INCH-POUND

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PERFORMANCE SPECIFICATION

CLOCK, AIRCRAFT, ELECTRONIC

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

1. SCOPE

1.1 Scope. This specification contains the technical and performance requirements for an electronic clock. The electronic clock is intended for use in military aircraft, which may be at a fixed military base, deployed to austere forward operating locations, or naval vessels afloat. This specification provides for first article testing described herein.

2. APPLICABLE DOCUMENTS

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

2.2 Government Documents.

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

Comments, suggestions, or questions on this document should be addressed to: OC-ALC/ENRS, 3001 Staff Drive, Tinker AFB, OK 73145-5990. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.

AMSC: N/A FSC 6645

INTERNATIONAL STANDARDIZATION AGREEMENTS

STANAG-3643	-	COATING, REFLECTION REDUCING FOR GLASS ELEMENTS USED IN AIRCREW STATION DISPLAYS

FEDERAL STANDARDS

FED-STD-595	-	COLORS USED IN GOVERNMENT PROCUREMENT

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-L-85762	-	LIGHTING, AIRCRAFT, INTERIOR, NIGHT VISION IMAGING SYSTEM (NVIS) COMPATIBLE

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-130	-	IDENTIFICATION MARKING OF U.S.
MIL-STD-461	-	REQUIREMENTS FOR THE CONTROL OF ELECTROMAGNETIC INTERFERENCE CHARACTERISTICS OF SUBSYSTEMS AND EQUIPMENT
MIL-STD-704	-	AIRCRAFT ELECTRIC POWER CHARACTERISTICS MILITARY PROPERTY
MIL-STD-810	-	ENVIRONMENTAL ENGINEERING CONSIDERATIONS AND LABORATORY TESTS
MIL-STD-1472	-	HUMAN ENGINEERING

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-454	-	GENERAL GUIDELINES FOR ELECTRONIC EQUIPMENT
MIL-HDBK-831	-	PREPARATION OF TEST REPORTS

(Copies of this document are available online at http://assist.daps.dla.mil/quicksearch/ or www.dodssp.daps.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 1911-5094.)

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

3. REQUIREMENTS

3.1 First Article. When specified in the contract or purchase order, three (3) samples shall be subjected to first article inspection (see paragraph 4.4).

3.2 Materials.

3.2.1 Nonmagnetic materials. Nonmagnetic parts shall be used, except when magnetic parts and ferrous materials are essential.

3.2.2 Toxic and corrosive fumes. Materials installed in the electronic clock and under the service conditions specified herein, shall have no adverse effect on the health of personnel when used as intended. This shall include any fungicidal agents that are used.

3.2.3 Protective treatment. Materials that are used in the construction of the electronic clock which are subject to deterioration and corrosion when exposed to climatic and environmental conditions during service usage shall be protected against any such deterioration in a manner that will in no way prevent compliance with the requirements specified herein. Protective coatings that will crack, chip, or scale during extremes of climatic or environmental conditions shall not be used.

3.2.4 Fungus proof materials. Materials that are nutrients for fungus shall not be used unless no other material can be used for that application. When 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.

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

3.2.5.1 Dissimilar metals. Dissimilar metals are defined in Guideline 16 of MIL-HDBK-454. Unless suitably protected against electrolytic corrosion by means of protective coating or hermetic sealing, intimate contact of dissimilar metals shall be avoided.

3.2.6 Protection of ferrous materials. Ferrous materials contained within hermetically sealed enclosures shall be considered suitably protected from corrosion.

3.3 Design and construction.

3.3.1 Case. The size and configuration of the case shall be as shown in figure 1 of this specification. The case shall consist of a body and a front panel. The case shall withstand normal shipping, handling and installation procedures. Mounting screws with normal torque applications of 12 inch-pounds shall not crush the case.

3.3.1.1 Case finish. The case shall be uniform in texture, and shall have a smooth surface with a durable lusterless black color No. 37038 in accordance with FED-STD-595. The finish shall not present evidence of breakdown during or after testing. Trademarks, company names, or other markings not related to the panel function shall not be displayed on the panel face.

3.3.2 Front glass. The front glass shall be flat and free from discolorations, scratches, or other flaws, which may interfere with reading of the Liquid Crystal Display (LCD) of the clock. The viewing distance for detecting discolorations, scratches, or other flaws shall be 18 inches. All reflecting glass surfaces shall be provided with a reflection-reducing coating conforming to STANAG-3643. In addition, the following reflectance tolerances shall apply in table I:

TABLE I. Reflectance tolerances.

Angle of Incidence	**Wavelength-Mill microns**	**Percent Reflectance**
0 degree	450 - 675	0.6 max.
0 degree	425 - 700	0.5 average
30 degree	450 – 625	1.0 max.
30 degree	425 – 700	0.5 average

3.3.3 Touch temperature. The maximum stabilized surface temperature of the electronic clock front panel and controls shall not exceed 49°C with a cockpit temperature of 26°C.

3.3.4 Thermal design. The clock shall be designed to operate throughout the temperature range of 3.4.1 without requiring forced air or liquid cooling.

3.3.4.1 Active visual signals. A heating system for the LCD shall be incorporated in the clock to permit operation down to -54°C. The heating methodology shall be compatible with the transflection techniques and shall contain an automatic temperature control.

3.3.5 Display lighting. The transmission of illumination through the LCD and cover glass of integrally lighted clocks shall be Night Vision Imaging System (NVIS) compatible in accordance with the lighting characteristics described below:

The center of emission shall be u = 0.088, v = 0.543 and within a radius of 0.037 on the 1976 CIE diagram at 0.1 foot-lamberts (fL). The NVIS Radiance (NR) shall not be greater than $1.7X10^{-10}$. NR is defined as the integral of the curve generated by multiplying the spectral radiance of the light source by the relative response curve of the NVIS. In addition

the average intensity of the display at 4.500 +/- 0.005 VDC shall be 1.0 +/- 0.2 fL with no measurement less than 0.5 or greater than 1.5. The clock shall meet the NVIS Quality Assurance provisions of MIL-L-85762 identified in Section 4.

