INCH-POUND

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PERFORMANCE SPECIFICATION

ALTIMETER, SERVO CONTROLLED, AUTOMATIC PRESSURE STANDBY

Comments, suggestions, or questions on this document should be addressed to Oklahoma City Air Logistics Center/ENSDAA, 3001 Staff Drive, Suite 1AB81A, Tinker AFB, OK 73145 or emailed to af71@tinker.af.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.daps.dla.mil.

AMSC N/A FSC 6610

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

1. SCOPE

1.1 Scope. This specification covers integrally-lighted altimeters that have an electromechanically servo driven pointer and a digital display of corrected altitude. The altimeters operate in the normal mode to display altitude transmitted by altitude computers or central air data computers. The altimeters incorporate an integral pressure sensor with electronic outputs to aid operation in the normal mode and to provide altitude inputs for the electronic display of pressure altitude when operated in the standby mode. The altimeters also incorporate an electrical output of barometric pressure setting which is required by some aircraft. A method is provided on the bezel of the altimeter for the selection of barometric setting to be displayed in either inches of mercury (in. hg) or millibars (mb). The altimeters are designed to operate from the following power sources: 115V, 400Hz (primary), 28V DC (secondary), and 18V DC (battery mode) from an optional rear mounted battery module. Altimeters meeting the requirements of this specification are interchangeable with AAU-19/A, AAU-19A/A, and AAU-19B/A, AAU-34/A, and AAU-37/A Altimeters.

1.2 Classification. Altimeters covered by this specification will be of the following types, as specified (see 6.2).

AAU-34B/A Altimeter - Integrally lighted, "aviation red" and "blue filtered" white lighting.
AAU-34C/A Altimeter - (Type AAU-34B/A Altimeter with integral lighting modified to provide night vision system (Type I, Class A, NVIS Green A) compatible lighting and "blue filtered" white lighting).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 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 these lists, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 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.

FEDERAL STANDARDS

FED-STD-H28/2 - Screw-Thread Standards for Federal Services

		Section 2, Unified Inch Screw Threads- UN and UNR Thread Forms
FED-STD-595/37038	-	Black Lusterless
FED-STD-595/37925	-	White, Lusterless

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-5541	-	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-A-8625	-	Anodic Coatings for Aluminum and Aluminum Alloys
MIL-C-14806	-	Coating, Reflection Reducing, for Instrument Cover Glasses and Lighting Wedges
MIL-L-25467	-	Lighting, Integral, Red, Aircraft Instrument, General Specification for
MIL-L-27160	-	Lighting, Instrument, Integral, White, General Specification for
MIL-PRF-38534	-	Hybrid Microcircuits, General Specification for
MIL-PRF-38535	-	Integrated Circuits (Microcircuits) Manufacturing, General Specification for
MIL-DTL-83488	-	Coating, Aluminum, High Purity
MIL-DTL-83723	-	Connectors, Electrical, (Circular, Environment Resisting), Receptacles and Plugs, General Specification for
MIL-L-85762	-	Lighting, Aircraft, Interior, Night Vision Imaging System (NVIS) Compatible

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-130	-	Identification Marking of U.S. Military Property
MIL-STD-461	-	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-464	-	Electromagnetic Environmental Effects Requirements for Systems
MIL-STD-704	-	Aircraft Electric Power Characteristics
MIL-STD-810	-	Environmental Engineering Considerations and Laboratory Tests
MIL-STD-859	-	Standard Calibration Table for Aeronautical Pressure Measuring Equipment
MIL-STD-865	-	Selective Brush Plating, Electro-Deposition
MIL-STD-882	-	System Safety
MIL-STD-889	-	Dissimilar Metals
MIL-STD-1916	-	DoD Preferred Methods for Acceptance of Product
MS24266	-	Connectors, Plug, Electrical, Straight, Miniature, Classes E, F, G and R

MS28105	-	Cover Glass, Aircraft Instrument Dial
MS33556	-	Housing, Indicator
MS33558	-	Numerals and Letters, Aircraft Instrument Dial, Standard Form of

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-454	-	General Guidelines for Electronic Equipment
MIL-HDBK-470	-	Designing and Developing Maintainable Products and Systems, Volume I
MIL-HDBK-781	-	Reliability Test Methods, Plans, and Environments for Engineering Development, Qualification, and Production
MIL-HDBK-831	-	Preparation of Test Reports
MIL-HDBK-5400	-	Electronic Equipment, Aerospace, General Specification for

(Copies of these documents are available online at https://assist.daps.dla.mil/quicksearch/ 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. The following other Government documents, drawings, and publications form a part of the document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEFENSE ELECTRONICS SUPPLY CENTER

86098-16-D-05	-	DESC Drawing, Connectors, Electrical Unshrouded Headers (Defense Electronics Supply Ctr., OH)

(Copies of this document are available from Defense Logistics Agency, 8000 Jefferson Davis Hwy, Richmond VA, 23297)

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.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME-Y14.100	-	Engineering Drawing and Related Documentation Practices

(ASME documents may be obtained online at http://www.asme.org/ or from ASME International, Three Park Avenue, New York, New York 10016-5990, USA.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM-B339	-	Pig Tin
ASTM-B545	-	Tin, Electrodeposited Coatings of

(ASTM documents may be obtained online at http://www.astm.org or from American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE-AS5202	-	Port or Fitting End, Internal Straight Thread

(SAE documents may be obtained online at http://www.sae.org/ or from SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001 USA.)

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, 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 Qualification. This specification defines the design, performance, and test requirements for an AAU-34B/A Altimeter with automatic pressure standby. This specification also provides for a similar design Altimeter AAU-34C/A which incorporates (NVIS Green A) night vision compatible integral lighting and "blue filtered" white lighting. This specification makes provision for qualification testing of the altimeter with its optional battery module. Altimeters furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.4 and 6.4). Battery modules shall meet the applicable requirements of this specification.

3.2 Nonstandard parts. Standard MS and AN parts shall be used where they suit the purpose. When no standard part is available, a nonstandard part may be used with prior approval of the procuring activity. When dual sources for parts or components are not available, prior approval of the procuring activity is required for use of sole source items.

3.3 Microelectronic Devices. Microelectronic devices shall meet the requirements of MIL-PRF-38535 (monolithic) and MIL-PRF-38534 (hybrid) and be listed on the associated Qualified Manufacturers Listing (QML).

3.4 Materials.

3.4.1 Nonmagnetic materials. Nonmagnetic materials shall be used for all parts of the altimeter, except where magnetic materials are essential. The extent to which magnetic materials are required shall be reported to the procuring activity.

3.4.2 Toxic and corrosive fumes. Materials, as installed in the altimeter and under the service conditions specified herein, shall not liberate deleterious or corrosive fumes. This shall include any fungicidal agents that are used.

3.4.3 Protective treatment. When materials which are used in the construction of the altimeter are subject to deterioration when exposed to climatic and environmental conditions likely to occur during service usage, they shall be protected against such deterioration in a manner that will in no way prevent compliance with the performance requirements of the specification. The use of any protective coating that will crack, chip, or scale with age or extremes of climatic or environmental conditions shall be avoided.

3.4.4 Fungus-proof materials. Materials that are nutrients for fungi shall not be used where it is practical to avoid them. Where used and not hermetically sealed, they shall be treated with a fungicidal agent acceptable to the procuring activity. However, if they are used in a hermetically sealed enclosure, fungicidal treatment will not be necessary.

3.4.5 Metals. Metals shall be of the corrosion-resistant type, unless suitably protected to resist corrosion during normal service life.

3.4.5.1 Dissimilar metals. Dissimilar metals are defined in MIL-STD-889. Unless suitably protected against electrolytic corrosion by means of protective coating or hermetic sealing, intimate contact of dissimilar metals shall be avoided.

3.4.6 Nonferrous metals. Nonferrous materials shall be used for all parts of the altimeter, except where ferrous materials are essential.

3.4.6.1 Protection of nonferrous materials. Nonferrous materials contained within hermetically sealed enclosures shall be considered suitably protected from corrosion. Requirements specified for fungicidal and corrosion protective treatment and anodizing of aluminum alloy parts will not be applicable for parts within hermetically sealed enclosures.

3.4.7 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.

3.4.8 Cementing Materials. Cases, components, or parts shall not be entirely dependent upon cements, epoxies or related materials to maintain integrity for the service life of the altimeter.

3.5 Design and Construction.

3.5.1 Case. The case shall consist of a body with a flange and a bezel, referencing MS33556 for guidance, except as shown in FIGURE 1. The back of the case shall provide for the mounting of a replaceable battery module and its electrical interface connection to the module. The electrical receptacle for the battery module on the back of the case shall be

provided with a cover that can be readily removed for installation of a battery module as required for some applications. Operation and performance of the altimeter with 115V, 400Hz and/or 28V DC electrical powers shall not be affected by operation of altimeters without a battery module installed or the failure of an installed battery module on battery-equipped altimeters. Battery-related BIT test and arming displays of the altimeter shall be inhibited when a module is not mounted on the altimeter. The altimeter outline dimensions and the external connections of the altimeter shall conform to FIGURE 1.

3.5.1.1 Body (altimeter). Unless otherwise approved by the procuring activity, the case body and mounting flange shall be made of lightweight, non-magnetic metal, uniform in texture and have a smooth surface with a durable black finish. The mounting flange of the body shall have a durable lusterless finish, Color No. 37038 of FED-STD-595. The rear surfaces of the two upper mounting flanges and the region identified on FIGURE 1 shall be free of paint and shall be tin plated in accordance with either ASTM-B545 or ASTM-B339, referencing MIL-STD-865 for guidance, to allow electrical grounding to the aircraft instrument panel and to comply with MIL-STD-464 requirements. The surface area on the back of the case as shown in FIGURE 1 shall also be plated to provide for electrical bonding of the altimeter to a battery module.

3.5.1.2 Bezel. The bezel of the case shall be made of nonferrous low-density metal and shall have a durable lusterless black finish, Color No. 37038 of FED-STD-595. The bezel shall be held in place by means of screws properly secured by lock washers or similar devices of a design approved by the procuring agency.

3.5.2 Cover glass, lighting wedge and displays. The cover glass shall conform to MS28105 and shall not interfere with the readability of the instrument. The glass shall be properly sealed and direct metal contact with the glass that could result in damage during service use shall not be made. If lighting wedges are used, they shall be replaceable as an assembly. Provisions shall also be made for alignment of the lighting wedge assembly to facilitate overhaul. If the cover glass is used as part of the lighting system, a glass may be used that deviates from the glass specified herein to the extent required for the lighting function, provided it does not interfere with the readability of the instrument. Provisions shall also be made for procurement and replacement of individual wedges in a wedge assembly. Wedge assemblies shall be interchangeable. All reflecting glass and transparent element surfaces shall be provided with a reflection-reducing coating, reference MIL-C-14806 for guidance. The distance between the inner surface of the cover glass and the dial shall be as small as practicable, and shall not exceed 0.156 inch. The use of plastic lighting elements shall be justified and requires the prior approval of the procuring agency. Protective measures shall also be taken to reduce any glare or reflection from the digital display elements.

3.5.3 Integral lighting. AAU-34B/A altimeters shall be integrally lighted with both red and white lighting circuits as shown in FIGURE 2. The red lighting shall be in accordance with MIL-L-25467. The white lighting shall be "blue filtered", referencing MIL-L-27160 for guidance, except the color tolerance shall be ±0.03 and the average luminance for the liquid crystal display shall be 1.5 ± .5FL. AAU-34C/A altimeters shall be of the same design as AAU-34B/A altimeters and meet the requirements for "blue filtered" white lighting, referencing MIL-L-27160 for guidance, except the color tolerance shall be ±0.03 and the average luminance for

the liquid crystal display shall be 1.5 ± .5FL. AAU-34C/A altimeters shall also incorporate NVIS Type I, Class A, "Green A" night vision compatible lighting that meets the requirements of MIL-L-85762 except the luminance level shall be 1.0 ± .5FL. The altimeter lighting shall operate on 5V AC or DC power. Lighting acceptability of production altimeters with red and/or white lighting shall be based on visual comparison with a prime standard. Acceptability of NVIS lighted production altimeters shall be by a method approved by the procuring activity. Prior to fabrication of qualification units, the method of lighting shall also be approved by the procuring activity. Deviations from the applicable lighting specification requirements shall be submitted to the procuring activity for approval.

3.5.4 Dial. The dial or dial assembly shall be securely retained in the instrument by positive means of alignment and shall be of sufficient thickness that warping or distortion does not result when the instrument is subjected to the environmental conditions specified herein. The display assembly shall be a shop-replaceable unit (SRU) removable at depot (overhaul) without damage.

3.5.5 Static connection. The static pressure connection (port) shall be in accordance with SAE-AS5202-06 and located as shown on FIGURE 1. A 150-wire mesh filter screen (either stainless steel or monel) shall be firmly installed in the static connection to prevent dirt particles from entering the sensor. For storage, shipping and handling purposes, a plug of acceptable material and design shall be provided. Each plug may incorporate a vent consisting of a hole at least 1/16 inch in diameter. The plug may also incorporate suitable filtering material to prevent the entry of particles which the supplier considers would be detrimental to the performance of the instrument.

3.5.6 Electrical receptacle (altimeter). The electrical receptacle for interface of the altimeter with aircraft wiring shall conform to MIL-DTL-83723 Series III and located as shown on FIGURE 1. It shall mate with connector MS24266-R16T-24SN. The electrical connections to the receptacle shall be as shown on FIGURE 3. The receptacle shall be provided with a suitable cap for shipping, handling and storage purposes. Altimeters shall be tested and delivered with suitable cover plate for the battery module receptacle to protect the instrument from damage as a result of exposure to the service conditions and tests specified herein as well as for shipping and handling. The cover plate shall be removable for installation of a battery module if required. The cover for the battery receptacle is subject to the prior approval of the government.

3.5.6.1 Electrical receptacle (battery module). An electrical receptacle as shown in FIGURES 1 and 3 and approved by the procuring activity shall be provided to interface the altimeter with the battery module connector (header type) 86098-16-D-05. The module header meets the requirements of Defense Electronics Supply Center, OH, Drawing 86098-16-D-05. When the module is mounted to the altimeter, the electrical connector shall mate with the receptacle of the altimeter and provide the power, signal, and returns identified by FIGURE 3 and 3.5.8.

3.5.7 Battery Module Interface. The altimeter shall be designed to operate with a battery module installed on the rear of the case. The mechanical and electrical interfaces shall conform

to FIGURE 1 and FIGURE 3.

3.5.7.1 Battery Module Pin Assignment. The following pin assignments apply to the altimeter receptacle for the battery module interface:

Pin 1. Battery discharge status. The battery module transmits a bi-level output signal indicating the battery state-of-charge to this pin. The altimeter shall sense and display a "B Err" message as specified herein when a logical high (>3.5V) signal is present indicating a potentially depleted battery. When in the inactive low state, the output impedance of the state-of-charge signal shall be no greater than .5KΩ.

Pin 2. Battery clock. The altimeter shall output a digital signal on Pin 2 as required for incrementing the state-of-charge counter of the battery module. A pulsed signal (0 to 5V) having a frequency of 9.25Hz shall be supplied to the state-of-charge counter of the battery module. When the altimeter battery module function is initially armed ("A") by setting of the altimeter control lever as specified herein, a single pulse shall be transmitted by the altimeter. The altimeter shall provide the signal continuously when the 18DC power derived from the external 28V DC power source for the altimeter is (<18V) DC and the altimeter is operating in the battery ("B") mode. The altimeter clock input to the battery module counter is also terminated to ground in the module through a 1OKΩ±5% resistance. The altimeter shall detect the installation of a module by monitoring for the presence of the resistance.

