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DETAIL SPECIFICATION

MANUALS, TECHNICAL: GENERAL ACQUISITION AND DEVELOPMENT 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 the general acquisition, format, content, and development requirements of technical manuals (see 6.5.45) and related data in support of weapons systems (see 6.5.52) and equipment (see 6.2 and 6.5.19).

1.2 Purpose. The purpose of this specification is to provide the requirements for the acquisition and tailoring of the types of technical manuals listed in 1.3. This specification along with selected associated detail specifications (see 6.5.4) forms an acquisition package containing all related technical information necessary to establish requirements for properly and uniformly producing acceptable technical manuals. Practices for the format, content and development of technical manuals are also included in this specification.

1.3 Classification. This specification covers the kinds and types (see 3.1.2, 3.1.3, and 3.2) of manuals classified as follows (see 6.2):

Kind	Title
C	Change Package.
R	Revision.

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

Type	Title
3	Combat System Technical Operations Manual (CSTOM).
4	Commercial Off-The-Shelf (COTS) Equipment Manual.
5	Operations Station Book (OSB) for Design, Construction and Major Modification.
7	Technical Repair Standard (TRS) for Hull, Mechanical and Electrical (HM&E) Equipment, Electronic Equipment, and Ordnance Equipment.
10	Training Aid Booklet (TAB).
11	Ship Information Book (SIB).
12	Hull, Mechanical and Electrical (HM&E) Equipment and Single Component Manual.
14	Electronic, Experimental Electronic, Service Test Electronic and Interior Communication (IC) Equipment Manual.
17	Hull, Mechanical and Electrical (HM&E) Systems and Electronic and Interior Communication (IC) Systems Manual.
18	Surface Missile Subsystem or Equipment Manual.
19	Surface Missile System Manual.
20	Digital Systems Manual.
21	Digital Equipment Manual.

2. APPLICABLE DOCUMENTS

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

2.2 Government documents.

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

(See Supplement 1 for list of associated specifications.)

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.

DOCUMENTS

DEPARTMENT OF DEFENSE

DODD 5200.1	DoD Information Security Program.
DOD 5220.22-M	National Industrial Security Program Operating Manual.
DODD 5230.24	Distribution Statements on Technical Documents.
DODD 5230.25	Withholding of Unclassified Technical Data from Public Disclosure.

(Application for copies of DOD documents should be addressed to the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094, or at http://www.dodssp.daps.mil.)

2.3 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 specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. Unless otherwise specified in the Technical Manual Contract Requirements (TMCR), the development of, technical manuals shall be in accordance with the requirements specified herein, the associated specifications, and the applicable appendices of this specification.

3.1.1 Digital Encoding of Technical Publications. Unless otherwise specified in the TMCR (see 6.2), technical publications shall be digitally encoded in accordance with Attachment A1 of Appendix A.

3.1.2 Change package. Except for SGML-tagged Electronic Technical Manuals (ETMs) and Interactive Equipment Technical Manuals (IETMs) changes (see 6.5.6) to existing manuals shall be in the form of corrected replacement pages to the basic manual in accordance with Appendix H. The change package (see 6.5.7) shall incorporate all approved information, all Advance Change Notices (ACNs) (see 6.5.3 and 6.6) and outstanding technical deficiencies (see 6.2).

3.1.3 Revision. Revisions (see 6.5.40) shall be either a complete revision (see 6.5.40.1) or update revision (see 6.2 and 6.5.40.3), and shall be in accordance with Appendix I and applicable associated specification (see 3.2.1 through 3.2.13). There are two forms of revisions: superseding and nonsuperseding (see 6.5.40.2). Revisions shall incorporate current information from previously issued changes to the existing manual. When a revision is acquired to cover a separate

equipment model or a different system application, and the basic issue is not to be superseded, the revision shall be identified as a nonsuperseding update revision. The nonsuperseding update revision shall be classified as "original," have a unique Government identification number on the cover and all pages, and shall not include a supersession notice.

3.1.4 Advertising. Technical manuals shall contain no advertising unless the contract specifies that the equipment (see 6.5.19) manufacturer shall be identified on the cover.

3.1.5 Copyrights and proprietary information credit line. Technical manuals shall not contain copyrighted material except as specified in the Federal Acquisition Regulations and Defense Federal Acquisition Regulation Supplement. When copyrighted material is to be included in a technical publication, the developer shall obtain prior written permission from the copyright owner or authorized agent for its use. The signed, written permission shall be delivered together with the final reproducible copy. The written permission shall contain a statement declaring whether or not a copyright credit line is required. When it is necessary to include copyright and proprietary material, it shall be clearly identified and the following warning statement shall be included on the title page:

> "This document contains copyright or proprietary materials. Infringement of copyright or proprietary material may violate existing Federal laws and statutes and result in criminal penalties, imprisonment, or removal from office."

3.1.6 Security classification, distribution statement and destruction notice. Security classification, distribution statement and destruction notice shall be in accordance with Appendix C (see 6.2). The overall security classification assigned to a technical manual shall agree with the highest classification assigned to any portion within. Security classification markings, and the handling and production of classified material shall be in accordance with DODD 5220.22-M and DODD 5200.1-R. The security markings shall be the same as for other title pages. For destruction notice see C.5.2.12.

3.1.7 Source data. The primary source data for technical manuals shall be engineering drawings and, if a contract requirement, Logistic Support Analysis (LSA) and Logistic Support Analysis Record (LSAR).

3.1.8 Maintenance coverage. Unless otherwise specified in the TMCR (see 6.2), organizational, intermediate, and depot maintenance levels shall be covered in a combined single manual.

3.1.9 Distribution statement. Each technical manual and modification thereto shall be marked, in accordance with DODD 5230.24, to denote its availability for distribution, release, and disclosure without additional approvals and authorizations (see C.5.2.10). This marking shall be in addition to a security classification (see 3.1.6) marking. Additionally, a determination shall be made in accordance with DODD 5230.25 whether the technical manual contains export-controlled technical data.

3.1.10 ETM and IETM Product Delivery. The level of ETM/IETM functionality shall be

identified during Concept of Operations (CONOPS) planning, referenced in the Interactive Electronic Technical Manual Process Plan (S0005-AD-PRO-010). The range and depth of subject matter coverage and the method of delivering information, required by all potential users, must be considered for new, changed, or revised TMs. Special attention shall be given to the fleet, overhaul, and training community's need to have certain long-line diagrams (oversized schematics, timing circuit diagrams, test set-up diagrams, wiring diagrams, and the like) delivered as a separately packaged hardcopy supplement or re-authored to be easily viewed on screen and printed.

3.2 Associated detail specifications. The associated detail specification to be used for acquisition shall be determined by the following paragraphs and the ordering data specified in 6.2. (See also the military equipment specification invoked in the contract or order for any special technical content requirements for a specific equipment.) The following requirements are applicable when specified in the TMCR (see 6.2).

3.2.1 CSTOM. Combat system information concerning design, detailed intersystem interface data, testing, maintenance, and capabilities in fleet user-oriented language and format shall be developed in accordance with MIL-DTL-24784/3. The CSTOM (see 6.6) shall document functional integration of all combat subsystems in performance of the major combat system operational functions (see 6.5.22) of detection and entry, tracking and identification, threat evaluation and threat-to-weapon pairing, and engagement and engagement assessment.

3.2.2 COTS equipment manual. Manuals available off-the-shelf from commercial sources (see 6.5.10 and 6.6) which include operation, maintenance, and other instructions to support equipment in the commercial market shall be acquired in accordance with MIL-DTL-24784/4.

3.2.3 OSB. The OSB (see 6.6) for design, construction or major modification shall be developed in accordance with MIL-DTL-24784/5.

3.2.3.1 OSB for design. The design OSB shall be developed during the later stages of concept design or early in the preliminary design but prior to detail design. The design OSB shall be used for guidance and development of a construction and major modification OSB, computer programming, manning and training, ship design modifications, and design approval documentation.

3.2.3.2 OSB for construction and major modification. The OSB for construction and major modification shall provide information required by the operator to understand and carry out the required functions of the shipboard operational systems.

3.2.4 TRS for HM&E, electronic and ordnance equipment. A Technical Repair Standard (TRS) shall be developed for HM&E, electronic and ordnance equipment in accordance with MIL-DTL-24784/7. Removal, disassembly, inspection and repair step-by-step procedures shall be in accordance with MIL-DTL-24784/7. The TRS shall provide intermediate and depot level support and repair (see 6.5.37) procedures. The TRS for the above equipment shall enable the user to follow procedures and perform a class B overhaul on that equipment.

3.2.5 TAB. A TAB (see 6.6) shall be developed in accordance with MIL-DTL-24784/10. The TAB shall be a schematic or pictorial representation of systems (see 6.5.44) and equipment installed aboard a specific ship. It shall be suitable for use as a training aid for the ship's crew in studying the installed systems of a ship, and as a reference document by engineering and technical personnel.

3.2.6 SIB. A SIB (see 6.6) shall be developed in accordance with MIL-DTL-24784/11. The SIB shall be a system level reference used by operating, maintenance, and overhaul personnel. It shall serve as the primary intra- and intersystem publication for installation and operation of ship systems and equipment. Coverage shall include mechanical, heating, ventilation, air conditioning, piping, electrical, and electronics systems on a ship.

3.2.7 HM&E equipment and single component manual. A topically structured manual (see 6.5.47) shall be developed for HM&E equipment or single components in accordance with MIL-DTL-24784/12. The manual shall provide operation, maintenance (all levels), and installation instructions for HM&E equipment. The manual for single components is applicable to items (see 6.5.27) performing only one function, such as pumps, valves, motors, and so forth, and which is normally integrated into an operating system or subsystem. These manuals shall provide operation, parts lists, installation and maintenance (all levels) instructions.

3.2.8 Electronic, service test electronic, experimental electronic, and IC equipment manual. A topically structured manual shall be developed for electronic, service test electronic, experimental electronic (see 6.2) and IC (see 6.6) equipment in accordance with MIL-DTL-24784/14. The manual shall provide operation, maintenance (all levels), and installation instructions. If the equipment is programmed for production, the manual shall include maintenance instructions, parts lists, and installation, inspection and pre-energizing procedures in accordance with MIL-DTL-24784/14.

3.2.9 HM&E systems manual and Electronic and IC systems manual. A topically structured manual shall be developed for HM&E, electronics, and IC systems in accordance with MIL-DTL-24784/17. The manual shall provide system and subsystem oriented instructions for operation, maintenance, installation, and test data.

3.2.10 Surface missile subsystem or equipment manual. A manual shall be developed for surface missile subsystems of weapon systems as well as separate independent equipment in accordance with MIL-DTL-24784/18. The manual shall provide operation, maintenance (all levels), and installation instructions for surface missile subsystems and equipment.

3.2.11 Surface missile system manual. A manual shall be developed for surface missile systems in accordance with MIL-DTL-24784/19. The manual shall be addressed to the class of ship aboard which the missile weapon system is installed. The system manual shall provide the information necessary for functional understanding of the interrelationships of subsystem or equipment configuration comprising the missile system and the functional interface between that

system and associated systems. The manual shall provide operation, testing, and fault isolation of independent areas within a subsystem or equipment.

3.2.12 Digital systems manual. A manual shall be developed for digital systems (complex combat system, command and control system, data processing system, and so forth) in accordance with MIL-DTL-24784/20. The manual shall provide functional descriptions as well as instructions for operation, maintenance, installation, fault isolation, and test of digital system and subsystem.

3.2.13 Digital equipment manual. A manual shall be developed for digital equipment (data processor, signal processor, and so forth) in accordance with MIL-DTL-24784/21. The manual shall provide functional descriptions as well as instructions for operation, maintenance, installation, fault isolation, and test of digital equipment.

3.3 Development products requirements. When specified in the TMCR (see 6.2), the following products shall be provided in the development and maintenance of a technical manual:

a. Outline and book plan - see 3.5.1 and 6.5.31.
b. Manual issues - see 3.5.1.

    1. Review Draft Copy (RDC) - see 6.5.39 and 6.6.
    2. Preliminary Technical Manual (PTM) - see 6.5.34 and 6.6.
    3. Final Reproducible Copy (FRC) - see 6.5.20 and 6.6.

c. Supplement - see 3.5.1 and 6.5.43.
d. Change package - see 3.1.2 and 6.5.7.
e. Revision - see 3.1.3 and 6.5.40.

3.4 Management data requirements. When specified in the TMCR or statement of work (see 6.2), the following management data products shall be provided in accordance with Appendix A:

a. Schedule and status reports.
b. Cost data.

3.5 Development details. The requirements for the development of technical manuals shall be in accordance with the appropriate associated specification (see 3.2) and the applicable appendices of this specification. Unless otherwise specified in the TMCR, the following requirements apply.

3.5.1 Development products and reports. Outline and book plans, RDCs, PTMs, FRCs, supplements, and digital data shall be in accordance with Appendix A.

3.5.2 Technical manual quality assurance requirements. When specified in the TMCR or statement of work (see 6.2), the following technical manual quality assurance requirements shall be in accordance with Appendix J:

a. Technical manual quality assurance (TMQA) program plan.
b. Quality records.
c. Validation plan.
d. Validation records.
e. Validation certification.
f. Verification disposition records.
g. Verification incorporation certification.

3.5.3 Writing style. The style of writing, level of writing, readability, comprehensibility (see 6.5.12) and referencing shall be in accordance with Appendix B.

3.5.4 Arrangement. Each manual shall be arranged in a standardized format (that is front matter, technical content, appendices, glossaries, indices, and Technical Manual Deficiency/Evaluation Report) and be appropriately divided by volume (see 6.5.50), part (see 6.5.33), chapter (see 6.5.8), section (see 6.5.41), and in accordance with Appendix C.

3.5.5 Safety precautions. Safety and health dangers (see 6.5.14), warnings (see 6.5.51), cautions (see 6.5.5), and notes (see 6.5.30) shall be in accordance with Appendix D.

3.5.6 Tabular material. Tables shall be in accordance with Appendix E.

3.5.7 Graphics. Illustrations, drawings, diagrams, sketches, and graphics shall be in accordance with Appendix F.

3.5.8 Numbering. The numbering of paragraphs, procedures, divisions, issues, changes, illustrations, tables, and publications shall be in accordance with Appendix G.

4. VERIFICATION

4.1 Conformance inspection. Conformance inspection shall be as specified (see 6.2).

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.

Unless otherwise specified, suggested packaging is commercial in accordance with ASTM D3951.

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. Technical publications developed in accordance with this specification are intended for use in the installation, operation, maintenance, repair, personnel training and logistics support of weapon systems and equipment or for accomplishment of assigned missions and to set a style and format standard for related publications for which no other standards exist.

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. The equipment or system models, configurations, and components to be covered (see 1.1).
c. When a new technical manual is required to support an equipment or system, the manual type must be specified (see 1.3 and 3.2).
d. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1).
e. Specify if digital encoding of technical publications is not required (see 3.1.1).
f. Changes must be specified only when they pertain to technical manual corrections resulting from a hardware change or modification. They may also be specified if it has been determined that significant omissions of technical data or information has been identified. Do not specify a change to correct minor or editorial corrections. When changes are justified on the above basis, the change must include the correction of all outstanding temporary or interim changes and may include minor changes (see 3.1.2). Whenever the number of change pages exceeds 25 percent of the total number of pages in the manual, an update revision must be specified (see 3.1.3). When the total number of pages requiring change exceed approximately 50 percent of the total number of pages in the manual, a complete revision must be specified (see 3.1.3). For revision packages, identify when different revision symbols are required (see Appendix I).
g. For change packages, the following must also be identified:

    1. When the existing cover or title page requires the addition of a current distribution statement, warning, and destruction notice.
    2. Applicable change letter and technical manual identification number.
    3. The equipment or system models, configurations, and components to be covered.
    4. When change symbols other than vertical lines are permitted.
    5. When rapid action changes are required.
    6. Availability of existing FRC or printed pages.

7. When interim changes are required. Note: NAVSEA is prohibited from issuing pen-and-ink changes, except for urgent corrections.
8. When advanced changes are required for urgent corrections.

h. Applicable security classification (see 3.1.6). For classified equipment and manuals, attach a DD Form 254 specifying the following:

1. Specify appropriate Distribution Statement if other than Distributions Statement C). Identify whether an Export Control Statement is required.
2. Security classification.
3. Downgrading and declassification notification.
4. Areas requiring security protection.

i. When the depth of coverage is other than that necessary to maintain the equipment or system through organizational (O), intermediate (I), and depot (D) level maintenance as defined by the maintenance philosophy (see 3.1.8). When the maintenance philosophy involves maintenance of the hardware at the "O", "I", and "D" levels, the manual must be developed to cover all levels of maintenance unless a separate manual is under acquisition to cover I and or D levels.

j. Whether or not installation data or chapter is required. Installation chapters are required whenever the military services are expected to or may install or reinstall the equipment or system. Whenever a system or equipment is only to be installed and reinstalled by the shipbuilder or manufacturer, installation information is not required (but may be included) in the manual. However if installation information is not included in the manual, installation data must be available to the Government in other forms such as drawings, procedures, and so forth (see 3.2).

k. Whether the equipment or system is intended for operational (field use), service test, or experimental (see 3.2.8). (If the equipment or system is considered to be experimental but is intended for service test, the manual should be specified as service test).

l. An outline and book plan must be specified whenever a technical manual is required for a new equipment or system (see 3.3).

m. An RDC must always be specified for every new technical manual (see 3.3). An RDC must be specified for each technical manual change package, unless changes to the technical manual have been pre-approved (technical manual deficiency/evaluation reports, engineering change proposals, and so forth) by the Government.

n. Supplement manuals (see 3.3) must be specified when:

1. Classified information can be confined to the supplement manual such that its basic technical manual will be routed as "unclassified".
2. It augments a technical manual to provide for a different model and can be justified as a cost effective method of promulgation.
3. It can be justified as a practical method of promulgation.

o. If the following verification and management data items (see 3.4 and 3.5.2) are to be delivered they must be specified in the statement of work:

1. TMQA program plan.
2. Validation plan.
3. Validation certification.
4. Records.
5. Verification incorporation certification.
6. Schedule and status report. A technical manual schedule and status report will be supplied at the frequency determined by the contract. The report should be in a narrative format and indicate the information necessary to provide a comprehensive management level analysis of all development activities.
7. Technical manual cost report. A technical manual cost report should be developed identifying the final cost of each final manual developed and provided to the Government (see Appendix A).
8. Engineering judgment records report. An engineering judgment record report should be developed for each deviation from technical specification requirements or parameters
9. Level of government review and approval required for the contractor's QAP.

p. Specify the number of weeks required for Government review of technical manual deliverables (see Appendix J).
q. Specify whether contractor support is required during verification (see Appendix J).
r. Specify simultaneous validation and verification where time and equipment facilities availability do not permit separate verification (see Appendix J).
s. Specify a PTM when it is necessary to field equipment for test and evaluation, or when an extended period of use is required prior to Government verification (normally applies to complex equipment and systems only) (see Appendix A).
t. Specify if technical manual deliverables are to be encoded in digital form (for use in electronic printing or for the interchange of text and graphics data) (see Attachment A1 of Appendix A).
u. Specify the delivery media (reproducible camera-ready copy, direct image copies, digital file, disks, tapes, and so forth) of the FRC (see Appendix A).
v. Double column text must normally be specified. When increased effectiveness of presentation results, a single column format is also acceptable (see Appendix A).
w. Specify if photographic negatives are required to expedite the printing of the manual (see Appendix A).
x. Running sheets and instructions must always be specified to accompany FRC (see Appendix A).
y. Specify if replenishment material (see 6.5.38) is required. When replenishment material is specified, it must always be delivered to the Government for subsequent use in reprinting. (No costs other than handling and shipping costs are justified on the acquisition of replenishment material).
z. Specify the use of orthographic diagrams and pattern coding (see Appendix F).
aa. Specify the additional symbology to be provided for mechanical system diagrams (see Appendix F).
bb. 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 Associated Data Item Descriptions (DIDs). This specification is cited in DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), as the source document for the following DIDs. When it is necessary to obtain the data, the applicable DIDs must be listed on the Contract Data Requirements List (DD Form 1423)), except where the DoD Federal Acquisition regulation Supplement exempts the requirement for a DD Form 1423.

DID Number	DID Title
DI-TMSS-80064	Technical manual Schedules and Status Report

The above DIDs were current as of the date of this specification. The current issue of the AMSDL must be researched to ensure that only current and approved DIDs are cited on the DD Form 1423.

6.5 Definitions.

6.5.1 Accuracy. The precision and technical correctness of the contents of a manual. Accuracy includes the requirements that the technical manual reflect the "as built" or "as is" configuration of the associated hardware.

6.5.2 Adequacy. A depth of scope of coverage sufficient to support all tasks and functions at the prescribed level of the user, consistent with the equipment to be used and the mission environment in which the manual is to be utilized.

6.5.3 Advance Change Notice (ACN). A controlled interim change to selected portions of a technical manual. An ACN is used to correct urgent deficiencies that impact personnel safety, impact mission accomplishment, or could result in damage to or permanent degradation of the equipment.

6.5.4 Associated detail specification. The associated detail specification is an extension of a general specification that covers requirements for specific types and kinds of manuals or equipments. The associated specification is prepared in the standard six-section format.

6.5.5 Caution. Highlights an essential operating or maintenance procedure, practice, condition, statement, and so forth, which, if not strictly observed, could result in damage to, or destruction of, equipment or loss of mission effectiveness. Cautions are further explained in Appendix D.

6.5.6 Change. A change is comprised of corrected replacement pages to the basic manual. It consists of technical information that improves or clarifies the basic manual without requiring rewriting or reorganization of the technical content of the basic manual.

6.5.7 Change package. A controlled change to the basic manual or revision comprised of change instruction sheet, certification sheet, title page, list of effective pages, and replacement or additional pages. Each package is identified by a unique Technical Manual Identification Number and each replacement or added page is identified by a change designator.

6.5.8 Chapter. The first major functional division of a publication.

6.5.9 Class B overhaul. Work which requires such overhaul or repair as will restore the operating and performance characteristics of a system, subsystem, or component to its original design and technical specifications.

6.5.10 COTS manuals. Manuals available off-the-shelf from a commercial source which include operation, maintenance, and other instructions for commercial equipment. Commercial manuals are developed to support the equipment in the commercial market.

6.5.11 Component. A composite fabricated unit (generally complete within itself) that is designed to perform a stated service when installed in its proper position.

6.5.12 Comprehensibility. The completeness with which a user in the target audience understands the text or text-graphics combination.

6.5.13 Copy freeze date. The copy freeze date is a date specified by the Government after which no additions, deletions, or changes will be accepted to the publication material. Additions, deletions, and changes after that date will be accumulated for development of a subsequent change or revision of the publication.

6.5.14 Danger. Danger signs are used to indicate a location, equipment, or systems where a imminent hazard exists, capable of producing immediate injury or death to personnel or threatens the primary mission of the ship.

6.5.15 Data base. Source data used in the development of a technical manual. These data consist of such things as specifications, standards, instructions, drawings, engineering design data, LSAR, DCN, SICR, and other similar data..

6.5.16 Data base control. The systematic management and recording of the presence, accuracy, currency, and completeness of the source data. This data includes specifications, standards, instructions, drawings, engineering design data, and logistics data.

6.5.17 Distribution statement. A statement used in marking a technical document to denote the conditions of its availability for distribution, release, or disclosure.

6.5.18 Engineering technical review. The action by engineering personnel to ensure the technical accuracy and adequacy of the source data being utilized in the development of the technical manual.

6.5.19 Equipment. One or more component assemblies capable of performing a complete function and having a specified nomenclature or model identification.

6.5.20 Final Reproducible Copy (FRC). The final document ready for reproduction and publication as an authenticated technical manual including all necessary changes made as a result of validation or verification and Government conditions of acceptance or approval. The delivery media includes, but is not limited to, reproducible camera-ready copy, direct image copies, digital files, disks, tapes, and so forth, as specified.

6.5.21 Foldout page. A foldout page has the same height as, but is wider than, a standard 11 inch page. Foldout pages are folded either 2 or 4 times (depending on width) to assume the dimensions of a standard page.

6.5.22 Function. A group of circuits or other devices which operate together to accomplish a portion of an equipment or system objective.

6.5.23 Hardware. Physical equipment such as machinery, and electronic unit, assembly or component, and so forth.

6.5.24 In-Process Review (IPR). A review of contractual requirements, technical documentation, and technical manual increments which may be carried out at any time during the manual development to:

a. Evaluate the product during the development process.
b. Ensure that the technical requirement, documentation, and manual are being written according to the applicable specifications.
c. Correctly reflect the approved configurations of the appropriate hardware.

6.5.25 Icon. Icons are pictorial images which may be used in lieu of words. See Appendix D for authorized safety icons.

6.5.26 Intermediate product. Work in progress and supporting source data.

6.5.27 Item. A nonspecific term used to denote any product, including systems, materials, parts, subassemblies, sets, accessories, and so forth.

6.5.28 Leading. The vertical spacing between lines of type measured from baseline to baseline (bottom of line to bottom of next line below). Leading is measured in points.

6.5.29 Multivolume manuals. Multivolume manuals are assigned individual technical manual identification numbers. If a volume, because of its bulk, warrants being further divided, the Government will decide how these divisions will be identified. When specified for use by the Government, volumes will be used when a publication exceeds 1,500 printed pages (750 sheets). Foldouts are counted in page units (sheets).

6.5.30 Note. Highlights an essential operating or maintenance procedure, condition, or statement.

6.5.31 Outline and book plan. The detailed scope of the manual with symbolic page and illustration coverage, annotated and appropriately defined to clarify the depth of coverage logically related to the subject of the manual.

6.5.32 Overhaul. The process of reconditioning a system or equipment to conform to the stated performance and technical specifications of the system or equipment with a life expectancy equivalent to similarly configured new systems or equipment. Overhaul is also performed to repair or replace parts and components that have failed or are of marginal quality because of wear, deterioration, or damage so as to preclude premature failure. Installation of authorized approved engineering or field changes may be included as part of the overhaul.

6.5.33 Part. A part is the next lower division of a publication below volume. Parts should normally be separately bound.

6.5.34 Preliminary Technical manual (PTM). A PTM will be developed for interim use to make the technical information available for test, verification, training, and operational use pending receipt of FRC and distribution of printed manuals.

6.5.35 Quality program review. A Government evaluation of quality-related data generated by the contractor as part of the QAP. The Government evaluation determines contractor compliance with the approved TMQA program plan. Quality program reviews evaluate the contractor QAP and should not be confused with technical reviews of technical manuals.

6.5.36 Quality review. A selective comparison of development processes and products with a given set of standards or objectives.

6.5.37 Repair. Work necessary to restore an unserviceable system or component to operational status without change in design, materials, number, location, or relationships of the component parts that have failed or are of marginal quality due to wear, deterioration, or damage. The repair process includes all necessary adjustment, alignment, and calibration procedures.

6.5.38 Replenishment material. Replenishment material consists of two copies of the final manual (all volumes, supplements, and changes thereto) and the photolithographic negatives, masks, and printing instructions. Replenishment material is used for printing additional copies of the manual when required for distribution or stock.

6.5.39 Review draft Copy (RDC). The RDC is used for review and coordination for technical accuracy and adequacy to evaluate the contractor's progress and assess compliance with applicable specifications and terms of the contract. RDC equates to review manuscript.

6.5.40 Revision. A revision is a second or subsequent edition of a published manual which normally supersedes the preceding edition.

6.5.40.1 Complete revision. A complete revision requires rewrite or reorganization of the technical content of the material and is in accordance with the current content requirements as outlined by this specification.

6.5.40.2 Nonsuperseding revision. Normally revisions supersede the preceding edition. However, when a new manual is needed to cover a different configuration of a system or equipment for which there is a high degree of commonality, a nonsuperseding revision can be acquired to minimize cost. A nonsuperseding revision will stand on its own and will be identified by a unique technical manual identification number.

6.5.40.3 Update revision. An update revision incorporates the basic manual, all previous changes, and new data that would require the issuance of an additional change. The update is developed by incorporating applicable portions of pages in the manual (paste-up or minor composition) without requiring rewrite or reorganization of the technical content of the material. It is developed in the style and format of the basic manual.

6.5.41 Section. The first major functional subdivision of a chapter.

6.5.42 Set. A set is a number of individual manuals or volumes which comprises a complete package of operational and maintenance information for an item.

6.5.43 Supplement. A supplement is a subsidiary document which complements information in a related manual.

6.5.44 System. Two or more equipments (sets) or components, each having its own identity and nomenclature, arranged and interconnected to perform a specific operation or function.

6.5.45 Technical manual. Technical manuals are publications that contain instructions for the installation, operation, maintenance, training, and support of weapon systems, weapon system components and support equipment. Technical manual information may be presented in any form or characteristic including, but not limited to, hard copy, audio and visual displays, magnetic tape, discs, and other electronic devices. A technical manual normally contains operational and maintenance instructions, parts lists or parts breakdowns, and related technical information or procedures exclusive of administration procedures. Technical Orders that meet the criteria of this definition may also be classified as Technical Manuals.

6.5.46 Technical Manual Quality Assurance (TMQA) Program. A systemic, coordinated effort to establish a high level of confidence that the technical manual product offered conforms to established, contractually defined technical requirements. A QAP includes efforts by the contracting activity and developing activity including IPRs, validation, and verification.

6.5.47 Topically Structured Technical Manual. A type of manual which relies upon a logical sequence of topics, a narrative style, and necessary illustrations and tables to provide a full description of the operation, maintenance, and repair of an equipment or weapon system. The

topically structured technical manual contrasts with the less common functionally structured manual, which makes far greater use of illustrations to support its brief narrative statements.

6.5.48 Validation. The final quality assurance iteration required of the contractor or developing activity during which the technical manual is tested for technical adequacy and accuracy and compliance with the provisions of the specifications and other technical contractual requirements. Validation is accomplished by actual performance of technical manual procedures on the system or equipment for which the manual was written. Validation is normally conducted at the developing activity or vendor's facility. In extenuating circumstances, validation may be conducted at an operational site.

6.5.49 Verification. The final quality assurance iteration by the Government for acceptance of the technical manual during which the technical manual is tested to determine its adequacy and operational suitability for the operation and maintenance of equipment. Verification may be tailored based on the Government's confidence level in the developing activity's QAP, compliance with provisions of the specifications and other technical contract requirements, and effective integration of logistic support requirements for the tasks to be performed. Verification is conducted with production equipment and with qualified fleet personnel of the prescribed skill level from the operating command or facility assigned to operate and maintain the equipment.

