

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

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

3.5.4 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 the rated voltage with the outer shell of the tube immersed in a water-ice mixture at a temperature of 0 °C (32 °F).

3.5.5 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.

3.5.6 Sleeve assembly. The sleeve assembly shown on SAE AS5813 drawing shall be furnished as a part of each SAE AS5813 tube.

3.5.7 Shipping caps. The threads of the coupling and the total pressure opening shall be suitably protected by a slip-on cap of non-strategic material.

3.6 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 MIL-STD-31000.

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

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

Name of tube (as shown on the AN or AS drawing)  
Rated voltage  
AN or AS part number  
National stock number  
Manufacturer's part number  
Contract or order number  
Manufacturer's name or trademark  
U.S. Property  
Word "TOP" at location specified on the AN or AS drawing

3.9 Installation.

3.9.1 Installation instructions. Unless otherwise specified (see 6.2), the contractor shall furnish one printed copy of instructions for each tube. The instructions shall contain illustrations and diagrams if necessary. Prior to printing, two copies shall be furnished to the procuring activity for approval. The instructions shall be arranged on a single sheet of paper either 8-1/2 inches X 11 inches, or 11 inches X 17 inches.

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3.9.2 Mounting screws. The contractor shall furnish four NASM35207-226 mounting screws and four NASM35338-41 lockwashers for installing the assembly.

3.9.3 Envelope. When required (see 6.2), an envelope containing the installation instructions, 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.

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

## 4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are as follows:

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

4.2 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in paragraphs 4.2.1 and 4.2.2.

4.2.1 Ambient temperature. The ambient temperature for all tests shall be 20 °C to 30 °C (68 °F to 86 °F).

4.2.2 Rated voltage. The rated voltage for type 1 tubes shall be 24 volts direct current (VDC) and the voltage for type 2 tubes shall be 115-volt, 400 Hz, single phase alternating current.

4.3 First article inspection. First article inspection shall consist of the individual tests of 4.5 and all the tests of 4.6.

4.3.1 First article sample. The first article sample shall consist of three tubes of each part number specified in the acquisition order. The sample shall be representative of production pitot tubes. The samples shall be identified with the manufacturer's part number and any other information specified by the procuring activity (see 6.2).

4.4 Conformance inspection. Conformance inspection shall consist of the individual tests of 4.5 and the tests 4.6.1 through 4.6.6.

4.4.1 Conformance inspection sample. Five tubes that have passed the individual tests shall be selected at random from each lot of 500 tubes or less. The five selected tubes shall be subjected to the tests of 4.6.1 through 4.6.6. A lot shall consist of all the tubes of the same part number submitted for acceptance under the same acquisition order.

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

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

4.5.2 Leakage. The impact pressure opening and drain holes shall be sealed and a test manometer connected to the impact connection. A pressure of 14.73 pounds per square inch (psi) (30 inches of mercury) shall be applied. The pressure shall not drop below 14.71 psi (29.95 inches of mercury) after a one-minute period.

4.5.3 Electrical circuit. The rated voltage shall be applied across the terminals of the tube for a period of two minutes at an ambient temperature of 20 °C to 30 °C (68 °F to 86 °F). After the two-minute period the power shall be 80 watts (W) +20/-5 percent.

4.5.4 High potential. The tube shall be subjected to a high potential test with the voltages listed in table I at a commercial frequency applied between each terminal and the case for a period of 60 seconds. No damage to the wiring or insulation shall result from this test.

TABLE I. Potential test voltages.

Tube type	Sea level	50,000 feet (altitude)
1	550 VRMS	110 VRMS
2	1,250 VRMS	500 VRMS

#### 4.6 Tests.

4.6.1 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 three hours consisting of one-hour periods at 1,000, 2,000, and 3,000 cycles per minute (Hz). Type I tubes shall be operated at 30 VDC and type 2 tubes shall be operated at 120 VAC, 400 Hz, single phase continuously during this test. No leaks or failures of any kind shall result from this test.

