

MIL-C-27298B(AS)
3 July 1980
 Superseding
 MIL-C-27298A(WEPS)
 1 December 1964

MILITARY SPECIFICATION

CLOCK, AIRCRAFT, MECHANICAL ABU-9/A

This specification is approved for use by the Naval Air Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

SCOPE

1.1 Scope. This specification covers one type of elapsed time mechanical aircraft clock.

APPLICABLE DOCUMENTS

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

REFERENCES

Federal

DD-G-451	Glass, Flat and Corrugated, for Glazing, Mirrors, and other uses
QQ-C-320	Chromium Plating (Electrodeposited)
QQ-N-290	Nickel Plating (Electrodeposited)
QQ-P-416	Plating, Cadmium (Electrodeposited)
QQ-Z-325	Zinc Coating, Electrodeposited, Requirements for

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Engineering Center, ESSD, Mahanwahuc, New Jersey 08733 by using the self-addressed Standard Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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SPECIFICATIONS (Continued)

Military

MIL-P-116	Preservation-packaging, Methods of
MIL-M-3171	Magnesium Alloy, Process for Corrosion Protection of
MIL-L-3918	Lubricating Oil, Instrument, Jewel Bearing
MIL-E-5272	Environmental Testing, Aeronautical and Associate Equipment, General Specification for
MIL-C-5541	Chemical Films for Aluminum and Aluminum Alloys
MIL-R-6855	Rubber; Synthetic, Sheet, Molded, and Extruded, for Aircraft Applications
MIL-S-6872	Soldering Process, General Specification for
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series, General Specification for
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-N-18307	Nomenclature and Nameplates for Aeronautical Electronic and Associated Equipment
MIL-P-23408	Plating: Tin-Cadmium (Electrodeposited)
MIL-L-25467	Lighting, Integral, Aircraft Instrument, General Specification for
MIL-D-1000	Drawings, Engineering and Associated Lists

STANDARDS

Federal

FED-STD-595	Colors
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Military

MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-143	Specifications and Standards, Order of Precedence for the Selection of

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STANDARDS (Continued)

Military (Continued)

MIL-STD-794	Parts and Equipment, Aeronautical, Preparation for Delivery
MIL-STD-889	Dissimilar Metals
MS3137	Connectors, Plug, Electric, Solder Type, Short, Push-Pull Coupling
MS24367	Lamp, Incandescent - Miniature Integral Lighting
MS24515	Lamp - Sub Miniature
MS28105	Window, Dial - Aircraft Instrument Cover, Glass
MS33558	Numerals and Letters, Aircraft Instrument Dial, Standard Form of

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

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), the contractor shall furnish sample units for first article inspection and approval (see 4.3.1 and 6.2).

3.2 Selection of Government documents. Except as provided in 3.2.1 and 3.2.2, specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.2.1 Commercial parts. Commercial parts having suitable properties shall be used, when on the date of invitations for bids, there are no suitable standard parts. In any case, commercial parts, such as screws, bolts, nuts, cotter pins, having suitable properties, may be used provided:

a. They can be replaced by the standard parts (MS or AN) without alteration.

b. The corresponding standard part numbers are referenced in the parts list and if practicable, on the contractor's drawings.

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3.2.2 Standard parts. With the exception of 3.2.1, MS and AN standard parts shall be used where they suit the purpose. They shall be identified on the drawings by their part numbers.

3.3 Materials. Materials shall conform to applicable specifications and shall be as specified herein. Materials for which there are no applicable specifications, or which are not specifically described herein, shall be of the best quality, of the lightest practicable weight, and suitable for the purpose intended.

3.3.1 Critical materials. Noncritical materials shall be used where practicable. Where the use of a critical material is essential to meet specification requirements, the material used shall be the least critical of those which are adequate for the purpose.

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

3.3.3 Metals. Metals shall be of the corrosion resistant type, or shall be suitably protected as specified herein to resist corrosion due to fuels, salt spray, or atmospheric conditions to which the clock may be subjected when in storage or during normal service life.

3.3.3.1 Dissimilar metals. Dissimilar metals as defined in MIL-STD-889 shall not be used in intimate contact with each other, unless protection against electrolytic corrosion is provided.

3.3.3.2 Magnesium alloy parts. Magnesium alloy parts shall be treated in accordance with Specification MIL-M-3171. When abrasion resistance is a factor, an anodic treatment approved by the procuring activity shall be used.

3.3.3.3 Aluminum alloy parts. Unless otherwise specified, aluminum alloy parts shall be covered with an anodic film conforming to Specification MIL-A-8625. Small holes, pipe threads, and case inserts need not be anodized. Aluminum alloys which do not anodize satisfactorily shall be coated with a chemical film in accordance with Specification MIL-C-5541.

3.3.3.4 Iron and steel parts. Iron and steel parts which are in hermetically sealed cases shall be cadmium plated in accordance with Specification QQ-P-416. Parts which are not in sealed cases shall be chromium, nickel, or zinc plated in accordance with Specifications QQ-C-320, QQ-N-290, or QQ-Z-325 respectively. Parts in a confined space in the presence of organic material shall be tin-cadmium plated in accordance with Specification MIL-P-23408. The class and type of plating shall meet the requirements of 3.3.4.