Pin 3. Battery power output. Provides an input of battery module power, (13.5V-l8V), for operation of the altimeter in the battery mode. The battery output shall be protected in the module by a fuse having a value not exceeding 0.5 Amp.

Pin 4. Battery power return.

Pin 5. Battery fuse test (6V tap). A 6V positive battery tap input from the battery module is provided for use in verification of the battery tap fuse of the module. The battery tap fuse has a value not exceeding .5 Amps. The 6V interface signal is supplied as a means of fuse verification only and shall not be subjected to positive (charging) currents or a steady state discharging load. The battery module design shall use enhancement devices for developing the state-of-charge signal. As a result, when the state-of-charge electronics are not powered, the state of charge shall not be terminated to ground.

3.5.7.2 Module fuses. The altimeter shall sense the failure of the fuses in the module. A "B Err" shall be displayed when a fuse has opened and a BIT test is performed or the altimeter is initially armed. Under power-up and normal operating conditions, the altimeter shall not cause the battery module fuses (thermal actuated type) to open. The altimeter shall not subject the module to positive charging currents or steady state discharging load except as required for normal operation in the battery mode.

3.5.8 Case grounding. The altimeter case shall be internally grounded to pin 14. The electrical system in the altimeter shall be DC isolated from the case.

3.5.9 Power common leads. The power common leads of the 28V DC power and the 115V 400Hz power shall be connected together. The 5V AC or DC lighting common shall not be connected to the 28V DC and 115V 400Hz common leads.

3.5.10 Synchro input. The altimeter shall be designed to operate electrically from a synchro signal originating in an altitude or air data computer. The computer synchro shall be a Bendix AY100GZ-88-A1, or equivalent or an approved electrical/electronic equivalent. The air data computer synchro shall be excited by 26V 400Hz power from the altimeter power supply through pins 3 and 15 of the receptacle as shown on FIGURE 3. The 26V 400Hz synchro excitation signal available from the altimeter on pin 15 shall be in phase (within 1%) with the 115V 400Hz input to pin 2. The synchro excitation shall be provided continuously when 115V 400Hz power is provided to the altimeter, regardless of the mode of operation or failure of the altimeter. The synchros in the altitude and air data computer shall be as shown in FIGURES 6 and 7. The scale factor of the altitude and air data computer synchros or electronic electrical/equivalents shall be 36º/1000 feet (360º/10,000 feet). Coarse altitude information required to compute the correct altitude in the normal mode shall be by means of the integral pressure sensor of the altimeter. Electrical zero of the altimeter shall be at zero altitude with the barometric setting at 29.92 inches Hg or 1013 millibars, as applicable.

3.5.11 Internal vibrator. The altimeter shall not require an integral vibrator to reduce friction to meet performance requirements.

3.5.12 Display. The display shall be as shown in FIGURES 4 and 5 for the AAU-34B/A and AAU-34C/A Altimeters. The display shall provide a direct reading of altitude in feet by means of a five digit electronic presentation. An electromechanical servo driven pointer shall provide a display of altitude information as required to supplement the digital display. A four digit display of barometric setting shall also be provided having a selectable scale to display the setting in inches of Hg (FIGURE 4) or millibars (FIGURE 5). An electronic display (flag) to indicate when the altimeter is operating in the standby mode shall be incorporated. The markings and finishes for the display shall be as specified by 3.12. The display shall be consistent with the uniformity of other panel displays and the uniformity of the integral lighting of the cockpit at all times. Prior approval by the procuring activity is required for any variations or changes in the display from those specified herein.

3.5.12.1 Control lever (reset). A control lever shall be provided as shown in FIGURE 1, FIGURE 4 and FIGURE 5 to enable the pilot to select the normal (NORM) mode of operation for display of static pressure defect corrected altitude received from a remote altitude (synchro) transmitter. The control lever shall also enable the pilot to revert to standby operation for the display of pressure altitude sensed by the integral pressure sensor of the altimeter. Clockwise movement of the lever shall select the normal mode of operation and counter-clockwise movement of the lever shall enable reversion to the standby mode.

3.5.12.1.1 Control lever (altimeter arming). The control lever shall also be used to arm the battery module equipped altimeter. Battery power discharge shall be inhibited when the altimeter is energized by normal aircraft power. Selecting the standby mode of operation and holding the control lever in the standby position for 2 seconds prior to release shall arm the altimeter. Holding the control lever in the direction for selection of normal operation for 3 seconds shall disarm the altimeter.

3.5.12.2 Standby mode indication. A display or flag to indicate the STBY (standby) mode of operation shall be provided against a yellow background that is in high contrast with the altitude display. The indication or flag shall not be visible when the altimeter is operating in the normal mode, but shall clearly indicate STBY when the instrument automatically reverts to the standby mode in the event a failure is detected or when the standby mode is selected by means of the control lever. When the altimeter is operating in the normal mode employing 115V 400Hz electrical power, the standby flag or indication shall not come into view in the event of loss of aircraft 28V DC power to the instrument.

3.5.12.3 Normal mode indication. When the normal mode is activated by means of the control lever, the standby flag or indication shall not be visible.

3.5.12.4 Altimeter armed and disarmed indications. When the altimeter is initially armed by holding the standby/normal control lever to the standby position for two seconds, the letter "A" shall be displayed to the left of the 10,000 foot digit of the digital altitude display as shown by FIGURES 4 and 5. The letter "A" shall remain visible for a period of ten minutes before the altimeter is automatically disarmed unless it is disarmed during this time period by holding the standby/normal control lever to the normal position for three seconds. Operation of the altimeter shall continue in the standby mode using aircraft power during this period. Arming the altimeter shall not prevent the altimeter from being set to the normal mode during this period or prevent resetting to the standby mode by disarming the altimeter.

3.5.12.4.1 Control lever - disarm. When the control lever is used to disarm the altimeter, the letter "A" on the display shall not remain visible. In the event of loss of all aircraft power to the altimeter during the ten minute armed period, the altimeter shall automatically revert to standby operation using battery power only. The letter "B" above the 1,000 foot digit shall then be visible as shown in FIGURES 4 and 5 to indicate that the altimeter is operating on battery power. When initially arming the altimeter, the digital display shall indicate the letters "B Err" if the altimeter detects that the battery state-of-charge counter has expired. The thousands of feet digit shall be used to display the letter "B" and the hundreds of feet digits shall display the letters "Err". When no external power is available, holding the control lever to the standby position for three seconds shall result in operation of the altimeter in the standby mode. The letter "B" shall also be displayed. Holding the control lever to the normal setting position for three seconds during operation when no external power is available shall result in a display of the word "OFF" on the digital display prior to automatically turning off battery power to the altimeter.

3.5.12.5 Digital altitude display and pointer relationship. The display shall be designed to provide a direct reading five digit presentation of altitude in feet. The two digits to the left of the pointer hub shall indicate 10,000 foot and 1,000 foot altitude levels respectively. The three

digits to the right of the pointer hub shall indicate hundreds (100's), tens (10's), and feet (0-9) altitude respectively. During each 1000 foot altitude increment, the pointer shall operate synchronous with the digital display or as otherwise specified herein. The pointer shall provide analog altitude information redundant to the digital display for the interval between each 1,000 foot increment of altitude.

3.5.12.5.1 Pointer. The pointer of the display shall make one revolution around the dial for each 1,000 feet of altitude with reference to a circular scale graduated in 50 feet increments. The pointer shall move smoothly around the dial when altitude is increasing or decreasing at any rate within 100,000 feet per minute. Except as noted herein or as specified for dynamic operation, the pointer shall be aligned with each dial graduation mark within ½ the width of the mark and shall be in sync with the digital altitude display.

3.5.12.5.2 Pointer rotation. The pointer shall move clockwise or counterclockwise, as applicable, when the altitude sensed and measured internally exceeds the altitude indicated by the pointer by ±2 feet.

3.5.12.5.3 Digital display. When operating normally, the altimeter shall provide a direct reading display of altitude by means of a five digit presentation having two digits to the left and three digits to the right of the center of the display as shown by FIGURES 4 and 5. The left side shall normally display 10,000 foot and 1,000 foot altitude increments or levels. The right side shall display 100 foot, 10 foot, and 1 foot (0-9) increments of altitude. The 1 foot digit on the extreme right shall normally be displayed as a fixed zero. Unless otherwise specified herein, the digital display shall provide an unambiguous direct reading of altitude in ten foot increments. For positive readings of altitude under 1,000 feet, the 1,000 foot digit shall not be blank, but display a zero. The digits 0-9 shall be activated in lieu of the fixed zero when in the external (VERN) test mode specified by 3.5.23.2 or when otherwise specified by 3.5.12.

3.5.12.5.4 Display operation. As required to improve readability at different rates of change of altitude and during display transitions at each 1,000 foot level, the design shall provide for variable steps for each of the active digits displayed. The digit indicating tens of feet shall display altitude in 10 foot steps when both the altitude and the altitude change rates are less than 10,000 feet and 750 fpm respectively. Otherwise, the digit shall display altitude changes in 20 foot steps at rates up to 2,500 fpm. At altitude rates between 2,500 and 6,000 fpm, the digit shall increment in 50 foot steps. At rates above 6,000 fpm, the 10 foot digit shall be displayed as a fixed zero. The 100 foot digit shall display altitude changes in 100 foot steps at altitude rates up to 15,000 fpm. At altitude rates from 15,000 fpm to 40,000 fpm, the 1,000 foot digit shall display altitude changes in 200 foot steps. Above the rate of 40,000 fpm, the 100 foot digit shall be a fixed zero and the 1,000 foot digit shall display changes in 1,000 foot steps. The software design shall enable ready adjustment of the values specified in order to provide for changes which may be required prior to manufacture of production altimeters.

3.5.12.5.5 Failed altimeter display. In order to provide alternative altitude displays as specified for emergency operation under specified failure conditions, the display shall be designed to provide for independent operation of the two digits displayed on the left of the pointer hub from the three digits to the right.

a. The altimeter design shall provide for detection of circuitry failures of the left side of the display. The pointer shall continue to operate and provide the altitude information which is normally redundant to that provided by the failed portion of the display.
b. Detected failure of the left side of the display which normally provides 10,000 foot and 1,000 foot level indications shall result in blanking of the left side of the display. The right side of the display shall then be used to display 10,000 foot and 1,000 foot information only. The first digit to the right of the pointer hub shall be used to display 10,000 foot increments of altitude and the second digit to the right of the hub shall display 1,000 foot increments of altitude. Altitude information for the interval between each 1,000 foot level shall continue to be provided by the pointer. The extreme right digit shall remain blank during operation in this failure mode.
c. Failure of the altimeter internal pressure sensor circuitry while the altimeter is in the "NORM" mode shall result in continued normal operation. The altimeter shall retain the 10,000 foot level information provided by the sensor prior to failure and compute the correct altitude levels as further changes are made. The altimeter shall not be capable of being reset to the "STBY" mode of operation when operating in this failure mode. Failure of the altimeter internal pressure circuitry while the altimeter is in the "STBY" shall cause "Err" to be displayed until the altimeter is switched to the "NORM" mode by reset lever. The three digits on the right side of the display shall be used to display the message "Err" to identify this failure mode while the left side of the display shall continue to show 10,000 foot and 1,000 foot digits. The "Err" message shall be displayed when there is an attempt to switch the altimeter from "NORM" mode to "STBY" mode or if the failure occurs when the altimeter is in the "STBY" mode.
d. Failure of the pointer positioning circuitry only shall not affect normal operation of the digital display of altitude.

3.5.12.5.6 Blanked zeros. Negative altitudes shall be displayed as direct reading negative values. A negative sign (line) comprised of more than one segment shall be displayed in lieu of a blanked zero for each applicable digit when the altitude to be displayed is negative. Zero altitude shall be displayed as a zero for the 10 foot and the 1 foot digits preceded by three negative signs.

3.5.12.5.7 Display stability. The display shall be designed to preclude instability of the digital altitude indication or the pointer when controlling aircraft at assigned altitudes. Altitude readings shall not be ambiguous when transitioning altitude levels and the pointer shall continuously track altitude accurately and smoothly. When the pointer approaches a 10,000 foot or 1,000 foot altitude level, the digital display shall not transition before the pointer reaches the 0 dial position consistent with the requirements of 3.5.12.5.4. After the altimeter indicates a change in altitude level, the digital reading shall not vary until the pointer has moved to indicate that altitude has increased or decreased by a minimum of 10 feet. Provisions also shall be made to activate the applicable digits as a function of altitude, altitude change rate and display

persistence as required to achieve synchronization of the pointer and the digital display at higher rates of pressure change. The design of the software shall enable ready adjustment of the values specified by this paragraph and 3.5.12.5.4 until firm values are established as required for manufacture of production units. Hysteresis as required to establish stable readings shall be kept to a minimum.

3.5.12.5.8 Display readability. The altitude displayed, and the necessary markings and scales, shall be of sufficient brightness and contrast so that the pilot can readily detect, read, and understand the displayed data under "full sunshine" to "full darkness" conditions. All display elements, including the standby mode indicator (flag), shall be clearly distinguishable from the inactive portion of the display in any ambient lighting, including a combination of both diffuse and specular reflection and in direct sunlight (10,000 foot candles). The altitude indicated by the pointer shall be clearly visible and readable for all positions around the dial. The tip of the pointer shall overlap but not completely cover any graduation on the dial. The tip of the pointer shall align with the center of each graduation mark around the dial within ½ a graduation width.

3.5.13 Electronic displays. All display elements, including the standby mode indicator (flag), shall be clearly distinguishable from the inactive portion of the display in any ambient lighting including a combination of both diffuse and specular reflection and in direct sunlight (10,000 foot candles). The display shall be readable to the pilot in a cockpit when the sun is at any angle 15 degrees or greater above the line of sight. Failure of any single segment of the display shall not cause the altitude to be misread by more than 10 feet and shall not result in failure or extinction of any other part of the display. Pointer displayed information may be used for meeting this requirement. The display of barometric pressure setting and the barometric pressure potentiometer output shall not be affected by altitude display failures.

3.5.13.1 Electronic displays luminance and contrast. The luminance and contrast of all displayed data shall be adequate for easy visibility in illumination environments from "full sunshine" to "full darkness". In a combined environment consisting of 10,000 foot candles (108,000 lux) diffuse illumination and a specularly reflected image of 2000 foot Lamberts (6,800 cd/m^2), the contrast $\frac{Lt-Lb}{Lb}$ shall be a minimum of 10. The difference luminance (δL) between the brightest images of the display and the dimmest in this environment shall be a minimum of 900 foot-Lamberts (3,100 cd/m^2), except for the standby flag which shall be a minimum of 600 foot Lamberts. In a combined environment consisting of 200 foot candles (2150 lux) diffuse illumination and a specularly reflected image of 2000 foot Lamberts, the contrast $\frac{Lt-Lb}{Lb}$ shall be a minimum of 2, except for the standby flag which shall be a minimum of 1.25. The difference luminance (δL) between the brightest image of the display and the dimmest in this environment shall be a minimum of 80 foot Lamberts except for the standby flag which shall be a minimum of 40 foot Lamberts (310 cd/m^2).

Lt: The total luminance of the image, or brighter area, including any background or reflected light, as measured in the specified lighting conditions.

Lb: The luminance of the background, or dimmer area, including any reflected light and any stray display emissions, measured in the specified lighting

conditions.

δL: (delta luminance) The difference between the higher luminance (Lt) and the lower luminance (Lb).

The contrast shall not degrade more than 20% from the specified value when measured at angles smaller than 30 degrees as shown in FIGURE 8 or when the diffuse reflected luminance is measured with the photometer and light source interchanged (that is, photometer on the axis of the display).

3.5.13.2 Solar radiation. The display elements and background shall not fade or become unreadable when the altimeter is subjected to solar radiation in accordance with MIL-STD-810 Method 505.1.

