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MIL-DTL-24784/14B (SH)
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SUPERSEDING
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ASSOCIATED DETAIL SPECIFICATION

ELECTRONIC, EXPERIMENTAL ELECTRONIC, SERVICE TEST ELECTRONIC, AND INTERIOR COMMUNICATION (IC) EQUIPMENT MANUAL REQUIREMENTS

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

1. SCOPE

1.1 Scope. This specification sets forth content requirements for the preparation of technical manuals covering the installation, operation, maintenance (all organizational, intermediate, and depot-level maintenance), and parts support of electronic, experimental electronic, service test electronic and interior communication (IC) equipment (see 6.4.3) of military or commercial design (see 6.4.1).

1.1.1 Scope of coverage. Unless otherwise specified in the technical manual contract requirements (TMCR), the manuals should include all information necessary to perform all (organizational, intermediate, and depot-level) maintenance. No manual should omit maintenance or logistics information for any electronic and IC equipment thereof designated repairable, regardless of the location of the designated repair point (ship, tender, or shore facility) unless the contract requires that the information be included in a separate document to be provided to the Government and reference is made thereto.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, ATTN SEA 05Q, 1333 Isaac Hull Ave SE Stop 5160, Washington Navy Yard DC 20376-5160 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

AREA TMSS

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

| | |
|-----------------|--|
| MIL-DTL-24784 | Manuals, Technical: General Acquisition and Development Requirements. |
| MIL-DTL-24784/7 | Technical Repair Standards (TRS) for Hull, Mechanical, and Electrical equipment, Electronic Equipment, and Ordnance Equipment. |

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

| | |
|-----------------------|---|
| ST000-AG-IDX-010 TMDE | Test Measurement Diagnostics Equipment Index; Version 3.0. |
| ST000-AB-GYD-010 | Portable Electrical/Electronic Test Equipment (PEETE); Storage Guide. |
| SE000-01-IMB-010 | Navy Installation and Maintenance Book |

(Applications for copies should be addressed to the Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

DEFENSE LOGISTICS SERVICES CENTER (DLSC)

| | |
|---------------------------|--|
| Cataloging Handbook H4/H8 | Commercial and Government Entity (CAGE) Codes. |
|---------------------------|--|

(Applications for copies should be addressed to the Defense Logistics Services Center, (Attn: DLSC-SBB), Federal Center, Battle Creek, MI 49017-3084.)

2.3 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 6829 Flowchart Symbols and Their Use in Micrographics.

(Application for copies should be addressed to the American National Standards Institute, 11 West 42nd Street, New York, NY 10036)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. The requirements for acquiring the product described herein shall consist of this document and MIL-DTL-24784.

3.2 Security classifications, distribution statement and destruction notice. Security classification, distribution statement and destruction notice markings shall be in accordance with MIL-DTL-24784.

3.3 Deliverable products and data items. Deliverable products and data items shall be in accordance with MIL-DTL-24784 (see 6.2).

3.4 Arrangement. Unless otherwise specified in the TMCR (see 6.2), the manual shall be arranged in a standardized format [that is, front matter, technical content, appendices, glossaries, indices and Technical Manual Deficiency/Evaluation Report (TMDER)] and appropriately divided by volume, part, chapter and section in accordance with the requirements of MIL-DTL-24784.

3.5 Format and development instructions. Unless otherwise specified in the TMCR, the writing style, safety precautions, tabular material, graphics, and numbering shall be in accordance with MIL-DTL-24784 (see 6.2).

3.6 Content for electronic and IC equipment manuals.

3.6.1 Technical content for service test electronics and IC technical manuals. The following data

need not be supplied:

- a. Descriptions of circuits in NAVSEA 0967-LP-000-0120 (see 3.6.3.3.1c).
- b. Scheduled maintenance action index (see 3.6.3.4.2).
- c. Reference to troubleshooting actions (see 3.6.3.4.4h).
- d. Troubleshooting index (see 3.6.3.5.2.1.1).
- e. Relay, lamp indices (see 3.6.3.5.2.1.2).
- f. Control diagrams (see 3.6.3.5.2.3).
- g. Troubleshooting dependency diagrams (see 3.6.3.5.2.8).
- h. Attaching hardware data (see 3.6.3.7.5 and MIL-DTL-24784).
- i. Phase 1 - Installation examination and pre-energizing procedures (see 3.6.3.8.9.1).

3.6.2 Technical content for experimental electronic and IC equipment manuals.

- a. Descriptions of circuits in NAVSEA SE000-01-IMB-010 (see 3.6.5.1c).
- b. Scheduled maintenance action index (see 3.6.3.4.2).
- c. Reference to troubleshooting actions (see 3.6.3.4.4h).
- d. Troubleshooting index (see 3.6.3.5.2.1.1).
- e. Relay, lamp indices (see 3.6.3.5.2.1.2).
- f. Protection device index (see 3.6.3.5.2.1.3).
- g. Maintenance turn-on procedure (see 3.6.3.5.2.1.4).
- h. Troubleshooting procedures (see 3.6.3.5.2.2).
- i. Control diagrams (see 3.6.3.5.2.3).
- j. Power distribution diagrams (see 3.6.3.5.2.3).
- k. Flow charts (see 3.6.3.5.2.6).
- l. Troubleshooting dependency diagrams (see 3.6.3.5.2.8).
- m. Section II, Repair (see 3.6.3.6.3).
- n. Attaching hardware data (see 3.6.3.7.5 and MIL-DTL-24784).
- o. Phase 1 - Installation, examination and pre-energizing procedures (see 3.6.3.8.9.1).

3.6.3 Chapters. The contents shall be arranged in chapters in accordance with the following:

- a. Chapter 1 - General information and safety precautions.
- b. Chapter 2 - Operation.
- c. Chapter 3 - Functional description.
- d. Chapter 4 - Scheduled maintenance.
- e. Chapter 5 - Troubleshooting.
- f. Chapter 6 - Corrective maintenance.
- g. Chapter 7 - Parts list.
- h. Chapter 8 - Installation.

3.6.3.1 Chapter 1, General information and safety precautions. All safety precautions necessary for the protection of personnel and the ship shall be included and cross-referenced as the initial paragraphs ahead of the introduction. These precautions shall be prepared in accordance with MIL-DTL-24784. The remaining content of this chapter shall be so that command level,

supervisory personnel, and other users having a general interest in the equipment can easily and rapidly determine the purpose, physical and functional characteristics, and the operational capabilities of the equipment.

3.6.3.1.1 Introduction. The introduction shall provide an explanation of the purpose, scope, supersedure data, and ship or shore applicability of the technical manual, including the models, serial numbers, and configurations covered. The interface relationship of the technical manual to other referenced publications and the relationship of the equipment to referenced systems or other equipment shall also be included. Warranty and guarantee information shall be included and shall be in accordance with the Federal Acquisition Regulations, including hardware modifications (such as ship alterations, engineering change proposals, machinery alterations, ordnance alterations, field changes, and so forth), as applicable (see 6.2).

3.6.3.1.2 Equipment description. The equipment description shall describe the intended use (why, where, when, how, and with what), capabilities, and limitations of the equipment. Text covering physical description or structural arrangement shall be brief, with special attention given to avoiding unnecessary or repetitious details that are easily illustrated. The equipment, or all units of the equipment shall be clearly illustrated and identified. If the technical manual covers more than one equipment configuration, a table defining the differences shall be included. Assembly and detail drawings as appropriate may be referenced.

3.6.3.1.3 Equipment illustration. Equipment illustrations shall be in accordance with the requirements of MIL-DTL-24784.

3.6.3.1.3.1 Reference data. Reference data, equivalent to the following, shall be included in tabular form:

- a. Descriptive (identification plate data) which identifies manufacturer, type, model, part or identifying number (PIN), Joint Electronic Type Designation (when applicable), repairable identification code (RIC) and allowance parts list (APL), as applicable.
- b. Functional characteristics, such as: power requirements, horsepower, pressure, capacity, modes of operation, power output, frequency, pulse characteristics, sensitivity, selectivity, including tolerances, where applicable.
- c. Capabilities and limitations, such as: pounds of thrust, knots, turning radius, minimum and maximum ranges, degree of coverage, resolution, accuracy.
- d. Rated outputs, such as: wattages, voltages, horsepower, gallons per minute.
- e. Environmental characteristics, such as: ambient temperatures, heat dissipation per unit, humidity limits.