3.3.5.1 Redundant lighting. The clock lighting circuit shall employ redundant lighting. Redundant lighting shall meet the requirements in paragraph 3.3.5 above.

3.3.6 Electrical connector. The electrical connector shall be located as shown in figure 1 of this specification. The connector used shall be MS27466T9B35P in accordance with MIL-STD-454 Guideline 10. The wiring shall conform to figure 2 of this specification.

3.3.6.1 Safety ground. A wire of minimum length connected internally to the equipment chassis shall be provided at pin number five on the power connector. No circuit shall be allowed to utilize this wire as its return.

3.3.7 Clock system. The solid state electronic clock shall contain: (1) LCD as shown in figure 1; (2) Electronic circuitry to keep track of time in the clock and elapsed time modes; (3) A six digit twenty-four hour numeric display for hours, minutes, and seconds; (4) A sweep second indication. The clock shall meet the following criteria:

a. Self test: The clock shall have an automatic self-test feature which shall illuminate all segments for the first five (5) seconds of display time after 28 VDC power is applied.

b. Luminance control: The clock lighting shall operate from the aircraft instrument luminance control. At low levels of luminance, individual segments shall not drop out of view.

c. Contrast: The display shall be clearly readable under the normal ambient lighting conditions found in airborne cockpits. The perceived luminance (Lp) shall be at least equal to the quantity below across the entire possible ambient light spectrum of 10^{-4} to 10^{6} fL.

d. Contrast performance of the display shall be computed when irradiated with a 10,000 foot-candle source measured at the face of the display. Contrast is defined as follows:

$$C = (L_2 - L_1) / L_1$$

Where C = Contrast
L_1 = Background Luminance
L_2 = Display Segment Luminance

The clock shall meet the contrast requirements of table II.

Display segment luminance shall be the average of at least three (3) spot measurements equally spaced from each other including one at each end of the segment and at the center of the segment.

$$Lp \geq 3.87L_1(0.926) + 0.05$$

Where $Lp = L_2 - L_1$

TABLE II. Contrast requirements for liquid crystal display.

Ambient Light (Foot Candles)	Contrast Comparison	Contrast
10,000	Active segment to black background (reflective mode)	≥ 12
10,000	Active segment to inactive segment (reflective mode)	≥ 12
10,000	Inactive segment to background (reflective mode)	≥ 0.1
0	Active segment	≥ 4.5

a. Display uniformity: The clock shall utilize a dichroic liquid crystal display with white segments on black background. The display shall conform to figure 1 of this specification. The numerals and segments shall at all times appear to be uniform in size and color. The apparent size of the segments or numerals shall not appear to change over the entire intensity range. The average luminance of each segment shall be determined by taking a minimum of three spot measurements, one at the center of the segment and one at each end of the segment. The maximum and minimum spot luminance within the segment shall be limited such that the most illuminated spot shall be not more than twice the brightness of the least illuminated spot. This shall be tested with the lighting voltage of 4.5 ± 0.5 VAC. The luminance variation between each segment of each numeral shall not be greater than 1.3 nor less than 0.7 times the average luminance of all segments in the numeral when measured at 4.5 ± 0.5 VAC. The luminance variation between each numeral of the display shall not be greater than 1.2 times nor less than 0.8 times the average luminance of all numerals in the display when measured at 4.5 ± 0.5 VAC.

b. The individually lighted segments shall not reduce their apparent length when the luminance is reduced to night level conditions.

g. All external transparent reflection surfaces of the segmented readout display shall be provided with a reflection reducing coating meeting the requirements of paragraph 3.3.2.

h. The digits shall be sharp and clearly readable in all ambient conditions. There shall be a minimum viewing cone of 60° (viewing cone is defined as a 30° angle from a center-line normal to the LCD). The digit sizes shall be per table III, and shall be of the seven-segment format. With the 10,000 foot-candle light source positioned in accordance with figure 3 of SAE AS 7788 normal to the display face, the display shall be clearly readable. Note: Clearly readable means anywhere in the viewing cone, at a distance of 36 inches, the correct time can be read by the operator within 3 seconds.

i. Solar radiation shall not degrade the LCD function during normal operational use.

j. The display shall not operate without the 28 VDC aircraft power applied.

TABLE III. Dimensions for liquid crystal display.

LCD	Dimension
Six Digit Display:	
Character height	0.250 inches
Character width	0.150 inches
Segment width	0.036 inches
Slant	0 degrees
Colon	0.060 in dia
ETC Character:	
Character height	0.150 inches
Character width	0.075 inches
Stroke width	0.025 inches
Numerals (seconds)	
Character height	0.067 inches
Stroke width	0.012 inches
Sweep second indicator:	
Height	0.240 inches

3.3.8 Clock controls. All clock controls and select functions shall be clearly labeled with the letters “SEL” for select, and “CTRL” for control, and shall be visible in all operating conditions. Labels shall be in accordance with MIL-STD-1472. The buttons shall be designed to allow easy use by a crewmember wearing flight gloves. A positive indication of control activation shall be provided, (e.g., snap feel, or audible click). The push button surface should be normally concave (intended) to fit the finger. When this is impractical, the surface shall provide a high degree of frictional resistance to prevent slipping. The button dimensions, resistance, displacement, and separation shall conform to figure 12 of MIL-STD-1472. The buttons shall be located on the lower portion of the clock face as shown in figure 1.