3.5.14 Electrical power.

3.5.14.1 Power (normal mode). The altimeter shall be designed to operate in the normal mode from an 115V 400Hz single-phase power supply in accordance with MIL-STD-704, except that the frequency range shall be from 312 to 510Hz for continuous operation and frequency change rates up to 1100Hz per second. The altimeter shall not require more than 25VA for normal operation. Normal mode operation of the altimeter shall not be affected by the absence or failure of 28V DC aircraft power to the altimeter. The altimeter shall also be capable of operating in the standby mode from the 115V 400Hz power supply if 28V DC external power is not available. If a heater is incorporated in the altimeter to assist in meeting specification warm-up performance requirements, the heater shall derive power from the 1l5V 400Hz power source only regardless of the mode of operation.

3.5.14.2 Power (standby mode). Power provided for normal operation in the standby (secondary) mode shall be 28V DC in accordance with the requirements of MIL-STD-704, category B except the voltage shall be from 13.5V to 30V. The current shall not exceed 100 milliamperes when supplied with normal power specified by MIL-STD-704 Category B. The altimeter circuits shall be capable of withstanding a reverse polarity of 28V DC without damage. The standby (secondary) mode of operation of the altimeter shall not be affected by removal of 115V, 400Hz power from the altimeter except for loss of heater power which may be required for initial warm-up. Power for operation in the standby (primary) mode shall also be provided simultaneously from the 115V 400Hz supply to the altimeter.

3.5.14.3 Lighting power. Lighting power shall be 5.0 ±0.1V AC or DC, 4.0Watts maximum.

3.5.14.4 Battery power. The altimeter battery module shall provide 18V DC power for operation of the altimeter in the standby (battery) mode. When the altimeter is armed and a total loss of external primary (115V AC, 400Hz) power and secondary (28V DC) power occurs, the altimeter shall automatically operate in the standby mode on battery (18V) power. There shall be no discontinuity of operation as a result of the power transfer. The altimeter shall operate from battery power ranging from 13.5 to 18V DC. The altimeter shall not source power to an installed battery module nor sink power to the module when battery voltage is less than 7.5V.

3.5.15 Reliability program. The contractor shall establish a reliability assurance program.

3.5.15.1 Reliability. The altimeter shall have a minimum acceptable mean-time-between-failure (MTBF) of 12,000 hours at 90 percent confidence level. A Reliability Test Plan (RTP) for demonstrating a 12,000 hour MTBF shall be submitted to the government for approval. The altimeters shall be procured with a 5-year failure-free warranty.

3.5.16 Maintainability program. The contractor shall establish a maintainability program. Guidance is provided in MIL-HDBK-470. The following shall be considered in the design of the altimeter:

a. Modularization of major components.
b. Minimization of complexity of maintenance tasks (for example: calibration adjustments, replacement of modules without soldering, inspections, et cetera) by maximum use of a simple design which induces optimum interchangeability and use of standardized equipment or commercial items.
c. Optimum accessibility of all components requiring maintenance, inspections, removal, or replacement.

3.5.16.1 Maintenance and repair cycles. The altimeter shall be completely repairable at depot level, down to the smallest, replaceable unit. The maintenance task time, which includes preparation (setup) for test, recognition (validation) of a fault, isolation of cause of the fault, repair of the fault, realignment and recalibration, and preliminary checkout shall not exceed 2 hours repair time for any single failure in an instrument. This requirement shall be achieved by utilizing the equivalent of one depot technician, authorized depot AGE (or equivalent), and authorized technical information.

3.5.16.1.1 Maintenance task test and demonstration. If any failures occur during reliability testing, the cognizant government inspector shall be notified to witness the fault isolation, repair, and checkout. The altimeter shall then be returned to reliability testing. All failures, actual and simulated, shall be considered as being a part of the timed corrective maintenance task demonstration. If required by the contract, a record of the events shall be submitted to the contracting activity in accordance with the appropriate line items of DD form 1423 entitled Maintainability Demonstration Reports. When demonstrating simulated failures, the replacement components shall be from a simulated spares inventory and not the same parts that were just removed for the demonstration. Also, alternate source components shall be used as the replacement component or parts on all simulated failure demonstrations.

3.5.16.1.2 Measurement of task times. Only the active time required completing a maintenance task, i.e., recognition, isolation repair, realignment and recalibration, and preliminary checkout of the repaired altimeter shall be considered and used in the compilation of maintenance task time. Preliminary checkout shall include all required temperature compensation and position error measurements, rough-ranging and cursory electrical-mechanical tests. Supply downtime, delays such as waiting for parts or their rework, relief breaks, test

equipment downtime, etc., shall be excluded from pertinent accumulated task time. However, if the specification performance testing reveals repair—related malfunctions, the time required to correct these malfunctions shall be included in the final maintenance task time figure.

3.5.16.1.3 Service and removability. The altimeter shall be designed to require no corrective or preventive maintenance while installed in the aircraft. The altimeter shall be removable by disconnecting the static pressure line and the electrical connector after removing four mounting screws and lifting the altimeter from the aircraft instrument panel. All other repair service shall be accomplished at depot-level facilities or by the contractor under terms of the warranty, if applicable.

3.5.16.2 Safety. The altimeter shall present no danger, injury, or hazard to operating and service personnel.

3.5.16.2.1 Hazard analysis. A safety hazard analysis shall be performed to determine, from a safety consideration, the functional relationships between the altimeter and its components and with equipments interfacing with the altimeter. The safety analysis shall identify all components, equipments, and materials whose performance degradation or functional failure could result in category III and IV hazards as defined in MIL-STD-882, as listed under paragraph entitled System Hazard Analyses, and the effects of storage, shelf life, transportation, and packaging. Where practicable, design changes shall be made to eliminate or minimize the hazards. If the hazards cannot be eliminated, alternative controls such as recommended changes to interfacing equipment shall be presented to the procuring activity for resolution. The analysis shall be presented at the final design review.

3.5.17 Remote reset. The altimeter shall be capable of being reset remotely from the standby to the normal mode by applying 115V 400Hz (high) to pin 13 and 115V 400Hz (common) to pin 3 as shown on FIGURE 3. Remote reset is used for test purposes only.

3.5.18 Synchro signal. The altimeter in the normal mode shall operate electronically to display altitude as transmitted by a synchro signal from altitude computers CPU46/A, CPU66/A, or from an air data computer with equivalent electrical or electronic signals approved by the procuring activity. The internal pressure transducer of the altimeter shall continuously provide coarse altitude at rates which will maintain specified accuracy of transmitted synchro altitude when in the normal mode and prevent reversion to the standby mode or loss of synchronization with the transmitting synchro. The altimeter shall meet specification performance requirements when changing from standby mode to normal mode or normal mode to standby mode. The performance of the altimeter shall not be affected when the difference in altitudes between the standby and normal modes is less than specified by TABLE I.

3.5.19 Standby operation. The altimeters shall provide a display of pressure altitude in accordance with MIL-STD-859 by application of electronic technology when operated in either the normal or the standby mode. The altimeter shall automatically operate in the standby mode when 28V DC or 115V AC 400Hz aircraft power or both are initially applied to the instrument. When the standby mode is selected or operation is in the standby mode, the display shall clearly show STBY on a background compatible with the display. The STBY indication shall not be

visible when the instrument is set to operate in the normal mode of operation.

3.5.20 Barosetting knob and control lever. The zero setting (baroset) knob and the control lever shall be attached to their respective shafts in such a manner that they may be easily removed from their shafts and replaced with knobs or levers of different lengths. An attachment means equivalent to a flattened surface on the shaft and a setscrew shall be used to provide positive securing for turning. The normal-standby control lever shall withstand a torque of 15 inch-pounds without damage to the lever or mechanism.

3.5.20.1 Bending. The barosetting knob and the normal-standby control lever shall withstand a force of 15 pounds applied at the extreme outward end of the setting knob or control lever without bending or without damaging the mechanism.

3.5.21 Time delay. A time delay shall be incorporated to prevent nuisance trips from occurring due to power fluctuations or pressure disturbances as encountered in turbulent air conditions. Normal power as defined in MIL-STD-704 shall not cause failure trips. The time delay shall be 2 seconds.

3.5.22 Electrical signals. The altimeter shall be capable of accepting electrical signals corresponding to pressure-altitudes which differ from the standby mode indication of the altimeter by as much as 4000 ± 560 feet.

3.5.23 Internal circuitry. The internal circuitry shall be such that under the following conditions of failure, the altimeter will automatically revert to standby operation:

a. Primary 115V 400Hz power failure.
b. The altitude input of the synchro differs from the altitude sensed by the internal pressure sensor by 4000 ± 560 feet.
c. Loss of both 115V 400Hz and 28V DC power (when the altimeter is armed).

3.5.23.1 Initiated BIT. The altimeter shall provide for initiated BIT which is accessible from the front bezel as shown in FIGURE 1, but requires that a recessed button be depressed to activate the test. The button shall not be capable of being set with the finger but shall require a ball point pen or similar object be used to activate the BIT. Upon activation of an altimeter in the normal or standby modes when a battery pack is installed, and the battery state of charge counter indicates a low charge or failure of a battery module fuse is detected, the display shall first indicate "B Err". Otherwise, the first display shall be total operating time in hours in one (1) hour increments that the altimeter has been operated up to 20,000 hours as a minimum. The altitude display shall be used for this purpose. After indicating the elapsed time, the altimeter display shall be activated and a check shall be made to enable an observer to verify that all display elements and internal circuits, as applicable, are satisfactory before returning to operation in the normal or standby mode as initiated. Initiated BIT shall be completed within 10 seconds. Any faults detected shall be indicated by means of a fault code (FC) employing the first four digits of the altitude display to show the letters FC and a two digit number.

3.5.23.2 Vernier (VERN) mode. The VERN mode shall enable the activation of the

normally fixed zero indicating digit of the display in order to attain resolution as needed to perform special tests or for calibration purposes. In order to enable such tests, provisions shall be made to activate this feature remotely by the use of 28V DC applied to electrical connector Pin 1 shown in FIGURE 3.

3.5.24 Standby and normal mode operation. When 115V 400Hz electrical power only is applied, the altimeter shall be capable of stand-alone operation in both the normal and standby (primary) modes. Initial application of 115V 400Hz power shall result in operation in the standby (primary) mode. Turning the control lever on the face of the bezel in the clockwise direction toward the NORM position shall activate altimeter operation in the normal mode. Operation of the control lever in the counter-clockwise direction to the standby position shall result in standby (primary) mode operation. Initial application of 28V DC alone or 28V DC and 115V 400Hz simultaneously shall also result in altimeter operation in the standby mode. The altimeter shall operate in the standby (primary) mode only if 115V 400Hz power is removed or not applied to the instrument. The switchover from one mode to the other shall be instantaneous. The altimeter shall not operate in the normal mode from the standby mode without setting the control lever on the face of the bezel or by resetting remotely during testing 3.5.17.

3.5.25 Compatibility (Altitude and Air Data Computers). The altimeter input requirements shall be compatible with the output characteristics of the CPU-46/A, CPU-66/A and the following Central Air Data Computers:

NSN		P/N	Manufacturer
(1)	6610-01-099-6186	2101984-3-1	Honeywell (07187)
(2)	6610-00-110-9455	948312-6-1	Honeywell (07187)
(3)	6610-01-047-6627	2100756-3-1	Honeywell (07187)
(4)	6610-01-089-1018	4025116-905	Honeywell (07187)
(5)	6610-01-308-1859	4025116-907	Honeywell (07187)
(6)	6610-99-891-9990	50-055-02	Meggitt Avionics (5524)

The altimeter shall also be compatible with the TTU-229/E test set.

3.6 Performance. The altimeter shall indicate pressure altitudes within the limits specified under the following environmental conditions or combinations thereof after a warm-up period not to exceed one minute at normal ambient conditions and two minutes at extreme environmental conditions:

a. Altitude: Altitudes ranging from -1,000 to +99,990 feet at rates up to 100,000 fpm.
b. Temperature: Continuous operation at temperatures ranging from -54° to +71°C (-65° to +160°F) and storage at temperatures ranging from -62° to +71°C (-80° to +160°F).
c. Humidity: Humidity up to 95 percent.
d. Salt-fog: Exposure to salt-sea atmosphere.
e. Vibration: Sinusoidal, random, and endurance in accordance with MIL-STD-810 Method 514.2 as modified by TABLE VI. Gunfire vibration in

accordance with MIL-STD-810, Method 519.2 as modified by TABLE VII.

f. Fungus: Fungus growth as encountered in tropical climates.
g. Dust: Sand and dust particles as encountered in desert areas.
h. Shock: Shock forces of 15g for basic design and 30g for crash safety for 11 milliseconds.
i. Acceleration:

(1) Structural g levels			(2) Operational g levels		
(a)	Fore:	3.0	(a)	Fore:	2.0
(b)	Aft:	9.0	(b)	Aft:	6.0
(c)	Up:	13.5	(c)	Up:	9.0
(d)	Down:	4.5	(d)	Down:	3.0
(e)	Lateral:	6.0	(e)	Lateral:	4.0

3.6.1 Electromagnetic interference. The altimeter shall meet the electromagnetic interference requirements of Parts 1 and 2 of MIL-STD-461 for equipment installed in systems as specified or modified as follows:

CE102	CS101	RE102	RS103
	CS114		
	CS115		
	CS116		

3.6.2 Pressurization. The altimeter shall withstand compartment pressurization up to an absolute pressure of 28 psi at standard sea level conditions.

3.6.3 Dielectric strength. The altimeter shall withstand application of 500V at a frequency of 60Hz for 30 seconds.

3.6.4 Magnetic property. The altimeter shall not cause the reading of an aircraft magnetic compass to change more than 1 degree at a distance of 8 inches from and magnetically east or west of the center of the compass.

3.6.5 Position error. There shall be no position error in the standby or normal modes.

3.6.6 Scale error. Scale errors shall not exceed the tolerances specified in TABLE IV.

3.6.7 Friction error. There shall be no measurable friction error.

3.6.8 Hysteresis. Apparent hysteresis shall be limited to the amount required by design to obtain stability of the display.

3.6.9 Response. The altimeter shall track altitude rates of change up to and including 100,000 fpm in both modes of operation. In the normal mode, the lag at a rate of 25,000 fpm shall not exceed 50 feet. In the standby mode, the lag at a rate of 10,000 fpm shall not exceed 100 feet. At the high rates of change, the altitude digital display may operate in increments larger than 10 feet as specified herein to obtain a more readable visual display. The pointer shall

track altitude change smoothly at all pressure change rates and shall not exceed the specified limits for lag. The requirements for this test shall be met without any operator action to hold the reset lever to prevent reversion to the standby mode.

3.6.10 Sensitivity and damping. The altimeter shall respond to and display changes in electrical input signals equivalent to 2 feet or less in the normal mode with the VERN feature activated. The system shall be so designed that the altimeter will display no noticeable oscillation, instability, or erratic motion when operating in the standby or normal mode. The altimeter shall also meet the requirements for sensitivity and damping when switching between normal and standby modes and the difference between modes is 500 feet. When operated in the VERN TEST mode, a change in pressure of 2 feet or less at sea level shall be detected and displayed.

3.6.11 Failure detection. Under the failure conditions specified in 3.5.12.5.5, the altimeter shall automatically revert to operation as specified by that paragraph. When the failure condition is such that automatic reversion to the standby mode from the normal mode is specified, the altimeter display shall immediately follow changes in pressure, and the altimeter shall meet the accuracy requirements specified herein. In the event of failure of the altitude display in the normal or standby modes, the barometric display and the barometric potentiometer shall not be affected.

3.6.12 Shelf life. The altimeter shall be designed to have a shelf life consistent with warranty and MTBF requirements.

3.6.13 Overpressure. The altimeter shall withstand a pressure of 35 inches Hg without a zero or calibration shift.

3.6.14 Underpressure. The altimeter shall withstand a pressure-altitude of 100,000 feet without a zero or calibration shift.