3.6.3.1.4 Equipment, accessories and document supplied. A tabular listing of all equipment and documents supplied shall be included. List the equipment and its units (see 6.4.7), and accessories (special tools, test equipment, miscellaneous parts, and Government furnished items) which form a part of, or are supplied with the equipment. The table shall include the following:

- a. Column 1, Quantity. This column shall contain the quantity of each unit and accessories supplied with the equipment.
- b. Column 2, Item name or nomenclature. This column shall contain the official name (for example, pump, winch) or nomenclature (name and designation) of each component, unit, or accessory.
- c. Column 3, PIN number, RIC number, or unit number. This column shall contain the PIN, RIC, or unit number of each equipment unit or accessory.
- d. Column 4, Overall dimensions. This column shall contain the crated (if available) and uncrated height, width, and depth in inches (or inches and centimeters) of each unit or accessory.
- e. Column 5, Weight and volume. This column shall contain the crated (if available) and uncrated weight and volume in cubic feet of each unit and accessory.

3.6.3.1.5 Equipment and publications required but not supplied. A tabular listing of all test equipment and publications required but not supplied with the equipment or system shall be included. Unless otherwise specified in the TMCR (see 6.2), NAVSEA ST000-AG-IDX-010 TMDE shall be used as a guide for the selection and application of test equipment required for shipboard use. If a measurement requirement is established which cannot be satisfied by the subcategory (SCAT) codes listed in this guide, or alternate test procedures cannot be developed utilizing the listed SCAT request for assistance should be directed to:

Commander
Naval Sea Systems Command
Arlington, VA 22242-5160
ATTN: SEA 0415

The listing shall contain:

- a. Column 1, SCAT code. When applicable, this column shall contain the four digit group of numbers, which is included in NAVSEA ST000-AG-IDX-010 TMDE used to identify a measurement requirement.
- b. Column 2, Test equipment category. This column shall contain the item name of each item of equipment required.
- c. Column 3, Representative test equipment model number. This column shall contain the model number of the standard or Substitute Standard General Purpose Electronic Test Equipment, listed in NAVSEA ST000-AG-IDX-010 TMDE, which can be used to satisfy the measurement parameters.
- d. Column 4, Equipment test parameters. This column shall specify the range of test parameters which must be satisfied by this test equipment item (it shall not define the ranges of the test equipment model).
- e. Column 5, Application. This column shall indicate the intended use of the test equipment (for example, scheduled maintenance, troubleshooting, corrective maintenance, or installation).

3.6.3.1.6 Field and factory changes. Equipment changes (for example, field changes, factory

changes, engineering changes or notices, modifications, and so forth) shall be identified and included in separate tables. Field and factory changes shall be contain the following:

- a. Column 1, Change number. This column shall list the change number for each field and factory change considered and included in the preparation of the manual.
- b. Column 2, Nomenclature. This column shall list the equipment nomenclature and Government serial numbers of equipments affected by the change.
- c. Column 3, Description. This column shall contain a brief statement identifying the change and its purpose.

3.6.3.2 Chapter 2, Operation. Operating instructions shall include all the procedures necessary to enable operating personnel to efficiently and effectively use the equipment in accomplishing its designated task. These operating instructions shall be in sufficient detail to allow operators, having previous experience in the operation of similar or related equipment, to independently and safely operate the equipment without additional training or explanation.

3.6.3.2.1 Introduction. The introduction shall describe each operator's relationship to the equipment and each other, and shall identify those units having controls and indicators which he is expected to use in the performance of his duties. The introduction shall be supported by illustrations which identify and locate all operator controls and indicators. The intended function and application of the equipment shall be fully explained so that the operator(s) will know exactly what the operator(s) should expect to accomplish with the equipment.

3.6.3.2.2 Controls and indicators. A description of all operator controls, indicators, protective devices and jacks shall include the following:

- a. Names of panel designations as marked on the equipment.
- b. Positions and operating functions for each control, and the normal operating condition of each indicator in each of the operating functions in tabular format.
- c. The text shall be supported by detailed illustrations (see figure 14-1).
- d. When more than one operator is required to operate the equipment, his designated position and function, and the relationship to his controls and indicators shall be specified.

3.6.3.2.3 Operating procedures. Operating procedures shall include the following:

- a. Operator turn-on. All steps necessary to bring the equipment from OFF through STANDBY condition to full operation.
- b. Modes of operation. Procedures for each mode of operation, for example, manual, automatic, local, remote, and so forth. The use and relative advantage of each mode shall also be described.
- c. Operation under interfering conditions. Describe the equipment antijamming and interference reduction features, the advantages of each feature, and the operating procedures to be followed in all possible situations. Supporting illustrations (such as indicator displays, wave forms, and so forth) shall be included which provide typical observations of jamming and interference for evaluation by the operator.

- d. Operator turn-off. This procedure shall include all steps necessary to bring the equipment from full operation through STANDBY to OFF condition.
- e. Battle-short or emergency operation. This procedure shall cover operating the equipment during emergency conditions (control failure, air failure, lube oil failure, loss of cooling water, and so forth). Emergency operator instructions shall be included. Provide a warning or caution to return the equipment to proper operation when the emergency is over.
- f. Emergency turn-off. This procedure shall cover turning the equipment off during an emergency (fire, water, smoke, hazard to personnel, loss of coolant, normal power, and so forth).
- g. Electromagnetic Interference (EMI). This procedure shall include information pertaining to the recognition of EMI (such as sights, sounds, lack of response, or other irregularities) and operating procedures to cope with them during operations.

3.6.3.2.3.1 Method of presentation. Operating procedures shall be presented in tabular form and shall be in concise, simply-worded, step-by-step procedures (see MIL-DTL-24784) and shall include the following:

- a. A short explanation of the operation to be performed.
- b. Initial safety requirements (actions, inspections, and reference to emergency turn-off procedures).
- c. Connection of any accessory equipment not permanently connected.
- d. Instructions for obtaining or confirming the presence of all critical inputs such as power, coolant, air, signal, air conditioning, and so forth.
- e. Procedures for setting controls and making adjustments which must be accomplished by the operator prior to equipment turn-on.
- f. Procedures for determining operational readiness and the acceptable indications expected from built-in indicators such as meters, lamps, gauges, cathode ray tubes, and recorder readouts.
- g. Milestones in the operational status of the equipment shall be identified and included by brief statements such as "the generator is now in STANDBY".
- h. Visual or aural observations which occur as a result of an operator action, such as boom lowering, sweep rotation, blower motor running, and so forth.
- i. Procedures that can be hazardous to personnel or equipment shall be emphasized by DANGERS, WARNINGS or CAUTIONS, as applicable. "Notes" shall not be used in lieu of DANGERS, WARNINGS or CAUTIONS (see MIL-DTL-24784).
- j. Illustrative material supporting the procedures shall identify and locate all operating controls and indicating devices as well as normal in-use positions or indications.
- k. Operator's checks and adjustments in proper sequence.
- l. Operator's maintenance actions and schedules.

3.6.3.2.4 Operators maintenance instructions and schedules. These instructions shall define maintenance tasks and schedules to be performed by the operator. The maintenance tasks shall be limited in scope such that they shall not be in conflict with his operational commitment; will not be beyond his technical training; will not be dangerous; will not be the responsibility of the maintenance technician; and will not potentially comprise the operation of the equipment.

Normally these tasks shall be restricted to minor adjustments, cleaning, and fuse or lamp replacement.

3.6.3.2.4.1 Method of presentation. Maintenance procedures shall be in concise, simply-worded, step-by-step procedures and shall include the following:

- a. A short explanation of the task to be performed.
- b. Initial safety requirements (actions, inspections, and reference to emergency turn-off procedures).
- c. Separately identified and defined steps for each task and major subroutine.
- d. Where possible, a limit of 10 steps to each identified task or subtask.
- e. Procedure that can be hazardous to personnel or equipment shall be emphasized by DANGERS, WARNINGS and CAUTIONS, as applicable. "Notes" shall not be used in lieu of DANGERS, WARNINGS or CAUTIONS (see MIL-DTL-24784).
- f. Illustrative material supporting the procedures shall identify and locate all maintenance points with clear pictorials showing essential details.
- g. Reference to the standard log sheet, if applicable (see MIL-DTL-24784).

