MILITARY SPECIFICATION

TIME-FREQUENCY STANDARD, DISCIPLINED,
AN/URQ-23, GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 This specification covers the performance requirements for a disciplined time-frequency (DTF) standard with Time Base and Frequency Control. The standard provides standard time and frequency signals of a high order of frequency accuracy and is capable of being phase locked to an external frequency signal and synchronized to an external time signal, as well as providing frequency memory capability to retain the frequency accuracy of the standard and remain at its last frequency after a loss of input signal.

1.2 Classification. Standards covered by this specification shall be of the following classes as specified. Frequency control refers to the capability to be phase locked to some standard input frequency. Time base refers to a synchronizable 1 pulse per second (PPS) generator.

1.2.1 Class 1. Standard shall operate continuously over MIL-E-16400 class 4 temperature range of 0°C to +50°C at ground level and up to 10,000 feet altitude (20.6 in Hg).

1.2.2 Class 2. Special shall operate continuously over MIL-E-16400 class 2 temperature range of -28°C to +65°C at ground level and up to 10,000 feet altitude (20.6 in Hg).

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

MILITARY

MIL-A-8625	- Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-P-15024	- Plates, Tags and Bands for Identification of Equipment
MIL-E-15090	- Enamel, Equipment, Light-gray (Formula No. 111)
MIL-E-16400	- Electronic, Interior Communication and Navigation Equipment, Naval Ship and Shore: General Specification for
MIL-E-17555	- Electronic and Electrical Equipment, Accessories, and Repair Parts, Packaging and Packing of

MIL-T-21200	- Test Equipment for Use with Electronic and Electrical Equipment, General Specification for
MIL-C-45662	- Calibration System Requirements
MIL-C-28777/2	- Cable Assembly, Electronic Test Equipment, (3 Wire, 3 Prong, 125 Volt, Molded) Grounding Plug Connector, and Terminal Lugs, 60 Hertz

STANDARDS

MILITARY

MIL-STD-105	- Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-108	- Definition of and Basic Requirement for Enclosure for Electric and Electronic Equipment
MIL-STD-454	- Standard General Requirements for Electronic Equipment
MIL-STD-461	- Electromagnetic Interference Characteristics Requirements for Equipment
MIL-STD-462	- Electromagnetic Interference Characteristics, Measurement of
MIL-STD-471	- Maintainability Demonstration
MIL-STD-781	- Reliability Tests: Exponential Distribution
MIL-STD-810	- Environmental Test Methods
MIL-STD-1364	- Standard General Purpose Electronic Test Equipment
MS-3102	- Connector, Receptacle, Electric, Box Mounting

HANDBOOKS

MILITARY

HDBK-217	- Reliability Stress and Failure Rate Data for Electronic Equipment
MIL-HDBK-472	- Maintainability Prediction

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

Specification and Measurement of Frequency Stability, John H. Shoaf, NBS Report 9794.

CHARACTERIZATION OF FREQUENCY STABILITY

James A. Barnes et al, IEEE Transactions on Instrumentation and Measurement, Vol. IM-20, No. 2, May 1971.

(Application for copies should be addressed to the Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, New York 10017).

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.

3. REQUIREMENTS

3.1 First article sample Prior to beginning production, four samples shall be tested as specified in 4.3 (see 6.2.1).

3.2 General. The standard shall be in accordance with MIL-E-16400 except as hereinafter specified.

3.3 Functional description. The DTF standard is a low noise precision standard with excellent short term stability characteristics and a frequency memory capability. It generates ultrastable standard frequencies of 5 megahertz (MHz), 1 MHz, and 100 kilohertz (kHz) which are capable of being phase-locked to an external 1 or 5 MHz input signal; and a time base of 1 PPS which may be time synchronized to a 1 PPS signal, or to 1 PPS algebraically added to a 1 MHz carrier without additional equipment. A time base of 1 million pulses per second (MPPS) is also provided. The memory capability guarantees that the standard will retain its accuracy and remain at its last frequency after a loss of the phase lock input. The standard shall be provided with one of the following memory options:

(a) Option 1. Volatile memory--Capable of retaining frequency accuracy, when the phase lock input signal is removed and returning to the last frequency after the input signal has been interrupted and restored, but not in the case of loss of power.
(b) Option 2. Non-volatile memory--Permanent memory capable of retaining frequency accuracy, when the phase lock input signal is removed and returning to the last frequency after the input signal has been interrupted and restored and, if power is lost, is capable of returning to the last frequency when power is restored.

3.4 Composition. The standard shall consist of the following items and other parts specified herein as required to make up a complete equipment and all modules shall comply with MIL-E-16400.

(a) A1 - Oscillator Module
(b) A1A1 - 5 MHz Oscillator Sub-Assembly
(c) A1A2 - Loop Filter/Oscillator Tuning Assembly
(d) A1A3 - Power Converter Module

(e) A1A4 - 1 PPS Generator and Frequency Control Module
(f) A1A5 - Buffer/Divider Module
(g) A1A6 - Front Panel Assembly
(h) A2 - Power Supply Module
(i) A3 - Battery Power Supply Standby Module
(j) A0 - Enclosure--Unit 1
(k) - Accessories

3.4.1 Mechanical requirements. The mechanical measurements of the equipments shall conform to figures 1, 2, and 3. Equipment and full size drawings will be available on request for examination at Naval Research Laboratory.

3.4.2 Degree of enclosure. The enclosure shall be splashproof in accordance with MIL-STD-108.

3.5 Reliability. The standard shall have a mean-time-between-failure (MTBF) of 2500 hours under shipboard conditions.

3.6 Parts and materials requirements. Materials and parts containing mercury shall not be used in these standards unless specifically required or approved by the procuring activity and unless the presence of mercury is noted in that requirement or approval.

3.6.1 Parts selection. Parts and materials shall be as specified herein. When definite parts and materials are not specified, a part or material shall be used which will enable the standard to meet the performance requirements specified. Acceptance or approval of a part or constituent material shall not be construed as a guarantee of acceptance of the finished product.

3.7 Performance requirements. The following requirements shall be met.

3.7.1 Warm-up. Warm-up shall be 45 minutes from a cold start (off at least 24 hours) to phase lock range (1 part in 10^8) The standard shall remain in phase lock range for at least 24 hours and continue aging at the rate specified in Table IV.

3.7.2 Accuracy. The standard shall be adjustable from the front panel to nominal frequency for a period of at least three years. Consequently the calibration cycle for the oscillator module will be every three years and internal adjustment will be possible at a calibration laboratory.

3.7.3 Reproducibility. Reproducibility shall be as shown in Table I. Typically, reproducibility, after periods of loss of power of less than fifteen minutes, shall be as shown in Figure 4.

3.7.4 Settability. Settability (see 6.4.8) shall be ±1 $PP10^{11}$ unlocked, ±2.5 $PP10^{12}$ locked.

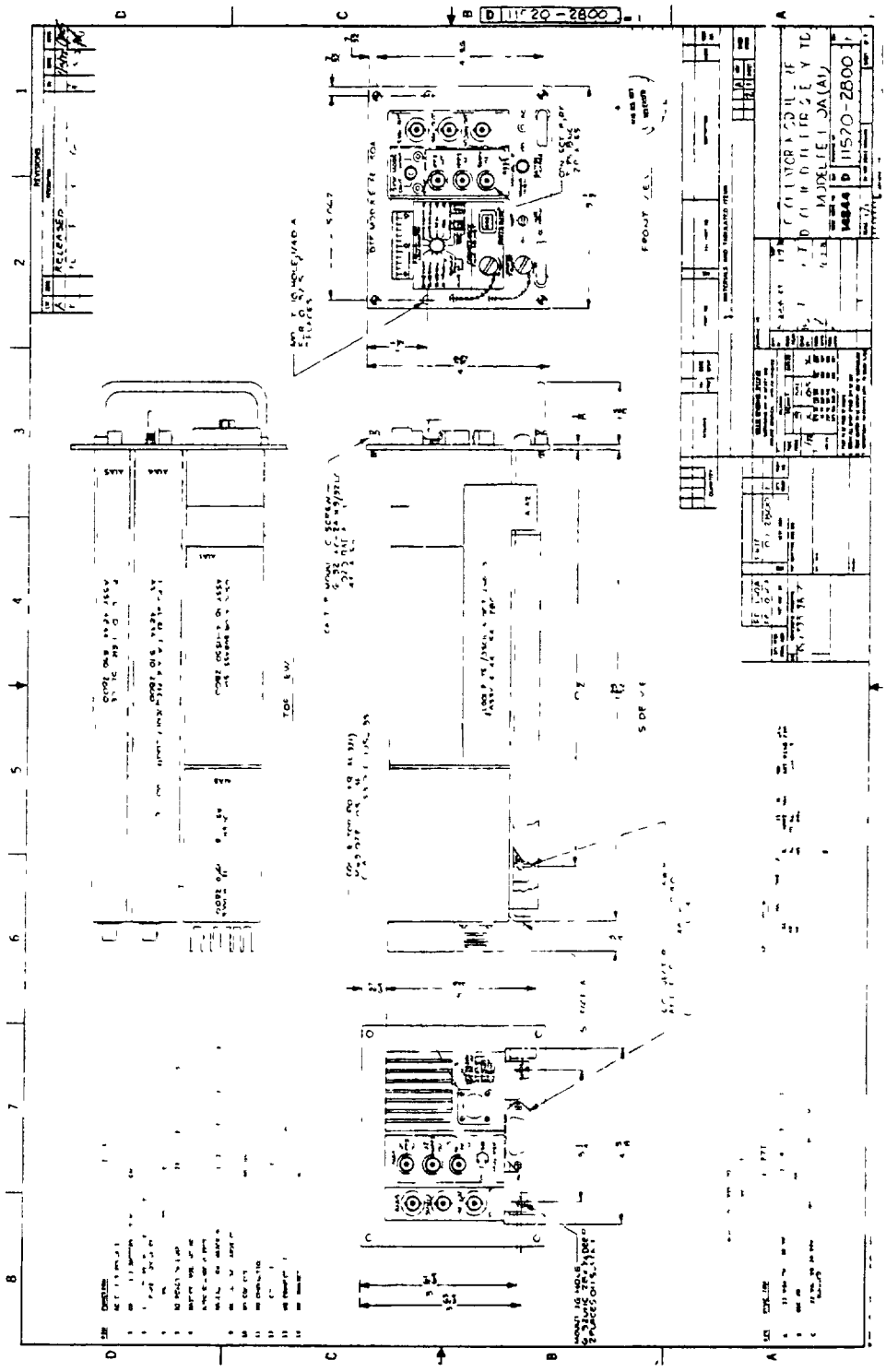

Figure 1. Oscillator module, RF-disciplined time frequency standard model FE-150A(A1).