3.6.15 Case or sensor leakage. Case or sensor leakage shall be less than 25 feet at an altitude of 40,000 feet after 1 minute.

3.7 Part numbering of interchangeable parts. All replaceable modules, assemblies, subassemblies and parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation and performance. The item identification and part number requirements of ASME-Y14.100 shall govern the manufacturer's part numbers and changes thereto.

3.8 Barometric scale setting. A zero setting system shall be provided to permit the altimeter to be set to indicate zero altitude with any existing ground level pressure throughout the range of 28.10 to 31.00 inches Hg or 950 to 1048 millibars as selected by depressing a button on the altimeter bezel. Application of the setting system shall not introduce additional scale errors of more than 25 feet in the standby mode of operation or more than 15 feet in the normal mode. The scale error requirements specified herein shall be met without regard to the clockwise or counter-clockwise direction of setting the standard barometric pressure (29.92 inches Hg or 1013

millibars).

3.9 Zero setting system.

3.9.1 Barometric scale setting design. The zero setting system, controlled by the setting knob in its normal position, shall be designed to permit the altimeter to be set to indicate zero altitude at any existing ground level pressure throughout the range of 28.10 to 31.00 inches Hg or 950 to 1048 millibars, as selected. The digits 31.00 through 28.10 in 0.01-inch increments or 1048 through 950 in 1 millibars increments shall be provided on a 4-digit barometric scale display. The display shall be located as shown on FIGURE 4 for inches of mercury (in. hg) and FIGURE 5 for millibars (mb). When rotated clockwise, the barometric scale setting knob shall cause the scale value to increase. Positive stops shall be provided to prohibit the setting of ground level pressures significantly outside the range of 28.10 to 31.00 inches of Hg or 950 to 1048 millibars. There shall be no damage to the stops or displacement of the mechanism when a twisting force of 6 inch-pounds is applied at the barosetting knob. The mechanism of the instrument shall not be damaged or dislocated when a pulling or pushing force of approximately 15 pounds is applied at the barosetting knob. The torque applied to the setting knob, as required for normally setting barometric pressure, shall not exceed 7 or be less than 2 inch-ounces throughout the setting range.

3.9.1.1 Barometric scale selection. Provisions shall be made for setting the barometric scale to inches of mercury or millibars prior to or during flight. The selection shall be by means of a recessed button on the altimeter bezel similar to that described for BIT test (3.4.23.1). The button shall be located on the bezel as shown in FIGURE 1. Depressing the button by the tip of a ball point pen or other small tipped object shall result in a barometric setting scale display change to indicate "IN.HG" or "MB" as applicable. After the button has been depressed to select the scale required, the altimeter shall continuously operate to display the scale selected for all subsequent flights and usage until the selection is changed again by depressing the button.

3.9.2 Electrical output device. An electrical output device as shown in TABLE III shall be provided to transmit the position of the barometric scale setting. The scale factor shall be such that with excitation of 10 volts across the potentiometer or its equivalent, the output voltage from wiper to ground (V1 of TABLE III) will change as specified by TABLE III. Any settable pressure setting below 28.10 inches of mercury or 950 millibars, as applicable, shall not make the voltage from wiper to ground, V1, become greater than 9.96 volts or less than the voltage measured at a setting of 28.10 inches of mercury or 950 millibars. Any settable pressure setting above 31.00 inches of mercury or 1048 millibars, as applicable, shall not make the voltage from wiper to ground, V1, become less than 0.057 volts or greater than the voltage measured at a setting of 31.00 inches of mercury or 1048 millibars. The system accuracy shall be such that the output voltage will be the design voltage plus or minus the voltage equivalent to 10 feet when the wiper is loaded by 1 mega-ohm, except at a pressure setting of 31.00 inches of mercury or 1048 millibars where the tolerance is the voltage equivalent to plus zero feet correction and minus 10 feet correction. Barometric settings approached from any direction shall reproduce output voltages within a plus or minus voltage equivalent to 10 feet when in the "IN.HG" setting mode. Regardless of the direction, the output voltage must agree with the design voltage within a voltage equivalent to ±10 feet when the wiper is loaded by 1 mega-ohm. The output device shall

be a 5K-ohm, 1-watt potentiometer or equivalent.

Note: The altimeter potentiometer (or equivalent) shall be isolated from all altimeter circuits.

3.10 Electronic components. For standard electronic components, reference MIL-HDBK-5400 for guidance.

3.11 Weight. The weight of the completely assembled altimeter, excluding the optional battery module, connecting fittings and screws, shall not exceed 3½ pounds.

3.12 Markings and finishes.

3.12.1 White. The following painted markings shall be finished in lusterless white, color No. 37925 of FED-STD-595. Minimum dimensions are specified. Any increase in dimensions shall be consistent with display technology to provide optimum readability and compatibility with existing aircraft instruments.

Marking	Height or Length (Inch ±0.015)	Width of Line or Graduation (Inch ±0.005)
10,000 ft & 1,000 ft		
Digital altitude display digits	0.38	0.045
0, 1, 2, 3, 4, 5, 6, 7, 8, 9		
100 ft, 10 ft & 1 ft		
Digital altitude display digits	0.31	0.04
0, 1, 2, 3, 4, 5, 6, 7, 8, 9		
Numerals 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 on dial	0.25	0.03
Lettering of bezel		
STBY, NORM,	0.09	0.015
IN.HG/MB, TEST	0.09	0.015
100 –foot graduations	0.25	0.03
50—foot graduations	0.18	0.02
Baro counter numerals	0.125	0.020
Lettering ALT	0.19	0.02
Lettering IN.HG, MB	0.06	0.007
A (altimeter armed indication)	0.11	0.01
B (battery power operation)	0.11	0.01
STBY flag size	0.22	0.48 wide

3.12.2 Background. The color of the STBY flag background shall be yellow when trans-illuminated with blue-white lighting and shall be in high contrast with the STBY marking of the display element and the digital altitude display. The color of the STBY flag background in reference to the CIE 1931 Chromaticity Diagram (MIL-L-85762) shall be as follows: x=.520±.03, y=.442±.03 when illuminated by a diffuse light source having a color temperature of

2237°K. The lettering of the standby flag shall be 0.125 in. high and 0.15 in. wide (minimum). The baro counter, dial, 1, 10, 100, 1000, and 10,000-foot digits shall be in high contrast with the numerals displayed. When operating in the NVIS lighting mode, the STBY flag chromaticity shall be as follows: u'=.100, v'=.580 and r=.02 based upon the CIE 1976 UCS Diagram shown in MIL-L-85762.

3.12.3 Dial. The size proportions of the painted numerals and letters on the dial shall conform to MS33558. The background of the dial shall be lusterless black, of FED-STD-595/37038. Each numeral shall distinctly indicate the graduation to which it applies and, if practicable, shall be so placed that the center of mass of the numeral will be on the radial line joining the appropriate graduation and the center of the dial. When several numbers are used in a group, the numerals shall be proportioned to obtain readability at a distance of 28 inches.

3.12.4 Marking and finish deviations. Prior approval of the procuring activity shall be obtained for markings and finishes which deviate from those specified.

3.13 Dial visibility. Except when viewed from below the dial centerline, the pointer, numerals, at least 1/16 inch of the shortest graduations, and all other markings shall be visible from any point within the frustum of a cone whose side makes an angle of 30 degrees with a perpendicular to the dial and whose small diameter is the aperture of the instrument case. When viewed from a point directly in front of and below the dial centerline, the same graduations and markings shall be visible from an angle of 15 degrees.

3.14 Screw threads. Unless otherwise specified, the threads of all machine screws shall conform to FED-STD-H28/2.

3.15 Finishes.

3.15.1 Aluminum alloy parts. Aluminum alloy parts shall be covered with an anodic film conforming to MIL-A-8625, except that the dial, small holes, and case inserts, need not be anodized. Parts which do not anodize satisfactorily may be coated in accordance with MIL-DTL-5541.

3.15.2 Steel parts. Steel parts shall be coated with ion vapor deposited aluminum, where practicable, in accordance with MIL-DTL-83488, type I or II as applicable, and of a class that is adequate to achieve the degree of protection required. Other protective coating, in lieu of MIL-DTL-83488, may be used if demonstrated to be satisfactory and approved by the procuring activity. Cadmium plating must be avoided when satisfactory alternative processes can be used.

3.16 Identification of product. Equipment, assemblies, and parts of the altimeter shall be marked for identification in accordance with MIL-STD-130. A nameplate shall be securely attached to the exterior of the altimeter case as shown in FIGURE 1. A decal bearing altimeter warranty information shall also be attached to the altimeter case as shown in FIGURE 1 when the procurement document specifies that a warranty is required.

3.17 Government-loaned property. (none).

3.18 Workmanship. The altimeter shall be constructed and finished in a thoroughly workmanlike manner. Particular attention shall be given to neatness and thoroughness of soldering, wiring, marking of parts and assemblies, plating, painting, riveting, machine screw assemblies, welding, brazing, and freedom of parts from burrs and sharp edges.

3.18.1 Dimensions and tolerances. Dimensions and tolerances not specified shall be as close as is consistent with the best shop practices. Where dimensions and tolerances may affect interchangeability, operation or performance of the altimeter, they shall be held or limited accordingly.

3.18.2 Screw assemblies. Assembly screws and bolts shall be tight. The word tight means that the screw or bolt cannot be appreciably tightened further without damage or injury to the screw or bolt threads.

3.18.3 Riveting. Riveting operations shall be carefully performed to insure that the rivets are tight and satisfactorily headed.

3.18.4 Gears. Gear assemblies shall be properly aligned and meshed to provide smooth operation.

3.18.5 Cleaning. The altimeter shall be thoroughly cleaned and loose, spattered, or excess solder, metal chips, or other foreign material shall be removed before final assembly. Burrs and sharp edges as well as resin flash which might crumble shall also be removed.

3.18.6 Assembly. Assembly of the altimeters shall be in conjunction with the supplier's internally approved assembly procedures. Guidance is provided in MIL-HDBK-454.

4. VERIFICATION

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

a. Qualification inspection (see 4.2).
b. Conformance inspection (see 4.3).

4.2 Qualification inspection. The inspection and testing of the altimeter shall be classified as follows:

a. Qualification testing. Qualification tests consist of all examinations and tests performed on sample altimeters with battery modules as required for approval for production (see 4.4).
b. Quality conformance tests. Quality conformance tests are the examinations and tests which are applicable to altimeters manufactured and submitted for acceptance under contract (see 4.5). The performance of altimeter battery mode tests using a simulated battery power supply requires prior approval by

the government.

4.3 Conformance inspection.

4.3.1 Standard atmospheric conditions. Whenever the pressure and temperature existing at the time of the test are not specified definitely, it is understood that the test is to be conducted at atmospheric pressure (29.92 inches Hg or 1013 millibars) and room temperature, 25°C (77°F). When tests are conducted with atmospheric pressure or room temperature differing materially from the values noted, proper allowance shall be made for the difference from the specified condition.

4.3.2 Reference standard barometer. The reference standard for atmospheric pressure measurement shall be a mercury barometer or equivalent which is maintained in accordance with the manufacturer's recommendations and which is accurate (with corrections) within ±0.005 inch traceable to the National Bureau of Standards. A reference barometer or equivalent newly introduced into service shall be checked at intervals of approximately 6 months until the stability of its calibration has been established.

4.3.3 Standard pressure. The standard pressures used in calibrating and testing the altimeter shall be as specified in MIL-STD-859. The VERN test function of the altimeter shall be externally activated when required to determine that accuracy requirements are met during tests.

4.3.4 Barometer. During testing, a Type A-1 barometer (photo scanner equipped) or other barometric pressure measuring equipment or equivalent or superior accuracy shall be used to measure scale errors, hysteresis, and after effect. The pressure measuring equipment shall be properly calibrated for accuracy. The barometer or other measuring equipment used shall be properly maintained and checked in accordance with the handbook of instructions furnished by the applicable manufacturer. Altitude settings shall be in terms of the certified scale.

4.3.5 Rate of pressure change. Unless otherwise specified, the rate of change in pressure during all tests shall be such as not to exceed the following changes in height indications:

Decreasing pressure	30,000 ft/min
Increasing pressure	30,000 ft/min

This rate shall be progressively reduced to 500 fpm or less as the check points are approached to avoid passing the checkpoint.

4.3.6 Attitude. Unless otherwise specified, the altimeter shall be tested in its normal operating position. The altimeter shall not require tapping or vibration to meet the performance requirements specified herein. However, tapping or the application of vibration shall not cause the altimeter display to operate erratically or to exceed tolerances.

4.3.7 Prime standard for lighting. The prime standard lighting reference shall be prepared as specified herein. A minimum of 20 areas covering the entire face of the altimeter

shall be measured for brightness level. A minimum of 10 areas covering the face of the altimeter shall be measured for color. The prime standard and its recorded overall brightness and color measurements shall be approved by the procuring activity. The standard(s) shall be checked at least every 50 hours of operation to determine any change in brightness and color. Variations greater than ±20 percent in two or more areas, or any out of tolerance condition, shall require the return of the standard for corrective action.

4.3.8 Adjustments. Adjustments and/or software changes shall not be made to the altimeter after initiation of testing without approval of the procuring agency. All altimeter samples shall have a Government seal affixed prior to initiation of tests.

4.3.9 Master synchro control transmitter and setting dial. A master synchro shall be suitably mounted on a turntable with an accuracy of at least 0.03 degree and a calibration chart which is accurate to at least ±0.03 degree. This synchro, with suitable calibration data shall be used for the electrical input signal. The master synchro shall be a Bendix AY100GZ-88-Z1 or equivalent. A digital signal equivalent synchro shall also be used. The equivalent master synchro and electronically simulated synchro shall be approved by the procuring activity. Tests shall normally be performed using the master electronically simulated synchro and verified by limited checks using the master synchro.

4.3.10 Electrical supply. Unless otherwise specified, all power shall be 115 ±3V, 400 ±5Hz for operation in the normal mode and standby (primary) mode, 28V DC ±1V for operation in the standby (back-up) mode and 5 +/-.1V AC or DC for integral lighting. Maximum power shall not exceed the limits specified by 3.5.14.

4.3.11 Standby mode. Unless otherwise specified, all tests shall be conducted in the standby (primary) mode with l15V 400Hz applied.

4.3.12 Test sequence. Any variation from the test sequence specified in 4.5 must be approved by the procuring activity. Prior to the start of each test, initiated BIT shall be activated to insure that no faults exist.

4.4 Qualification testing.

4.4.1 Test samples. The test samples shall consist of a minimum of 9 altimeters representative of the production equipment. The samples shall be identified with the manufacturer's part number and such other information as required by the procuring activity. The tests shall be conducted on two groups of samples as follows:

a. Group 1: All tests, except reliability (three samples).
b. Group 2: Reliability (six samples).

4.4.1.1 Disposition of samples. All test samples shall be delivered on contract provided the sample has been operated less than 10 percent of the specified MTBF operation and has been completely overhauled and meets the individual tests and is representative of production units currently being accepted. Sampling plan B test samples shall not be delivered as production

items, but shall be delivered to the government as test samples.

4.4.2 Test report. The contractor shall prepare a test report in accordance with MIL-HDBK-831 as guidance.

4.4.3 Qualification Tests. The qualification tests shall consist of all the tests specified by 4.6.

4.5 Quality conformance tests. The quality conformance tests for the production altimeter shall consist of:

a. Individual tests.
b. Sampling tests.