3.6.3.2.5 Standard log forms (model set). Unless otherwise specified in the TMCR (see 6.2), a model, or model set, standardized log form (see MIL-DTL-24784) developed from design engineering data will be included at the end of Chapter 2 for equipment requiring the periodic recording of data for monitoring its performance and accomplishing trend analysis.

3.6.3.2.5.1 Applicability. Operating machinery and equipment which are integrated into functioning ships and facility systems similar, but not limited to, the following types of equipment, shall include the model log form:

- a. High pressure air compressors.
- b. Diesel engines.
- c. Air conditioning plants.
- d. Carbon dioxide scrubbers.
- e. Carbon monoxide - hydrogen burners.
- f. Steam or vapor distilling plants.
- g. Turbine generators.
- h. Electronic equipment cooling water and dry air systems.
- i. Boilers.
- j. Propulsion plants.

3.6.3.2.5.1.1 Waiver of requirement. When it is deemed that the development of such a form would be of no value to the Government for the equipment being covered, a waiver (with justification and rationale) for standard log form requirements shall be requested at least 3 months prior to submittal of the review draft copy.

3.6.3.2.5.2 Criteria. The "model" standardized log form shall serve as an operating log that shall be a guide to all ships of all classes. It is not intended that this model shall in any way inhibit an

individual ship from accommodating its specific needs through the addition or deletion of readings as deemed necessary on a case basis. The basic criteria to be utilized in developing the model shall be:

- a. Analyzing the various parameters associated with monitoring the performance of the equipment to ascertain those that provide trend determinant information.
- b. Synthesizing the results of the above analysis to ensure that only "key" (that is, necessary) parameters are included; the goal being to keep to an absolute minimum the total number of log readings required in running the plant.
- c. Arranging the order of monitoring on the appropriate log forms in such a manner that the log keeper and the reviewing officer can quickly tell when problems, either short-term or long-term in nature, are beginning to develop (that is, by function as opposed to order of physical arrangement).
- d. Duplicate readings shall be eliminated where feasible (that is, where the parameter is generally associated with a single function and where duplicated readings are not normally compared with one another).

3.6.3.2.5.3 Training summary. A training summary for use of the form shall also be included in Chapter 2. It shall indicate how to use the chart and an explanation of the significance of the monitoring points and readings.

3.6.3.2.5.4 Request for number. The contractor shall advise the Government of the requirement for log forms. The Government shall arrange for a forms stock number, and printing and stocking of the log form.

3.6.3.3 Chapter 3, Functional description.

3.6.3.3.1 Functional description. Chapter 3 shall include a detailed analysis of the principles of operations of the overall equipment and its functions. The development of the equipment functions in every mode of operation shall be described. The structure and organization of this chapter shall parallel the organization of Chapter 5, Troubleshooting. The text shall refer to and support the Chapter 5 functional troubleshooting diagrams. The descriptions shall be presented in successive levels of increasing detail as follows:

- a. Overall level (level 1). The text shall support and refer to the overall functional block diagram (see MIL-DTL-24784). All major functions (see 6.4.4) such as transmit, receive, control, display, power distribution, cooling, and so forth shall be described at this level.
- b. Major function level (level 2). Describe the development of each major function at the level of detail shown on its related signal flow diagram, logic diagram, or other diagram included in Chapter 5. The text shall support and refer directly to the diagrams.
- c. Circuit level (level 3). When specified in the TMCR (see 6.2), briefly describe conventional electronic circuits found in NAVSEA SE000-01-IMB-010; refer to the maintenance schematic diagrams in Chapter 5. Describe in detail circuits not covered in NAVSEA SE000-01-IMB-010; support these circuits by simplified schematic diagrams (see MIL-DTL-24784). Describe alternating current and direct current power distribution in detail; support the descriptions by

reference to the power distribution diagrams in Chapter 5. Describe mechanical devices, cooling systems, and so forth; support the descriptions by reference to mechanical schematic, overall and functional block diagrams.

3.6.3.3.2 Integrated circuits and micro-miniature capsules. Simplified schematics in accordance with NAVSEA SE000-01-IMB-010 or logic diagrams showing input and output connections, truth tables, and waveforms as applicable, supported by a brief description of overall functional operation, shall be included for circuits within different types of nonrepairable integrated circuits and micro-miniature capsules. Nonrepairable circuits are not required for functional understandings of theory of operation. Manufacturer's data sheet information may also be included if it contains the technical contents of this requirement and meets the format and legibility requirements of this specification.

3.6.3.3.3 Digital equipment. The functional description of digital equipment shall be similar to that for conventional equipment. However, the functional and hardware makeup of digital equipment requires a variation in the method of presentation and descriptive requirements. Special considerations relative to the functional description of digital equipment are specified herein.

3.6.3.3.3.1 Method of presentation. An overall description of the functional relationship of the logic sections, units, and assemblies comprising the equipment shall be provided. The following shall be included:

- a. An introduction to, and description of the signal characteristics:
 1. Signal levels or bi-stable states utilized by the equipment; that is, true (1) and false (0), and their relative voltage levels.
 2. Interpretation of the word-code bit structure; that is, address, instruction, or data bit codes.
 3. Signals, identified by their operational accomplishment.
- b. Overall and functional block diagrams and descriptions.
- c. Logic principles shall be described beginning with an introduction to the basic digital logic symbology used in the manual. Each logic function shall be described and supported by Boolean equations, truth tables, simplified logic diagrams, and timing diagrams.
- d. Functional description of power distribution, power supplies, and regulators shall conform to 3.6.5.1c.

3.6.3.4 Chapter 4, Scheduled maintenance. It is intended that the engineering effort required to develop preventive maintenance data be expended only once and that the data, where applicable be used both in this chapter and in Logistic Support Analysis (LSA) or maintenance requirements cards (MRC) where one or more of the latter three data items are required by the contract (see 6.2). The preparation of this chapter of the manual should therefore be delayed until completion of the, LSA or MRC; submissions of the manual draft copy for review should be marked "TO BE SUPPLIED UPON COMPLETION OF LSA". When the approved LSA, or MRC data is

available, it shall be included in the manual in the identical technical content and, wherever practicable, in the identical format. When included in the manual, such LSA, or MRC data shall be integrated with other technical data required by this specification to be in this chapter. The manual as delivered shall reflect the detailed maintenance requirements of the completed MRCs. This chapter shall contain preventive maintenance procedures and performance test instructions to be accomplished on a scheduled or condition monitoring basis. When an MRC or a reference standards book is available or prepared under the same contract, this information may be duplicated in the technical manual without change in format. These procedures shall be correlated with the installation checkout requirements of 3.6.3.8.9 such that any maintenance or performance test procedure also required for checkout may be properly referenced from Chapter 8, Installation. The installation standards summary sheet (see 3.6.3.8.9.3.2) shall also include space for any maintenance or performance standard test result that should be recorded by the installer. The recorded information shall provide a reference standard to the Navy technician when troubleshooting or when needed for installation acceptance certification or for certifying proper overhaul.

3.6.3.4.1 Introduction. The introduction shall be an explanation of the purpose, scope, and arrangement of the scheduled maintenance data. When a preventive maintenance procedure is critical to the operation of the equipment and the schedule for servicing is absolute (not just recommended), this information shall be conspicuously written as a caution. The following applicability statement shall be included:

"The scheduled maintenance instructions in this manual are intended to duplicate those furnished in the Planned Maintenance Systems (PMS). In case of conflicts, the PMS documentation takes precedence. Such conflicts should be reported immediately on the user comment sheet in accordance with the maintenance procedures for this manual."

3.6.3.4.2 Scheduled maintenance action index. This index shall include all scheduled performance procedures. The index shall be tests and preventive maintenance actions tabulated as follows:

- a. Column 1, Periodicity. This column shall contain an alphanumeric list of all maintenance actions contained in the chapter. The following periodicity symbols, as appropriate, shall be used in the order of increasing periodicity as listed in Table I:
- b. Column 2, Maintenance action. This column shall list the maintenance action which corresponds to the periodicity number in column 1.
- c. Column 3, Reference. This column shall state the paragraph number that contains the procedure listed in column 2.

