

INCH-POUND

MIL-DTL-24784/18B (SH)

15 February 2002

SUPERSEDING

MIL-DTL-24784/18A(SH)

15 March 1999

ASSOCIATED DETAIL SPECIFICATION  
SURFACE MISSILE SUBSYSTEM OR 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, and parts support of surface missile subsystems or equipment.

1.1.1 Scope of coverage. Unless otherwise specified in the technical manual contract requirements (TMCR) (see 6.2), 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 subsystem or 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 ensure the completeness of this list, document users are cautioned that they must meet all

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.

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 (HM&E) Equipment, Electronic Equipment, and Ordnance Equipment.
MIL-DTL-24784/19	Surface Missile System Manual Requirements.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document 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 in the TMCR, the issues are those cited in the solicitation.

#### NAVAL SEA SYSTEMS COMMAND (NAVSEA)

OPNAV Form 4790/7 ST000-AB-GYD-010	Planned Management System Feedback Report Portable Electrical/Electronic Test Equipment (PEETE) Storage Guide.
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(Application for copies should be addressed to the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, 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).

#### INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 991                      Standard for Logic Circuit Diagrams.

(Application for copies should be addressed to the Institute of Electrical and Electronics Engineers, Inc., 445 Hoes Lane, P.O. Box 1331, Piscataway, N.J. 08855-1331.)

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 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 preparation 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 Technical content for surface missile subsystem or equipment manuals. Surface missile subsystem or equipment manuals shall be applicable to subsystems and equipment of weapon systems as well as to separate independent units.

3.6.1 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.

3.6.2 Chapter 1, General information and safety precautions. This chapter shall describe the equipment in physical and functional terms, and shall present general operation and interface requirements. All safety precautions necessary for the protection of personnel and the ship shall be included and cross-referenced ahead of the introductory paragraph. These precautions shall be prepared in accordance with the basic specification. Also, the content of this portion shall be such 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.

3.6.2.1 Introduction. Included as general and introductory information shall be:

- a. Superseded data
- b. Applicability of technical manual, including capabilities, system interface description, model differences, serial numbers, and configuration covered.
- c. The interface relationship of the technical manual to other referenced publications (see MIL-DTL-24784 and MIL-DTL-24784/19).
- d. A frontispiece consisting of an overall view of the subsystem or equipment as shown in figure 18-1 or figure 18-2.

3.6.2.2 Purpose. This paragraph shall briefly describe the equipment, the purpose, the intended use of the equipment, and shall explain how it works with any closely related equipment. Official nomenclature shall be used for the first mention of each subsystem or equipment. Common names, if they exist through long-time usage, shall be introduced parenthetically at this point and used consistently thereafter. Reference may be made to a list of equipment in the reference data paragraph (see MIL-DTL-24784). The text shall be supported by an overall illustration that shall call out any significant features presented in the text. This illustration shall depict and identify all physically separate units (see 6.4.4), both major and ancillary, as the units appear when fully assembled.

3.6.2.3 Capabilities. This portion shall provide a concise statement of all significant operational characteristics and capabilities of the subject equipment, including such information as input and output signals, load limits, frequency, range, testable items, resolution, memory capacity, and reaction time. The data should be presented in a tabular format.

3.6.2.4 System description. If the equipment operates as part of a system, a brief system description shall be included, with reference to any system manuals (see MIL-DTL-24784/19). This shall be a nontechnical orientation of the subject equipment with other equipment in the system. The system description shall discuss only those components of the system necessary to introduce the subject equipment's system-contributing capabilities. An illustration shall be used to clarify the relationships. Figure 18-3 is a typical equipment/system integration illustration.

3.6.2.5 Model differences. The differences between models of the equipment shall be briefly delineated in this portion. Descriptions of major physical differences shall be supported by reference to appropriate illustrations. These major differences shall also be reflected in the operating instructions, maintenance instructions, and parts list. Multiple model differences that involve a number of equipment sections or subsections shall be presented in tabular form. The method for handling differences between models in other portions of the manual shall be defined here.

3.6.2.6 Equipment illustration. Equipment illustrations shall be in accordance with MIL-DTL-24784.

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

- a. Official nameplate designations and nomenclature of all equipment [type, model, and component identification number (CID)], major units, and support equipment. This list shall include common names and quantities required per unit, and Repairable Identification Code (RIC), if available.
- b. Detailed operating characteristics, and significant equipment capabilities and limitations such as: pounds of thrust, knots, turning radius, minimum and maximum ranges, degree of coverage, resolution, accuracy, wattages, voltages, horsepower, gallons per minute.
- c. Power input requirements and other externally supplied inputs (such as data and control signals, pressurized air, and as data and control signals, pressurized air, and coolant water) shall be listed, along with identity of the source of each, such as: ships supply, specific associated equipment, gyrocompass, power requirements, horsepower, pressure, capability, modes of operation, power output, frequency, pulse characteristics, sensitivity, selectivity, including tolerances, where applicable.
- d. Environmental characteristics, such as: ambient temperatures, heat dissipation per unit, humidity limits, coolants (air flow in cubic feet per minute, water or oil in gallons per minute per unit, chilled and demineralized seawater).

3.6.2.8 Equipment and accessories required. A tabular listing of all equipment required shall be included. The equipment and its units, and accessories (such as hydraulic oil lines, waveguide, special cables, special tools, test equipment, miscellaneous parts, and Government furnished items) that form a part of, or are supplied with, the equipment shall be listed. The table shall include the following:

- a. Column 1. Quantity. This column shall contain the quantity of each unit and accessory 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. CID number, RIC number, or unit number. This column shall contain the RIC and CID or unit number of each equipment unit or accessory.
- d. Column 4. Overall dimensions. This column shall contain the crated and uncrated height, width, and depth of each unit and accessory.
- e. Column 5. Weight and volume. This column shall contain the crated and uncrated weight and volume (in cubic feet) of each unit and accessory.

3.6.2.8.1 Related attaching equipment. Equipment and systems (such as controls, foundation mounts, couplings, and appurtenances) and related publications that are not furnished with the basic equipment covered by this manual, but that attach or relate importantly to the basic equipment, shall be described in sufficient detail to establish their correlation with respect to physical and functional interfaces. A reference should be made to the system manuals (see MIL-DTL-24784/19), and to the shipbuilder's power plant technical manual if it contains additional applicable information.

3.6.2.9 Reference publications. A list of applicable referenced publications shall be provided, giving publication numbers and titles of basic items of issue. The list shall include publications covering systems with which the equipment is used, associated equipment, and support equipment. It shall also include other official documents of interest or use to operating or maintenance personnel, such as special directives, basic training manuals, NAVSUPPUB 2002, NAVSEA ORDALT 00, and NAVSEA OP 1700.

3.6.2.10 Description. The information contained in this portion of the manual shall provide a brief description of the physical configuration of the equipment and a thorough description of the way in which the equipment functions.

3.6.2.10.1 Physical description. A concise description of the significant physical features of the equipment shall be provided. This portion shall include information such as the following:

- a. Arrangement of major units, assemblies, and subassemblies. The description shall stress the physical aspects of the major units and identify the assemblies and subassemblies contained in each major unit. Separate descriptions of individual sub-units shall appear only when unique physical features or special handling precautions are involved.
- b. Provisions for power, input and output signals, hydraulic and pneumatic connections, and similar items.
- c. Provision for heating, cooling, ventilating, desiccating, weather- proofing, and shock mounting.
- d. All unique or unusual mechanical features. Care shall be exercised to minimize redundancy between the physical description contained in this portion and the functional description when describing those mechanical aspects that are directly involved in the operational functions.

The text shall be supported by illustrations showing significant physical features. These illustrations shall show and identify principal sections; major assemblies; subassemblies and plug-in units; and mechanical and structural features that are noteworthy, such as maintenance access covers, chassis slides, tilt mechanisms, cable-retracting devices, built-in storage drawers, shock mounts, casters, shafts, adjustable couplings. The level of detail shall be equal to the text descriptions. Illustrations of fully assembled major units and partially assembled major units shall be supported by multiple callouts to provide as much coverage as possible. Separate illustrations of individual subunits shall be included only if unique physical features exist. Figure 18-4 is an example of the type of illustration required. For complex equipment, illustrations showing overall general arrangements, such as shown in figure 18-5, shall be provided with appropriate supporting notes.