4.5.1 Individual tests. Each altimeter shall be subjected to the following tests as described under 4.6. The tests may be performed in any sequence.

a. Examination of product (see 4.6.1).
b. Control lever operation and damping (see 4.6.2).
c. Control lever operation (battery mode) (see 4.6.3).
d. Automatic standby reversion (see 4.6.4).
e. Altitude deviation (see 4.6.5).
f. Power interruption (see 4.6.6).
g. Position error (standby mode) (see 4.6.7).
h. Zero setting scale (standby and normal modes) (see 4.6.8).
i. Barometric potentiometer output test (see 4.6.9).
j. Scale error at room temperature (standby mode) (see 4.6.10).
k. Scale error at room temperature (normal mode) (see 4.6.11).
l. Scale error at room temperature (battery mode) (see 4.6.12).
m. Hysteresis (standby mode) (see 4.6.13).
n. Case or sensor leakage (see 4.6.14).
o. Scale error -54°C (-65°F) (standby and normal mode) (see 4.6.15).
p. Scale error +71°C (+160°F) (standby and normal mode) (see 4.6.16).
q. Lighting and display tests of MIL-L-25467, MIL-L-27160 for guidance only, and MIL-L-85762, as applicable (see 4.6.17).

4.5.2 Sampling tests.

4.5.2.1 Sampling plan A tests. Samples shall be selected at random in accordance with the following schedule and subjected to the tests specified as described under 4.6. No production units shall be shipped prior to satisfactory completion of the sample plan A testing for that lot. Failure of sample plan A will invoke MIL-STD-1916 sampling procedure as specified in 4.5.2.4.3.

Quantity	Samples
First 15	3 (Zero when sampling plan B is invoked)

Next 50	1 (Zero when sampling plan B is invoked)
Each additional 100 or fraction thereof	1 (Zero when sampling plan B is invoked)

a. Individual tests (see 4.6.1 - 4.6.17).
b. Torque, push and pull tests (see 4.6.18).
c. Bending (see 4.6.19).
d. Barosetting knob functional test (see 4.6.20).
e. Vibration error (standby mode) (see 4.6.21).
f. Response (normal mode) (see 4.6.22).
g. Voltage variation (normal and standby mode) (see 4.6.23).
h. Sampling plan A tests of MIL-L-25467, MIL-L-27160 for guidance only, and MIL-L-85762, as applicable (see 4.6.24).
i. Display readability test (see 4.6.24.1).
j. Luminance and contrast (see 4.6.24.2).

4.5.2.2 Sampling plan B. Unless otherwise specified (see 6.2), 3 altimeters shall be selected at random from the first 15 on the contract or order, and 3 altimeters shall be selected at random from the first month's portion of the second and each succeeding 500 altimeters on the contract or order and subjected to the following tests as described under 4.6. Tests need not follow the test sequence shown.

a. Sampling plan A tests (see 4.5.2.1).
b. Magnetic property (see 4.6.25).
c. Power consumption (see 4.6.26).
d. Dielectric strength (see 4.6.27).
e. Scale error at -15°C (+5°F) (battery mode) (see 4.6.28).
f. Scale error at +71°C (+160°F) (battery mode) (see 4.6.29).
g. Compatibility tests (see 4.6.30).
h. Electromagnetic interference (see 4.6.31).
i. High temperature exposure (see 4.6.32.1).
j. Low temperature exposure (see 4.6.32.2).
k. Vibration endurance (see 4.6.32.3).
l. Acceleration test (see 4.6.32.4).
m. Humidity (see 4.6.32.5).
n. Salt fog (see 4.6.32.6).
o. Dust (see 4.6.32.7).
p. Fungus (see 4.6.32.8).
q. Shock (see 4.6.32.9).
r. Solar radiation (see 4.6.32.10).
s. Sampling plan B tests of MIL-L-25467, MIL-L-27160 for guidance only, and MIL-L-85762, as applicable (see 4.6.32.11).
t. Overpressure (see 4.6.32.12).
u. Underpressure (see 4.6.32.13).
v. Internal examination (see 4.6.32.14).
w. Maintainability (see 4.6.32.15).

4.5.2.3 Sampling plan C. Unless otherwise specified (see 6.2), four (4) altimeters shall be selected at random from the first 10 of each monthly production quantity and subjected to the following tests as described under 4.6. No samples shall be selected from the last two monthly-production quantities.

a. Individual tests (see 4.6.1 - 4.6.17).
b. Product reliability acceptance test (see 4.6.32.16).

4.5.2.4 Rejection and retest. When an altimeter selected from a production run (after passing the individual tests) fails to meet the subsequent tests of the specification, items still on hand or later produced shall not be accepted until the extent and cause of failure is determined and appropriately corrected. The contractor shall provide a brief written report to the Government representative explaining the cause of failure and the action taken to preclude recurrence. After corrections have been made, all necessary tests shall be repeated.

4.5.2.4.1 Individual tests may continue. For operational reasons, individual tests may be continued pending the investigation of a sampling test failure, but final acceptance of altimeters on hand or later produced shall not be made until it is determined that the items meet all the requirements of the specification.

4.5.2.4.2 Defects in items already accepted. The investigation of a test failure could indicate that defects may exist in altimeters already accepted. If so, the contractor shall fully advise the procuring activity in writing of all defects likely to be found and methods of correcting them.

4.5.2.4.3 MIL-STD-1916 sampling procedure. A failure of sampling A tests, except torque, push and pull, bending, and plan A lighting tests, shall invoke an increase in quality assurance through MIL-STD-1916 sampling procedures. The MIL-STD-1916 procedure will be in addition to the sample plans required under contract or order. The MIL-STD-1916 procedure will be performed until five consecutive lots are accepted. The MIL-STD-1916 inspection level shall be II and the AQL (normal inspection) shall be 1.5. Testing under the procedure will include individual tests and the test or tests of sample plan A which invoked MIL-STD-1916 sampling procedure.

4.6 Test methods.

4.6.1 Examination of product.

a. Qualification tests. Prior to the final assembly of the altimeter to be subjected to qualification tests, a detailed examination shall be made to verify compliance with each of the design requirements of Section 3 that are not covered by specific tests. The detailed results shall be included in the test report required by 4.4.2.
b. Quality conformance tests. Each altimeter submitted for acceptance shall be examined externally to determine conformance with applicable drawings and

with each of the requirements of Section 3 that can be inspected in this manner. Workmanship shall be examined thoroughly to insure compliance with requirements of 3.18 with respect to materials, markings, outline dimensions, connectors, display and assembly using whatever tools, gauges, scales, et cetera, that are necessary.

4.6.2 Control lever operation and damping. With the barometric scale set at 29.92 inches Hg or 1013 millibars, the altimeter shall be electrically connected to the master synchro which is electrically zeroed as specified in 3.5.10. The synchro input shall be set to a point 500 ±50 feet from the ambient pressure altitude. The system shall then be energized with the 115V 400Hz single-phase power. The 28V DC power shall not be applied to the altimeter. The altimeter shall then indicate operation in the STBY mode to display ambient pressure. The control lever shall then be set to the NORM position. The altimeter shall then read the electrical altitude ±10 feet. The barometric setting knob shall be used to produce a reading of 250, 500 and 750 feet. At each point, the altimeter shall be changed from the NORM mode to the STBY mode and back by use of the control lever. The altimeter shall be observed for stable operation. The 26V 400Hz power to the remote synchro shall be monitored during this test and shall be present at any time that the altimeter is electrically connected to the 115V 400Hz power source.

4.6.3 Control lever operation (battery mode). Using the preceding setup with the battery module installed, the altimeter shall be energized with 115V 400Hz power. The standby altitude reading shall be recorded. The control lever shall then be set from the standby to the normal mode with the synchro input set at 500 ±50 feet and the reading recorded. The control lever shall be held in the standby position for two seconds to arm the altimeter. The display shall enter the standby mode and indicate the ambient altitude. The letter "A" should become visible to the left of the digital display and remain visible. The reading of altitude shall be recorded and agree with the prior standby reading. The 115V 400Hz power shall be removed and the altimeter shall automatically continue to display standby altitude without interruption. The letter "A" shall no longer be visible and the letter "B" shall appear above the 1,000 foot digit of the digital display to confirm operation on battery power. Reapply 115 VAC power and verify that the "B" indication for battery operation extinguishes and the letter "A" is illuminated. The altitude reading shall be recorded and shall not have changed. The control lever shall be set to the normal position for two seconds and the dial display shall indicate the word "OFF" for three seconds before battery power is automatically shut off. Repeat the preceding test with 28V DC power only. Remove 28V DC power and rotate and hold the control lever to the normal setting position for two seconds. Verify that the display indicates the word "OFF" for three seconds prior to automatically removing battery power to the altimeter.

4.6.3.1 Control lever - standby. With no external power applied to the altimeter, the control lever shall be held to the standby position to arm the altimeter. The altimeter shall immediately operate in the standby mode to indicate ambient altitude and display the letter "B" above the 1,000 foot digit. External power (28V DC) shall then be applied to the altimeter and the altimeter shall automatically cease operation in the battery mode and operate satisfactorily in the standby mode using 28V DC power. The letter "B" shall not be visible after external power is applied.

4.6.4 Automatic standby reversion. The altimeter shall be operated in the normal mode to display an altitude of approximately 5,000 feet with 115V 400Hz electrical power and 28V DC power applied to the instrument. The 115V 400Hz electrical power to the altimeter shall then be switched off. The altimeter shall automatically respond by displaying the STBY indication and the approximate ambient altitude. The reset lever shall be turned to the normal position but the altimeter shall not respond but remain in the standby mode. Resetting shall be attempted several times and no response shall be noted.

4.6.5 Altitude deviation. The altimeter shall be operated in the normal mode with 115V 400Hz and 28V DC electrical power applied and the synchro input and the static pressure set at 10,000 feet. The synchro input of altitude shall then be slowly increased while maintaining the static pressure at 10,000 feet. The altitude at which the altimeter automatically reverts to the standby mode of operation shall be recorded. The altimeter shall then be reset to the normal mode of operation and the test repeated for decreasing synchro input of altitude. The altitude at which the altimeter automatically reverts to standby operation shall be recorded. The test as described shall be repeated with the static pressure and the synchro input of altitude set at 50,000 feet. The recorded values at which the altimeter automatically reverted to operation in the standby mode shall be within the tolerances specified by TABLE I for the deviation test. When qualification or production data indicate that the altimeter consistently meets the altitude deviation requirements, this test may be performed as a sampling plan A test with prior approval of the procuring activity.

4.6.6 Power interruption. The altimeter shall be energized with 115V 400Hz power and 28V DC power and operated in the standby mode. The altimeter shall then be reset to the normal mode and the standby flag shall not be visible. The altimeter shall be set from the normal mode to standby mode and back to normal mode by use of the control lever and the altimeter pointer shall be observed for stable operation. The control lever shall then be rotated to select the standby position and the altimeter shall immediately return to indicate the ambient pressure altitude. The altimeter shall then be reset to the normal mode by use of the remote reset (FIGURE 3, Pin 13). The 115V 400Hz power shall then be interrupted externally which shall cause the altimeter to revert to standby (back-up) operation. Upon re-energizing the line with 115V 400Hz power, the instrument shall immediately operate in the standby mode and not operate in the normal mode until the normal-standby switch is actuated again. During these tests when the altimeter is reset from the normal mode to standby or vice versa, the pointer shall not exhibit erratic or other objectionable pointer movement characteristics. During preproduction and sampling testing, a test shall be conducted to show compliance with the time delay requirements of 3.5.21.

4.6.7 Position error (standby mode). The altimeter position error reading shall be taken with the instrument vented to atmosphere and in each of the following positions. The reading in positions b, c, d, and e shall not differ from the reading in the normal position. The test shall be performed with the pointer initially set at the 0-foot position of the dial.

a. Normal operating position.
b. Rotated about the longitudinal axis 90 degrees.
c. Rotated about the longitudinal axis 180 degrees.

d. Rotated about the longitudinal axis 270 degrees.
e. Dial face up.

When qualification test data indicate that the altimeter is not affected by position error, this test may be deleted for the production lot.

4.6.8 Zero setting scale (standby and normal modes). The altimeter shall be subjected to atmospheric pressure for the test in the standby mode and an electrical signal approximately equivalent to atmospheric pressure shall be used for the test in the normal mode. The barometric pressure scale shall be set successively to increasing values specified in TABLE II beginning with 28.10 inches of mercury or 950 millibars, as selected by means of the "IN HG/MB" button on the altimeter bezel. The pointer indication shall be recorded at each test point. The test shall then be performed by setting the barometric pressure scale to successively decreasing values specified in TABLE II starting with 31.00 inches of mercury or 1048 millibars and the pointer readings shall be recorded at each test point. The test shall be repeated for the normal mode of operation. After the series of readings has been recorded, the difference between the readings at the setting of 29.92 or 1013 millibars and each other setting shall be determined. The differences shall be recorded and compared with the values in the column titled Correct Difference. The recorded difference shall not vary from the correct difference at any setting specified in TABLE II by more than 10 feet or millibars equivalent for the test in the standby mode and the difference between the values recorded for the clockwise and counterclockwise rotation of the baroset knob at each test point shall not exceed 10 feet or equivalent. The recorded difference for the test performed in the normal mode shall not differ from the correct difference by more than 10 feet at each setting and the difference in readings for each test point for increasing and decreasing settings shall not exceed 5 feet. There shall be no erratic pointer motion, oscillation of digits, or lag and jump during this test.

NOTE 1: The reading obtained at the 29.92 setting or the 1013 millibars setting for the clockwise direction of rotation of the barosetting knob shall be used to compute the differences for both directions of rotation.

NOTE 2: The design of the altimeter shall be such that the test requirement shall be met when atmospheric pressure is within the range -1,000 to +6,000 feet.

NOTE 3: This test may be performed with the static port connected to a controlled pressure source if provisions are made to insure that some altimeters are subjected to controlled pressures and settings other than 29.92.

4.6.9 Barometric potentiometer output test. The electrical position of the barometric potentiometer or electronic equivalent shall be accurately measured with the barometric counter set successively to the following settings without overshoot. The settings for AAU-34B/A and AAU-34C/A altimeters for the barometric scale in inches of mercury are: 28.10, 29.00, 29.92, 30.03, 31.00, High Stop 30.50, 29.92, and 28.50. The settings for the barometric scale in millibars are: 950, 980, 1013, 1030, 1048, 1048, High Stop, 1030, 1013, and 965. The output of the barometric potentiometer shall be within the equivalent of ±10 feet of the position defined in 3.9.2 and TABLE III, except at the setting 31.00 where the position shall be within the

equivalent of +0,-25 feet. The High Stop position shall provide a voltage greater than 0.057 volts when the potentiometer is excited with 10 volts. The voltage at the low stop position shall be less than 9.96 Volts. The two readings at the 29.92 inches of mercury or 1013 millibars settings shall be compared and shall not differ by more than the equivalent of 20 feet. This test may be conducted in conjunction with the test specified by 4.6.8.

NOTE: The barosetting scale shall be designed such that at standard sea level pressure when the setting of 1013 millibars is selected, the display shall indicate an altitude of 0 feet. (The correct setting for 0 feet is 1013.25, but is not attainable with a four digit electronic display.) The design shall provide for correct readings at settings of 1012 and 1014 millibars and the other settings.

4.6.10 Scale error (standby). The altimeter shall be tested for scale errors as follows: The barometric setting shall be set at 29.92 or 1013 millibars (approaching the setting from either direction) and shall remain at this setting during all scale error tests. The a1timeter in the standby (primary) mode shall be subjected to successively decreasing and increasing pressures as specified in TABLE IV. The scale error shall not exceed the tolerance specified in TABLE IV. During this test, the pointer and digits of the display shall be observed for stability. Oscillation of the digital display, instability, or erratic motion of the pointer shall be cause for rejection. The scale error test shall be repeated in the standby (back-up) mode for test points of TABLE IV marked with an asterisk. The scale error tests may be conducted with the altimeter in an altitude chamber.