TABLE I. Periodicity symbols.

| INTERVAL | SYMBOLS |
|--------------------------------------|----------------|
| Daily | D |
| Weekly | W |
| Monthly | M |
| Quarterly (3 months) | Q |
| Semiannually (6 months) | S |
| Annually | A |
| Overhaul cycle | C |
| As specified (explain circumstances) | R (see note 1) |

1. An R periodicity shall be preceded by a recommended calendar periodicity (for example, DR, WR, MR, and so forth).

3.6.3.4.3 Preventive maintenance procedures. These procedures shall include information required to examine, clean, and lubricate the equipment, and shall contain:

- a. Safety precautions.
- b. Tools, parts, materials, and test equipment.
- c. Cleaning solvents. Solvents shall be identified by Government specification numbers and National Stock Numbers.
- d. Instructions for properly maintaining all safety devices and interlocks with warnings, and cautions.
- e. Instructions for lubrication at shipboard operating temperatures; also types and quantities of lubricants to be applied. Lubricants shall be identified by Government specification numbers and National Stock Numbers. Specific lubricants for arctic or tropic environments shall be included. When a proprietary lubricant is approved, a Government Specification lubricant shall be listed as an emergency substitute.
- f. The minimum rating of the technician who can be expected to perform the task.
- g. Procedures of obtaining access to subassemblies of subcomponents.
- h. Instructions for in-place balancing and noise reduction.
- i. Inspection procedures for parts which deteriorate due to cycles of use, age, or climatic conditions.
- j. Illustrations to identify lubrication points and other pertinent data.
- k. Other information pertinent to these procedures.

3.6.3.4.4 Scheduled performance tests. These tests shall contain step-by-step procedures necessary to verify that the equipment is operating within standards in all modes of operation and shall contain the following:

- a. Safety precautions.
- b. A list of tools and test equipment identified by type, manufacturer, and model number.
- c. The title of the test to be performed.
- d. The minimum rating of the technician expected to perform the task.
- e. Preliminary setup data required to perform the test.

- f. Detailed procedures for accomplishing the test. Procedures requiring lengthy and identical setup data shall be presented in detail in one procedure and referenced in succeeding procedures.
- g. Values or conditions, with tolerances, indicative of normal operation.
- h. References to troubleshooting or corrective actions to be used if the test values are not within tolerances (6.2).
- i. Illustrations to support the test.

3.6.3.5 Chapter 5, Troubleshooting. Troubleshooting procedures and data shall contain all information necessary for a technician to locate a malfunction in the equipment. Troubleshooting shall be presented based on locating potential faults in a unit, assembly, subassembly module, or piece part, depending on the maintenance concept (see 6.4.6) for the level of maintenance being performed. When the troubleshooting concept limits the location of a fault to a repairable item (such as the unit, assembly, subassembly or module) for organizational level maintenance, troubleshooting procedures and data shall also be presented that will permit a repair of the item at the intermediate- or depot-level maintenance facility, except when this information is included in another technical manual and the procedures can be directly referenced. When more than one level of maintenance must be provided for, organizational- and intermediate-level troubleshooting procedures shall be separated so that the organizational-level troubleshooting procedures are identified as "Organizational-level troubleshooting", and are presented first. Intermediate-level troubleshooting procedures shall follow organizational-level procedures and shall be identified "Intermediate-level procedures". Immediately following this title the following statement shall be included: "These procedures are authorized for accomplishment by Depot-level activities only." When a separate depot-level manual is specified in the TMCR (see 6.2), it shall include the information required by MIL-DTL-24784 and MIL-DTL-24784/7.

3.6.3.5.1 Troubleshooting instructions. This chapter shall contain all instructions and information necessary to locate troubles and conduct tests on each component, assembly, or subassembly of the equipment as follows:

- a. Troubleshooting guides providing step-by-step procedures for logical isolation of faults. This information shall direct the technician to observe meters, fuses, circuit breakers, valves, and other available indicators which would indicate the presence of trouble.
- b. Complete instructions on signal tracing for electrical circuits including the use of special test instruments and unusual servicing techniques.
- c. Where appropriate because of equipment complexity, troubleshooting diagrams (see MIL-DTL-24784) including schematics giving details of mechanical and electrical assemblies and relationships as follows:
 1. Mechanical schematic diagrams.
 2. Signal flow diagrams.
 3. Piping diagrams.
 4. Control diagrams.
 5. Power distribution diagrams.
 6. Maintenance schematic diagrams in accordance with MIL-DTL-24784.

3.6.3.5.2 Troubleshooting data. This chapter shall contain all the information required to enable the technician to locate malfunctions in the equipment.

3.6.3.5.2.1 Introduction. The introduction shall explain the approach and logic of the troubleshooting principles presented in the manual. Describe the troubleshooting data and show how they relate to one another.

Unless otherwise specified in the TMCR (see 6.2), the troubleshooting index shall be presented in

3.6.3.5.2.1.1 Troubleshooting index. tabular form (see MIL-DTL-24784).

3.6.3.5.2.2 Relay coil, switch, and indicator lamp indices. Unless otherwise specified in the TMCR (see 6.2), the indices shall be in tabular form for all relay coils, switches and indicator lamps (see MIL-DTL-24784).

3.6.3.5.2.3 Protective device index. When specified in the TMCR (see 6.2), the protective device index shall list all protective devices, such as fuses, circuit breakers, and so forth, in tabular form (see MIL-DTL-24784).

3.6.3.5.2.4 Maintenance turn-on procedure. When specified in the TMCR (see 6.2), include a maintenance turn-on procedure to energize the equipment from the fully de-energized condition to full operation (see figure 14-2). This procedure shall enable the technician to determine which major function or supporting function is malfunctioning. Each step of the procedure shall include the action to be taken (STEP), the observation to be made (OBSERVE), and shall presume that normal conditions have been observed in previous steps. Reference shall be made to the procedure for troubleshooting or corrective action to be used (REFERENCE) if the observation is out of tolerance. Built-in monitors such as meters, dials, lamps, and so forth, shall be used when possible for making observations, as opposed to the use of external test equipment. The procedure is complete when the equipment is fully energized and all switches and controls are positioned for proper operation. The maintenance turn-on procedure may be presented in a troubleshooting dependency diagram (see 3.6.3.5.2.8).

3.6.3.5.2.5 Troubleshooting procedures. When specified in the TMCR (see 6.2), troubleshooting procedures shall be directly related to, and support the troubleshooting diagrams. Troubleshooting information shall be developed to guide a technician in the logical order of isolating a fault. This information shall direct the technician to observe meters, fuses, circuit breakers, valves, built-in test equipment, and other available indications showing the presence of trouble. The analysis of normal indications in relation to faulty indications shall be stressed. This information may be in tabular, illustrative, or narrative format, whichever lends to faster troubleshooting. Test programs shall be developed for digital devices when the method is the most practical method of troubleshooting logic.

3.6.3.5.2.6 Troubleshooting diagrams. Unless otherwise specified in the TMCR (see 6.2),

troubleshooting diagrams shall be provided that consist of signal flow diagrams, piping diagrams, control diagrams, power distribution diagrams, logic diagrams, maintenance schematic diagrams, and dependency diagrams, as required.

3.6.3.5.2.7 Integrated circuitry packages and nonrepairable assemblies. When integrated circuit packaging techniques, such as Dual In-Line packages, are utilized, the level of detail on the logic diagrams may be restricted to that necessary to isolate problems to either a specific integrated circuit package or if the maintenance concept so dictates, to a specific nonrepairable assembly, providing there is sufficient detail to understand the process of troubleshooting.

3.6.3.5.2.8 Assemblies and subassemblies, modules, standard electronic modules, designated nonrepairable.

Logic diagrams, functional information, hardware and test data shall be supplied to the extent required to understand the operation of the equipment, concept of troubleshooting, and to serve the basis for affecting a critical repair.

3.6.3.5.2.9 Flow charts. When specified in the TMCR (see 6.2), flow charts for digital devices shall be provided to support the explanation of machine instructions and test programs, and shall conform to ISO 6829.