6.5.50 Volume. The first separately bound subdivision of a publication.

6.5.51 Warning. Highlights an essential operating or maintenance procedure, practice, condition, statement, and so forth, which if not strictly observed, could result in injury to, or death of, personnel or long term health hazards. Warnings are further explained in Appendix D.

6.5.52 Weapon systems. Items that can be used directly by the Armed Forces to carry out combat missions.

6.5.53 Work instructions. The written directions for accomplishing tasks of a type and in the detail appropriate to the task and the people performing the task.

6.6 Acronyms used in this specification. The acronyms used in this specification are defined as follows:

a. ACN - Advance Change Notice
b. AMSDL - Acquisition Management Systems and Data Requirements Control List
c. APL - Allowance Parts List
d. ASCII - American Standard Code for Information Interchange
e. CAGE - Commercial and Government Entity
f. CD - Classification of Defects
g. COTS - Commercial Off-the-Shelf
h. CSTOM - Combat System Technical Operations Manual
i. DCN - Design Change Notice
j. DID - Data Item Description

k. DoDISS - Department of Defense Index of Specifications and Standards
l. DTD - Document Type Definition
m. ESDS - Electrostatic Discharge Sensitive
n. ESWBS - Expanded Ship Work Breakdown Structure
o. FOSI - Formatting Output Specification Instance
p. FRC - Final Reproducible Copy
q. GL - Grade Level
r. HCP - Hardness Critical Process
s. HM&E - Hull, Mechanical and Electrical
t. IC - Interior Communication
u. ID - Reference Identifier
v. IPB - Illustrated Parts Breakdown
w. IPR - In-Process Review
x. LSA - Logistic Support Analysis
y. LSAR - Logistic Support Analysis Record
z. NAVSEA - Naval Sea Systems Command
aa. OGL - Overall Grade Level
bb. OSB - Operations Station Book
cc. PDL - Page Description Language
dd. PIN - Part Identification Number
ee. PMS - Planned Maintenance System
ff. PPI - Plan Position Indication
gg. PTM - Preliminary Technical manual
hh. QA - Quality Assurance
ii. QAP - Quality Assurance Program
jj. RAC - Rapid Action Changes
kk. RDC - Review Draft Copy
ll. RGL - Reading Grade Level
mm. RHI - Range Horizontal Indication
nn. SICR - Supply Item Change Record
oo. SGML - Standard Generalized Markup Language
pp. SIB - Ship Information Book
qq. SM&R - Source, Maintenance and Recoverability
rr. SPAWAR - Space and Naval Warfare Systems Command
ss. TAB - Training Aid Booklet
tt. TM - Technical Manual
uu. TMCR - Technical Manual Contract Requirements
vv. TMDER - Technical Manual Deficiency/Evaluation Reports
ww. TMQA - Technical Manual Quality Assurance
xx. TRS - Technical Repair Standard
yy. UATMCS - User Activity Technical Manual Current Sheet

6.7 Subject term (key word) listing.

Associated specification
Change package
Final Reproducible Copy
Preliminary Technical Manual
Outline and book plan
Quality Assurance
Review Draft Copy
Revision
Supplement
Validation
Verification

6.8 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.

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APPENDIX A

DEVELOPMENT PRODUCTS AND REPORTS

A.1. SCOPE

A.1.1 Scope. This appendix establishes the requirements for the development of technical manual data products and reports (that is, outline and book plan, RDC, PTM, FRC, supplements, schedules and status reports, and cost reports). This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

A.2. APPLICABLE DOCUMENTS

A.2.1 General. The documents listed in this section are specified in sections A.4 through A.7, and attachment A(1) of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections A.4 through A.7, and attachment A(1) of this specification, whether or not they are listed.

A.2.2 Government documents.

A.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-PRF-28001	Markup Requirements and General Style Specification for Exchange of Text and its Presentation.
MIL-PRF-28002	Raster Graphics Representation in Binary Format, Requirements for.

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-1840	Automated Interchange of Technical Information.
MIL-STD-38784	Standard Practice for Manuals, Technical: General Style and Format Requirements.

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HANDBOOKS

DEPARTMENT OF DEFENSE

MIL-HDBK-38790	Printing Production of Technical Manuals.

(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.)

A.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.

DEPARTMENT OF DEFENSE

DOD 5010.12-M	Procedures for the Acquisition and Management of Technical Data.
DOD 5220.22-M	National Industrial Security Program Operating Manual.
ISO/IEC 12064-1	Open Document Format: Image Applications, Simple Document Structure: Raster Graphics Content Architecture.

(Application for copies should be addressed to the Government Printing Office, Attention Superintendent of Documents, Washington, D.C. 20402.)

A.2.3 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified in the TMCR, 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).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI X3.4	Information Systems - Coded Character Sets - 7-Bit American National Standard Code for Information Interchange.
ANSI X3.32	Graphic Representation of the Control Characters of ASCII.
ANSI X3.41	Code Extension Techniques for Use with the 7-Byte Coded Character Set of ASCII.

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

JOINT COMITEE ON PRINTING (JCP)

JCP D10	Writing, White and Colored

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(Application for copies should be addressed to the Chief Paper Procurement Section, MMPP, U.S. Government Printing Office, North Capital and "H" St, NW, Washington DC 20401.)

A.2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

A.3. DEFINITIONS

A.3.1 Definitions and acronyms. The definitions and acronyms used in section 6 of this specification apply to this appendix.

A.4. OUTLINE AND BOOK PLAN

A.4.1 Outline and book plan. When specified, an outline and book plan shall be developed for each technical manual. The narrative outline shall be submitted to the Government for acceptance prior to development of the RDC. If rejected, the unacceptable portions shall be corrected and resubmitted. The book plan shall be based on the accepted narrative outline, maintained by the contractor during the technical manual development process, and submitted to the Government for acceptance when development is completed.

A.4.1.1 Narrative outline. The narrative portion of the narrative outline shall indicate the planned technical manual development approach, identify which options are permitted by the contract and associated detail specification, and specify options the contractor is electing to pursue. The outline shall contain the following requirements:

a. A text outline that shall be in accordance with the requirements of the content specification, showing volume (see 6.5.50), part (see 6.5.33), chapter (see 6.5.8), section (see 6.5.41) and paragraph titles to indicate the intended coverage of the various aspects of the equipment or system. Each paragraph title or notation shall be followed by a brief statement outlining the information to be presented. The text outline shall clearly show the specific equipment or system and related procedures and data planned for inclusion in the manual.
b. An illustration outline and a table outline that shall be keyed to the text outline. Each illustration and table listed in the outlines shall be described. The illustration outline shall contain figure numbers, title, information, intent, approximate size and nature of illustration (exploded view, schematic, line drawing). The table outline shall describe the tables by table number and information content.
c. An estimated page count for each chapter and a statement indicating the scope, depth or coverage.
d. A synopsis of the validation approach to the manual content requirements shall be included based on a plan for use as supplied by the Government and a logistics support analysis of the equipment. The synopsis shall indicate coverage on a comprehensive and systematic basis of

the most effective and efficient method of performing necessary maintenance. The synopsis shall be correlated to the LSARs (if available) by direct referencing.

e. For equipment requiring overhaul (see 6.5.32).

1. The approach to be used in presenting the overhaul strategy shall be described. A repair process flow chart shall be used to present the overhaul strategy.
2. The range and depth of outline coverage shall be based upon the LSARs and reliability centered maintenance program of the equipment and the complexity of the planned overhaul and shall include:

a) The minimum procedures and testing requirements to ensure that the class B overhaul can be performed in an efficient manner by a journeyman-level mechanic.
b) The minimum mandatory replacement parts consistent with the required period between planned overhauls.

f. For compound items, the preferred method of data presentation is to divide the major unit into functional volumes and parts. Each assembly should be contained in a separate volume. It may be considered appropriate to present the test data record sheets for an item as a separately bound part of a volume. For HM&E equipment, examination, test, and repair action record data sheets shall be contained in a separately bound part of a volume for each item.
g. The outline shall fully enforce all content requirements.
h. Problems regarding requirements, interpretation, and application shall be identified.
i. Conflicts between guidance documents shall be highlighted.

A.4.1.2 Book plan coverage. After acceptance of the narrative outline, a book plan shall be developed with the content and format requirements of the associated detail specifications. The book plan shall portray the planned manual coverage by volume, division, and so forth, and shall reflect the approved outline. The book plan shall be developed based on the development of a table of contents for each planned volume (including separately bound parts of that volume):

a. A text guide shall list chapter, section, and informative paragraph titles. A brief statement (outlining the content and intended coverage) shall follow each chapter, section, and paragraph title.
b. A list of illustrations and a list of tables shall be keyed to the text plan. Each illustration and table listed shall be described. The illustration plan shall contain figure numbers, title, information content, and approximate size and nature for all illustrations (such as schematic, line drawing, and exploded view). A sample of each drawing type referenced in the illustration plan shall be included.
c. The estimated total number of text and illustration pages per chapter shall be listed.
d. Data for the front matter, including a brief description of the material to be presented in the foreword, shall be developed.

e. Data required for the technical content portion of the manual shall outline the planned coverage by proposed volumes, divisions, and so forth, in accordance with the content and format requirements of the applicable associated detail specification.

A.4.2 Model manual. When specified or approved by the Government, an existing manual covering similar equipment may be used as an outline and that manual shall be marked up and submitted as a book plan. The text from the model manual may be used verbatim with changes to cover the equipment differences and to correct inconsistencies, unclear wording, or obvious editorial or typographical errors. However, the format requirements in this specification shall apply for all new manuals. All inconsistencies, unclear wording, or errors noted in the model manual shall be identified to the Government. All deviations from the model manual shall be approved by the Government.

A.4.3 Milestone schedule. As an addendum to the book plan, a milestone schedule for development of the publication shall be furnished for the individual contract. Milestones to be identified shall include, but are not limited to, the following:

a. Outline and book plan submission.
b. RDC drafting - 25, 50, 75, and 100 percent completion points.
c. Schematic preparation.
d. Parts listing.
e. Editing.
f. Composition.
g. RDC submission.
h. Validation.
i. Reproducible development completion.

A.4.4 Outline and book plan updating. The outline and book plan shall be kept up-to-date throughout the development of the technical manual review draft and until the draft is accepted. Significant changes to the book plan shall be submitted to the Government for acceptance. Improved data presentation shall be a prime justification in developing changes to the outline and book plan.

A.4.5 Outline, book plan, and model manual acceptance. The outline and book plan or model manual shall be submitted to the Government for acceptance prior to development of the RDC. If rejected, the unacceptable portions shall be corrected and resubmitted. The accepted outline, book plan or model manual shall become an addendum to the applicable associated detail specification governing the development of the technical manual to the extent that it agrees with the requirements of the contract. The accepted document shall be available for review and comparison with the RDC at all scheduled in-process review conferences. Acceptance of the outline, book plan or model manual by the Government shall not waive any requirements within the scope of the contract.

APPENDIX A

A.5. MANUAL ISSUES

A.5.1 Manual issues. Three types of manual issues are addressed by this appendix: RDC,PTM, and FRC.

A.5.2 RDC. RDCs shall be developed for review and coordination for technical accuracy (see 6.5.1) and adequacy (see 6.5.2) to evaluate the contractor's progress and assess compliance with applicable specifications and terms of the contract. RDCs shall be submitted for acceptance prior to development of the PTM or FRC.

A.5.2.1 RDC development. The RDC shall be developed as follows:

a. RDC shall be formulated in accordance with the approved outline and represent the configuration of the hardware (see 6.5.23).
b. The text shall be computer generated, double spaced, on one side of the paper and shall contain the exact wording and content intended for the reproducible copy. The RDC may be issued initially in single column format and may include voids where information is not available. The production method may be the most economical method at the option of the contractor. When the RDC is presented in computer or other form such that the paragraphing or symbols cannot be readily understood, it shall be annotated to make the paragraphing and symbols clear to the reviewer.
c. All front matter, text, tables, and illustrations shall meet the content, format, page size and image area requirements of the applicable associated detail specification.
d. The binding edge shall not be less than 1 inch and the outside edge not less than 1/4 inch. The method of duplication, covering and binding shall provide legible, collated copies.
e. Unclassified RDCs shall be duplicated and loose leaf bound in pressboard or equivalent binders.
f. Reproduction of penciled illustrations are acceptable if their technical content, clarity, correctness, and adequacy meet specification requirements. Illustrations submitted for review shall be legible.
g. Illustrations, drawings, and tables shall be final size, complete with titles, figures, and table numbers.
h. Official nomenclature, common names, and equipment abbreviations shall appear in their normal-reading sequence. The nomenclature shall be used consistently in the text, figures, and tables of the text plan. Transposed nomenclature shall be used in illustrated parts breakdowns (IPBs) or indices.
i. The words "REVIEW DRAFT COPY" shall be placed on the cover and title page above the technical manual identification number.
j. The RDC shall be complete in all respects with all in-process review comments incorporated. A completed and signed validation certificate shall accompany the RDC submitted for technical review. Following review, the developing activity shall incorporate all required changes.
k. Shading or color-coding is not required in the RDC but functional boundaries shall be illustrated by dotted lines. Hardware boundaries shall be indicated by dot-dash lines, with

the number of dots corresponding to the level of containment (first level, second level, and so forth).

l. The RDC shall be proofread, technically edited, validated in accordance with the validation plan, and collated in the same manner as the final manual prior to submittal.

A.5.3 PTM. PTM shall be developed for interim use to make the technical information available for test, verification, training, and operational use pending receipt of final reproducible copy and distribution of printed manuals.

A.5.3.1 PTM development. The PTM shall be developed as follows:

a. The PTM shall reflect the style, format and content of the RDC (when applicable) with all Government review comments incorporated and shall be superseded by a final manual.
b. The text shall be technically edited, validated and shall be computer generated. The text shall be typed double column and single spaced so that the conversion effort from preliminary to FRC is minimal.
c. All front matter, text, tables, and illustrations shall meet the content, format, page size and image and requirements of the applicable associated detail specification.
d. The words "PRELIMINARY ISSUE" shall be placed on the cover and title page above the Technical Manual Identification Number. Letters shall be 18-point boldface type and capitalized.
e. Unclassified preliminary copies may be duplicated, loose-leaf bound, and delivered in accordance with this specification.
f. The reproducible copy and integrally-related artwork (including schematics, wiring diagrams, and block diagrams) shall be of sufficient darkness to reproduce clearly at required reproduction size without additional treatment. Illustrations shall be final size, complete with figure numbers and titles.
g. The method of duplication, covering and binding shall provide legible, collated copies.

A.5.3.2 Interim issue of PTM. When PTM is to be provided as an interim edition, preliminary issues for training purposes or for other early uses, or when there is insufficient time (less than approximately 6 months) to permit acceptance and still provide printed final manuals with the delivered equipment, permission to supply PTM shall be requested from the Government. Permission shall also be obtained from the Government prior to shipping the PTM when any required data are missing. Prior to shipment with any equipment, a review copy of the PTM shall be submitted to the cognizant Government representative for approval and acceptance. The delivery of PTM does not relieve the contractor of any contractual requirements pertaining to delivery of complete, adequate, and accurate final manuals. PTMs shall be updated to represent production equipment prior to submittal with the hardware.

A.5.3.3 Replacing PTMs with final manuals. When the contractor is responsible for printing and distribution, a self-addressed, contractor-furnished postcard containing information equivalent to the following notice shall be attached to the title page of all PTMs which accompany the equipment:

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"IMPORTANT NOTICE: This is a preliminary technical manual for (insert nomenclature of equipment), publication (insert number). A copy of the FINAL manual will be forwarded directly to you when printed. Return this card IMMEDIATELY, indicating your activity and mailing address."

A.5.4 FRC. A final document shall be developed ready for reproduction and publication as an authenticated technical manual including all necessary changes made as a result of validation or verification procedures and Government conditions of acceptance or approval. The delivery media shall include, but will not be limited to, reproducible camera-ready copy, direct image copies, digital text and graphic files, disks, tapes, and so forth.

A.5.4.1 FRC development. The FRC shall be developed as follows:

a. The FRC shall incorporate all comments resulting from the technical and format compliance reviews, approved changes resulting from verification, and any comments resulting from interim use of a PTM.
b. Text pages shall be prepared using a word processor or document publishing system (see Attachment A1). A master copy suitable for reproduction shall be printed.
c. The FRC shall include all text pages (including tabular data and emergency page markings when applicable), and reproducible artwork suitable for reproduction.
d. FRC shall be in accordance with MIL-P-38790 and supplied in final size.
e. If required, reduction shall be obtained by positive to positive production without the use of negatives (see 6.2).
f. Type styles and sizes (fonts) shall be comparable to those shown on figure A1. Minimum printed type size for text shall be 10-point elite type. Nomenclature callouts, tabular material, and symbols on illustrations shall be uppercase with 7-point (0.10 inch) minimum printed size. Spacing and lettering shall conserve space without lessening usability or clarity of material. Letters, lines, and symbols shall be of a uniform contrast throughout the text material and shall not touch.
g. The FRC shall be of a quality which will permit reduction to 16mm or 35mm negatives [multiform negatives for foldout pages (see 6.5.21)] suitable for subsequent enlargement to full size photolithographic negatives which may be used to produce offset printing plates.
h. There shall be no drawing data, other than horizontal lines, placed closer than 1/8-inch from the image area limit.
i. Running feet of text pages shall include "Original" at the inboard edge and the page number at the outboard edge.
j. Unless otherwise specified, the FRC shall have the following minimum acceptable features:

1. Double column format for 8 1/2 by 11 inch and larger manuals, single column format for smaller manuals.
2. Single spacing.
3. Justified right margins.
4. Headings prepared using the same software as the text.
5. FRC paper stock shall meet or exceed the requirements of JCP D10.

6. FRC printing (or ink) shall be of such color and consistent contrast to permit quality reproduction.

A.5.4.2 FRC leading and vertical spacing. Layout shall conserve space without lessening usability or clarity of material . Blank pages and spaces shall be avoided whenever possible. Leading (see 6.5.28) and vertical spacing as indicated by figure A-1shall be used for best legibility and conservation of space. Double spacing of text within a paragraph, or similar wastefulness, is unacceptable. Layout practices shall not result in:

a. The first line of a paragraph being at the bottom of a page or column.
b. The last line of a paragraph being at the top of a new page.
c. A sidehead falling on the last line of a page or column.
d. Dangers (see 6.5.14), warnings, (see 6.5.51), cautions (see 6.5.5) and notes (see 6.5.30) being divided so that first lines or group of icons (see 6.5.25) appear on one page and remaining lines or group of icons on another (first lines or group of icons may appear in the left column with remaining lines in the right column on the same page).
e. Dangers, warnings, cautions and notes being separated from the paragraph they apply to (dangers, warnings, cautions and notes may appear in the left column with applicable paragraphs in the right column on the same page).
f. Undesirable location of an illustration or table.

A.5.4.3 Page size and reproduction area for final reproducible copy. Text and artwork shall not exceed the following dimensions for the indicated size manual. Unless otherwise specified, manuals shall be prepared in 8 1/2 by 11 inch size. When specified, manuals shall be produced in accordance with the dimensions of table A.I.

TABLE A.I. Size of printed manuals.

Paper size of printed manuals	Width	Text/Art	Depth	Text/Art	Depth (Including marginal copy)	
(Inches)	(Inches)	(Picas)	(Inches)	(Picas)	(Inches)	(Picas)
4 by 5 ½#	3 1/8	19	4 ½	27	5	30
4 ½ by 7	3 5/8	22	6	36	6 ½	39
4 by 8	3 1/8	19	7	42	7 ½	45
4 ½ by 8	3 ½	21	7	42	7 ½	45
5 ½ by 7	4 ½	27	5 ¾	35	6 ¼	38
5 by 8	4 1/8	25	7	42	7 ½	45
6 ½ by 9 ½	5 ½	33	8 ½	51	9	54
9 ½ by 6 ½	8 ½	51	5 ½	33	6	36
8 ½ by 11	7 ¼*	44	9	54	10	60
17 by 11	15 3/4	94	9	54	10	60

A 4 by 5 1/2 inch manual, volume, or part shall not exceed 200 pages (100 sheets). Double column, each column shall be approximately 3 1/2 inches wide with an approximately 1/4 inch gutter between. Single column shall be 7 1/4 inches wide.

A.5.4.4 Oversize reproducible copy. Unless otherwise specified, final reproducible copy shall be supplied final size. When specified, reproducible copy may be prepared oversize not to exceed 50 percent larger than the prescribed image area for each printed manual page size. Type shall be of such size that after final reduction the text shall be no smaller than that prescribed in figure A-1. When oversize final reproducible copy is specified, reduction shall be positive to positive (without using film) in accordance with MIL-P-38790; when negatives are used, they shall be in accordance with MIL-P-38790.

A.5.4.5 Margin data. Margin data (generally the running heads and feet) shall be placed outside that portion of the page used for either narrative text, full page tabular data or full page illustrations, but within the printing area dimensions of the page. When applicable, margin data also consists of the change number, security classification, page content and equipment identification, figure number and figure title. When pages are deleted, a statement shall be included in the margin of the succeeding page. The margin data shall be mounted on full page illustrations, including those for foldout pages that have been prepared in exact printing size (or in the same size as text pages). Margin data shall not be on an overlay. Text may be separately prepared in single column galleys and then attached to the appropriate layout page.

A.5.4.5.1 Running heads and feet. Complete running heads and feet shall be included on all pages except title pages or pages otherwise blank. Blank pages which back up classified pages shall be marked with the security classification of the backed up page.

A.5.4.5.2 Running heads.

A.5.4.5.2.1 Security classification. The security classification, including unclassified pages, of classified manuals shall be at the top center of each page in bold face type in accordance with DOD 5220.22-M. For foldouts, the security classification shall be marked in bold face type, 3/4 inch from the right-hand edge and repeated continuously to the left with four inches of space between each marking.

A.5.4.5.2.2 Technical manual identification number. The technical manual identification number, as assigned for each volume and part, shall be in bold face type at the upper outer edge of each page and outer segment (page unit) of each foldout page.

A.5.4.5.3 Running feet.

A.5.4.5.3.1 Page number. Page numbers shall be located at the lower outer edge ending at the outside margin and shall be in bold face type. Even numbers, including zero, shall be assigned to left-hand pages and odd numbers to right-hand pages. The page number for a foldout page shall be so placed (lower outer edge ending at the outside margin) that the number will be visible when the printed page is folded.

A.5.4.5.3.2 Issue indicator. When specified, the issue indicator of basic manuals, revisions and the change designator for change pages shall be located at the outer edge of all pages on the same

line as, and 1/2 inch to the inside of, the page number. When specified, the word "Original" shall be included on basic pages.

A.5.4.5.3.3 Security classification. The security classification, including unclassified pages, of classified manuals shall be at the bottom center of each page in bold face type in accordance with DOD 5220.22-M. For foldouts, the security classification shall be marked in bold face type, 3/4 inch from the right-hand edge and repeated continuously to the left with four inches of space between each marking.

A.5.4.5.3.4 Foldout figure number and title. The figure number and title for a foldout page shall be so placed (lower outer corner) that the number will be visible when the printed page is folded.

A.5.4.5.4 Binding edge. When specified, the binding edge shall indicate the equipment or subject to which the manual applies and relate to the prime title. Appropriate abbreviations may be used. Top-bound manuals shall place this information on the top, left-hand corner.

A.5.4.5.5 Outer edge. When specified, significant reference information such as chapter, section or subject titles or paragraph number or figure number shall be used or added. Appropriate abbreviations may be used. Top bound manuals shall have this information placed on the top, right-hand corner.

A.6. SUPPLEMENT

A.6.1 Supplements. When specified, supplements shall be developed. They shall conform in style and format with the existing manual.

A.6.1.1 Classified supplements. The title pages of both the basic manual and the supplement shall contain a cross-reference note. Supplements shall contain the minimum amount of information required to protect security and maintain continuity of thought. Government approval is required for each supplement.

A.6.1.2 Safety supplements. All text, lettering, numbering, and so forth, for safety supplements shall be in red. Detailed requirements for formal safety supplements (see figure A-2) are as follows:

A.6.1.2.1 Safety supplement margin. The abbreviated title of a safety supplement shall have multiple "SS" along the top, bottom, and side borders with the word "SAFETY SUPPLEMENT" at the bottom of the page.

A.6.1.2.2 Title designation. The words "SAFETY SUPPLEMENT" shall be positioned above the words "TECHNICAL MANUAL". The nomenclature shall be the same as the basic manual.

A.6.1.2.3 Supplement notices and replacement notices. A notice shall reference the basic manual supplemented, and, if applicable, reference any publication(s) replaced.

A.6.1.2.4 Responsibility notice. The responsibility notice shall be positioned above the Distribution Statement.

A.6.1.2.5 Distribution statement. Unless otherwise specified, the distribution statement from the basic manual shall be used for supplements.

A.6.1.2.6 Publication date. The publication date shall be the same as the date of the replaced interim safety supplement unless the formal supplement contains additional changes.

A.6.1.2.7 Security information. The security markings shall be the same as for other title pages.

A.6.1.3 Operational supplements. Detailed requirements for formal operational supplements (see figure A-3) shall be the same as for formal safety supplements except:

a. The margin shall consist of multiple "OS" in lieu of "SS".
b. The words "OPERATIONAL SUPPLEMENT" in lieu of "SAFETY SUPPLEMENT".
c. The supplement shall be printed in black.

A.6.1.4 Routine supplements. A routine supplement title page will be the same as operational supplement title page except that the title shall be the single word "SUPPLEMENT" and margins shall be blank.

A.6.1.5 Incorporation of supplements into manuals. Whenever practical, supplements, other than those of a higher classification, shall be incorporated into the manual's next revision.

A.7. TECHNICAL MANUAL SCHEDULE, STATUS AND COSTS REPORTS

A.7.1 Schedule and status reports. A technical manual schedule and status report shall be supplied in accordance with 3.4 at the frequency determined by the contract. The report shall be in a narrative format and indicate the information necessary to provide a comprehensive management level analysis of all development activities.

A.7.2 Cost reports. Technical manuals shall be acquired in a cost-effective manner. Cost and pricing data shall be obtained for each new, revised or changed manual. A separate analysis shall be provided together with supporting documentation for each manual developed. The cost of technical manuals shall be limited to the effort and material needed to produce the manual from source data.

A.8. Technical Manual Plan (TMP).

A.8.1 TMP overview. The TMP reflects the current state of planning for ship, system, and equipment technical manual coverage, based on the known maintenance concept for hardware items. It provides visibility of key TM-events, their relationship with other ILS elements and schedule for their accomplishment. The TMP will be updated periodically to:

a. Define the level of technical manual coverage to be acquired, and the process for development/acquisition of technical manuals.
b. Identify anticipated Contractor or Government TM-preparing activities, so far as known.
c. Specify the quality assurance requirements to be met.
d. Assign review and acceptance authorities.
e. Describe the planned printing, stocking, and distribution criteria.
f. TMs being prepared for delivery as ETMs or IETMs

A.8.1.1 Purpose of the TMP. The TMP addresses, in general terms, those requirements which apply to a ship acquisition project.

A.8.1.2 TM quality. TMs shall be written to the reading and skill levels of the intended target audience to ensure they understand the TM-text and/or text-graphics combination.

A.8.1.2.1 Technical Manual Management Team (TMMT). A select group to monitor and oversee the development and execution of TM-related plans and TM-deliverables shall be organized and convened under the guidance of NAVSEA. The TMMT shall be composed, as necessary, of key representatives from:

a. The Planning Yard {Task and fund to chair in writing]
b. Ship's Superintendent
c. NSDSA
d. Engineering Technical Codes
    1. HM&E
    2. Ord
    3. Electronics
e. CNET/TRALANT
f. The Fleet
g. The Contractor

A.8.1.2.2 Active contractor involvement. The contractor shall recommend specific contractor and Navy participation in technical manual validation and verification effort. The recommendation shall ensure that validation and verification is completed in sufficient time to support ship operational test and evaluation.

A.8.2 Technical Manual Contract Requirements (TMCRs). TMCRs attached to the TM CDRL-exhibit will be divided into three categories: Master, Subordinate, and General (Blanket). TMCRs in conjunction with the appropriate CDRL-exhibit shall require the shipbuilder to provide accurate, adequate, comprehensible, and useable TMs for the operation, maintenance and overhaul of all standard, modified-standard and non-standard contractor furnished, repairable, APL-worthy equipment and systems. TMs shall also be employed as the teaching text-book in Navy training classrooms.

A.8.2.1 Master TMCR. The Master TMCR will specify requirements applicable to all technical manuals and will define the requirements and use of the Subordinate and Blanket TMCRs. The

requirements specified in the Master TMCR, together with the requirements of Subordinate and Blanket TMCRs, will provide detailed guidance to the contractor for development, status accounting, and management of contractor furnished technical manuals.

A.8.2.2 Subordinate TMCRs. Subordinate TMCRs will contain requirements for development of ship specific, general information technical manuals. Subordinate TMCRs, although separately numbered, are contained in the Master TMCR. Unless specific deviations are cited, technical manuals prepared under Subordinate TMCRs must also meet the requirements and procedures of the Master TMCR.

A.8.2.3 General (Blanket) TMCRs. General TMCRs contain requirements for development of contractor furnished new and modified system and equipment manuals, permanent change pages to existing technical manuals, and commercial manuals.

A.8.3 TM-product and TM-data deliverables.

a. TMCRs incorporate all the necessary requirements from appropriate Performance Specs and/or Standards directly into the CDRL contract exhibit. Except for TRSs and COTS Manuals, delivery media of FRC shall be in digital form. The contractor shall recommend a convenient digit-format for any required supplementary materials for COTS manuals.
b. The following Master/Subordinate set, complemented with a small group of stand-alone TMCRs, shall be used:

Master TMCR	Issues		
	RDC	Prel	FRC*
General format			
General style			
General QA requirements			
Outline and book plan requirements		X	X
Status reports			X
TMQA program plan		X	X
Validation plan requirements		X	X

Subordinate TMCRs	Issues		
	RDC	Prel	FRC*
CSTOM	X	X	X
OSB a) for design b) for construction	X	 X X	 X
SIB		X	X
HM&E equipment		X	X
Electronic equipment		X	X

HM&E and electronic equipment	X	X	X
Surf missile subsystem/equipment		X	X
Surf missile system	X	X	X
Updated revisions		X	X
Permanent change pages		X	X

Subordinate TMCRs*	Issues		
	RDC	Prel	FRC*
Propulsion Operators Guide (POG)		X	X
Power switchboards technical manual		X	X
Underway replenishment and cargo/stores/weapons handling manual		X	X
Assault landing craft handling/support services/loadout and flight deck facilities system manual		X	X
Central Control System Manual (CCSM)		X	X

* - Prepare as updated non-superceding revisions; model manuals, from an earlier ship, will be provided)

Stand-alone TMCRs*	Issues		
	RDC	Prel	FRC*
HM&E hardware TRSs		X	X
Ordnance hardware TRSs		X	X
Electronic hardware TRSs	X	X	X
COTS manuals a) review b) supplementary materials	 X	 X	 X X
7. IETMs a) IETM quality assurance data b) IETM validation certification c) Interactive electronic TM	 X	 X X	 X X X

A.8.3.1 Technical Manual Organization Plan (TMOP). A 3-part TMOP shall present the contractor's TM development plan. The TMOP shall explain the purpose and scope of each

technical manual, and the interfaces and overlaps between technical manuals. It will include a schedule for technical manual production and integration.

a. Part-1 of the TMOP shall describe the Contractor's approach to satisfying the TM requirements of the contract. It shall identify each TM, (such as; operator manual, maintenance manual, SIB, and TRS) the Contractor, and shall describe the scope and inter relationships of all TMs (including SRD and GFI) planned for the ship. Specific requests for deviations to requirements in TMCRs shall be highlighted. No changes to requirements cited in TMCRs are permitted, unless specifically authorized.
b. Part-2 of the TMOP shall describe the Contractor's plans and procedures for the development of technical publications, for the control and use of source data, and for the validation of all Contractor-furnished TMs and TRSs, including permanent change pages and revisions.
c. Part-3 of the TMOP shall identify, by graphic or other means, each TM planned for the ship and the specific TMCR to be employed in its development or acquisition shall be identified.