3.6.3 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.

3.6.3.1 Introduction. The introduction shall provide an explanation of the purpose, scope, supersedure data, and applicability of the technical manual, including the models, serial numbers, and configurations covered. The interface relationship of the technical manual to other reference publications and the relationship of the equipment to referenced systems or other equipment shall also be included.

3.6.3.2 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 18-6).
- 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.

3.6.3.3 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.

3.6.3.3.1 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.

3.6.3.4 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 so 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.

3.6.3.4.1 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 WARNINGS and CAUTIONS, as applicable. "Notes" shall not be used in lieu DANGERS, of 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).

3.6.4 Chapter 3, Functional description. This chapter 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 (see MIL-DTL-24784).

3.6.4.1 General functional description. The general functional description shall provide an overall explanation of the functional operation of the equipment in relationship to the system of which it is a part. This explanation shall provide an understanding of the way in which the equipment performs functions by modes of operation, placing emphasis on the primary modes, without going into mechanical or electrical circuit details. To ensure continuity, this description shall bridge the gap between the introductory description and the more detailed descriptions to follow. First order equipment-to-system interfaces, such as, target data accumulation, processing and display, target designation, types of guidance, launcher assignment, and pointing characteristics, shall be described. The description shall be supported by a functional block diagram of equipment-to-system interface showing only main data flow from the equipment to related equipment within the system. Figure 18-7 depicts a typical relationship between equipment and system.

3.6.4.1.1 General functional description data flow. The general functional description data flow shall be described in groups of signals between major components within the equipment. Text for subordinate modes of operation shall reference applicable portions of normal mode description. Unique or not commonly known features, engineering concepts, or specialized applications of existing concepts shall be explained only when necessary for an understanding of the functional

operation of the equipment. This provision shall apply, for example, to unique features and concepts of self-checking and automatic test programming features of equipment. The text shall be supported with block diagrams. The number of diagrams required for clarity depends upon the variety of outputs and the changes imposed by different operational modes. When summary troubleshooting block diagrams are contained in the fault-isolation portion of the manual, appropriate references shall be made to avoid redundancy.

3.6.4.2 Detailed functional description. The detailed functional description shall begin with a detailed block diagram presentation of each major functional block presented in the general functional description. The presentation shall clearly indicate what group of signals covered in the general functional description is being expanded in the detailed functional description. For example, data flow on the general functional block diagram should be expanded into individual signals and the generation path of the individual signals further expanded into a detailed block diagram. Figure 18-8 is a typical example of this technique. Outputs shall be identified by names or fire control symbols. Diagrams that are redundant, in total or in part, with troubleshooting diagrams contained in the fault-isolation portion of the manual shall not be included.

3.6.4.2.1 Troubleshooting diagrams. The troubleshooting diagrams in the fault-isolation portion of the manual shall be used in the detailed functional description as the basic supporting illustrations. Diagram titles shall be synonymous with the heading titles.

- a. The description shall first briefly describe the composition of the output by tracing the output back to its origin. This will illustrate functional dependency of the circuits or mechanisms and will familiarize the technician with the way in which the signal flow diagram and associated pyramid diagram, when required, are to be used for fault-isolation. It also provides the technician with a summary of the total generation path as background for the more detailed description that will follow.
- b. Next, the text shall, in effect, "talk through" each of the signal flow diagrams from source to output. These presentations shall be supplemented, as required for completeness, by reference to second-order supporting diagrams contained in the fault-isolation portion of the manual. As required for clarity, additional supporting illustrations shall be provided. These may include timing diagrams or a block diagram giving a more condensed view of a particularly complex signal flow diagram (see MIL-DTL-24784). Such additional illustrations shall be consistent with the troubleshooting diagrams with respect to nomenclature, symbology, and reference designations. These diagrams shall clearly label and define source and destination input and output signals and mechanical occurrences, and the time and phase relationships.

3.6.4.2.2 Functional elements. Functional elements consisting of electrical, electronic, pneumatic, hydraulic, mechanical, and optical units, shall be described in sufficient detail to provide the technician with a complete understanding of how these elements accomplish their functions. Depth of coverage, which may be defined as detailed circuit analysis or mechanical analysis, shall be restricted to areas of new or unusual design. Descriptions of conventional circuits or devices that are covered in Navy Class A training generally shall not be extended below the level of single function stages or individual active elements; for example, amplifier stage,

rectifier, synchro, motor transducer, and digital logic block. However, the learning objectives of the Class A School should be the determining factor for the depth of coverage.

3.6.4.2.3 Detailed functional elements. When functional elements are new, unusual, or complex in design and therefore require more detailed coverage, such coverage may be presented at one time and not in a straightforward sequence with respect to each individual signal flow diagram. In such instances, specific paragraph references shall be provided in logical functional sequence with respect to each individual signal flow diagram. In such instances, specific paragraph references shall be provided in logical functional sequence for all out-of-sequence text material. Typical examples are as follows:

- a. Unusually lengthy descriptions of complex functional elements (circuitry or mechanism) should be deferred as amplifying information if such descriptions would tend to obscure the continuity of an overall description.
- b. Complex functional elements having identical multiple applications, or one application contributing to two or more output functions, shall be fully described only once and otherwise covered by references to that point in the text.

3.6.4.3 Functional description continuity. The continuity of the general and detailed functional descriptions shall be such that summarizing is not required for understanding combined functions of the equipment as operated in the intended weapon system application. In instances where the various functional units may, by multiple switching, assume a variety of configurations, coverage shall be accomplished by assuming each of the various possible conditions and describing only the modified portion of the signal path, action, or information flow. Illustration of alternate configurations shall be limited to that required to integrate signal modification and control.

3.6.4.4 Detailed analysis. A detailed analysis shall be provided for areas of new, unusual, or complex design. Descriptions of conventional circuits or devices that are covered in Navy Class A training shall be included only to the depth required to integrate them into the overall analysis.

3.6.4.4.1 Detailed analysis text. Detailed analysis text shall be supported as appropriate by detailed logic diagrams and partial electrical, electronic, pneumatic, hydraulic and mechanical schematics (see MIL-DTL-24784). Detailed logic diagrams shall include the level of detail specified in IEEE 991. Detailed mechanical analysis descriptions shall be supported as appropriate by mechanical schematics, gearing and linkage diagrams. Cutaway views shall show internal parts of complex mechanisms in the detail necessary to ensure comprehension of a detailed mechanical analysis. Callouts shall be used to locate each functionally significant part.

3.6.4.4.2 Mathematical analysis. Mathematical analysis shall be provided for equipment elements that perform mathematical functions, such as fire control, guidance, and computer equipment, in sufficient detail that shall provide the technician or trainee with a complete understanding of the mechanics of the equipment performing the function. Mathematics shall be limited to the level of high school algebra, geometry, and trigonometry. However if a higher level of mathematics is required for a valid definition, it shall be presented in the simplest possible

terms, preferably including an approximate equivalent expressed in a simpler form. Mathematics shall not be used to justify design or to describe basic circuit elements.

3.6.5 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 3.6.9.9 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 3.6.9.9.3.2) 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.

3.6.5.1 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."

3.6.5.2 Scheduled maintenance action index. This index shall include all scheduled performance procedures. The index shall be tests and preventive maintenance 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.

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 (note 1)

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

- 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.

3.6.5.3 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 (NSNs).
- 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 NSNs. 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.

3.6.5.4 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 may 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.
- i. Illustrations to support the test.

3.6.6 Chapter 5, Troubleshooting. This chapter shall include an introduction to explain the material content of the volume as related to the PMS (see 6.4.3). The material contained in this portion shall result from a maintenance analysis and verification program and shall provide all information, procedures, and diagrams required by a technician to locate a malfunction in the equipment. This portion shall comprise at least the following items unless otherwise specified in the TMCR:

- a. Introduction.
- b. Supporting maintenance data.
  1. Troubleshooting index.
  2. Maintenance turn-on procedure.
  3. Relay, switch, and lamp index.
- c. Troubleshooting diagrams (see MIL-DTL-24784).
- d. Reference diagrams.