3.3.8.1 Mode selection. The display shall have two modes, one for clock time and one for elapsed time. Depressing the SEL button momentarily shall change from clock mode to elapsed time mode, and back again. The display shall indicate which mode the clock is in at any time by showing a “C” when in clock time and “ET” when in elapsed time mode. When power is first applied, the clock shall display the clock time mode.

3.3.8.2 Time set controls. To set the time, the clock shall first be placed in clock time mode by momentarily depressing the SEL button. Setting the hours digits shall be accomplished by next depressing and leaving depressed the SEL button, immediately followed by depressing the CTRL button not to exceed one (1) second. The hours digits on the display shall commence flashing awaiting setting, and both buttons shall then be released.

a. Momentarily depressing the CTRL button again shall advance the hours digits by one unit increment. Depressing the CTRL button for 2.0 –0.0/+0.5 seconds shall make the hours digits automatically scroll by increasing at a rate of one value every ½ second.

b. Momentarily depressing the SEL button shall make the minutes digits flash. Momentarily depressing the CTRL button again shall advance the minutes digits by one unit increment. Depressing the CTRL button for 2.0 –0.0/+0.5 seconds shall make the minutes digits automatically scroll by increasing at a rate of one value every ½ second.

c. Momentarily depressing the SEL button shall make the seconds digits flash. Momentarily depressing the CTRL button again shall advance the seconds digits by one unit increment. Depressing the CTRL button for 2.0 –0.0/+0.5 seconds shall make the seconds digits automatically scroll by increasing at a rate of one value every ½ second.

d. Momentarily depressing the SEL button again shall bring the clock back to clock mode.

3.3.8.3 Elapsed time controls. With the clock set in elapsed time mode, momentary depression of the CTRL button shall start the elapsed timer counting upward. Momentarily depressing the CTRL button a second time shall stop the timer count. Depressing the CTRL button a third time shall zero all digits. The above elapsed time cycle shall be repeated every time by depressing the CTRL button. The sweep second indicator and all digits on the clock shall be synchronized. Switching back and forth between clock and elapsed time modes with the SEL button shall not affect the performance of either mode. The sweep second indicator shall operate during both elapsed time and clock time modes.

3.3.9 Electrical power.

3.3.9.1 Clock power. The electronic clock shall be designed to operate from 28 VDC input power in accordance with MIL-STD-704 normal and abnormal conditions. Total power consumption shall not exceed 5 watts, excluding lighting power, but including any needed display heating. The clock shall be capable of operating, excluding display, during aircraft power interrupts and transients in accordance with MIL-STD-704.

3.3.9.2 Lighting power. The lighting shall operate from 0 to 5 volts, 400 hertz alternating current, and luminance shall be governed by the aircraft dimmer switch.

3.3.9.3 Keep alive power source. A keep alive internal power source shall be provided for the electronic clock. The keep alive internal power source shall keep the timing circuits of the clock continuously operating for a minimum of thirty (30) days when aircraft (28 VDC) power is not applied. The keep alive system shall provide not less than 4.5 nor more than 5.5 VDC, shall have at least a 500mAH capacity, and shall have a minimum 5 year shelf life. Temperature requirements in paragraph 3.4.2 shall be met.

3.3.9.3.1 Battery maintenance. Clock designs that incorporate an internal removable battery system to meet the requirement in paragraph 3.3.9.3 above, shall provide for easy battery maintenance in the aircraft in fifteen (15) minutes or less. Inspection, installation, or removal of the clock battery shall not require disassembly of any component of the clock case assembly. Clock case assembly screws, bolts, fasteners, or soldered components shall not be removed. The

clock design shall include an external battery cover on the electrical connector side of the case assembly to allow easy and unobstructed access to the battery. Unique special tools or equipment shall not be required to operate the battery cover. Function and operation of the battery cover shall not interfere with, or impede the function of the electrical connector on the case assembly. The battery cover shall be in accordance with Section 5 of MIL-STD-1472.

3.3.9.3.2 Battery design. The battery terminal polarity shall be prominently marked. The connection design shall prevent reverse polarity engagement. The clock circuitry shall relieve the battery load upon application of external aircraft power, and shall charge the battery. The clock circuitry shall not allow the battery to be charged by an outside power source. The battery circuitry shall limit the output current rate in case of an external short applied to the system. A discharged or missing battery shall not prevent normal operation of the clock using aircraft power.

3.3.9.3.3 Installation markings. Connections, polarity, minimum acceptable voltage for operation, normal voltage and types of batteries required shall be marked in a prominent place on or adjacent to the battery compartment.

3.3.9.3.4.1 Warning label. Clocks with battery systems shall be labeled externally as follows:

WARNING
Remove batteries before
shipment or inactive storage
of 30 days or more

3.3.10 Reliability. The clock shall meet a minimum Mean Time Between Failure (MTBF) of 5000 hours.

3.3.11 Useful life. The clock shall have a useful life of not less than 20 years under any combination of operating and storage life, when the operational service life has not been exceeded.

3.3.12 Operational service life. The clock shall have an operational service life after delivery of not less than 15 years, fully operating including display, under any natural combination of environmental conditions specified herein.

3.3.13 Maintainability program. While installed in the aircraft, the clock shall require no corrective or preventive maintenance (aside from battery replacement). The electronic clock shall be removable by removing two mounting screws, lifting the electronic clock from the aircraft instrument panel, and disconnecting the electrical connector.

3.3.14 Safety. The electronic clock shall present no danger, injury, or hazard to operating and service personnel.

3.3.14.1 Electrical Overload Protection. The clock design shall include electrical overload protection. MIL-HDBK-454, Guideline 8 should be consulted for reference only.