A.8.3.1.1 Intended purpose. The TMOP shall clearly define the intended purpose of each manual, delineate the scope of each manual, and explain the interface and overlap between and among manuals. The TMOP shall include the following information.

a. Description of General Plan for Evolving Technical Manuals. A description of the scope of the technical manual program for the system or equipment under consideration. This shall include a summary of any assumptions, conditions, or limitations affecting the overall TMP along with the reasoning and impact of each on the plan.
b. Method of Use of Data. A detailed description of procedures which will assure that all pertinent design, operation, and maintenance data is adequately, accurately, and clearly reflected in the applicable TMs.
c. Method for Achieving Standardization. A detailed account of procedures to achieve maximum standardization in writing style, art work, nomenclature, abbreviations and symbols.
d. Use of Specifications. Compile a list of TMCRs/TMSRs to be acquired from the NSDSA to support the acquisition process. Provide a listing of anticipated "deliverables" which probably will be cited in the TMCR and your plans to "tailor" the documents to eliminate "overkill", for use during this acquisition. Include a listing of hardware technical specifications which may specify unique/additional TM coverage requirements.
e. Integration and Coordination Between Contractors. Pertinent information concerning agreements with major suppliers of equipment. An explanation of the methods to be used to relate and control the integrating associate contractors or subcontractors.
f. Deliverable TM-Product Review and Approval Process. This section shall describe the general procedures for preparation of TM Outline/bookplans, RDC (manuscripts), preliminary copy, and final repro-copy (hard-copy or digit form). This section shall also include a description of approval procedures [contractor internal and with the government]. Reference to the "Time-Phasing Chart" is suggested to illustrate understanding of expected approval-cycle delays.
g. Validation and Verification Program Procedures and Planning Information. A strategy to produce a validation plan by the TM-developer and scheme to review and comment on Verification Plans prepared by the acquiring activity. Specific reference to already prepared

plans is considered appropriate. Key milestones should be reflected in the "Time-Phasing Chart". A short description of TM-concerns (i.e., Reading Grade Level/Comprehensibility, appropriate range and depth of subject matter, etc.) should be included.

h. Method of "Progressive Transition". A synopsis of the major steps required for progressive transition of the "TM-Data" from the conceptual phase through definition phase to the acquisition phase and including training support. This section should include a synopsis of the process for incorporating "approved" engineering changes into the affected TMs.

i. Time Phasing Chart. A bar chart, pert chart, gantt chart or graphic flow diagram to portray, by year and month, an effort that correlates TM-events to program phasing of training, support, equipment and all other support systems and acquisition program related milestones. These events must be appropriately sequenced into the plan to coincide with acquisition milestone phases of the system or equipment.

j. TM Block Diagram. A presentation (block diagram, manual tree, flow chart, etc) of specific manual coverage proposed for the prime articles, components, support equipment, product end items,and training equipment. The type such as commercial TM, equipment TM, system manual, TRSs, and numbers of these TMs will be indicated. This part of the plan shall include a brief description of the contents of each manual or groups of manuals shown in the graphic presentation. These descriptions will be keyed to and arranged in the same sequence as the presentation and will include:

    1. Specific reference to particular NSDSA-prepared TMCR. Anticipated need to request a waiver from stated requirements for non-compliance will be highlighted (and justified). Describe your understanding of "deletion-tailoring" limitations cited in DOD 5010.12
    2. Any special features or innovations of this TM-project.
    3. Projected requirements of new presentation techniques based upon peculiarities of the system or equipment configurations and maintainability design. (As an example; a better/clearer means of presenting technical subject matter for digital-theory electronics.)

k. Other. The completed TMOP should also include statements relative to the following topics [linked to appropriate sections]:

    1. Production lead time
    2. Proposed delivery schedule
    3. Cost reduction or cost avoidance proposals
    4. In-process review efforts (use of the Fleet and/or CNET during IPRs)
    5. Illustration preparation and control
    6. Control of classified information
    7. Method of handling changes and revisions and incorporating data affecting one or multiple, interrelated manuals
    8. For IETM/ETMs; The method used to identify specific oversized schematic diagrams, timing circuit diagrams, test set-up diagrams, or wiring diagrams to be delivered as hard-copy supplements needed to support the Training Command, Fleet users, IMAs, and Overhaul Facilities.

A.8.3.2 Ship class, system, and equipment TMs. TMs shall encompass all functional areas of the ship, i.e., HM&E and Electronics (including ordnance, communications, etc.). Ship Class TMs include hull unique, and ship system/equipment-level manuals as well as handbooks, lists, guides, charts, standards, etc., specified in the Ship's Spec.

A.8.3.2.1 Contractor responsibilities. TMCRs together with the Acquisition Specifications and DD Form 1423, Contract Data Requirements List (CDRL), shall describe the contractor responsibilities for the acquisition and development of technical manuals. Ship class manuals will be developed and maintained in accordance with NAVSEAINST 4160.3A, S0005-AA-PRO-010, and the applicable TMCRs.

A.8.3.2.2 Central Control System (CCS) manual. A CCS manual shall be developed to cover the operation and maintenance of the main and ship control consoles. The CCS manual shall be prepared as a system-level manual.

A.8.3.2.3 Propulsion Operator's Guide (POG). The POG shall provide technical information and data, in summary form, for start-up, normal operations, shut-down, damage/casualty control, and fault isolation for the propulsion plant and major auxiliary systems. The POG shall be developed for publication as a pocket-sized manual, in accordance with the requirements of the applicable TMCR. A Model Manual will be identified.

A.8.3.2.4 Stores Handling and Fueling-at-Sea (SHFS) manual. The SHFS shall describe, in detail, the ships' fueling-at-sea and replenishment-at-sea capabilities. The SHFS manual shall contain a summary of all replenishment, fuel and stores handling equipment, describing their functions and stowage locations if portable or mobile. The SHFS shall be prepared as a system-level manual.

A.8.3.2.5 Weapons Systems Handling and Stowage (WSHS) manual. Shall describe, in detail, each step of the shipboard handling procedures required for replenishment, reloading, maintenance, and stowage of weapons. The manual shall include a summary of all pertinent data for the stowing of weapons to be accommodated.

APPENDIX A

USE	TYPE STYLE	CAPITAL-IZATION	LEADING	VERTICAL SPACING
Publication Number	San Serif Bold 10	Upper Case	—	30-Points from Top of Page
Page Number	San Serif Bold 10	—	—	30-Points from Bottom of Page
Change Number	San Serif Bold 10	Upper and Lower Case	—	30-Points from Bottom of Page
Page Content/ Equipment Identification	San Serif Bold 10	Upper and Lower Case	2	30-Points from Top of Page
Security Classification	San Serif Bold 14	Upper Case	—	30-Points from Top and Bottom of Page
Deleted Page Notation	Serif Bold 8	Upper and Lower Case	2	30-Points from Top and Bottom of Page
Part Number, Chapter Number and Title	San Serif 14	Upper Case	6	48-Points Below Publication No.: 18-Points Above Text, Table, or Illustration
Section Number and Title	San Serif 14	Upper Case	6	28-Points Below Publication No.: 24-Points Below Chapter Title: 18-Points Above Text, Table, or Illustration
Table of Contents, List of Illustrations, List of Tables, Foreword/ Preface/ Introduction, Safety Summary, Index, Glossary and Appendix Headings	San Serif 14	Upper Case	—	48-Points Below Publication No.: 18-Points Above Text
Text	San Serif 10	Upper and Lower Case	1	18-Points Below Publication No., Chapter/Section Title: 12-Points Above/Below Table or Illustration; 6-Points Above Page No.; 6-Points Above/Below Danger, Warning, Caution and Note Headings

FIGURE A-1. Style, capitalization, leading and vertical spacing. (sheet 1 of 3)

APPENDIX A

USE	TYPE STYLE	CAPITALIZATION	LEADING	VERTICAL SPACING
Emphasis	Italic Bold 10	Upper and Lower Case	1	—
Formulas and Equations	Math 10	Upper and Lower Case	1	12-Points Above/Below Text, Table or Illustration
Primary Sideheads	San Serif 10	Upper Case	2	18-Points Below Publication No., Chapter/Section Title: 12- Points Above/Below Table or Illustration; 6-Points Above Page No.; 6-Points Above/Below Warning, Caution and Note Headings
Subordinate Sideheads	San Serif 10	Upper and Lower Case	2	18-Points Below Publication No., Chapter/Section Title: 12- Points Above/Below Table or Illustration; 6-Points Above Page No.; 6-Points Above/Below Warning, Caution and Note Headings
Figure Number and Title	Serif or Italic Bold 10	Upper Case for First Letter of Each Principal Word	2	18-Points Below Illustration
Legend Text	San Serif 8	Upper Case for First Letter of First Word	1	28-Points Above Illustration
Legend on Artwork	San Serif 8	Upper Case	1	As Required
Table No. and Title	Serif or Italic Bold 10	Upper Case for First Letter of Each Principal Word	2	18-Points Above Table
Boxhead Titles	Serif 10	Upper Case for First Letter of Each Principal Word	1	—
Table Text	Serif 10	Upper and Lower Case	2	—

FIGURE A-1. Style, capitalization, leading and vertical spacing. (sheet 2 of 3)

APPENDIX A

USE	TYPE STYLE	CAPITAL-IZATION	LEADING	VERTICAL SPACING
Rules	¾ Point Width	—	—	—
Footnotes	Serif 8	Upper and Lower Case	1	18-Points Below Text or Table
Warnings and Cautions (Headings)	San Serif Extra Bold 10 (Boxed)	Upper Case	—	6-Points Above and Below Text
Notes (Headings)	San Serif Extra Bold 10	Upper Case	—	6-Points Above and Below Text
Maintenance Parts List, Numerical Index and Reference Designation Index Column Heads	San Serif 8	Upper Case	1	—
Maintenance Parts List Text	San Serif 8 or 10	Upper and Lower Case	1	—
Numerical Index and Reference Designation Index Text	San Serif 8	Upper and Lower Case	1	6-Points Space After Every Tenth Entry
All type sizes may be plus-or-minus one point. Slight variations in spacing and leading are permitted. Final reproducible copy shall use above type sizes.				
IT IS NOT THE INTENT OF THIS SPECIFICATION TO SPECIFY THE METHODS OR COMPOSING EQUIPMENT TO BE USED, BUT ONLY TO SPECIFY REQUIRED RESULTS				

FIGURE A-1. Style, capitalization, leading and vertical spacing. (sheet 3 of 3)

APPENDIX A

T.O. ATS-1F-4E-2-14SS-1

SAFETY SUPPLEMENT

TECHNICAL MANUAL

MAINTENANCE INSTRUCTIONS

INTEGRATED ELECTRONIC CENTRAL

TARGET IDENTIFICATION SYSTEM ELECTRO-OPTICAL (TISEO)

USAF SERIES F-4E AIRCRAFT

THIS PUBLICATION SUPPLEMENTS T.O. ATS-1F-4E-2-14 DATED 15 JULY 1977. Reference to this supplement will be made on the title page of the basic manual by personnel responsible for maintaining the publication in current status.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AFFECTED AF PERSONNEL.

DISTRIBUTION STATEMENT: Distribution authorized to U.S. Government agencies only, administrative and operational use, 20 June 1990. Other requests for this document shall be referred to OO-ALC/MMDO, Hill AFB, Utah 84056-5609.

WARNING: This document contains technical data whose export is restricted by the Arms Export Control Act (Title 22, U.S.C., Sec 2751 et seq) or the Export Administration Act of 1979, as amended (Title 50, U.S.C., App 2401 et seq). Violations of these export laws are subject to severe criminal penalties. Disseminate in accordance with provisions of AFR 80-34.

HANDLING AND DESTRUCTION NOTICE: Comply with distribution statement and destroy by any method that will prevent disclosure of contents or reconstruction of the document.

Published under authority of the Secretary of the Air Force

1 JULY 1990

1. Page 2-34, subparagraph 2-49.g. of basic manual is amended to read:

g. ATS TRAINING SAMPLE. The PO and P1 tag may be followed by a paragraph title. This title is ended, and the actual text of the paragraph begun, with a backslash character. If there is no title for the paragraph, the tag should be followed immediately with a backslash.

2. Page 12-83 of basic manual is amended to add Warning preceding subparagraph 12-158.b. to read:

WARNING

After TCTO 1F-4-9876 the mount's antenna cable connector must be wrapped with silicone tape and cable stowed to mount with a retaining strap prior to installing mount in aircraft.

3. Page 14-78 of basic manual is amended to add Warning preceding subparagraph 14-161.b. to read:

WARNING

After TCTO 1F-4-9876 the mount's antenna cable connector must be wrapped with silicone tape and cable stowed to mount with a retaining strap prior to installing mount in aircraft.

SAFETY SUPPLEMENT 1

FIGURE A-2. Safety supplement.

APPENDIX A

T.O. ATS-11P3-2-9-7S-5

OPERATIONAL SUPPLEMENT

TECHNICAL MANUAL

STORAGE AND MAINTENANCE PROCEDURES

BAROSTAT LOCK INITIATOR

F-111 SERIES AIRCRAFT

PART NO. 90166-5

THIS PUBLICATION SUPPLEMENTS T.O. ATS-11P3-2-9-7 DATED 5 FEBRUARY 1979 AND FORMALIZES INTERIM OPERATIONAL SUPPLEMENT T.O. ATS-11P3-2-9-7S-5 DATED 9 JULY 1987. Reference to this supplement will be made on the title page of the basic manual by personnel responsible for maintaining the publication in current status.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AFFECTED AF PERSONNEL

DISTRIBUTION STATEMENT: Distribution authorized to U.S. Government agencies only, administrative or operational use, 15 April 1987. Other requests for this document shall be referred to OO-ALC/MMDO, Hill AFB, Utah 84056-5609.

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HANDLING AND DESTRUCTION NOTICE: Comply with distribution statement and destroy by any method that will prevent disclosure of contents or reconstruction of the document.

Published under authority of the Secretary of the Air Force

1 JULY 1990

1. Page 3-59, figure 3-13 (sheet 1 of 3), NOTES of basic manual is amended to add NOTE 3 to read:

   3. CLEARANCE BETWEEN FORWARD AND AFT VARI RAMP AND INTAKE STRUCTURE, TOP AND BOTTOM, SHALL BE 0.060 MINIMUM OPERATING CLEARANCE.

2. Page 4-2, table 4-1 of basic manual is amended to change LIFE (MONTHS) SHELF and SERVICE columns from 102 to read 120.

3. Page 4-28, paragraph 4-15 of basic manual is amended to renumber existing subparagraph j. through o. to read i. through n. and renumber existing subparagraph i. to read o. and insert in proper sequence.

4. Page 6-12, paragraph 6-32, reference to PPP-T-620 (4 places) of basic manual is amended to read T-T-620 (4 places).

FIGURE A-3. Operational supplement.

APPENDIX A

ATTACHMENT A1

DIGITAL ENCODING OF TECHNICAL PUBLICATIONS

A1.1. SCOPE

A1.1.1 Scope. This attachment specifies the digital encoding or digitization requirements associated with the development and delivery of technical manuals conforming to the format requirements of this specification. This attachment is mandatory for each FRC or final manual deliverable, and the information contained herein requires compliance. These requirements are not applicable to other technical manual products such as RDC, PTM, and so forth.

A1.2. SOURCE FILE DEVELOPMENT REQUIREMENTS

A1.2.1 General requirements. Manuals developed in general accordance with this specification shall conform to the document type definition in accordance with MIL-STD-38784. Technical manual and artwork shall meet the requirements of this specification, including the requirements specified for FRC printed form and style (see Appendix A, A.5.4). All corrections required due to verification and review of the preliminary manuals shall be incorporated. Technical manual in digital form shall conform to the requirements specified in MIL-STD-1840, MIL-PRF-28001, MIL-PRF-28002, ISO/IEC 12064-1, and the requirements set forth in this attachment.

A1.2.2 Textual source file requirements. Textual material marked in accordance with MIL-PRF-28001 is referred to as a text source file. A complete SGML-tagged source file(s) of all text data (SGML Instance) is a mandatory part of each final technical manual product.

A1.2.3 Graphic source file requirements. Illustrations artwork, photographs and other graphic material shall be developed in accordance with MIL-PRF-28002 and ISO/IEC 12064-1. This data is referred to as a graphic source file. Raster illustration or graphic source files for all figures and illustrations shall be a mandatory part of each final technical manual product.

A1.2.4 Source file interchange format. The format of all digital source files shall be in accordance with MIL-STD-1840. It is the source files to which all subsequent changes and updates must be made to maintain the technical publication throughout its operational life. When corrections are made to a working, intermediate, or output file, corrections must be incorporated in the source file which is the primary final product.

A1.2.5 Inspections. The Government reserves the right to perform any of the inspections set forth in MIL-PRF-28001 to ensure that supplies and services conform to prescribed requirements.

APPENDIX A

ATTACHMENT A1

A1.3. DIGITAL FILE REQUIREMENTS

A1.3.1 Files and file formats, general. The following specific digital source files and products are required for the final issue of each technical manual. Technical publication information consists of text and associated illustrations in digital form. This information shall be organized into file sets. Each requisite file of a set shall be encoded in a format in accordance with MIL-STD-1840, and be accompanied by the applicable data file header records in accordance with MIL-STD-1840.

A1.3.2 Declaration file format. The declaration file shall be in 7-bit ASCII and shall uniquely identify the delivery document. The declaration file shall be developed in accordance with the requirements of Section 5 of MIL-STD-1840. There shall be one declaration file provided with each final manual delivered in digital form. (Declaration files may also contain the characters permitted by ANSI X3.4.)

A1.3.3 SGML conforming text source file format. The file set of a technical manual containing SGML conforming files shall consist of SGML coded text source files with at least one text source file per document, mandatory. Each file shall be accompanied by identifying data file header records. The text source files shall be ASCII, SGML coded text files tagged in accordance with MIL-M-28001 as specified by the document type definition of MIL-PRF-28001 and the following:

a. Text files shall be provided on 9-track magnetic tape at 6250 characters per inch or 1600 if so specified in the contract in data format conforming to MIL-STD-1840. Media other than magnetic tape (for example, magnetic diskettes, optical disks, and so forth) shall be provided when specified in the contract.
b. The appropriate document declaration set shall be referenced in the SGML text using the following public identifier:

<!DOCTYPE doc PUBLIC "-//USA-DOD//DTD MIL-STD-38784C 900102//EN" >

c. Document numbers for the following items must be physically present in the text stream using the appropriate attribute as defined in MIL-PRF-28001: chapter, section, paragraph, figure, table, footnote, appendix, steps, and list items.
d. All internal (cross) references shall be tagged as defined by the document type definition in Appendix B of MIL-STD-38784. For internal references, a reference identifier (ID) shall be provided which specifies the unique ID of that part of the manual which is being referenced. Accordingly, an ID value shall be provided for the appropriate reference within the manual. For external references, the referenced document number shall be provided.
e. Information in table A1.I shall be tagged as defined by the document type definition (DTD).

APPENDIX A

ATTACHMENT A1

TABLE A1.I. Information to be tagged.

Cross reference Technical manual identification number (Doc No) Equipment model number Equipment serial number Footnote Graphic Index flag	National stock number Part description Part number Start and end of change Start and end of emergency information Start and end of emphasis * Test equipment
* For use only when format specification cannot provide desired emphasis.	

f. Hyphenation and spell checking. The processing system that produces the text digital products required by this paragraph must electronically spell check the document text. Line ending machine generated hyphens are not permitted.

g. Page integrity. Page integrity is the maintenance of physical or logical page boundaries at specific places in a publication. The processing system that prepares the digital products must provide page break indicators in the tagged text files for use in maintaining page integrity during future updates to the technical manual. The page break indicator as defined by the document type definition of MIL-STD-38784 and associated page number shall be used.

A1.3.4 Document type definition (DTD) data file format. A document type definition shall be used to define the organization and logical structure of elements, entities, and attributes allowed in a particular document. It shall also be used to control automated processing functions (such as parsing) that support quality assurance requirements. The document type definition data file shall be in accordance with the document type definition in Appendix B of MIL-STD-38784 and shall define the structure and content of the technical manual. A standard DTD shall be cited. It can be provided on diskette, if the contractor desires, and requests it. The standard Navy/NAVSEA DTD (NAVSEA Class 2 DTD) is readily available on INTERNET. It can be viewed on-line at:

http://navysgml.dt.navy.mil/dtdfosi/repository.html

A1.3.5 Output specification and formatting output specification instance (FOSI). When specified, the Government will provide a FOSI for use by the contractor. The FOSI provides a set of formatting characteristic values used to rigorously describe composition processing functions to be performed on the elements of a text document to provide the required format and style. The FOSI shall be expanded by the contractor to contain values for characteristics for every context in which a tag has a unique formatting requirement. Each unique tag shall be accompanied with a description of its attributes if it effects the formatting. Technical manuals conforming to this specification and encoded in accordance with MIL-STD-38784 shall (if

specified in the contract) be accompanied by a FOSI which incorporates any contractor unique attributes for output format and style stated in this specification.

A1.3.6 Illustration data source file format. Each set of text source files for a technical publication shall be supported with an illustration data source file for each illustration in the technical publication.

a. Raster illustration data files shall be in accordance with the requirements of MIL-PRF-28002 and ISO/IEC 12064-1.
b. Each illustration data file shall be accompanied by identifying header records (see Section 5 of MIL-STD-1840).
c. A printout of all raster file header records will accompany all digital raster illustration files.
d. Where there are multiple instances of the same illustration in different locations of the technical publication, a single illustration file may be used to satisfy all of the illustration instances.
e. All digital raster illustrations shall be cropped and sized to fit the designated window for printing with no further manipulation.
f. The use of color and photographs is prohibited.
g. The fixed-length blocks of the raster files are to be padded using ASCII Decimal 32 (space) to the appropriate size.
h. For documents conforming to this specification, 8 1/2 inch by 11 inch or smaller illustrations are to be MIL-PRF-28002 type I files. All larger sizes are to be in accordance with ISO/IEC 12064-1.

A1.3.7 Page description language (PDL) data files. Unless otherwise specified, the PDL shall be as follows. Output page description language files shall be provided as allowed by MIL-PRF-28001. The page description language shall be postscript or a postscript compatible language. The file format shall be written with 256 byte ANSI type F fixed-length records with block length of 2048 bytes. All data header records shall be as defined in Section 5 of MIL-STD-1840. The data header record shall be written in the first physical block of the file, with the block padded using ASCII Decimal 32 (space) to the appropriate size. There shall be only one postscript or postscript compatible file for the final issue of each technical manual.

A1.3.8 Hardcopy print from PDL files. A hardcopy printout of the PDL files shall accompany each final technical manual deliverable.

A1.3.9 Special word data file format. Any special word data files and their format (see MIL-STD-1840) shall be as specified.

APPENDIX A

ATTACHMENT A1

A1.4. SPECIAL SOURCE FILE REQUIREMENTS

A1.4.1 Acquisition specification file format. When specified, technical manuals shall be developed in accordance with this specification and provided in a special digital file format as specified in the acquisition contract. Unless otherwise specified, special contract digital files shall only be provided supplemental to the SGML files defined herein.

A1.4.2 Commercial digital file format. When specified, technical manuals shall be developed in accordance with this specification and provided in a standard off-the-shelf commercial file format as defined in the contract. Unless otherwise specified, commercial digital files shall only be provided supplemental to the SGML files defined herein.

APPENDIX B

STYLE OF WRITING

B.1. SCOPE

B.1.1 Scope. This document establishes the requirements for the style and level of writing to be used in the development of technical manuals, changes, and revisions. This general style of writing supplements the various requirements cited in specific associated detail specifications. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

B.2. APPLICABLE DOCUMENTS

B.2.1 General. The documents listed in this section are specified in sections B.4 through B.9 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections B.4 through B.9 of this specification, whether or not they are listed.

B.2.2 Government documents.

B.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).

STANDARDS

DEPARTMENT OF DEFENSE

ASME Y14.38M - Abbreviations and Acronyms.
MIL-STD-1309 - Definitions of Terms for Testing, Measurement and Diagnostics.

(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.)

B.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.

APPENDIX B

PUBLICATIONS

DEPARTMENT OF DEFENSE

JCS Pub 1 - DOD Dictionary of Military and Associated Terms.

GOVERNMENT PRINTING OFFICE (GPO)

GPO Style Manual - US Government Printing Office Style Manual.

(Application for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

DEPARTMENT OF THE NAVY

SL160-AA-LST-010-WORDS - Baseline Word Lists for NAVSEA/SPAWAR Technical Manuals.

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

B.2.3 Non-Government publications. The following documents 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 specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issue of the documents cited in the solicitation (see 6.2).

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 945 Recommended Practice for Preferred Metric Units for Use in Electrical and Electronics Science and Technology. (DoD Adopted)

(Application for copies should be addressed to the American National Standards Institute, Inc., 445 Hoes Lane, P. O. Box 1331, Piscataway, N.J. 08855-1331.)

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

NIST Special Publication 811 Guide for the Use of the International System of Units (SI).

(Application for copies should be addressed to the NIST Metric Program Building 820, Room 304, 100 Bureau Drive, Stop 2000 Gaithersburg, MD 20899-2000.)

B.2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein the text of this document takes precedence. Nothing in this document,

however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

B.3. DEFINITIONS

B.3.1 Definitions and acronyms. The definitions and acronyms used in section 6 of this specification apply to this appendix.

B.4. STYLE OF WRITING

B.4.1 Style of writing. Writing style shall be in accordance with GPO Style Manual. Style of writing shall ensure:

a. Technical content shall be presented in language free of vague and ambiguous terms, using the simplest words and phrases which will convey the intended meaning. GPO Style Manual shall be used as a general guide for capitalization, punctuation, compounding of words, numerals in the text and spelling of nontechnical words. All essential information shall be included, either by direct statements or by reference. Sentences shall be short and concise. Punctuation shall be used in a manner which aids in reading and prevents misreading. Sentences shall be rewritten when extensive punctuation is necessary for clarity. Technical words shall be used only when no other wording will convey the intended meaning.
b. For maximum clarity and usefulness, there shall be consistency in terminology and organization within the same publication or series of publications. Nomenclature shall be consistent within a publication and throughout parts lists, parts breakdowns and other directly related publications.
c. Quotation marks and underscoring shall not be used for emphasis.
d. Words which have more than one meaning which will fit the context in which they are used, such as "replace" for "reinstall," shall not be used.
e. Chapter, section and paragraph headings shall be descriptive of the contents of the division they head; "General" and "Miscellaneous" shall not be used unless no other title will suffice.
f. Statements which explain applicability for individual items of equipment shall use specific serial number(s), block designation(s), specific model designation(s) or similar identification. Such terms as "on later equipment" and "on early serial numbers" shall not be used.
g. Technical publications shall make no reference to age, sex, race or national origin. Use sex neutral terms, except avoid use of the word "person" (terms such as "midshipman" and "workman" are considered sex neutral). Terms such as male and female connectors, pins, and so forth, are acceptable.

B.4.1.1 Support of user tasks. To the extent possible, information shall be presented that:

a. Directly supports the immediate task of the user.
b. Minimizes need for reading, studying, and conceptualizing skills.
c. Minimizes need to refer to other documents or text material.

B.4.1.2 Standard english grammar. Rules of grammar for standard American English shall be used. Colloquial, substandard, and slang expressions shall not be used. Infinitives may be split and sentences may be ended with prepositions in cases where not doing so sounds awkward or stilted and is likely to distract the user's attention from comprehending the content.

B.4.1.2.1 Grammatical person and mood. The second person imperative mood shall be used for procedures. Third person indicative mood shall be used for description and discussion.

B.4.1.2.2 First person pronouns. First person pronouns should be used, to avoid indefinite passive construction.

B.4.1.2.3 Positive form. Procedural steps shall be in positive form ("Close the container" rather than "Do not leave the container open") unless the meaning demands the negative form.

B.4.1.2.4 Concrete and specific language. Concrete and specific language shall be used to reduce vagueness.

B.4.1.2.5 Use of "shall", "will", "should" and "may". Use "shall" whenever a manual expresses a provision that is binding. Use "should" and "may" whenever it is necessary to express non-mandatory provisions. "Will" may be used to express a declaration of purpose. It may be necessary to use "will" in cases where simple futurity is required.

B.4.2 Sentences and phrases.

B.4.2.1 Complex sentences. If a sentence has more than one clause and is more than 20 words in length, it shall whenever possible be rewritten as two or more simple sentences.

B.4.2.2 Sentences in procedures. Sentences directing the actions of the user shall be in the active voice and imperative mode. If more than one person is involved, the directions shall be in the active voice, indicative mode, third person.

B.4.2.3 Word order. Sentences and clauses shall be written using simple word order (subject, verb, object) to the extent possible. Modifiers, including prepositional phrases, shall be as close as possible to the word modified. These word order requirements shall be relaxed only to the extent necessary to avoid ambiguity or distortion of meaning. Procedural steps shall start with an active verb; lubricate, remove, tighten, and so forth.

B.4.2.4 List form. If any series of three items or more appears in a sentence, the sentence shall be written so the items will appear in explicit list form.

B.4.3 Simple versus complex phrases. Complicated phrases shall be avoided.