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3.3.4 Protective treatment. When materials are used in construction of the clock that are subject to atmospheric or environmental conditions likely to cause corrosion in normal service life, they shall be protected against corrosion in a manner that will in no way prevent compliance with the performance requirements of this specification. Finishes and protective coatings which will crack, chip, or scale during normal service life or are affected by extremes of atmospheric or environmental conditions, shall not be used.

3.3.5 Fungus-proof materials. Materials which are nutrients for fungi shall not be used where it is practicable to avoid them. If used, they shall be treated with a fungicidal agent acceptable to the procuring activity. If the materials are used in a hermetically sealed enclosure, fungicidal treatment will not be necessary.

3.3.6 Fumes and vapors. Materials used in the construction of the clock shall not produce corrosion, deleterious, or toxic fumes or vapors under the conditions specified herein.

3.4 Design and construction. The clock shall be so constructed that no parts will work loose in service and so that it will withstand the normal shocks, vibrations, and such other conditions as incident to service without failure, shipping, storage, and installation.

3.4.1 Maintenance. The design shall be such as to facilitate, as much as possible, disassembly, repair or overhaul, service maintenance, reassembly using those tools and items of maintenance equipment which are normally available as commercial standards.

3.4.2 Case. The case shall conform to Figure 1. The case mounting flange shall be made of nonferrous metal, uniform in texture, having a smooth surface, and shall be rain and dust tight. The case shall be finished with a lusterless black material, Color No. 37038 of MIL-STD-595. The finishing material shall be of a durable type to withstand usage encountered in service.

3.4.3 Weight. The weight of the completely assembled clock shall not exceed one pound.

3.4.4 Screw threads. Screw threads 0.060 inch in diameter and larger shall be in accordance with Specification MIL-S-7742.

3.4.5 Clock controls.

3.4.5.1 Winding and setting knob. The winding and setting knob, located in the lower left hand corner of the clock case, shall be used to wind the mainspring of the clock when turned in a clockwise direction.

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and shall engage the setting gear for the hour and minute hands of the clock when pulled out into the setting position. The knob shall be free to turn counterclockwise with a ratchet gear. The winding and setting knob shall not require a force of more than 3 pounds to pull it into the setting position.

3.4.5.2 Elapsed time knob. The elapsed time knob, located in the upper right hand corner of the clock case, shall start and stop the elapsed time function of the clock at will to take "time-out" (up to 60 minutes and repeating). Three pushes of the knob shall complete the elapsed time functions, causing the elapsed time and sweep second hands to start, stop or fly-back. The fly-back position of the sweep second hand and the elapsed time hand shall be "60" as indicated on the dial. The elapsed time function shall not interfere with the hour and minute time hands.

3.4.6 Balance wheel and hairspring unit. The balance wheel and hairspring unit shall be temperature compensated metal. The balance wheel shall be fitted with not less than 12 screws, at least 4 of which shall be regulating screws.

3.4.6.1 Balance staff. The balance staff shall be readily removable and replaceable without disturbing the poise of the balance wheel.

3.4.6.2 Hairspring. The hairspring shall be of the Breguet type and shall be constructed from corrosion-resisting metal.

3.4.7 Level regulator. A lever regulator to adjust the clock time rate shall be accessible from the regulator opening on the case and shall be centered on the regulator scale, within 10 percent of either the "fast" or "slow" scale range.

3.4.8 Movement. The clock shall have an 8-day movement with not less than 15 jewels located at bearing points most essential to reduce friction of train, escapement, and totalizing mechanism parts.

3.4.9 Lubrication. The clock shall be sufficiently lubricated for at least 2 years' operation. The lubricant shall conform to Specification MIL-L-3918 and shall be of such quality that satisfactory lubrication will be provided when the clock is run at temperatures of +55° to -35°C.

3.5 Electrical requirements

3.5.1 Integral lighting. The clock shall be integrally red lighted in accordance with Specification MIL-L-25467. The lighting design shall employ a wedge for light transmission and distribution. The wedge shall not rotate in the bezel after assembly.

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3.5.2 Electric connectors. The case shall be provided with a 3-pin connector Deutsch -5606-3P or Deutsch -5605-3P or approved equivalent. The connector shall mate with one conforming to MS3137E-3S.

3.5.2.1 Pin designation. Pin 1 shall be for ground return and shall be grounded to the metal case. Pin 2 shall be a spare. Pin 3 shall be designated for 5-volt current.

3.5.2.2 Wiring. Internal wiring shall be color coded, neat, and accomplished in such a manner that individual wires may be easily traced. The wiring shall be insulated from the instrument case.