3.4 Performance. The electronic clock shall operate as specified herein under the following conditions:

3.4.1 Response time. At an ambient temperature of -54°C the heater shall be capable of providing normal 0°C response time within 3 minutes after power is applied. After 28 VDC power is applied, the clock shall be fully operable including illumination of the display and response times shall be:

a. Ton + Toff at 0°C to +85°C = 0.33 seconds
b. Ton + Toff at -5°C = 1.4 seconds
c. Ton + Toff at -10°C = 2.5 seconds
d. Ton + Toff at -15°C = 3.0 seconds

With: Ton = Time from 0% to 30% of maximum contrast.
Toff = Time from 90% to 10% of the maximum contrast.

3.4.2 Temperature. Operating temperature ranging from -54°C to +71°C and storage temperature ranging from -62°C to +85°C.

3.4.3 Dielectric strength. There shall be no insulation breakdown when 250 volts dc is applied between isolated pins and between pins and the case for a period of 10 seconds.

3.4.4 Temperature shock. Exposure to 85°C, then to -62°C, and return to 85°C under conditions specified in MIL-STD-810, Method 503.

3.4.5 Low pressure (altitude). Altitudes ranging from sea level to 100,000 feet per MIL-STD-810, Method 500, Procedures II and III.

3.4.6 Humidity. Relative humidity up to 95 percent including condensation as defined in MIL-STD-810, Method 507, Procedure I.

3.4.7 Salt fog. Exposure to simulated salt sea atmosphere as defined in MIL-STD-810, Method 509, Procedure I.

3.4.8 Fungus. Fungus growth as encountered in tropical climates as defined in MIL-STD-810, Method 508.

3.4.9 Sand and Dust. Sand and dust particles as encountered in desert areas as defined in MIL-STD-810, Method 510, and Procedure I.

3.4.10 Electromagnetic interference. The clock shall neither generate nor be susceptible to electromagnetic interference. No external protection (external wire shielding, etc.) shall be necessary to maintain EMI integrity. Electromagnetic interference shall be in accordance with MIL-STD-461 as specified for Class A1 equipment. The specific methods required are: CE01, CE03, CE07, CS01, CS02, CS06, RE01, RE02, RS01, RS02, and RS03.

3.4.11 Vibration. Random and gunfire vibration as defined in FIGURES 3 and 4 of this specification in accordance with MIL-STD-810, Methods 514 and 519.

3.4.12 Acceleration. Acceleration as described below in accordance with MIL-STD-810, Method 513, and Procedures I and II. (See 4.6.21.2).

TABLE IV. Acceleration procedures.

Procedure I Structural g levels	Procedure II Operational g levels
Fore 9.0	Fore 2.0
Aft 9.0	Aft 9.0
Up 13.5	Up 12.0
Down 4.5	Down 3.0
Lateral 6.0	Lateral 4.0

3.4.13 Shock. Shock forces as described in MIL-STD-810, Method 516, Procedure I and Procedure V.

3.4.14 Sunshine. Sunshine as encountered in normal operating conditions as defined in MIL-STD-810, Method 505, and Procedure II.

3.4.15 Error. Error shall not exceed the TABLE V tolerances.

TABLE V. Error tolerance.

Accuracy	**Tolerance**
Accuracy per 24 hrs. (room temperature, 25°C)	± 2 seconds
Accuracy during 24 hr low temp operation (-54°C)	± 8 seconds
Accuracy during 24 hr high temp operation (+71°C)	± 8 seconds
Accuracy of (room temperature, 25°C) elapsed time mode per 24 hrs.	± 2 seconds

3.4.16 Burn-in test. The clock shall be operated for 24 hours as specified in paragraph 4.6.7 Burn-in test.

3.5 Weight. The weight of the clock and battery together shall not exceed 16 oz.

3.6 Identification of product. Equipment, assemblies, and parts shall be marked for identification in accordance with MIL-STD-130. Markings shall include: item name, manufacturer's CAGE, military part number, NSN, and serial number.

3.7 Workmanship. The electronic clock shall be constructed and finished in a thoroughly workmanlike manner in accordance with MIL-STD-454, Guideline 9. 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.

3.7.1 Dimensions and tolerances. Dimensions and tolerances not specified shall be consistent with the best shop practices. The clocks must be interchangeable and compatible with the existing instrument panel cut out.

3.7.2 Screw assemblies. Assembly screws and bolts shall be "tight". The word "tight" means that the screw or bolt cannot be appreciable tightened further without damage or injury to the screw, bolt threads, or assembly.

4. VERIFICATION

4.1 Classification of Inspection. The inspections shall be classified as follows:

a. First article inspection (see 4.4)

b. Conformance inspection (see 4.5)

4.2 Responsibility for inspection. Unless otherwise stated in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure compliance with stated requirements.

4.3 Conditions and guidelines.

4.3.1 Standard conditions. The following conditions shall be used to establish normal functional performance characteristics:

a. Temperature: 25° ± 10°C

b. Surrounding air pressure: Room ambient conditions

c. Humidity: Room ambient up to 90% relative humidity

d. Lighting level: Maximum brightness

e. Altitude: Normal upright operating position

4.3.2 Erratic operation. After completion of and during the tests specified, clocks shall be tested per paragraphs 4.6.3 (gross visual verification of compliance), 4.6.4, 4.6.5, and 4.6.6 (5 minute duration with a gross visual verification of compliance). No signs of abnormal operation or physical damage shall be present.

4.4 First article inspection. First article inspections shall consist of tests identified in table VI.

TABLE VI. First article inspection.