B.5. LEVEL OF WRITING

APPENDIX B

B.5.1 Readability. Unless otherwise specified in the associated detail specification, the Reading Grade Level (RGL) shall be nine. Technical manuals shall be written to the capability of the target audience for which they are intended. The method employed to determine readability of narrative material is optional; however, it must meet the quality assurance provisions identified in Section 4 of this specification. The overall grade level (OGL), determined in B.5.7.1, shall not exceed the appropriate RGL by more than one grade level. The grade level (GL) of each sample, shall not exceed the appropriate RGL by more than three grade levels. Nonnarrative material, such as procedural steps, is not subject to RGL.

B.5.2 Sample selection. Samples of text shall be analyzed for readability. Select samples as follows:

a. Count the number of pages of text in the publication. The count shall include all full and partial pages that contain text in the form of consecutive sentences. The count shall not include pages containing only illustrations, tables, lists, and so forth. Record the number of text pages.
b. The basic number of samples is determined by the table B.I.

TABLE B.I. Basic number of samples.

NUMBER OF TEXT PAGES	DIVISOR DIVIDED BY "N"	BASIC NO. OF SAMPLES	
		MIN	MAX
90 and above	10	9	30
54 to 89	9	6	9
32 to 53	8	4	6
1 to 31	6	2	4

c. Divide the number of text pages by the appropriate divisor, "N". Round off the quotient to the next lowest whole number..
d. For publications that contain fewer than 12 pages, randomly select two samples and mark them for analysis.
e. For publications that are 12 pages or more, randomly select a number between one and "N". The number selected shall be marked as the first page of text to be analyzed. Starting at the selected page, mark every "Nth" page of text to the end of the publication. The marked pages shall identify starting points for the basic samples to be analyzed.
f. Check marked pages to verify that at least one sample has been selected for each chapter of the publication. If any chapter (see 6.5.8) has been missed, randomly select one text page from that chapter and add it to the basic samples to be analyzed.

B.5.3 Raw data collection. For each sample marked, raw data must be collected. Data collection will consist of counts of the numbers of words, sentences, and syllables in each sample. The size of each sample is based on the number of words to be analyzed. Samples shall start at the beginning of the first full paragraph on each marked sample page. If a sample falls on a page

containing procedural instructions, start sample at beginning of first full sentence on page. Headings, captions, and paragraph titles shall not be counted in the sample.

B.5.4 Word count. For each sample, count the number of words as follows:

a. For each sample, count all words up to the end of the sentence containing the 200th word. If the marked sample page contains fewer than 200 words, the sample can be extended to the next page of text; but, do not extend the sample into a new chapter or text pertaining to a completely new subject.
b. Count as a word all numbers, letters, symbols, and groups of letters surrounded by white spaces. Hyphenated words and contractions count as one word.
c. Record the number of words in each sample.

B.5.5 Sentence count. For each sample, count the number of sentences as follows:

a. Count all sentences in sample including the sentence that contains the 200th word.
b. Count as a sentence each unit of thought that can be considered grammatically independent of another sentence or clause. A period, question mark, exclamation point, and semicolon usually denote independent clauses and thus mark the end of a sentence.
c. Record the number of sentences in each sample.

B.5.6 Syllable count. For each sample, count the number of syllables as follows:

a. For most words, count syllables the way the word is normally pronounced aloud..
b. Count all numbers as one syllable. However, if a numeric expression contains several numbers separated by hyphens, count each number as a syllable.
c. Acronyms and abbreviations are counted as one syllable unless they actually spell out a word of more than one syllable.
d. Count as one syllable all words that are included in a baseline word list for Navy technical manuals (see SL160-AA-LST-010/TM-WORDS) and all expanded versions of those lists that are authorized for technical manual acquisitions.
e. Record the number of syllables in each sample.

B.5.7 Grade level calculations.

B.5.7.1 Sample grade levels. Calculate the GL of each sample as follows:

a. Calculate the average sentence length (L). Divide the number of words in the sample (V) by the number of sentences in the sample (T): (L = V/T). Round off quotient to the nearest one hundredth.
b. Calculate the average number of syllables per word (D). Divide the number of syllables (C) in the sample by the number of words (V) in the sample: (D = C/V). Round off quotient to the nearest one hundredth.

c. Calculate the GL of each sample by the following formula. Round off each GL to the nearest integer.

$$GL = 0.39(L) + 11.8(D) - 15.59$$

B.5.7.2 OGL. The OGL of a publication is calculated as follows:

a. Add the total number of words (W) from all samples combined. Record total.
b. Add the total number of sentences (S) from all samples combined. Record total.
c. Add the total number of syllables (P) from all samples combined. Record total.
d. Calculate the average sentence length (A). Divide total number of words (W) by total number of sentences (S): (A = W/S). Round off quotient to the nearest one hundredth. Record quotient.
e. Calculate the average number of syllables per word (B). Divide total number of syllables (P) by total number of words (W): (B = P/W). Round off quotient to the nearest one hundredth. Record quotient.
f. Calculate the OGL of the manual by the following formula. Round off the OGL to the nearest integer.

$$OGL = 0.39(A) + 11.8(B) - 15.59$$

B.6. REFERENCES

B.6.1 References. References shall be kept to a minimum and shall be limited to Government approved documents such as military specifications and standards, technical manuals, drawings, engineering change data, and other approved material which will enhance the clarity and support the repair requirements and processes delineated in the manual. When commercial documents are the only suitable reference material available, approval shall be requested of the Government upon request of the manual developing activity. Strong justification must be provided. Referencing shall conform to the following:

a. Where a small amount of information is needed (fewer than two pages), the applicable material shall be copied verbatim.
b. Where a large amount of material is required (more than two pages) the applicable material shall be referenced fully, including the publication number and title. Reference to alternative repair procedures and drawings required to refurbish parts is acceptable if that refurbishment information is not routinely required.
c. Where the reference is to an entire content of another document, the reference shall be only to the title of the publication and the publication identifying number. It is not considered necessary to repeat quality control standards or other approved routine procedures which have been addressed during specialty training.

B.6.1.1 Text references. The text shall refer to:

APPENDIX B

a. Only models or types covered by the manual. To facilitate coverage of modified or additional models or types at a later date, references should be held to a minimum consistent with clarity.
b. The basic number of Government specifications and standards. When the contractor cannot find out the Government specification number, the contractor shall request this information from the Government, furnishing complete information concerning the material's composition, properties, characteristics, applications, manufacturer's specification number, and so forth.
c. Temperature readings as calibrated on the equipment. If other than Fahrenheit, the equivalent in Fahrenheit shall follow in parentheses. General temperature references, such as room temperature, shall normally be given in degrees Fahrenheit.
d. Speed, distance and other instrument readings, as calibrated on the equipment.
e. Switch positions and panel markings exactly as marked on the equipment. However, symbols on panel markings may be spelled out when they cannot be produced by the composing equipment used to prepare the PTM or FRC, such as the symbol for "ohm", "infinity", and so forth.
f. Measurements in U.S. standard units (ounces, pounds, gallons, inches, feet, knots, miles, and so forth) except instances in which metric measurements are required. When the metric system is used on the equipment, conversion to U.S. standards shall follow in parentheses. If the content specification so requires, conversion of U.S. measurements to metric measurements shall be indicated.
g. Illustrations by figure number, including section letter and number when applicable, and the sheet number for multisheet illustrations, when applicable. References shall be made only to illustrations within the same manual or another volume of the same manual.
h. Figure numbers first, followed by the index number. However, when multiple references in a paragraph refer to the same figure, only the first reference need indicate the figure number. When the sequence is unbroken for procedures requiring two or more pages, the figure number followed by a dash and the word "Continued" shall be repeated after the first reference on each succeeding page. If two or more figures are involved in the same sequence, the figure with the greater number of items shall be cited as described above. Index callouts for items on remaining figures shall have the index number follow the figure number. In such cases, the paragraph lead-in shall contain a statement similar to the following: "Item numbers below refer to Figure 3-4 unless otherwise indicated."
i. Parts on diagrams by enough of their reference designation to identify the item.
j. Tables by table number. Reference shall be made only to tables within the same manual or another volume of the same manual.
k. Other supporting paragraphs in the same manual or another volume of the same manual, by exact paragraph title (without the paragraph number) in capital letters, followed by the volume, part, chapter and section number in parentheses.
l. Other subordinate paragraphs of the same primary paragraph as "above" or "below."
m. Other technical manual identification numbers including exact paragraph title, when applicable, but omitting dates, page, figure and paragraph numbers. Reference may be made only to publications in the publication system(s) of the Service(s) that will use the publications and are authorized at user level.
n. Footnotes, when essential for reference, explanation, comments, and so forth. Footnotes shall be numbered. Identical footnotes shall not be repeated within the chapter. Footnotes in the

text shall not be used for mandatory requirements. Footnotes to the text shall be placed at the bottom of the page with a one inch horizontal rule placed flush left two spaces below the text and the footnote placed under the rule.

o. Series of items as follows:

1. By following the basic number with "-series" when all numbers in the series are included.
2. By following the basic number with "series" (without dash) when the basic number is immediately followed by a letter or is succeeding a higher number.

p. When a reference applies only to one sentence, it shall be enclosed in parenthesis.
q. When a reference applies to the entire paragraph it shall be enclosed in parenthesis.

B.6.1.2 Text reference placement. References shall conform to the following:

a. When a reference applies to one item within a sentence, place the reference parenthetically immediately after the item being referenced.
b. When a reference applies to an entire sentence, place the reference at the end of the sentence with a period outside the parenthesis or show the reference in a complete sentence.
c. When reference applies to an entire paragraph or paragraphs, place the reference after the paragraph title.
d. When reference is made to items in figures by reference designations, the numbers shall be indicated in the following manner: "The ON-OFF switch (158, figure 3-6) on the center console controls the TWT cooling."

B.6.2 Consolidation of material. To the extent possible, all information required to complete a single task shall be put in one location in the manual. Information and artwork shall be repeated as necessary to fulfill this requirement. The need for the user to refer to other parts of the manual or to other information sources during performance of a task shall be minimized.

B.6.3 Reference to zones. In reference to zones, the numeral shall be listed first to avoid possible confusion with references designations .

B.6.4 Enclosures. Enclosures may be used to include closely-related material which is not an inherent part of the manual. The enclosures, identified in full, shall be listed by numbers in the order they are mentioned in the text. Enclosures shall be inserted immediately after the last Appendix. The page designation shall be "Enclosure ___, page ___ of ___."

B.7. USAGE OF TERMS

B.7.1 Abbreviations and acronyms. The use of abbreviations and acronyms shall be such that there is no need for experienced users to consult a glossary of abbreviations and acronyms. Abbreviations and acronyms should be used for those systems, subsystems, equipment, components, organizations, or other items which are ordinarily referred to by their abbreviations

or acronyms by experienced personnel. When abbreviations or acronyms are used as markings on the equipment, the same abbreviations and acronyms shall be used in the technical manual. Use of abbreviations and acronyms shall be held to a minimum and each shall be spelled out the first time it appears in each chapter, section, part, job guide, work package or other division where confusion may exist or usability would be enhanced. An excellent rule to follow is; "when in doubt, spell it out." Abbreviations and acronyms which are accepted as words (radar, sonar, laser, and so forth) need not be spelled out. When a phrase is being abbreviated or acronymed, the first letter of each word shall be capitalized and elements shall not be separated by periods. Abbreviations and acronyms used shall be in accordance with ASME Y14.38M, except that abbreviations may be plural (s) or possessive ('s) after the first use. If a manual is prepared on composing equipment which cannot produce a certain abbreviation or symbol, such as "+/-" for "plus or minus", a substitute symbol, such as "+ or -", or an abbreviation, such as "POM", may be used. New abbreviations and acronyms shall not be created for words or terms that already have abbreviations and acronyms established in ASME Y14.38M. All abbreviations and acronyms used in the manual shall be explained in the manual's foreword, preface, or introduction.

B.7.2 Automatic electronic test and checkout terminology. Terms used for automatic electronic test and checkout shall be in accordance with MIL-STD-1309.

B.7.3 Military terms. Military terms used shall be in accordance with Joint Chiefs of Staff (JCS) Pub 1, or any dictionary or glossary of military terms of the appropriate Service.

B.7.4 Synonyms. Use of synonyms to provide variety in technical writing can lead to confusion. If there are several synonyms for a concept or object, only one shall be selected and used consistently throughout the technical manual.

B.7.5 Shortened equipment names. In each section supporting a single user task, official terminology shall be used for the first reference to a hardware item. Official terminology shall be used wherever the use of a shortened name might be ambiguous.

B.7.6 Nomenclature. Nomenclature associated with systems, equipment, and components shall be introduced by means of illustrations coordinated with descriptive text.

B.8. ORGANIZATION OF TASKS

B.8.1 Organization of the technical manual. To ensure comprehensibility (see 6.5.12), technical manuals shall be organized on the basis of the user's need for information. In complex equipment or systems, or systems where hierarchies of functional and physical relationships exist, corresponding technical tasks shall be grouped together in order of importance. An overview of the hierarchical arrangement of tasks by which the manual is organized shall be provided. This overview may be illustrated as a family tree or top-down breakdown of the tasks. The hierarchical arrangement shall be described in the introductory chapter of the technical manual.

APPENDIX B

B.9. USE OF METRICS

B.9.1 Metric practices. Metric practices, measurement units, symbols, and so forth, shall be in accordance with NIST Special Publication 811 and IEEE 945.

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APPENDIX C

MANUAL ARRANGEMENT

C.1. SCOPE

C.1.1 Scope. This appendix documents the arrangement of the technical manual in accordance with a standardized format. It describes the prescribed arrangement for front matter, technical content, appendices, glossaries indices, and deficiency reports. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

C.2. APPLICABLE DOCUMENTS

C.2.1 General. The documents listed in this section are specified in sections C.4 through C.10 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections C.4 through C.10 of this specification, whether or not they are listed.

C.2.2 Government documents.

C.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).

STANDARDS

DEPARTMENT OF DEFENSE

DODD 5220.22 National Industrial Security Program Operating Manual

(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.)

C.3. DEFINITIONS

C.3.1 Definitions and acronyms. The definitions and acronyms used in section 3 of this specification apply to this appendix.

APPENDIX C

C.4. ARRANGEMENT

C.4.1 Arrangement. Each manual shall be arranged into volumes according to a standardized format (as applicable):

a. Front matter.
b. Technical content subject matter.
c. Appendices.
d. Glossaries.
e. Indices.
f. Technical Manual Deficiency/Evaluation Reports (TMDERs).

C.5. FRONT MATTER

C.5.1 Front matter. Unless otherwise specified, material preceding the first chapter shall consist of the following as a minimum in the order specified:

a. Cover and Title Page or Abbreviated Title (as applicable)
b. Change Instruction Sheet (applicable only to changes)
c. List of Effective Pages
d. Change Record Page
e. Table of Contents
f. List of Illustrations
g. List of Tables
h. Foreword, Preface, and Introduction
i. Safety Summary (as applicable)
j. Frontispiece

C.5.2 Cover and title page. Manuals shall have either a cover or title page, or an abbreviated title. When specified, there shall be a cover and title page. The cover and title page shall contain the information indicated by figure C.1. Figure C.1 also lists the requirements for abbreviated titles. Abbreviated titles shall be used only when specified. Unless otherwise specified, if there is both a cover and title page, the date shall be omitted from the cover page. When specified, a manual shall require a backbone for binder or cover. FRC for the backbone or cover of a manual shall be in accordance with figure C.2. The technical manual identification number shall appear in the upper left-hand corner of the cover and title page, and will be furnished by the Government. When specified, certain information such as the supersedure notice, supplement notice, disclosure notice and destruction notice, as applicable, may be placed on the reverse side of the title page if additional space is needed to avoid overcrowding of the title page (that is, small technical manuals such as job guides and work cards). The reverse side of the title page, when used as a continuation of the title page, shall be numbered.

C.5.2.1 Review draft copy. When specified, the words "Draft" or "Final Draft" shall be centered above the words "TECHNICAL MANUAL."

C.5.2.2 Preliminary technical manual. When applicable, the word "PRELIMINARY" shall be centered above the words "TECHNICAL MANUAL" (or type of publication).

C.5.2.3 Title. The technical manual title as indicated by the applicable content specification shall consist of the following, located as shown on figure C.1.

a. WARNING (if the manual contains unverified data).
b. Heading "TECHNICAL MANUAL"
c. Type of Manual
d. Maintenance Level (if restrictive)
e. Prime title (type and model)
f. Subtitle (as applicable)
g. Manufacturer

C.5.2.3.1 Title warning. When specified, a manual containing unverified data shall have the following warning centered above the heading TECHNICAL MANUAL:

WARNING

This manual contains unverified procedures. Refer to the Verification Status Page(s) prior to performing any operation or maintenance procedures.

C.5.2.3.2 Type of manual. The type of manual shall be placed beneath the "TECHNICAL MANUAL" heading.

C.5.2.3.3 Maintenance level(s). The level(s) of maintenance, as appropriate, shall be placed beneath the manual type. When only one maintenance manual is being acquired to support a weapon, equipment or hardware, no level shall be specified unless restrictive, since it will be the only manual available for repair and maintenance at any designated maintenance level (Organizational, Intermediate or Depot).

C.5.2.3.4 Prime title. The nomenclature of the equipment, type, model, part number or subject (blocks, serial numbers or registration numbers, if appropriate) shall be positioned below the words identifying the manual type or maintenance level, if applicable. When specified, the national stock number and identification of other equipment covered in the manual shall be indicated. The classification of the equipment nomenclature shall be indicated (U), (C), (S), (TS), as specified in DOD 5220.22-M if the publication itself is classified. The prime title shall be the same on all volumes and parts of a multivolume or part technical manual set.

C.5.2.3.5 Subtitle. A subtitle shall be used and located immediately below the prime title to indicate the contents of every separately bound volume and part of a technical manual.

C.5.2.3.6 Manufacturer. When specified, the identification of the manufacturer of the equipment shall appear below the equipment nomenclature or subtitle, as applicable.

C.5.2.4 Contract number. When specified, the original contract number shall be placed on all new issues and carried forward on all subsequent cover and title pages. If the contract number for a change or revision is different from the original number, the number applicable to the change or revision shall be indicated on the cover and title page in addition to the original number. No more than two contract numbers, the original and the latest, need appear.

C.5.2.5 Seal. The Department of the Navy Seal, with command identifier, is placed below the contract number(s).

C.5.2.6 Supersedure notice. Unless otherwise specified, the supersedure notice shall include a list of all currently superseded supplements and Rapid Action Changes (RAC). Superseded supplements and RACs shall normally be listed individually, but when several alphabetically or numerically sequenced supplements and RACs are superseded, they shall be grouped. When specified, FRC that supersedes a PTM shall include the supersedure notice. The applicable portions of the following supersedure notice shall be used:

> "This (manual, change, revision or RAC) supersedes (applicable manual, change, revision number or portions of) dated (date of superseded document), Change (change number) dated (change date), including (superseded supplement or RAC numbers)."

C.5.2.7 Supplement notice. A supplement notice is used to show dependent and supporting publications when one cannot be used without the other. They apply to supplements, supplemental or partial manuals, and basic manuals. Dependency is shown by such statements as "INCOMPLETE WITHOUT SWXXX-XX-XXX-XXX" or "USE WITH SWXXX-XX-XXX-XXX". Supporting publications are depicted by such statements as "THIS PUBLICATION SUPPLEMENTS SWXXX-XX-XXX-XXX". Cross-reference notes to supplements, or to augmented manuals, shall be placed on the cover and title page initially, or at time of change or revision.

C.5.2.8 Volume notice. When specified, the cover and title page of each volume shall contain a statement that the applicable volume is incomplete without the other volumes in the set.

C.5.2.9 Disclosure notice. When specified by the Government, a special disclosure notice will be placed on the cover and title page.

C.5.2.10 Distribution statement. All technical manuals shall have a distribution statement placed on the cover and title page. The appropriate distribution statement will be provided by the Government. Unless otherwise specified, Distribution Statement C shall be placed on the cover and title page of each manual, manual supplement, manual revision or change, as follows:

APPENDIX C

"Distribution Statement C: Distribution authorized to US Government agencies and their contractors; (fill in reason); (date of determination). Other requests for this document shall be referred to (insert name of controlling DOD office)."

C.5.2.11 Export control notice. When required, the following Export Control Notice shall be placed on the cover and title page of each manual, manual supplement, revision or change:

> "WARNING: This document contains technical data whose export is restricted by the Arms Export Control Act (Title 22, U.S.C. SEC 2751, et seq) or the Export Administration Act of 1979, as amended, Title 50, U.S.C., App 2401 et seq. Violations of these export laws are subject to severe criminal penalties. Disseminate in accordance with provisions of DOD Directive 5230.25."

C.5.2.12 Destruction notice. All technical documents marked with distribution statements B, C, D, E, F or X shall be marked with the destruction notice from DOD 5230.24 on the cover and title page as follows:

> "Destruction Notice: Destroy by any method that will prevent disclosure of contents or reconstruction of the document."

C.5.2.13 Authority notice. The authority notice will be provided by the Government. Manuals to be jointly used shall show a joint authority notice.

C.5.2.14 Publication date. The publication date of the manual shall be the cutoff date from which no further changes to the manual are permitted without issuing a formal change. This is normally the "approved date", that is, the date the Government accepts the manual subject to the inclusion of specified comments. If the Government does not advise the contractor the exact date to use, the publication date shall be the date at which the last material to be included was received (copy freeze date). The day, month, and year shall be given in that sequence.

C.5.2.15 Change letter and date. The change letter and date shall be placed on the cover and title page as follows:

"CHANGE A 15 OCTOBER 1992" or "CHANGE 1 15 OCTOBER 1992"

C.5.3 List of effective pages. A list of effective pages shall be in accordance with figure C-3. The list of effective pages shall back up the title page and be numbered. When the last page is a right-hand page, it shall not be backed up and will list the next succeeding page as blank, for example, "B/(C blank)". The list of effective pages shall be a complete list of all manual pages, including title page, the list of effective pages, verification status pages, table of contents pages, safety summary pages, blank pages, deleted pages, added pages and foldout pages. The list of effective pages shall include a statement of the total number of pages in the manual. The list of effective pages shall be updated for each change or revision. The listing shall be held to a

minimum by grouping numbers where applicable. The page numbers for a blank page and the printed side of the sheet shall be listed as separate numbers even though a double number will appear on the printed side of the sheet. Appropriate change numbers shall be placed in the "Change No." column. The words "Deleted" or "Blank" shall be placed along side the page number of pages so effected.

C.5.3.1 Acquiring service identification. The abbreviation of the acquiring Service, for example, USAF, shall be placed in the lower right corner of the list of effective pages (page "A" only). If a Service acquires a manual for exclusive use of another Service, the symbol in the lower right-hand corner of the page shall still show the abbreviation of the acquiring Service.

C.5.3.2 List of effective pages for multivolume manuals. A list of effective pages covering all volumes shall be developed for the basic manual and shall be included in Volume I.

In a multivolume manual, each of the volumes, except Volume I, shall include the listing of pages provided in that particular volume.

C.5.4 Change record. Unless otherwise specified, a change record, when included, shall be in accordance with figure C-4, and shall be included in each separate volume. The change record should not back or be backed up. These pages shall not be numbered.

C.5.5 Table of contents. A table of contents listing parts, chapters, sections and paragraphs in the same order and with the exact titles used in the text, with page number, shall be placed at the beginning of each publication (see figure C-5). In publications containing alphabetical indexes, only primary and first subordinate paragraphs shall be listed in the table of contents. There shall be no table of contents preceding individual parts, chapters or sections. Each manual or volume in a set of manuals shall contain its own table of contents. Volume I or the first manual of the set shall contain a complete table of contents covering the entire set. Entries shall indicate the volume in which the referenced material appears. Layout shall conform to figure C-5, except that a single column format shall be used when the manual is prepared in single column.

C.5.5.1 Table of contents for review draft copy. The page number column for tables of contents may be left blank when working on RDC during the early stages of development. The page number column may be filled, if the composition equipment can produce the table of contents automatically.

C.5.6 List of illustrations. Publications containing ten or more illustrations (including charts and graphs assigned figure numbers) shall have a list of illustrations showing the figure number, title, and page number of each figure. This list shall include foldout pages, schematics, and so forth. The security classification, if any, of illustration titles shall be indicated. Layout shall conform to figure C-6 except that a single column format shall be used when the manual is prepared in single column. Each manual or volume in a set of manuals shall contain its own list of illustrations. In addition, Volume I or the first manual of the set shall contain a list of illustrations for all volumes or manuals in the set.

C.5.7 List of tables. Manuals containing ten or more tables (including charts assigned table numbers) shall have a list of tables showing the table number, title, and page number of each table. The security classification, if any, of table titles shall be indicated. Layout shall conform to figure C-7 except that a single column format shall be used when the manual is prepared in single column. Each manual or volume in a set of manuals shall contain its own list of tables. In addition, Volume I or the first manual of the set shall contain a list of tables for all volumes or manuals in the set. When both are brief, the list of illustrations and list of tables may be included on the same page.

C.5.8 Foreword, preface or introduction. A foreword, preface or introduction (see figure C-8) shall contain the purpose and scope of the manual plus any other information required by the content specification. The foreword, preface or introduction shall define abbreviations and nonstandard symbols, including any icons used in the manual if not explained elsewhere. The first volume of a manual shall contain general information and reporting requirements regarding all volumes and specific information applicable to Volume I, as required. When specified, submittal and routing instructions for technical manual improvement reports shall be included in the foreword, preface or introduction as provided by the Government (see C.8).

C.5.9 Safety summary. The safety summary shall be located as the last page(s) of the front matter. Figure C-9 is an example of the content and format of safety summaries.

C.5.10 Frontispiece. (See Appendix F).

C.6. PARTITIONMENT

C.6.1 Divisions. The hierarchical breakdown of a publication shall be divided into volumes, parts, chapters, sections and paragraphs, as appropriate. There shall be at least two of each subdivision used, except paragraphs, that is, where there is a Volume, Part, Chapter 1 or Section I, there shall be a Volume, Part, Chapter 2 or Section II. All volumes, parts, chapters, sections and primary and first subordinate paragraphs shall be titled except procedural steps or those statements which follow a colon. The second and all following subparagraph lines shall begin at the left margin. Breakout shall be planned so as to subordinate that which should be subordinated.

C.6.1.1 Volumes. Volumes shall be used when a publication exceeds 1500 printed pages (750 sheets). Volumes shall be separated by complete chapter, where possible. Each volume of a manual will be formatted into two or more separate parts according to required subject matter and be identified by a unique technical manual identification number, stock number, title, and subtitles that describe the contents. Prime titles for HM&E equipment shall be consistent with the official expanded ship work breakdown structure (ESWBS) nomenclature. When the simplicity of the system or equipment is such that the final manual will be 100 pages or less and contain no classified information, the required technical content coverage may be combined into a single volume.

C.6.1.2 Parts. When a volume exceeds approximately three inches in thickness, it shall be divided by complete chapters (where possible) into separately bound parts. Each part shall be numbered consecutively in Arabic numerals. Each part shall be identified by both its volume and part numbers and have a unique technical manual identification number assigned as provided by the Government.

C.6.1.3 Chapters. The manual shall be divided into chapters to provide a logical work sequence arrangement. Chapters shall start on a right-hand page and shall be identified by use of an Arabic numeral on the heading page. Pages within a chapter are identified by use of a chapter number, hyphen, and successive page numbers.

C.6.1.4 Sections. Sections shall be formatted in accordance with this specification. When multiple coverage in chapters of manuals for compound items is approved by the Government, a chapter sectioning technique may be employed. In this instance, a section that reflects a separate breakout item or separate allowance parts list (APL) identified unit shall start on a new right-hand page.

C.6.2 Paragraphs. Text shall be divided into primary paragraphs and subordinate paragraphs. Paragraphs may also be divided into procedural steps. Procedural steps may be further divided if necessary. Decimal paragraph numbering shall be used.

C.6.2.1 Primary paragraphs. Primary paragraphs shall be used to divide text within chapters or sections into two or more main portions. There shall be at least two primary paragraphs in each chapter or section, except when a chapter or section of a manual is comparatively brief, the section could consist of one primary paragraph. A primary paragraph begins with a primary sidehead which shall be prepared as follows:

a. All capitals.
b. Boldface type.
c. Stand alone (no text on the line).

C.6.2.2 First subordinate paragraphs. First subordinate paragraphs are used to divide text under primary headings into two or more subjects. There shall be at least two first subordinate paragraphs when a primary subject is subdivided. First subordinate paragraphs begin with first subordinate sideheads which shall be prepared as follows:

a. All capitals.
b. Boldface type.
c. With text being run-in.

C.6.2.3 Second subordinate paragraphs. Second subordinate paragraphs are used to further subdivide material under first subordinate paragraphs. Second subordinate paragraphs normally begin with second subordinate sideheads which shall be prepared as follows:

a. Upper and lowercase.
b. Boldface type.
c. With text being run-in.

C.6.2.4 Third and fourth subordinate paragraphs. Third and fourth subordinate paragraphs are used to further subdivide material under second subordinate paragraphs. Third and fourth subordinate paragraphs begin with subordinate sideheads which shall be prepared in the same manner as second subordinate sideheads.

C.6.2.5 Paragraph headings. Paragraph headings (titles) are identified as primary sideheads, first subordinate sideheads, second subordinate sideheads, and so forth (see figure C-10). Each paragraph heading (sidehead) shall describe that paragraph's contents and start with a significant word. Periods shall follow paragraph titles. There shall be two spaces between the paragraph number and the title.

C.6.2.5.1 Informative headings. Headings shall be informative and not merely labels. Headings shall serve two purposes. First, they shall make access to information easier by permitting the reader to scan a page to find the information needed. Second, they shall alert the reader to the type of information contained in the text to follow.

C.6.2.5.2 Headings and relevance. A paragraph or procedure heading shall uniquely identify the content of the material that it heads. All material under a single heading shall be consistent with the heading.

C.6.2.5.3 Heading length. Headings shall be limited to 10 words or less. Only 10 percent of all headings shall be more than 7 words in length.

C.6.2.5.4 Headings per page. To facilitate the user's search for information in the technical contents sections of the manual:

a. If more than half of a page consists of text, there shall be at least two headings on the page.
b. If one-fourth to one-half of a page consists of text, there shall be at least one heading on the page.

C.6.2.5.5 Primary sideheads. Primary sideheads divide text within chapters or sections into two or more portions. There shall be at least one primary sidehead in each chapter or section. Primary sideheads stand alone (are not run in with text) and shall appear in capital letters. They shall begin at the left margin and shall be underscored.

