

INCH-POUND

MIL-DTL-17896E  
8 April 2008  
SUPERSEDING  
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DETAIL SPECIFICATION  
BAROMETER, ANEROID

Inactive for new design after 7 June 1991

This specification is approved for use by all departments and agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers aneroid barometers for marine use to measure atmospheric air pressure by means of an evacuated metal cell or cells.

1.2 Classification. Barometers should be of the following types, as specified (see 6.2).

Type I - Normal range (26.5 to 31.5 inches/900 to 1060 millibars)

Type II - High range (28 to 38 inches)

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 or 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.

Comments, suggestions, or questions on this document should be addressed to Defense Supply Center Richmond, ATTN: DSCR-VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297-5616 or e-mailed to [STDZNMGT@dla.mil](mailto:STDZNMGT@dla.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST database at <http://assist.daps.dla.mil>.

## MIL-DTL-17896E

### 2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards 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).

#### FEDERAL STANDARDS

FED-STD-H28 - Screw-Thread Standards for Federal Services.

#### DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-S-901 - Shock Tests, H. I. (High Impact) Shipboard Machinery, Equipment, and Systems, Requirements for.

MIL-DTL-15090 - Enamel, Equipment, Light Gray, (Navy Formula No. 111).

#### DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests.

MIL-STD-1916 - DoD Preferred Methods for Acceptance of Product.

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

2.2.2 Other government documents, drawings, and publications. This other government drawing forms a part of this document to the extent specified herein. Unless otherwise specified, the issue of this document is that cited in the solicitation or contract (see 6.2).

#### DEFENSE LOGISTIC AGENCY DRAWINGS

13873-03-0001 - Mercury Free.

(Copies of this document are available from Defense Supply Center Richmond, Attn: DSCR-VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297-5616 or e-mail [STDZNMGT@dlm.mil](mailto:STDZNMGT@dlm.mil).)

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 that are those cited in the solicitation or contract.

#### AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI Z26.1 - American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways – Safety Standard.

## MIL-DTL-17896E

(Application for copies should be addressed to the American National Standards Institute 25 West 43rd Street, 4th floor New York, NY 10036. Electronic copies of ANSI standards may be obtained from <http://www.ansi.org/>.)

## ASTM INTERNATIONAL

- ASTM B 108 - Standard Specification for Aluminum-Alloy Permanent Mold Castings.
- ASTM D 788 - Standard Classification System for Poly (Methyl Methacrylate) (PMMA) Molding and Extrusion Compounds.

(Application for copies should be addressed to ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Electronic copies of ASTM standards may be obtained from <http://www.astm.org/>.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

## 3. REQUIREMENTS

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

3.2 Material.

3.2.1 Corrosion resistance. Metal parts used in the construction of the barometer shall be resistant to corrosion due to electrolytic decomposition, fungus, salt fog, and any other atmospheric condition that may be encountered during use or storage. Aluminum alloy parts shall be anodized or alodined.

3.2.2 Mercury free. All materials used in the barometer or any supplied components shall be mercury free in accordance with drawing 13873-03-0001. A certificate of compliance shall be included with each barometer.

3.3 Design and construction. The barometer shall consist of a case, window, dial, set and index hands, and an aneroid mechanism with the option of a bezel ring and reflector or spacer ring. The barometer shall be constructed so that no parts will work loose due to strains, jars, vibrations, shock, and other conditions incident to shipment, storage, installation, and service. All screws, nuts, and threaded parts shall conform to FED-STD-H28, except where a definite need for a special thread can be demonstrated to exist. Fasteners shall be adequately secured with lock washers, elastic stop nuts, or similar devices to prevent loosening when subjected to vibrations. No special tools shall be required to adjust the barometer.

3.4 Case. The case shall be made of a commercial spun, drawn, or cast brass or bronze, or shall be an aluminum-alloy die casting in accordance with ASTM B 108 alloy number 356.0, B443.0, or 713.0. The case shall be circular in shape and shall have an inside depth of not less than two inches

## MIL-DTL-17896E

nor more than four inches. It shall have a diameter (as measured across the free aperture of the crystal) of 4.75 inches  $\pm$  0.375 inch (120.65  $\pm$  9.52 mm). A circular mounting flange shall be a part of the case. The flange shall be secured to the case by brazing, silver soldering, or mechanical assembly. The flange shall be sturdily made and shall not exceed seven inches in diameter. Three mounting holes with rubber bushing inserts having a 0.188 inch (4.77 mm) inside diameter shall be spaced at uniform distances around the flange. They shall be located so that the barometer can be readily mounted on a wall or similar support without the use of special tools. The top hole shall be on the vertical centerline in line with the 30.0-inch mark. A zero adjusting screw shall be provided for setting the index hand. The adjusting screw shall be accessible through an opening in the case; the opening shall be labeled "Regulator". The opening shall provide for the passage of air to the movement and shall be protected by a fine-mesh screen insert, which shall be readily removable for access to the zero adjusting screw.