4.6.11 Scale error (normal mode). This test shall be performed with the barometric setting at 29.92 in Hg or 1013 millibars (set from either direction). The altimeter shall remain at this setting for the duration of the test. The altimeter shall be energized with 115V 400Hz power and 28V DC and set to operate in the normal mode. The master synchro shall then be adjusted to the proper electrical position corresponding to the altitude specified in TABLE IV. The pneumatic altitude pressures shall also be adjusted during the test to the approximate test altitude as required to provide coarse altitude information to support altimeter operation in the normal mode. Scale errors in the normal mode shall not exceed the tolerances specified in TABLE IV. This test may be combined with the scale error test 4.6.10 by resetting to the normal mode after readings have been taken in the standby mode. The altimeter shall reset to the standby mode after readings have been taken in the normal mode. Scale errors in the normal mode shall not exceed the tolerances specified in TABLE IV. During this test, the pointer and digits of the display shall be observed for stability. Oscillation of the digital display, instability, or erratic motion of the pointer shall be cause for rejection.

4.6.12 Scale error (battery mode). With no external power applied, the altimeter shall be turned on by setting the control lever to the standby position for two seconds. The scale error test shall then be performed for the 0ft, 3,000ft, and 5,000ft test points. After return to zero altitude, the control lever shall be set to the normal position for three seconds. The altimeter shall display the word "OFF" for three seconds and end operation.

4.6.13 Hysteresis. The altimeter shall be subjected to decreasing pressures and scale error readings shall be taken at the test points listed in TABLE V. The pressure shall then be

decreased until an altitude of 80,000 ft is attained. Not more than 15 minutes after the altimeter has been first subjected to the pressure corresponding to 80,000 feet the pressure shall be increased until the pressure corresponding to the first test point shown in TABLE V is reached. The altimeter shall remain at this pressure at least 1 minute, but not more than 5 minutes before a test reading is taken. The pressure shall again be increased at the same rate until the pressure corresponding to the second test point in TABLE V is reached. The altimeter shall remain at this pressure for at least 1 minute, but not more than 5 minutes before a test reading is taken. The readings of the altimeter at the test points shall not differ from the readings of the altimeter for the same test points specified in 4.6.11 by more than the tolerance specified in TABLE V. All test readings shall also be within the tolerances of TABLE IV. This test may be combined with the test specified in 4.6.10.

4.6.14 Case or sensor leakage. A vacuum sufficient to produce a reading of approximately 40,000 feet shall be slowly applied to the static pressure connection of the altimeter, at which point the connection tubing shall be pinched off or otherwise completely sealed. The reading of the altimeter after 1 minute shall not have changed more than 25 feet. Altimeters shall be tested individually in the Vernier (VERN) mode. The entrapped volume including the pressure sensor shall not exceed 50 cubic inches.

4.6.15 Scale error at -54°C (-65°F) (normal and standby mode). The altimeter shall be tested for standby scale error in the standby (primary) mode only in accordance with 4.6.10, except that during the test and for a period of 3 hours before the test, the altimeter shall be at a temperature of -54°C ±5°C (-65°F ±9°F). Electrical power shall not be applied to the altimeter during the three hour temperature exposure period. (The exposure and waiting period may be reduced to the period of time required to obtain thermal stability of the test unit as determined by a thermal survey.) After 115V 400Hz electrical power is applied, data shall be recorded for each applicable test point in TABLE IV. The test shall be repeated for the normal mode. The master synchro shall be set to the electrical position corresponding to the altitude values. The data shall be recorded for the applicable test points in TABLE IV. Checks for proper operation of the baroset knob, and the control lever shall be made.

4.6.16 Scale error at +71°C (+160°F) (standby and normal mode). The test specified in 4.6.15 shall be conducted, except that the temperature shall be 71°C ±5°C (+160° ±9°F).

4.6.17 Lighting. Power shall be applied to the altimeter for performance of applicable Individual Tests of MIL-L-25467, MIL-L-27160 for guidance only, and MIL-L-85762. The display elements shall be operated and checked during this test. The test shall be performed in the standby (primary) mode and repeated for the standby (secondary) mode, and the (battery operated) mode.

4.6.18 Torque, push and pull. The following tests shall be conducted to demonstrate that the barometric setting mechanism shall not be damaged when subjected to the torque and push and pull forces on the knob as specified in 3.9.1.

a. The presence of the required stops shall be verified. A twisting force of 6 inch-pounds shall be applied at the barosetting knob against each stop.

b. A pulling force of 15 pounds shall be applied to the barosetting knob. While the force is applied, the knob shall be rotated at least 90 degrees. This shall be repeated with a pushing force of 15 pounds.

4.6.19 Bending. The barosetting knob and the normal-standby mode control lever shall each be subjected to a force of 15 pounds applied at the extreme outward end of the setting knob and control lever respectively without bending or without damaging the mechanism or the case. This test shall demonstrate that the requirements of 3.5.20.1 are met.

4.6.20 Barosetting knob functional test. The barosetting system shall be operated from 28.10 to 31.00 and back to 28.10 inches of mercury or 950 to 1048 and back to 950 millibars. The torque required for operation shall be within the values specified in 3.9.1. The adjustment of barometric setting from the high stop to the low stop shall be made within 9 to 12 revolutions of the setting knob.

4.6.21 Vibration error (standby). The altimeter shall be mounted on the vibration stand in the normal operating position and electrically operating in the standby mode. The altimeter shall be subjected to sinusoidal and random vibration tests except gunfire vibration in accordance with MIL-STD-810 and as specified in 3.6 (e) and TABLE VI. Altimeters with battery modules attached shall be armed prior to being subjected to the sinusoidal and random vibration tests. The altimeter shall remain armed for approximately the first 10 minutes during the test until automatically disarmed. The testing shall then continue in the standby mode for the remainder of the test.

4.6.21.1 Vibration resonance search. During vibration resonance searches as required to be performed as part of the sinusoidal cycling functional tests, the pressure to the altimeter shall be maintained constant or at room ambient. As the resonant search is performed, the altimeter display shall not exhibit oscillations greater than 20 feet and pointer variation from the normal shall not exceed 20 feet.

4.6.21.2 Post resonance search sinusoidal cycling vibration test. Upon completion of the resonance search, the remainder of the sinusoidal functional vibration test for each axis shall be performed while the altimeter is being pressure cycled. The pressure to the altimeter shall be cycled from room ambient to approximately 40,000 feet altitude and return to sea level at a rate of about 2,000 to 4,000 feet per minute. The function of the altimeter under test shall be noted to be satisfactory with respect to stability and readability. The altimeter shall not exhibit any permanent shift in calibration as a result of the vibration tests.

4.6.22 Response. For qualification only, the altimeter in the normal mode shall be connected electrically to a synchro transmitter which shall be capable of being driven at a rate of 100,000 fpm. The static pressure shall simultaneously be adjusted to produce approximately the same pressure rates as the synchro transmitted rate. The synchro and static pressure inputs of altitude shall then be changed at the rate of 100,000 fpm for increasing and decreasing altitudes. The altimeter shall not revert to standby operation or fail to display altitude while being driven at the high rates of pressure change, and when the synchro comes to an abrupt stop, the altimeter shall stop at the appropriate electrical value within 2 seconds. The stops of the transmitting

synchro shall be set at 0 and 70,000 feet. The test shall be repeated at a rate of 80,000 fpm to determine that the digital display of altitude and pointer motion is readable and is not erratic. A test shall then be conducted to show compliance with the lag and display requirements at rates of 25,000 feet per minute and 10,000 feet per minute as specified in 3.6.9. During this test when the pressure rates are being applied, the reset lever shall not be touched by the operator. For production sampling plan A, the rate of change of altitude shall be 90,000 fpm.

4.6.23 Voltage variation (normal and standby mode). The altimeter, connected electrically to 115V 400Hz only and operating in the normal mode, shall be tested for accuracy at all test points of TABLE IV from 0 to 10,000 feet at power conditions of 115V-400Hz, 108V-312Hz, 108V-380Hz, 121V-312Hz, 121V-420Hz and 121V-510Hz. The change in reading from that obtained at normal power (115V-400Hz) shall not exceed 10 feet. The test shall be repeated with 28V DC electrical power only connected to the altimeter for operation in the standby mode. The power conditions shall then be varied from 13.5V DC to 30V DC. The reading obtained when operating at 13.5V DC shall not vary from the reading obtained with normal power 28V DC by more than 10 feet. The power shall then be increased to 30V DC for a period of one minute. There shall be no damage to the electronics or to the display of the altimeter. The 28V DC power leads to the altimeter shall then be reversed and no damage to the altimeter shall result.

4.6.23.1 Battery receptacle pin - test. A test shall be performed with 18V DC power applied to the applicable altimeter receptacle pins for the battery. The voltage shall then be varied from 7.5 to 18.5V DC. Operation of the altimeter shall be satisfactory without power interruption throughout the range 13.5 to 18V DC.

4.6.24 Lighting. Sampling plan A lighting tests shall be conducted in accordance with MIL-L-25467, MIL-L-27160 for guidance only, and MIL-L-85762 as applicable. The test shall be performed in the standby (primary mode) and repeated for the standby (secondary mode), and the battery operated mode.

4.6.24.1 Display readability. The altimeter shall be tested to determine that the display readability requirements of 3.5.12.5.8 are met. The altimeter display shall be exposed to ambient light levels of 0 to 10,000 foot candles. With the lighting on or off, as required, all display elements shall be readily discernible from a distance of 28 inches in front of the display and the requirements of 3.13 shall be met.

4.6.24.2 Luminance and Contrast. The altimeter shall be tested to determine that the luminance and contrast requirements of 3.5.13 are met. The display luminance and contrast shall be measured using the test setup shown in FIGURE 8 and using the diffuse illumination specified in section 3.5.13.1 herein. Light sources used shall have a color temperature between 3000 and 5000 Kelvin. The following measurements shall be taken and used to calculate the required contrast $\frac{Lt-Lb}{Lb}$ and (δL). Measurements shall be taken with a photometer having a sensing aperture equivalent to at least 1.8 minutes of arc, as measured from the normal operating distance (28 inches). If luminances of smaller areas are measured, then a series of measurements shall be taken within an area equivalent to the 1.8 minutes of arc area and the luminance of the active areas shall be averaged with the luminance of any inactive areas on a weighted basis.

4.6.25 Magnetic property. The altimeter, not operating, shall be rotated in a vertical plane about a short bar magnet compass with the nearest part of the altimeter 8 inches from and magnetically east or west of the center of the compass. Starting directly under the compass, the altimeter shall be held in positions 0°, 45°, 90°, 135°, 180°, 225°, 270°, and 315° from the initial position. At each of these positions, the altimeter shall be rotated about its own horizontal axis until it is in the normal upright position. The horizontal magnetic field intensity shall be 0.17-0.19 oersted. With the altimeter at any specified position, the compass deflection shall not exceed 1 degree. This test shall be repeated with the altimeter operating at rated voltages in the standby and the normal modes.

4.6.26 Power consumption. The altimeter shall be tested to determine compliance with 3.5.14.1, 3.5.14.2, 3.5.14.3 and 3.5.14.4.

4.6.27 Dielectric strength. The altimeter shall be checked for insulation resistance by testing from the terminals indicated to case ground at the potentials indicated for no more than 30 seconds. The maximum voltage shall be raised from zero by rheostat control. Switching to the voltage from zero shall not be permitted. There shall be no breakdown of insulation or other permanent damage to the altimeter as a result of this test.

Pins	Potential to Case
2, 3, 13, 15, 17, 18, 19, 20, 21, 22, 23, 24	500V 60Hz

Where applicable, the test shall also be performed for any spare pins that have been used with prior approval of the procuring activity.

4.6.28 Scale error at -15°C (+5°F) (battery mode). The scale error test 4.6.12 shall be performed after the temperature has been set and stabilized at -15°C.

4.6.29 Scale error at +71°C (+160°F) (battery mode). The test specified in 4.6.12 shall be performed after the temperature has been set and stabilized at +71°C.

4.6.30 Compatibility Tests. Compatibility tests as required to demonstrate compliance with 3.5.25 shall be conducted in accordance with the applicable document for the equipment specified herein (see 6.2 and 6.2.1). The government may elect to perform all or a portion of this test.

4.6.30.1 Compatibility - computers. Compatibility with altitude computers and air data computers and the TTU-229/E Test set.

4.6.31 Electromagnetic interference. The altimeter shall be tested in accordance with MIL-STD-461 to demonstrate compliance with the requirements of 3.6.1. During the measurement of emissions, the altimeter shall be dynamically operated. Interference measurements shall include the interference produced during operation of the control lever and the baroset knob.

4.6.32 Environmental tests. The altimeter shall be subjected to the following tests conducted in accordance with the specified methods and procedures of MIL-STD-810. Upon completion of each test, the altimeter shall meet the tests specified in 4.6.10, 4.6.11, 4.6.13, and 4.6.14 for room temperature. When external connections are required to simulate installed conditions, they shall consist of standard AN or MS fittings and at least 10 feet of 1/4 inch aluminum or copper tubing coiled and so arranged as to allow drainage of condensed vapors. They shall be attached to the static pressure port of the altimeter. During all environmental tests (excluding non-operating environments), the lighting circuits shall be energized and checked for proper operation. After each exposure test, the displays, lighting, baroset knob, and control level shall be checked for proper operation.

4.6.32.1 High temperature exposure. The high temperature exposure test shall be conducted in accordance with Method 501.1, Procedure I.

4.6.32.2 Low temperature exposure. The low temperature exposure test shall be conducted in accordance with Method 502.1, Procedure I.

4.6.32.3 Vibration endurance. The sinusoidal cycling and random vibration endurance test shall be conducted in accordance with MIL-STD-810 Method 514.2, Procedure 1A, except as specified by TABLE VI. Gunfire tests shall be conducted in accordance with MIL-STD-810 and as specified by TABLE VII.

4.6.32.4 Acceleration tests. The acceleration tests shall be performed in accordance with Method 513.2, Procedures I and II, except where noted herein.

4.6.32.4.1 Structural test. The altimeter shall be subjected to acceleration of the magnitudes specified in the directions 3.6 (i) and in accordance with Method 513.2, Procedure I. The test time duration in each direction shall be at least 1 minute following centrifuge stabilization.

4.6.32.4.2 Operational test (normal and standby mode). The altimeter shall be mounted in each of the three positions specified in 4.6.32.4.1 and subjected to the operational accelerations specified in 3.6 (i) for the appropriate axis. The complete test shall be performed for the normal mode. The test shall be repeated at ambient pressure altitude only for the standby (primary) mode. This test shall be performed for each of the following altitudes:

a. Ambient pressure altitude.
b. Approximately 5,000 feet (24.896 in. Hg).
c. Approximately 25,000 feet (11.103 in. Hg).

4.6.32.4.3 Readings. Readings shall be taken prior to and during acceleration. The change in reading shall not exceed the values specified in TABLE VIII. Readings shall be taken after the test and shall not deviate from the initial readings.

4.6.32.5 Humidity. The altimeter shall be subjected to a humidity test in accordance

with Method 507.1, Procedure I.

4.6.32.6 Salt fog. The salt fog test shall be conducted in accordance with Method 509.1, Procedure I. The altimeter shall be thoroughly examined not sooner than 48 hours after completion of this test and there shall be no evidence of internal or external corrosion or deterioration that would affect subsequent operation of the altimeter. There shall be no corrosion or damage as a result of this test that would affect subsequent operation of the altimeter.

4.6.32.7 Dust. The dust test shall be conducted in accordance with 510.1, Procedure I.

4.6.32.8 Fungus. The altimeter shall be subjected to a fungus test in accordance with Method 508.1, Procedure 1 after which it shall be thoroughly examined. There shall be no evidence of fungus growth. This test need not be performed if a detailed review of all altimeter components is made and appropriate certification is provided concerning the use of only non-nutrient material.