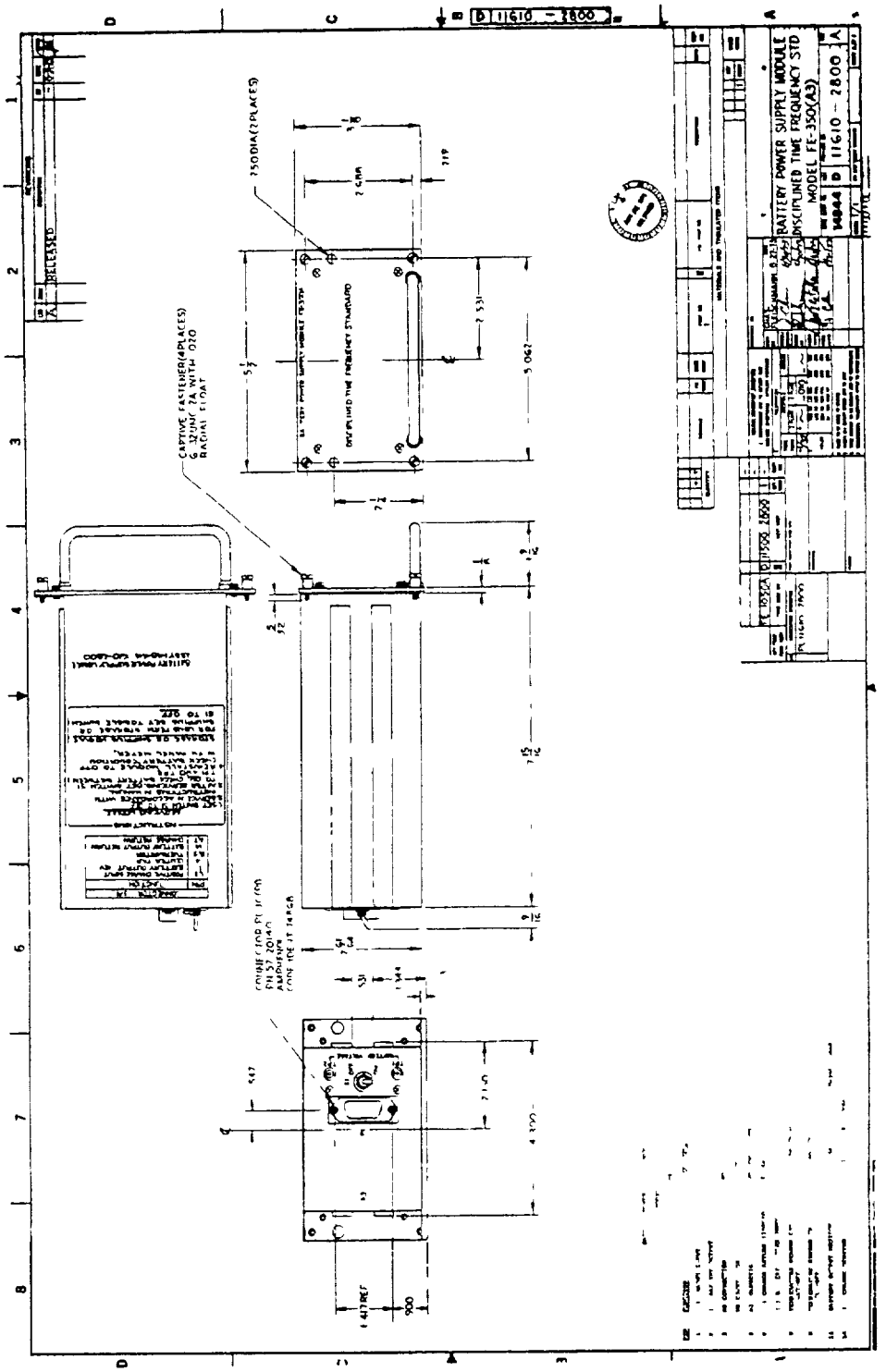

Figure 2. Battery power supply module disciplined time frequency standard model FE-350(A3).

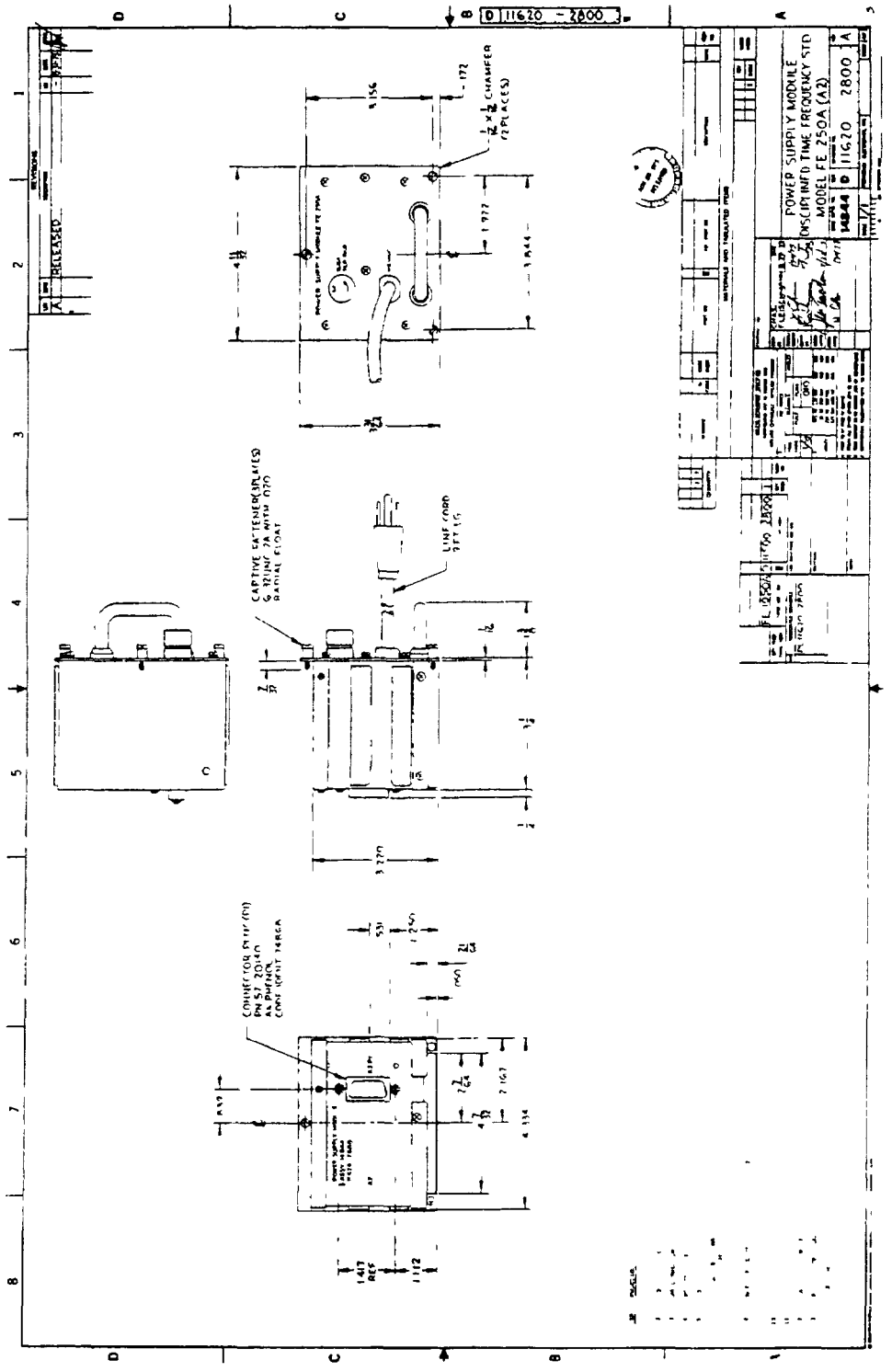

Figure 3. Power supply module disciplined time frequency standard model FE-250A(A2)

Table I. Reproducibility.

Type of memory	Fractional frequency difference after four hours
Volatile without reference	$\pm 1 PP10^{8}$
Volatile with reference	$1 - 2PP10^{12}$
Non-volatile without reference	$1 - 2PP10^{9}$
Non-volatile with reference	$1 - 2PP10^{12}$

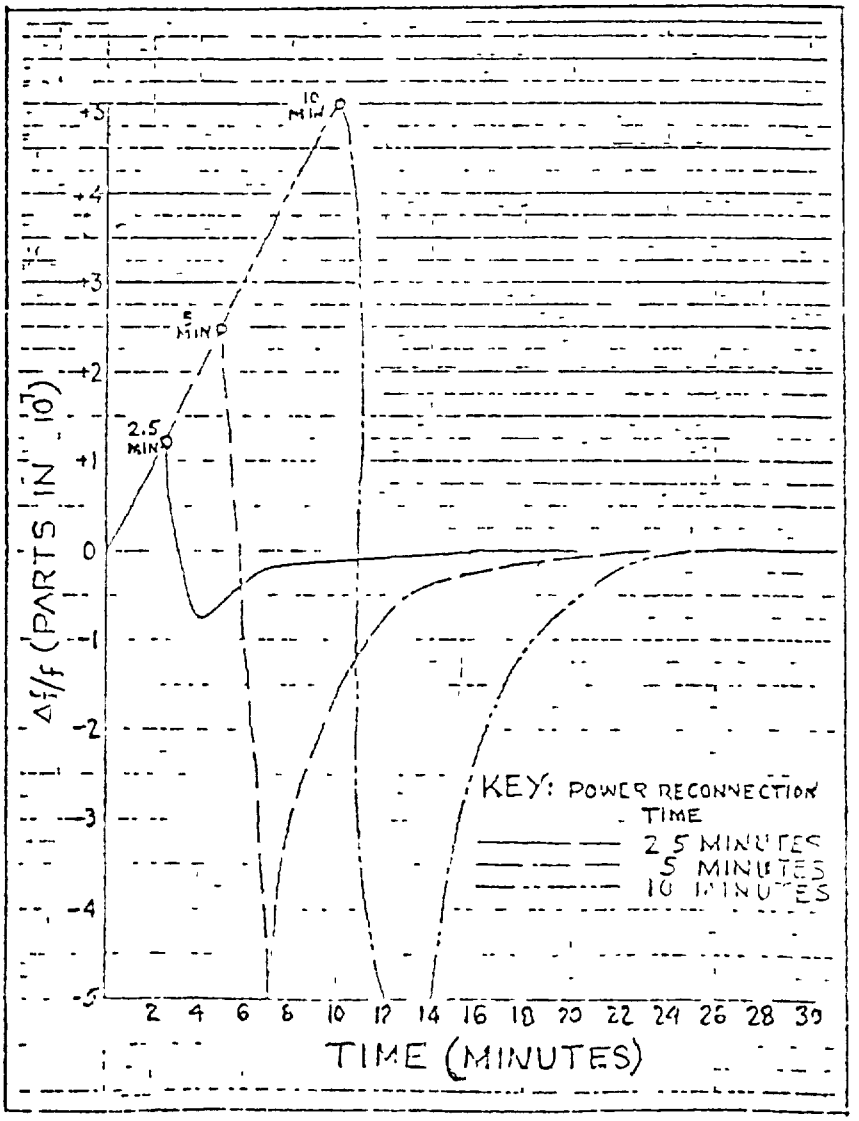

Figure 4. Typical frequency reproducibility versus power reconnection time.

3.7.5 Frequency stability. The standard deviation of frequency instabilities shall not exceed the limits of 3.7.5.1. The equation of Table II shall be used to compute the maximum standard deviation specified for the type standard.

Table II. Frequency stability.

Calculate using the following equation:
$T_y^2(N,T,\tau) = \sigma_y^2(2,\tau,\tau) = \sigma_y^2(\tau) = \frac{\sum_{k=1}^{M} (\bar{Y}_{k+1} - \bar{Y}_k)^2}{2(M-1)}$
N = number of samples
T = the period of sampling
τ = the sample time
$\bar{y}_k$ = average fractional frequency during interval k $\frac{\Delta f}{I}$
M = total number of measurements
T = τ and N = 2 will be used as a standard for measurements

3.7.5.1 Short term stability. After three days of continual operation, the 5 MHz output signal of the standard shall meet the fractional frequency requirements of Table III.

Table III. Short term stability.

Fractional frequency requirements	
Averaging time	Stability
100 milliseconds (ms)	6 PP 10^{12}
1 second	2 PP 10^{12}
10 seconds	2 PP 10^{12}
100 seconds	3 PP 10^{12}

3.7.5.2 Oscillator aging. Quartz crystal oscillator aging in non-phase locked operation (free running) shall meet the requirements of Table IV.

Table IV. Oscillator aging.