3.6.6.1 Introduction. The introduction shall include a brief explanation of fault-isolation contained in the program, and state that familiarity with trouble-shooting material is required prior to performing any troubleshooting. The text shall briefly explain the purpose, scope, and arrangement of the troubleshooting material. The explanation shall be supported by a sample troubleshooting problem. The text shall require mandatory reporting via PMS Feedback Report (OPNAV Form 4790.7) of any failure of fault-isolation material to lead to a corrective action. The text shall also refer to use of the Table of Established Values if one is provided and if its use relates to material in this portion.

3.6.6.1.1 Sample problem. A sample problem shall be provided for a failure in one of the replaceable components, and procedural text shall be provided to describe typical use of the material contained in the fault-isolation portion of the manual. This text shall be supported by appropriate illustrations, primarily through references to actual diagrams and maintenance procedures. The same problem shall be presented in an overall illustration of how to use the fault-isolation material, using excerpts of the material contained in the manual. Figure 18-9 is a typical example.

3.6.6.2 Supporting maintenance data. This portion shall contain or refer to the data in the following paragraphs.

3.6.6.2.1 Troubleshooting index. The troubleshooting index shall be presented in tabular form (see MIL-DTL-24784).

3.6.6.2.2 Maintenance turn-on procedure. Include a maintenance turn-on procedure to energize the equipment from the fully de-energized condition to full operation (see figure 18-10). This procedure shall enable the technician to determine which major function (see 6.4.1) 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 assume 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, and lamps 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.

3.6.6.2.3 Relay coil, switch, and indicator lamp index. A relay coil, switch, and indicator lamp index shall be prepared in tabular form (see MIL-DTL-24784).

3.6.6.2.4 General troubleshooting information. This portion shall contain general information and procedures to facilitate use of the diagrams for troubleshooting in accordance with the approved manual outline. This information may include data that is applicable to all diagrams and thus need not be repeated in the general notes on each diagram. Examples of such information may include but not be limited to the following:

- a. Method for designating and locating test points
- b. Location and identification of parts by reference designations
- c. Voltage supply measurements to be performed prior to any troubleshooting or testing.

3.6.6.3 Troubleshooting diagrams. Troubleshooting diagrams (see MIL-DTL-24784) shall be categorized as Case A and Case B. Case A diagrams comprised of signal flow diagrams, detail pyramids, summary pyramids, if applicable, ladder diagrams, and power distribution diagrams. Case B diagrams comprised of high density type signal flow diagrams, summary block diagrams, if applicable, ladder diagrams, and power distribution diagrams. The diagrams shall provide

complete coverage of equipment functions for fault-isolation by shipboard maintenance technicians using test equipment and tools available aboard ship. The diagrams shall always lead to a corrective action or to information required by the technician to correct the malfunction in minimum time. Based upon the list of equipment output functions developed by the maintenance analysis and the approved manual outline, the following shall apply:

- a. Every output function shall be shown in a signal flow diagram. Associated functions may be included on one diagram.
- b. Every output function, except noncritical voltages for relay closure and lamp illumination in other equipment of the weapon system or associated equipment, shall be displayed in a separate detail pyramid. Associated functions may be included on one diagram.
- c. Primary power distribution diagrams shall illustrate ships power from the first terminal board, breaker box, or fuse box outside the subject equipment to the various terminal boards and jacks within the equipment where each supply voltage is being distributed. Secondary power distribution diagrams shall illustrate complete internal distribution of each supply voltage, and extend back only to the nearest point where the transformer or dc power supply primary input can be correlated to the appropriate primary power distribution diagram.
- d. The ladder diagram technique shall be used primarily to show all relay coils within an equipment and the path of energizing current for each. However, coils that are in series with the main path of signal flow and that appear on signal flow diagrams or on power distribution diagrams shall not be repeated in relay ladder diagrams. The same technique shall be used for such items as indicating lamps, solenoids, and control mechanisms, as applicable.

3.6.6.3.1 Sequencing of troubleshooting diagrams. The sequence of trouble-shooting diagrams in a manual shall be as follows:

- a. For Case A, each signal flow diagram shall be followed by the detailed pyramid(s) for the output functions depicted on it. Each complex multisheet detailed pyramid shall be preceded by its summary pyramid if one is required. The ladder diagrams shall follow all the signal flow diagrams and pyramids. The power distribution diagrams shall follow the ladder diagrams. Deviations from this arrangement shall be approved by the Government.
- b. For Case B, summary block diagrams shall precede the signal flow or group of signal flow diagrams encompassed by each. The ladder diagrams shall follow all the signal flow diagrams. The power distribution diagrams shall follow the ladder diagrams. Deviations from this arrangement shall be approved by the Government.

3.6.6.3.2 Cross-referencing maintenance documents. Documents shall be cross-referenced to save time required for troubleshooting and to reduce bulk. Point-to-point referencing shall be used within any one type of document, and document references may be used across types where applicable. Point-to-point reference is required in detail pyramids and in signal flow diagrams. Document-to-document reference is to be used when referencing from one category of PMS material to another, as from a detail pyramid to an MRC. The overall criterion for referencing in the maintenance documents requires that the technician shall never be dead-ended during maintenance actions.

3.6.6.3.2.1 Point-to-point reference. Point-to-point reference in a detail pyramid would be: "FROM BOX A4-13, Fig. 3-19, SH 1," and document-to-document referencing from the same pyramid would be: "MRC R-44" shown in a pyramid box. In addition, interface connections shall have FROM or TO notes identifying source of destination equipment, respectively. For example, "From COMPUTER MK 100 via FC SWBD." Point-to-point referencing is required primarily between sheets of multiple sheet diagrams.

3.6.6.3.2.2 Document-to-document reference. Document-to-document referencing pertains to various types of maintenance documentation in the manual in addition to diagrams. It may be either by formal reference, for example, "Fig. 7-21, SH 3" in a troubleshooting index, or by implication to be used as needed; for example, identity of relay contacts on signal flow diagrams permits access to appropriate relay ladders via the relay index. Diagram-to-diagram referencing, a form of document-to-document referencing, may be used to pick up input circuitry for a signal flow diagram from a relay ladder to avoid repeating a long interlock "string." Unless otherwise specified in this document, such cross-referencing requires specific and adequate information at each termination to provide the equivalent of a direct connection between diagrams; for example, "TO 3TB 14-6. Fig. 7-18, SH 2 (A3)."

3.6.7 Chapter 6, Corrective maintenance. This chapter shall reference the equipment alignment, adjustment, repair, replacement, and overhaul information contained on corrective MRCs. Determination of the requirements and maintenance levels, that is, organizational (shipboard), intermediate (tender), and depot or shipyard, shall result from the maintenance analysis and interpretation of the maintenance plan. Additional criteria for establishing maintenance levels shall include, but not be limited to, provisioning data, allowance lists, maintenance lists, maintenance personnel skill requirements, and maintenance echelon facilities. When a separate depot-level manual is required by the TMCR (see 6.2), it shall include the information required by MIL-DTL-24784 and MIL-DTL-24784/7.

3.6.7.1 Introduction. The introduction shall provide a brief explanation of the purpose, scope, and arrangement of the corrective maintenance material, sufficient for an understanding of its use and relationship to the rest of the maintenance documentation. The introduction shall also include and explain the use of a Table of Established Values or an Adjustment Effectivity List, if required by the approved manual outline.

3.6.7.1.1 Table of established values. Any functional parameters with center values dependent upon specific parts or assemblies in the equipment, and which have sufficient accuracy or long-term stability requirements with respect to established center values, shall be listed in a Table of Established Values. Such parameters shall be listed in alphabetical order of symbols or descriptive nomenclature, or by appropriate functional groups, as applicable. Adequate space shall be provided for write-in entries of the actual values pertaining to individual sets of the equipment. In addition the table shall reference the establishing procedure for each datum value to be entered. Usually, this will be an adjustment procedure, but may be the replacement procedure itself if the installed item is to be monitored for long-term stability although no compensating adjustments are required. This table is to be included in the manual and the values are to be entered by the technician using the material. Figure 18-11 is an example of a table of established values.

