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SPECIFICATION INTERPRETATION DOCUMENT

FOR MIL-M-38793

PREPARATION OF CALIBRATION TEST PROCEDURES
FOR AUTOMATIC TEST EQUIPMENT (ATE) USING THE
PORTABLE AUTOMATIC TEST EQUIPMENT CALIBRATOR
(PATEC)

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INTERPRETATION

1.0 INTRODUCTION.

1.1 PURPOSE. This document provides instructions for general preparation and technical content detail preparation of calibration procedures for test and measurement equipment.

1.2 SCOPE. This document specifies requirements for preparation of Calibration Test Program Instructions (CTPI) on Automatic Test Equipment (ATE) using the Portable Automatic Test Equipment Calibrator (PATEC) concept for on-station calibration support. It will supplement the Calibration Test Program (CTP), an automated procedure identified with a Computer Program Identification Number (CPIN), which calibrates the features and parameters to the accuracies and tolerances identified in the Calibration Measurement Requirements Summary (CMRS).

2.0 APPLICABLE DOCUMENTS. The following documents of the exact issue listed form a part of this document to the extent specified herein. Where no date is listed, the latest issue shall apply.

DOD 5220.22-M	Industrial Security Manual for Safeguarding Classified Information
MIL-M-38784	Manuals, Technical: General Style and Format Requirements, dated 16 Apr 1983
MIL-P-38790A	Printing Production of Technical Manuals; General Requirements for, dated 1 June 1981
TO 33K-1-101	Calibration Standards and Associated Equipment
MIL-STD-1839A	Calibration and Measurement Requirements, dated 28 October 1988
DI-QCIC-80278A	Calibration Measurement Requirements Summary, dated 28 October 1988
NAVAIR 17-35TR-Series	Technical Requirements Documents
NAVAIR 17-35CR Series	Calibration Requirements Documents
NAVAIR 17-35NCE-1	Navy Calibration Equipment List, dated 1 April 1991

2.1 ORDER OF PRECEDENCE. In the event of a conflict between the text of this specification and the references cited herein, except DOD 5220.22-M, the text of this specification shall take precedence.

3.0 REQUIREMENTS.

3.1 GENERAL REQUIREMENTS. Preparation of the CTPI manual shall be in general accordance with MIL-M-38784 and MIL-P-38790A, except where designated otherwise in this document. The manual, as part of the Calibration Test Program Set (CTPS), shall contain all of the essential information, beyond that provided by the CTP, required by the technician for performing calibration of the Automatic Test Equipment (ATE).

3.1.1 DEVELOPMENT OF TEXT. The CTPI shall provide calibration personnel with information required to perform calibration, including planned personnel interventions, to connect and disconnect equipment, to record calibration factors and tolerances, and as to disposition (special calibration, repair, adjustment, etc). The CTPI shall be written in simple practical language. Text shall be prepared in single column format. All non-standard terminology, symbols, and abbreviations should either be avoided or must be explained at the first usage in each procedure. The procedures shall not contain maintenance instructions, such as require disassembly or reassembly of Test Replaceable Unit's (TRU). Adjustment/alignment procedures shall be limited to front/rear panel controls, TRU embedded procedures, and/or external adjustments, unless necessary to complete the calibration, refer to paragraph 3.2.1.6.2.

3.1.2 ILLUSTRATIONS. Illustrations shall be prepared in accordance with the requirements of MIL-M-38784.

3.1.3 SECURITY CLASSIFICATION. If at all possible, classified matter should not be included in the CTPI manual. However, if classified information must be included, it shall be identified in accordance with DOD 5220.22-M. Special precautions shall be taken to assure that selection of calibration equipment or settings of calibration equipment and test instruments do not inadvertently reveal or provide supplemental information which would allow determination of frequencies or other parameters resulting in a compromise of classified information.

3.2 DETAILED REQUIREMENTS.

3.2.1 ARRANGEMENT. CTPI manuals shall contain the following material arranged in the sequence shown:

- Front Matter
- Introduction
- Section I. Identification and Description
- Section II. Equipment Requirements
- Section III. Preliminary Operations

Section IV. Calibration Process
Calibration Performance Table
Calibration Dependency Table
Appendices (if required)

3.2.1.1 FRONT MATTER. The requirements of MIL-M-38784 are applicable.

3.2.1.1.1 TITLE PAGE. In addition to the requirements of MIL-M-38784, the title page shall reference the current associated Computer Program Identification Number (CPIN) of the software with which the manual is to be used. This reference statement shall be placed beneath the contract number as shown in Figure 1.