3.6 Dial and hands.

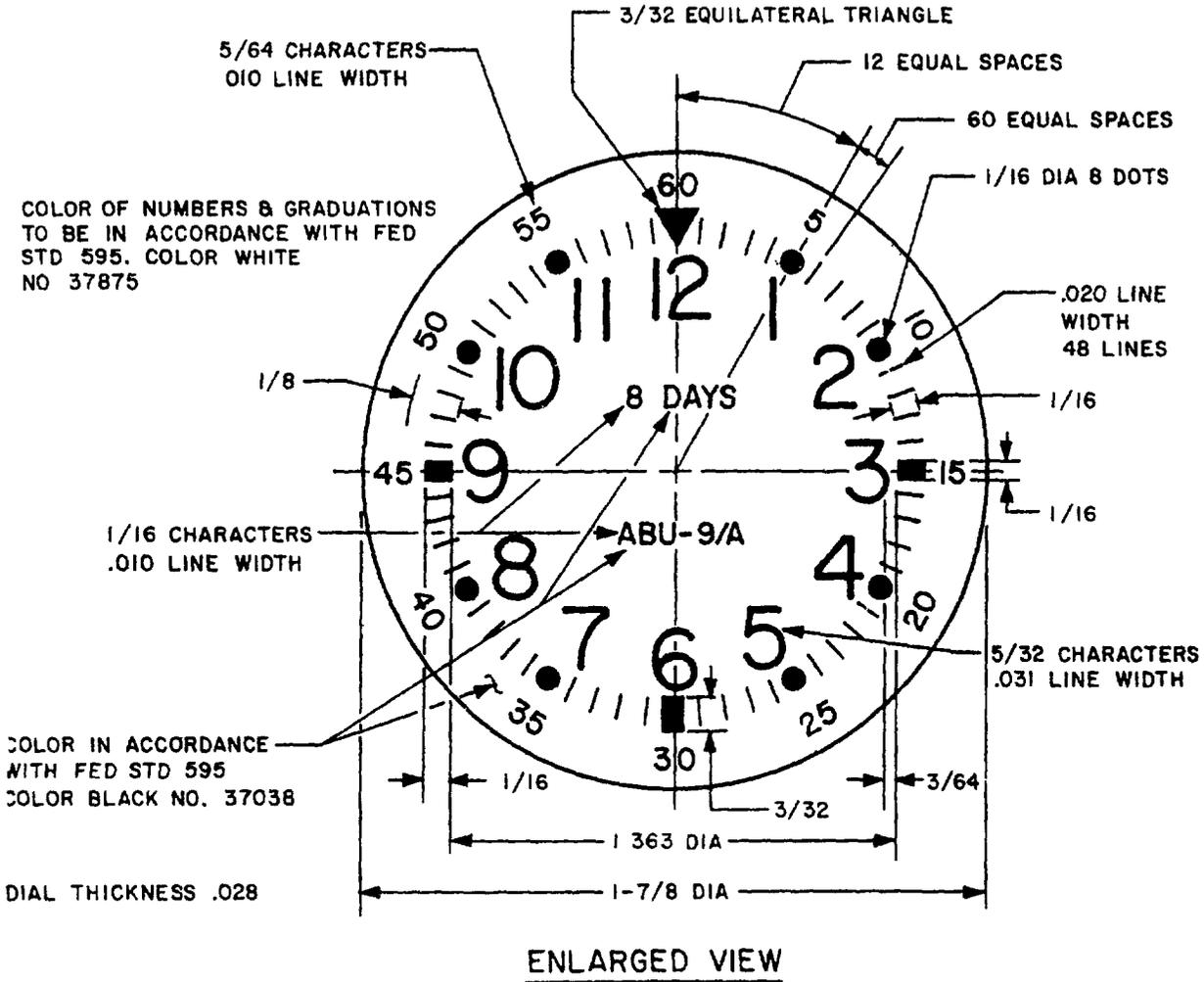
3.6.1 Dial. The clock dial shall be constructed from aluminum or aluminum alloy and shall conform to Figure 2. The dial shall be so securely fastened by at least two screws into the case or frame of the mechanism that it will not loosen or turn when the clock is vibrated.

3.6.1.1 Dial marking. The dial shall be marked as shown in Figure 2. Unless otherwise specified, all visible portions of the dial shall be lusterless black Color No. 37038 of FED-STD-595 and all markings on the dial shall be lusterless white Color No. 37875 of FED-STD-595. The colors shall not change as a result of service use or subjecting the clock to the inspections specified herein. The form of the numerals and letters shall be in accordance with MS33558. Numerals shall distinctly indicate the graduation to which each applies. If practicable, each numeral shall be placed so that the center of area of the numeral(s) is on the radial line joining the appropriate graduation and the center of the dial. Any confusion resulting in doubt as to the graduation to which the numeral applies shall be cause for rejection. When several numerals are used in one group, the space between the numerals shall be not less than 1/64 inch.

3.6.2 Hands. The hands of the clock shall be firmly attached to the mechanism but also shall be readily adjustable. The shaded portion of the hands shall be finished lusterless black, Color No. 37038 of FED-STD-595. The unshaded portion shall be finished in lusterless white, Color No. 37875 of FED-STD-595. The hands shall be suitable for integral lighting and shall conform to Figure 3. The hands shall be light weight metal and sufficiently rigid to prevent flexing under vibration.

3.7 Cover glass. The quality of the cover glass shall be in accordance with Specification DD-G-451, Type II, Quality AA. Any flaws permitted by Specification DD-G-451 shall not interfere with reading of the dial. The dimensions of the cover glass shall be in accordance with MS28105. When a wedge prism is required for integral lighting, the thin edge of the prism shall not be less than 5/64-inch thick. The cover glass shall be held in place by a threaded screw ring retainer or separable mounting flange bezel with a watertight seal.