C.6.2.5.6 Subordinate sideheads. Subordinate paragraphs shall be numbered. First subordinate paragraphs shall have a sidehead. Second and subsequent subordinate paragraphs should, but are not required to, have a sidehead. The first letter of the first word and of each principal word shall be capitalized, and the title shall be underscored. The text shall begin on the same line as the title and paragraph number and be separated by a period (if using a title) and two spaces. Carry over

lines for all subordinate paragraphs shall return to the left margin. Breakdowns beyond the third subordinate shall not be used without the approval of the contracting activity. Figure C-10 shows samples of decimal paragraph numbering and decimal paragraph numbering with added material. Single column format shall use the same conventions as double column.

C.6.3 Procedures. Step-by-step procedures (see figure C-11) for removal, disassembly, repair, and inspection of the repairable items shall be developed only as required. Procedural steps and checklist items shall be numbered. Extensive use of uniform standards and methods is encouraged. Instructions shall be limited to areas where the sequence of operations is not standard shop practice or where special techniques are required for access to a part requiring repair. Instructions on the tagging, labeling, and match-marking of parts shall be included in the procedure. When examinations and inspections must be performed prior to or during disassembly, the procedure shall so specify.

C.6.3.1 Procedural step content. A procedural step shall be limited to a single operation or to repetitions of a single operation with the following exceptions:

a. If simultaneous operations are required, they shall be listed together in the same step.
b. If the step is a major step in a dual-level presentation, the major step shall express the action with a single verb; for instance, "Turn equipment ON".
c. If the step represents a detailed procedure, as in (b), but the procedure is so basic that the details should rarely be needed by the intended users, or if the procedure is very frequently repeated, such as turn on, turn off, and calibration procedures, the step shall refer to the procedure with a single verb and cite a reference to the detailed steps. For instance, "Turn equipment ON (see 3-46 for details)."
d. Verification of the result of an operation may be included in the step.

C.6.3.2 Procedure length. Each separate procedure shall be limited to a maximum of 10 steps.

C.6.3.3 Indentations. Procedural steps in a paragraph structure shall be indented. Procedural steps in each level of substep shall be indented an additional two spaces. When step numbers require double characters (aa), (10), and so forth, the number shall be indented only one space in order to maintain right justification of the numbers. All lines on warnings, cautions and notes shall be indented five spaces or characters from both left and right margins. When the right margin is unjustified, indentations of five spaces shall be from the maximum allowable width of the typed text.

C.6.3.4 Dual-level presentation. If users of a procedure are expected to vary widely in experience and capability, the Government may direct that certain procedures be presented in a dual-level format. In this format, detailed steps appropriate for inexperienced users shall be listed under major steps. The major steps, without reference to the detailed steps, shall be sufficient to support the performance of experienced users (see figure C-11). Dual-level, step-by-step procedures shall be provided in any of the following cases:

a. When accomplishment of the required action would not be obvious to a journeyman mechanic unfamiliar with the peculiar equipment covered by the manual.
b. When a peculiar or special action is required.
c. When safety-related or precautionary procedures are required to prevent personnel injury or equipment damage.
d. When the required action involves an area with a known history of failure due to improper procedures.
e. When, because of complexity of a particular procedure, it is necessary to maintain the continuity of the manual.
f. When verification of the manual demonstrates the need for a step-by-step procedure to satisfactorily complete the required action.

C.6.3.5 Introduction to procedure. Prior to the listing of procedural steps, introductory information shall be provided to help the user carry out the procedure without interruption.

C.6.3.5.1 Lead-in. Procedural steps shall not be prefaced by a lead-in which duplicates the heading.

C.6.3.5.2 Relevance of procedural text. A procedure shall present only that information necessary for completing a task or preventing error.

C.7. APPENDICES

C.7.1 Appendices. Each appendix shall contain a statement delineating its purpose and application. Appendices shall immediately follow the last chapter of the manual. Appendices shall begin on a right-hand page. Pages, paragraphs, illustrations and tables for appendices shall be numbered. Each manual or volume in a set of manuals shall contain its own appendices. In addition, Volume I or the first manual of the set shall contain a list of appendices for all volumes or manuals in the set. Appendices shall be used to separate relatively bulky information from the body of the manual when such separation will increase the clarity of the overall manual. When used, appendices shall be identified by capital letters.

C.8. GLOSSARIES

C.8.1 Glossaries. Glossaries shall be used in technical manuals only when the terms are not adequately defined in the text, in the Navy, DOD or standard dictionary, or contained in the manual foreword, preface, or introduction. If a glossary is required, it shall immediately precede the alphabetical index, if any. Page numbers for a glossary shall be consecutively numbered as specified in Appendix G. Each manual or volume in a set of manuals shall contain its own glossary. In addition, Volume 1 or the first manual of the set shall contain a glossary for all volumes or manuals in the set.

APPENDIX C

C.9. INDEX

C.9.1 Alphabetic index. Unless otherwise specified, an alphabetical index shall be developed when the number of titled paragraphs in a publication exceeds 100 (see figure C-12). When specified, an index shall be prepared regardless of the number of paragraphs. It shall list pertinent subjects under every topic for which users are likely to look. "See" and "see also" references may be included to guide the user to other pertinent entries. All applicable paragraph numbers for each item shall be indicated. The alphabetical index shall be so constructed as to enable the user to easily locate any part, information or operation described in the text. Alphabetical indices shall begin on a right hand page. Page numbers for alphabetical indices shall be consecutively numbered. The alphabetical index shall be located at the end of the publication but will be located before foldout page(s). Each manual or volume in a set of manuals shall contain its own index. In addition, Volume I or the first manual of the set shall contain an index for all volumes or manuals in the set.

C.10. FORM FOR REPORTING DEFICIENCIES

C.10.1 TMDER. The three copies of TMDER shall be included at the back of each separately bound volume or part of a NAVSEA manual. The TMDER is a user activity technical manual comment sheet (UATMCS) and shall be used to provide feedback on corrections and suggested improvements to the methods and procedures specified by a technical manual. The technical manual identification number and title shall be preprinted on each form by the developer.

C.10.2 Instructions to manual users. The following statements are examples of instructions to be included in the general information section or foreword, as applicable, of each technical manual:

a. For materials under NAVSEA's and SPAWAR’s cognizance, errors, omissions, discrepancies, and routine suggestions for improving technical manuals shall be reported to the Commanding Officer, Port Hueneme Division, Naval Surface Warfare Center (Code 5E30), Port Hueneme, CA 93043, on a Technical Manual Deficiency and Evaluation Report. To facilitate such reporting, three copies of Form 4160/1 are included at the end of this manual. All comments will be thoroughly investigated and originators advised of actions taken. Extra copies of NAVSEA Form 4160/1 may be requisitioned from the above address.
b. Urgent priority technical manual deficiencies shall be reported by Naval message with transmission to Port Hueneme Division, Naval Surface Warfare Center (Code 5E30), Port Hueneme, CA. Local message handling procedures shall be used. The technical manual deficiency shall identify each message processed by technical manual identification number and title.

APPENDIX C

SECURITY CLASSIFICATION 1

IDENTIFICATION NUMBER 2

VOLUME NO./PART NO. 3 REVISION NO 4

WARNING 6

TECHNICAL MANUAL 7

TYPE OF PUBLICATION 8

MAINTENANCE LEVELS 9

NOMENCLATURE OF EQUIPMENT 10

TYPE, MODEL, PART NUMBER,

NATIONAL STOCK NUMBER

OR

SUBJECT

SUBTITLE 11

Manufacturer of Equipment 12
Contract Number 13

Navy Seal 14
Supersedure Notice 15
Supplement Notice 16
Volume Notice 17
Disclosure Notice 18
Distribution Statement 19
Export Control Notice 20
Destruction Notice 21

Authority Notice 22

DATE 23

CHANGE - DATE 24

SECURITY CLASSIFICATION 25

NOTE: Vertical spacing compressed to fit specification border.

FIGURE C-1. Cover/title page. (sheet 1 of 4)

APPENDIX C

	NOTES	TYPE POINT SIZE
1.	The security classification assigned by the acquiring activity shall be as specified in DOD Manual 5200.1, or DOD 5220.22-M, , when the manual itself is classified.	24
2.	The acquiring activity shall furnish the TM identification number(s). If the manual will be jointly used by more than one Service, the acquiring Service's number shall be located immediately below it. Each Service's number shall be prefixed with the word Army, Navy, Marine Corps, or Air Force as appropriate. All numbers shall appear above the ruled line, near the right margin, except for Naval Sea Systems Command numbers, which shall be on the left margin.	24
3.	.Required for multivolume/multipart sets only, located below TM identification number.	
4.	(N) Required when it is advisable to indicate status for publications subject to frequent revisions. Especially significant when the same TM identification numbers are maintained by a change of the publication date.	14
5.	The title is required to provide all information necessary to relate the manual to its subject and content, such that readers can discern the applicability of the manuals and can discriminate between manuals of similar applicability. The title consists of a heading, the type of manual, the level of maintenance, the prime title, and subtitle as applicable.	14
6.	WARNING – Required if manual contains unverified data.	
7.	The words TECHNICAL MANUAL shall appear in the upper center portion of the page, aircraft flight manuals excepted. When applicable, the word PRELIMINARY shall be centered above the words TECHNICAL MANUAL. For flight manuals, the appropriate term shall be used. Not required for Space and Naval Warfare Systems Command and Naval Sea Systems Command technical manuals.	14

FIGURE C-1. Cover/title page Continued. (sheet 2 of 4)

8.	Required to define the specific type of technical manual (e.g. Maintenance Manual, IPB. RPSTL, etc.)	14
9.	Required to define the specific intended level of maintenance, when the manual is restricted for use at a specified level.	14
10.	The prime title: nomenclature of the equipment, type, model, part number, (blocks, serial numbers, registration numbers, if appropriate), or subject shall be positioned below the words identifying the manual type. Also, the classification of the equipment nomenclature shall be indicated as specified in DOD Manual 5200.1 or DOD 5220.22-M, when the manual itself is classified.	18 to 24
11.	Indicates the content covered. Required on multivolume/multipart publications to differentiate between the coverage among volumes.	14
12.	Identification of the manufacturer of the equipment shall appear below the equipment nomenclature.	8
13.	The original contract number shall be placed on all new issues and carried forward on all subsequent title pages. If the contract number for a change or revision is different from the original number, the number applicable to the change or revision shall be indicated on any new title pages, in addition to the original number. No more than two contract numbers, the original and the latest, need appear.	8
14.	The Department of the Navy seal, with Command identifier, is used.	1¼ to 1½ inches
15.	When a manual supersedes a previous issue, or another manual, a supersedure notice shall be placed in the space indicated.	8
16.	When a manual supplements, or is supplemented by, another manual, a supplement notice shall be placed in the space indicated.	8
17.	When a manual is one volume of a multivolume set, a volume notice shall be placed in the space indicated.	8
18.	A disclosure notice shall be placed in the space indicated on all manuals except those with Distribution Statement A.	8
19.	The distribution statement shall be placed in the space indicated.	8
20.	When required, the export control notice shall be placed in the space indicated.	8
21.	When required, the destruction notice shall be placed in the space indicated.	8

FIGURE C-1. Cover/title page Continued. (sheet 3 of 4)

22.	Indicates the authority under which the manual is acquired and issued. It shall be placed on the cover/title page (not T-2). The statement will be furnished by the acquiring activity.	8
23.	The publication date; normally the Approval date.	18
24.	Changed title pages shall show a change number and date.	14
25.	Same as 1.	24

NOTE 1: Spacing between the necessary information shall be such as to result in an attractive well balanced title page.
NOTE 2: Horizontal lines 1 point high shall be placed across the page, one just below the TM identification number and the second just above the date.

When an abbreviated title followed by text on the same page is used instead of a cover/title page, the abbreviated title shall be confined to a 7 by 5 1/2 inch area. Type size shall be such that all the information can be included within the prescribed area. Abbreviated title pages shall be used only when specified by the acquiring activity.

FIGURE C-1. Cover/title page Continued. (sheet 4 of 4)

APPENDIX C

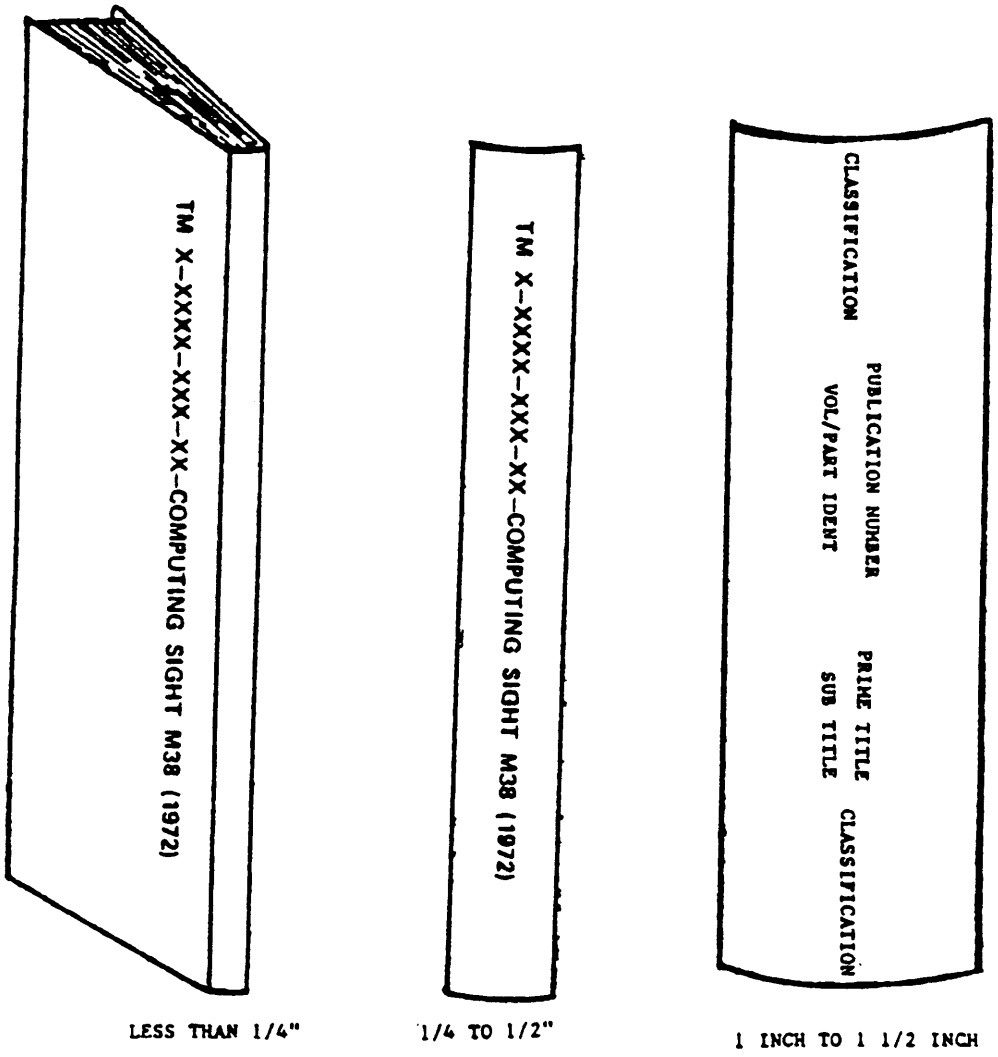

FIGURE C-2. Backbone for binder or cover.

APPENDIX C

INSERT LATEST CHANGED PAGES DESTROY SUPERSEDED PAGES

LIST OF EFFECTIVE PAGES

Dates of issue for original and changed pages are:

Original ..... 0 ..... 1 January 1988
Change ..... 1 ..... 19 September 1988
Change ..... 2 ..... 20 December 1988
Change ..... 3 ..... 21 February 1989
Change ..... 4 ..... 6 July 1989
Change ..... 5 ..... 25 September 1989
Change ..... 6 ..... 27 December 1989
Change ..... 7 ..... 29 March 1990

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 376, CONSISTING OF THE FOLLOWING:

Page No.	*Change No.	Page No.	*Change No.	Page No.	*Change No.
Title	7	3-41	0	4-48	0
T-2	7	3-42 Blank	0	4-49 - 4-51	6
A - B	7	3-43	0	4-52 - 4-54	0
VS-1 . VS-4	7	3-44	6	4-55	2
i-ii	2	3-45	0	4-56 Blank	0
iii	7	3-46	2	4-57	2
iv - viii	2	3-47 - 3-54	7	4-58 - 4-59	0
ix - x	0	4-1 - 4-2	0	4-60	7
1-1 - 1-2	0	4-3	5	4-61 - 4-64	0
1-3	3	4-4	0	4-65	2
1-4 Blank	0	4-5	7	4-66	0
2-1 - 2-2	0	4-6	0	4-67	3 or 2
2-3	2	4-7	5	4-68	0
2-4 - 2-8	0	4-8 4-9	0	5-1/6-1 - 6-4	0
3-1	5	4-10	2	A-1 - A-4	7
3-2 Blank	0	4-11	0	Glossary 1 - Glossary 3	0
3-3 - 3-4	7	4-12 - 4-13	3	Glossary 4 Blank	0
3-5	2	4-14 - 4-15	0	Index 1 - Index 2	2
3-6	4	4-16	3	Index 3	0
3-7	0	4-17	0	Index 4 - Index 5 Added	7
3-8	4	4-18 - 4-19	3	Index 6 Blank	7
3-9 - 3-10	0	4-20	0		
3-11	4	4-21 - 4-22	6		
3-12 - 3-18	0	4-23 - 4-29	0		
3-19	2	4-30 Blank	0		
3-20 Blank	2	4-31	2		
3-21	0	4-32 - 4-33	0		
3-22 - 3-23	5	4-34	2		
3-24 Blank	0	4-34 - 4-37	0		
3-25	2	4-38	2		
3-26 Blank	0	4-39	0		
3-27	4	4-40	3		
3-28 Blank	0	4-41	2		
3-29 -3-30	0	4-42 - 4-43	0		
3-31 - 3-32	2	4-44	3		
3-32.1 Added	7	4-45	0		
3-32.2 Blank	7	4-46	2		
3-33	5	4-46.1 Added	7		
3-34 - 3-35	5	4-46.2 Blank	7		
3-36 - 3-38	0	4-43.3 - 4-16.4 Deleted	2		
3-39 - 3-40	5	4-47	1		

*Zero in this column indicates an original page

A Change A USAF

FIGURE C- 3. List of effective pages.

APPENDIX C

PUBLICATION NUMBER

RECORD OF CHANGES

CHANGE NO.	DATE	TITLE OR BRIEF DESCRIPTION	ENTERED BY

FIGURE C-4. Change record page.

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T.O. 1C-1308-2-1

TABLE OF CONTENTS

FIGURE C-5. Table of contents. (Example)

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T.O. 1C-1308-2-1

LIST OF ILLUSTRATIONS

FIGURE C- 6. List of illustrations. (Example)

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LIST OF TABLES

FIGURE C- 7 List of tables. (Example)

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"FOREWORD"

The purpose of the Operational Stations Book (OSB) is to describe the operational relationships and procedures employed within the shipboard operational spaces and stations during the ship's maximum tactical environment and/or major evolutions which take into account the design philosophy utilized in space allocations and equipment arrangements within the ship. The book provides operational personnel with space orientation within the hull, space and station functional requirements, management philosophy, station manning requirements, responsibilities and operational procedures. The operational relationships and procedures described in the OSB are the product of both the design philosophy employed by the designer and verification by experienced Fleet personnel.

The basic organization and procedures for departmental and divisional spaces may be based on this book. The format has been prepared in such a manner that this book may be promulgated as doctrine for the spaces included.

This book is written to be used by all personnel concerned with personnel training, planning and operation of spaces included. It is intended to be used by ship's personnel for instruction, orientation, information, and ready reference for the operations described herein.

Operational concepts rather than technical descriptions have been emphasized. This book is not intended to duplicate technical information covered by equipment manuals or similar publications, nor is it intended as a substitute for individual operator training requirements. It is not intended that this book duplicate information which may be presented in the Combat System Technical Operations Manual (CSTOM) (if applicable), except to the extent required for continuity and thoroughness of understanding. Other guidance information can be obtained by referring to the Ship Information Booklet, Booklet of General Plans, Shipyard Plans, Technical and System Manuals, Naval Warfare Publications (NWP), and so forth.

Appendices (if included) are used to summarize or amplify such areas as the external or internal communications facilities employed in operating the spaces described in this book.

User Activity Comment Sheets (affixed at the rear of this book) are provided to report any possible deficiencies in this book or in the concepts presented. It is not desired that typographical errors be reported. Additional sheets may be reproduced locally. Comments should be forwarded directly to Commander, Naval Sea Systems Command, Manning and Controls Integration Branch, 2531 Jefferson Davis Hwy., Arlington, VA 22242-5160.

FIGURE C-8. Foreword, standard. (Example)

APPENDIX C

SAMPLE SAFETY SUMMARY

This publication describes physical and chemical processes which may require the use of chemicals, solvents, paints, or other commercially available material. The user of this publication should obtain the material safety data sheets (Occupational Safety and Health Act (OSHA) Form 20 or equivalent) from the manufacturers or suppliers of materials to be used. The user must become completely familiar with the manufacturer/supplier information and adhere to the procedures, recommendations, warnings, and cautions of the manufacturer/supplier for the safe use, handling, storage, and disposal of these materials. The following are general safety precautions and instructions that people must understand and apply during many phases of operation and maintenance to ensure personal safety and health and the protection of DOD property. Portions of this may be repeated elsewhere in this publication for emphasis.

DANGER, WARNING AND CAUTION STATEMENTS

DANGER, WARNING and CAUTION statements have been strategically placed throughout this text prior to operating or maintenance procedures, practices or conditions considered essential to the protection of personnel (WARNING) or equipment and property (CAUTION). A DANGER, WARNING or CAUTION will apply each time the related step is repeated. Prior to starting any task, the DANGERS, WARNINGS or CAUTIONS included in the text for that task will be reviewed and understood. Refer to the materials list figure at the beginning of the appropriate manual section for material used during maintenance of this equipment. The detailed warnings for hazardous material only are listed separately in the safety summary as the “Hazardous Materials Warnings” section.

HAZARDOUS MATERIALS WARNINGS

Warnings for hazardous material in this manual are designed to warn personnel of hazards associated with such items when they come in contact with them during actual use. Additional information related to hazardous material is provided in (insert applicable references for Service(s) using the manual). For each hazardous material used, a material safety data sheet is required to be provided and available for review by users. Consult your local safety and health staff concerning any questions on hazardous chemicals, MSDSs, personal protective equipment requirements, and appropriate handling and emergency procedures.

FIGURE C-9. Safety summary. (Sheet 1 of 2)

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This Hazardous Materials Warnings section gives the complete warnings for hazardous material used in this manual. To help the user understand the potential hazards of these materials, a more detailed warning for these materials and an explanation of the hazard symbols follow. The number after the word WARNING is the same number for the warning used in the procedures of this manual.

EXPLANATION OF HAZARD SYMBOLS

The abstract symbol bug shows that a material may contain bacterial or viruses that present a danger to your life or health.

The symbol of drops of a liquid onto a hand shows that the material will cause burns or irritation of human skin or tissue.

The rapidly expanding symbol shows that the material may explode if subjected to high temperatures, sources of ignition, or high pressure.

The symbol of a person wearing goggles shows that the material will injure your eyes.

The symbol of a flame shows that a material can ignite and burn you.

The symbol of a skull and crossbones shows that a material is poisonous or is a danger to life.

The symbol of three circular wedges shows that the material emits radioactive energy and can injure human tissue or organs.

The symbol of a human figure in a cloud shows that vapors of a material present a danger to your life or health

FIGURE C-9. Safety summary Continued. (Sheet 2 of 2)

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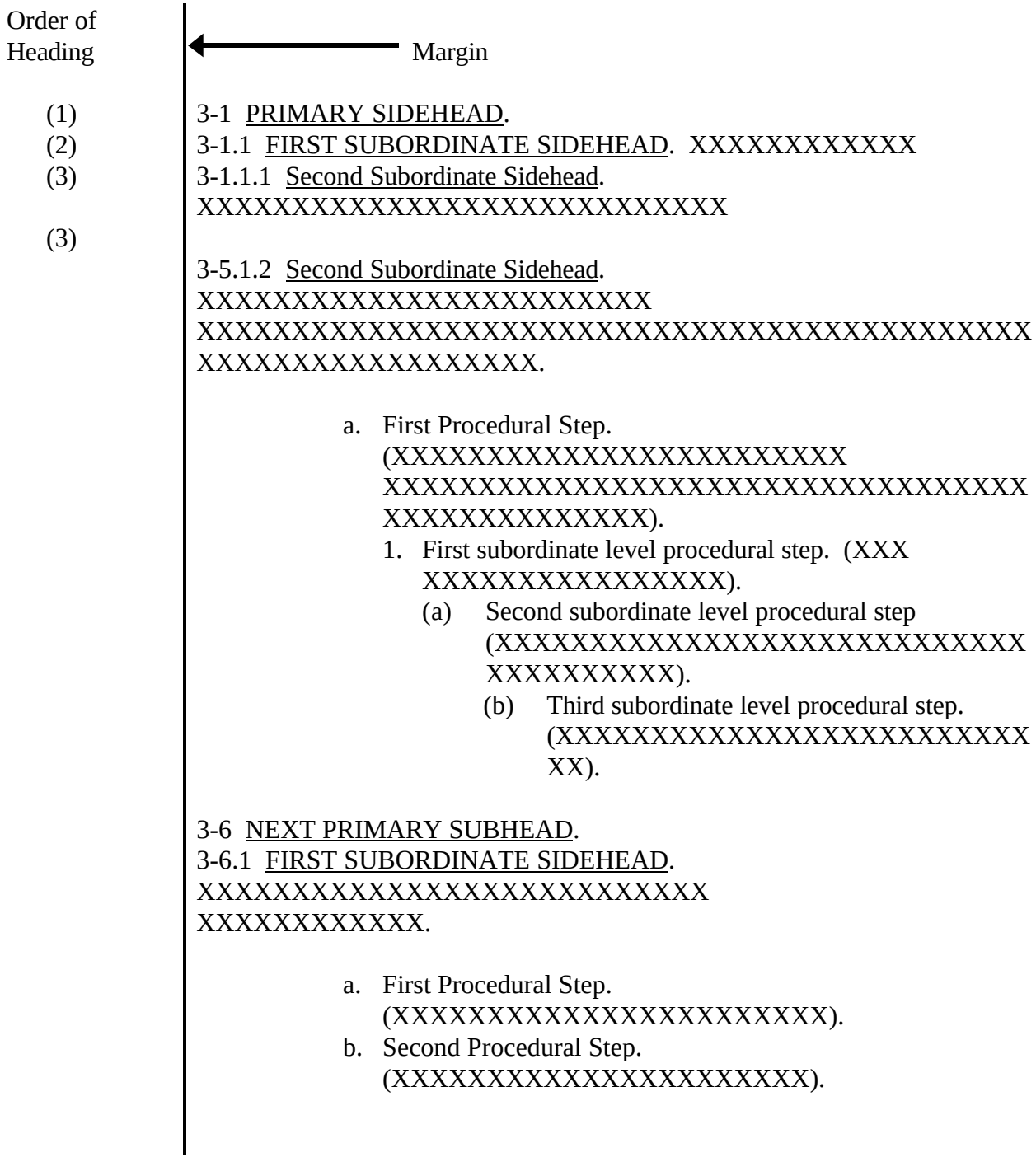

FIGURE C-10. Paragraph heading.