4.6.32.9 Shock test. The shock test shall be performed in accordance with Method 516.2, Procedures I and III figure 516.1-2, amplitude (a) time duration(c).

4.6.32.10 Solar radiation. The altimeter shall be subjected to solar radiation in accordance with Method 505.1, Procedure II. During the 14th hour of each of the three cycles, the altimeter shall be energized for 30 minutes and the display shall function properly. At the end of the test, there shall be no evidence of damage or fading of any of the display elements.

4.6.32.11 Lighting and display. The Sampling Plan B tests of MIL-L-25467, MIL-L-27160 and MIL-L-85762 shall be performed as applicable. The test shall be performed in the standby (primary) mode and repeated for the standby (secondary) mode and the (battery operated) mode. The Display readability test (4.6.24.1) and the Luminance and contrast test (4.6.24.2) shall also be performed.

4.6.32.12 Overpressure. The altimeter shall be subjected to a pressure of 35 inches Hg absolute with the baroset at 29.92 inches of mercury or 1013 millibars. The application of pressure shall not damage any part of the altimeter or cause a permanent zero or calibration shift that result in the altimeter failing to meet specification requirements.

4.6.32.13 Underpressure. The altimeter shall be subjected to a pressure equivalent to an altitude of 100,000 feet. The application of the vacuum shall not damage any part of the altimeter or cause a permanent zero or calibration shift that result in the altimeter failing to meet specification requirements.

4.6.32.14 Internal examination. Upon completion of all environmental tests, the altimeter shall be subjected to room temperature tests specified in 4.5.1. One altimeter shall be disassembled and thoroughly examined to determine compliance with the requirements of Section 3 which are capable of being determined in this manner. In addition, there shall be no evidence of corrosion, deterioration of any external or internal component, or accumulation of any foreign material which would adversely affect performance or most probably induce a

malfunction of the altimeter.

4.6.32.15 Maintainability. A maintainability demonstration test shall be conducted to show compliance with the specified requirements of 3.5.16. This test may be conducted in conjunction with the test specified in 4.6.32.14. Guidance is provided in MIL-HDBK-470.

4.6.32.16 Reliability. The altimeter shall be subjected to a reliability test in accordance with the contractor's government approved Reliability Test Plan (RTP) for demonstrating a 12,000 hour MTBF. Guidelines for the RTP are provided within MIL-HDBK-781.

4.7 Packaging inspection. The packaging, packing, and marking shall be inspected for conformance to Section 5.

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 commands. 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 AAU-34B/A Altimeter is intended to replace the AAU-19/A, AAU-19A/A, AAU-19B/A, AAU-34/A and AAU-37/A Altimeters. The AAU-34B/A Altimeter incorporates all functions of the altimeters it replaces. The AAU-34C/A Altimeter incorporates night vision compatible Type A, NVIS "Green A" lighting and "blue filtered" white lighting. The two altimeters covered by this specification are intended for use with altitude computers CPU46/A and CPU66/A, Central Air Data Computers, and Standard Central Air Data Computers (SCADCs) to provide a display of static pressure defect corrected altitude in the normal mode and uncorrected pressure altitude in the standby mode. The installation of a battery on the rear of the altimeter case enables altimeter operation for a limited time when all aircraft power is lost to the altimeter. This capability was developed primarily for use by the Navy. In the unlikely event that loss of both 115V AC 400Hz and 28V DC aircraft power occurs during carrier launch, a battery back-up power capability is available.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. Altimeter type (see 1.2).

c. Qualification and conformance test plans for Altimeter with battery module and/or tests of altimeters or battery modules only (see 4.4.3).
d. When sampling plan B and C test are not to be conducted (see 4.5.2.2 and 4.5.2.3).
e. Compatibility test requirements (see 4.6.30).
f. Government-loaned property (see 6.2.1).
g. Levels of packaging and packing required (see 5.).

6.3 Data. Data generated by this document is not deliverable unless specified on the Contract Data Requirements List (DD Form 1423) referencing the appropriate data item description in the military departments' Authorized Data List (ADL). The data produced by this specification is as follows:

a. Data for approval for nonstandard parts (see 3.2).
b. A record of events during corrective maintenance task demonstration as specified in 3.5.16.1.1.
c. A safety hazard analysis (see 3.5.16.2.1).
d. Test report in accordance with MIL-HDBK-831 as guidance (see 4.4.2).
e. Warranty decal information, as applicable (see 3.16).
f. A Reliability Test Plan (RTP) (see 3.5.15.1).
g. Requirements for optional battery modules (3.1).

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL-83419 whether or not such products have actually been listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Oklahoma City Air Logistics Center/ENSDAA(AF-71), 3001 Staff Drive, Suite 1AB81A, Tinker AFB, OK 73145 or email af71@tinker.af.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.daps.dla.mil.

6.5 Subject Term (key word) listing.

AAU-34B/A
AAU-34C/A
Altitude
Display
Integral lighting

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

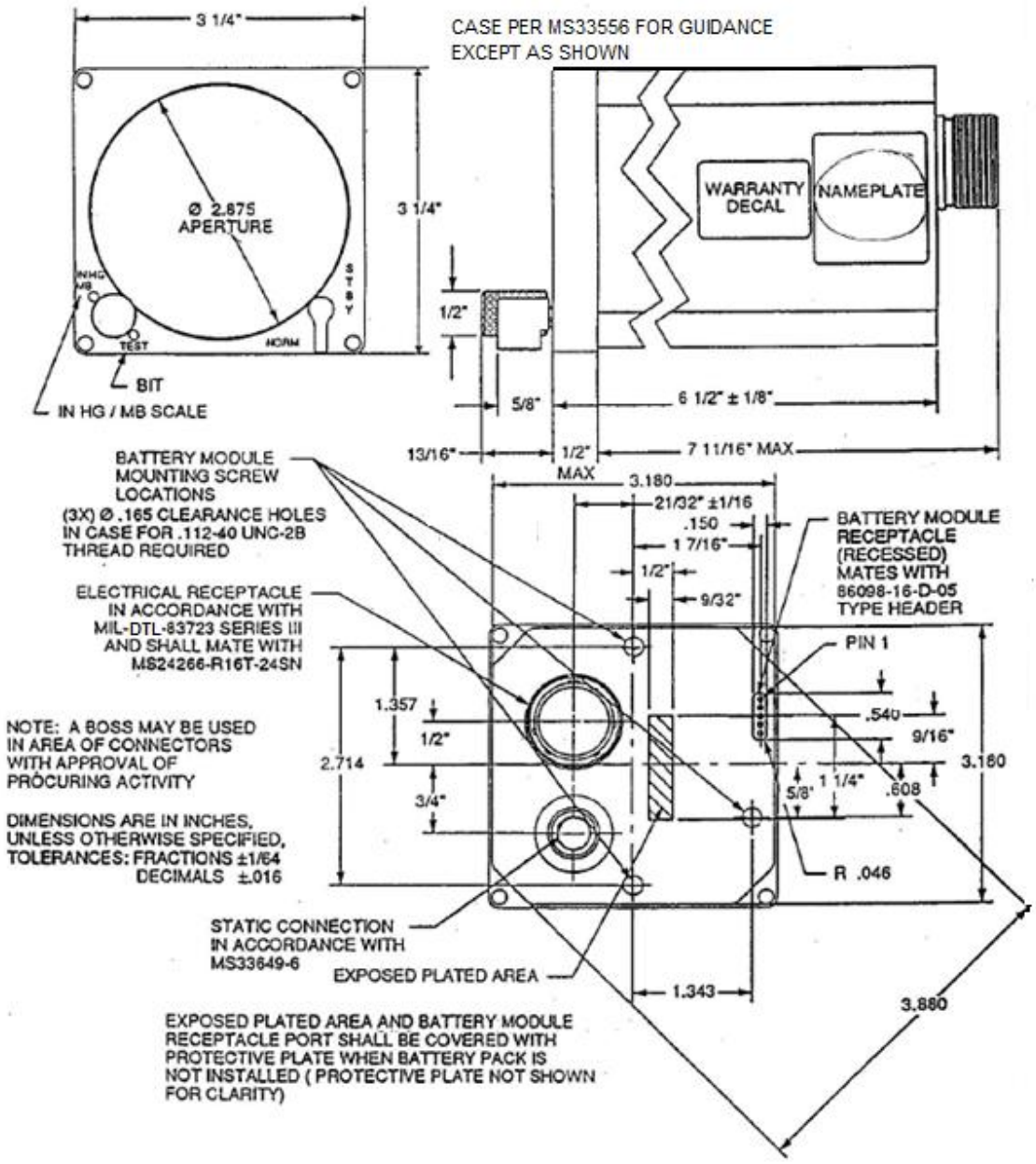
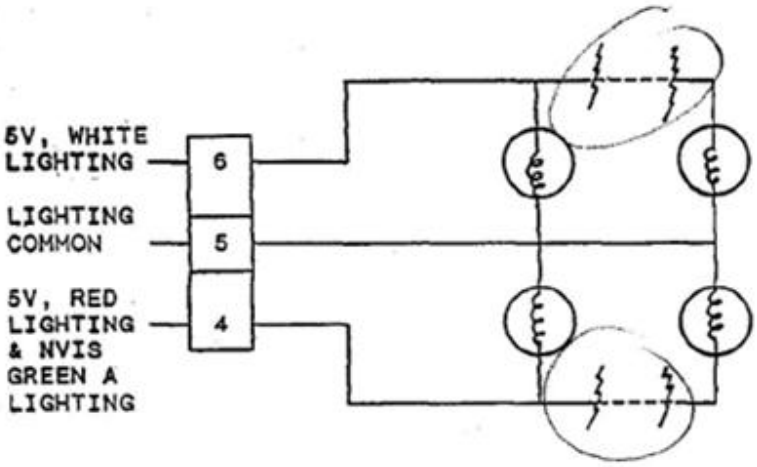


FIGURE 1. Case.



ELECTRICAL RECEPTACLE IN ACCORDANCE WITH MIL-DTL-83723 SERIES III

NOTE 1: AAU-34B/A Altimeters use pin 6 (HI) and pin 5 (LO) for white lighting. Pin 4 (HI) and Pin 5 (LO) are used for Red lighting.

NOTE 2: AAU-34C/A Altimeters use Pin 4 (HI) and Pin 5 (LO) for night vision compatible lighting (NVIS). Pin 6 (HI) and Pin 5 (LO) are used for white lighting.

FIGURE 2. Lighting circuits.

ALTIMETER ELECTRICAL RECEPTACLE
MIL-DTL-83723 SERIES III
(Mates with MS 24266-R16T-24SN)

RECEPTACLE PIN	ALTIMETER INPUT OR OUTPUT FUNCTION
1	INPUT FOR VERN (VERNIER) MODE OF OPERATION 3.5.23.2
2 3	115V 400Hz (HI) 115V 400Hz (LO POWER INPUT FOR OPERATION IN NORMAL/STANDBY (PRIMARY) MODE 3.5.14
4 5 6	5V RED LIGHTING HI (+) 5V NVIS LIGHTING HI (+) 5V COMMON, LO (-) 5V WHITE LIGHTING HI (+) POWER INPUT FOR INTEGRAL LIGHTING 3.5.14.3
13	115V 400Hz (HI) INPUT FOR REMOTE RESET 3.5.17
14	ALTIMETER INTERNAL GROUND TO CASE 3.5.8
15 17 18 19	SYNCHRO H2 SYNCHRO Y2 SYNCHRO X2 SYNCHRO Z2 SYNCHRO INPUT. (SYNCHRO C2 INPUT USES THE 115V 400HZ (LO) PIN 3) 3.5.10
20 21	28V DC (+) 28V DC (-) POWER FOR OPERATION IN THE STANDBY (BACK-UP) MODE 3.5.14.2
22 23 24	POTENTIOMETER, HI (+) WIPER POTENTIOMETER, LO (-) POTENTIOMETER OUTPUT FROM ALTIMETER 3.9.2, TABLE III

NOTE: 1. All unspecified pins are reserved and may not be used without prior approval of the procuring activity.

2. Electrical power (28VDC) may be applied to pins 7 and 10 by ground test equipment or by a test function in some aircraft.

ALTIMETER BATTERY RECEPTACLE (mates with battery module header type 86098-16-D-05)

Pin 1 Battery Status Input
Pin 2 Altimeter Clock Output to Battery
Pin 3 Battery Power Input (18V DC, Nominal)
Pin 4 Battery Common Power Return
Pin 5 Battery Tap Input, 6 V DC (Fuse Test)

FIGURE 3. Receptacle pin assignments

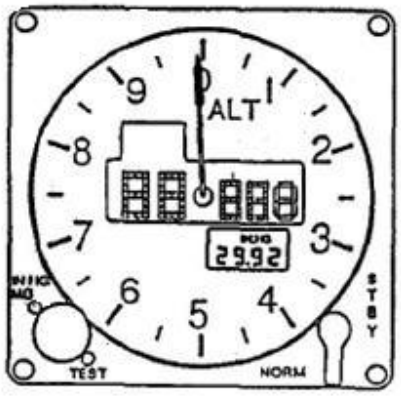


Figure 4A Altitude display (feet) NORMAL mode.

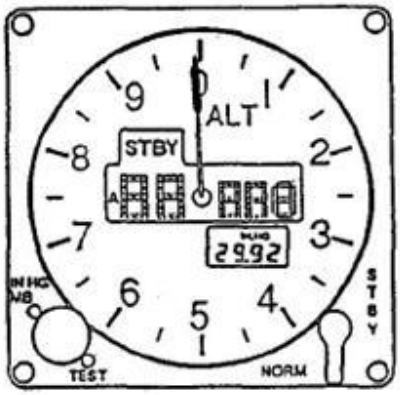


Figure 4B Altitude display (feet) STANDBY mode. "ARMED" for potential battery use.

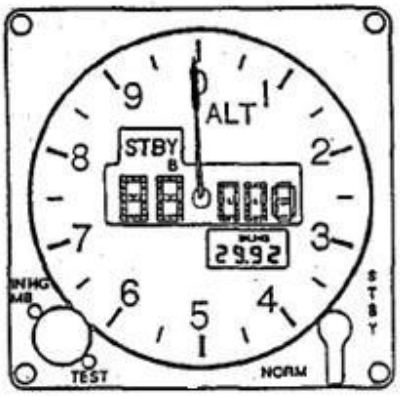


Figure 4C Altitude display (feet) Operating in STANDBY on BATTERY power only. External power not available.

FIGURE 4. AAU-34B/A and AAU-34C/A Presentation.
Shown with In. Hg. barometric setting scale (inches of mercury)

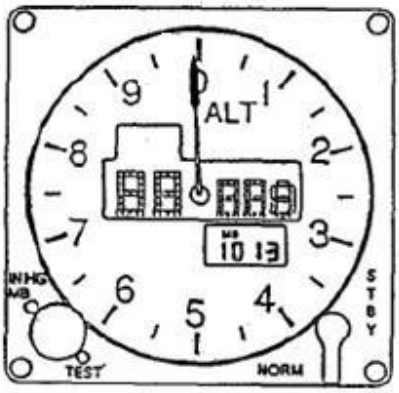


Figure 5A Altitude display (feet) NORMAL mode.

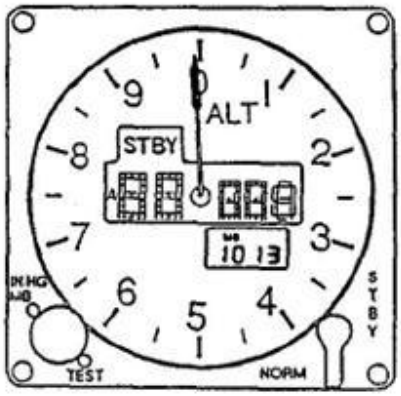


Figure 5B Altitude display (feet) STANDBY mode. "ARMED" for potential battery use.