3.2.1.2 INTRODUCTION. The requirements of MIL-M-38784 are applicable.

3.2.1.3 SECTION I. IDENTIFICATION AND DESCRIPTION. This section shall contain the following information.

3.2.1.3.1 TEST INSTRUMENT IDENTIFICATION. Commercial test instruments shall be identified by manufacturer, model number, and nomenclature. Military test instruments shall be identified by model number, nomenclature, and principle function if not evident from the nomenclature. Identification shall include, for example:

- a. Set and component (AN/URM-25E) and (SG-11)
- b. Military item and commercial counterpart (AN-USM-105A) and (Hewlett-Packard 160B)
- c. Model variations (ME-25, A, B, and C)
- d. Any other identification specified by the procuring activity, such as manufacturer's part number.

3.2.1.3.2 CALIBRATION DESCRIPTION. The Test Instrument parameters, performance specifications, and test methods pertinent to the calibration, shall be presented in tabular form (Table 1, see Figure 2). They shall include the detail necessary to support the operational requirements identified in the Unit Under Test (UUT) Test Requirements Document (TRD), Calibration Measurement Requirements Summary (CMRS), or other applicable document. The test method description shall clearly indicate how each Test Instrument performance specification is verified and shall refer to alternate methods if utilized in the procedure. Variations in Test Instrument parameters or performance between models shall be identified.

3.2.1.3.3 ACCESSORIES. All accessories peculiar to a test station TRU that requires calibration with the test station shall be identified and described.

3.2.1.4 SECTION II. EQUIPMENT REQUIREMENTS. This section shall contain a list of the calibration equipment and accessories required in the calibration process. The information given shall include the generic name, minimum use specifications (parameters, range, and accuracy required by the procedure), and one or more recommended equipment items selected from NAVAIR 17-35NCE-1, or AF TO 33K-1-101.

3.2.1.4.1 NOUN. The first column shall contain a reference item letter assigned during the preparation of the procedure and generic or common name for the equipment.

3.2.1.4.2 MINIMUM USE SPECIFICATIONS. The second column shall present the minimum use specifications, which are defined as the parameters, accuracy, range, input impedance and any other pertinent factors which are required during the performance of the tests and measurements described in the procedure. This information is intended to assist in selecting suitable substitute equipment in the event equipment listed in column three is not available.

3.2.1.4.3 CALIBRATION EQUIPMENT. The third column shall contain one or more examples of equipment which meet or exceed the second column minimum use specifications, and which are adequate for the performance of the procedure.

3.2.1.4.4 EQUIPMENT LIST DEVIATION. Prior approval of the procuring activity shall be obtained for deviations from the specified equipment list.

3.2.1.5 SECTION III. PRELIMINARY OPERATIONS. This section shall include all initial setup, hookup, and warm-up instructions for the test station, calibration standards and other equipment, which for some procedural or technical reason cannot be part of the instructions displayed to the technician on the test station display.

3.2.1.5.1 TEST JIGS AND FIXTURES. When special test jigs and other test fixtures are required in the calibration process, the necessary instructions, drawings and schematics for the fabrication will be included in the preliminary operations. If the logical location is in a specific paragraph, the notation shall be included in the preliminary operations that the fixture or jig is required and the location of the necessary instructions and parts list shall be referenced.

3.2.1.5.2 PREPARATION FOR TESTING. Complete step-by-step instructions shall be provided to effect all calibration interconnections (electronic and mechanical), physical positioning, switch/control settings, CTP loading and any other actions required to establish the correct testing configuration for performing the programmed test procedures. These instructions shall include directions to perform applicable ATE

self test/confidence tests, visual inspection of the test station, safe-to-turn-on tests, and other pretest checks prior to connecting the ATE to any external equipment.

3.2.1.5.3 SPECIAL ENVIRONMENTAL CONDITIONS. Environmental conditions that affect the accuracy or validity of measurements shall be described and may include an explanation of the reasons for the requirement.

3.2.1.6 SECTION IV. CALIBRATION PROCESS. This section shall describe the details (software, text, figures, illustrations, and tables) essential to calibration of the automatic test equipment and related items. A reference shall be included to the calibration software CPIN, thereby establishing the link between the CTPI and the calibration software.