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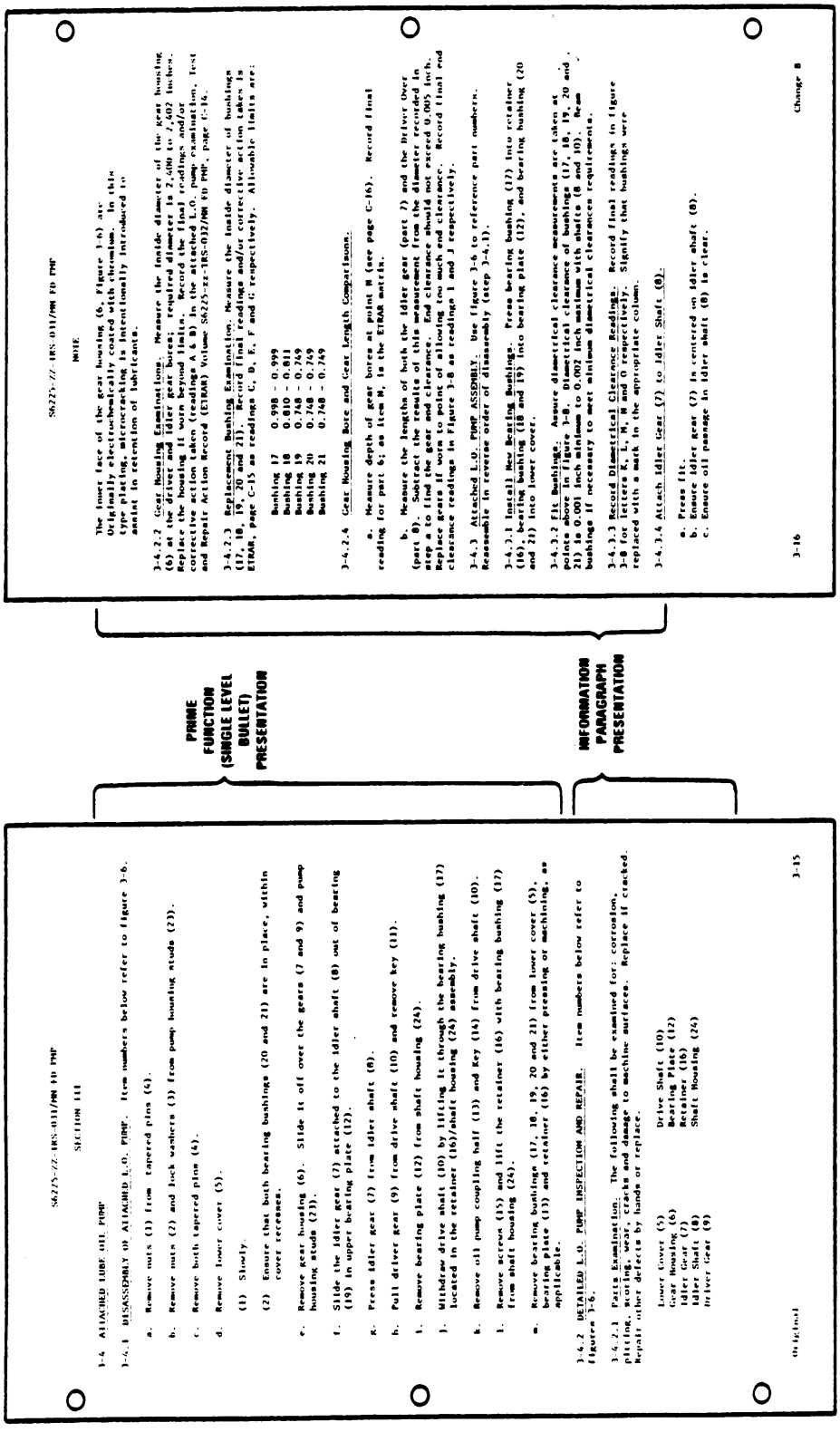

FIGURE C-11. Step by step procedural styles. (Sample) Sheet 1 of 2

APPENDIX C

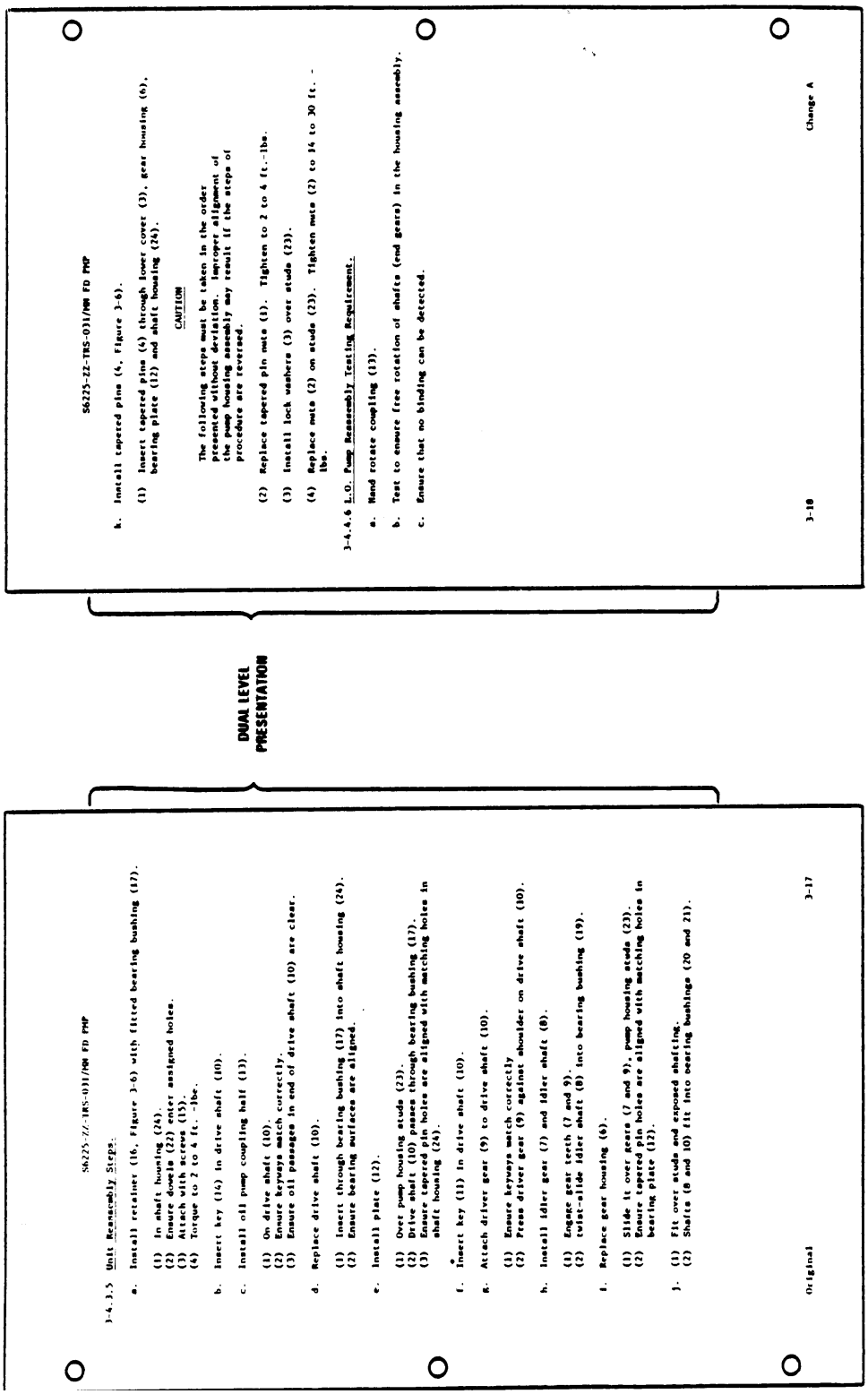

FIGURE C-11. Step by step procedural styles Continued. (Sample) (Sheet 2 of 2)

INDEX

FIGURE C-12. Alphabetical index. (Example)

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APPENDIX D

SAFETY AND HEALTH WARNING AND CAUTIONS

D.1. SCOPE

D.1.1 Scope. This appendix documents the safety, health warnings and caution requirements associated with the operation and maintenance of shipboard systems and equipment. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

D.2. APPLICABLE DOCUMENTS

D.2.1 General. The documents listed in this section are specified in sections D.4 through D.10 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections D.4 through D.10 of this specification, whether or not they are listed.

D.2.2 Government documents.

D.2.2.1 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.

PUBLICATION

DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

Public Law 91-596.- Occupational Safety and Health Act of 1970.
Executive Order 12196. -Occupational Safety and Health Programs for Federal Employees.

(Application for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

D.2.3 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified in the TMCR, 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).

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AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z535.3 Criteria for Safety Symbols.

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

D.2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

D.3. DEFINITIONS

D.3.1 Definitions and acronyms. The definitions and acronyms used in section 3 of this specification apply to this appendix.

D.4. DANGERS, WARNINGS, CAUTIONS, AND NOTES

D.4.1 Dangers, warnings, cautions, and notes. Unless otherwise specified, dangers, warnings and cautions shall precede the text but follow paragraph headings to which they apply. Notes may precede or follow applicable text, depending upon the material to be highlighted. Dangers, warnings, cautions and notes shall not contain procedural steps nor shall the headings be numbered. When a danger, warning, caution or note consists of two or more paragraphs the heading DANGER, WARNING, CAUTION, or NOTE shall not be repeated above each paragraph. If it is necessary to precede a paragraph by both a danger and a note, a warning and a note, or a caution and a note, and so forth, dangers shall precede warnings, warnings shall precede cautions, which in turn shall precede notes.

DANGER

WARNING

CAUTION

Dangers, warnings, cautions and notes shall be short, concise and used only to emphasize important or critical data. Dangers, warnings and cautions may be worded positively or negatively and shall state the hazard and result or reason, unless obvious. Attachment D1 of this appendix provides additional requirements for inclusion of warnings and cautions. Unless otherwise specified, icons shall be used as described in Attachment D1.

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D.5. HAZARDS

D.5.1 Health hazards. Procedures prescribed for the operation of equipment shall be consistent with the safety standards established by OSHA Public Law 91-596 and OSHA Executive Order 12196. When exposure to hazardous chemicals or other adverse health factors or use of equipment cannot be eliminated, guidance pertaining to the exposure shall be included in the Safety Summary or a Warning. A list of personnel protective devices shall be included.

D.6. NUCLEAR SURVIVABILITY

D.6.1 Nuclear hardness. If equipment to be operated, maintained or overhauled has nuclear survivability requirements (that is, over pressure and burst, thermal radiation, electromagnetic pulse or transient radiation effects on electronics), applicable cautions shall be incorporated into technical publications to ensure that hardness of equipment is not degraded during operation and maintenance.

D.6.2 Nuclear hardness symbol. Unless otherwise specified, all Hardness Critical Processes (HCP) shall be marked with the symbol:

HCP

When approved by the Government, the symbol **HCP** may be used in lieu of the boxed HCP symbol. The symbol shall be prepared in the same style and size as the applicable paragraph sidehead. The symbol shall not be included in the paragraph title in the table of contents. Use of the symbol is as follows:

a. When the entire procedure and all subordinate paragraphs and steps relate to establishing nuclear hardness, the symbol shall be inserted immediately following the paragraph number:

for example: "1.2 HCP LRU REPAIR."

b. When all subordinate paragraphs and steps do not contribute to establishing nuclear hardness, only those which do contribute will be annotated with the symbol.

c. Maintenance actions which could degrade hardness, but which are not directly involved in establishing nuclear hardness, will not be annotated with the symbol, but will be preceded by a caution.

D.6.3 Nuclear hardness symbol explanation. When applicable, the foreword, preface, or introduction shall include the symbol and an explanation of the HCP symbol and other pertinent information as necessary to emphasize the uniqueness of hardness features. This shall include an explanation that all paragraphs, procedures and steps identified by the symbol must be followed as written to ensure nuclear hardness is not degraded. This explanation shall be preceded by a CAUTION heading.

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D.7. ELECTROSTATIC DISCHARGE SENSITIVITY

D.7.1 Electrostatic Discharge Sensitive (ESDS) parts. If equipment to be handled or maintained contains ESDS parts, components or circuits, applicable cautions and symbols shall be incorporated into technical publications to ensure ESDS parts are not damaged or degraded during handling or maintenance.

D.7.2 ESDS symbol. Unless otherwise specified, all paragraphs which address handling or maintenance which could damage ESDS parts shall be identified by the following symbol indicating a sensitive electronic device:.

When approved by the Government, the symbol **ESD** may be used in lieu of the ESDS symbol. The symbol shall be prepared in the same style and size as the applicable paragraph sidehead. The symbol shall not be included in the paragraph title in the table of contents. Use of the symbol is as follows:

a. When the entire procedure and all subordinate paragraphs and steps describe handling or maintenance which could damage ESDS parts, the ESDS symbol shall be inserted immediately following the paragraph number:

for example "1.2 **ESDS** **ESDS** LRU REPAIR."

b. When all subordinate paragraph and steps are not related to handling or maintenance which could damage ESDS parts, only those related will be annotated.
c. Maintenance actions which could damage ESDS parts, but which are not directly related to handling or maintenance of ESDS parts, will not be annotated with the ESDS symbol, but will be preceded by a caution.
d. Illustrations, drawings and schematics shall be marked with the ESDS symbol.

D.7.3 ESDS symbol explanation. When applicable, the foreword, preface, or introduction shall include the ESDS symbol and an explanation of the ESDS symbol.
Other pertinent information shall be included as necessary to emphasize the uniqueness of ESDS parts. This will include an explanation that the ESDS symbol requires that all ESDS parts be handled according to ESDS device handling procedures. This explanation shall be preceded by a CAUTION heading.

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D.8. ENERGY EFFICIENCY

D.8.1 Energy efficiency requirements. When specified, technical manuals covering products that directly consume energy in normal operations, and that commonly have a method of expressing energy efficiency, shall include their energy efficiency.

D.9. ENVIRONMENTAL PROTECTION STANDARDS

D.9.1 Environmental protection. All technical manuals that require the use, transportation, handling, storage or disposal of fuels, toxic and hazardous substances, chemicals, ordnance and munitions, and so forth, shall meet the requirements of the Federal Environmental Protection Standards.

D.10. EMERGENCY INFORMATION

D.10.1 Emergency page markings. Pages containing emergency information shall have a broken black border in accordance with the requirements of figure D-1. FRC for emergency pages shall be 1/4 inch oversize to ensure proper printing of the bleed borders. Emergency page markings are not considered margin data.

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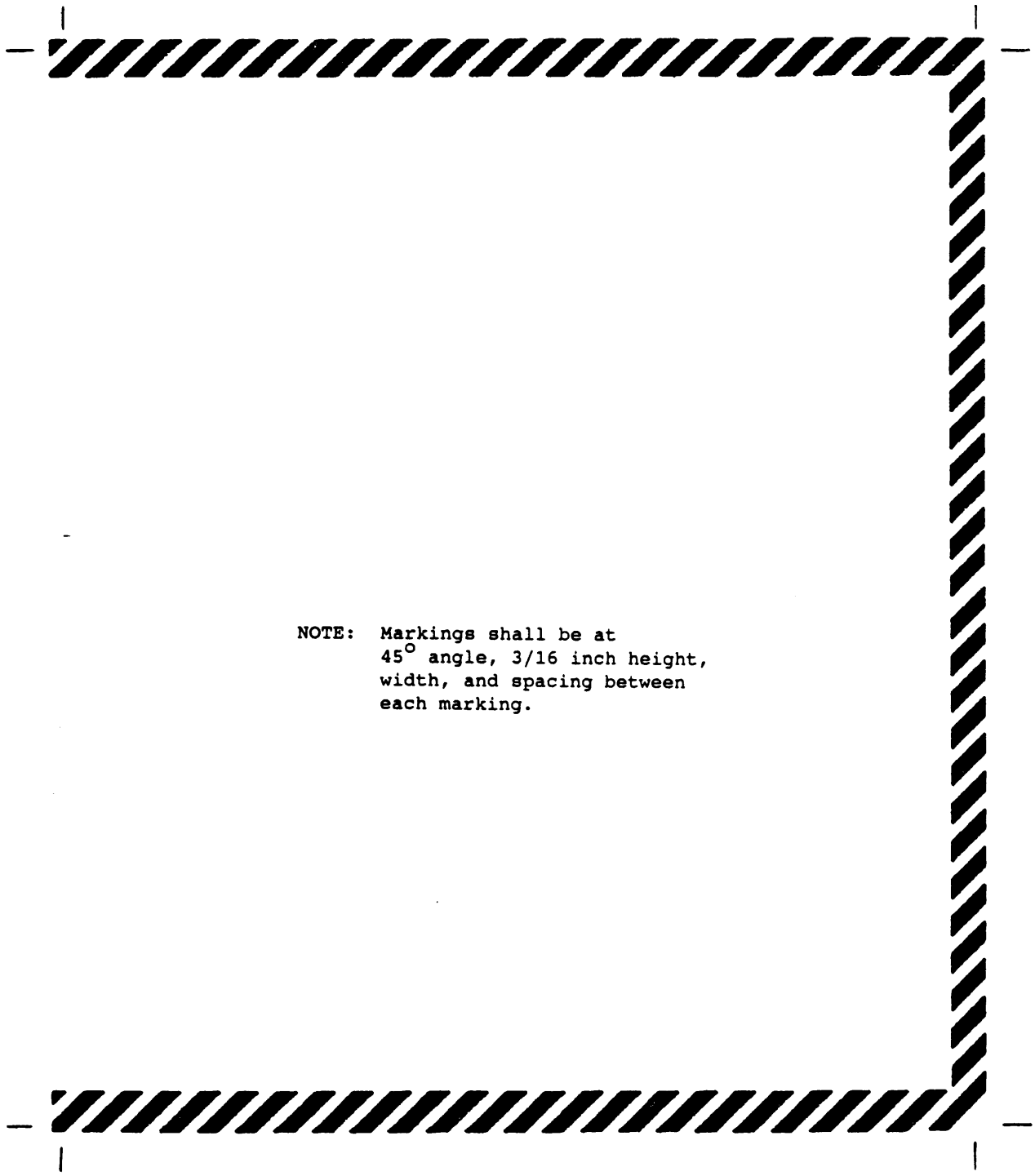

FIGURE D- 1. Emergency page marking. (Example)

APPENDIX D

ATTACHMENT D1

STANDARD PRACTICES FOR INCLUSION OF OCCUPATIONAL SAFETY AND HEALTH WARNINGS AND CAUTIONS IN TECHNICAL MANUALS

D1.1. SCOPE

D1.1.1 Scope. This document identifies standard practices for the inclusion of Occupational Safety and Health guidance in the text of technical manuals. The intent is to provide sufficient information to allow a standardized approach to the task, eliminate confusion, and improve the technical manual development process overall. The criteria for safety symbols in technical documents are in conformance with ANSI Z535.3.

D1.2. GENERAL REQUIREMENTS

D1.2.1 Human factors. Technical manual procedures are subject to being overlooked or circumvented when they are deemed unworkable or impractical. Careful consideration of environmental factors, equipment design or layout, human nature, and other human factors will help ensure the overall integrity of the task procedures.

D1.2.2 When to use DANGER, WARNING, or CAUTION statements.

D1.2.2.1 DANGER. DANGER is used to indicate a location, equipment, or system where imminent hazard exist, capable of producing immediate injury or death to personnel or threatens the primary mission of the ship.

D1.2.2.2 WARNING. WARNING is used to indicate a location, equipment, or system where a potential hazard exist, capable of producing injury to personnel, if approved procedures are not followed.

D1.2.2.3 CAUTION. CAUTION is used to indicate where hazard exist, that could severely damage equipment, a system, or the ship, causing loss of mission capability if approved procedures are not followed.

D1.2.3 General. Operating, maintenance, and safety instructions are used to indicate procedures to be followed in operating and maintaining equipment and complex systems normally tended by trained technicians. These information signs shall be prepared with limited detail and shall cover emergency and safety procedures fully. General safety information provides notice of general safe practice or rules related to health, first aid, sanitation and housekeeping.

D1.2.4 Design criteria. Danger, warning and caution icons or symbols shall be in accordance with ANSI Z535.3. These signs shall be compatible with precautions in applicable manuals.

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ATTACHMENT D1

a. As indicated by the definition in this standard, DANGER statements are used to indicate imminent hazard to personnel or equipment, WARNING statements are reserved for the protection of personnel and CAUTION statements are reserved for equipment or system protection. Do not use CAUTIONS for health hazards.

1. WARNINGS and CAUTIONS should be used for those unique conditions, steps or processes that require additional emphasis because of the inherently dangerous nature of the task or the potential for a "surprise" not otherwise readily obvious from the procedure.
2. A WARNING should be used to advise of injury or occupational illness potential, but only based on the reasonable likelihood that the reader's health or safety will be impacted in such a manner as to cause immediate concern and a disabling injury or occupational illness will result if the task procedure or stated precaution are not closely followed. Injury is defined as a traumatic bodily harm caused by a single or 1-day exposure to an external force, toxic substance (usually associated with accidents and spills in work places where the specific agent is not normally in the environment), or physical agent which will result in restricted duty, lost time, or worse. The occupational illness is defined as any abnormal physical condition or disorder, other than one resulting from an injury (as defined above), caused by repeated exposure to chemical, biological, or physical agents associated with the occupational environment which will result in restricted duty, lost time, or worse.
3. Specific direction as to which specific procedures require the use of warnings or cautions should be obtained from the LSAR and system safety. The responsible safety office also should be requested to review technical manual procedures for compliance with safety concerns.

b. Risk assessment - and the related issue of whether or not additional emphasis is required - is somewhat subjective. Decisions concerning these issues should be based on as much information as possible including historical mishap data from related systems, research, and the experience of all those involved in the technical manual development process. Often, the latter is the best indicator of the need for additional comment. Through the acquisition phase of major weapon systems, the decision to include a DANGER, WARNING or CAUTION statement in the text can often be made by consulting the Operating and Support Hazard Analysis or other system safety engineering analysis.

c. DANGERS, WARNINGS or CAUTIONS are not to be used for environmental protection concerns or security information.

D1.2.5 Wording and structure of DANGER, WARNING, and CAUTION statements.

a. A DANGER, WARNING or CAUTION statement should consist of four parts: a signal word (DANGER, WARNING, CAUTION), a concise statement of the hazard, minimum precautions, and the possible result if the DANGER, WARNING or CAUTION is disregarded, unless obvious. An icon is optional. In cases where hazardous materials are

being used and the conditions on D1.2.7e.2 exist, a hazardous material icon(s) shall be used. See paragraph D1.5 for guidance on constructing the icons.

1. The signal word will always be included using one of the styles, or similar, referenced in this specification. Whichever style is used, it must be used consistently.
2. The remaining parts can be arranged in any way that gets the point across; however, following the format of statement first, precaution second, and result third is often the most clear and concise method. Brevity is important. If the possible result is obvious, it need not be included.
3. A precaution is a short statement of hazard mitigation that tells the reader to take care, for example "use eye protection", or "keep arms and hands clear". Certain precautions may reference other publications or direct people to consult with another agency (for example, "...consult Bioenvironmental Engineering"). However, guidance of this nature should be considered for inclusion in a safety summary (see D1.2.7).

b. DANGER, WARNING or CAUTION statements shall never contain procedures critical to the effective and safe completion of the task. For example:

"WARNING

Cleaning with compressed air can create airborne particles that may enter eyes or penetrate skin. Pressure shall not exceed 30 psig. Wear goggles. Do not direct compressed air against skin."

c. Negatively worded statements (for example, "Failure to adhere..." or "Do not use ...") are acceptable and sometimes the best way to convey the message.
d. Multiparagraph or excessively long DANGER, WARNINGS and CAUTIONS are not specifically disallowed by this specification but lengthy statements are a good indication that the task procedures are not written with the needed safety steps or procedures included.
e. Pay strict attention to the definitions of "shall", "will", "should", and "may" in this specification. The use of these words must be consistent with exposures or conditions which require comparable DANGER, WARNINGS or CAUTIONS.

D1.2.6 Placement of DANGER, WARNING, or CAUTION statements.

a. This specification contains general requirements.
b. DANGER, WARNINGS or CAUTIONS should be placed in the text immediately prior to the step or procedure to which they apply. The same DANGER, WARNING or CAUTION need not be repeated within a procedure as long as the emphasis and impact of the DANGER, WARNING or CAUTION is not lost because of a break in the procedures.

c. There is no stated maximum on the number of unrelated DANGER, CAUTIONS or WARNINGS that can be placed on a page. Under no conditions should they be so numerous so as to obscure the procedures. Properly written procedures should eliminate the need for consecutive WARNINGS. Sandwiching short (one line or two line) procedures between WARNINGS and CAUTIONS should be avoided.

D1.2.7 Safety summary sheets or sections.

a. All technical manuals containing dangers, warnings, or cautions shall have a Safety Summary. In conjunction with properly written procedures, the Safety Summary, which can contain general safety precautions, can eliminate the need for many DANGER, WARNINGS or CAUTIONS.

b. Provide a Safety Summary in accordance with this specification in the front of the manual preceding the first text page. The safety summary provided on figure C-9 is only an example of the type, depth, and format of general shop safety information necessary. It is not all inclusive. Only the first two paragraphs (see figure C-9), or similar wording detailing the significance and use of DANGER, WARNING and CAUTION statements, should be considered common to all Safety Summaries. Additional paragraphs can be added depending upon the class of hazard found in the technical manual.

c. Nearly any topic can be considered for inclusion in a Safety Summary: mechanized material handling equipment; overhead lifting devices; wood or metal working machine use and guarding; and so forth. General precautions related to storage, and so forth, can also be included.

d. Safety summaries are an excellent place to provide general safety or health instructions, but they must be tailored to the technical manual.

1. Live circuitry guidance is probably not applicable to a corrosion control technical manual. This does not preclude the possibility, however, of a WARNING in the text of a corrosion control technical manual if the text establishes the likelihood of exposure to injurious current.
2. The converse is also true. It would be appropriate to include live circuitry guidance in the Safety Summary of a maintenance manual. However, WARNINGS inserted in the text prior to every point of potential current exposure would not be required, as long as the procedures identify the proper controls, for example, "discharge capacitor XXXX," or "...turn off power and tag out (lock out) switch." It is reasonable to assume a trained maintenance technician is fully aware of the hazards of live circuitry; emphasis beyond a Safety Summary would be needed only in the event that the equipment, procedures or work environment presented an unusual situation to the technician.

e. Inclusion of general guidance in a Safety Summary does not preclude the need for a DANGER, WARNING or CAUTION if the text calls out a nonroutine use or application.

1. For example: in a parts cleaning technical manual, general guidance in the Safety Summary related to air pressures (30 psig), chip guarding, eye protection, and so forth, would suffice as long as the task procedures include the minimum required controls (pressure regulation, and so forth) as procedural steps. A CAUTION may still be required, however, if the text specifies 15 psig for a delicate piece of equipment that would be damaged if the technician proceeded under the general guidance included in the Safety Summary.
2. Many industrial hygiene and occupational health concerns can be addressed in the same manner. In technical manuals that frequently call for routine solvent applications, WARNINGS would not be needed throughout the text as long as the minimum required controls are called for in the task procedures. General guidance regarding solvents could be included in the Safety Summary. Additional emphasis would then be required only if a procedure calls for a nonroutine application, such as heating the solvent, or an unusual, potentially more toxic solvent. In that event, a DANGER or WARNING could be used depending on the ability of the process to cause immediate safety or health concerns. This approach can be used for many of the occupational health concerns associated with commonly used substances, for example, hydraulic fluids, oils, fuels, paints, thinners, adhesives, sealants, and so forth.

f. DANGER, WARNINGS or CAUTIONS should not simply be extracted from the text and inserted verbatim in a Safety Summary. An acceptable approach would be to provide a general summary of guidance, classed by exposure. DANGER, WARNINGS or CAUTIONS must still be placed in the text, however, based on the risk associated with the steps or procedure.

g. Excessively long Safety Summaries are discouraged. If a technical manual requires extensive safety or health guidance, a safety section or chapter should be considered.

D1.3. QUALITY CONTROL

D1.3.1 Rewrite. The Government will recommend rewrite under the following conditions:

a. When any part of a procedure, DANGER, WARNING, CAUTION, or Safety Summary is not consistent with existing Occupational Safety and Health Administration and Service safety requirements or is detrimental to existing Service safety and health programs.

b. When WARNING statements are misused for equipment protection or otherwise misused outside of the intent of this specification and this appendix.

c. When CAUTION statements are misused for personnel protection, or otherwise misused outside of the intent of this specification and this attachment.

d. When DANGER, WARNING, or CAUTION statements contain procedural steps, they should be included in the task description. Minimum protective equipment requirements or minimum precautions are allowable.

e. When DANGER, WARNING, or CAUTION statements are excessively long.

f. When DANGER, WARNING, or CAUTION statements are so numerous on a page that necessary task procedural steps are visually obscured.
g. When Safety Summaries are used to the exclusion of DANGER, WARNINGS and CAUTIONS in the text unless indicated by the nature and class of hazard associated with the text, or when otherwise used outside of the intent of this specification (that is, they should provide tailored, general guidance).
h. When DANGER, WARNINGS or CAUTIONS are extracted from the text verbatim and inserted in the Safety Summary.
i. When statements detailing the significance and use of DANGER, WARNING and CAUTION statements are not provided in the Safety Summary.
j. When the wording of DANGER, WARNINGS or CAUTIONS varies throughout the text even though the same or very comparable conditions are being emphasized.
k. When a DANGER/WARNING does not serve to prevent disabling injury or death, or a DANGER/CAUTION does not serve to prevent damage or destruction of equipment.
l. When a procedure lacks required emphasis because of its inherently dangerous nature or a step requires additional emphasis because of its critical safety impact.
m. When WARNINGS or CAUTIONS contain vague precautionary statements such as "avoid all contact", or rely too frequently on references to other technical manuals or outside agencies. In these cases, inclusion in a Safety Summary or input conditions page will be recommended as appropriate.
n. When WARNING or CAUTION statements contain general safety precautions.

D1.4. POINTS OF CONTACT

D1.4.1 Coordination. All those involved in the technical manual development process must remember that the OSH guidance included in technical manuals is not the only line of defense against serious mishaps, but it is sometimes the last. The effective inclusion of OSH guidance can almost never be accomplished by a single individual with a distinct background. It must be a coordinated effort among system experts, safety professionals, technical writers, and the potential user. Questions arising from this process should be referred to the appropriate Safety Office and the Government acquiring activity. Do not ignore existing contractual or Command requirements.

D1.5. CONSTRUCTION OF HEALTH HAZARD ICONS/SAFETY SYMBOLS

D1.5.1 Hazard icons. Icons/safety symbols may be used to save space in the manuals while still conveying a clear message of the hazard to the technician using the manual. Since the icon presents a visual image of the hazard rather than a more abstract message, recognition should be much faster than with a worded warning. ANSI Z535.3 provides general criteria for the design evaluation and use of safety symbols to identify and warn against specific hazards and provide information to avoid personnel injury and damage to equipment.

APPENDIX E

TABULAR MATERIAL

E.1. SCOPE

E.1.1 Scope. This appendix documents the form and format requirements for data to be presented in tables, charts and graphs. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

E.2. APPLICABLE DOCUMENTS

E.2.1 General. The documents listed in this section are specified in sections E.4 and E.5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections E.4 and E.5 of this specification, whether or not they are listed.

E.2.2 Non-Government publications. The following documents 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 specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issue of the documents cited in the solicitation (see 6.2).

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 200 - Reference Designations for Electrical and Electronics Parts and Equipment (DoD Adopted).

(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.)

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

E.3. DEFINITIONS

E.3.1 Definitions and acronyms. The definitions and acronyms used in section 3 of this specification apply to this appendix.

APPENDIX E

E.4. TABULAR, CHART, OR GRAPH FORM

E.4.1 Tables, charts, and graphs. Reference data (other than illustrations, drawings, diagrams) shall be presented in tabular, chart or graph form. Any other type of data which lends itself to tabular, chart or graph form may also be so presented. Tables, charts and graphs shall be so designed that they are easily understood. Charts shall be presented as tables or illustrations, whichever is most appropriate. Graphs shall be considered illustrations, and be assigned figure numbers. Figure E-1 provides an example of a typical table. Tables shall include the following:

a. Center the word "Table", the applicable number, and the title above the head rule.
b. Capitalize the word "Table" and each principal word in the title.
c. Capitalize each principal word in column heads.
d. Single space entries within the table.
e. Align related entries in different columns.
f. Align entries within columns as follows:

1. For decimal data, decimal points shall be aligned.
2. For mathematical notation, multiplication signs shall be aligned.
3. All other numeric data shall be aligned flush right.
4. Alphabetic or alphanumeric data shall be aligned flush left.

g. Indent carryover lines two spaces.
h. Specify units of measurement in row or column headings.
i. Arrange row entries in tables in groups of up to five rows. Groups shall be separated with white space if no entries are blank, and with light horizontal lines if any entries are blank. At least 25 percent of the area within tables and between columns and groups of rows shall be white space.

E.4.2 Table cutline. For RDC, the point at which a table or (when appropriate) chart is to be placed shall be indicated by a break in the text and the insertion of the table number and title. Cutlines shall be placed at the end of the first paragraph or subparagraph to which they pertain. The table number shall begin at the left margin and there shall be a double space above and below the cutline. For the PTM or FRC, the table is mounted in place and the cutline becomes the table title.

E.4.3 Table titles. Tables shall be assigned table titles. The title shall follow two spaces after the table number and shall be centered above the applicable table. The first letter of the first word and of each principal word shall be capitalized. Full page tables, placed sideways on a page, shall be turned 90 degrees counterclockwise. The table number and title for a turned table shall also be turned 90 degrees counterclockwise to stay centered above the table. Table titles should begin with an identifying name. For example:

"Table 3-1. Guidance System Test Points"

The title shall be short and describe the contents or purpose of the table. Tables applicable to one Service, in a manual that will be used by more than one Service, shall be identified. For example:

"Table 2-3 (Army Only). Fuel Indicator Correction Factors."