3.6.7.1.2 Adjustment effectivity list. A cross-reference list shall be provided to relate equipment adjustment and alignment procedures to output functions. All adjustment and alignment procedures for the subject equipment shall be listed in numerical order. For each procedure, the outputs that are subject to change when that procedure is accomplished shall be referenced. When more than one output is affected by a given procedure, the output that is most critical or most sensitive to the procedure shall be flagged, underlined, or marked by asterisks, as governing the priority setting. If two or more outputs are equally critical to one procedure, then only one shall be flagged arbitrarily unless the several outputs are related to different specific portions of the procedure. In the latter situation, the applicable step numbers shall be identified as a reference guide to verification of restored operability following any equipment adjustments resulting from indications other than specific test faults. Figure 18-12 is a sample of an adjustment effectivity list.

3.6.7.2 Yard or tender corrective maintenance. When specified in the TMCR (see 6.2), this chapter shall provide procedures and instructions for performing maintenance that is beyond the capabilities of the ships force. The procedures shall be presented in step-by-step narrative form and shall be supported by selected illustrations, approved by manual outline review, and by reference to appropriate engineering drawings, specifications, ordnance directives, and similar data. The presentation format for yard or tender procedures shall be based upon recommendations submitted in the manual outline and approved by the Government. General overhaul and repair practices shall be presented first. The subsequent sections shall cover the major physical subdivisions of the equipment. For each item requiring replacement, procedures shall be given for removal, installation, and test. If repair is practicable below the level of replacement parts, procedures shall be given. If repair or replacement requires readjustment or alignment, references shall be made to Corrective MRCs when appropriate, otherwise the required procedure shall be included. Procedures that are obvious upon inspection of equipment shall be omitted. Block diagrams illustrating possible sequences of disassembly and reassembly shall be provided.

3.6.8 Chapter 7, Parts list. When an illustrated parts breakdown (IPB) is acquired, the requirements for 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 3.6.8.7). 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.

3.6.8.1 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.

3.6.8.2 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 6.4.2) or unit number and allowance parts list (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.

3.6.8.3 Parts list. The parts list shall be in tabular form in accordance with MIL-DTL-24784. 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 (Subassembly parts)	1A1A1 1A1A1AT1 1A1A1B1 1A1A1C1 1A1A1CR1 1A1A1R1 and so forth
Unit	2 and so forth

3.6.8.4 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 numbers. 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: DIELEC-TRIC 3PF, 500 VDCW; MIL type CCZ1UJ030C.
2	CAPACITOR, FIXED GLASS: DIELECTRIC PF, $\pm 1\%$ 300 VDCW, mfr 86969, dwg 231B743H15.
3	RESISTOR, FIXED, COMPOSITION: 3000 ohms $\pm 5\%$ 1/2w; mfr dwg 4469D69
4	RESISTOR, FIXED, COMPOSITION: 4000 ohms $\pm 5\%$ 1/2w; MIL type RC20GF402J.

3.6.8.5 List of attaching hardware. A standard 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	SCREW, CAP, HEX HEAD, DRILLED HEAD, CRES: MS51100-8 UNF-2A, 1 in 1q.
B	WASHER, FLAT, STEEL, FOUND, 0.750 in. ID, in. OD, 0.066 in. thickness.

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.

3.6.8.6 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.

3.6.8.7 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).

3.6.8.7.1 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.

3.6.9 Chapter 8, Installation. Drawings and information concerning installation shall be provided in this chapter when specified in the TMCR (see 6.2). The following type of information shall be included: site selection, or installation location guidelines (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.

3.6.9.1 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.

3.6.9.2 Site or installation location information. 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.

3.6.9.3 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.

3.6.9.4 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.

3.6.9.5 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.

3.6.9.6 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.

3.6.9.7 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.

3.6.9.8 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.

3.6.9.9 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.

3.6.9.9.1 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 (COSAL) 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.

3.6.9.9.2 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.

3.6.9.9.3 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.

3.6.9.9.3.1 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.

3.6.9.9.3.2 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 trouble-shooting and for a standard to be re-established after overhaul (see figure 18-13). 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 surface missile subsystem or 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. Scope of coverage if other than specified (see 1.1.1)
- c. 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).
- d. Deliverable products and data items (see 3.3).
- e. Arrangement if other than standardized format (see 3.4).
- f. Format and preparation instruction if other than specified in MIL-DTL-24784 (see 3.5).
- g. When LSA or MRC data is required or if the section is to remain blank (see 3.6.5)
- h. When a depot-level manual is required (see 3.6.7).
- i. When procedures and instructions for maintenance beyond the ships force capability is required (see 3.6.7.2)
- j. When IPB is provided a listing of the CAGE codes is required (see 3.6.8)

- k. When installation information is required, specify the drawings, site or installation location, and reference publication required (see 3.6.9, 3.6.9.1 and 3.6.9.3).
- l. Inspection procedures if other than specified (see 3.6.9.9.1)
- m. 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 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).

6.4.2 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.

6.4.3 PMS. PMS for scheduled maintenance, an aspect of the Navy's maintenance and material management system.

6.4.4 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 with respect to the previous issue due to the extent of the changes.

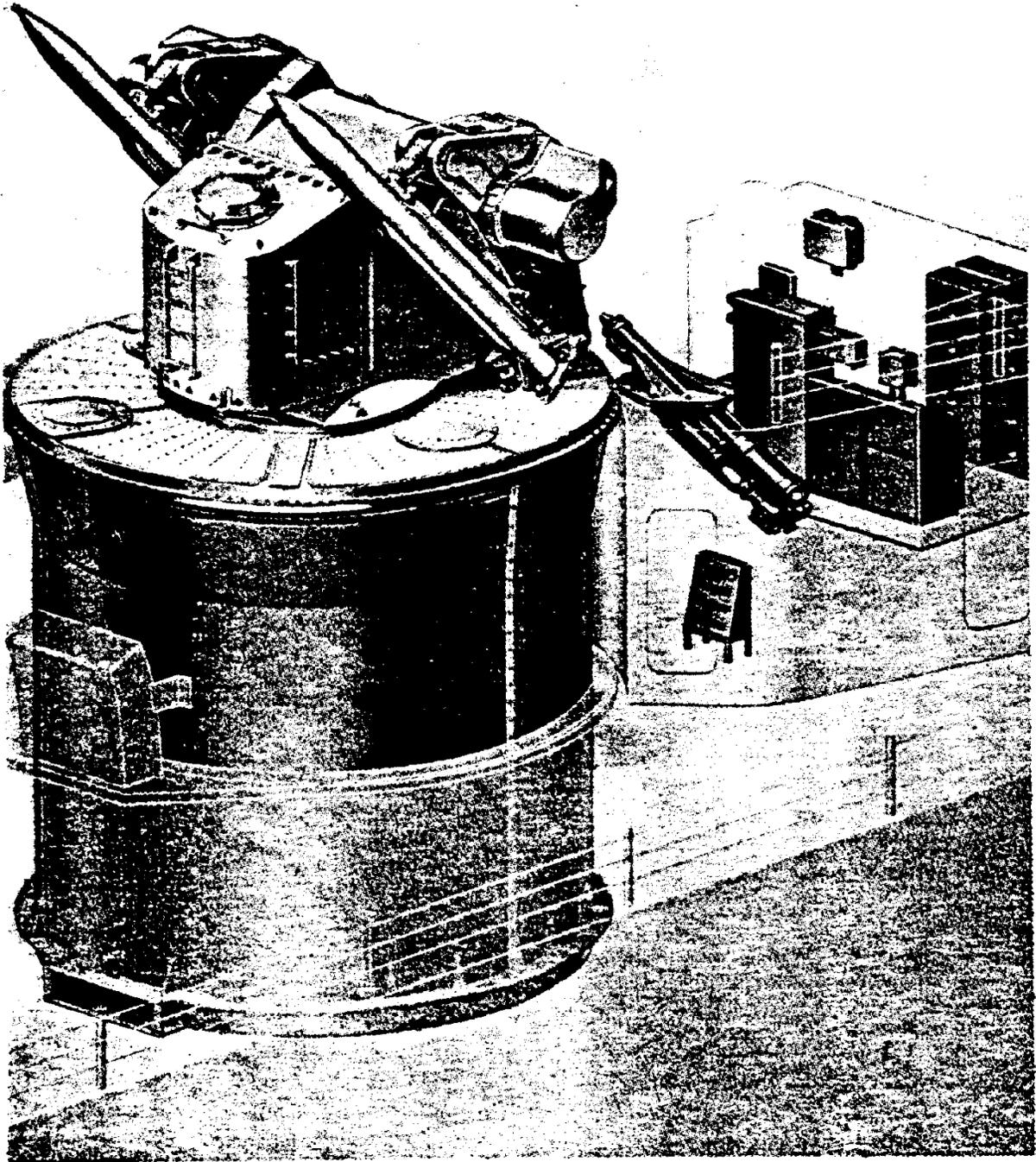


FIGURE 18-1. Frontispiece, typical subsystem.