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

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4.6.3 Endurance. Type I tubes shall be operated at 30 VDC and type 2 tubes shall be operated at 120 VAC, 400 Hz, single phase continuously for five hours. There shall be no damage of any kind except discoloration that will not affect corrosion resistance. This test may be combined with the vibration test by extending the period of power application to five hours.

4.6.4 Heat conductivity. One liter (L) of tap water shall be placed in a glass beaker. 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. A thermometer shall be suspended in the water at a distance of approximately 1-1/4 inches from the surface of the tube. With the tube and water at approximately room temperature, the temperature shall be recorded. With the water being gently stirred to assure uniform temperature, the applicable rated voltage shall be applied to the tube. Fifteen minutes after the voltage has been applied, the temperature of the water shall have risen not less than 8 °C (14.4 °F) from the temperature previously recorded.

4.6.5 Weight. The tube shall be weighed without the AN3115 electrical assembly, NASM35207 screws or NASM35338 lock washers. The SAE AS5813 tubes shall be weighed with the sleeve assembly installed. The weight shall not exceed 1.0 pound.

4.6.6 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 1-1/2 inches long (an aircraft compass with the compensating magnets removed may be used as the free magnet) in a magnetic field of  $0.18 \pm 0.01$  gauss. The test shall be conducted first with no voltage applied to the tube and then repeated with the applicable rated voltage applied. The deflection of the free magnet (compass) shall not be greater than 5 degrees.

4.6.7 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 knots to 600 knots in increments of 50 knots. This test shall be made by comparison with the results obtained under similar conditions with a standard tube (a standard tube is a pitot tube with a known accuracy and calibration). The error in indicated airspeed obtained shall not exceed 1.0 knot.

4.6.7.1 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 test interval shall not differ from the indicated airspeed, at zero pitch, by more than 1.0 knot.

4.6.8 Corrosion due to salt spray. The tube, complete with sleeve (SAE AS5813 only) and electrical receptacle attached, shall be exposed to salt spray in accordance with ASTM B 117 for a period of 50 hours. No excessive corrosion or damage to any part of the tube shall result from this test.

4.6.9 Deicing. The tube shall be tested in an icing wind tunnel at an indicated tunnel speed of 100 knots and a temperature of  $-15\text{ °C} \pm 5\text{ °C}$  ( $5\text{ °F} \pm 9\text{ °F}$ ). The nose of the tube shall be coated with an ice cap approximately 1/4 inch thick and then the type I tubes shall be operated at 22 VDC and type 2 tubes shall be operated at 105 VAC, 400 Hz, single phase. The time required to clear the ice cap after the applicable voltage is applied shall not exceed two minutes.



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4.6.10 Cold resistance. The tube shall be subjected to a temperature of -65 °C (-85 °F) for 48 hours. There shall be no evidence of damage. At the option of the procuring activity, any or all tests shall be conducted after this test.

4.6.11 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 39.29 psi (80 inches of mercury) shall be applied. The pressure shall not drop below 39.19 psi (79.80 inches of mercury) during a one-minute period.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the inventory control point's packaging activities within the military service or defense agency, or within the military service's system command. Packaging data retrieval is available from the managing military department's or defense agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The pitot 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 temperatures to -65 °C (-85 °F).

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Style and rated voltage (AN or AS part number) (see 1.2.1).
- c. The specific issue of individual documents referenced (see 2.2.1 and 2.3).
- d. First article, if required (see 3.2 and 4.3).
- e. Installation instructions (see 3.9.1).
- f. Information required for first article sample (see 4.3.1).
- g. Packaging requirements (see 5.1).

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6.3 Marking. MIL-STD-129 may be used for guidance in marking interior packages and exterior shipping containers.

6.4 Subject term (key word) listing.

airspeed indicators

impact pressure

6.5 Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes 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.

Custodians:

Army - AV

Navy - AS

Air Force - 11

DLA - GS

Preparing Activity:

DLA - GS1

(Project 6610-2011-002)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST database at <https://assist.daps.dla.mil>.