Time period	Aging rate
After one day of turn-on for the next three days	3.3 PP10^{10} per day
After four days for the next seven days	2.1 PP10^{10} per day
After 11 days for the next 60 days	0.66$10^{10}$ per day

3.7.5.3 Orientation stability. The average frequency change observed when the instrument is placed successively with each of its six surfaces down shall not exceed 1.5×10^{-9}.

3.7.5.3.1 Inclination. The average frequency change observed at ±45° shall not exceed $\pm 5.0 \times 10^{10}$.

3.7.5.4 Shock and vibration stability The requirements of Table V shall be met. Best mounting axis for gravity and vibration stability shall be marked on the outer case. The standard shall meet MIL-E-16400. Output frequency shall not vary due to shock and vibration by more than 2 PP 10^{9}. The standard shall meet the following vibration requirements of Table V in three orthogonal planes of orientation.

Table V. Vibration stability.

Frequency of vibration	Displacement	Equivalent g factor	Phase noise (milliradians) (peak to peak values)
5 hertz (Hz)	60 mils	0.08	0.32
7 Hz	60 mils	0.15	0.32
10 Hz	60 mils	0.31	0.36
15 Hz	60 mils	0.69	0.80
20 Hz	40 mils	00.82	1.03
25 Hz	40 mils	1.28	1.83
30 Hz	20 mils	0.92	1.54
33 Hz	20 mils	1.11	1.73

3.7 5.5 Frequency stability as a function of supply voltage. The fractional frequency change observed for a ten percent variation in line voltage when operated from alternate current (AC) power, or for ±4 volts variation from 26 volts when operated from direct current (DC) power, shall not exceed 2 PP x 10^{11}.

3.7.5.6 Frequency stability as a function of temperature. The fractional frequency shift observed when the ambient temperature is varied from -28°C to +65°C shall not exceed 5 PP 10^{10}.

3.7.5.7 Frequency stability as a function of load. The fractional frequency change from open circuit to a 50 ohm resistive or reactive load shall not exceed 2 PP x 10^{11} on the 5 MHz and the 1 MHz outputs of a free running standard.

3.7.5.8 Humidity. The output frequency shall not vary due to changes in humidity by more than 5 PP 10^{10}.

3.7.6 Output signals. The following output signals shall be provided:

(a) Output frequencies. These outputs shall be provided on both front and rear BNC connectors and shall be labeled to identify the frequency.

(1) Five MHz sinewave at >1.0 V root-mean-square (rms) into 50 ohms.
(2) One MHz sinewave at >1.0 V rms into 50 ohms.
(3) 100 kHz squarewave at >1.0 V rms into 50 ohms.

(b) Output pulses. Time base outputs shall be provided on front and rear BNC connectors and shall be labeled to indicate type of pulse.

(1) One PPS at +4.7V ±10 percent into 50 ohms, 20 ±1 microseconds (µs) wide. Rise time less than 20 nanoseconds (ns). Jitter less than 100 picoseconds (unsynchronized).
(2) One MPPS at 5 V PP into 50 ohms, TTL compatible, 0.1 (µs) wide.

3.7.6.1 Harmonic distortion. The harmonic distortion levels in the 5 MHz and 1 MHz output frequencies shall be at least 40 decibels (dB) below the required outputs.

3.7.6.2 Non-harmonically related outputs. The level of any signal component not harmonically related to the 5 MHz and 1 MHz outputs shall be at least 110 dB below the required outputs.

3.7.6.3 Single sideband noise (dB/Hz). The level of single sideband noise referenced to the carrier in the 5 MHz and 1 MHz output signals shall be as shown in Table VI.

Table VI. Single sideband noise (dB/Hz) referenced to carrier.

Frequency from carrier	Carrier	
	5 MHz	1 MHz
10 Hz	-130	-135
100 Hz	-140	-140
1 kHz	-160	-145
10 kHz	-165	-150

3.7.6.4 Isolation of output circuits. Output circuits shall be isolated so that a short circuit occuring on one frequency output line shall not degrade the other frequency outputs. The phase noise from the 1 PPS shall be less than 0.005 ns on the 5 MHz and 1 MHz outputs.

3.7.7 Phase lock. The standard shall provide the capability of being phase locked to the following external input signals:

(a) 5 MHz (sine wave) ≥1 V PP
(b) 1 MHz (sine wave) or square wave) ≥1 V PP
(c) 1 MHz (sine wave) +1 PPS ≥1 V PP
(d) 1 MHz (square wave) +1 PPS ≥1 V PP

Phase lock input impedence shall be greater than 1000 ohms. Locking range shall be 1 part in 10^8.

3.7.7.1 Memory operation. A memory capability shall be provided on the frequency standard in accordance to Options 1 or 2 of 3.3. In addition the memory shall store an analog voltage in digital forms.

3.7.8 Time base synchronization The time base of the standard shall be capable of being synchronized from the following external input signals.

(a) 1 PPS ≥1 PP, >5 µs wide
(b) 1 PPS +1 MHz sine wave (algebraically added) - equal amplitudes of 1 - 3 V PP minimum, pulse width >5 µs.
(c) 1 PPS +1 MHz square wave (algebraically added) - equal amplitudes of 1 - 3 V PP minimum, pulse width >5 µs.

Synchronization delay shall be less than 0.200 us. The phase relationship between the 1 MPPS and the 1 PPS shall not change upon synchronization of the 1 PPS. The jitter between the input pulse being used to synchronize the DTF, and the output pulse of the DTF, while synchronized shall measure to be less than 1 ns.

3.7.9 Operating controls, switches and indicators. The time-frequency standard shall be provided with controls, switches and indicators which, with the associated circuits, will permit adjustment and operation of the standard. All controls shall be in accordance with Requirement 28 of MIL-STD-454.

3.7.9.1 AC operation indicator. An AC operation indicator shall be mounted on the front panel. It shall indicate that the AC line input is energized.

3.7.9.2 Oscillator frequency controls. Oscillator frequency controls shall be screwdriver adjustable. Coarse and fine oscillator frequency controls shall be accessible from the front panel. The coarse frequency control shall provide quartz crystal frequency adjustment not less than 1 part in 10^7. The fine frequency control shall provide adjustment in PP 10^{11} with a numeric readout from 0 to 999. The controls shall be marked in the positive direction adjacent to the access hole. The holes shall be covered when not used and covers (plugs) shall be secured to the front panel with a chain type device.

3.7.9.2.1 Linearity of fine frequency adjustment. Linearity of adjustment over the range of 999 PP 10^{11} shall be within ±30 percent of the dial indication.

3.7.9.3 Time constant switch. A two-position switch, selecting either a long or a short control loop time constant, shall be provided. The switch shall be screwdriver adjustable and accessible via a front panel opening. The adjustment shall be suitably identified. Time constants shall be 100 seconds or 1 second switch selectable.

3.7.9.4 One MHz reference selector. A sine or square wave 1 MHz selector switch shall be provided in the rear of the instrument. It shall enable accommodation of a sine wave or square shape as the 1 MHz reference input.

3.7.9.5 Sync mode switch. A sync mode toggle switch shall be mounted on the front panel of the standard to select the mode of operation. Two positions shall be provided.

(a) Continuous: The continuous mode with timing sync input signals being applied continuously, syncs to every input pulse.
(b) Intermittent: The intermittent mode, where timing sync input signals are applied intermittently, syncs to first pulse after switch is thrown.

3.7.9.6 Sync and unlock indicators. Two front panel indicators shall be supplied.

(a) Sync indicator to indicate synchronization to external 1 PPS input.
(b) Unlock indicator to indicate a 1 MHz or 5 MHz input phase lock loop condition.

3.7.9.7 Reset switch. A pushbutton switch shall be provided to reset the unlock indicator circuit after a phase lock interruption.

3.7.9.8 Circuit check switch and meter A switch and meter shall be mounted on the front panel of the instrument. The switch and meter shall provide facilities to monitor and check the pre-selected functions listed in Table VII.

3.8 Electrical power requirements.

3.8.1 Power sources. The standard shall be designed to operate from 115 V rms ±10 percent at frequencies of 50 Hz ±5 percent, 60 Hz ±5 percent and 400 Hz ±10 percent when either or neither side of the power supply is grounded. DC power shall be as specified in 3.8.3.

3.8.1.1 Voltage transients. The standard shall not be damaged or interrupted by voltage transients of ±20 percent or less amplitude and 2 seconds or less duration.

3.8.1.2 Frequency transients. The standard shall operate during and not be damaged or interrupted by frequency transients of ±3 percent for two seconds or less duration.

3.8.1.3 Resonant points. Particular attention shall be given the elimination of circuits resonant at beat frequencies between the power frequency and other frequencies present in the standard.

3.8.1.4 Primary power cable. The primary power cable assembly shall be integral to and a permanent part of the power supply. It shall be in accordance with MIL-C-28777/2. The legend 115 volts, alternating current (VAC) shall be clearly marked adjacent to the point where the cable enters the power supply panel.

3.8.1.5 Fuse. A fuse and fuse holder shall be provided for 115 volt AC operation.

3.8.1.6 Total power input. The total power required to operate the standard shall not exceed 30 watts maximum.

3.8.2 Internal standby battery. The standard shall include an internal standby battery power supply which shall be capable of operating the standard for not less than seven hours, at +22° C(+2°-0°C) when the battery is fully charged. A battery charging current and battery voltage level position shall be provided on the front panel as part of the circuit check function. A front panel toggle switch providing Manual Low, Manual High, and Auto positions shall enable selection of the mode for charging the internal battery pack by charging circuit in the standard. A battery relay switch shall provide a mode so that batteries can remain charged when transporting cold.

3.8.2.1 Battery connection. The battery shall be internally connected across the output from the power supply in such a way that the battery receives charging current while the 115 volt power line is energized. During power input interruptions, the battery shall automatically furnish power to operate the equipment with no break in operation during changeover. The battery shall be capable of being disconnected and removed without interrupting equipment operation. Similarly the power supply unit shall be capable of being disconnected and removed without interrupting operation.

3.8.2.2 Cutout protection for battery. A cutout circuit shall protect the battery from completely discharging during extended 115 volt power interruptions. The cutout shall be set to disconnect the battery before the battery voltage drops to a point which will result in either deterioration in equipment performance or damage to the battery.

3.8.3 External DC power. The standard shall be capable of operating from an external DC source of 24 to 30 volts, direct current (VDC), 26 watts (cold start) and 12 watts nominal. A connector (MS3102E-10SL-3S) in accordance with MS 3102 shall be located at the rear of the standard and bear the legend +22 to +30 V EXT. DC IN adjacent to the connector with appropriate pin identification markings. The standard shall be capable of switching from AC or battery power to external DC power with no break in operation.

3.9 Electromagnetic interference. The standard shall conform to the requirements of MIL-STD-461 for Class IC equipment.

3.9.1 Reduction. Any parts employed for the reduction of electromagnetic interference, such as capacitors and filters, shall be of a type approved by the procuring activity.

3.10 Magnetic characteristics. The standards shall conform to the magnetic characteristics requirements of MIL-E-16400, including magnetic field, external magnetic fields, electromagnetic compatibility, magnetic signature, magnetic materials, and eddy current magnetism, except as hereinafter specified.

3.11 Design and construction. The standard shall be designed and constructed in accordance with the requirements specified.

3.11.1 Dimensions and weight. The housing dimensions of the standard shall be 12 inches (304.8 mm) long by 5 1/2 inches (139.70 mm) wide by 7 3/4 inches (178.55 mm) high. The weight with batteries shall be 25 pounds maximum.

3.11.2 Construction. The standard shall use miniature construction where possible. Maximum use shall be made of integrated circuits and non-repairable subassemblies.

3.11.2.1 Accessibility. Accessibility shall be in accordance with Requirement 36 of MIL-STD-454.

3.11.2.2 Identification plates. Unless otherwise specified herein, the standard shall carry identification and marking in accordance with MIL-P-15024.