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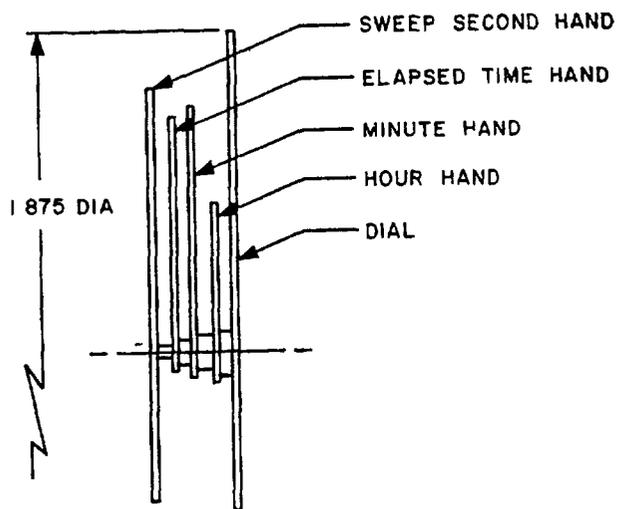
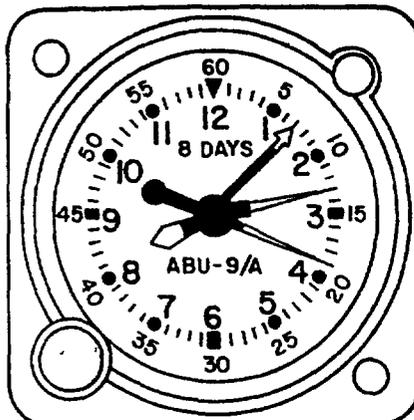


DIMENSIONS IN INCHES. UNLESS OTHERWISE SPECIFIED,
TOLERANCES: DECIMALS $\pm .010$ - FRACTIONS $\pm 1/64$.

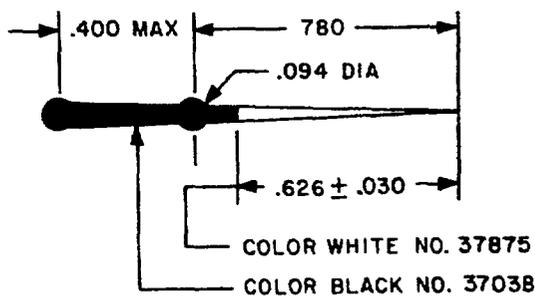
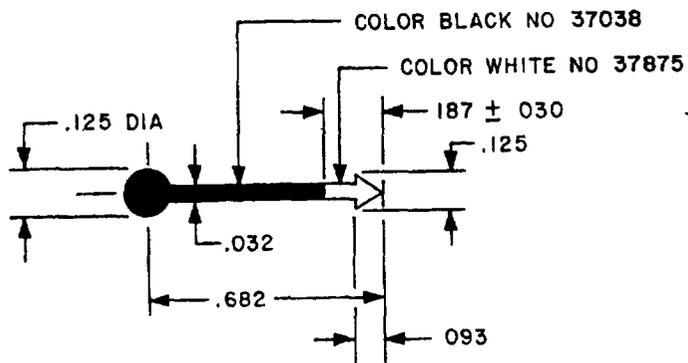
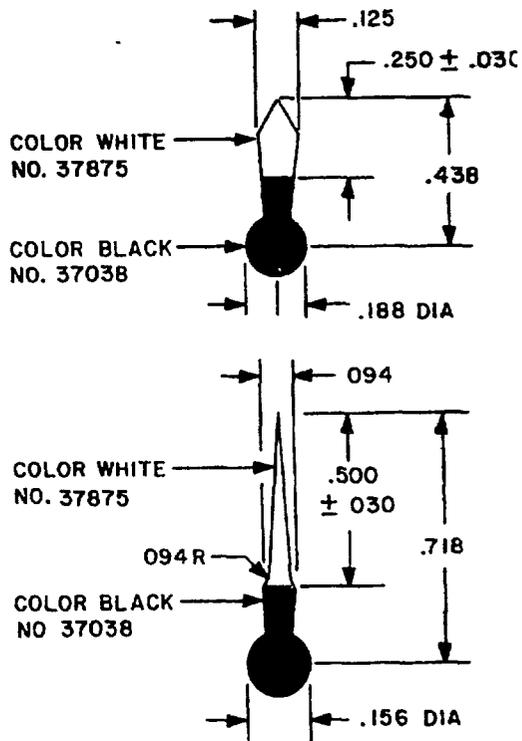
FIGURE 2. ABU-9/A Clock Dial

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COLORS IN ACCORDANCE WITH FED-STD-595



DIAL AND HAND ARRANGEMENT ENLARGED VIEW



DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED, TOLERANCES DECIMALS ± .010

FIGURE 3. ABU-9/A Clock Hands

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3.7.1 Cover glass mounting. The distance from the inner surface of the cover glass to the surface of the dial on which the marking is applied shall not exceed .250 inch.

3.7.1.1 Cover glass gasket. If used, the cover glass gasket shall conform to class 2, grade 60, of Specification MIL-R-6855, or a nonshrinking material acceptable to the procuring activity.

3.7.2 Snap or screw rings. If used, snap or screw rings shall be removable from the case without damage or breaking the case or cover glass. Steel snap or screw rings shall not be used.