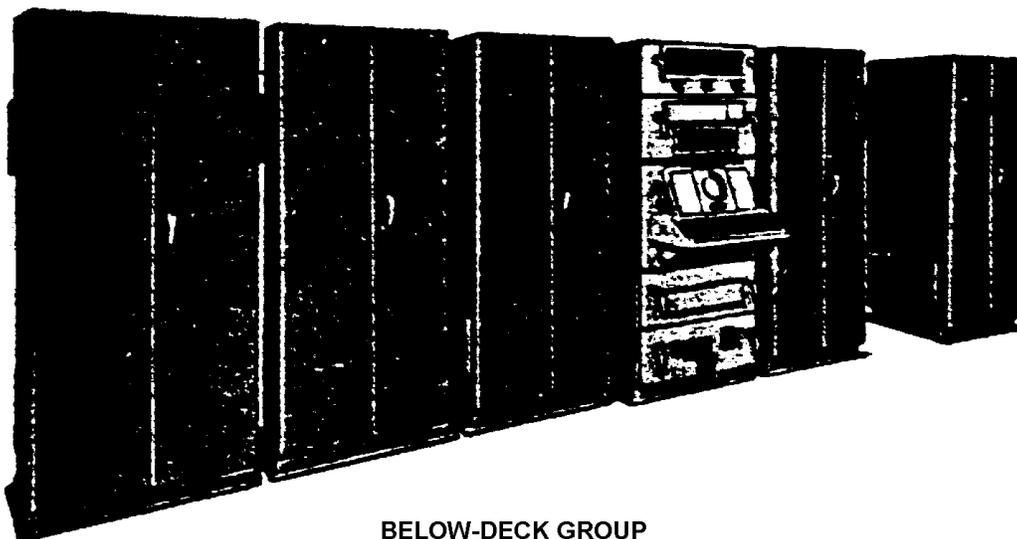
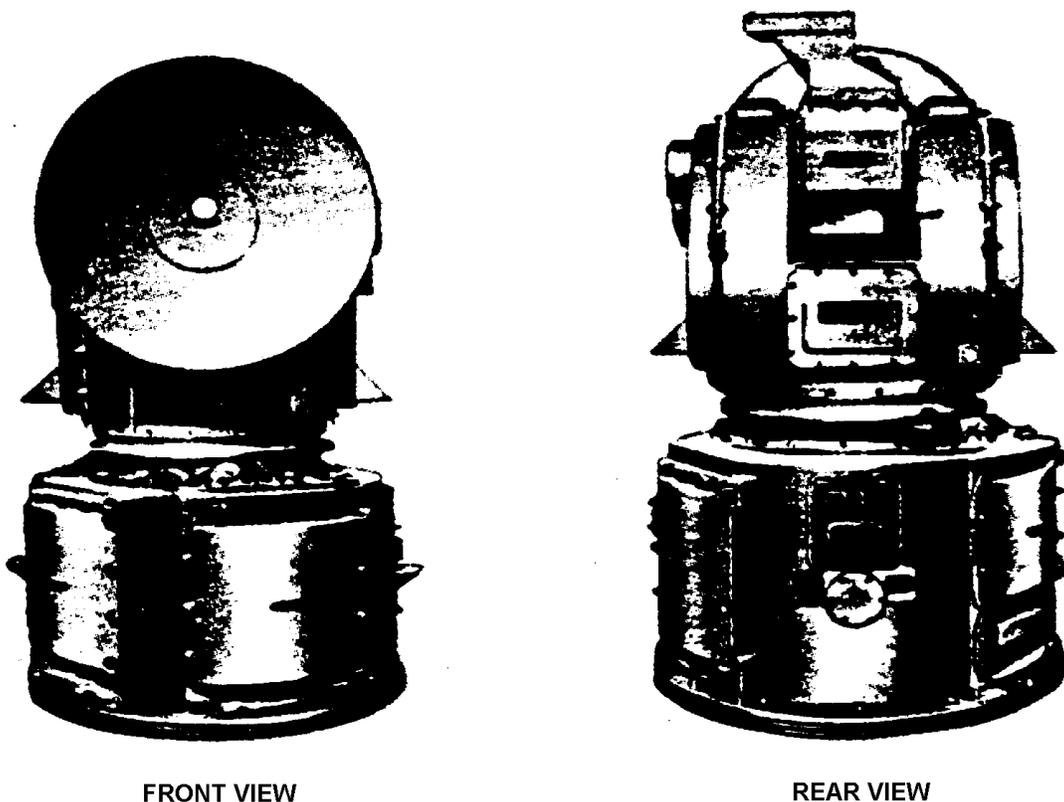


FIGURE 18-2. Frontispiece, typical equipment.