3.4.1 Exterior finish. The exterior for the brass or bronze case shall be brush finished and protected by a transparent lacquer or plastic coating. Aluminum die cast cases shall be anodized or alodined and painted. The finish paint shall be in accordance with MIL-DTL-15090.

3.4.2 Bezel ring. The bezel ring, if used, shall be the same material as the case and shall have a polished or brushed finish and a protective coating of the same finish as the case. It shall be sufficiently thick to be rigid. The bezel ring shall be attached to the case by threads or other means adequate to ensure a tight fit. The bezel ring shall hold the window snugly in the case. The bezel ring shall allow removal of the window and aneroid mechanism.

3.4.3 Window. The window shall be either glass in accordance with ANSI Z26.1 or plastic in accordance with ASTM D 788, class 3. The window shall show no defects that will interfere with the assembly or operation of the barometer. A hole shall be provided in the center of the window for the reception of the set hand knob assembly.

3.5 Dial. The dial shall be metal and have a dull white or silver white matte finish. Lettering, numerals, and graduations shall be engraved, deep etched, or stamped into the surface and shall be filled with a durable black enamel. Means shall be provided to prevent the dial from shifting its position with respect to the index hand or case.

3.5.1 Type I barometer graduations. For type I barometers, two sets of graduations shall be provided on two concentric scales: an outer scale graduated in inches of mercury and an inner scale graduated in millibars. The graduations of the inch scale shall extend 360 degrees on the dial ranging from 26.5 to 31.5 inches. The graduations shall be divided in two hundredths with tenths and inches accentuated and identified. The millibar scale shall range from 900 to 1060 millibars and shall be graduated in millibars with fives and tens accentuated and tens identified (990, 1000, 1010). The indications of the millibar scale shall be equivalent to the corresponding values of the inch scale throughout the range of the millibar scale.

3.5.2 Type II barometer graduations. For the type II barometer, the graduations shall be in inches of mercury extending 360 degrees on the dial, ranging on a scale from 28 to 38 inches. The graduations shall be divided into tenths with tenths and inches accentuated and identified.

## MIL-DTL-17896E

3.6. Reflector or spacer ring. The reflector or spacer ring, if used, shall be of formed, drawn, or spun metal with white enamel finish or with the same finish as the dial. The reflector or spacer ring shall fit or be held snugly.

3.7 Indicating hands.

3.7.1 Index hand. The index hand shall be of rigid metal construction with black lacquer finish and centered with relation to the dial and dial graduations. The method of attachment shall be such that the index hand can be easily removed yet will not be accidentally loosened or shifted in position by vibration or jarring. The end of the pointer shall extend more than half way over the smallest graduation on the outer scale but not beyond the longest graduation on the outer scale. The breadth of the hand at the end near the graduations shall be such as to facilitate accurate readings.

3.7.2 Set hand. The set hand shall be of brass or stainless steel, clear lacquered and shall be of the same general width as and concentric with the index hand. The assembly shall be moisture and dust resistant and shall eliminate movement of the hand by vibration under service conditions specified in 3.9 and when tested in accordance with 4.6.5.

3.8 Aneroid mechanism. The aneroid mechanism shall consist of an evacuated metal cell or cells that are sensitive to variations in atmospheric pressure. The cell or cells shall be connected with the index hand by the necessary series of levers, sector racks, pinions, pivots, or linkage chains in such a manner that variations in atmospheric pressure shall be transmitted to the index hand from the cells. The aneroid mechanism shall be mounted on a frame or base plate that can be attached to the case and removed easily for the purpose of adjustment and calibration.

3.8.1 Position compensating. The aneroid mechanism shall be accurately balanced or counter-balanced to withstand the test of 4.6.7.

3.8.2 Mechanical stops. Mechanical stops shall be provided to keep the cell or cells from damage when subjected to one half inch of mercury pressure over the upper range and one half inch of mercury pressure below the lowest range of the barometer.

3.9 Service conditions. The barometer shall operate under any of the following service conditions.

- a. Ambient, low, and high temperature compensation.
- b. Shock.
- c. Vibration.
- d. Salt fog.