3.11.2.2.1 Location and marking. A metal identification name plate shall be affixed to the standard. As a minimum, the following shall be marked on the identification plate.

(a) Nomenclature or noun name
(b) Contract number
(c) Specification number
(d) Class
(e) Serial number
(f) U.S.

3.11.2.2.2 Overall. The overall identification plate of each standard shall be affixed to the outside of the enclosure.

3.11.2.3 Thermal design. Any heat-producing or heat sensitive parts shall have sufficient heat sinking to limit heat concentration and preclude degradation of circuit boards and other parts Unless otherwise required by the specification, forced air cooling shall not be used.

3.11.2.4 Finish. Unless otherwise specified, the exterior painted finish of the standard shall be gray enamel in accordance with Type III, Class 2 of MIL-E-15090.

3.11.2.4.1 Unpainted surfaces. The exterior finish of unpainted module surfaces shall be cleared anodized, in accordance with Type II, Class I of MIL-A-8625.

3.11.2.5 Electron tubes. Unless specifically approved in advance by the procuring activity, electron tubes shall not be used.

3.11.2.6 Panel.

3.11.2.6.1 Panel marking. Panel markings shall be screened, engraved, or etched into the metal.

3.11.2.6.2 Controls. All controls necessary for operating the standard shall be placed on the front panel, except for the sine-square wave 1 MHz reference input selector switch, which shall be mounted on the rear panel. Buffered outputs of 5 MHz, 1 MHz and 100 kHz shall be mounted on both rear and front panels.

3.11.3 Enclosures.

3.11.3.1 Style. The standard shall be designed for rack mounting, portable use, and panel mounting. The standard shall be enclosed in an anodized or painted aluminum housing equipped with a flat retractable handle on the top of the case. The case shall be suitable for installation in racks by means of a rack carrier and shall have panel mounting holes for installation therein.

3.11.3.1.1 Handle. One hinged retractable steel reinforced leather handle shall be provided on the top of the case. The grip portion of the handle shall be at least 3/4 inch (.750 mm) wide.

3.12 Environmental requirements. Environmental requirements shall be as specified herein (see 3.7.5.3, 3.7.5.3.1 and 3.7.5.4).

3.13 Safety. The design shall promote maximum safety of both operational and maintenance personnel and equipments during all phases of operational life as specified in Requirement 1 of MIL-STD-454.

3.13.1 Personnel protection. The design shall incorporate methods to protect personnel from accidental contact with voltages in excess of 30 Vrms or DC while operating a complete standard.

3.13.2 Control positions. Controls shall be identified in such a manner that operators do not easily cause damage to the standards.

3.13.3 Line fuses. A fuse shall be provided in one side of the incoming power supply line. Unless otherwise specified, the fuse shall be accessible at the rear panel.

3.14 Test, measurement and diagnostic equipment (TMDE) (see 6.4.13). Test provisions for the equipment shall conform to Requirement 32 of MIL-STD-454, except as specified herein.

3.14.1 Test point criteria. Multiple use of test points is permitted for the following requirements.

(a) Signal quality and circuit performance. Test points, test jacks, or both shall be provided to permit the injection of signals where applicable and the monitoring of signals at the input/output terminals of the system, each unit and each assembly (see 6.4.10).

(b) Calibration. All built-in TMDE shall be provided with test points or test jacks, or both, on the front panel to allow isolation of the TMDE from the prime circuit and the injection of test signals into the TMDE for purposes of calibration of the prime system system/unit while the built-in TMDE is removed for calibration repair or replacement. All TMDE alignment and adjustment features shall be organized to enable the technician to view all pertinent instrumentation at the same time he is making any TMDE adjustments.

(c) Fault isolation. Test points, test jacks, or both, shall be provided to permit the injection/measurement of signals at input/output terminals where applicable of the unit, assembly or subassembly (see 6.4.9) input/output terminals to determine satisfactory operation or malfunction of the unit, assembly, or subassembly.

(d) Shop testing. Shop testing of assemblies and subassemblies shall be performed with the assemblies and subassemblies removed from the prime equipment. Test points shall be provided so that the assembly can be (a) activated (such as DC and dynamic signals applied, and (b) checked for quality of operation. Assembly and subassembly test points shall be provided in a single connector. Assembly and subassembly test points when approved by the procuring activity may be placed at various nodes or locations on the assembly and subassembly.

3.14.2 General purpose electronic test equipment (GPETE). GPETE for use at all levels of maintenance shall be selected from the standard and substitute standard GPETE types listed in MIL-STD-1364.

3.14.3 Built-in test equipment (BITE).

(a) BITE levels. BITE shall be provided for the following levels.

(1) Level A BITE shall provide a GO, NO-GO indication of performance and quality of the DTF standard. As a minimum, level A BITE shall indicate the unit is powered and operating with battery condition indicated and with monitoring of functions indicated in Table II.

(2) Level B BITE shall provide a GO, NO-GO determination of quality and performance of each assembly. As a minimum, Level B BITE shall monitor the functions indicated in Table VII.

Table VII. Circuit monitor functions.

Circuit check	
Switch position	Description
5 MHz output	Indicates operation of 5 MHz output
1 MHz output	Indicates operation of 1 MHz output
100 kHz output	Indicates operation of 100 kHz output
Memory voltage	Indicates level of phase lock loop control voltage
5 MHz or 1 MHz reference input	Indicates 5 MHz or 1 MHz reference input signal level
Lock indicator	Indicates lock condition - direct 1 MHz phase meter output

Table VII. Circuit monitor functions. (Continued).

Circuit check	
Switch position	Description
Battery charge/discharge current	Indicates relative level of charge/discharge current
Battery voltage	Indicates internal battery voltage
External DC	Indicates external DC voltage input level
Outer oven	Indicates outer oven operation
Regulator voltage	Indicates voltage regulator operation
Inner oven monitor	Indicates inner oven operation

(b) BITE activation.

(1) Level A activation shall be automatic and not require operator initiation.
(2) Level B activation may be automatic or manual.

(c) GO-NO GO indicators. All BITE GO, NO-GO indicators shall be covered or uncovered, as required. If covered, they shall be made visible by the removal of not more than one cover plate.

(1) Indicators for Level A BITE shall be lights, meters, or other indicators installed on the system/unit control panel.
(2) Indicators for Level B BITE shall be provided on the front panel of the DTF standard.

(d) BITE dependability.

(1) Level A BITE shall detect DTF standard failure at least 98 percent of the time.
(2) Level B BITE shall isolate at least 90 percent of the detected system/unit failures to the assembly.

3.15 Self-check. Provisions shall be made for quickly and accurately monitoring the operation of the standards in accordance with Table VII.

3.16. Accessories. When ordered the following accessories shall be provided:

(a) Circuit board extenders
(b) Module extender cables

3.17 Quantitative maintainability requirements. The mean corrective maintenance time (MCT) shall not be greater than 15 minutes when repair is made at the organizational level (see 6.4.7) by replacement of modules, chasis mounted electronic, electro-mechanical, electrical, and mechanical parts. The MCT of

the repairable modules shall not be greater than two hours when repair is accomplished by replacement of piece parts.

3.17.1 Interchangeability. Mechanical and electrical interchangeability shall exist between similar assemblies, subassemblies, and replaceable parts supplied by a supplier. In the design of the equipment provisions shall be made for design tolerance sufficient to accommodate various articles such as transistors, integrated circuits, resistors, and other parts having the limiting dimensions and characteristics set forth in the specifications for the particular part involved without departure from the specified performance.

3.17.2 Storage. The standards shall not be adversely affected and shall perform in 3.7 after storage in the nonoperating condition for a period of four months at temperatures specified.

3.17.2.1 Handling procedures. Standards in non-operating storage for periods greater than four months shall contain the legend CAUTION on the standard enclosure. Precautions that must be followed to preclude adverse affects and damage during storage shall be indicated on the enclosure. Other methods and approaches to this requirement are permissible, provided the standards conform to the performance requirements of this specification, and the alternate methods and approaches used are approved by the procuring activity.

3.18 Workmanship. Workmanship shall be in accordance with Requirements 9 and 32 of MIL-STD-454 and as specified herein.

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 in the contract or purchase order, the supplier may use his own or any other facility suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Government verification. All quality assurance operations performed by the supplier will be subject to Government verification at any time. Verification will include: (a) surveillance of the operations to determine that practices, methods, and procedures of the written quality program are being properly applied, (b) Government product inspection to measure quality of product to be offered for acceptance, and (c) Government product inspection of delivered products to assure compliance with all inspection requirements of this specification. Failure of the supplier to promptly correct deficiencies discovered by him or of which he is notified shall be cause for suspension of acceptance until corrective action has been made or until conformance of product to prescribed criteria has been demonstrated.

4.2 Classification of examination and tests. The method of examination and testing shall be classified as follows:

(a) First article inspection (see 4.3)
(b) Quality conformance inspection (see 4.4)

(1) Production inspection (see 4.4.1)
(2) Production control inspection (see 4.4.2)
(3) Environmental tests (see 4.4.3)
(4) Inspection of preparation for delivery (see 4.6)

(c) Reliability tests (see 4.4.4)
(d) Maintainability demonstration (see 4.4.5)

4.2.1 Test equipment. The equipment specified in Table VIII shall be used to conduct the tests specified herein. Such test equipment shall be calibrated in accordance with the requirements of MIL-C-45662.

4.3 First article inspection. Unless otherwise specified (see 6.2.1), four units shall be required for first article inspection. First article inspection shall consist of all examination and testing necessary to determine compliance with the requirements of this specification. First article inspection shall include the tests specified in Table IX.

Table VIII. Test equipment.

Item	Functional title	Specified type or equivalent required characteristics	Acceptable alternate systems
1	Reference Frequency Standard	HP 5061A	
2	Quartz Crystal	FEI FE-150A	
3	Computing Counter/ Keyboard	HP 5360A/5375A	
4	Time Interval Plug-in for Item 3	HP 5379A	
5	Spectrum Analyzer	HP E03-8553B	
6	Wave Analyzer	GR 1910A	
7	Digital Recorder for use with Item 3	HP 5050B	
8	Variable Auto-Transformer	Capable of output in excess of 132 Volts AC, 25 Watts	
9	Filtered DC Power Supply	Electro Model EFB	
10	Mixer/Trigger Plug-in	HP K10-5061	
11	Attenuator, 12 dB, 1 dB steps, 50 ohms	HP 355C	
12	Attenuator, 120 dB, 10 dB steps, 50 ohms	HP 355D	
13	Environmental Test Chamber		
14	Error Multiplier	FEI FE-47A	
15	Microwave Multiplier	FEI FE-6086A	
16	Oscilloscope	Tektronix 454	
17	Expanded Scale AC Voltmeter	Simpson 1349	
18	DC Connector	ITT Cannon MS 3106-R10SL-3S(C)	
19	Digital Phase Comparator	FE-40A	
20	50 ohm Feedthrough Termination	FEI 10971-2640 or HP110488	
21	TTL Load Box	FEI FE-6101A	

Table IX. First article inspection.