3.2.1.6.1 INTERCONNECTION INSTRUCTIONS. The procedure shall specify the type, length, and dress of leads; grounding, and relative equipment placement, whenever such factors must be controlled to ensure the success of the calibration. Interconnection information, down to the UUT level, shall be described in words or shown in simple line drawings, block diagrams, or combination thereof, as required for clarity.

3.2.1.6.2 ADJUSTMENT INSTRUCTIONS. Instructions shall be limited to external front/rear panel adjustments and meet the following qualifications:

a. Adjustments shall not be made prior to the running of the calibration program.

b. Instructions shall not normally be given to adjust the parameter when the measurement is within tolerance, unless this is specifically necessary or desirable for the parameter in question.

3.2.1.6.3 TESTING PROCEDURES. Sufficient information shall be included to enable the technician to: start testing, intervene when required, interpret test results, perform normal and emergency shutdown procedures, and to restart testing subsequent to intervention or shutdown. All necessary safety precautions shall be included.

3.2.1.6.3.1 TEST START. These procedures shall instruct the technician in the proper method of starting calibration under CTP control. When this information is contained in the applicable ATE manual(s), reference shall be made that familiarization with the procedures contained therein is required. That information shall be repeated in this manual only to the extent required to enable a technician, trained in the use of the applicable ATE, to start testing.

3.2.1.6.3.2 TECHNICIAN PARTICIPATION/INTERVENTION. When required to augment visual displays under program control, specific instructions shall be provided for performance of manual procedures. These instructions shall be limited to the description of circumstances which may occur, make reference to the applicable test indication number(s) and visual display data. Sufficient information shall be provided to enable the technician to determine the required actions, make necessary calculations and decisions, perform manual operations and return testing to program control or terminate testing, as applicable. Instructions relative to tests detailed in the CTP shall not be repeated here.

3.2.1.6.3.3 TERMINATION AND RESTART. These procedures shall instruct the technician in the proper method(s) to terminate testing under both routine and emergency conditions and to re-establish testing under CTP control. When this information is contained in the applicable ATE manual(s), reference shall be made that familiarization with the procedures contained therein is required. That information shall be repeated in this manual only to the extent required to enable a technician trained in the use of the applicable ATE to terminate and restart testing.

3.2.1.6.3.4 VERIFICATION AND CORRECTIVE ACTION. The following note shall be placed at the beginning of the calibration process.

NOTE

Unless otherwise specified, verify the results of each test and take corrective action whenever the test requirement is not met. Complete all tests for data collection first, then correct problem and recalibrate affected areas.

3.2.1.6.3.5 CALIBRATION CURVES AND CHARTS. Instructions for preparation of calibration curves, charts, and tables shall be included if required for use of the test instrument.

3.2.1.7 CALIBRATION PERFORMANCE TABLE. A calibration performance table shall be located after the calibration process. The performance table shall consist of all calibratable parameters, showing range values as applied to the test instrument for each measurement parameter, and the performance limits for each measurement as specified in the CMRS. The performance limits shall be expressed in units of the same parameter as the test instruments capability. Each parameter shall be referenced to a test number corresponding to the source code listing. See Figure 5.

3.2.1.8 CALIBRATION DEPENDENCY TABLE. This table will show the requirement for calibrated instruments and/or functions for use during the calibration process based on the calibration hierarchy for the ATE station. See Figure 6.

3.2.1.9 APPENDICES. Appendices may be used to present supplementary or reference material, extracts from National Institute of Standards and Technology (NIST) bulletins, dimensional tolerances for coaxial fittings, alternate test or calibration methods or other essential information which has no logical location in the preceding instructions.

4.0 QUALITY ASSURANCE PROVISIONS. The requirements of MIL-M-38784 and MIL-P-38790A are applicable.

5.0 PREPARATION FOR DELIVERY. The requirements of MIL-M-38784 and MIL-P-38790A are applicable.

6.0 DEFINITIONS

6.1 AUTOMATIC TEST EQUIPMENT (ATE). A computer controlled configuration of test instruments and switching assembled to provide automated and semi-automated testing of components of a weapon system.

6.2 UNIT UNDER TEST (UUT). A generic term referring to the item being tested. It is most often a component of the weapon system. However, it can also be the ATE during Self-Test and Calibration.