3.8 Performance. The clock shall perform satisfactorily when subjected to the tests specified in Section 4 of this specification.

3.8.1 Reliability in mean time between failure (MTBF). The clock shall have a minimum of 5000 hours of mean (operating) time between failures when tested and accepted as outlined under the requirements of 4.4.3.

3.9 Rate accuracies.

3.9.1 Room temperature rate.

3.9.1.1 The average of the daily rates for 5 consecutive days shall not exceed 30 seconds.

3.9.1.2 The average daily rate shall not differ from the variation of any daily rate by more than 15 seconds.

3.9.2 Temperature compensation rates.

3.9.2.1 Zero °C compensation. The rate of the clock for 6 hours shall not vary from the starting error by more than 10 seconds.

3.9.2.2 Minus 35° C compensation. The rate of the clock for 6 hours shall not vary from the starting error by more than 75 seconds.

3.9.2.3 Plus 55° C compensation. The rate of the clock for 6 hours shall not vary from the starting error by more than 15 seconds.

3.9.3 Vibration error rate. The rate of the clock for 4-1/2 hours shall not vary from the starting error by more than 15 seconds. During vibration the tip of the minute and second hands shall not exceed 0.0626-inch oscillation.

3.9.4 Rates under environments.

3.9.4.1 High temperature exposure. The rate of the clock for 6 hours shall not vary from the starting error by more than 15 seconds.

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3.9.4.2 Low temperature exposure. The rate of the clock for 6 hours shall not vary from the starting error by more than 15 seconds.

3.9.4.3 Humidity exposure. The rate of the clock for 6 hours shall not vary from the starting error by more than 20 seconds.

3.9.4.4 Shock exposure. The rate of the clock for 6 hours shall not vary from the starting error by more than 20 seconds.

3.9.4.5 Vibration endurance. The rate of the clock for 6 hours shall not vary from the starting error by more than 20 seconds.

3.9.4.6 Operation in a magnetic field. When the clock is subjected to high and low field strengths as specified under 4.6.13 and operated for 6 hours after each subjection, the clock rates shall not differ by more than 15 seconds.

3.10 Run down time. After being fully wound the clock shall operate for 8 days (192 hours) minimum before stopping.

3.11 Identification of product.

3.11.1 Nameplate. A nameplate conforming to Specification MIL-N-18307, shall be securely attached to the exterior of the case and shall be marked in accordance with the requirement of MIL-STD-130 except that the FSN shall be omitted.

3.11.2 Manufacturer's part number. The manufacturer's part number on the nameplate shall be identical with the manufacturer's engineering production drawing number including applicable dash numbers if the drawing is tabulated and covers more than one part.

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

3.13 Soldering. Soldering shall be performed in accordance with Specification MIL-S-6872.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government.

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The Government reserves the right to perform any of the inspections set forth in the specification when such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Classification of inspection. Inspection of the clocks shall be classified as follows:

a. First article inspection. First article inspection consist of examinations and tests performed after the award of contract on sample clocks to determine that the clocks meet the requirements of this specification. The sample shall be representative in design, performance and configuration of the clocks which will be produced on the manufacturer's production line.

b. Quality conformance inspection. Quality conformance inspection consists of examination and tests performed on clocks manufactured and submitted for acceptance under contract.

4.3 First article inspection. The first article inspection of the clocks shall consist of all the examinations and tests of this specification performed in the order listed herein.

4.3.1 First article inspection sample. First article inspection samples shall consist of three clocks of each manufacturer's part number manufactured in accordance with this specification. The samples shall be forwarded at the contractor's expense for first article inspection and shall have been previously subjected only to the individual inspection. The samples shall be forwarded to the laboratory designated by the procuring activity, in the contract or purchase order (see 6.2).

4.3.1.1 First article inspection sample identification. The first article inspection samples shall be plainly identified by durable tags, securely attached, and marked with the following information:

Sample for First Article Inspection
CLOCK, AIRCRAFT, MECHANICAL ABU-9/A
Submitted by (Manufacturer's name, date) for
First Article Inspection in accordance with
Specification MIL-C-27298(AS) under
contract or order number.
Manufacturer's Part Number

4.4 Quality conformance inspection. The Quality conformance inspection shall consist of the Individual inspection, the Sampling plans, and the Reliability assurance tests of this specification. The contractor shall furnish all samples and shall be responsible for accomplishing

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the required inspections except that Sampling plan B shall be conducted at a Government laboratory designated by the procuring activity. Quality conformance inspection, except for Sampling plan B, shall be under the supervision of the Government quality control representative. The contractor shall furnish test reports showing quantitative results for all tests required by this specification, signed by an authorized representative of the contractor or laboratory as applicable. Acceptance or approval of material during the course of manufacture shall in no case be construed as a guarantee of the acceptance of the finished product.

4.4.1 Individual inspection. Each clock submitted for acceptance shall be subjected to the Individual inspection. This inspection shall determine compliance with the requirements of material, workmanship, operational adequacy, and reliability. As a minimum, each clock accepted shall have passed the following inspections:

Examination of product.

Room temperature rate.

Bulb check.