Test	Requirement paragraph	Test paragraph	Quantitative requirement	Models to be tested
PRODUCTION INSPECTION				
Pre-operational preliminary	4.4.1.1	4.4.1.1.1		
Operational tests:		4.4.1.2		
Circuit Check	3.7.9.8	4.4.1.2.1	Table on front panel	
5 MHz Output	3.7.6 a(1)	4.4.1.2.2		
Frequency	3.7.2	4.4.1.2.2.2(b)	adjustable to nominal for three years	
Level	3.7.6 a(1)	4.4.1.2.2.2(c)	>1.0 V(rms) into 50 ohms	
1 MHz Output	3.7.6 a(2)	4.4.1.2.3	derived from 5 MHz	
Level	3.7.6 a(2)	4.4.1.2.3.2(b)	>1.0 V(rms) into 50 ohms	All four units
100 kHz Output	3.7.6a(3)	4.4.1.2.4		
Frequency	3.7.2	4.4.1.2.4	derived from 5 MHz	
Level	3.7.6 a(3)	4.4.1.2.4.2(b)	>1.0 V(rms) into 50 ohms	
Shape	3.7.6 a(3)	4.4.1.2.4.2(b)		
1 PPS Output	3.7.6 b(1)	4.4.1.2.5		
Level	3.7.6 b(1)	4.4.1.2.5.2(b)	+4.7V ±10 percent into 50 ohms	
Width	3.7.6 b(1)	4.4.1.2.5.2(b)	20 ±1 µs	
1 MPPS Output	3.7.6 b(2)	4.4.1.2.6		
Level	3.7.6 b(2)	4.4.1.2.6.2(b)	5V PP into 50 ohms	
Width	3.7.6 b(2)	4.4.1.2.6.2(b)	0.1 µs	

Table IX. First article inspection (Continued).

Test	Requirement paragraph	Test paragraph	Quantitative requirement	Models to be tested
Time Base Synchronization	3.7.8	4.4.1.2.7		
1 PPS	3.7.8 a	4.4.1.2.7	Minimum 1 V PP >5 µsec wide	
Sync delay	3.7.8	4.4.1.2.7	<0.200 µsec	
Sync mode switch	3.7.9.5	4.4.1.2.7	Continuous or intermittent	
Sync indicator	3.7.9.6 a	4.4.1.2.7	front panel	
Phase Lock Characteristic	3.7.6	4.4.1.2.8		All four units
5 MHz	3.7.7 a	4.4.1.2.8.1	≥1 V PP	
1 MHz	3.7.7 b	4.4.1.2.8.2	≥1 V PP	
Unlock detector	3.7.9.6 b	4.4.1.2.8.3	front panel	
Memory Operation	3.7.7.1	4.4.1.2.9	volatile or non-volatile	
Production Control Tests	4.4.2.3			
Orientation Stability	3.7.5.3	4.4.2.3.1	1.5×10^{-9}	
Inclination	3.7.5.3.1	4.4.2.3.1.2(d)	$\pm 5.0 \times 10^{-10}$	
Fine and coarse frequency adjustment	3.7.9.2	4.4.2.3.2	Fine adjustable in PP10^{11} Coarse adjustment ≥1P x 10^{7}	One out of every ten units
Linearity of fine frequency adjustment	3.7.9.2.1	4.4.2.3.2.2(b)		
Frequency stability versus load	3.7.5.7	4.4.2.3.3	$\pm 1 \times 10^{11}$	
Frequency stability versus line voltage	3.7.5.5	4.4.2.3.4	$\pm 1 \times 10^{11}$	

Table IX. First article inspection (Continued).

Test	Requirement paragraph	Test paragraph	Quantitative requirement	Models to be tested
Warm-up (plotted curve)	3.7.1	4.4.2.3.5	45 minutes	
Aging Rate (Two week phase recording)	3.7.5.2	4.4.2.3.6	Table IV	
5 MH Output	3.7.6	4.4.2.3.7		
Short Term stability	3.7.5.1	4.4.2.3.7.2(b)	Table III	
Harmonic Distortion	3.7.6.1	4.4.2.3.7.2(c)	<-40dB	
Non-Harmonic Spurious	3.7.6.2	4.4.2.3.7.2(c)	<-110dB	
Phase Noise	3.7.6.3	4.4.2.3.7.2(d)	Table VI	
1 MHz Output	3.7.6			
Harmonic Distortion	3.7.6.1	4.4.2.3.8.2(b)	<-40dB	
Non-Harmonic Spurious	3.7.6.2	4.4.2.3 8.2(b)	<-110dB	One out of every ten units
Isolation of Outputs	3.7.6.4	4.4.2.3.9	<0.005 ns	
Battery life test	3.8.2	4.4.2.3.10	seven hours at 22±2°C	
1 PPS Output	3.8.6 b(1)	4.4.2.3.11		
Jitter	3.7.6 b(1)	4.4.2.3.11.2(b)	<100 picoseconds (unsynchronized)	
Rise time	3.7.6 b(1)	4.4.2.3.11.2(c)	<20 ns	
Time Base Synchronization	3.7.8	4.4.2.3.12		
1 PPS + 1 MHz	3.7.8 b & c	4.4.2.3.12.2(c)		
Reproducibility	3.7.3	4.4.2.3.13	Table 1 and Figure 1	

Table IX. First article inspection (Continued).

Test	Requirement paragraph	Test paragraph	Quantitative requirement	Models to be tested
Environmental Tests	4.4.3.3			
Altitude	1.2.1	4.4.3.3.1	ground level to 10,000 feet	
Temperature	1.2.1 3.7.5.6	4.4.3.3.2	-28°C to +65°C 5PP 10^{10}	
Humidity	3.7.5.8	4.4.3.3.3	5PP 10^{10}	
Vibration	3.7.5.4	4.4.3.3.4	Table V	
Shock	3.7.5.4	4.4.3.3.5	2PP 10^{9}	
Inclination	3.7.5.3.1	4.4.3.3.6	1.5×10^{-9}	Random picked units
Fungus	3.4.2	4.4.3.3.7		
Splashproof	3.4.2	4.4.3.3.8		
Magnetic Environment		4.4.3.3.9		
Electromagnetic Interference	3.9	4.4.3.3.9.2		
Reliability	3.5	4.4.4	MTBF of 2500 hours under shipboard conditions	
Maintainability	3.17	4.4.5		

4.4 Quality conformance inspection.

4.4.1 Production inspection. The following product inspection shall be performed on every unit delivered. Unless otherwise specified herein the tests shall be performed under the conditions specified in 4.5.1.1 and after the instrument has been placed in operation as specified in 4.5.1.2.

4.4.1.1 Pre-operational inspection (preliminary). Before the instrument is placed in operation, the inspection in 4.4.1.1.1 shall be accomplished.

4.4.1.1.1 Visual and dimensional examination. The equipment shall be examined visually and dimensionally to determine that the quality of all materials and workmanship is as specified herein. The following characteristics shall be examined:

(a) Completeness
(b) Identification plates, identification markings, and labels (see 3.11.2.2)
(c) Alignment and tightness
(d) Finish (see 3.11.2.4)
(e) Fit and placement of units and parts
(f) Ease of operation of jacks, switches and sliding parts
(g) Mountings and brackets
(h) Fastening and securing of devices or parts
(i) Accessibility of units and parts for replacement (see 3.11.2.1)
(j) Welded and soldered joints
(k) Forms, harnesses, and other wiring
(l) Grounding connections
(m) Overall dimensions (see 3.11.1)
(n) Treatment for prevention of corrosion

4.4.1.2 Operational tests. Each standard shall be energized as specified in 4.5.1 and subjected to the following operating tests.

4.4.1.2.1 Circuit check. The circuit check switch shall be set to each position and the indication of the associated meter shall be observed and compared for conformity with acceptable range of meter indications shown on the front panel. If a meter reading is outside the range of typical indication, this alone shall not be a cause of rejection if the unit meets the requirements of the remainder of this specification.

4.4.1.2.1.1 Set-up.

(a) DTS standard, [unit under test (UUT)].

Inputs: 115 VAC/60 Hz
1 MHz and 5 MHz reference signal
+26 VDC ±4 VDC external power source

4.4.1.2.1.2 Procedural steps.

(a) Apply 115 VAC or +26 VDC input power and allow standard to warm-up for a minimum of one hour.
(b) Begin with circuit check switch in the LOCK INDICATOR position. Allow standard to stabilize and achieve a lock condition as indicated on the meter.
(c) Continue to rotate the CIRCUIT CHECK switch clockwise, pausing at each switch position to assure meter indication is approximately in conformance with the nominal indication (region indicated in red, next to each switch position). Also refer to Table X.

4.4.1.2.2 5 MHz output. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.6a(1).

4.4.1.2.2.1 Set-up.

(a) Frequency error analyzer, Frequency Electronics Model FE-47A, or equivalent.

Meter range. 10^{10}
Inputs: 5 MHz reference from cesium standard
5 MHz from DTF standard
115 VAC/60 Hz

(b) Radio frequency (RF) voltmeter, Boonton Model 91H, or equivalent, with 50 ohm probe.
(c) DTF standard, (UUT)

Inputs: 115 VAC/60 Hz
Output: 5 MHz

4.4.1.2.2.2 Procedural steps.

(a) Apply 115 VAC input power to the standard and allow it to warm-up for a minimum of one hour.
(b) Using the frequency error analyzer, adjust the standard to an accuracy of $1PP10^{10}$. The 5 MHz output shall conform to 3.7.2.
(c) Using the RF voltmeter, measure the 5 MHz output level, for conformance with 3.7.6a(1).

4.4.1.2.3 1 MHz output. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.6a(2).

Table X. Circuit check.

Test switch position	Approximate meter reading	Requires
A 5 MHz	+6 to +10	
B 1 MHz	+6 to +10	
C 100 kHz	+6 to +10	
D-1 Lock Ind.	+6 to +9	No Reference
Lock Ind.	SWEEP ±0	Reference-Unlocked
Lock Ind.	0	Locked To Reference
D-2 Memory V.	ADJ +1 to +9	Locked to Reference
Memory V.	0 or 10	Unlocked/No Reference
E Ref. Input		
Ref. 5 MHz	+6 to +10	1 to 10Vp-p Input
Ref. 1 MHz	+6 to +10	1 to 4Vp-p Input
F Outer Oven	+4 to +10	
G Inner Oven	+4 to +10	
H Reg. Volts	+2 to +4	+22 to +30V Input
I Battery Volts	+6 to +10	Usable Range
J Battery Charge	MAN LO +0.2 to +0.5	
Battery Charge	AUTO +0.5 to +5.0	
Battery Charge	MAN HI +4.0 to +5.0	
K DC Input	+7 to +10	

4.4.1.2.3.1 Set-up.

(a) RF voltmeter, Boonton Model 91H, or equivalent, with 50 ohm probe.
(b) DTF standard (UUT)

Inputs: 115 VAC/60 Hz
Output: 1 MHz

4.4.1.2.3.2 Procedural steps.

(a) Apply 115 VAC input power and allow standard to warm-up for a minimum of one hour.
(b) Using the RF voltmeter, measure the 1 MHz output level for conformance with 3.7.6a(2)

4.4.1.2.4 100 kHz output. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with the specification requirement. The 100 kHz is derived from the 5 MHz and shall conform to 3.7.2.

4.4.1.2.4.1 Set-up.

(a) DTF standard (UUT).

Inputs: 115 VAC/60 Hz
Output: 100 kHz

(b) Oscilloscope, Tektronix, Model 545, or equivalent.
(c) Load box (TTL compatible)

4.4.1.2.4.2 Procedural steps.

(a) Apply 115 VAC input power and allow standard to warm-up for a minimum of one hour.
(b) Using the oscilloscope, measure and record the peak-to-peak output level and symmetry. The level of the 100 kHz output shall be measured for conformance with 3.7.6a(3). The shape of the 100 kHz output shall measure to be a square wave with overshoots and undershoots no greater than 10 percent when operated into 50 ohms.

4.4.1.2.5 1 PPS output. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.6.b(1).

4.4.1.2.5.1 Set-up.

(a) DTF standard (UUT).

Inputs: 115 VAC/60 Hz
Output: 1 PPS

(b) Oscilloscope, Tektronix, Model 545A, or equivalent.