3.10 Accuracy and calibration. The accuracy and calibration of the barometers shall be such as to withstand the tests specified in 4.6.8 through 4.6.10.

3.11 Drift. The barometer shall be guaranteed to withstand aging effects for a period of one year, and recalibration at the end of the first six months shall agree with the original

## MIL-DTL-17896E

calibration within 0.05 inch at any point on the scales. The change in calibration for the second six-month period shall not exceed 0.03 inch due to the aging process.

3.12 Marking. The letters shall be of such size as to be easily readable and neat in appearance.

3.12.1 Dial. The following shall be imbedded above the center of the dial, for the identification of the scale to which it applies:

INCHES OF MERCURY  
MILLIBARS

The following shall be imbedded below the center of the dial:

U.S. GOVERNMENT

3.12.2 Case. The following information shall be molded or embedded in clear legible gothic characters on the case or placed on an identification plate, which shall be attached to the case:

BAROMETER, ANEROID TYPE  
NAVY DEPT., NAVSEASYS COM  
MANUFACTURER  
MANUFACTURER TYPE NO.  
(optional)  
CONTRACT NO.  
NATIONAL STOCK NUMBER  
YEAR OF MANUFACTURER  
U.S.A.

3.12.3 Identification plate. The identification plate shall be of such material and construction that will identify the barometer through its useful service life and shall be marked as follows:

<p>CAUTION</p> <p>THE INTENDED USE OF BAROMETERS MAKE IT MANDATORY THAT MATERIAL FURNISHED SHALL CONTAIN NO METALLIC MERCURY AND SHALL BE FREE FROM MERCURY CONTAMINATION.</p>
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#### 4. VERIFICATION

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

- a. First article inspection (see 4.2).
- b. Conformance inspection (see 4.3).

4.2 Inspection conditions. Unless otherwise specified in the contract or order, the instrument shall be tested in an upright vertical wall mounting position and shall be lightly tapped or

## MIL-DTL-17896E

vibrated before each test reading is taken. Vertical shall be considered the position in which the instrument will normally be mounted against a vertical plane with the 30.0-inch mark approximately at the highest point of the scales. Whenever atmospheric pressure or pressure variation is indicated in inches in this specification, it shall be construed as pressure or variation in inches of mercury.

4.2.1 Inspection standards. Prior to conducting the inspections, the manufacturer shall submit a complete description of the prime standards and the test standards proposed for the inspection of the barometer.

4.2.1.1 Prime standard. The prime standard shall be a mercurial manometer traceable to the National Institute of Standards and Technology (NIST).

4.2.1.2 Test standard. The test standard shall be a mercurial or aneroid manometer. The test standard, when compared to the prime standard on two successive runs, shall be able to repeat readings at the same points throughout the range within 0.005 inches.

4.3 First article inspection. First article inspection shall consist of the tests shown in table I. Shock and vibration tests shall be conducted after completion of all other tests.

Table I. First article inspection.

Inspection	Requirement paragraph	Inspection
Examination, visual, material, and dimensional	-----	4.5
Protection, over/under pressure	3.8.2	4.6.1
Temperature compensation at ambient temperature	3.9	4.6.2
Temperature compensation at low and high	3.9	4.6.3
Shock	3.9	4.6.4
Vibration	3.9	4.6.5
Salt fog	3.9	4.6.6
Position compensating	3.8.1	4.6.7
Accuracy – calibration error	3.10	4.6.8
Hysteresis	3.10	4.6.10
Friction	3.10	4.6.11

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-STD-1916 and shall consist of the individual tests (see 4.4.1) for each unit produced, as well as sampling plan A tests (see 4.4.2) or sampling plan B tests (see 4.4.3), as specified (see 6.2).

4.4.1 Individual tests. Each unit shall be subjected to the inspection specified in 4.5.

4.4.2 Sampling plan A tests. Sampling plan A tests are in addition to the individual tests and shall include the tests specified in 4.6.1, 4.6.7, 4.6.8, and 4.6.9. The manufacturer shall select

## MIL-DTL-17896E

the type of sampling plan (attribute, variable, or continuous) in accordance with MIL-STD-1916. The sample size shall be selected in accordance with verification level I of MIL-STD-1916.

4.4.3 Sampling plan B tests. Sampling plan B tests are in addition to the individual and sampling plan A tests and shall include the tests specified in 4.6.2 through 4.6.5. The manufacturer shall select the type of sampling plan (attribute, variable, or continuous) in accordance with MIL-STD-1916. The sample size shall be selected in accordance with verification level I of MIL-STD-1916.