E.4.4 Boxhead titles and rules. The first letter of the first word and of each principal word of boxhead titles shall be capitalized; the remaining letters shall be lowercase. Tables shall be so designed that related entries in different columns are aligned (see figure E-2). Carry over lines of tabular material shall be indented two spaces unless adequately spaced between entries. Tables shall be vertically ruled as required for clarity. A horizontal rule shall be placed at the beginning (head) and at the end (foot) of a table and following column heads (boxhead titles). The closing rule is omitted at the foot of a continued table; the opening rule is omitted at the head of the continuation of the table. For preprogrammed tables, with columns ruled for continued tables, the opening rule may be included at the head of the continuation of the table.

E.4.5 Continued table material. When a table is continued on a following page, the number and title shall be repeated at the head of the columns on all following pages of the table, followed by a dash and the word "Continued." Boxhead titles shall also be repeated. The above information shall not be repeated on a following page when the page is a foot page of a head to foot tabular arrangement. When a table entry is continued, the entry or its identifying number or letter from the first column shall be repeated in the first column followed by a dash and the word "Continued." The abbreviation "Cont" may be used when table columns are too narrow for "Continued" to be spelled out.

E.4.6 Footnotes. The footnotes, which shall be kept consistent with clarity, shall be placed immediately below the table in which they are referenced. If a table is continued onto other pages, all footnotes shall be placed at the bottom of the page on which they are referenced or at the end of the table and the directory note "See footnotes at end of table" shall be placed at the bottom of pages containing footnote references. For footnotes coming before the end of the table, and for a directory note, a one inch horizontal rule shall be placed flush left below the table and the footnote or directory note placed under the rule. Footnotes at the end of the table shall be started on the second line below the closing rule. All table notes and footnotes shall be indented five spaces from the left margin of the table and carry over lines shall return to the left margin of the table.

E.4.7 Tabular material. When a small amount of tabular information is to be inserted, and will not require referencing from adjacent text, it may be included within a paragraph of text without identifying it as a table.

E.4.8 Line graphs. Line graphs shall conform to the following:

a. The number of ideas conveyed per graph shall be minimized. Line graphs shall have a maximum of four lines (that is, lines that show the relationship of variables). Such lines shall be coded for easy identification.
b. If there is a natural orientation for the axes (for example, altitude on vertical axis), the axes shall be so oriented.
c. Grid lines shall support the intended use (that is, more grid lines shall be provided where accurate interpretation is required). Grid lines shall be no less than 0.1 inch apart when reduced to final size and shall be lighter than the graph line.
d. Graph scales shall be linear unless they must be nonlinear for proper comprehension and use. They shall include the zero value of the variables. One line break may be used per scale in order to include the zero value if this saves space without jeopardizing clarity.
e. For complex graphs, instructions shall be provided for use and interpretation.

E.5. EXAMPLES OF TABULAR DATA

E.5.1 Parts list for HM&E equipment. Parts lists for HM&E equipment shall be in tabular form and include the following:

a. Column 1, figure and index (find) number. This column shall contain the figure number and index number which shows the location of the part.
b. Column 2, name (nomenclature) and description. This column shall contain the designation name of the part and descriptive data to identify the parts of the equipment. Descriptive information shall include the Part or Identifying Number(PIN) of the part whenever available. Those parts which do not have a PIN shall include physical characteristics (material, grade, series, dimensions, specification, and any other information necessary to order replacement parts from the original supplier of the part without going to the prime contractor. The preceding requirement must include all the information necessary to acquire parts when parts are acquired from multiple commercial sources.
c. Column 3, Quantity. This column shall identify the quantity of parts required.
d. Column 4, Commercial and Government Entity (CAGE) code. This column shall contain the original item manufacturer's CAGE identification code. CAGE code 81849 shall be used for military parts and code 80058 for Joint Electronics Type Designation System (JETDS) items.
e. Column 5, Original manufacturer's part number. This column shall be the part number assigned by the original manufacturer of the part. Part numbers are not required for common hardware items that are available from many sources.

E.5.2 Parts list for electronic equipment. Parts lists for electronic equipment shall be in tabular form and include the following (see figure E-3):

a. Column 1, Reference designation. This column shall contain the reference designations of all parts listed in sequential order. The unit numbering method of assigning reference designations, as specified in IEEE 200, shall be used to identify units, assemblies,

subassemblies and parts. Mechanical part (MP) numbers shall be assigned to mechanical parts subject to replacement, such as handles, slides, and so forth, that are included in the APL but not assigned MP numbers in the engineering drawings. With the exceptions of screws, nuts, bolts, and other attaching hardware, every functioning part in the equipment shall have a reference designator. The parts list shall be divided and arranged by major units in numerical sequence (for example, unit 1 with its parts will precede unit 2 with its reference designations parts, and so forth). When reference designations have been cancelled for more than two consecutive items, only the first and last of the designations are to be listed, separated by the word "through". For example: 3A1R69 through 3A1R100 not used.

b. Column 2, Notes. This column shall contain equipment reference information such as serial number, model number, configuration data, and so forth.

c. Column 3, Name and description. This column shall include descriptive data to identify the parts of the equipment and aid in determining substitutes. Such information shall consist of the name, electrical or mechanical characteristics, and PIN of the item, and when applicable, attaching hardware. Common parts (for example, washers, springs, nuts, bolts, and so forth) shall be identified only by the PINs. Those parts not having a PIN shall also include physical characteristics (material and sufficient dimensions) to identify the parts within the set the manufacturer's part number and CAGE or the equipment contractor's part number and CAGE, federal supply code (FSC) number. FSC code 31349 shall be used for military parts and code 80058 for JETDS items, and drawing number. Replaceable mechanical parts that are assigned as "MP" numbers in accordance with (a) preceding, shall include the manufacturer's part number or engineering drawing number along with the name and description of the item. The statement "Same as . . .," or equivalent, shall not be used for describing identical parts. For identical parts that are used more than five times in the equipment, key number the complete list of common item descriptions and reference made thereto by the item number. Attaching hardware, with quantity required, shall be identified by the assigned letter code. For example, C(4) would be the third listed piece of attaching hardware in which four pieces are used. When nonstandard parts have been approved and there are multiple sources, each source shall be cited in the description. If selected values for critical parts are required, sufficient information, such as criteria for selection and range of values, shall be provided to permit the repair activity to make selection. For each part, the part number of the actual item manufacturer shall be used, unless the part is physically modified by the equipment contractor.

d. Column 4, Figure and item number. This column shall reference the parts location illustration by figure number and item number enclosed in parenthesis [for example, 6-119(17)].

E.5.3 Protective device index. This index shall be in tabular form and include the reference designation, front panel marking of the device, trip-out value of the circuit breaker, and rating of fuses, name of the circuit protected, and a reference to troubleshooting diagrams.

E.5.4 Relay, switch, and indicator lamp index. A relay coil, switch, and indicator lamp index shall be prepared in tabular form. The first column of each index shall list each relay coil, switch, or lamp alphanumerically by reference designation. Subsequent columns of the relay index shall give the name of the functional bus and shall identify the coil supply voltage, including polarity and frequency, as appropriate. Subsequent columns in the lamp index shall identify the lamp name and the energizing bus voltage. Subsequent columns in the switch index shall identify the switch bus and the switched voltage. In all of the indexes, columnar references shall be made by figure number, sheet, and zone to a troubleshooting diagram where the item is active.

E.5.5 Standard log forms. Guidance regarding standard log form requirements should be obtained from the Government.

E.5.5.1 Format. The following consideration should be given in development of the log form.

a. Log forms shall planned in columnar format for simple use, with adequate space for identification, data and check off. The time line should normally be on an hourly or daily basis and may be arranged on a vertical (left side) or horizontal axis (top), depending on the number of monitoring points.
b. Sheets shall have one dimension of 8-1/2 inches. Sheets should limit the second dimension to 11 inches when practical, by using the reverse side for continuation.
c. Monitoring points should indicate the normal values for each monitoring point, and should indicate the maximum (MAX) and minimum (MIN) tolerance for which normal operation can be expected.
d. Values, that were to fall below the minimum or above the maximum, that would present danger to personnel, or would cause damage to the equipment, should be indicated in "red" or by bold face type or other method to be conspicuous.
e. Instructions for use of the form shall be included on the form or with the set, when necessary. Codes, such as H = High; L = Low; B = Bubbles that are used should be described in the instructions or in a legend.
f. Action procedures shall be indicated for danger readings (see (d)) such as shutdown; cutback; open valve, and so forth in the instructions or by a separate related column.
g. Space should also be provided to indicate the make, size, model, application, and location of the equipment, or other relevant information.
h. Space for signing the watch, normally on the reverse side.
i. Space should also be provided, if required, for certification by the watch officer, engineering officer, and so forth, normally on the reverse side.

E.5.6 Troubleshooting index. The troubleshooting index shall be in tabular form. The index shall list all equipment, list all major and supporting functions (in alphabetical order), provide references to the technician (to the appropriate procedures), and list diagrams that are to be used to troubleshoot a specific function (see figure E-4).

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TABLE X-1. Signal characteristics. (example)

Signal Name	Amplitude	Duration
B. xxxxxxxxxxxx	xxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxx	
C. xxxxxxxxxxxxxxxx 1 xxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxx 2 xxxxxxxxxxxxxxxx

[1] xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

[2] xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

FIGURE E-1. Typical table.

Binocular	Power[1] of Magnification	Diameter of Exit Pupil (in.)	Effective Focal Length (in.)		Filter[2]
			Objective	Eyepiece	

[1]Maximum magnification xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

[2]Optional filters xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

FIGURE E-2. Boxhead titles, table rules and column entries. (Example)

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TABLE ZZ. RADAR SET AN/SPS-XX, PARTS LIST

Amplifier-Oscillator Group OA-2815/SPS-XX (Unit 2)

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	FIGURE NUMBER (ITEM)
2		AMPLIFIER - OSCILLATOR GROUP OA-2815/ SPS-XX: Provides drive power for AN/ SPS-XX final stage, made in three cabinets which can be separated; mfr 89661, part no. 478D-800G02.	1-1
2AT1	1	ATTENUATOR, FIXED: 50 ohms, 1 watt, bnc type connector; mfr 91578, type RT3-M-51. (Attaching Parts) B(1), T(4)	6-119(17)
2B1		FAN, CENTRIFUGAL: Cw rotation, 3 o'clock blast, aluminum case, 6-13/ 32 in. long, 6-7/17 in. w; mfr 82877, type DRFPKS406; 89661, dwg 331C158H03; (Attaching Parts) L(8), T(8), Z(8)	6-119(42)
2C1 thru 2C8		CAPACITOR, FIXED, PAPER DIELECTRIC: 0.01 F±10%, 600 Vdc working; mfr 56289, part no. 102P15; 89661, dwg 54B7098H07.	6-119

NOTE 1 Serial number: RT3-M-51.789

FIGURE E-3. . Parts list table, electronic equipment. (Example)

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TABLE ZZ. TROUBLESHOOTING INDEX RADIO SETS AN/SRC-XX AND AN/SRC-XX

FUNCTIONAL AREA	TROUBLE-SHOOTING PARAGRAPH	TROUBLE-SHOOTING DIAGRAM	FUNCTION DESCRIPTION PARAGRAPH	ALIGHMENT/ ADJUST PARAGRAPH
AC Power	5-3	5-8	3-9a	6-105, 6-106
DC Power	5-4	5-19	3-9b	6-107 through 6-110, 6-127
Keying	5-5	5-24	3-13	6-22
Receive RF	5-8	5-1	3-4	6-112 through 6-115
System Channel and Frequency Selection	5-9	5-16	3-10, 3-12	6-121

FIGURE E-4. Troubleshooting index. (Example)

APPENDIX F

ILLUSTRATIONS, DRAWINGS, AND SKETCHES

F.1. SCOPE

F.1.1 Scope. This appendix documents illustration requirements. It describes illustration use and placement, photographs and line drawings, artwork, engineering drawings and other types of illustrations. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

F.2. APPLICABLE DOCUMENTS

F.2.1 General. The documents listed in this section are specified in section F.4 through F.10 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in section F.4 through F.10 of this specification, whether or not they are listed.

F.2.2 Government documents.

F.2.2.1 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)

NAVSEA OP 1700 - Standard Fire Control Symbols.
SE000-01-IMB-010 - Navy Installation and Maintenance Book.

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

F.2.3 Non-Government publications. The following documents 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 specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issue of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ANSI Y32.10 - Graphic Symbols for Fluid Power Diagrams.

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(Application for copies should be addressed to the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017.)

INSTITUTE OF ELECTRICAL, ELECTRONICS ENGINEERS (IEEE)

IEEE 315 - Graphic Symbols for Electrical and Electronic Diagrams (DoD adopted).
IEEE 991 - Diagrams, IEEE Standard for Logic Circuit (DoD adopted).

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

SOCIETY OF AUTOMOTIVE ENGINEERS STANDARDS

SAE J1780 - Hydraulic System Diagrams and Associated Tables for Marine Vehicles.
SAE AS 1290 - Graphic Symbols for Aircraft Hydraulic and Pneumatic Systems. (DoD adopted)

(Application for copies should be addressed to the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

F.2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

F.3. DEFINITIONS

F.3.1 Definitions and acronyms. The definitions and acronyms used in section 3 of this specification apply to this appendix.

F.4. ILLUSTRATION TYPES

F.4.1 Examples of illustration types. The following are example illustration types, as applicable:

a. Isometric projection exploded views.
b. Illustrated parts breakdown.
c. Engineering drawings.
d. Sectional views.
e. Assembly, disassembly, reassembly, installation, and fabrication drawings.
f. Schematic diagrams, block diagrams, and timing circuit diagrams.
g. Item location illustrations.
h. Test setup diagrams.

i. Wiring diagrams.
j. Gearing and linkage diagrams.
k. Piping diagrams.

F.4.2 Illustration selection criteria. Exploded view isometric drawings shall be used whenever necessary to show the proportionate size of machinery parts, proper relation to other parts, and assembly or disassembly sequence. It is preferable that all parts be exploded in isometric projection of their line of assembly axis. Sectional views or item location drawings should be used to indicate where critical measurements shall be taken or when the information presented is easier to understand when depicted as a cross-sectional view. Parts should be numbered in disassembly order sequence, with a parts list including part name, quantity, and number on each figure. As a rule, sectional drawings are not needed when isometric drawings are available. For general drawing requirements see F.5.1.

F.4.3 Block diagrams.

F.4.3.1 Functional block diagrams. On functional block diagrams, the generation paths of all major output functions shall be depicted in condensed form by appropriate flow line connections of functional blocks. The functional blocks shall be chosen for the most logical presentation of signal paths without regard to physical hardware boundaries. One block may be a portion of one physical assembly, while another may encompass two or more assemblies, in whole or in part. Also, one block may contribute to two or more generation paths. Where functional blocks do not coincide with physical assemblies, physical orientation shall be provided either by adding dashed borderlines with identifying captions or by adding "part __" captions near the functional blocks. All major function outputs shall be identified by name or fire control symbol, as applicable, and generation paths shall be individually identified. Coded flow lines or coded directional arrows correlated by an accompanying legend may be used. The number of diagrams required for clarity depends upon the variety of major output functions and the changes imposed by different operational modes. In any case, differences in generation paths for different modes shall be clearly indicated.

F.4.3.1.1 Overall functional block diagram. The overall functional block diagram shall show the major functions of the equipment correlated in a logical manner to show outputs, inputs, cooling, built-in-test-equipment, air pressurization, power distribution, and so forth. Hardware packaging shall be subordinated to the functional arrangement. The following shall apply:

a. For multifunction equipments, whether single or multiunit, each major function shall be represented by a block and shall show the functional generation of outputs, cooling, air pressurization, power distribution, and so forth.
b. The blocks shall be connected by lines and arrowheads showing the direction of the flow.
c. Each block shall be identified by the functional name only.
d. Each functional input and output shall be identified by title. Waveforms shall be included as applicable.

e. Modes of operation shall be identified by title or symbols, as applicable.
f. Ancillary equipment shall be shown by blocks when the ancillary equipment is associated with major functions. Ancillary blocks shall be identified by nomenclature and shall be identified as "(Ancillary)".

F.4.3.2 Summary block diagrams. For large and complex equipments, such as fire control radars, summary block diagrams shall be provided for each Case B signal flow or related group of signal flow diagrams. The summary block diagrams shall serve as an aid for training and for fault isolation down to a particular portion of a related signal flow diagram. Each summary block diagram should be limited to one sheet whenever possible.

F.4.4 Cable run diagrams. Isometric diagrams shall be used to indicate the location of all cable runs between compartments or areas. Each cable run diagram shall indicate by deck, compartment, and frame identification the location of all cables shown on the interconnecting diagrams.

F.4.5 Control diagrams. Control diagrams shall be included for all control circuits. Control circuits shall be grouped according to energizing voltage, control function, mode of operation, or physical limits of cabinet or assembly, as applicable. Supporting information required to clarify the use of the diagram shall be provided in the general notes. The functional name and reference designation for each relay, switch, lamp, and so forth, shown shall be included. All relay energizing circuits shall be shown with all tie points and terminals and with switches and relay contacts in their operating positions. All terminal connections, switches, interlocks, contacts, or other relays in series with the energizing path, plus lamps or indicators (electrically connected in the energizing or indicating status of contact closures), shall be shown. The following note shall appear on all control diagrams: "All switches and relay circuits are shown in operating positions." In cases of multiple operating positions, switch and relay positions shall be explained by a specific note on the diagram.

F.4.6 Diagrams and wire run list. Diagrams and wire run lists shall be arranged functionally. When wiring diagrams are included in a manual, wire run lists shall not be included.

F.4.7 Engineering drawings and wire run lists. Engineering drawings and wire run lists, are acceptable only if they meet the content, arrangement, legibility and format requirements of the contract and content specification, and the style, format and production requirements contained in this document. They must have all unnecessary data removed that would reduce the comprehension or clarity of the illustration and must be reduced or redrawn to meet foldout restrictions. When wiring diagrams are included in a manual, wire run lists shall not be included.

F.4.8 Equipment illustration. For installations consisting of more than one unit or assembly, a pictorial illustration representing the equipment, or all units comprising the equipment shall be included and shall be designated figure 1-1. If two units of the equipment differ between models, the alternate units shall be shown side by side (if clarity is not sacrificed) and designated by

applicable model numbers. If more than two units differ, two frontispieces should be furnished and designated as figures 1-1 and 1-1A. The illustration shall show the major units of the equipment, relative size of each unit, basic interconnections between units, and their relationship with other equipment. The illustration shall be a left-hand full page or foldout (never backed up) and shall be assigned the folio (blank/1-0).

F.4.9 Exploded views. Exploded views of the equipment shall be used in parts breakdowns and for reference in disassembly and assembly instructions. Index numbers shall be used to identify parts. If the equipment is of such a nature that it cannot be adequately illustrated by a single exploded view, it shall be exploded by subassemblies as separate views. In such cases, an exploded view showing the complete equipment exploded into its major subassemblies shall be shown first. Parts which attach and connect the major assemblies together shall be shown on this illustration. These views and those in parts breakdowns shall be the same, with the sequence of index numbers in the order of disassembly. Parts in an exploded view shall be shown in proportional size. The spacing of parts shall achieve maximum clarity and effective use of space. The relationship of parts shall be shown by the use of assembly lines where the main line of exploded parts has been broken into two or more groups for convenience of layout on the page. Leader lines and index numbers shall be used to assist in locating parts. Parts for which disassembly is not required, such as wafers, switches, and so forth, need not be exploded.

F.4.9.1 Sectional views. Sectional views may be illustrated for units with few components as long as clarity is not sacrificed (see F.6.12).

F.4.10 Frontispiece illustration. A frontispiece shall illustrate the system, equipment or repairable item covered in the manual. It shall be placed on the page preceding Chapter 1.

F.4.11 Function diagrams.

F.4.11.1 Single-function diagrams. When specified, single-function diagrams for nonprogrammable devices which result in a unique output function may be prepared to the requirements of signal flow diagrams (see F.4.22).

F.4.11.2 System control function diagrams. System control function diagrams shall be provided for all system control circuits. The control function diagrams shall be at the system level but shall be constructed in accordance with F.4.5. The diagrams shall show essential fault isolation test points or comparable indicators, and shall include appropriate references to equipment manuals.

F.4.11.3 System data function diagrams. System data function diagrams shall show in detail the system information needed to isolate faults within signal or data flow paths. Data function diagrams shall include tolerance values and shall contain references to equipment publications where necessary. All inputs required to develop the output shall be shown. The data function diagrams shall be constructed in accordance with F.4.22.

F.4.12 Hydraulic and pneumatic schematics. Hydraulic system diagrams shall be developed in accordance with SAE J1780. Where necessary, hydraulic and pneumatic schematics may be prepared as orthographic diagrams and pattern coded to show hydraulic and pneumatic devices, and associated mechanical and electrical devices and actuating mechanisms, using standard symbols where possible. The illustration shall be developed for color symbolization only if such patterns are not adequate and if the contracting activity authorizes use of color. Illustrations planned for color shall be developed in accordance with F.6.14. A series of hydraulic schematics can show mechanical actions and sequential functions of parts through a complete cycle. Arrows shall be used to show directional flow.

F.4.13 Ladder diagrams. Ladder diagrams shall be prepared in accordance with the following:

a. Diagrams shall be used to illustrate schematically the energizing path and circuit connections for all relay coils and contacts, indicator lamps, solenoids, interlocks, clutches, and motors, other than those shown on signal flow and power distribution diagrams; these shall include parts energized by a bus, or by automatic or manual switching.
b. All such items, including those not illustrated on the ladder diagrams, shall be listed in associated ladder indices.
c. Relay ladder diagrams shall include all relay contacts that are in series with the energizing path of the coils.
d. Relay coils and contacts and other applicable parts shall be grouped on the ladder diagrams in a manner consistent with the equipment design or construction, such as, energizing voltage, control functions, mode of operation, or physical limits of cabinet or subassembly. Supporting information required to clarify the selected grouping of components, and the mode or switch positions assumed on the diagram, shall be provided in general specific notes on the apron of the diagram.
e. Control voltages and energizing buses shall be represented by horizontal lines located at the top of the illustration. Circuit components and relay wires shall be shown in vertical lines, except that connecting elements between vertical strings may be horizontal. Common returns and ground shall be represented by horizontal lines at the bottom of the diagram. Long series string, which have many references or circuit elements, can be doubled back to accomplish the required vertical arrangement. Ladder circuits may be arranged in one or more horizontal rows. Modification of this standard arrangement may be permitted for complex energizing paths, if a net gain in diagram usability can be achieved through more efficient layout.
f. All energizing paths illustrated shall be shown as they are physically connected, with switches in normal positions. However, all relay contacts shall be shown in de-energized condition, unless otherwise specifically and clearly noted. All terminals, connector pins, switches, and contacts of other relays in series with the energizing path shall be shown, plus indicator lamps that are electrically connected in the energizing path or that are indicating the status of contact closures. All relays and lamps shall be identified by functional title where applicable.
g. Terminal board connections and relay contacts in the energizing paths shall be identified.

h. The color of indicating lamps shall be included. Indicator lamps and controls shall be labeled by reference designation and by the panel inscription that appears where they are mounted.
i. Actuating conditions of other than manually operated control and switches shall be noted.

F.4.14 Line drawings, engineering drawings, and photographs. Line drawings shall be used in lieu of photographs. Engineering drawings are acceptable if they meet the format and content requirements of this specification and the legibility requirements of the basic specification. Photographs may be used when in conformance with F.7.

F.4.15 Logic diagram. Logic diagrams shall be provided for digital devices and digital circuitry of conventional analog equipment in accordance with IEEE 991. Distinctive shapes shall be utilized. Internal and external data shall be included. Logic diagrams shall cover digital functions such as Input-Output Control, Memory Control, Data Transfer, Clock-pulse generation and distribution, and so forth. Emphasis shall be placed on functional development and presentation rather than on hardware groupings.

F.4.15.1 Basic logic diagrams. Basic logic diagrams shall depict logic functions with no reference to physical implementations. Basic diagrams shall consist primarily of logic symbols which are used to simplify logic relationships to make them comprehendible. Nonlogic functions are not normally shown.

F.4.15.2 Detailed logic diagrams. Detailed logic diagrams shall depict all logic functions and nonlogic functions, socket locations, pin numbers, test points, and other physical elements necessary to describe the physical and electrical aspects of the logic. The symbols shall be connected by lines that represent signal paths. The diagrams shall illustrate signal priority based upon the weapon function of the equipment.

F.4.15.3 Digital logic diagrams. Digital logic diagrams shall illustrate logical functions of modules, nests, and assemblies. Design or engineering drawings shall be used as source data to develop digital logic diagrams. Diagrams shall illustrate combinational, storage, delay, and sequential functions to define processing of variable signal input(s) and resultant output(s). Graphic symbols for logic diagrams shall be in accordance with IEEE 315.

F.4.15.4 Fault logic diagrams. Fault logic diagrams shall be based on a fault indication observed during troubleshooting. The diagrams shall comprise a branching series of questions pertaining to fault isolation. Each question shall pertain to a further observation or measurement, and shall result in a "yes" or "no" answer, thereby progressively narrowing the possible functional area of the fault. Tolerance values shall be presented in those instances where a definitive "yes" or "no" is not obtained. This progression and elimination shall isolate the functional area of the equipment containing the fault and then refer the user to the portion of the manual containing that information needed to complete the fault isolation and repair. Each diagram shall include or make reference to information necessary to establish the test or operating conditions required for

starting the fault isolation procedure. Only three types of blocks shall be used. Shaded blocks (right and bottom border lines weighted) shall contain questions which may be answered from observation, without changing test setup and without special equipment. Single-line blocks shall contain questions requiring measurement by special setup of external test equipment. Double-line boxes (conclusion boxes) shall list the functional area within an equipment that is the probable source of malfunction and shall reference a procedure or another diagram for further isolation or correction of a fault.

F.4.16 Piping diagrams. Piping diagrams shall be developed for fluid cooling, air, gas, steam, oil and hydraulic systems. Fluid symbols shall be in accordance with ANSI Y32.10, with hydraulic systems supplemented by SAE AS 1290. These diagrams shall show, when significant, flow rate, temperature, pressure, and all devices which measure, control, or modify the flow. Also, a test data table shall be included on the piping diagram and reference shall be made to appropriate corrective actions and functional descriptions.

F.4.16.1 Simplified piping diagrams. These diagrams (hydraulic, pneumatic, or fluid) shall show the interconnection of components by piping, tubing, or hose, and sequential flow in the system. Pumps, heat exchangers, valves, gauges, and so forth, shall be clearly identified.

F.4.16.2 System piping run diagrams. Isometric diagrams shall be used to indicate the location of all system piping runs between compartments and areas. Each piping run diagram shall indicate by deck, compartment, and frame identification the location of all pipes, valves, fittings, tanks, and so forth.

F.4.17 Power distribution diagrams. Power distribution diagrams shall depict the distribution of primary ac power, secondary ac power, and dc power from the terminal board, breaker, or fuse box to the various assemblies, subassemblies or modules of the equipment. Normally, a separate diagram shall be developed for each voltage level used within the equipment. The following rules apply in the preparation of power distribution diagrams:

a. Show and identify motors, transformers, regulators, power supplies, assemblies, subassemblies, and modules.
b. Show and identify all power line devices such as fuses, circuit breakers, switches, and relay contacts.
c. Show and identify all connections including plugs, jacks, and terminal boards in the distribution path.
d. Use dot and dash lines to set off hardware boundaries such as units, assemblies, and subassemblies. Identify each unit, assembly, and subassembly by reference designation. Include a figure reference to the schematic diagram covering the unit, assembly, and subassembly.
e. Reference all relay contacts to the appropriate control diagrams. All relay contacts shall be shown in the operating condition.
f. Include voltages and tolerances, as required.

g. Show and identify all metering circuits and indicators.
h. Show all grounds, commons, neutrals, and return lines.
i. Display the power path from left to right and from top to bottom, whenever practicable.
j. Conspicuously mark on the diagram the functional names of all "main line" switches and circuit breakers. In addition, set off any power control markings engraved or stenciled on the equipment in a rectangular box, for example:

MAIN POWER

k. Show all relay coils in series with the main power distribution path. Relay control circuits shown on control diagrams need not be repeated on distribution diagrams.
l. Add the following note to all control diagrams: "All switches and relay circuits are shown in operating positions."

F.4.18 Printed-circuit board. Printed-circuit boards shall be illustrated foil side up. When printed wirings appear on both sides of the board, both sides shall be illustrated. All parts mounted on the board shall be outlined in black solid (front) or dashed line (rear) (even though mounted on the reverse side of the board) and their connections to the printed wiring clearly illustrated. If insufficient room exists, separate illustrations, top and bottom views, shall be provided. Each part shall be labeled with the applicable reference designation. To facilitate parts location, a locating grid and corresponding guide chart shall be provided when more than 30 items are mounted on a board.

F.4.19 Pyramids.

F.4.19.1 Detail pyramids. For Case A, a set of troubleshooting diagrams shall be developed to illustrate the functional dependency and continuity of equipment outputs for specified modes of operation. These diagrams shall be made up of functional dependency boxes arranged in a pyramid format. Pyramids shall result from paralleling the coverage of signal flow diagrams for all output functions. Each pyramid shall describe circuitry as it exists in an energized condition on the associated signal flow diagram. The box at the top or apex of the pyramid shall represent the output function of the signal flow diagram and shall reflect the result of all boxes illustrated below it on the diagram; feedback-type loops excepted. An in-tolerance indication by the signal characteristics of the apex box shall absolutely represent an in-tolerance condition of all boxes below it. If any condition, circuit or component represented by boxes below the apex box is out of tolerance, the function described by the apex box must absolutely indicate an out-of-tolerance condition. With the exception of a feedback-type loop, all characteristics of the output function must be presented in the apex box.

F.4.19.1.1 Apex boxes. Every pyramid shall have an apex box and no other box in the pyramid shall occupy the same level on the sheet occupied by the apex box. A descriptive title of the signal or a fire control symbol from NAVSEA OP 1700 shall be centered on the first line of the apex box. Below the descriptive title, enter a thorough description of the characteristics of the

output function and instruction for measuring these characteristics within required tolerances. Where this description becomes too lengthy, a note may be used in the apex box and the description placed in a specific note on the apron of the sheet. Each detail pyramid shall be identified in the upper right-hand corner of the apex box by an alphanumeric code. A code letter signifying mode of equipment operation will be prefixed to an Arabic numeral in separate sequence for each mode. The following are examples of codes provided to establish standard modes of operation for all equipment.