4.4.1.2.5.2 Procedural steps.

(a) Apply 115 VAC input power and allow standard to warm-up for a minimum of one hour.
(b) Using the oscilloscope, measure the pulse width and the peak-to-peak output levels for conformance with 3.7.6b(1).

4.4.1.2.6 1 MPPS output. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.6b(2).

4.4.1.2.6.1 Set-up.

(a) DTF standard (UUT).

Inputs: 115 VAC/60 Hz
Output: TTL load box

4.4.1.2.6.2 Procedural steps.

(a) Apply 115 VAC input power and allow standard to warm-up for a minimum of one hour.
(b) Using the oscilloscope, measure the peak-to-peak output levels and the pulse width for conformance with 3.7.6b(2).

4.4.1.2.7 Time base synchronization. One PPS - Connect a reference 1 PPS input signal which conforms with 3.7.8a to the one PPS in BNC of the standard and move the SYNC MODE switch which conforms to 3.7.9.5 to the continuous position to test for time synchronization. A SYNC INDICATOR on the front panel shall be tested that it indicates synchronization to the external one PPS input with the SYNC MODE switch in both the continuous and intermittent positions. After synchronization the output one PPS of the DTF shall be compared with the reference one PPS to determine the SYNC DELAY which should measure to be less than 0.200 µs. The phase relationship of the one MPPS with the one PPS shall be checked before and after synchronization of the one PPS to test that it remains the same. The jitter between the input pulse being used to synchronize the DTF, and the output pulse of the DTF, while synchronized shall be measured for conformance with 3.7.8.

4.4.1.2.8 Phase lock characteristic. The following shall be tested:

4.4.1.2.8.1 5 MHz. Connect a 5 MHz reference signal which conforms to 3.7.7a onto the 5 MHz reference in BNC on the standard and set the circuit check meter on the lock indicator position. The meter should show the direct 1 MHz phase meter output and indicate when the DTF standard is phase locked. If the frequency of the DTF is outside of the locking range, its frequency can be determined by the direction and time it takes the needle of the meter to sweep full scale (1 µs) and the DTF can be tuned into the locking range with no additional equipment.

4.4.1.2.8.2 1 MHz. A MHz reference signal which conforms to 3.7.7b or c or d shall be connected onto the 1 MHz +1 PPS on BNC or the standard and the same procedure as given under 5 MHz followed.

4.4.1.2.8.3 Unlock indicator The unlock indicator on the front panel shall be checked that it indicates 1 MHz and 5 MHz input phase lock loop condition. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.9.6b.

4.4.1.2.8.3.1 Set-up.

(a) DTF standard (UUT).

Inputs: 115 VAC/60 Hz
5 MHz reference signal from standard

4.4.1.2.8.3.2 Procedural steps.

(a) Apply 115 VAC input power and allow standard to warm-up for a minimum of one hour.
(b) Set the standard's CIRCUIT CHECK switch to the LOCK INDICATOR position. The meter should indicate a reading of approximately Zero. Depress the RESET switch, the UNLOCK indicating lamp should be extinguished.
(c) Remove the 5 MHz reference input signal to the standard. The UNLOCK indicator lamp should light and the CIRCUIT CHECK meter should indicate between +6 and +9.

4.4.1.2.9 Memory operation. The memory operation shall conform with 3.7.7.1. It shall be tested by first phase locking the DTF with a 5 MHz or 1 MHz reference input signal described in 4.4.1.2.8 and setting the circuit check meter on the memory voltage position. Record the meter reading. Disconnect the reference signal. Compare the memory voltage meter reading with the recorded one. The memory voltage reading should be the same as previously recorded. A phase recording should be made during this procedure and continued for several hours showing no frequency change greater than 3 PP 10^{11}. To test the non-volatile memory operation (Option 2) of 3.3, follow the above procedure, and in addition record the frequency, then remove all power. After power is restored, the DTF should return to within 1 or 2 parts in 10^9 of its previous frequency before the power was removed. The memory voltage should read within ±1 small division on the meter dial.

4.4.2 Production control inspection. Production control inspection shall be conducted on a sampling basis in accordance with 4.4.2.1. This inspection shall comprise the examination and testing of 4.4.2.3 toward proving satisfactory performance through the entire range of operation, detection of deterioration of the design or deviations from approved processing of materials, and demonstration that the standard will function satisfactorily under adverse conditions. Unless otherwise specified herein, these tests shall be conducted at normal ambient room temperature.

4.4.2.1 Sampling plan. From each lot which has passed the product inspections of 4.4.1, a random sample of units shall be selected and subjected to production control inspection. Sampling shall be in accordance with MIL-STD-105, General Inspection Level 1, and an AQL of 1.5 percent.

4.4.2.2 Rejection. If an inspection lot is rejected, the supplier may withdraw the lot from further inspection. The supplier may also rework a rejected lot to correct the defects or screen out the defective units and reinspect the lot using tightened inspection. Rejected lots shall be kept separate from the new lot and shall not lose their identities. The results of each test shall be compared with the requirements of this specification. Failure to conform to this specification for any test shall be counted as a defect, and the unit shall be rejected. If the number of rejections in any sample exceeds the acceptance number for the sample, the lot represented by the sample shall be rejected.

4.4.2.3 Production control tests. One out of every ten standards shall be subjected to the following tests.

4.4.2.3.1 Orientation stability. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.5.3.

4.4.2.3.1.1 Set-up.

(a) Frequency error analyzer, Frequency Electronics Model FE-47A, or equivalent

Meter range: 10^9
Inputs: 5 MHz reference from cesium standard
5 MHz from DTF standard (UUT)
115 VAC/60 Hz

(b) DTF standard (UUT)

Inputs: 115 VAC/60 Hz
Output 5 MHz

4.4.2.3.1.2 Procedural steps.

(a) Apply 115 VAC input power and allow standard to warm-up for a minimum of one hour.
(b) Adjust the standard to a Zero indication on the FE-47A on its 10^9 range with the standard in its normal orientation.
(c) Place the standard in five other orientations (left side down, top down, right side down, back down, front down) for about one minute in each position. Record at least ten one second measurements for each position to assure that the frequency shift does not exceed the requirement of 3.7.5.3.
(d) Measure as in (c) the average frequency change for inclination of ±45° for conformance with 3.7.5.3.1.

4.4.2.3.2 Fine and coarse frequency adjustment. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.9.2.

4.4.2.3.2.1 Set-up.

(a) Frequency error analyzer, Frequency Electronics Model FE-47A, or equivalent.

Meter range: 10^8 and 10^{10}
Inputs: 5 MHz reference from cesium standard
5 MHz from DTF standard (UUT)
115 VAC/60 Hz

(b) DTF standard (UUT)

Inputs: 115 VAC/60 Hz
Output: 5 MHz

4.4.2.3.2.2 Procedural steps.

(a) Apply 115 VAC input power and allow standard to warm-up for a minimum of one hour.
(b) Remove FINE and COARSE ADJUST covers and set the FINE ADJUST to 500 as indicated on PART IN 10^{11} counter. Vary the COARSE ADJUST to provide a zero indication on the analyzer's meter. Set analyzer to 10^{8}.
(c) Vary the FINE and COARSE ADJUST controls to their maximum clockwise position. Measure and record the frequency offset indicated on the analyzer's meter.
(d) Vary the FINE and COARSE ADJUST controls to their maximum counter-clockwise position. Measure and record the frequency offset indicated on the analyzer's meter.
(e) Calculate the total frequency variation between the maximum positions of the frequency adjustments and determine whether it complies with 3.7.9.2.
(f) Repeat step (b) and set meter range of analyzer to 10^{10}.
(g) Vary FINE ADJUST from 0 to 999 and record total excursion.
(h) The fine frequency control shall be varied over its range of 999 PP 10^{11} while measuring the output frequency. Linearity of adjustment shall conform with 3.7.9.2.1.

4.4.2.3.3 Frequency stability versus load. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.5.7.

4.4.2.3.3.1 Set-up.

(a) Frequency error analyzer, Frequency Electronics Model FE-47A, or equivalent.

Meter range: 10^{10}
Inputs: 5 MHz reference from cesium standard
5 MHz from DTF standard (UUT)
115 VAC/60 Hz

(b) DTF standard (UUT).

Inputs: 115 VAC/60 Hz
Output: Load (defined below)

4.4.2.3.3.2 Procedural steps.

(a) Apply 115 VAC input power to the standard and allow one hour minimum for warm-up.

(b) Place a 1,000 ohm, 1/2 watt resistor, in series with the analyzer's input from the standard.
(c) Using the analyzer, measure the output frequency offset as indicated on the analyzer's meter.
(d) Place a short across the 1,000 ohm resistor and measure the output frequency offset as indicated on the analyzer's meter, allowing the DTF to stabilize.
(e) The offsets measured shall not exceed the requirement of 3.7.5.7.

4.4.2.3.4 Frequency stability versus supply voltage. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.5.5.

4.4.2.3.4.1 Set-up.

(a) Frequency error analyzer, Frequency Electronics Model FE-47A, or equivalent.

Meter range: 10^{10}
Inputs: 5 MHz reference from cesium standard
5 MHz from DTF standard (UUT)
115 VAC/60 Hz
+22 to +30 VDC external soruce

(b) DTF standard (UUT).

Inputs: 115 VAC/60 Hz
Output: 5 MHz

(c) Auto transformer, variac, or equivalent
100 watts minimum
(d) DC power supply, power design, Model 4005, or equivalent, variable, +22 to +30 VAC, 1.5 A.

4.4.2.3.4.2 Procedural steps.

(a) Apply 115 VAC input power to the standard and allow a minimum of one hour for warm-up.
(b) Using the Variac, set the input voltage level to 115 VAC. Measure and record the output frequency as indicated on the analyzer's meter.
(c) Repeat step (b) with the Variac set to 103.5 VAC.
(d) Repeat step (c) with the Variac set to 126.5 VAC.
(e) Connect external DC, set at +26 VDC and remove 115 VAC source from standard.
(f) Measure the 5 MHz output frequency using the frequency error analyzer.
(g) Vary the external DC level to +22 VDC and measure the frequency change as indicated on the frequency error analyzer.
(h) Vary the external DC level to +30 VDC and measure the frequency change indicated on the frequency error analyzer.

4.4.2.3.5 Warm-up. (plotted curve) The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.1.

4.4.2.3.5.1 Set-up.

(a) Frequency error analyzer, Frequency Electronics Model FE-47A, or equivalent.

Meter range: 10^{8}
Inputs: 5 MHz reference (cesium standard) 1-10 V
5 MHz from DTF standard (UUT)
115 VAC/60 Hz

(b) DTF standard (UUT)

Inputs: 115 VAC/60 Hz
Output: 5 MHz

(c) A warm-up curve shall be plotted for the standard from a cold start (off at least 24 hours) for conformance with 3.7.1. The frequency shall be recorded every 30 seconds and additionally the lowest frequency shall be noted for plotting the warm-up curve.

(d) After warm-up, adjust the analyzer to the PP10^{10} range and vary the DTF standard's FINE or COARSE ADJUST to assure that Lock has occurred between the DTF and the reference signal. A phase recording shall be made to record the phase locked loop condition of the standard for the next 24 hours.

4.4.2.3.6 Aging. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.5.2.

4.4.2.3.6.1 Set-up.

(a) Frequency error analyzer, Frequency Electronics Model FE-47A, or equivalent

Meter range: 10^{10}
Inputs: 1 MHz or 5 MHz reference from cesium standard
1 MHz or 5 MHz from DTF standard (UUT)
115 VAC/60 Hz

(b) DTF standard (UUT)

Inputs: 115 VAC/60 Hz
Output: 5 MHz or 1 MHz

(c) Chart recorder, Esterline-Angus Model AW, or equivalent.