Inspection	Number of sample units	Requirement paragraph	Method paragraph
Group I			
Exam. Of Product	All sample units	3.2, 3.3, 3.4, 3.5, 3.6, 3.7	4.6.1
Accuracy		3.4.15	4.6.2
Lighting & Display		3.3.5, 3.3.7,3.3.9.2	4.6.3
Mode Select		3.3.8.1	4.6.4
Time Set		3.3.8.2	4.6.5
Elapsed Time		3.3.8.3	4.6.6
Burn in Test		3.4.16	4.6.7
Group II *			
Response Time	All sample units	3.4.1	4.6.8
Low Temperature		3.4.2	4.6.9
High Temperature		3.3.3, 3.3.4, 3.4.2	4.6.10
Clock Power		3.3.9.1	4.6.11
Dielectric Strength		3.4.3	4.6.12
Temperature Shock		3.4.4	4.6.13
Low Pres. (Alt)		3.4.5	4.6.14
Humidity		3.4.6	4.6.15
Salt Fog		3.4.7	4.6.16
Fungus		3.4.8	4.6.17
Dust		3.4.9	4.6.18
EMI		3.4.10	4.6.19
Vibration		3.4.11	4.6.20
Gunfire Vibration		3.4.11	4.6.21
Acceleration		3.4.12	4.6.22
Shock		3.4.13	4.6.23
Sunshine		3.4.14	4.6.24

Footnote: * If the clock is hermetically sealed, the dust, humidity, fungus, and salt fog tests may be performed on the empty case.

4.4.1 Test samples. The samples shall consist of 3 test samples representative of the production equipment. Samples shall be subjected to tests as per table VI. Upon completion of the first article tests, the Group I tests, excluding the burn-in test, shall be run again to assure the clock

functions properly. They shall be tested under the conditions specified herein and at the location designated by the activity responsible for qualification.

4.4.2 Inspection routine. Tests shall be run in the listed order.

4.4.3 Failures. Any failure shall be cause for refusal to grant qualification. The procuring activity shall have final authority to decide what constitutes a failure. Failed equipment shall be reworked or redesigned as required, subject to the approval of the procuring activity, and subjected to the entire qualification test. If other tests were satisfactorily completed prior to the failure, these tests shall be rerun, unless the vendor can show that the rework or redesign in no way affects performance of the prior tests. Full details concerning failures, corrective action, and measures taken to prevent recurrence of the failures during production shall be provided to the procuring activity.

4.4.4 Test report. The contractor shall prepare a first article test report. As a reference only refer to MIL-HDBK-831.

4.5 Quality conformance inspection. Quality conformance (production) inspections shall consist of test identified in table VII.

4.5.1 Test samples. The samples shall consist of clocks representative of production. They shall be tested under the conditions specified herein and at the location designated by the activity responsible for qualification.

4.5.2 Inspection routine. Tests shall be run in the listed order.

4.5.3 Failures. When an item selected from a production run fails to meet the specification due to a relevant failure, no items still on hand or later produced shall be accepted until the extent and cause of failure has been determined and appropriately corrected. The procuring activity shall have final authority as to what constitutes a failure. The contractor shall provide descriptive documentation to the Government representative about the cause of failure and the action taken to preclude recurrence. After correction, all tests shall be repeated.

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

TABLE VII. Conformance inspection.

Inspection	Number of sample units		Requirement paragraph	Method paragraph
Individual Tests	All sample units			
Exam of Product			3.2.3, 3.4.3.5, 3.6,3.7	4.6.1
Self-Test			3.3.7.a	4.6.3.2.1
Elapsed Time Operation			3.3.8.3	4.6.6
Sampling plan A tests	4 clocks selected randomly from the first 20 of initial production run			
	Sample 1 (2 clocks)	Sample 2 (2 clocks)		
Low temperature		X	3.4.2	4.6.9
High temperature		X	3.3.2, 3.3.4, 3.4.2	4.6.10
Humidity	X		3.4.6	4.5.15
Vibration	X		3.4.11	4.6.20
Sampling plan B tests	4 clocks selected randomly from each 100, or fraction thereof, manufactured on the production run			
Lighting & display			3.3.5, 3.3.7, 3.3.9.2	4.6.3
Burn in test			3.4.16	4.6.7
Vibration (Perf. Test only)			3.4.11	4.6.20
Gunfire vibration			3.4.11	4.6.21
Operational test			3.4.12	4.6.22.2
Shock			3.4.13	4.6.23

4.6 Methods of inspection.

4.6.1 Examination of product. The electronic clock shall be inspected to determine compliance with the requirements specified herein with respect to materials, workmanship, and marking. The electronic clock shall be placed in the face down position, shaken by hand, and inspected in this position to determine that no loose hardware or foreign materials are present.

4.6.2 Accuracy. The electronic clock shall be electrically connected and powered. It shall be operated for a minimum of 240 hours and shall not exceed the tolerances shown in table V.

4.6.3 Lighting and display.

4.6.3.1 Clock display night lighting performance. Clocks shall be tested to verify conformance to all requirements of paragraph 3.3.5.

4.6.3.2 Display. A test shall be performed to verify compliance with requirements of 3.3.7.

4.6.3.2.1 Self-test. A self-test shall be performed to verify compliance with 3.3.7.a.

4.6.3.2.2 Contrast test. The illumination for the contrast test shall be uniform and diffused. Except as otherwise specified herein, contrast measurements shall be taken with no cover glass or other transparent surface in front of the display. At least 3 measurements of the indicia and of the background shall be taken with the optical axis of the photometer perpendicular to the surface being measured. An average of the indicia and background readings shall be used to determine contrast conformance.

4.6.3.2.3 Dim control operations. A dim control operations test shall be conducted with the electronic clock properly connected and powered, to evaluate brightness extremes. The extremes of the dim controls should cause the display to go from full bright to completely off. During this test all display requirements listed in 3.3.7 shall be met.

4.6.4 Mode select switch operations. With the electronic clock properly connected and powered the SEL button shall be set in the clock mode and then in the elapsed time mode. In each position the electronic clock shall operate in the correct corresponding mode.