4.4.2 Sampling plans. The Sampling plans shall consist of Sampling plan A and Sampling plan B inspections. The inspection samples selected for sampling tests shall first have passed the Individual tests. The test samples which have been subjected to Sampling plan A inspection shall not be delivered on contract until they have been refurbished and resubmitted and passed all the Individual inspections. Inspection samples which have been subjected to the Sampling plan B inspection shall not be delivered on contract.

4.4.2.1 Sampling plan A sample selection. Sampling plan A samples shall be selected at random in accordance with the following schedule:

<u>Quantity Offered for Acceptance</u>	<u>Quantity to be Selected for Inspection</u>
First 15	(See note)
Next 50	1
Next 75	1
Next 100	1
Each additional 200 or fraction thereof	1

When a defective clock occurs, no items from those still on hand or later produced shall be accepted until the extent and cause of failure have been determined and appropriately corrected. In addition, when a failure occurs shift to one sample out of fifteen (when Sampling plan B is omitted) and procured as indicated.

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NOTE: When Sampling plan B is invoked, the quantity shall be zero.
When Sampling plan B is to be omitted, the quantity shall be one.

4.4.2.1.1 Sampling plan A inspection. Each sample selected for Sampling Plan A inspection shall be subjected to the following tests:

Integral lighting.
Plus 55°C compensation.
Zero °C compensation.
Minus 35°C compensation.
Run down.
Shock test.
Vibration error.

4.4.2.2 Sampling plan B instructions. Two clocks shall be selected at random from the first 15 produced on contract and submitted within 10 days after manufacture. These samples shall be forwarded to a Government laboratory designated by the procuring activity. Each sample shall be plainly identified by a durable tag, securely attached and marked with the following information:

CLOCK, AIRCRAFT, MECHANICAL
Submitted by (Manufacturer's name, date)
for Production Acceptance Sampling Plan B
inspection, in accordance with Contract or
Order No. _____
Manufacturer's part number _____

4.4.2.2.1 Sampling plan B inspection. Each sample selected for Sampling plan B inspection shall be subjected to the following tests:

Sampling plan A.
Vibration failure.
Altitude.
Operation in a magnetic field.
Magnetic effect.
High temperature exposure.
Low temperature exposure.
Humidity.
Salt spray.
Fungus resistance.
Lamp life.
Life.
Internal examination.

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4.4.3 Reliability assurance tests. Test samples which have successfully passed the Individual tests shall be tested for reliability assurance. When the clocks are operated under the room temperature rate test requirements of 4.6.2, no more than 3 failures, as defined in 4.4.3.1 failure criteria, shall occur out of 125 clocks produced.

4.4.3.1 Failure criteria. Complete stoppage of the clock, indicating defective jewels, bearings, gears, other damaged or broken parts, or dirt particles, shall be considered a clock failure.

4.4.3.2 Individual tests may continue. For operational reasons, individual tests may be continued pending the investigation of a sampling test failure. But final acceptance of clocks on hand or produced later will not be made until it is determined that the clocks meet all the requirements of this specification.

4.5 Inspection conditions.

4.5.1 Standard conditions. Unless otherwise specified, all inspection required by this specification shall be made under the following conditions:

Temperature	Room ambient $25^{\circ} \pm 5^{\circ}\text{C}$
Pressure	Normal atmospheric (approximately 29.92 inches Hg).
Humidity	Room ambient up to 90 percent relative humidity.

4.5.2 Attitude. Unless otherwise specified, the clock shall be tested in its normal operating position.

4.5.3 Integral lighting. The clock lighting system shall be energized during all tests except Humidity, Fungus resistance, Salt spray or as otherwise specified herein and shall operate satisfactorily when energized. The lighting shall operate satisfactorily after completion of each test unless otherwise specified herein.

4.6 Inspection methods.

4.6.1 Examination of product. Each clock shall be examined externally to determine conformance with the applicable drawings and with all the requirements of this specification not covered by tests.

4.6.2 Room temperature rate. The clock shall run for 1 day to break in the parts. The Room temperature rate test shall be conducted for 5 consecutive days. During this test period, the clock shall not be rewound and the elapsed time function shall run continually.

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On the first day the clock shall be fully wound and its starting error noted. The daily rates of the clock shall then be determined for 4 consecutive days. The average of the daily rates for the 4-day test period shall not exceed 30 seconds. Any daily rate noted in the test period shall not vary from the average daily rate by more than 15 seconds.

4.6.3 Bulb check. Power shall be applied to check that each bulb lights.

4.6.4 Integral lighting. Each clock shall be subjected to and shall meet the requirements of the following tests specified in Specification MIL-L-25467:

- a. Operation.
- b. Dial visibility.

4.6.5 Plus 55°C compensation. The clock shall be fully wound and then subjected to a temperature of $55^{\circ}\text{C} \pm 2^{\circ}\text{C}$ (127.4°F to 134.6°F) for a period of 6 hours. The clock shall not gain nor lose more than 15 seconds during this period.

4.6.6 Zero °C compensation. The clock shall be fully wound and then subjected to a temperature of $0 \pm 2^{\circ}\text{C}$ (28.4°F to 35.6°F) for a period of 6 hours. The clock shall not gain nor lose more than 10 seconds during this period.

4.6.7 Minus 35°C compensation. The clock shall be fully wound and then subjected to a temperature of $-35^{\circ}\text{C} \pm 2^{\circ}\text{C}$ (-27.4°F to -34.6°F) for a period of 6 hours. The clock shall not gain nor lose more than 75 seconds during this period.