6.3 CALIBRATION TEST PROGRAM (CTP). An automated test procedure used for calibration of ATE.

6.4 INTERFACE TEST ADAPTER (ITA) OR INTERFACE DEVICE (ID). An adapter that provides connectivity between the ATE and the UUT often connected to a common switching interface on the ATE side and the unique connectors and cables on the UUT side. During Self-Test this is usually a loop-back point, while during Calibration, the ID connects the ATE to the external calibration standards, and between ATE components when they are used as working standards.

6.5 CALIBRATION TEST PROGRAM INSTRUCTIONS (CTPI). The calibration procedure that provides the testing authority for testing the UUT. It is the procedure whose contents are described in this document.

6.6 CALIBRATION TEST PROGRAM SET (CTPS). A combination of a CTP, ITA, and CTPI for a specific UUT.

6.7 PORTABLE AUTOMATIC TEST EQUIPMENT CALIBRATOR (PATEC). An Air Force concept for on-station calibration often, but not exclusively, using a CTPS.

6.8 TEST REPLACEABLE UNIT (TRU). A test instrument installed in an ATE which performs a certain testing function.

6.9 CALIBRATION EQUIPMENT ACCESSORIES. Those items required in addition to the calibration standards, e.g. cables, probes, waveguide adapters, etc.

6.10 SELF TEST/CONFIDENCE. A test program set (TPS) that uses only ATE assets along with an ID and cables to functionally check the test station and provide a high confidence level that the test station is operational.

6.11 ATE STATION EQUIPMENT ACCESSORIES. Those items furnished with, but not physically part of an ATE station. Examples are cables, adapters, probes, etc.

TECHNICAL MANUAL
CALIBRATION PROCEDURE
FOR
ATE STATION
XXXXX-XX
P/N XXXXX
USING
CALIBRATION INTERFACE TEST ADAPTER (ITA)
P/N XXXX

(DEVELOPING ORGANIZATION NAME)

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Figure 1. Example of Title Page

ATE STATION
XXXXX-XX
P/N XXXXX
USING
CALIBRATION INTERFACE TEST ADAPTER (ITA)
P/N XXXX

(DEVELOPING ORGANIZATION NAME)

1 CALIBRATION DESCRIPTION:

Table 1.

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
VM2710A (VXI Technology, Inc) Digital Multimeter		Tested using Meter Calibrator
DC Voltage	Range: $\pm 0.1/\pm 1.0/\pm 10/\pm 100/\pm 300$ VDC Accuracy: 0.1 V range, ± 12 μ V DC; 1.0 V range, ± 0.1 mV DC; 10 V range, ± 1.2 mV DC; 100 V range, ± 13 mV DC; 300 V range, ± 36 mV DC	Compared to a DC Voltage Standard
AC Voltage	Range: 0.1/1.0/10/100/300 V rms @ 400 Hz only	Compared to an AC Voltage Standard
CAUTION		
300 V range input limited to 140 V rms due to wiring and switching voltage limitations.		
	Accuracy: 0.1 V range, ± 250 μ V rms; 1.0 V range, ± 1.1 mV rms; 10 V range, ± 11 mV rms; 100 V range, ± 110 mV rms; 300 V range, ± 218 mV rms	
AC Frequency Response	Range: 1 V range only Accuracy: @ 40 Hz, ± 6.1 mV rms; @ 100 Hz, ± 2.9 mV rms; @ 5 kHz, ± 1.1 mV rms; @ 25 kHz, ± 1.8 mV rms; @ 75 kHz, ± 4.7 mV rms;	

Figure 2. Example of Calibration Description Table

2 EQUIPMENT REQUIREMENTS:

The following lists the equipment specifications required for Automatic Test Station (ATS) calibration.