4.6.5 Time set operation. With the electronic clock properly connected and powered the time setting controls shall be operated to confirm compliance with 3.3.8.2.

4.6.6 Elapsed time operation. With the electronic clock properly connected and powered, it shall be operated in the elapsed time mode for a minimum of 24 hours. The error tolerances of table V shall not be exceeded.

4.6.7 Burn-in test. The clock shall be operated for 24 hours at a temperature of 50°C. During and after the test the clock shall show no signs of erratic operation when tested per paragraph 4.3.2.

4.6.8 Response time. The clock shall be subjected to a test to verify compliance with 3.4.1.

4.6.9 Low temperature. The electronic clock shall be subjected to a low temperature test in accordance with MIL-STD-810, Method 502, Procedures I and II. The low temperature extremes shall be those specified by paragraph 3.4.2. The test duration shall be 24 hours for the Procedure I, and two hours for Procedure II. The operational checkout shall verify the requirements of paragraphs 3.3.3 and 4.3.2.

4.6.10 High temperature. The electronic clock shall be subjected to a high temperature test in accordance with MIL-STD-810, Method 501, Procedure I and II, Table 501.2-I for induced conditions. Use 7 cycles for the storage test and 3 cycles for the operational test. The operational checkout shall be in accordance with paragraph 4.3.2. Thermal evaluation and testing shall verify compliance with the requirements of 3.3.3 and 3.4.2.

4.6.11 Extreme voltage variation. The electronic clock shall be properly connected and tested for compliance with 3.3.9.1. The electronic clock shall be properly connected, and with input power applied and set at extreme voltages as specified in MIL-STD-704, Table II, undervoltages, overvoltages, and transients shall be applied in accordance with MIL-STD-704. Clock performance shall be tested per paragraph 4.3.2.

4.6.12 Dielectric strength. The electronic clock shall be subjected to a dielectric strength test and 250 VDC shall be applied for a period of 10 seconds during the test between isolated pins and the case. There shall be no evidence of insulation breakdown.

4.6.13 Temperature shock. The electronic clock shall be subjected to a temperature shock test in accordance with MIL-STD-810, Method 503, Procedure I, except that the test shall be continued for eight cycles. The temperature extremes shall be -62°C and +85°C. After the electronic clock has returned to room temperature, it shall be examined and there shall be no evidence of any cracked connectors, circuit or module breaks. The electronic clock shall then be operated in accordance with paragraph 4.3.2 and show no sign of erratic operation.

4.6.14 Low pressure (altitude). The electronic clock shall be subjected to a low pressure (altitude) test in accordance with MIL-STD-810, Method 500, Procedures II and III. Pressure in the chamber shall be reduced to the equivalent of 100,000 ±500 feet with an altitude change rate of 1,800 ft/min. The electronic clock shall operate immediately and its operation shall be observed for 1 hour. The clock shall be tested for erratic performance in accordance with paragraph 4.3.2. Pressure in the test chamber shall be increased to atmospheric and after the electronic clock has returned to room temperature, it shall show no signs of abnormal operation, when tested per paragraph 4.3.2, after 6 hours of operation.

4.6.15 Humidity. The electronic clock shall be subjected to a humidity test in accordance with MIL-STD-810, Method 507, Procedure I, (non-hazardous test items), cycle 3, the operational checkout shall consist of erratic operation testing in accordance with paragraph 4.3.2.

4.6.16 Salt Fog. The electronic clock shall be subjected to a salt fog test in accordance with MIL-STD-810, Method 509, Procedure I, for 48 hours of exposure and 48 hours of drying time. At the end of the 48-hour period, the electronic clock shall be operated for six hours showing no signs of erratic operation when tested per paragraph 4.3.2.

4.6.17 Fungus. The fungus test shall be conducted in accordance with MIL-STD-810, Method 508, for 28 days. Upon completion of this test the electronic clock shall show no signs of erratic operation when tested per paragraph 4.3.2. There shall be no deterioration nor shall any part of the electronic clock support fungus growth.

4.6.18 Dust. The dust test shall be conducted in accordance with MIL-STD-810, Method 510, Procedure I, air velocity = 8.9 m/s, silica flour dust composition, dust concentration of 10.6 ±7 g/m³, 6 hours at 23° and 6 hours at 71°C, the clock shall be re-oriented at 2 hour intervals with the display face, backplate and a side alternately facing the blowing dust. Following completion of this test the electronic clock shall be examined to determine that no physical deterioration has occurred. The clock shall show no signs of erratic operation when tested per paragraph 4.3.2.

4.6.19 Electromagnetic interference. The clock shall be tested in accordance with the applicable requirements of MIL-STD-461, to verify compliance with 3.4.10. The electronic clock shall not experience erratic operation when tested per paragraph 4.3.2.

4.6.20 Vibration. The electronic clock shall be tested in accordance with MIL-STD-810, Method 514, procedure I, using the spectra of Figure 3 of this specification. The clock shall not exhibit erratic operation when tested in accordance with paragraph 4.3.2 during vibration per the performance curve, nor after vibration per the endurance curve. The performance test shall be ½ hour in each axis. The endurance test shall be 1 hour in each axis.

4.6.21 Gunfire vibration. The electronic clock shall be tested in accordance with MIL-STD-810, Method 519 using the test described herein. The electronic clock shall not experience erratic operation when tested per paragraph 4.3.2 during or after the test. The test shall consist of 15 minutes of random testing per axis according to the spectrum of Figure 4 of this specification. In addition, the clock will be subjected to a 7.5 minute sine dwell per axis at the following acceleration levels and frequencies:

TABLE VIII. Gunfire vibration

Frequency (Hz)	Acceleration (g)
33	3.0
67	3.0
100	5.0
133	10.0
167	10.0
200	10.0
233	15.0
267	15.0
300	15.0
333	15.0
367	15.0
400	15.0
433	15.0
467	15.0
500	15.0
533	15.0
567	15.0
600	15.0
633	15.0
667	15.0
700	15.0
733	15.0
767	15.0
800	15.0
833	15.0
867	15.0

4.6.22 Acceleration. The acceleration tests shall be performed in accordance with MIL-STD-810, Method 513, Procedures I and II, except where noted herein. There shall be no signs of erratic clock operation when tested per paragraph 4.3.2.