3.6.3.5.2.10 Coding instruction sheets. Coding instruction sheets shall be provided for all programs. The listing shall contain all coding and address data as well as an adequate notes section to ensure understanding (see figure 14-3).

3.6.3.5.2.11 Test programs. Test programs with coding instruction sheets shall be developed and included to support troubleshooting procedures.

3.6.3.5.2.12 Troubleshooting dependency diagrams. Unless otherwise specified in the TMCR (see 6.2,) one of the following types of troubleshooting diagrams shall be provided to augment the troubleshooting procedures. Supporting information required to explain the use of the diagrams shall be provided in the test or general notes.

- a. Fault logic diagrams (see MIL-DTL-24784).
- b. Troubleshooting-maintenance dependency-matrix chart (see MIL-DTL-24784).

3.6.3.6 Chapter 6, Corrective maintenance. This chapter shall contain instructions required to adjust and align the equipment, remove, clean, inspect, repair, reinstall, and align all repairable parts, modules, subassemblies, and assemblies. The instructions shall identify the action to be accomplished; safety precautions to be observed; tools, parts, materials, and test equipment required; preliminary control settings; test equipment setup instructions; and step-by-step instructions, with supporting illustrations, to accomplish the maintenance task. Corrective maintenance instructions shall be provided for all items designated repairable irrespective of the maintenance concept unless this information is included in another technical manual and can be referenced.

3.6.3.6.1 Introduction. The introduction shall contain an explanation of the purpose, scope, and arrangement of the corrective maintenance data.

3.6.3.6.2 Section I, Adjustments and alignment. This section shall contain all information and procedures required to perform all necessary adjustments and alignments as follows:

- a. Nonoperator type adjustments.
- b. Alignments requiring external jigs, test equipment, or bench setups.
- c. Alignments that are accomplished after a repair or replacement of a part or module.
- d. Test equipment setup and other illustrations necessary to support the procedures.

3.6.3.6.3 Section II, Repair. The repair section shall contain all procedures required in the repair of assemblies and repairable parts. Repair procedures shall include but not be limited to the following:

- a. Removal, disassembly, and inspection.
- b. Repair or replacement of piece parts.
- c. Cleaning and inspection.
- d. Preassembly, adjustment, installation, calibration, and checkout.
- e. Exploded views, sectional views, wiring diagrams, and photographs (if absolutely necessary see MIL-DTL-24784) to support the procedures.
- f. Obvious repair actions such as soldering, use of multimeters, hand tools, and so forth shall not be included except where these actions involve hazards to personnel or equipment.
- g. Repair procedures shall be arranged in numeric-alpha unit designation order of the equipment.

3.6.3.6.4 Supporting illustrations and data. The use of clear, sharp illustrations to supplement description and maintenance coverage is required. Exploded views are required for parts location illustration. As a minimum, illustrations or sketches of the following shall, when applicable, be included:

- a. Typical bearings for rotating or moving equipment.
- b. Method of taking clearance measurements where required.
- c. Typical mechanism for absorbing thrust where applicable.
- d. Locking devices when applicable.
- e. Typical seal assembly (pressure and vacuum seals or controlled leakage between rotor and casing).
- f. Typical assembly or blading to rotor, with lock devices, where applicable.
- g. Typical assembly of field poles, laminated core iron, electrical windings, commutator, slip rings, and brush rigging where applicable.
- h. Equipment assembly with upper casing partially removed.
- i. Series of illustrations showing installation of supervisory instruments (such as resistance temperature detectors in bearings).

3.6.3.7 Chapter 7, Parts list. When a separate illustrated parts breakdown (IPB) is acquired, the requirements of chapter 7 are satisfied if the IPB: (1) provides figure(s) with parts locations, parts

names, part numbers and CAGE codes of part vendors and (2) provides list of manufacturer's names, addresses and CAGE codes for parts (see 6.2). Otherwise supplemental information is required for missing information. When a separate IPB is not acquired the parts list shall list and identify and shall reference or include an illustration that will show the location of all repair parts (see 3.6.3.7.7). All mechanical parts subject to replacement, although not provisioned as a spare part, such as handles, slides, plates, covers, and so forth included in the provisioning documentation shall be included in the parts list and identified in the respective parts-location diagram. This chapter shall include:

- a. Introduction.
- b. List of major components or list of major units in top-down breakdown sequence.
- c. Parts list.
- d. List of common item descriptions.
- e. List of attaching hardware.
- f. List of manufacturers.
- g. Parts location illustrations.

3.6.3.7.1 Introduction. The introduction shall contain an explanation of the scope and arrangement of the parts list. The following type of information shall be included:

- a. Models of equipments and, where all equipment of a specific model do not have interchangeable parts, serial number of equipments covered.
- b. Explanation of any special notes.
- c. Explanation and instructions for using the list of common item descriptions.
- d. Explanation and instructions for using the list of attaching hardware.
- e. Explanation and instructions for using the parts list.
- f. Explanation and use of the list of manufacturers.

3.6.3.7.2 List of major components or major units. A list of major components or a list of major units in tabular form shall be included as follows:

- a. Column 1, PIN, RIC, or unit number. This column shall list the PIN (see 6.4.5) or unit number and APL for each major component, if available.
- b. Column 2, Quantity. This column shall list the quantity of components.
- c. Column 3, Name or nomenclature. This column shall contain the approved nomenclature of the major components and shall be subdivided as follows:
 1. Name of unit. This column shall list the approved name of the unit.
 2. Designation. This column shall list the type designation of the unit.
- d. Column 4, Page number. This column shall list the number of first page of the parts listing for major unit.

3.6.3.7.3 Parts list. The parts list shall be in tabular form in accordance with MIL-DTL-24784. When specified in the TMCR (see 6.2), the parts list shall be divided by major units. Each unit

shall be arranged in numerical sequence (for example, unit 1 with its parts, and so forth, will precede unit 2 with its parts). All parts attached to the unit shall be listed first in alphanumerical order, followed by unit assemblies with parts and then subassemblies with parts, also listed in alphanumerical order. The list shall be arranged as follows:

| | |
|---------------------|--------------|
| Unit | 1 |
| (Cabinet parts) | 1AT1 |
| | 1B1 |
| | 1C1 |
| | 1CR1 |
| | 1R1 |
| | and so forth |
| Assembly | 1A1 |
| (Assembly parts) | 1A1AT1 |
| | 1A1B1 |
| | 1A1C1 |
| | 1A1CR1 |
| | 1A1R1 |
| | and so forth |
| Subassembly | 1A1A1 |
| (Subassembly parts) | 1A1A1AT1 |
| | 1A1A1B1 |
| | 1A1A1C1 |
| | 1A1A1CR1 |
| | 1A1A1R1 |
| | and so forth |
| Unit | 2 |
| | and so forth |

3.6.3.7.4 List of common item descriptions. This list shall include the description of all identical parts that are used more than five times in the equipment. The description of each common item shall totally identify the item including manufacturing CAGE code and part number or military standard number. Like parts should be grouped and arranged in alphanumerical order. Item numbers shall be assigned consecutively, for example:

| <u>Item number</u> | <u>Description</u> |
|--------------------|---|
| 1 | CAPACITOR, FIXED,CERAMIC: DIELECTRIC 3PF, 500 VDCW; MIL type CCZ1UJ030C |
| 2 | CAPACITOR, FIXED GLASS: DIELECTRIC 5100 PF, + 1% 300 VDCW, mfr 86969, dwg 231B743H15. |

- | | |
|---|---|
| 3 | RESISTOR, FIXED, COMPOSITION: 3000 ohms + 5% 1/2w; mfr 42384 dwg 4469D69 |
| 4 | RESISTOR, FIXED, COMPOSITION: 4000 ohms + 5% 1/2w; MIL type RC20GF402J. |

3.6.3.7.5 List of attaching hardware. A list shall be included that shows items of attaching hardware. Attaching hardware shall be listed alphanumerically and identified by an assigned letter. For example:

| <u>Letter code</u> | <u>Name and description</u> |
|--------------------|--|
| A | CAPSCREW, 1/4-28, UNF-2A, 1 in. lg, HEX HEAD, DRILLED HEAD, CRES MS51100-8. |
| B | WASHER, FLAT, 0.750 in. ID, 0.312 in. OD, 0.066 in. thickness, STEEL, ROUND. |

Items used fewer than five times need not be included in the list of attaching hardware providing the item is completely identified in the parts list, following the part identification that is being attached.