4.4.2.3.6.2 Procedural steps.

(a) Apply 115 VAC input power and allow standard to warm-up for one day.
(b) After one day of minimum warm-up time, begin a chart recording of the output frequency.
(c) Continue to record the output for 2 weeks to test for conformance of the aging rate with requirements of Table IV.

4.4.2.3.7 5 MHz output. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.5.1.

4.4.2.3.7.1 Set-up.

(a) Spectrum Analyzer, Hewlett-Packard Model 141S/8554L/5882A, or equivalent.

Bandwidth: 50 MHz

(b) X Band Multiplier, Frequency Electronics Model FE-7049. (Equivalent system can be used for X band multiplier.)
(c) Wave Analyzer, General Radio, Model 1910A, or equivalent.
(d) Low noise amplifier, Princeton Applied Research, Model PAR-113. (Equivalent system can be used for low noise amplifier.)
(e) DTF standard, (UUT).

Inputs: 115 VAC/60 Hz
Output: 5 MHz

4.4.2.3.7.2 Procedural steps.

(a) Apply 115 VAC input power to the standard and allow it to warm-up for a minimum of 3 days.
(b) Using the X band multiplier and computing counter, measure the short term stability for the averaging times of 100 ms, 1 second, 10 seconds, and 100 seconds to assure conformance with 3.7.5.1 (Table III).
(c) Using the spectrum analyzer, measure the harmonic content of the 5 MHz output signal to assure the standard meets the requirements of 3.7.6.1 and 3.7.6.2.
(d) Using the X band multiplier, low noise amplifier and wave analyzer, measure the phase noise at 10 Hz, 100 Hz, 1 kHz and 10 kHz to assure that it meets the requirement of 3.7.6.3 (Table VI).

4.4.2.3.8 1 MHz output. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.6.

4.4.2.3.8.1 Set-up.

(a) Spectrum Analyzer, Hewlett-Packard Model 141S/8554L/8552A, or equivalent.

Bandwidth: 10 MHz

(b) DTF standard (UUT).

Inputs: 115 VAC/60 Hz
Output: 1 MHz

4.4.2.3.8.2 Procedural steps.

(a) Apply 115 VAC input power and allow standard to warm-up for a minimum of one hour.
(b) Using the spectrum analyzer, measure the harmonic, subharmonic and spurious content of the 1 MHz output signal to assure the standard meets the requirements of 3.7.6.1 and 3.7.6.2.

4.4.2.3.9 Isolation of outputs. Outputs shall be tested for isolation to conform with 3.7.6.4. The phase noise of the 1 PPS on the 5 MHz and 1 MHz outputs shall be measured for conformance with 3.7.6.4.

4.4.2.3.10 Battery life test. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.8.2.

4.4.2.3.10.1 Set-up.

(a) Frequency error analyzer, Frequency Electronics Model FE-47A, or equivalent.

Meter range: 10^{10}
Inputs: 5 MHz reference from cesium standard
5 MHz from DTF standard (UUT)
115 VAC/60 Hz

(b) Chart recorder, Esterline-Angus, Model AW, or equivalent.
(c) DTF standard (UUT).

Inputs 115 VAC/60 Hz
Output: 5 MHz

4.4.2.3.10.2 Procedural steps.

(a) Apply 115 VAC input power and allow standards to warm-up for a minimum of 24 hours.
(b) Disconnect the 115 VAC power and allow standard to operate on internal battery. Monitor the standard's 5 MHz output frequency using the frequency error analyzer.

(c) Continue to monitor the output frequency for seven hours to assure that it meets the requirement of 3.8.2.
(d) Battery operation shall be checked for conformance with 3.8.2.1 and 3.8.2.2.

4.4.2.3.11 One PPS output. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.6b(1).

4.4.2.3.11.1 Set-up.

(a) Computing counter, Hewlett-Packard Model 5360A, or equivalent.

Inputs: 5 MHz reference to 5 MHz INPUT on rear panel EXT. INT. switch to EXT.
1PPS output to t1 and t2 time interval plug in.

(b) DTF standard (UUT).

Inputs: 115 VAC/60 Hz
Output: 1 PPS

(c) Oscilloscope, Tektronix, Model 545A, or equivalent.

4.4.2.3.11.2 Procedural steps.

(a) Apply 115 VAC input power and allow standard to warm-up for a minimum of one hour.
(b) Using the oscilloscope, measure the peak-to-peak output levels for conformance with 3.7.6b(1).
(c) Using the computing counter, measure the rise time of the 1PPS output to assure conformance with 3.7.6b(1).
(d) Using the computer counter and the method described in the Computing Counter Applications Library Number 13, measure the jitter of the 1PPS output. The jitter shall not exceed the requirement of 3.7.6b(1).

4.4.2.3.12 Time base synchronization. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.8.

4.4.2.3.12.1 Set-up.

(a) Frequency standard, 1PPS reference source, 1-10 Vpp, Width >5 µs; Rise time <100 ns; 1 MHz reference source, 1-3 Vpp.
(b) DTF standard (UUT).

Inputs: 115 VAC/60 Hz
Output: 1 PPS

4.4.2.3.12.2 Procedural steps.

(a) Apply 115 VAC input power and allow the standard to warm-up for a minimum of one hour.
(b) Connect 1PPS output of a reference standard to the 1PPS INPUT of the standard under test. Set SYNC MODE switch to the CONT position. (In intermittent mode sync will occur to first pulse after switch is thrown.) The SYNC lamp pulse duration shall increase and become stable indicating synchronization with the 1PPS input signal.
(c) Connect 1PPS + 1 MHz output of a reference standard to the 1PPS INPUT of the standard under test. Set SYNC MODE switch to the CONT position. (In intermittent mode sync will occur to first pulse after switch is thrown.) The SYNC lamp pulse duration shall increase and become stable indicating synchronization with the 1PPS + 1 MHz input signal. The capability of the standard to be synchronized by signals conforming with 3.7.8b and 3.7.8c shall be tested.

4.4.2.3.13 Reproducibility. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.3.

4.4.2.3.13.1 Set-up.

(a) Frequency error analyzer, Frequency Electronics Model FE-47A, or equivalent.

Meter range: 10^{10}
Inputs: 5 MHz reference from cesium standard
5 MHz from DTF standard (UUT)
115 VAC/60 Hz

(b) Chart recorder, Esterline-Angus, Model AW, or equivalent.
(c) DTF standard (UUT)

Inputs: 115 VAC/60 Hz
Output: 5 MHz

4.4.2.3.13.2 Procedural steps.

(a) Apply 115 VAC input power and allow one hour for warm-up.
(b) Adjust COARSE ADJUST to provide a zero indication on the analyzer's meter.
(d) Disconnect the 115 VAC input power and after 2.5, 5.0, and 10.0 minutes of loss of power reconnect the 115 VAC input power and check the output frequency for conformance with 3.7.3, Table I, Figure 1. Typical frequency excursions shall measure to be equal or less than those shown in Figure 4.

4.4.2.3.14 Settability. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.7.4.

4.4.2.3.14.1 Set-up.

(a) Frequency error analyzer, Frequency Electronics Model FE-47A, or equivalent.

Meter range: 10^{8}, 10^{10}, and 10^{11}
Inputs: 5 MHz from DTF standard (UUT)
115 VAC/60 Hz

(b) DTF standard (UUT).

Inputs: 115 VAC/60 Hz
5 MHz or 1 MHz reference signal from cesium standard
Output: 5 MHz

(c) Chart recorder, Esterline-Angus Model AW, or equivalent.

4.4.2.3.14.2 Procedural steps.

(a) Apply 115 VAC input power to the standard and allow a minimum of one hour for warm-up.
(b) Remove the FINE and COARSE ADJUST covers and set the FINE ADJUST to 500 as indicated on PART 10^{11} digital counter. Vary the COARSE ADJUST to provide a zero indication on the analyzer's (10^{8} scale) meter.
(c) Vary the FINE ADJUST to provide a zero indication with the analyzer's meter set to the 10^{10} range.
(d) Vary the FINE ADJUST to provide a zero indication with the analyzer's meter set to the 10^{11} range. The settability should comply with 3.7.4.
(e) Connect 5 MHz or 1 MHz reference signal from cesium standard to reference input of DTF and phase lock DTF to cesium standard. Phase record the output (5 MHz or 1 MHz) of the DTF versus the reference standard for one day to check the compliance with 3.7.4. In this state the phase lock loop will automatically tune the oscillator.

4.4.2.3.15 External DC power. The standard shall be connected as described. The following procedural steps shall be performed to verify compliance with 3.8.3.

4.4.2.3.15.1 Set-up.

(a) DTF standard

Output: 5 MHz

(b) Multimeter, Simpson Model 260, or equivalent.

Range: 10 A

(c) Chart recorder, Esterline-Angus, Model AW, or equivalent.
(d) Frequency error analyzer, Frequency Electronics Model FE-47A, or equivalent.

Meter range: 10^8
Inputs: 5 MHz reference from cesium standard
5 MHz from DTF standard (UUT)
DC power +22 to +30V, 1.5 A

4.4.2.3.15.2 Procedural steps.

(a) Connect a DC ammeter in series with the positive leg of a +26 VDC external source and apply to rear connector of DTF standard (UUT).
(b) Measure the initial input power drain (approximately 1 A DC).
(c) Allow the standard to remain in operation for a minimum of one hour, measure the input power drain. The power drains shall not exceed the requirement of 3.8.3.

4.4.2.4 Production control inspection. Standards to be inspected shall be randomly selected in accordance with the sampling plan of 4.4.2.1 and inspected for the following:

4.4.2.4.1 Dimensions. The dimensions of the modules and outer shell shall be checked for conformance with the drawings of 3.4.1.

4.4.2.4.2 Weight. The weight of the standard shall be checked for conformance with 3.11.1.

4.4.2.4.3 Steady state supply line voltage. Operation shall be checked for conformance with 3.8.1.

4.4.2.4.3.1 Voltage transients. Operation shall be checked for conformance with 3.8.1.1.

4.4.2.4.3.2 Frequency transients. Operation shall be checked for conformance with 3.8.1.2.

4.4.2.4.4 Standby battery power supply check. Operation of the internal battery power supply shall be checked for conformance with 3.8.2, 3.8.2.1, and 3.8.2.2.

4.4.2.4.5 Total power input. The total power required to operate the standard shall be checked for conformance with 3.8.1.6.

4.4.2.4.6 External DC power. (See 4.4.2.3.15.)

4.4.3 Environmental inspection. Environmental inspection shall be conducted on a sampling basis in accordance with 4.4.3.1. Except for first article testing, the Government may waive this requirement on the basis of evidence that the

suppliers production and quality control are such as to assure manufacture of satisfactory standards. This inspection shall consist of examinations and tests to prove satisfactory performance and durability during and after the severe environmental conditions of 4.4.3.3.

4.4.3.1 Sampling plan. From each lot which has passed the production inspection of 4.4.1, a random sample of units shall be selected for environmental testing. These tests may be conducted concurrently with product control inspection on different samples from the lot being tested. The sample size and lot acceptance level shall be based upon Table XI. The Government inspector may, at his discretion, further reduce sample size. When equipments having plug-in units and accessories are procured, at least one of each type plug-in unit and accessory shall be tested in (or with) the equipment. The sample size shall be increased as necessary to meet this condition.

Table XI. Sampling for environmental inspection.

Lot size	Sample size	Number of units nonconforming in any environmental test	
		Acceptance number	Rejection number
1 to 100	1	0	1
101 to 300	2	0	1
301 to 500	4	1	2
501 to more	8	2	3

4.4.3.1.1 Rejection. Each of the sample units selected in accordance with Table XI shall be subjected to the tests of 4.4.3.3. The results of each test shall be compared with the requirements of this specification. Failure to conform to the requirements of this specification for any such test shall be counted as a defect and the unit shall be rejected. If the number of rejections in any sample exceed the acceptance number for the sample, the lot represented by the sample shall be rejected. Rejected lots may be offered again for product control inspection provided the supplier has inspected all units of the lot by performing the test(s) causing rejection and correcting all noncompliance.