4.6.22.1 Structural test. The electronic clock shall be subjected to the acceleration specified in paragraph 3.4.12 for the appropriate axes in accordance with MIL-STD-810, Method 513, Procedure I, for a period of one minute. The fore direction shall be defined with the electronic clock mounted in its normal operating position and rear of the case toward the center of rotation.

4.6.22.2 Operational test. The electronic clock shall be mounted in each of the three positions specified in MIL-STD 810, Method 513, and subjected to the operational accelerations specified in 3.4.12 for the appropriate axes.

4.6.23 Shock. The electronic clock shall, while operating, be subjected to shock test in accordance with MIL-STD-810, Method 516, Procedure I (functional shock using Figure 516.3-1), Procedure V (crash hazard using Figure 516.3-1), and Procedure IX (catapult launch/arrested landing). The electronic clock shall not be damaged nor shall it subsequently fail or show erratic operation when tested per paragraph 4.3.2 as a result of this test.

4.6.24 Sunshine. The sunshine test shall be performed in accordance with MIL-STD-810, Method 505, Procedure II, hot dry cycle, for 10 cycles of 24 hours. Clock performance shall be tested per paragraph 4.3.2 before and after exposure to solar radiation.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.1). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department' 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 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of the specification.

b. Part or Identifying Number (See 3.6)

c. Inspection requirements (See 3.1)

d. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (See 2.2)

e. Case finish and color (See 3.3.1.1)

f. Packaging requirements (See 5.1)