3.6.3.7.6 List of manufacturers. The list of manufacturers shall contain the names, addresses, and CAGE number of all manufacturers supplying items for the equipment as referenced in the parts list. The list shall be presented in numerical sequence by CAGE number. CAGE numbers shall be in accordance with Cataloging Handbook H4/H8.

3.6.3.7.7 Parts location illustrations. Illustrations shall be included to provide positive and rapid location of parts. Types of parts location illustrations include exploded views, when approved by the Government, engineering drawings and sectional views, printed-circuit boards, as applicable (see MIL-DTL-24784). Suitable parts location illustrations located in other chapters of the manual may be referenced.

3.6.3.7.7.1 Criteria for illustrations. Items shall be called out on illustrations by call-out leader, index number, or grid coordinates. Standard attaching hardware items (such as nuts, bolts, washers, screws) need not be called out or illustrated, except when they are on exploded views or are referenced in a procedure. Multiple items of attaching hardware connecting parts together need not show every item; for example, if four screws and washers attach one part to another, only one screw and washer need be shown, but all four screw holes on the part must be shown. Exploded views shall be supplied for units, subassemblies, and components designated Navy repairable but may be included in Chapter 6, "Repair and replacement", for parts-location purposes.

3.6.3.8 Chapter 8, Installation. Drawings and information concerning installation shall be provided in this chapter. The following type of information shall be included: site selection, or installation location guide lines (such as moisture precautions and maximum temperature allowed as appropriate), special tools and materials requirements, unpacking, and handling (if unusual

procedures or precautions are required), preparation of foundations, mechanical assembly procedures, mounting instructions, bolting diagrams, safety precautions, grounding and bonding, clearances for access, ventilation, fluid cooling requirements, clearances for motion under shock, and recommendations for reduction of electrical and electromagnetic interference, and other interface requirements, as applicable. In addition, this chapter shall contain tests and test procedures required to demonstrate that the equipment after installation is capable of satisfying operational requirements. Also, it shall include information relating to the electromagnetic compatibility (EMC) measures taken in the original design or subsequently incorporated to maintain EMC integrity of the equipment at all times in its life cycle. The measures include, as a minimum shielding, filtering, grounding, bonding, and routing.

3.6.3.8.1 Installation drawings. When specified in the TMCR (see 6.2), reproduction of appropriate installation control drawings shall consist of the following, as applicable:

- a. Drawing list.
- b. Block diagrams.
- c. Outline and installation drawing.
- d. Auxiliary cooling diagram.
- e. Auxiliary dry gas diagram.
- f. Cable running sheets.
- g. Summary list of installation material.
- h. RF transmission line diagram.
- i. Hydraulic fluid piping diagram.

3.6.3.8.2 Site or installation location information. When specified in the TMCR (see 6.2), data shall contain information supplemental to the installation drawings. If all site information is contained on the installation drawings, reference shall be made to the applicable drawings by figure number.

3.6.3.8.3 Reference publications. When specified in the TMCR (see 6.2), reference shall be made to military-issue general publications required to complete the installation, when it is impractical to include such information.

3.6.3.8.4 Tools and materials required for installation. Include information supplemental to the summary list of installation material. If no supplemental information is required, reference the drawing by figure number.

3.6.3.8.5 Unpacking and repacking. Include information supplemental to the installation drawings regarding unpacking and repacking. Include step-by-step procedures to prevent damage to the equipment or injury to personnel. Supporting illustrations shall be provided to clarify procedures. When packing for reshipment is required, step-by-step procedures for packing shall be included and illustrated. When packing is simply the reverse of unpacking, this fact need only be stated. Any special environmental conditions required for storage shall be provided. Instructions shall be included for items in the following categories:

- a. Depreservation procedures required at time of installation.
- b. Represervation packaging required prior to repacking for storage or shipment.
- c. Intricate mounting, blocking, or bracing.
- d. Special cushion inserts.
- e. Repairable items.
- f. Sensitive or fragile components.
- g. Items held in special cradles.
- h. Items furnished in reusable containers.
- i. Special environmental conditions required for storage.
- j. Special handling procedures required.
- k. Container storage or disposition instructions, as applicable.

The instructions shall be detailed to prevent handling damage to the equipment or injury to personnel. In addition, step-by-step procedural illustrations may be used to supplement the packing and handling instructions.

3.6.3.8.6 Preparation of foundations. Include information supplemental to the installation drawings. If all foundation preparation information is contained on the installation drawing, refer to the drawings by figure number.

3.6.3.8.7 Input requirements. A summary of the input data contained on the installation drawings shall be included. Parameters with tolerances should be included with each of the inputs listed. Examples of inputs are as follows:

- a. Power.
- b. Ventilation.
- c. Dry air (waveguide pressure).
- d. Ship gyro information.
- e. Fluid cooling.
- f. Steam.
- g. Freon.

3.6.3.8.8 Installation procedures. The following types of supplemental information which are not provided on the installation drawings shall be included or referenced:

- a. Instructions required to assemble units.

- b. Instructions required to mount units. Include bolting and bracing diagrams and data on shock mounts.
- c. Instructions for making electrical, plumbing, transmission line, and all other interface connections (external) to the equipment.
- d. Instructions for interconnecting units comprising the equipment.
- e. Servicing procedures, such as initial lubrication.
- f. Instructions for bonding and grounding.

3.6.3.8.9 Installation checkout. Step-by-step procedures shall be provided to demonstrate that the equipment operates correctly and within tolerances. These procedures shall provide for equipment checkout in three test phases as follows:

- a. Phase 1 - Installation inspection and pre-energizing procedures.
- b. Phase 2 - Turn-on and preliminary tests.
- c. Phase 3 - Installation verification test.

3.6.3.8.9.1 Phase 1 - Installation inspection and pre-energizing procedures. When specified in the TMCR (see 6.2), inspection procedures shall be provided in the form of check lists to verify the following:

- a. That all units of the equipment and required auxiliary equipments have been installed and that their location and orientation is proper; that all cables, filters, antennas, waveguides, transmission lines, dehydrators, coolant lines, piping, and so forth, have been installed in accordance with plans and specifications; that continuity exists in all interconnections.
- b. That the test equipment listed in Chapter 1 is on board, operating satisfactorily, has been calibrated and has adequate storage in accordance with NAVSEA ST000-AB-GYD-010.
- c. That the APL is on board, that the Coordinated Shipboard Allowance List includes the equipment data.
- d. That all field changes, ship alterations, and mandatory retrofits have been accomplished.
- e. That all installation and reference standards are entered on the Installation Standards Summary Sheet.
- f. That all rotating devices are free from obstruction.
- g. That there is access to the equipment for maintenance.
- h. That all pre-energizing servicing procedures, including lubrication have been accomplished.
- i. That it is safe to turn on the equipment.

3.6.3.8.9.2 Phase 2 - Initial turn-on and preliminary test. Procedures shall be included for energizing the equipment for the first time. This may be accomplished by reference to the applicable portions of Chapter 2. Step-by-step procedures shall be included for testing the equipment electrical supply circuits including distribution panels, switches, breakers, relief valves, and interlocks. Procedures shall be included for testing piping, electrical cables, wire rope, stays, for proper installation of transmission lines and waveguides, hangar spacing, torquing of connectors, pressure testing, flow rates, standing wave ratio and attenuation checks, and so forth.

3.6.3.8.9.3 Phase 3 - Installation verification test. Complete instructions shall be included for

testing the equipment in all modes of operation. Where applicable, refer to the scheduled performance tests in Chapter 4. Procedures shall cover checking gauges, meters, alarms, and other sensing devices for proper operation and calibration. The tests shall verify that all inputs are in tolerance. Where applicable, include voltage standing wave ratio and insertion loss tests to verify the proper installation of antenna-to-equipment waveguide runs; transducer impedance and source level checks to verify proper installation of transducers, domes, and cables. Preliminary setup data shall be included in each procedure. When it is required that an alignment be accomplished prior to performing a test, the alignment shall be included or referenced in the procedure.