4.5 Visual, material, and dimensional inspection. The barometer shall be visually, materially, and dimensionally examined to verify compliance with the requirements of this specification.

#### 4.6 Tests.

4.6.1 Protection against over pressure and under pressure. At room temperature, the test pressure shall be applied in the sequence shown in table II. Each pressure indicated in table II shall be compared with the test standard. The test points at which data is taken shall have the same pressure valve for increasing and decreasing pressure within 0.04 inch of the test standard barometer during any one test cycle. The rate of pressure change between test points shall be not greater than one inch per minute. This test shall not be interpolated in the test specified in 4.6.8.

Table II. Test procedure.

Type	Under pressure test (one hour)		Increase pressure and hold for 5 to 15 minutes at approximate pressure shown	Over pressure test (one hour)		Decrease pressure and hold for 5 to 15 minutes at approximate pressure shown
I	24	+0 -0.5	27, 29, 31	34	+0.5 -0	31, 29, 27
II	28	+0 -0.5	31, 33, 35,	38	+0.5 -0	35, 33, 31

Note: Pressure values are in inches of mercury.

4.6.2 Temperature compensation at ambient temperature. At any constant pressure within the range of the dial, a change in temperature from 80 °F  $\pm$  2 °F to 40 °F  $\pm$  2 °F (26.7 °C  $\pm$  1.1 °C to 4.4 °C  $\pm$  1.1 °C), or vice versa shall not cause a change in indication greater than 0.04 inch. In making this test, the barometer shall be held at each temperature for at least one hour before a reading is taken.

4.6.3 Temperature compensation at low and high temperature. At any constant pressure in the range 29.4 through 30.6 inches, the sample barometer shall be subjected to a temperature of 0 °F (-17.8 °C) and the change of indication from the indication at room temperature noted. The temperature shall then be raised to 115 °F (46.1 °C) and the change in indication from the indication at room temperature noted. The sample barometer shall be held at each temperature for at least one hour before readings are taken; during this period the temperature shall not vary



## MIL-DTL-17896E

more than 5 °F (2.7 °C). The change of indication from the indication at room temperature shall not be greater than 0.04 inch.

4.6.4 High-impact shock test. The barometer shall be shock tested to meet the high-impact grade B shock requirements in accordance with MIL-STD-901.

4.6.5 Vibration. The sample shall be subjected to the tests specified in 4.6.5.1 through 4.6.5.4. The barometer shall be clamped in a vertical or horizontal normal mounting position on a vibrating table that can be controlled within 10 percent of the specified frequencies and amplitudes. The vibration table shall be designed to provide approximately sinusoidal vibration at all specified frequencies and amplitudes.

4.6.5.1 Direction of vibrations. The barometers shall be vibrated successively over the specified ranges of applied frequencies in three mutually perpendicular directions. Two directions of vibration shall lie in the plane of the barometer.

4.6.5.2 Rate of change of vibration frequencies. The frequency of applied vibration shall be varied uniformly at a rate of approximately 1 hertz (Hz) per minute.

4.6.5.3 Amplitude of applied vibration. The amplitude (1/2 total excursion) of the vibration table shall be in accordance with table III.

Table III. Amplitude-frequency conditions.

Frequency of vibration (Hz)	Amplitude	
	Horizontal (inch/mm)	Vertical (inch/mm)
2 to 10	0.060/1.524	0.060/1.524
10 to 33	0.030/0.762	0.030/0.762

4.6.5.4 Ninety-minute test. The equipment shall be vibrated for at least 30 minutes in each of three directions specified in 4.6.5.1 for a total of at least 90 minutes. The range of the applied frequencies shall be from 2 through 33 Hz. Shock mounts shall not be blocked or removed. After this test is completed, the barometers shall again be subjected, without resetting, to the tests specified in 4.6.7 through 4.6.10.

4.6.6 Salt fog tests. At least two sample aneroid barometers shall be subjected to the salt fog tests of MIL-STD-810. The external and internal structure of the barometers shall be examined to determine evidence of corrosion and for evidence of material that, if attacked by fungi, may lead to instrument failure under service conditions. The barometers shall then be tested in accordance with 4.6.7 through 4.6.10.

4.6.7 Rotation of barometer. The barometer shall be rotated successively into positions 45 degrees forward and 45 degrees backward from vertical and 45 degrees left and 45 degrees right from vertical and the indication read in each position. The difference in indication in any of these positions shall be not greater than 0.04 inch from the indication when the instrument is vertical.