4.6.8 Run down. The clock shall be fully wound and allowed to run down. The clock shall not run down completely before 8 days (192 hours).

4.6.9 Shock test. The clock shall be tested in accordance with Procedure I of Specification MIL-E-5272. An acceleration of 20 g's shall be attained with the clock operating and being oriented in each of the following positions:

- a. Face up.
- b. Face down.
- c. With face vertical.

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- d. The numeral "15" up.
- e. The numeral "30" up.
- f. The numeral "45" up.
- g. The numeral "60" up.

After the Shock test the clock shall be examined for evidence of damage that would adversely affect subsequent operation. The clock shall then be fully wound and operated for a period of 6 hours. The clock shall not gain nor lose more than 20 seconds during this period.

4.6.10 Vibration error. The clock shall be fully wound and mounted in its normal upright position on a vibration stand with all hands operating. The clock shall be so vibrated for periods of 30 minutes at each of the following frequencies; 500, 750, 1000, 1250, 1500, 1750, 2000, 2500, and 3000 cycles per minute that a point on the clock describes a circle, the diameter of which shall be 0.003 to 0.005 inch. The oscillations of the hands shall not exceed 0.0625 inch. After the Vibration error test, the clock shall be carefully examined for loosened screws or other parts and damage that would affect subsequent operation. The clock shall not gain nor lose more than 15 seconds during this test period.

4.6.11 Vibration failure. The clock shall be so subjected to vibration on a vibration stand for 3 hours at a frequency of 2000 cycles per minute that a point on the clock describes a circle, the diameter of which shall be 0.018 to 0.020 inch. All clock hands shall be operating. After the Vibration failure test, the clock shall be carefully examined for loosened screws or other parts and damage that would affect subsequent operation. The clock shall then be fully wound and operated for a period of 6 hours. The clock shall not gain nor lose more than 20 seconds during this period.

4.6.12 Altitude. The clock shall be tested in accordance with Procedure II of Specification MIL-E-5272 except that the chamber shall be reduced to 0.810 inches of mercury (80,000 feet) for a period of four hours. At the conclusion of the test the clock shall be subjected to and meet the requirements specified in the Room temperature rate test and the Run down test.

4.6.13 Operation in a magnetic field. The clock shall be subjected, for at least 10 seconds, to the following field strengths, in the order given:

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a. In a magnetic field with a horizontal strength of 0.15 to 0.22 oersted.

b. In a magnetic field with a horizontal strength of approximately 2.4 oersted.

c. In a magnetic field with a horizontal strength of 0.15 to 0.22 oersted.

After each field strength subjection, the clock shall be fully wound and operated for a period of 6 hours, and its rate noted. After the 6-hour operation, the clock rates noted from (b) and (c) shall not differ by more than 15 seconds and the clock rates noted from (a) and (c) shall not differ by more than 5 seconds.

4.6.14 Magnetic effect. The clock shall be revolved about a short bar magnet compass with the nearest part of the clock 5-1/2 inches from the bar magnet. The compass shall have its compensating magnets removed and shall be set up in a uniform magnetic field whose horizontal intensity is between 0.17 and 0.19 oersted. The clock shall be revolved in a horizontal plane which is perpendicular to the axis of the bar magnet. The clock shall be held in positions 0, 45, 90, 135, 180, 225, 270, and 315 degrees. At each of these positions the clock shall be rotated 360 degrees about its horizontal axis. The deflection of the compass at any of the specified positions shall not exceed three degrees. This test shall be repeated with no power applied. The same tolerance shall apply.

4.6.15 High temperature exposure. The clock shall be tested in accordance with Procedure I of Specification MIL-E-5272. The test period shall be 24 hours. After the chamber has returned to room temperature and the clock has been exposed to this room temperature for a minimum period of 4 hours, the clock shall be carefully examined for evidence of damage that would adversely affect subsequent operation. The clock shall then be fully wound and operated for a period of 6 hours. The clock shall not gain nor lose more than 15 seconds during this period.

4.6.16 Low temperature exposure. The clock shall be tested in accordance with Procedure II of Specification MIL-E-5272. The test period shall be 24 hours. After the chamber has returned to room temperature and the clock has been exposed to this room temperature for a minimum period of 4 hours, the clock shall be carefully examined for evidence of damage that would adversely affect subsequent operation. The clock shall then be fully wound and operated for a period of 6 hours. The clock shall not gain nor lose more than 15 seconds during this period.

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4.6.17 Humidity. The clock shall be tested in accordance with Procedure I of Specification MIL-E-5272. The total test time shall be 120 hours (5 cycles). After the chamber has returned to room temperature and the clock has been exposed to this room temperature for a minimum period of 4 hours, the clock shall be carefully examined for evidence of damage that would adversely affect subsequent operation. The clock shall then be fully wound and operated for a period of 6 hours. The clock shall not gain nor lose more than 20 seconds during this period.

4.6.18 Salt spray. The clock shall be tested in accordance with Procedure I of Specification MIL-E-5272. After completion of the test procedure, the clock shall meet the requirements of the Room temperature rate test.