3.6.3.8.9.3.1 Test procedure. Testing procedures shall be presented in a logical order as follows:

- a. Energize the equipment.
- b. Test the first units (normally power supplies) which must be operating properly. When test results are within the required tolerance, include reference to the next logical test. Include a reference to the corrective maintenance or troubleshooting data to be used if test results are not within tolerances.

3.6.3.8.9.3.2 Installation standards summary sheet. The installation standards summary sheet shall provide spaces for recording the results of all installation verification tests and significant reference standard tests that should be made a matter of record for reference by the technician during troubleshooting and for a standard to be re-established after overhaul (see figure 14-4). Each space shall be identified by the step or paragraph number which provides the instructions for accomplishment. Each space shall contain the respective unit of measurement (for example, amp., dB., or V.). When applicable, waveforms shall be included to show the points on the pattern where the measurement is to be taken. In addition, critical installation data shall be included, such as the length of the transmission line.

4. VERIFICATION

4.1 Quality assurance requirements. The quality assurance requirements for delivery of book plans, review draft copies, preliminary technical manuals, final reproducible copy, technical manuals, replenishment materials, changes and revisions shall be in accordance with MIL-DTL-24784.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military

Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but it is not mandatory.)

6.1 Intended use. The technical manuals prepared to this specification are intended to be used for installation, operation, maintenance, repair, and parts support of electronic and IC equipment. The technical manual will be used as a training document in the classroom and as a source for on-the-job training.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of the specification (or any TMCR referencing this specification).
- b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
- c. Type and quantity of deliverable products (see 3.3).
- d. Arrangement if other than standardized format (see 3.4)
- e. Format and preparation instructions if other than as specified in MIL-DTL-24784 (see 3.5).
- f. Warranty and guarantee information (see 3.6.3.1.1).
- g. Test equipment required for shipboard use (see 3.6.3.1.5).
- h. Whether standard log form is required for chapter 2 operation.
- i. Circuits found in NAVSEA SE000-01-IMB-010 and circuits not covered in NAVSEA SE000-01-IMB-010 (see 3.6.3.3.1c.).
- j. When LSA and MRC data is required or if the section to remain blank (see 3.6.3.4).
- k. When a separate depot level maintenance manual is to be acquired in accordance with MIL-DTL-24784/7 (see 3.6.3.5).
- l. Troubleshooting index (see 3.6.3.5.2.1).
- m. When indicator lamp indices are required (see 3.6.3.5.2.1.2).
- n. Protective devices (see 3.6.3.5.2.1.3).
- o. Maintenance turn-on procedures (see 3.6.3.5.2.1.4).
- p. Troubleshooting procedures (see 3.6.3.5.2.2).
- q. Troubleshooting diagrams (see 3.6.3.5.2.3).
- r. Flow charts (see 3.6.3.5.2.6).
- s. Troubleshooting dependency diagrams (see 3.6.3.5.2.8).
- t. Requirements for parts lists (see 3.6.3.7). Name and description of each part need not be furnished. If a separate IPB is acquired, only that IPB and the requirements for a List of Manufacturers (f) are required.
- u. When the parts list is to be divided by major unit (see 3.6.3.7.3)
- v. When installation information is required, specify the drawings (3.6.3.8.1), site or installation location (3.6.3.8.2), and reference publications required (see 3.6.3.8.3).
- w. Inspection procedures (see 3.6.3.8.9.1)
- x. Packaging requirements (see 5.1).

6.3 Technical manual acquisition. This specification (or a TMCR based on this specification) must be listed on the Contract Data Requirements List (DD Form 1423) in order to acquire the technical manuals described by this specification. An alternate acquisition strategy should be devised by contracting officers for those solicitations or contracts which are exempted from using the Uniform Contract Line Item Numbering System (UCLINS).

6.4 Definitions. The words or phrases used throughout this specification must be as defined in MIL-DTL-24784 and the following.

6.4.1 Commercial design. Equipment engineered and manufactured primarily for commercial purposes. For military applications, the acceptability of commercial off-the-shelf manuals supporting the equipment or system can be established in accordance with MIL-DTL-24784/4 or this specification as directed by the Government.

6.4.2 Interim change. The Naval Space and Warfare Command method of promulgating rapid changes to a technical manual. The information required to amend, correct or modify a manual when emergency or urgent changes are necessary and there is insufficient time available to publish a permanent change. Interim changes are subject to replacement by a permanent change. (Interim changes are often referred to as temporary changes.)

6.4.3 IC equipment. Equipment normally used for shipboard interior communication. These include navigation or related equipment designated IC equipment such as the following:

- a. Plotting tables.
- b. Deck reckoning indicators.
- c. Gyros and gyro amplifiers.

6.4.4 Major function. An essential functional operation which is fundamental to operation (as opposed to a circuit) of the equipment (for example, transmit, receive, display, hoist, and so forth).

6.4.5 PIN. An alphanumeric designator which identifies parts, items, or bulk materials, that are covered by a specification or standard. The number derived from a military specification such as type RWR74549R9FM; or a military standard such as MS 18272.

6.4.6 Maintenance concept;. The planned concept by which the equipment, assemblies, units, components, modules, or piece parts are to be repaired or replaced by designated maintenance level activities (organizational, intermediate or depot).

6.4.7 Unit. A major building block for a set or system, consisting of a collection of basic parts, subassemblies, and assemblies packaged together as a physically independent entity. Refer to IEEE 200 for a detailed description.

6.5 Subject term (key word) listing.

Depot-level maintenance

Installation

Intermediate maintenance

Operation

Organizational maintenance

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

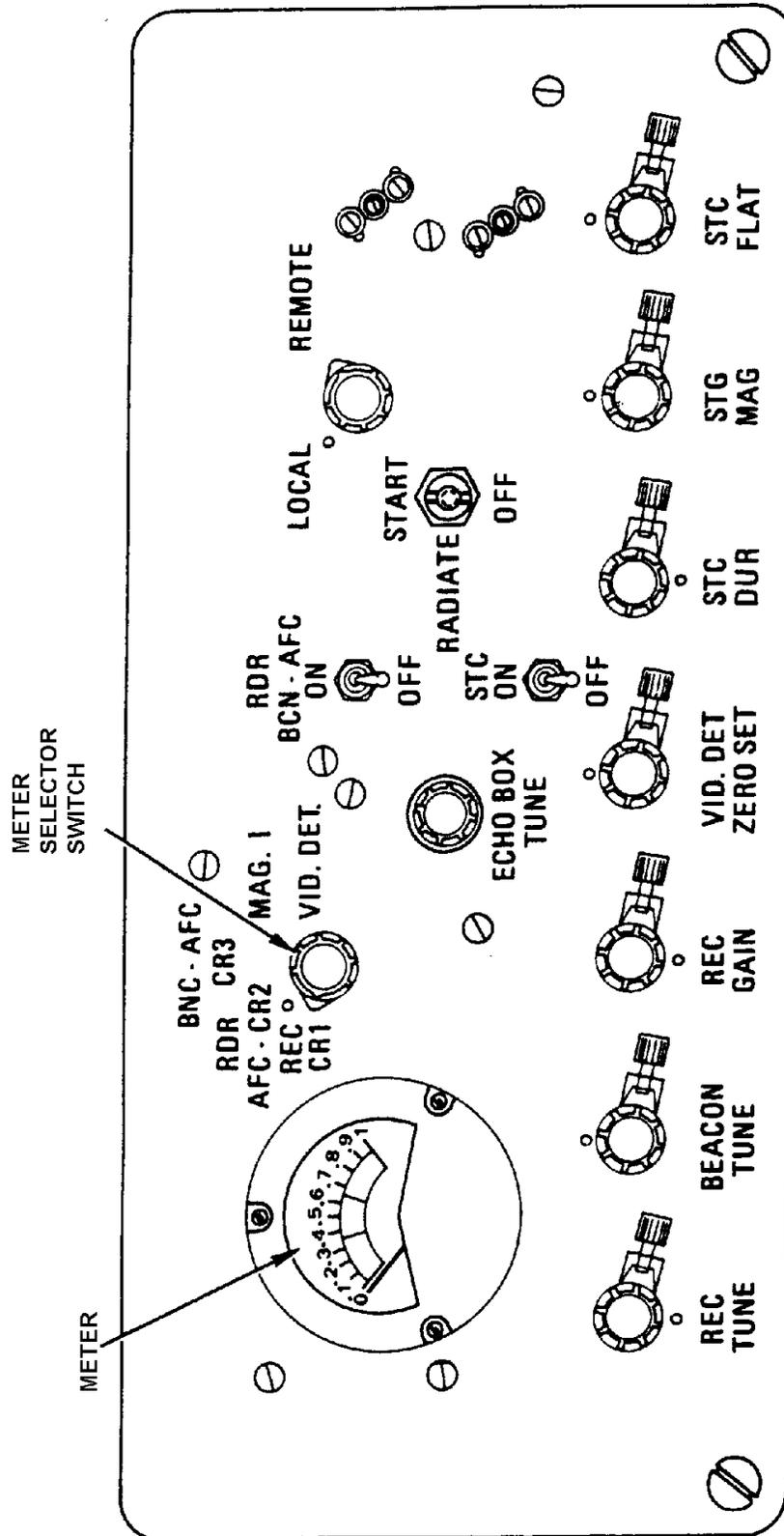


FIGURE 14-1. Equipment controls and indicators.