## MIL-DTL-17896E

4.6.8 Calibration error at room temperature.

4.6.8.1 Temperature. Room temperature may be considered to be any temperature between 65 °F and 80 °F (18.3 °C and 26.7 °C). During this test, the temperature shall not change more than 5 °F (2.7 °C) from the temperature at the start of the test. The barometer shall have been at room temperature for at least one hour before this test is begun and shall not have been subjected to pressure variation in excess of one inch for a period of at least 15 hours preceding the test. The sample barometer shall be compared with the test barometer throughout the range over which the tests are made.

4.6.8.2 Pressure. The pressure shall first be reduced from current atmospheric pressure to the lowest design pressure (26.5 inches for type I and 28 inches for type II), then increased to the highest design pressure (31.5 inches for the type I and 38 inches for the type II), and finally reduced to current atmospheric pressure. Test data of barometer readings shall be taken at both increasing and decreasing pressures. The rate of pressure change between test points shall be not greater than one inch per minute.

4.6.8.3 Test points. The pressure shall be held approximately constant for at least 5 minutes but not more than 15 minutes before test data is taken. At least five test points shall be taken. Test points shall be taken at approximately one inch intervals. Test points at which data is taken shall have the same pressure value for both increasing and decreasing pressure within 0.04 inch in any one test cycle. When tested in this manner, the calibration error shall not exceed values specified in table IV.

Table IV. Calibration error tolerances.

Indicated reading	Error in inches mercury ( $\pm$ )	Indicated reading	Error in inches mercury ( $\pm$ )
26.5 - 26.9	0.040	29.4 - 30.4	0.025
26.9 - 27.4	0.035	30.4 - 30.9	0.030
27.4 - 27.9	0.035	30.9 - 31.5	0.035
27.9 - 28.4	0.030	31.5 - 34.0	0.040
28.4 - 28.9	0.030	34.0 - 36.0	0.040
28.9 - 29.4	0.025	36.0 - 38.0	0.040

4.6.9 Change in scale or calibration error between test points. The scale or calibration errors shall not change in magnitude by more than four percent of the pressure change between any two test points as specified in 4.6.8.

4.6.10 Hysteresis. Differences in readings at the same pressure between data at decreasing and increasing pressures (see 4.6.8) shall not exceed 0.04 inch.

4.6.11 Friction. If pressure is increased or decreased and is then brought to a constant value without reversing direction while the instrument under test is free from vibration, light tapping or vibration of the barometer shall not produce a change in indication greater than 0.04 inch.

## MIL-DTL-17896E

Movement of the index hand shall be free of backlash, hanging, or irregular motion when the pressure is varied uniformly. These tests may be combined with those of 4.6.8.

4.7 Rejection and retest. Any unit failing to meet the individual tests and the sampling plan A or B tests shall be cause for rejection of the entire lot. Barometers that have been rejected may be replaced or repaired and the lot retested using a tightened sample size in accordance with verification level II of MIL-STD-1916. Prior to retesting, the manufacturer shall provide in writing to the procuring activity all corrective actions taken to correct the defect(s). Units rejected after retest shall not be resubmitted and the lot shall be rejected unless specific approval is authorized by the procuring activity granting additional corrective actions and testing.

## 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 material is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Service or Defense Agency, or within the military department'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 intended use of the barometers covered by this document is as follows:

Type I - for measuring atmospheric air pressure.

Type II - for measuring atmospheric air pressure in pressure controlled areas such as submarines or boiler rooms.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Type (see 1.2).
- c. Specific issue of individual documents referenced (see 2.2.1 and 2.3).
- d. When first article inspection is required (see 3.1).
- e. Required sampling plan tests A or B (see 4.4).
- f. Packaging (see 5.1).

MIL-DTL-17896E

6.3 Changes from previous issue. Measurement designation changed from “Not Measurement Sensitive” to “Inch-Pounds”. Not for New Design statement restored. Fractional dimensions were changed to decimal units. Metric and Celsius conversions were added except for pressure measurements. Mercury free requirement was added by addition of paragraphs 2.2.2 and 3.2.2. This summary of changes is done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in this summary. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of this summary and relationship to the last previous issue.

6.4 Subject term (key word) listing.

air  
atmospheric  
boiler  
marine  
pressure  
submarine

Custodian:  
Navy - SH

Preparing Activity:  
DLA - GS1

(Project 6685-2008-001)

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 data base at <http://assist.daps.dla.mil>.