	Noun	Minimum Use Specifications	Calibration Equipment	Sub-Item
2.1	PORTABLE AUTOMATIC TEST EQUIPMENT CALIBRATOR (PATEC) CONSISTING OF THE FOLLOWING COMPONENTS:	(See specifications for individual components of the PATEC, listed below.)	AFPSL PATECCORE	
2.1.1	METER CALIBRATOR	Range: 0 to 1100 VDC Accuracy: $\pm(9 \text{ ppm of output} + 0.8 \mu\text{V})$ on the 220 mV DC range; $\pm(8 \text{ ppm of output} + 1.2 \mu\text{V})$ on the 2.2 VDC range; $\pm(8 \text{ ppm of output} + 4 \mu\text{V})$ on the 11 VDC range; $\pm(8 \text{ ppm of output} + 8 \mu\text{V})$ on the 22 VDC range; $\pm(9 \text{ ppm of output} + 100 \mu\text{V})$ on the 220 VDC range; $\pm(11 \text{ ppm of output} + 600 \mu\text{V})$ on the 1100 VDC range VDC Temperature Coefficient if operating $>5 \text{ }^\circ\text{C}$ from calibration temperature: 0 to $10 \text{ }^\circ\text{C}$ and 40 to $50 \text{ }^\circ\text{C}$: $\pm(1.5 \text{ ppm of output} + 0.5 \mu\text{V})/^\circ\text{C}$ on the 220 mV DC range; $\pm(1.5 \text{ ppm of output} + 2 \mu\text{V})/^\circ\text{C}$ on the 2.2 VDC range; $\pm(1 \text{ ppm of output} + 1.5 \mu\text{V})/^\circ\text{C}$ on the 11 VDC range; $\pm(1.5 \text{ ppm of output} + 3 \mu\text{V})/^\circ\text{C}$ on the 22 VDC range; $\pm(1.5 \text{ ppm of output} + 40 \mu\text{V})/^\circ\text{C}$ on the 220 VDC range; $\pm(3 \text{ ppm of output} + 200 \mu\text{V})/^\circ\text{C}$ on the 1100 VDC range	Fluke 5700A	

Figure 3. Example of Equipment Requirements List Table

Channel #	Function	Driver (Model)	GPIB Address
02	Meter Calibrator	FL5700	02
03	Angle Position Indicator	NA8810	03
04	Universal Counter (CHA)	HP5335	12
05	Universal Counter (CHB)	HP5335	12

Figure 4. Example of TMA Configuration Table

APPENDIX A

The Calibration Resource Utilization chart shows which PATEC standards and FATSS assets are required to calibrate each instrument in the FATSS. Refer to the Key, which follows to identify each specific resource. This chart is useful for preserving the validity of the calibration sequence when failure of a FATSS instrument, used as a working standard, requires the operator to skip momentarily a later instrument calibration. For example, if the Digital Multimeter fails calibration only the Phase Angle Voltmeter and Synchro Resolver can be calibrated until the Digital Multimeter is repaired and passes calibration, because the Digital Multimeter is used as a working standard during at least part of the calibration of every other FATSS instrument. Refer to Calibration Resource Utilization chart, Station column 1. Note that an X is in every box corresponding to the FATSS instruments on the left except for the two exceptions mentioned above. The Calibration Order chart is included to show an implicitly valid and correct sequence of FATSS calibration. If each instrument passes, while done in this order, the FATSS calibration is absolutely valid.

CALIBRATION RESOURCE UTILIZATION																
	PATEC							STATION								
	A	B	C	D	E	F	G	1	2	3	4	5	6	7	8	9
Digital Multimeter	X															
Counter				X				X								X
Waveform Analyzer	X			X				X	X							
Pulse Generators 1 & 2								X	X					X		X
Function Generators 1, 2 & 3		X	X					X	X	X				X	X	
Phase Angle Voltmeter	X															
Oscilloscope	X			X				X					X			
Three Phase AC								X	X							
DC Power Supplies 1-11							X	X								
Signal Generators 1-8	X						X	X	X							
Synchro Resolver	X					X										
Clock 10		X														

KEY	PATEC	STATION
<i>A</i>	Meter Calibrator (5700)	<i>1</i> DMM (2710)
<i>B</i>	Universal Counter (5335A)	<i>2</i> Counter (2461)
<i>C</i>	Spectrum Analyzer (H-P3585A)	<i>3</i> Waveform Analyzer (TVS 625A)
<i>D</i>	Leveled Sine Wave Generator (SG503)	<i>4</i> Function Generators (1370)
<i>E</i>	10 dB Step Attenuator (8496B)	<i>5</i> Function Generator (1385)
<i>F</i>	API (NA8810)	<i>6</i> Pulse Generator (3152)
<i>G</i>	Power Resistor 1 Meg Ohm HPRS	<i>7</i> Oscilloscope (H-P54645)
		<i>8</i> Phase Angle Voltmeter (NA227)
		<i>9</i> Clock 10

Figure 5. Example of Calibration Dependency Table