6.2. Subject term (key word) listing.
Keep Alive Battery
Liquid Crystal Display
Night Vision

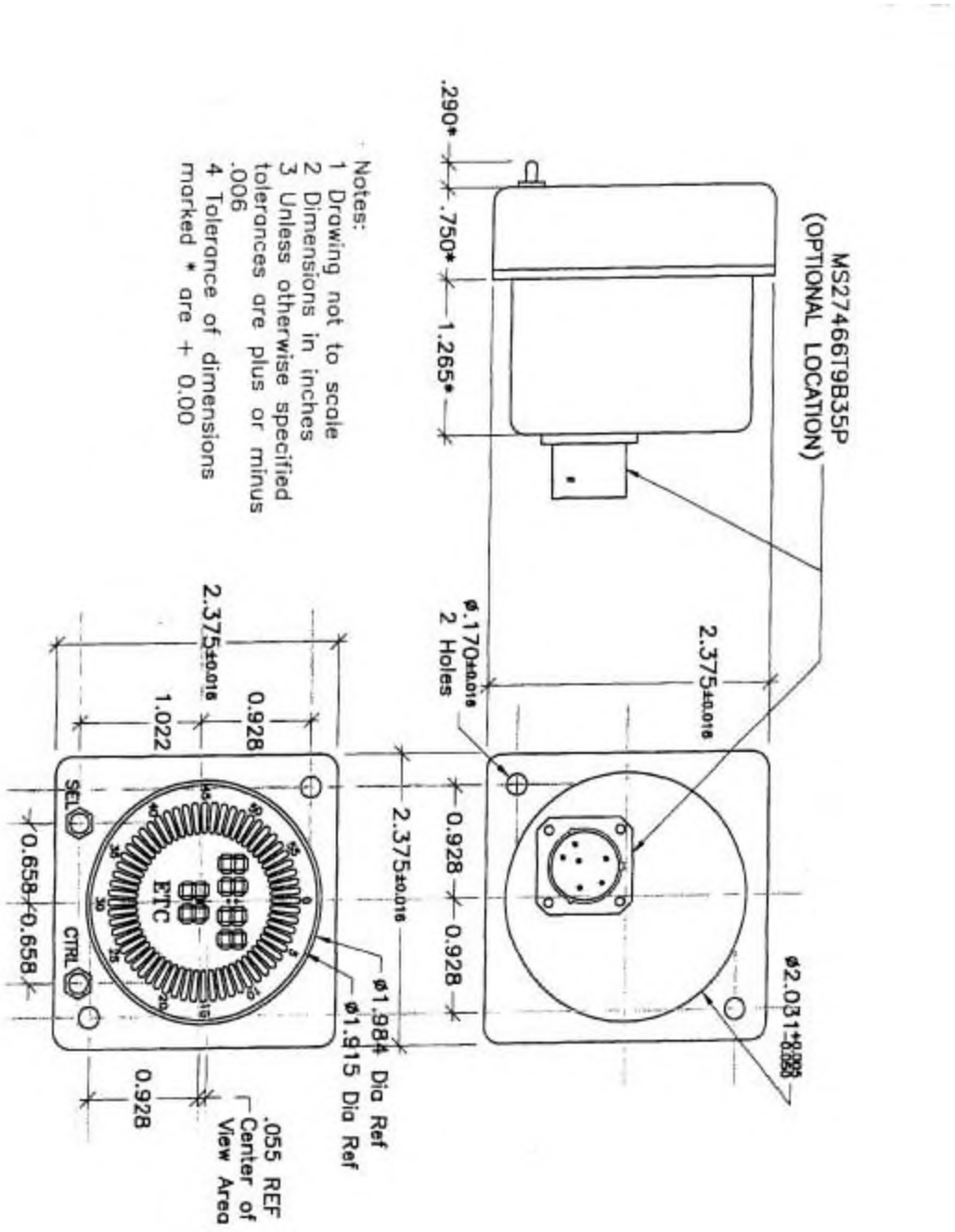

FIGURE 1. Clock

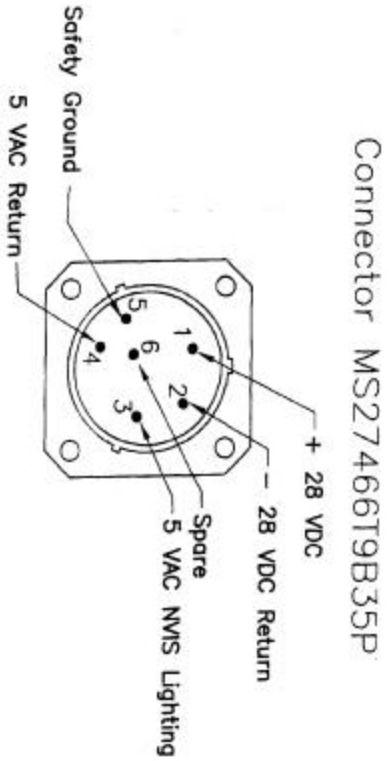

FIGURE 2. Wiring

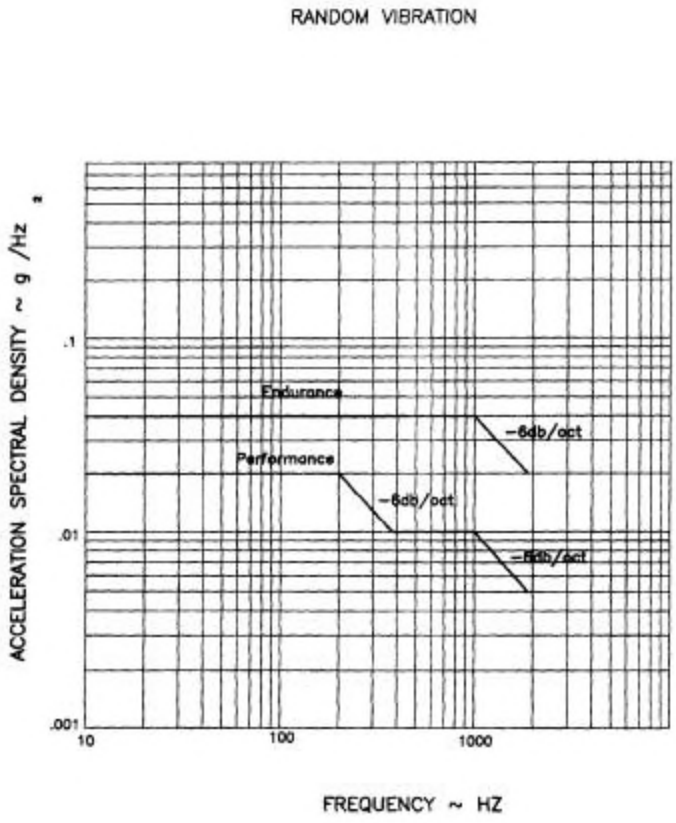

FIGURE 3. Random Vibration

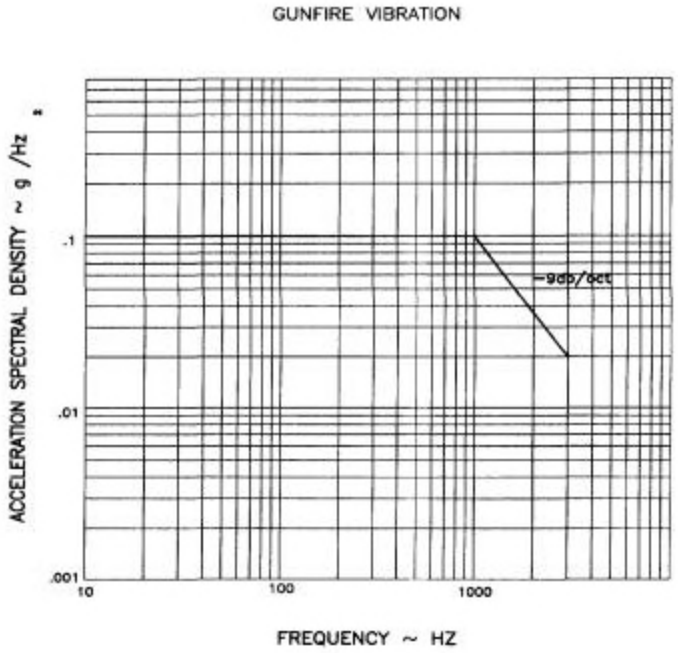

FIGURE 4. Gunfire Vibration

Custodian:
Air Force – 99
Army – AV

Review activity:
DLA - GS

Preparing Activity:
Air Force - 71

Agent:
Air Force - 99

(Project 6645-0547)

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 Online database at http://www.dodssp.daps.mil/.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS OKLAHOMA CITY AIR LOGISTICS CENTER (AFMC)
TINKER AIR FORCE BASE OKLAHOMA

FEB 09 2004

MEMORANDUM FOR HQ AFMC/LOS/LGISA

FROM: OC-ACL/EN
3001 Staff Dr
Tinker AFB OK 73145

SUBJECT: Certification of MIL-PRF-32144, Project Number 6645-0547, Performance Specification Clock, Aircraft, Electronic

1. The performance specification review of MIL-PRF-32144, Project number 6645-0547 has been completed. We hereby certify this specification as being performanced-based as required under Military Specifications and Standards Reform.

2. It has been fully coordinated by all applicable OC-ALC organizations. Point of contact is Orentha Hudson, OC-ALC/ENRS, DSN 336-3654.

JOHN J. OVER
Director of Engineering