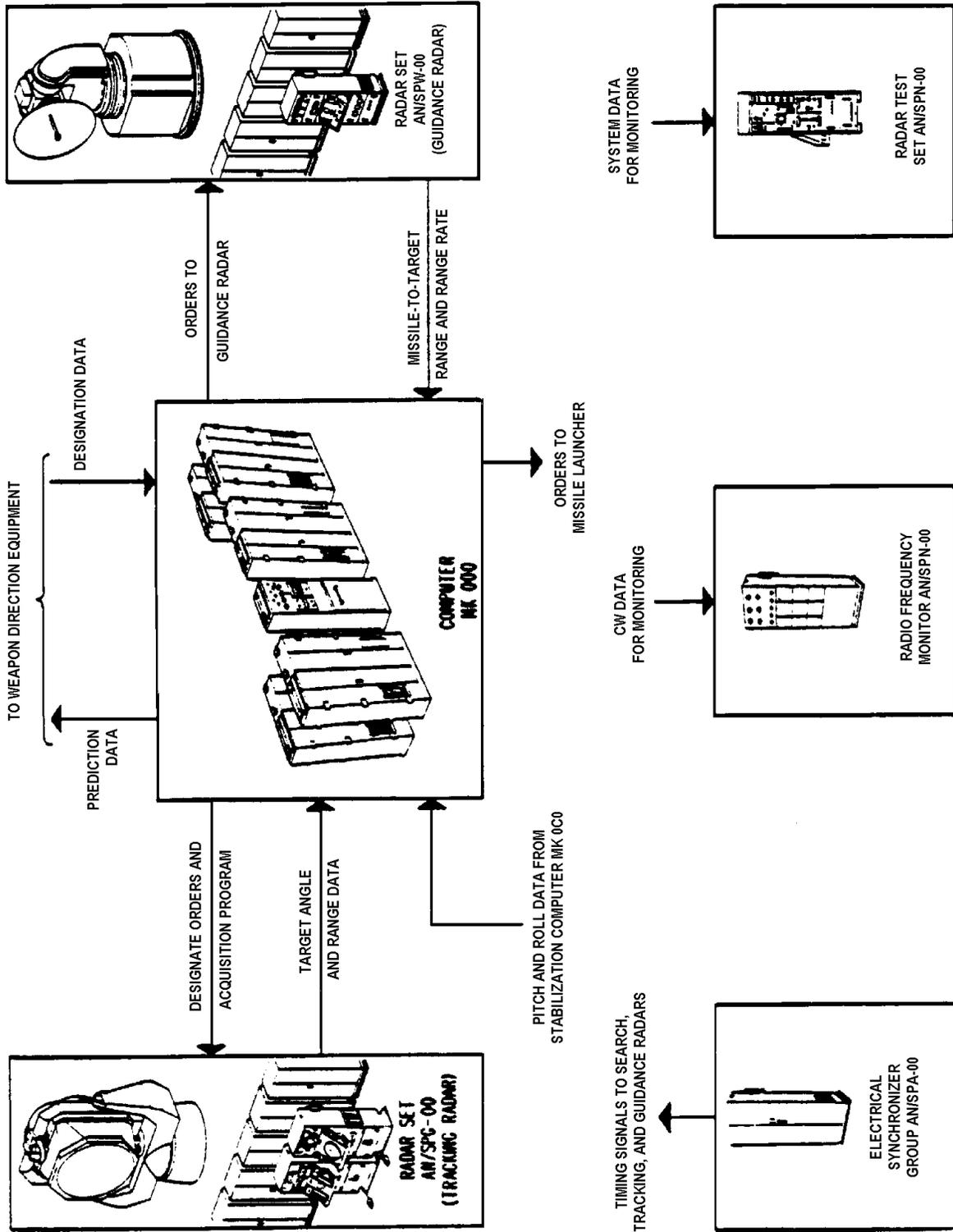


FIGURE 18-3. Equipment/system integration installation

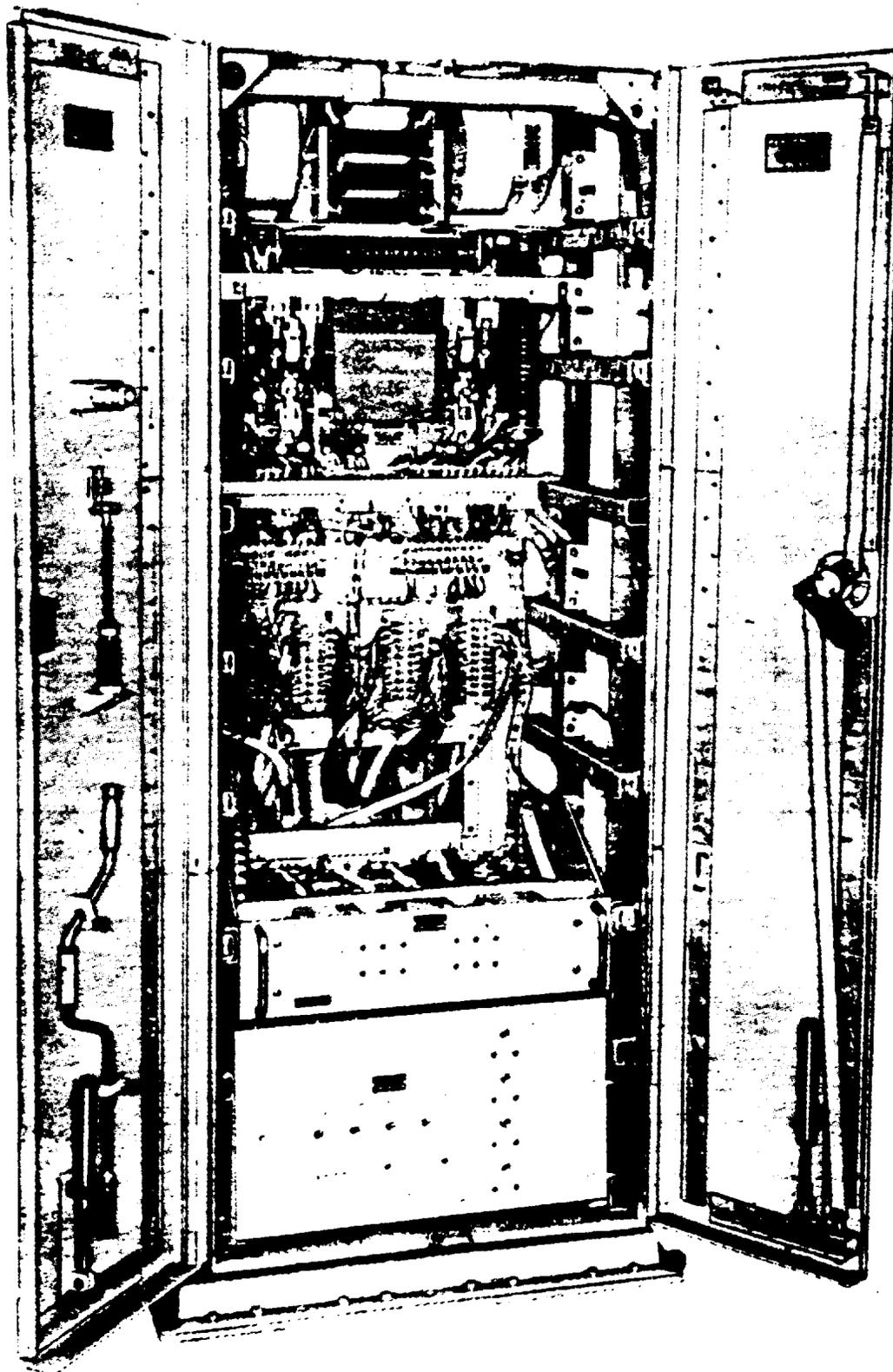


FIGURE 18-4. Physical description illustration, simple equipment.