4.4.3.1.2 Noncompliance. If a sample unit fails environmental inspections, the supplier shall immediately investigate the cause of a failure and shall report to the Government inspector the results thereof and details of the corrective action taken on each equipment which was manufactured with the same conditions, materials, processes, and so forth to assure that all equipments will fully conform to the requirements of this specification. If the Government inspector does not consider that the corrective action will enable the product to conform to the specified requirements, or if the supplier cannot determine the cause of failure, the matter shall be referred to the contracting officer.

4.4.3.1.3 Reinspection. Unless otherwise specified, sample units which have been subjected to and passed environmental inspections may be accepted on contract provided that damage is corrected and that they are resubjected to and pass the production and production control inspections of 4.4.1 and 4.4.2.

4.4.3.2 Environmental tests. In addition to the tests hereinafter described, the inspector may require performance of any of the tests of 4.4.1 and 4.4.2 as part of the satisfactory operation test of 4.4.3.2.1.

4.4.3.2.1 Satisfactory operation tests (see 6.4.4). The tests for satisfactory operation during the course of environmental or reliability tests shall consist of the following tests.

4.4.3.2.1.1 Circuit check. Follow procedure of 4.4.1.2.1.

4.4.3.2.1.2 Output frequencies. Follow procedures of 4.4.1.2.2.2, 4.4.1.2.3.1 and 4.4.1.2.4.2.

4.4.3.2.1.3 Spectral purity. Follow procedures of 4.4.2.3.8.

4.4.3.2.1.4 Time base outputs. Follow procedures of 4.4.1.2.5.1 and 4.4.1.2.6.1.

4.4.3.2.2 Satisfactory operation check. The check for satisfactory operation during the course of environmental and reliability testing shall consist of the following (see 6.4.5):

4.4.3.2.2.1 Monitor 1 MHz output.

4.4.3.3 Environmental tests. The environmental test methods and procedures shall be as specified herein.

4.4.3.3.1 Altitude. The standard shall be tested for conformance with 1.2.1.

4.4.3.3.2 Temperature. The standard shall be tested for conformance with 1.2.1 (MIL-E-16400 Navy Class 2) and 3.7.5.6.

4.4.3.3.3 Humidity. The standard shall be tested for conformance with MIL-E-16400 Navy Class 2 and 3.7.5.8.

4.4.3.3.4 Vibration. The standard shall be tested for conformance with .7.5.4.

4.4.3.3.5 Shock. The standard shall be tested for conformance with 3.7.5.4.

4.4.3.3.6 Inclination. The standard shall be tested for conformance with .7.5.3.1.

4.4.3.3.7 Fungus. The fungus test method 508 of MIL-STD-810 shall be performed. Certification that the requirements for fungus enert materials of MIL-T-21200 have been met will negate the necessity for this test.

4.4.3.3.8 Splashproof test. The equipment shall be subjected to the splashproof test of MIL-STD-108 and comply with the acceptance criteria therein.

4.4.3.3.9 Magnetic environment. The standard shall be placed in a magnetic field environment, a steady state field of 25 oerstads, a field varying approximately sinusoidally from 0 to 25 oerstads at the rate of 1 Hz. The field shall be applied in three mutually perpendicular axes. The duration of each application shall be not less than five minutes. The magnetic field strength shall be confirmed before the standard is injected into the field. At the conclusion of the tests performed the standard shall pass the test of 4.4.3.2.2.

4.4.3.3.9.1 External magnetic fields. The standard shall be subject to a magnetic field of 2 gauss DC and 2 gauss peak-to-peak 50, and 400 Hz in three mutually perpendicular axes. The fractional frequency shift caused by these fields shall not exceed $\pm 2 \times 10^{-12}$. At the conclusion of the tests performed the standard shall pass the test of 4.4.3.2.2.

4.4.3.3.9.2 Electromagnetic compatibility. Compliance with 3.8 shall be verified by tests performed in accordance with MIL-STD-462.

4.4.4 Reliability inspection. Reliability of the standard shall be verified in accordance with MIL-STD-781, except as hereinafter specified. Reliability testing shall be performed only as part of the first article inspection. The test conditions, method and duty cycle shall be as specified.

4.4.4.1 Burn-in. Debugging and burn of equipments, assemblies or parts prior to performance of the reliability testing shall be limited to the debugging and burn-in to be performed on all production equipment.

4.4.4.1.1 Preventive maintenance. Except for normal battery replacement in equipments powered by self-contained batteries, no preventive maintenance shall be performed during the reliability test.

4.4.4.2 Reliability test method.

4.4.4.2.1 Test schedule. The test shall consist of three 8-hour periods per day. One period shall be manned. The two remaining periods need not be manned.

4.4.4.2.2 Humidity. The humidity need not be rigorously controlled during the reliability tests but the test chamber should have a relative humidity of approximately 35 percent at 22°C ±2°C.

4.4.4.2.3 Duty cycle. All performance measurements shall be made using nominal 115V, 60 Hz power source. The frequency of the 100 kHz and 5 MHz output

shall be measured daily. Maximum frequency drift shall be in accordance with Table IV, 3.7.5.2. No frequency adjustments may be made during the test. On a weekly basis, the following tests shall be performed in accordance with Table VIII.

(a) 5 MHz level
(b) 1 MHz level
(c) 100 kHz level and shape
(d) 1 PPS output level and width
(e) 1 MPPS output level and width
(f) Time base synchronization
(g) Phase lock characteristics

4.4.4.2.4 Power input voltage cycling. Equipment powered by other than self-contained batteries shall have the input voltage sequentially cycled during testing. The power input voltage shall be maintained at the nominal voltage of 115 VAC ±5 percent during the first 8-hour period, at the high voltage of 125 VAC during the second 8-hour period, and at the low voltage of 105 VAC during the third 8-hour period. This sequence shall be repeated throughout the reliability test.

4.4.4.2.5 Failure action. In the event of failure(s) (see 6.4.14), failure action shall be taken as required by MIL-STD-781.

4.4.4.2.5.1 Corrective action. In the event of failures, the supplier shall make any modification(s) necessary to conform with the reliability requirements. Any modification introduced into any equipment(s) delivered under any contract as a result of deficiencies (that is, failure to conform to the specified requirements) discovered from the reliability tests shall be included in all equipments delivered under that contract at no additional cost to the Government. Such modifications shall be incorporated in all equipments not yet delivered and retroactively to those already delivered.

4.4.5 Maintainability demonstration. Conformance to the maintainability requirements shall be demonstrated in accordance with Method 4 of MIL-STD-471.

4.5 Test methods.

4.5.1 Test conditions and initial turn-on procedure. Unless otherwise specified herein, all tests shall be performed under the conditions specified in 4.5.1.1 and after the instrument has been placed in operation in accordance with 4.5.1.2.

4.5.1.1 Test conditions. The following test conditions shall apply:

(a) Temperature: 22°C ±2°C
(b) Barometric pressure: Factory or laboratory ambient
(c) Humidity: 40 to 65 percent relative humidity
(d) Input power: 115 volts ±10 percent, 60 Hz ±5 percent
(e) Warm-up: Three days minimum

4.5.1.2 Initial turn-on procedure. The instrument shall be placed in operation by performing the following steps:

(a) Set time constant to short position.
(b) Plug in AC power cord. Place battery switch on front panel in Auto position.
(c) Place circuit check meter on desired output position and wait required warm-up time. Meter will read 50 percent or greater, if desired output is available.
(d) Set circuit check meter to each position and compare with information for correct readings on the front panel for each position.

4.6 Inspection of preparation for delivery. Inspection of preparation for delivery shall be conducted to insure conformance with the requirements of Section 5.

5. PREPARATION FOR DELIVERY

(The preparation for delivery requirements specified herein apply only for direct Government procurements. Preparation for delivery requirements of referenced documents listed in Section 2 do not apply unless specifically stated in the contract or order. Preparation for delivery requirements for products procured by contractors shall be specified in the individual order.)

5.1 Preservation, packaging, packing and marking. Unless otherwise specified, preparation for delivery shall be in accordance with the applicable levels of preservation, packing and marking specified in MIL-E-17555 (see 6.2.1).

6. NOTES

6.1 Intended use. This specification is intended for use to incorporate those requirements which are common to all designated types of Disciplined Time Frequency Standards.

6.2 Ordering data. Procurement documents should specify:

6.2.1 Procurement requirements.

(a) Title, number, and date of this specification.
(b) Title, number, and date of detail specification.
(c) Class desired.
(d) Number of first article samples to be submitted if other than specified in 4.3.
(e) When an explosion-proof external battery pack required.
(f) Type of inspection (4.3.1) (4.3.5).
(g) Levels of preservation and packaging (5.1).

6.3 First article. Invitations for bids should provide that the Government reserves the right to waive the requirement for first article samples as to those bidders offering a product which has been previously procured or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending procurement.

6.4 Definitions.

6.4.1 Primary standards. Primary standards are measurements standards which have defined nominal frequencies and ideally, drift-coefficients of zero. They require no other reference and are used where long-term stability is of primary importance, for example, as central (national) time or frequency standards. These standards are certified by the Naval Observatory when requested, and are housed in a closely controlled environment.

6.4.2 Secondary standards. Secondary standards are those standards with accuracies certified as a result of comparison to primary reference standards and authorized for use, to certify the accuracy of subordinate local standards.

6.4.3 Transfer standards. Transfer standards are those measurement standards with accuracy certified as a result of comparison to higher accuracy level reference standards and used to certify the accuracy of operating test and measuring equipment.

6.4.4 Satisfactory operation tests. Satisfactory operation tests are a series of selected short tests which prove the standard is capable of continually operating in a satisfactory manner.

6.4.5 Satisfactory operation check. Satisfactory operation check is a single measurement which can be monitored to demonstrate that the standard has not degraded during the performance of a particular test.

6.4.6 Specified equipment repair time. The median of the various repair times for the equipment is the specified equipment repair time.

6.4.7 Organizational level. Organizational level is the field and shipboard user organizations which perform immediate minor maintenance on assigned equipment. Phases normally consist of inspecting, servicing, lubricating, adjusting and replacing of parts, assemblies, and sub-assemblies.

6.4.8 Settability. Settability is the degree of closeness to which the frequency of the unit under test may be set with respect to the control available on the unit.

6.4.9 Subassembly. Two or more parts which form a portion of an assembly, but having parts which are individually replaceable (that is, modules and printed circuit boards with components).

6.4.10 Assembly. A number of parts or subassemblies or any combination thereof, joined together to perform a specific function and capable of disassembly (i.e., audio amplifier, synthesizer, crystal oscillator).

6.4.11 Special purpose test equipment (SPTE). SPTE includes all equipment designed and fabricated by the contractor to test the particular system and equipment.

6.4.12 Test fixtures. Test fixtures include all maintenance aids, such as extender boards, cables interface devices and adapters, used to fault-locate to the circuit on the subassembly.

6.4.13 TMDE. Test, measurement and diagnostic equipment are all instruments, devices (electrical, electronic, mechanical, magnetic, or chemical, and so forth), tools and interface equipment used to. test, observe, measure, monitor, modify, generate, calibrate and/or control physical properties, movements and other characteristics. This includes power sources, modifiers, scalers, jigs, templates, monitoring devices, waveguides, standards and programming software to test, measure and diagnose.

6.4.14 Failure. Equipment failure is any departure from the required performance outside of the required accuracies not correctable by normal use of the operating controls.

Preparing activity:
Navy - EC

(Project 6625-N661)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

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A GIVE PARAGRAPH NUMBER AND WORDING

B RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

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