4.6.19 Fungus resistance. The clock shall be tested in accordance with Procedure I of Specification MIL-E-5272 except that the test period shall be 14 days. After the testing procedure has been completed, any evidence of the growth of fungi found upon inspection shall be cause for rejection of the clock.

4.6.20 Lamp life. The clock shall be subjected to the Life test specified in Specification MIL-L-25467. (This test shall be run concurrently with the Life test, if practicable.)

4.6.21 Life test. The equipment (without vibration isolators) shall be subjected to a 5000-hour life test under the following simulated service conditions:

Temperature:	20°C to 45°C (68°F to 113°F)
Altitude:	Normal (0 to 5000 feet)
Humidity:	Room Ambient (up to 90 percent)
Vibration:	25 cps +5 cps at applied double amplitude of .02 inch

The vibration provision can be met by mounting the equipment solidly, that is without the equipment shock vibration mounts, to a strong (non-magnetic) flat plate which is supported by vibration mounts and to which a suitable motor with an asymmetric weight is attached which will meet the requirements of amplitude and frequency. The direction of vibration is not critical. The duration of vibration should be at least 10 minutes out of every hour of "on" time and continuous vibration is permissible.

The daily record of clock performance, making particular note of any inaccuracies, shall be maintained. In the event of parts failures during this test the defective parts shall be replaced and the operation resumed for the balance of the 5000-hour test period.

Failures shall be recorded throughout the test indicating the following:

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- a. Part.
- b. Part function.
- c. Nature of the failure.
- d. Operating environment at the time of failure.
- e. Number of hours the part operated prior to the

failure.

A report of all parts failures shall be submitted to the procuring activity for approval immediately upon completion of the first 1000 hours and the last 4000 hours of operation. The reports shall include proposals of suitable and adequate design or material corrections for all failures which occurred.

4.6.22 Internal examination. The case of the clock shall be opened and the internal mechanism examined. The lamp circuit of the indicator shall also be examined as specified in Specification MIL-L-25467. Any deterioration or damage which could in any manner prevent the clock from meeting operation or maintenance requirements during service life shall be cause for rejection.

5. PACKAGING

5.1 Packaging. The clocks shall be packaged in accordance with Specification MIL-STD-794, Level A or C as specified in contract or order (see 6.2). For Level A packaging the method of preservation shall be in accordance with Specification MIL-P-116, Method 1A-8.

5.2 Packing. The clocks shall be packed in accordance with Specification MIL-STD-794, Level A, B, or C as specified in contract or order (see 6.2).

5.3 Marking. The interior and exterior containers shall be marked as specified in Specification MIL-STD-794.

5.3.1 Precautionary marking. The following precautionary markings shall appear on two opposite sides of each interior package and shipping container wherever practicable.

FRAGILE
DELICATE INSTRUMENTS
HANDLE WITH CARE

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6. NOTES

6.1 Intended use. The Clock, Aircraft, Mechanical ABU-9/A covered by this specification is intended for use as the primary timepiece and elapsed-time indicator in aircraft requiring integral red light.

6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number, and date of this specification.
- b. Number of first article samples. (4.3.1).
- c. The point of inspection for first article inspection (4.3.1).
- d. Applicable requirements listed under "Ordering Data" of MIL-STD-794.
- e. The point of inspection for Sampling plan B tests. (4.4.2.2).
- f. First article inspection requirements (see 3.1 and 4.3.1).
- g. The designated model, design data, and part number,
- h. Whether or not first article is to be waived (see 6.4).

6.3 Drawing requirements. The attention of contractors is invited to the fact that Government contracts for equipment, whether procured directly by the Government or through another contractor, require that all drawings submitted must be in accordance with the requirements of Specification MIL-D-1000.

6.4 First article test provisions. The manufacture of clocks on contract shall not commence until the samples submitted are pronounced satisfactory by the procuring activity. When a contractor is in continuous production of the clocks from contract to contract, the submission of further first article samples on the subsequent contracts may be waived at the discretion of the procuring activity. Approval of first article samples or the waiving of first article tests does not reduce the requirements for acceptance testing.

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6.4.1 It shall be understood that the clocks supplied under contract or order shall be identical to the corresponding first article sample in design, construction, quality, material, workmanship, and method of manufacture. Deviation from the standards of the first article sample and clocks previously procured under this specification shall be made only by the procuring activity. Evidence of unauthorized change shall constitute cause for rejection.

6.5 Design data. No data is required by this specification, or by applicable document referenced in Section 2, unless specified in the contract or order. (See paragraph 6.2).

6.6 Precedence of documents. When the requirements of the contract, this specification, or applicable subsidiary specifications are in conflict, the following precedence shall apply.

a. Contract. The contract shall have precedence over any specification.

b. This specification. This specification shall have precedence over all applicable subsidiary specifications. Any deviation from this specification, or from subsidiary specifications where applicable, shall be specifically approved in writing by the procuring activity.

c. Referenced specifications. Any referenced specification shall have precedence over all applicable subsidiary specifications referenced therein. All referenced specifications shall apply to the extent specified.

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DOCUMENT IDENTIFIER (Number) AND TITLE

MIL-C-27298B(AS) CLOCK, AIRCRAFT, MECHANICAL ABU-9/A

NAME OF ORGANIZATION AND ADDRESS OF SUBMITTER

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