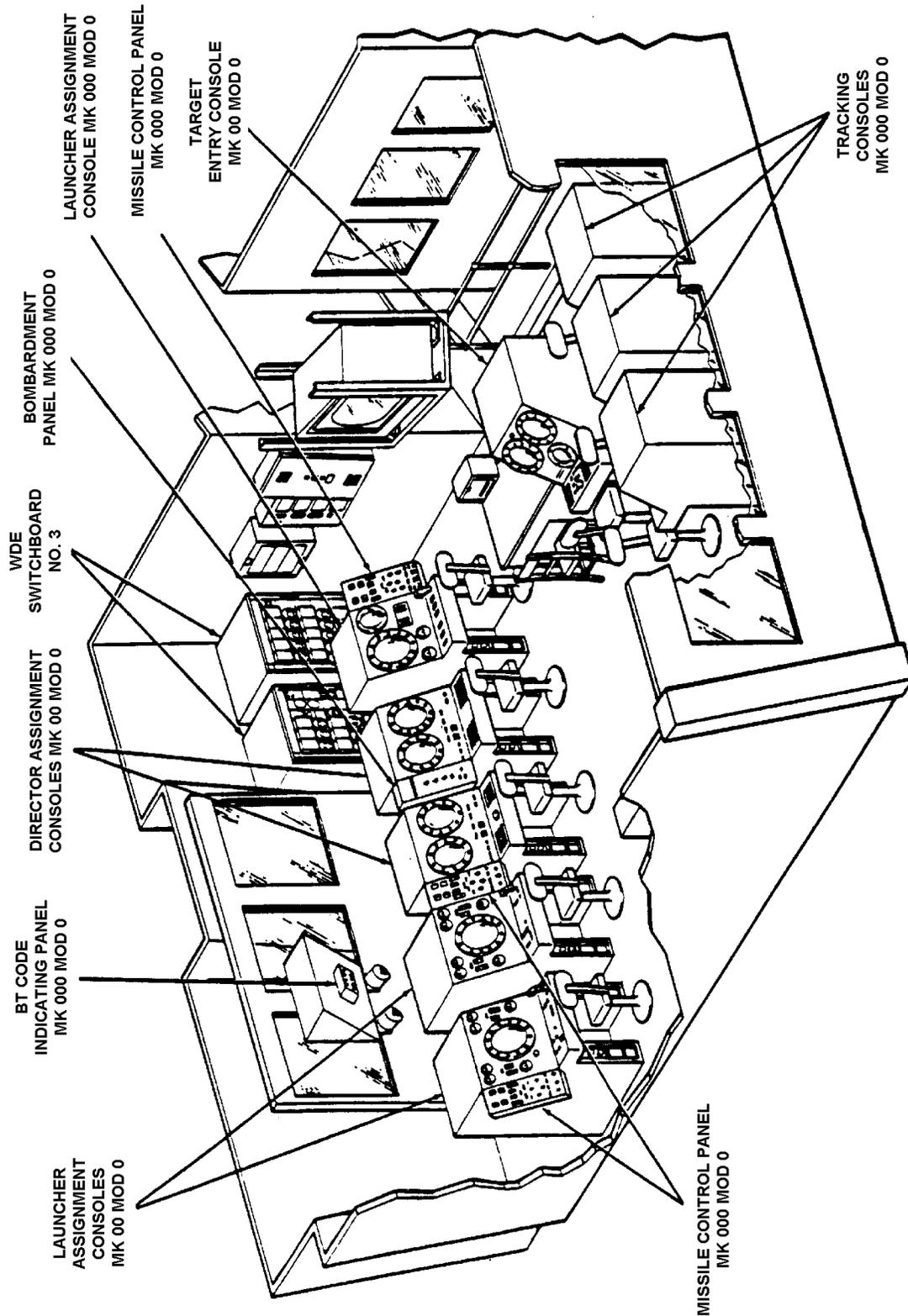


FIGURE 18-5. Physical description illustration, complex equipment

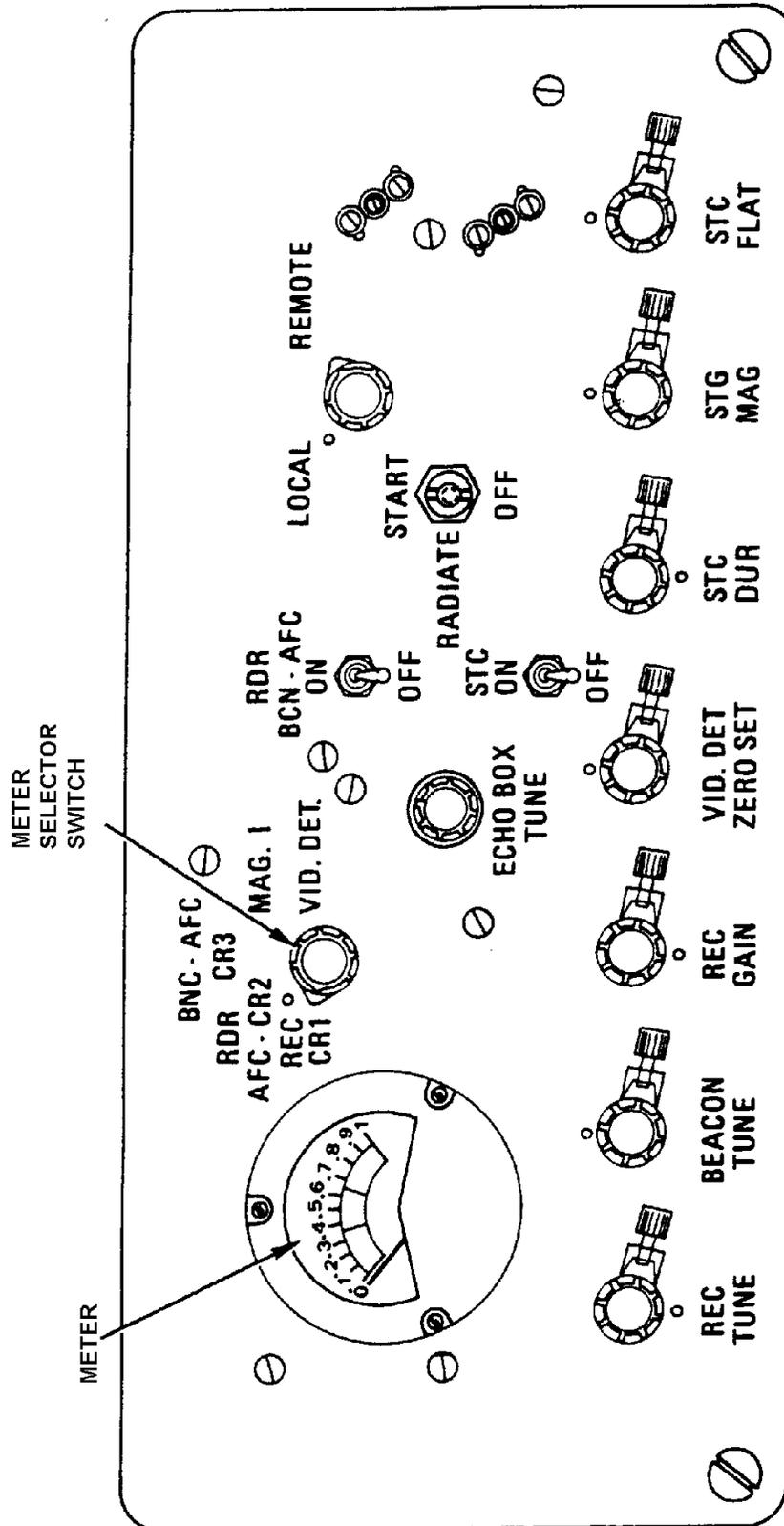


FIGURE 18-6. Equipment controls and indicators.

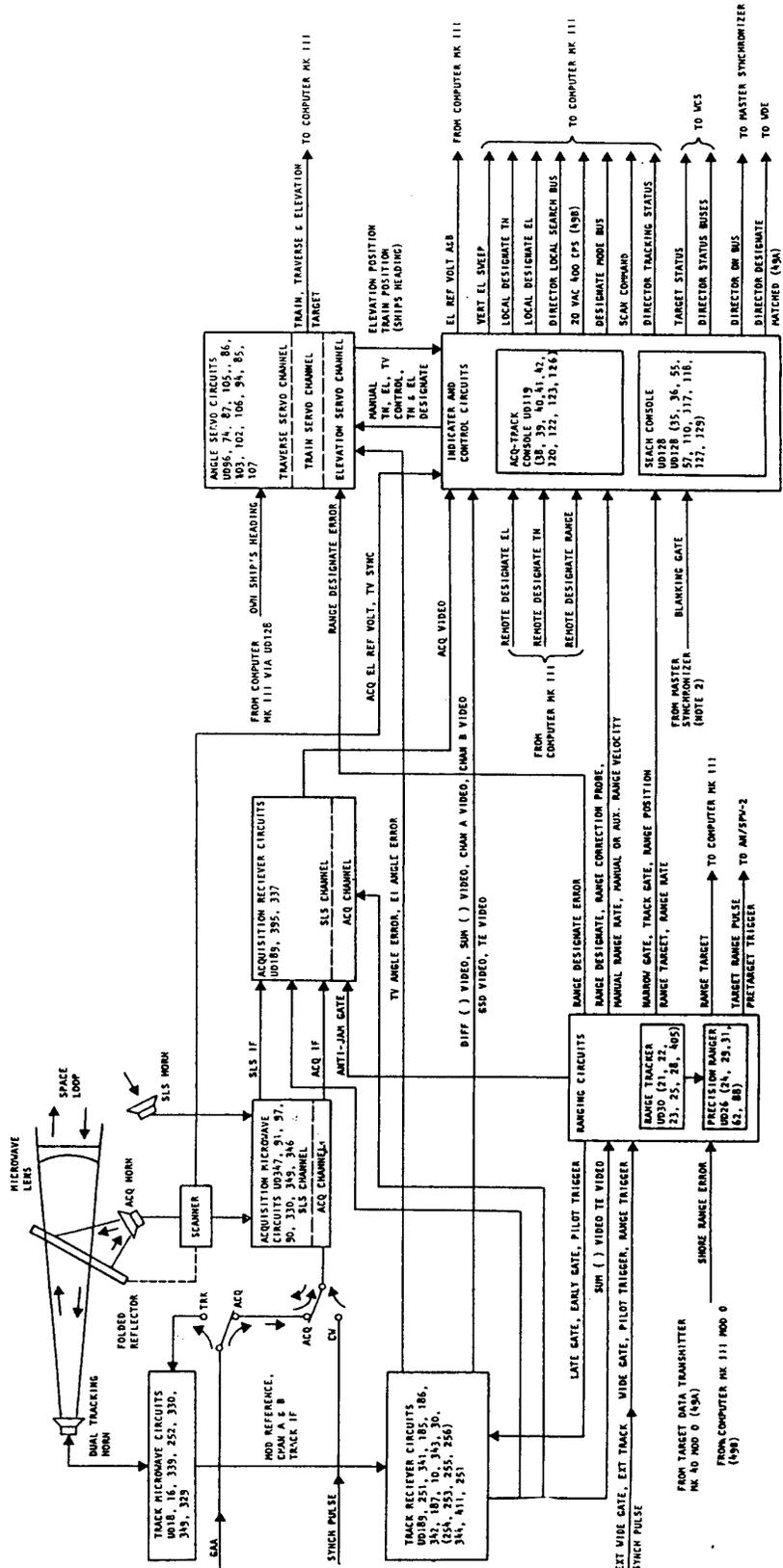


FIGURE 18-7. Equipment/system relationship block diagram (Sample)