| STEP | OBSERVE | REFERENCE | | | | | | | | |
|--|---|---|-------|-----|--------------|-----|------|--------------|--|--------------------------------|
| <p>1. Preliminary Procedure.</p> <p>a. Position the following switches on rear deck assembly 1A210A1 as indicated.</p> <table border="0" data-bbox="305 436 657 583"> <tr> <td><u>Switch</u></td> <td><u>POSITION</u></td> </tr> <tr> <td>POWER</td> <td>OFF</td> </tr> <tr> <td>BATTLE SHORT</td> <td>OFF</td> </tr> <tr> <td>STOW</td> <td>BRAKES APPLY</td> </tr> </table> <p>b. Position POWER switch on console 1A220A20 (see figure 5-2) to OFF.</p> <p>c. Check to ensure that all chassis or subassemblies in the four compartments of electronic rack assembly, 1A70 are in the retracted position and all covers are secured.</p> <p>d. Remove all obstructions from the rotational paths of the director main antenna assembly.</p> <p>2. Power off</p> <p>a. At power control panel perform the following.</p> <p>(1) Check convenience lamp indicators.</p> | <u>Switch</u> | <u>POSITION</u> | POWER | OFF | BATTLE SHORT | OFF | STOW | BRAKES APPLY | <p>Covers Secured</p> <p>Director Clear</p> <p>Lighted</p> | <p>Schematic, figure 5-233</p> |
| <u>Switch</u> | <u>POSITION</u> | | | | | | | | | |
| POWER | OFF | | | | | | | | | |
| BATTLE SHORT | OFF | | | | | | | | | |
| STOW | BRAKES APPLY | | | | | | | | | |
| <p>e. At track meter panel, 1A340-02. check COOLANT FAILURES lamp.</p> | <p>Extinguished (Depress RESET button if lamp is lighted)</p> | <p>Relay diagram, figure 5-77, SH #(4B)</p> | | | | | | | | |

FIGURE 14-2. Maintenance turn-on procedure.

XYZ ROUTINE- PROGRAM LISTING

| LOC | MEMORY CONTENTS | LABEL | ORD | ADR | MOD | CONSTANT | SCL | NOTES |
|-------|-----------------|-------|------|--------|-----|-----------|-----|--------------------------------|
| 01443 | 000330700 | | FRS | 030700 | | | | |
| 01447 | 051510457 | | TMI | 01457 | | | | |
| 01453 | 034706277 | | TRA | 06277 | | | | |
| 01457 | 000077632 | | SET | 37632 | | | | |
| 01463 | 034706403 | | ORG | 06403 | | | | |
| | | | ORG | 06103 | | | | |
| 06102 | 001037632 | A1 | STO | TEMPR | 1 | | | SAVE INSERTED NUMBER |
| 06107 | 035106123 | | TMI | A3 | | | | -/- NEGATIVE INSERT |
| 06113 | 014077763 | A2 | GET | ONE | | | | KEY FOR FIX RESET |
| 06117 | 035035357 | | STO | KTYPF | | | | TYPE OF RESET KEY |
| 06123 | 000077760 | A3 | GET | ZERO | | | | |
| 06127 | 035037633 | | STO | TEMPR | 2 | | | CLEAR RESET /NRS/ KEY |
| 06122 | 000077632 | | GET | TEMPR | 1 | | | |
| 06137 | 004706147 | | TRA | SUB 1 | | | | GO TO RESET NUMBER SUBROUTINE |
| 06143 | 000706327 | | TRA | A14 | | | | |
| 06137 | 055437634 | SUB1 | STV* | TEMPR | 3 | | | ENTRANCE - RESET NUMBER SUBRTN |
| 06153 | 034313700 | A4 | PRS | 1 | | | | |
| 06157 | 035106243 | | IMI | RE13 | | | | CHECK LAST BCD BIT FOR SIGN |
| 06163 | 034313700 | A5 | PRS | 1 | | | | |
| 06167 | 035106213 | | TMI | **5 | | | | CHECK 2ND BCD BIT FOR SIGN |
| 06173 | 034333600 | A6 | FRS | 2 | | | | CHECK 3RD AND 4TH BITS |
| 06177 | 002206177 | | TMI | OUT | | | | |
| 06203 | 034077633 | A7 | GET | TEMPR | 2 | | | TEMPORARY RESET KEY |
| 06207 | 002737634 | | TRA | TEMPR | 3 | | | EXIT - RESET NUMBER SUBROUTINE |
| 06213 | 005077766 | A8 | EXT | MAXNO | | | | |
| 06217 | 034333600 | FRS | FRS | 2 | | | | CHECK 3RD AND 4TH BITS |
| 06223 | 002206277 | | TMI | OUT | | | | |
| 06227 | 044041030 | A0 | GET | | | 020000000 | | KEY TO RESET 2 |
| 06233 | 005477633 | A10 | ADD | TEMPR | 2 | | | |
| 06237 | 005737344 | | TRA | TEMPR | 3 | | | EXIT - RESET NUMBER ROUTINE |
| 06243 | 034313700 | RE13 | PRS | | | | | |
| 06247 | 035106303 | | TMI | RE3 | | | | CHECK 2ND BIT FOR SIGN |
| 06253 | 034077766 | A11 | EXT | MAXNO | | | | |
| 06257 | 034333600 | | FRS | 2 | | | | CHECK 3RD AND 4TH BITS |
| 06263 | 001106277 | | TMI | OUT | | | | |
| 06267 | 034077762 | A12 | GET | HALF | | | | KEY TO RESET 1 |

FIGURE 14-3. Coding instruction sheet.

RADIO RECEIVER R-XXX/URR
NAVSEA
 INSTALLATION STANDARDS SUMMARY

| | |
|--|--|
| Input Voltage _____ Vac Input Frequency _____ Hz (When reference standard tests are made) | Date _____ Serial Number _____ of Model _____ Installed in (ship or station) _____ _____ Length of transmission line _____ _____ |
|--|--|

Record on this summary sheet the test indications which have been obtained during the installation verification test.

| Paragraph No. | Observed Value | Reference Standard |
|---------------|--|--|
| 8-10 | a. _____ Check | |
| 8-21 | a. _____ Vdc b. _____ Vdc c. _____ Vdc d. _____ Vdc | a. 1.0 to 1.2 Vdc b. 2.35 to 2.36 Vdc c. 24.0 to 24.5 Vdc d. 12.6 to 12.8 Vdc |
| 8-33 | a. _____ Vdc b. _____ Vdc c. _____ Vdc d. _____ Vdc | a. 2.5 to 2.7 Vdc b. 11.3 to 11.7 Vdc c. 3.0 to 3.6 Vdc d. 6.6 to 7.0 Vdc |

FIGURE 14-4. Installation standards summary sheet.

Custodian:
Navy - SH

Review Activity:
Navy - EC

Preparing activity:
Navy -.SH
(Project TMSS-N322)

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MIL-DTL-24784/14B (SH)

2. DOCUMENT DATE (YYYYMMDD)

15 February 2002

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4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed)

5. REASON FOR RECOMMENDATION

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(2) DSN

(if applicable)

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SEA 05Q

b. TELEPHONE (Include Area Code)

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