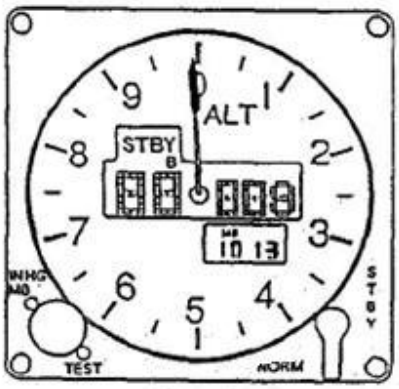
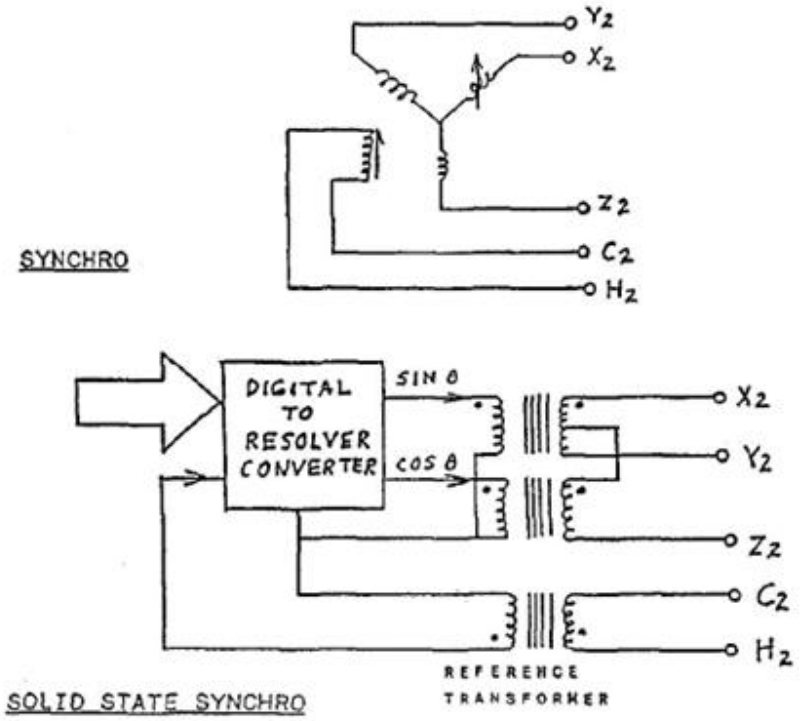


Figure 5C Altitude display (feet) Operating in STANDBY on BATTERY power only. External power not available.

FIGURE 5. AAU-34B/A and AAU-34C/A Presentation. Shown with MB barometric setting scale (millibars)



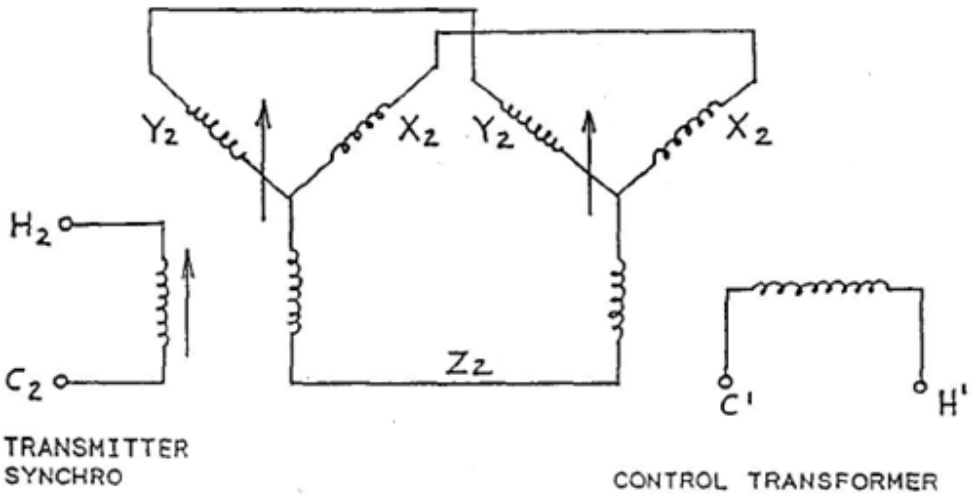
a. The rotor or reference transformer shall be excited with rated voltage so that voltage C_2 to H_2 is in phase with power excitation ground to phase.

b. At the electrical zero position (0=zero degrees), the voltage from Z_2 to X_2 and Z_2 to Y_2 shall be in phase with C_2 to H_2 and the power excitation. Voltage X_2 to Y_2 shall be null. If C_2 is connected to Z_2 then the voltage H_2 to X_2 is less than H_2 to C_2.

c. Rotation of the synchro to an increasing angle function (schematically shown as synchro rotor clockwise), the voltage Y_2 to X_2 shall increase in phase with C_2 to H_2 and the power excitation.

d. The X_2, Y_2, and C_2 designations will be assigned to the aircraft wiring diagram of the component connector.

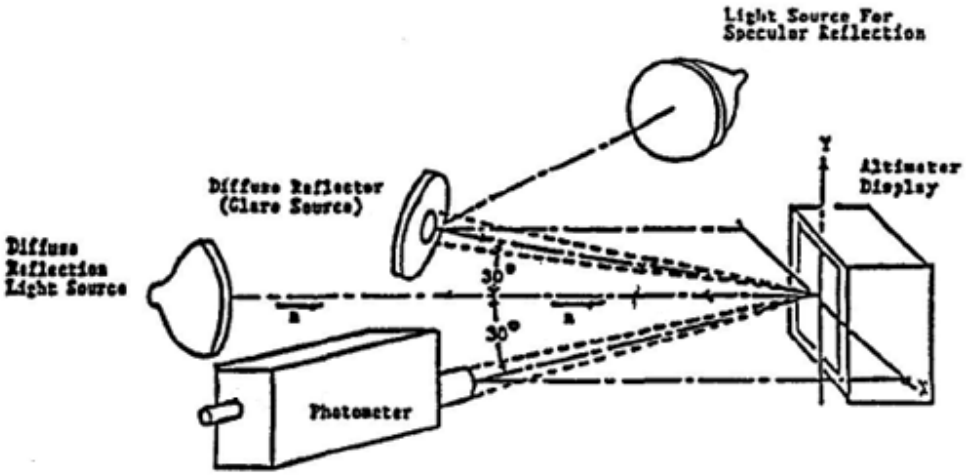
FIGURE 6. Electrical Zero Transmitter.



a. The control transformer shall be connected to an electrical servoed transmitter synchro. The voltage C' to H' shall shall be null.

b. If the transmitter synchro is rotated to an increasing function (schematically shown as rotor clockwise), the voltage C' to H' shall increase in phase with C_2 to H_2.

FIGURE 7. Electrical zero control transformer.



Notes:

1. Luminance of the glare source is measured by putting a mirror (preferably silvered) 7 inches in place of the display and leaving the photometer focused at the display surface.
2. The diffuse ambient should be measured by substituting a diffuse surface of known reflectance for the display surface and measuring its luminance, then calculating the illumination level.
3. The diffuse and specular reflected light can be measured separately and summed or measurements can be taken directly with both light sources on at once.
4. Ordinary photo studio lights are not purely diffuse light sources, but are an acceptable approximation in this test.
5. Contrast shall not degrade more than 20% from specified values when measured at angles smaller than the 30 degrees shown in Figure 8, or when diffuse reflected luminance is measured with a photometer and light source interchanged (that is, photometer on the axis of the display.

FIGURE 8. Combined specular and diffuse measurement setup.

TABLE I. Altitude deviation tolerances.

Test Point Altitude (ft)	Reversion to Standby Mode Synchro Input, Equivalent Altitude (ft)	
	Increasing Altitude	Decreasing Altitude
10,000	14,000 ±200	6,000 ±200
50,000	54,000 ±3.00	46,000 ±200

TABLE II. Zero setting scale.

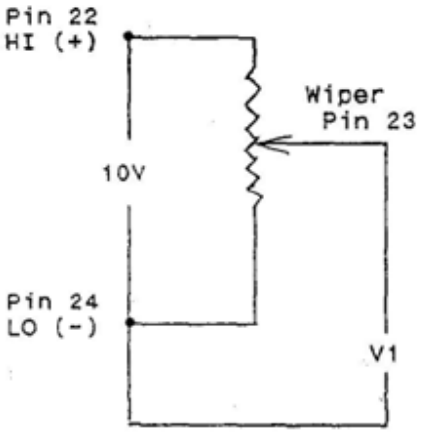
Pressure Scale Setting In. Hg	Correct Difference (ft)	Pressure Scale Setting Millibars	Correct Difference (ft)
28.1	-1727	950	-1773
28.5	-1340	965	-1344
29.0	- 863	980	- 920
29.5	- 392	1000	- 364
29.92	0	1013	0
30.5	531	1030	454
30.9	893	1045	856
31.0	983	1048	936

NOTE: The reading at 1013 millibars shall be 0 as the display cannot be adjusted to read the correct setting of 1013.25 for this point.

TABLE III. Baroset - volts - feet correction relationship.

AAU-34B/A and AAU-34C/A Altimeters

Pressure Setting In. Hg	Volts (V)	Feet Corr.
28.10	9.09	-1727
28.50	7.80	-1340
28.86	6.65	- 996
29.00	6.21	- 863
29.31	5.23	- 570
29.50	4.64	- 392
29.92	3.33	0
30.03	3.00	+ 100
30.50	1.56	+ 531
30.73	0.87	+ 740
30.90	0.36	+ 893
31.00	0.06	+ 983



AAU-34B/A and AAU-34C/A Altimeters

Pressure Setting Millibars	Volts (V)	Feet Corr.
950	9.24	-1773
965	7.81	-1344
980	6.40	- 920
1000	4.55	- 364
1013	3.33	0
1030	1.82	+ 454
1045	0.48	+ 856
1048	0.21	+ 936

NOTE 1: The potentiometer is isolated from all altimeter circuits.

NOTE 2: The reading at 1013 millibars shall be 0 as the display cannot be adjusted to read the correct setting of 1013.25 for this point.

TABLE IV. Scale errors.

EQUIUVALENT PRESSURE UNITS OF MERCURY AT 0°C		STANDARD ALTITUDE	SYNCHRO POSITION	STANDBY MODE		NORMAL MODE +25°C #-54°C #+71°C
				ROOM TEMP	#-54°C #+71°C	
MM	INCHES	FEET	DEGREES	FEET	FEET	FEET
787.87	31.018	-1,000	324	±20	±30	±10
760.00	29.921	0	0	20 *	30	10
746.37	29.385	500	18	20	30	10
732.93	28.856	1,000	36	20	30	10
719.70	28.335	1,500	54	20	30	# 10
706.65	27.821	2,000	72	20	30	# 10
693.80	27.315	2,500	90	20	30	10
681.14	26.817	3,000	108	20	30	# 10
656.38	25.842	4,000	144	20	30	# 10
632.36	24.896	5,000	180	20 *	35	10
609.05	23.978	6,000	216	25	35	# 10
564.51	22.224	8,000	288	25	35	# 10
522.65	20.577	10,000	0	25 *	40	10
483.34	19.029	12,000	72	25	40	10
446.34	17.577	14,000	144	30	40	10
428.90	16.886	15,000	180	30 *	45	10
411.90	16.216	16,000	216	30	45	10
379.53	14.942	18,000	288	35	45	10
349.25	13.750	20,000	0	40 *	60	10
320.96	12.636	22,000	72	45	60	# 10
282.03	11.103	25,000	180	50	70	# 10
225.69	8.885	30,000	0	55 *	80	10
178.83	7.041	35,000	180	75	90	10
140.66	5.538	40,000	0	80 *	120	# 10
110.62	4.355	45,000	180	105	130	# 10
86.99	3.425	50,000	0	130	200	# 10
68.40	2.693	55,000	180	175	260	10
53.79	2.118	60,000	0	220	320	# 10
33.28	1.310	70,000	0	340	520	# 10
20.70	0.815	80,000	0	550	820	# 10

NOTE 1: Test to be run up and down scale. The total number of test points used in testing at 200 hour intervals and after environmental exposure may be reduced to ten points which are approved by the procuring activity. Final reliability testing and testing after the last environmental exposure must include all test points.

NOTE 2: Points marked # to be tested during preproduction and sampling tests only.

NOTE 3: Points marked * to be tested during preproduction and sampling tests only.

NOTE 4: Prior to the start of scale error tests and after the completion of scale error tests, initiated BIT shall be activated to determine that altimeter performance and display operation are satisfactory. The initiated BIT check may be performed prior to and after all temperature operation and exposure tests.

TABLE V. Hysteresis error.

Test Point	Altitude (Feet)	Tolerance (±Feet)
First	40,000	10
Second	20,000	10
Third	0	10

TABLE VI. Vibration tests.

Functional Vibration Test				
Frequency Range (Hz)	Type of Motion	Test Time Per Axis		MIL-STD-810 Applicable Curve
		Sweep Time	Sweep Rate Cycle	
5-50	Sinusoidal Cycling	30 minutes (Includes resonance dwell of 5 minutes)	7.5 minutes	Figure 514.2-2 5-33Hz, Curve C; 33-50 Hz, Curve B (2g)
50-2000	Random	30 minutes		Figure 514.2-2A, 50-1000 Hz; Maximum acceleration power spectral density W = 0.009 G /Hz. Minimum overall g rms = 3.6. 1000-2000 Hz; -6dB/octave
Non-functional Vibration Endurance Test				
Frequency Range (Hz)	Type of Motion	Test Time Per Axis		MIL-STD-810 Applicable Curve
		Sweep Time	Sweep Rate Cycle	
5-50	Sinusoidal Cycling	90 minutes (Includes resonance dwell time 30 minutes)	7.5 minutes	Figure 514.2-2, 5-33Hz, Curve C; 33-50 Hz, Curve B (2g)
50-2000	Random	60 minutes		Figure 514.2-2A, 50-1000 Hz; Maximum acceleration power spectral density W = 0.027 G /Hz. Minimum overall g rms = 6.3 1000-2000 Hz; -6dB/octave

NOTE: Random vibration testing of altimeters with a battery pack installed shall be limited to 6g maximum.

TABLE VII. Gunfire vibration (non-functional)

Frequency Hz/ Tolerance	Test Levels, g	Battery Module Test Levels, g
33 ±2	3	3
67 ±3	3	3
100 ±5	5	4.5
133 ±7	10	4.5
167 ±8	10	4.5
200 ±10	10	4.5
233 ±12	15	4.5
267 ±13	15	4.5
300 ±15	15	4.5
333 ±17	15	4.5
367 ±18	15	4.5
400 ±20	15	4.5
433 ±22	15	4.5
467 ±23	15	4.5
500 ±25	15	4.5
533 ±27	15	4.5
567 ±28	15	4.5
600 ±30	15	4.5
633 ±32	15	4.5
667 ±33	15	4.5
700 ±35	15	4.5
733 ±37	15	4.5
767 ±38	15	4.5
800 ±40	15	4.5
833 ±42	15	4.5
867 ±43	15	4.5

NOTE: 1. The dwell time at each of the listed frequencies shall be five minutes for each axis.

2. Battery module tests shall be performed with the battery module installed on the altimeter.

TABLE VIII. Operational acceleration tolerances.

Direction and "g" level		ALTITUDE		
		0 Feet	5,000 Feet	25,000 Feet
Fore	2g	20	30	40
Aft	6g	30	40	60
Up	9g	40	50	80
Down	3g	20	30	40
Lateral	4g	30	40	60

Custodians:
Air Force - 71

Preparing activity
Air Force - 71

(Project 6610-2011-001)

Reviewer activities:
Navy - SA
Air Force - 99
DLA - GS

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/.