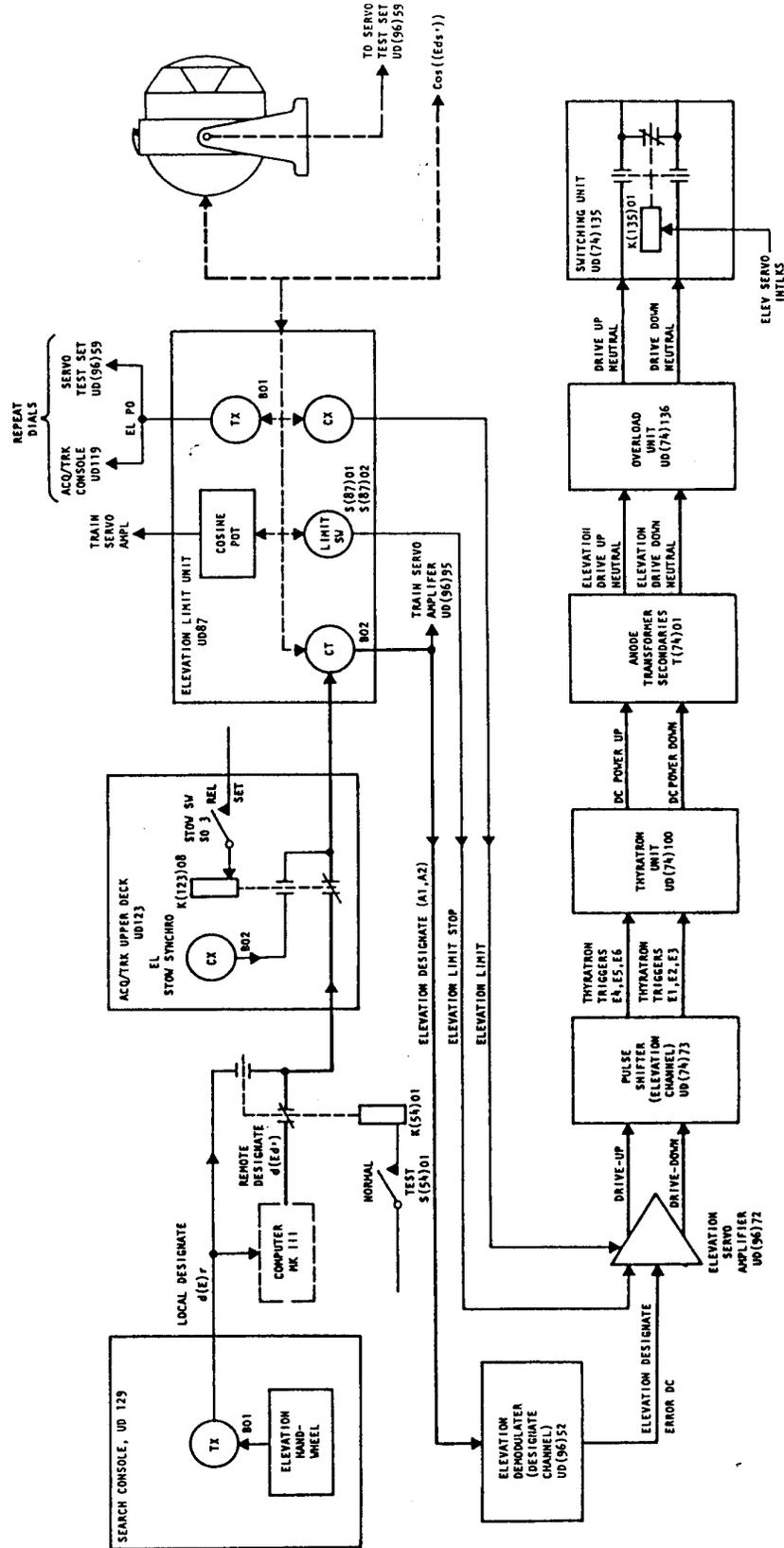


FIGURE 18-8. Functional block diagram, detailed.



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 18-10. Maintenance turn-on procedure.

CLASSIFICATION			
NAVORD OP 0000 (PMS/SMS) VOLUME 0 PART 0			
TABLE 0-0. RADAR SET AN/XXX-00, TABLE OF ESTABLISHED VALUES			
Parameter	Value		Establishing Procedure
	PC IN	PC OUT	
<b>Absolute Range Calibration</b>			MRC R-12
Precision Range Gear Train Range Dial Slippage	_____	_____	
Range of 2nd Range Calibrator Return	_____	_____	
Range of 6th Range Calibrator Return	_____	_____	
Range of 11th Range Calibrator Return	_____	_____	
Range of 16th Range Calibrator Return	_____	_____	
Range of Maximum Range	_____	_____	
Range Calibrator Return	_____	_____	
<b>ACQ-SLS Test Fixture Attenuator Setting AT(20)11:</b>			
SLS switch at BLANK	_____	_____	
SLS switch at CANCEL	_____	_____	
<b>Acquisition Receiver Sensitivity (Pulse Compression Out)</b>	_____	_____	MRC R-19
<b>Angle Servo Input (Elevation):</b>			1. Perform MRC R-5 through R-11. 2. Perform test of figure 5-62, sheet 5, box 19 and record values.
<b>Second Range Calibrator Return:</b>			
3 Mils Up	_____	_____	
1 Mil Up	_____	_____	
1 Mil Down	_____	_____	
3 Mils Down	_____	_____	
<b>4:1 Signal-to-Noise Range Calibrator Return:</b>			
3 Mils Up	_____	_____	
1 Mil Up	_____	_____	
1 Mil Down	_____	_____	
3 Mils Down	_____	_____	
<b>2:1 Signal-to-Noise Range Calibrator Return:</b>			
3 Mils Up	_____	_____	
1 Mil Up	_____	_____	
1 Mil Down	_____	_____	
3 Mils Down	_____	_____	

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CLASSIFICATION

FIGURE 18-11. Table of established values.

Table 4-1. ADJUSTMENT EFFECTIVITY LIST

MR Number	Adjustment/Alignment Procedures	Output
R-1	1. Adjust VERT. POS. RANGE	Preamplifier output dc reference range.
	2. Adjust 2ND STAGE PLATE BAL. And VAR. ATTEN. BAL	Preamplifier output dc reference stability.
R-2	1. Adjust GAIN ADJ.	Preamplifier gain calibration
	2. Adjust attenuator section balance.	Attenuator dc differential balance.
	3. Adjust HF differential balance capacitor.	Preamplifier high frequency differential balance.
R-3	1. Adjust out compensation.	Preamplifier high frequency response.
	2. Adjust input capacitors.	Square-cornered, flat-topped square wave display.
	3. Adjust attenuator capacitors.	Square cornered, flat-topped square wave display.

FIGURE 18-12. Adjustment effectivity list.

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.	Ref. Std.	Paragraph No.	Ref. Std.
8-10	a. _____ Check	8-46	a. _____ $\mu$ V
			b. _____ $\mu$ V
8-21	a. _____ Vdc		c. _____ Check
	b. _____ Vdc		d. _____ $\mu$ V
	c. _____ Vdc		e. _____ $\mu$ V
	d. _____ Vdc		f. _____ $\mu$ V
		8-51	a. _____ Sec
8-33	a. _____ Vdc		b. _____ Check
	b. _____ Vdc		c. _____ Check
	c. _____ Vdc		d. _____ Hz
	d. _____ Vdc		e. _____ Hz
			f. _____ Check
			g. _____ Check

FIGURE 18-13. Installation standards summary sheet.

Custodian:  
Navy - SH

Review Activity:  
Navy - EC

Preparing activity:  
Navy - SH  
(Project TMSS-N324)

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

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