A	Acquisition or Search Mode
D	Designate Mode
R	Air Ready Mode
T	Track Mode
Lo	Load
La	Launch
P	Point

The specific coded symbols to be used shall be determined by technical direction based on the maintenance analysis, or should be requested from the Government.

F.4.19.1.2 Functional dependency boxes. All boxes on the pyramid diagram, other than the apex box, shall be functional dependency boxes. Functional dependency boxes are graphical representations of a test point and all of the circuitry between it and the test point associated with the next functional dependency box below it in the dependency chain. Each functional dependency box shall contain an identification of the test point, test equipment required, test setup, test point location, panel or circuit indications, waveforms, and references to other documents available for use in isolating and correcting the trouble. DANGERS, WARNINGS, and CAUTIONS shall be placed on the apron of the diagram and shall precede notes. The order of applicable information shall be in accordance with figure F-1. Reference shall be made to specific notes contained on the apron of each diagram for information that is too lengthy for inclusion in the boxes. All functional dependency boxes within a pyramid below the apex box shall be identified by a descriptive title and an Arabic number. The number shall appear in the upper right-hand corner of each box in line with the top line of the title. To number functional dependency boxes on a pyramid, begin at the top level to the left and number each successive box appearing to the right in an ascending numerical order. When the top line of boxes has received numbers, proceed to the next lower level and repeat the process until all boxes have been numbered. Apply this numbering procedure only to the complete, unbroken, pyramid.

F.4.19.1.3 Quick-look features. If a reading direct from a dial, a meter, or an indicator on the equipment panel can be considered as a testable point, such readings shall be placed inside a quick-look feature box at the bottom of the functional dependency box to which it applies. The order of presenting the information will be panel nomenclature followed by the circuit symbol appearing on the schematic diagram.

F.4.19.1.4 Feedback loops. Special consideration shall be given to the preparation of pyramid encompassing feedback loops. In some equipment where a loop is comprised of numerous functional elements, the loop must be broken in a manner that will facilitate troubleshooting.

F.4.19.1.5 Cross-referencing in pyramids. Referencing in pyramids shall be in accordance with the following: Point-to-point referencing can be categorized as Case A1 and Case A2. Case A1 is a layout problem that occurs whenever a pyramid diagram is too large to be included on one sheet without any breaks. As shown in the illustration, both TO and FROM notations are to be used for Case A1 in abridged form; that is, on the same sheet, TO BOX 13 S115 or FROM BOX 1 SH 1. Case A2 occurs when an output function becomes a subordinate parameter of another output function as a result of mode switching or when two or more output functions use common circuitry or mechanisms below a point of convergence. In Case A2 the display of interrelated functions is a matter of engineering judgment. In Case A2 the junction pyramid box is repeated on each diagram and its number in each case must correspond with that assigned in the natural arrangement of each individual diagram. Only FROM notes shall be used to indicate where each "incomplete" diagram is continued on the other diagram. Case A2 references shall be unabridged, that is, FROM BOX T2, Fig. 3-18, SH 1 (referencing an apex box) or FROM BOX 7, Fig. 3-20, SH 1 (referencing a functional dependency box).

F.4.19.1.6 Layout of detailed pyramids. Boxes shall be spaced horizontally at a consistent distance between centerlines or multiples thereof. Vertical spacing between boxes shall be consistent where possible, except that the tops of boxes in any one level shall line up. Where a series of functional dependency boxes results in a chain too long for the available intelligence area in height, the chain shall be broken into suitable lengths and the subordinate sections displayed in successive columns to the right on the same sheet. If required, a large pyramid shall be broken into two or more sheets.

F.4.19.2 Summary pyramid diagrams. If required by engineering determinations and equipment complexity, summary pyramids shall be provided to show the complete format of the corresponding detail pyramid in condensed size, to fit on one foldout page without breaks if possible. The apex box and each functional dependency box shall contain the same identifying numbers and the same titles that appear on the detail pyramid. No other text, data, or waveforms shall be included in boxes (permitting minimum height), except that information inside quick-look borders shall be given. General and referenced notes are not required.

F.4.20 Reference diagrams. This section shall contain such detailed interconnection and schematic (electronic, electrical, hydraulic, and mechanical) diagrams as are required to supplement the troubleshooting diagrams for final specific fault isolation. For digital equipment, detailed logic diagrams of repairable modules or assemblies shall be provided in addition to schematics when it is impractical to include sufficiently detailed logic information on signal flow diagrams for guidance in final fault isolation. The detailed reference diagrams shall include those referenced in other less detailed maintenance and troubleshooting diagrams in the manual. Engineering design or manufacturing drawings shall be used for these diagrams whenever required. Wiring information in the form of wiring diagrams or tabular point-to-point wire

running lists shall not be included unless specified by the contracting activity. Schematic diagrams shall be used to illustrate electrical, hydraulic, mechanical, and electronic functioning of units and assemblies. Interconnection diagrams shall be laid out to show only external connections by unit assemblies or equipment.

F.4.21 Schematic diagrams.

F.4.21.1 Maintenance schematic diagrams. Maintenance schematic diagrams shall include unit-to-unit interconnection diagrams, intra-unit interconnection diagrams, and unit, assembly, and subassembly schematic diagrams. Complete coverage of the equipment shall be provided by these diagrams. Maintenance schematic diagrams shall be prepared in accordance with the following:

a. The schematic diagram for each unit shall be drawn so that, together with the interconnecting diagrams, all circuit elements are included and all circuits can be traced from unit to unit.
b. Schematic diagrams shall be zoned by alphanumeric coordinates in accordance with F.6.9. The location of all circuit elements by zones shall be included in a table located on the apron of diagrams containing more than 100 parts. When a part such as a relay or a twin tube is drawn in sections at different locations, list as many coordinates as necessary to locate all sections.
c. Major and minor signal paths shall be represented by different line weights. The heavier line weight shall show the major signal path. Whenever possible, signal flow shall be from left to right and from top to bottom. Arrowheads denoting the direction of signal flow shall be placed on the signal flow lines.
d. The use of ground and voltage buses is discouraged except in the power supply. However, voltage bus connections can be shown by broken lines directly beneath the connection. As a substitute for ground buses, individual grounds should be used and appropriate notes shall be included to indicate sources. If separate ac, dc, and signal grounds are actually used in the equipment, they shall be shown by keyed symbols.
e. All significant voltages at buses, tube pins, transistor elements, and so forth, shall be shown except when this data can be presented best in a voltage chart (see F.4.21.1j). Indicate whether the voltage is ac or dc; dc voltages shall be shown by polarity. Where critical voltages occur within the equipment, tolerances for those voltages shall be shown in the illustrations.
f. The functional names of all operating controls and adjustments shall be conspicuously marked on the schematic. For example:

VERT CENT		BIAS ADJ	and so forth

In addition any operating front panel markings on the equipment shall be set off in a rectangular box. For example:

RF GAIN		AGC ADJ	and so forth

The functional name of all stages (tubes, transistors, and so forth) also shall be included.

g. The function, source, and destination of all input and output circuits shall be identified and indicated by figure number.
h. Power and signal frequencies shall be designated in hertz (Hz). Resistance values, if more than 1 ohm, shall be noted for all wire-wound devices such as motors, relay coils, and transformers.
i. Rated current and voltage values of primary and secondary windings of power transformers shall be indicated.
j. A resistance and voltage chart for a schematic diagram shall be provided on the apron or on preceding page size pages. This chart shall give the normal resistance and voltage to ground (or other points of significance) for each tube socket pin. In addition, list all conditions which effect the resistance or voltage values given, such as control settings, equipment connections, tubes removed from sockets, and so forth. If semiconductors (transistors, diodes, and so forth) are employed in circuits, adequate caution notices must be included to prevent damage to these devices when making resistance measurements in the circuit. No intra-element resistance measurements (that is, between emitter, base, and collector) are required to be made on transistors. Also, resistance of power supply buses and other points of significance shall be indicated.
k. Each schematic diagram shall be identified by the reference designation number, located in the lower right-hand corner of the image area.
l. Schematic diagrams shall be presented in alphanumeric order corresponding to the referenced designation of units, assemblies, subassemblies, and so forth. When two or more identical assemblies, or modules are used, redundant schematic diagrams need not be repeated. However, a table which cross references the reference designation to the figure number of the common schematic diagram shall be provided immediately preceding the schematic diagram. Schematic diagrams covering more than one unit, assembly, or module shall include on the apron or convenient location of the illustration for identification purposes, all the reference designations of the unit, assemblies, and modules to which they refer.
m. Circuit elements shall be grouped functionally and arranged to make signal flow obvious from left to right and top to bottom. Circuit elements shall not be arranged to fill up white space or to maintain tube or transistor alignment. Circuit elements shall be arranged in textbook form for the convenience of the user. Layout shall not be distorted to achieve fit.
n. Breaks in lines shall be used as frequently as possible to avoid cluttered diagrams. Add necessary notes or text to explain how to use break symbols, where to find mating ends of broken lines on drawing, and so forth.

F.4.21.2 Mechanical schematic diagrams. These diagrams shall show sufficient detail to explain the operational sequence and arrangements of a mechanical device including the electrical control circuits. Nomenclature, symbols, PIN, and necessary descriptive data shall be shown as required. Gears, shafts, clutches, levers, mechanically-driven switches, motors, synchros, and so forth, shall be shown in functional arrangement. Gear ratios or number of teeth and direction of rotations,

and so forth, shall be given. Symbols used on these diagrams shall conform to any symbology requirements provided by the Government.

F.4.21.3 Simplified electrical and electronic schematic diagrams. These diagrams shall show, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. These diagrams shall be arranged functionally to show the operation of the circuits in the same manner as illustrated in NAVSEA SE000-01-IMB-010.

F.4.22 Signal flow diagrams. Signal flow diagrams shall consist of detailed block diagrams illustrating the functional development of each major function from its origin to its measurable output. The flow path shall begin with one or more initial inputs (or appropriate interface conditions) and proceed through each unit, assembly, and subassembly influencing the signal flow. Each hardware level block shall reference a schematic diagram to isolate the faulty part. All items shown on the signal flow diagram shall be identified by their reference designations. The following shall apply:

a. Titles of diagrams shall correspond to the signal flow described.
b. Diagrams shall depict such signal flow as: receive, transmit, RHI display, PPI display, bearing data, antenna rotation, elevation data, and so forth.
c. All test points necessary to isolate the trouble to the lowest level of hardware block shall be shown. Include test parameters required to define satisfactory operation. Where signal flow diagrams depict signal flow in more than one mode of operation, that data shall be presented on the apron for all modes. Apron notes shall also include test data for test equipment setup. All inputs and outputs shall have signal description information.
d. References shall be made to the functional description, troubleshooting procedures, corrective actions, and so forth, as appropriate, by paragraph number. Normally these references shall be included with the notes.
e. The display of more than one function or mode of operation on one diagram shall be allowed only if clarity is not sacrificed and the functions are relatively simple.
f. Screwdriver adjustments, dial adjustments, and adjustable controls shall be shown.
g. The reference designations shall be placed in each hardware block. Reference to the figure number of the schematic diagram shall be placed adjacent to the reference designation.
h. All input and output signals and connectors and terminals in the signal path shall be shown. Identify the signal, and show all lead numbers, connector numbers, and terminal identifiers.
i. All built-in controls and monitoring devices shall be shown. Do not show external test equipment, unless it is a permanent part of the equipment.
j. Hull grounds, chassis grounds, signal grounds, and power grounds shall be shown.
k. All leads of components such as motors, generators, synchros, and so forth, shall be identified.
l. All relay coils that are energized by the signal shall be shown.
m. All relay contacts and relay terminals in the flow path shall be shown and identified. All relay contacts shall be depicted in operational mode. References to control diagrams on which the relay coils appear shall be shown adjacent to the relay contacts.

n. All switches which affect signal flow shall be shown and identified. Switch terminals and panel markings corresponding to the switch positions shall also be shown.
o. Mechanical couplings of all controls, switches, potentiometers, synchros, and so forth, shall be shown.
p. Signal paths shall be identified by weighted lines and arrowheads.
q. Test instruction procedures and test data shall be shown on the apron pages of the diagrams.

F.4.22.1 Types of signal flow diagrams. Signal flow diagrams may be either a physical dependency type or a functional dependency type.

a. Major subdivisions on the physical dependency type will be shown as either cabinet, chassis, or unit limits indicated by broken lines.
b. Functional dependency type, as it relates to functional dependency boxes are shown in solid lines.
c. The method selected shall remain consistent for all signal flow diagrams in the manual. When a functional dependency box area is used on a signal flow diagram, it shall correspond in every detail with its associated functional dependency box on the respective pyramid. This will give both detail pyramids and signal flow diagrams reference to common schematic diagrams.

    1. When the cabinet or chassis limit method is used, both diagrams shall refer to schematic diagrams but they will not necessarily group test and testable points together. A functional dependency box of a detail pyramid could be a part of one or a group of several chassis assemblies.
    2. Where the functional dependency method is used to subdivide signal flow diagrams, reference can be made directly to alignment procedures specified for a pyramid.

d. The determination of descriptive limits, physical or functional dependency, shall result from the maintenance analysis. For Case B signal flow diagrams, the density of content shall be such that complete flow to the output function is depicted on one sheet whenever possible.

F.4.22.2 Types of elements on signal flow diagrams. The following functional elements such as connections, monitoring devices, and test points with values, are to be shown on signal flow diagrams, as applicable.

a. All adjustable parts or subassemblies. Identify any screwdriver setting, dial setting, or adjustable knob.
b. Amplifiers. Identify all leads or terminals that are part of the depicted signal flow.
c. Chassis and cabinet (unit) limits. Show the enclosures where the functional elements are installed. Identification of cabinets, major assemblies, and chassis within a cabinet, including unit designations, shall be placed in the upper left-hand corner of each outline.

Reference to schematics and applicable maintenance requirement cards should be placed immediately below the unit designation.

d. Coaxial cable and waveguides. Label the signal being transmitted and show significant functions.

e. Intercabinet and intracabinet connections. Label all connections other than soldered joints. Identify the lead, connector, or terminal number of both sides of the connection. Where the location of the connection in an equipment is obvious from adjacent unit limits, it need not be indicated beside the connection; but, where it is not obvious, added information identifying the physical location of the connection shall be placed adjacent to the symbol.

f. Dials and meters. Show dials and meters, which are a physical part of the equipment as required by engineering layout, as quick-look features with the panel nomenclature within the quick-look box. Do not show any meters that must be plugged in to take a measurement.

g. Fire control symbols and mathematical quantities. Identify all applicable quantities defined in NAVSEA OP 1700 by the corresponding standard fire control symbols. The contractor's symbols, where different, or mathematical quantities shall be entered beneath the standard symbols.

h. Grounds. Differentiate between hull ground, chassis ground, and common returns. Use appropriate symbols and identifiers, which shall be specifically identified in apron notes.

i. Hand-set values for static tests. Hand-set values shall be indicated by use of a rectangular box tied with a dashed line to the generation path signal to indicate the mechanical connection. The rectangular box shall contain the panel nomenclature of the dial, indicator knob, and the hand-set values below the nomenclatures. If more than two values are to be shown, [see (n)].

j. Motors and generators (electrical). Do not show any internal parts of electrical motors and generators, but identify all leads.

k. Potentiometers. Give the range of the potentiometer if it is restricted to less than full travel. Show mechanical coupling if motor-driven.

l. Relay coils and solenoids. Give the reference designation or other specific identifiers. Identify coil terminals.

m. Relay contacts. Identify the energizing bus above and give the relay reference designation below. Identify associated terminals. All contacts shall be depicted assuming the relays in de-energized condition, unless otherwise specifically and clearly noted.

NOTE

When relay pin or terminal identification is difficult because of a specialized type of relay, a relay pin identification diagram shall be provided that presents a schematic bottom view of the relay(s) shown on the signal flow diagram. The pin or terminal identification diagram should be located on the apron of the signal flow diagram if space permits, otherwise the information should be placed on a separate sheet ahead of the signal flow diagram.

n. Readout values for static tests. If only one or two problems are used, show values in a box representing the test point or dial [see (i)]. If more than two problems are used, indicate the panel nomenclature of the readout device in the box and place the values for the respective problems in a table on the apron as a specific note.

o. Scale factors. Show scale factors where applicable, such as, at outputs of computing amplifiers, computing potentiometers, and resolvers. For transformers where scale factor values are involved, show the relative values at both the primary and secondary windings.

p. Switches. Identify switch terminals. Identify actuating condition for other than manually actuated switches, including pressure limits for hydraulically or pneumatically actuated switches.

q. Summing network. Identify leads or terminals of summing networks. Show impedance value or ratio to unit impedance for each input lead, as applicable.

r. Terminal boards. Identify the terminal board. Show only the terminals that apply to the circuit. Identify leads or terminal numbers, as applicable.

s. Testable points. Identify all applicable testable points. Give the same information for a testable point as required to be illustrated for a built-in test point jack. The information to be provided at a testable point on a signal flow diagram is the same as required for a functional dependency box on a pyramid, except that test point location and schematic diagram reference need not be repeated here if otherwise obvious. Information shall appear in the same order as in the pyramid box when the functional dependency method of signal flow diagram subdivision is used.

t. Transformers. Indicate both primary and secondary sides; identify all leads or terminals.

u. Synchros and resolvers. Identify the functional type of synchro. Identify all leads. Show mechanical coupling if motor-driven. Indicate relative speeds when multispeed synchros are used.

v. Valves. Illustrate fluid transmission from valve ports in path of signal flow. Give pressure limits for pressure control of bypass valves.

w. Pumps or compressors. Illustrate pump in operation giving flow rate. Also indicate pressure, if pressure control is integral with the pump.

x. Mechanisms. Illustrate mechanisms, as required to show continuity and sequence of mechanical actions, contributing to the output function.

y. Flasks or accumulators. Indicate working pressure range of flasks and accumulators. Also give allowable overall leakage rate, if applicable.

z. Motors and actuators (hydraulic or pneumatic). Include as required.

aa. Waveforms (Case A only). Indicate or reference the expected waveform for the signal at all applicable testable points. Waveforms should be photographs or realistic representations of actual waveforms as seen on an oscilloscope utilizing a white image on black background. Stylized waveforms shall be shown as a normal line drawing with black lines. Waveform characteristics and measurements may be superimposed on the image or referenced in an associated table. If a grid is superimposed on the image, vertical amplitude and horizontal time scales shall be included.

bb. Waveforms (Case B only). Validated waveforms or voltages shall be provided for each test point shown, where such data will provide additional information useful in troubleshooting and circuit analysis. The waveforms must contain sufficient information and detail, including tolerances, to enable complete evaluation of the test point monitored. The waveforms and supporting notes should be placed on the apron of each diagram or on a separate sheet preceding the diagram. Waveforms may be placed near the applicable test points only when they will not cause undue clutter, possible misinterpretation, or require the diagram to be expanded to the extent that an additional sheet would be required to depict the total signal flow. Waveforms shall not be provided for power supply or bus voltages, ground or return jacks, or any parameter that is obvious or that cannot be typically presented.

cc. Fixed resistors, capacitors, and coils. Fixed resistors, capacitors, and coils shall be shown if their presence contributes significantly to modification of the signal. These components need not be identified by reference designation or value unless they reveal a test point; in which case, a validated waveform or voltage shall be provided.

F.4.22.3 Cross-referencing in signal flow diagrams. Cross-referencing in signal flow diagrams shall be in accordance with the following. Where substantial portions of circuitry or mechanism are common to two or more output functions, or in different modes of operation for the same output function, the common portion of generation paths shall be shown on one diagram and cross-referencing used for referring to the common points from other signal flow diagrams. Cross-referencing in signal flow diagrams can be used for the same reasons set forth in Case A1 and Case A2 for pyramids (see F.4.19.1.5), with the following additional requirements.

a. Each signal break, whether a point of coincidence between diagrams or between sheets of the same diagram, shall be identified by the name of the signal or by specific connecting terminals to permit cross-referencing. Except where lines cross from one sheet to the following sheet, signal flow diagram zones shall be included in the reference and referenced points need not be brought out to either end of the sheet.

b. Since the signal flow diagrams are read in either direction, a TO or a FROM notation shall be given at each signal break on a page from Case A referencing. For each end of a break, the choice of TO or FROM shall be in accordance with the direction of flow in that path.

c. For Case A2 referencing, use a FROM notation only, on the diagram requiring completion of common generation path by reference, giving the name of the signal or the terminal designation, the figure number, sheet number, and zone number, in that order.

d. In those instances where referencing is required and the signal does not have a name, a common referable point or a connecting terminal between changing sheets, use an upper case letter inside a circle to indicate where the signal path stops on one sheet and picks up on another. The reference notes will include this circled letter.

e. In those instances when a signal flow between the point of origin and final output become modified by an interfacing equipment, depict the logic treatment of that signal within the interfacing equipment.

F.4.23 System fault logic and troubleshooting-maintenance dependency-matrix diagrams. System fault logic diagrams shall be developed for fault indications observed during either scheduled tests or operation. Fault logic diagrams shall be constructed in accordance with F.4.15.4. These diagrams shall isolate the functional area of the equipment at fault and then refer the user to the equipment technical manual containing the information needed to complete the fault isolation and repair. Each diagram shall include or make reference to information necessary to establish the system test or operating conditions required for starting the fault isolation procedure. The conclusion boxes shall list the equipment or functional area within an equipment that is the probable source of malfunction and the technical manual reference or references for further isolation and repair of the fault. Troubleshooting-maintenance dependency-matrix diagrams in accordance with F.4.26 may be substituted for or augment fault logic diagrams.

F.4.24 System interconnection diagrams. System interconnection block diagrams shall be presented with each equipment or component shown as a block. All cables running between equipments shall be identified by cable number. The number of active and spare leads in each cable shall be included. The illustrations shall also indicate all junction boxes, switchboards, and so forth, into which interconnection cables enter or leave.

F.4.25 Timing circuit diagrams. Timing circuit diagrams shall be provided for all significant timing relationships. These diagrams shall show the exact timing relationships and the origins of all timing signals (conventional and digital).

F.4.26 Troubleshooting-maintenance dependency-matrix chart. Matrix charts shall show the functional dependency of output signals or indications upon circuit elements, circuits, modules, and so forth. These charts shall be developed in accordance with the following:

a. Each vertical column is annotated to represent a circuit element, circuit, assembly, and so forth.
b. The horizontal rows are annotated to represent a procedural step which results in an observable output or indication.
c. Symbols shall be used, in the body of the grid, to show the relationship between circuit elements, circuit, and so forth, and observable output or indication.
d. All circuits, assemblies, modules, and so forth, shall be exercised in a manner to permit logical diagnosis.
e. All outputs shall be clearly defined and performance specifications given.
f. All symbols shall be defined.
g. Use of chart shall be fully explained.

F.5. GENERAL ILLUSTRATION INFORMATION

F.5.1 Illustrations, drawings, and sketches. Style and techniques shall be of a quality which will produce artwork that will clearly, adequately, and economically portray the information to be illustrated. Illustrative material shall be used to: describe an item or idea if this can be done more efficiently and effectively by graphic methods; clarify text; present phases difficult to describe by

text alone; call attention to details; and furnish graphic identification of parts and tools. Multiple sheet, or sequence number illustrations, in addition to step-by-step operational type, may be used for depicting disassembly, assembly, removal, installation, and so forth. Illustrations, other than foldouts, shall be located as near as possible to the point at which they are first referenced, except where this would require unnecessary duplication of illustrations.

a. Illustration use. Liberal use of illustrations is encouraged to ensure clarity of descriptive text and procedural steps. Exploded views shall be used to the greatest extent possible. Redundant drawings shall not be included. When only a part of an existing drawing is required, only that section of the drawing shall be provided.

b. Illustration placement. Each illustration shall be included as part of a paragraph or follow as closely as possible to its first reference in the narrative text. Use of fold-out illustrations is discouraged. However, when an illustration does require a foldout sheet, such as for a large schematic diagram, it shall be located at the end of its relative discussion in the text and shall be printed with an apron. Foldup-foldout (map fold) illustrations are strictly prohibited.

c. Illustration titles. Illustrations shall be assigned figure titles. The title shall follow two spaces after the figure number and shall be centered below the applicable illustration (except for foldout figures). The first letter of the first word and of each principal word will be capitalized. Full page illustrations, placed sideways on a page, shall be turned 90 degrees counterclockwise. The figure number and title for a turned illustration shall be placed at the bottom of the page with the manual in its normal position. When the majority of illustrations are turned, the figure number and title shall also be turned to appear below the illustration. Figure titles should begin with an identifying name. For example:

"Figure 3-1. Guidance System Gyroscope Assembly."

The title shall be short and describe the contents or purpose of the illustration. Illustrations applicable to one Service, in a manual that will be used by more than one Service, shall be identified. For example:

"Figure 2-3 (Navy only). Fuel Indicator."

d. Material or parts list. A material or parts list shall be included with each drawing. Only those parts referenced in the text shall be identified on the drawing. When specifying disassembly in accordance with disassembly sequence numbers, all parts shall be listed. Text and illustrations shall complement each other to communicate the required information. Nomenclature shall be consistent throughout the manual.

e. Acceptability of drawings and illustrations. Engineering drawings and illustrations that are not prepared primarily for illustration purposes are acceptable if the copy print is legible, reproducible, and readable when reduced to manual size. All irrelevant material shall be removed.

f. Callouts. Illustrations shall identify key part locations with callouts neatly placed around the drawing. Care shall be taken not to introduce clutter and distractions. The associated operator's manual identification numbers should be included as a cross-reference indicator to aid the user. Cite the method used to present data as a note in the drawing.

g. Drawing reduction. Drawings which are to scale but not dimensioned shall be reduced for inclusion in the manual. A line approximately three to six inches long, indicating the actual scale of the subject drawing, shall be added to the drawing before reduction. The scale shall then be reduced in the same proportion as the drawing.

h. Drawing identification. Drawings and sketches reproduced or modified from an existing approved blueprint or drawing shall contain information identifying the drawing.

F.6. ILLUSTRATION DETAILS

F.6.1 Scale. Illustrations shall be prepared to as small a scale as possible consistent with effective use of space, with all essential detail legible; be same size as areas they will occupy in the manual page, or be of such oversize as to permit uniform reduction to this size.

F.6.1.1 Letter size. The scale shall be such as to provide for a minimum final letter size, when printed, as required by figure A-1.

F.6.2 Border rules. Border rules shall not be used for single illustrations, but shall be used to separate multisection illustrations on the same page.

F.6.3 Use of human figures. Where it is necessary to illustrate an operation, procedure, or installation, illustrations may include a human figure or parts of the body. Jewelry shall not appear in any illustration. The human figure shall not be permitted to obscure details of the equipment necessary for a complete understanding of its operation. The human figure shall be clothed as designated by the Government. A cross section of races and sexes shall be used.

F.6.4 Credit lines. The artist's name shall not appear on any artwork; neither shall a manufacturer's name, symbol, or trademark appear on artwork for the purpose of identifying the illustration. A contractor's identification number may be used. When used, such numbers shall be in approximately 4- to 6-point type and placed in the lower right-hand corner of the illustration sufficiently removed to avoid being confused as part of the illustration or margin data.

F.6.5 Callouts. Index numbers, reference designations, nomenclature, leader lines, legends, procedures, and so forth, shall be used, when necessary, to identify significant features. Callouts shall be prepared by a mechanical or electronic method, rather than freehand lettering, except that engineering drawings prepared are acceptable. Type size shall be no smaller than 8-point and no larger than 10-point. Lettering shall be in upper case. Nomenclatures shall appear on illustrations only if it can be done without crowding or reducing type size so as to make reading difficult (diagram callouts shall be no smaller than 8-point). Callouts shall be placed in the background areas of illustrations when practical. Care shall be taken not to introduce clutter and distractions.

F.6.5.1 Index numbers. Index numbers for each separate figure shall start with Arabic numeral 1 and continue consecutively. All multisheet illustrations shall be considered one figure. Sequence on exploded views used to show assembly or disassembly shall be in disassembly order. Otherwise, sequence shall be from top to bottom or clockwise, when possible. New callouts inserted between items when an illustration is changed shall be the same as the preceding index number with an added decimal number. When it is necessary to add a callout between items which have already been added by the preceding method, an alpha character shall be used (for example, a callout added between 22.1 and 22.2 would be 22.1A). This system shall also be used in basic publications when errors are discovered so late in development that renumbering of all following index numbers would delay submittal. Suffixed index numbers need not be eliminated for a revision unless the illustration must be reaccomplished. All functional items shown on exploded views shall be identified except for exploded views used for disassembly or assembly.

F.6.5.2 Nomenclature. Nomenclature of more than one line shall have the left margin justified. All lines of copy shall parallel the horizontal edges of the figure, whenever possible. When specified, a cross reference shall list the official nomenclature and its corresponding acronym or general usage nomenclature.

F.6.5.3 Leader lines and arrowheads. Leader lines and arrowheads may end close to the callout and object, or may touch the objects to which they apply. Lines shall be uniform, short and straight as possible; however, dog leg shaped lines are permitted. Lines and arrowheads shall not cross or come in contact with other callout lines or arrowheads nor shall they obscure essential details. A line should be highlighted or changed from black to white to make the line easier to follow. Arrowheads may be added for clarity. Arrowheads shall be uniform in shape and size when multiple arrowheads are used on a page.

F.6.6 Legends. Unless the legend is contained as part of the figure, legends shall be placed four spaces above the cutline (RDC) or illustration (PTM and FRC) and shall be headed by the word "Legend" followed by the number of the figure to which it is applicable. The entire legend shall be indented 5 spaces. If the legend is continued, the figure number and title shall be repeated, followed by a dash and the word "Continued". Only that information which is necessary to clearly identify the items shall be included in the legend. Where methods such as the tabular presentation technique (as in an Illustrated Parts Breakdown) are used, no legends are required. When index numbers are used, a legend consisting of their numerical listing and their identification shall be included on, adjacent to (same page) or facing, the artwork.

F.6.7 Steps. Essential illustrations depicting mechanical operations shall be included as necessary. Operational or procedural illustrations shall have one or more text steps with each illustrated step. It is not necessary to illustrate each step of a maintenance procedure, such as the removal of screws with an ordinary screw driver, lifting off a cover after the screws have been removed, and so forth. Procedural illustrations should supplement the text by clarifying procedures which are of a special nature or are not obvious. The text step shall be as close to the

illustrated step as possible. Steps shall be identified in the order in which they are to be accomplished. Alternate types of operational and procedural step illustrations are acceptable.

F.6.8 Reference designations. Reference designations shall be included. Reference designations marked on equipment take precedence.

F.6. 9 Zoning on diagrams. Diagrams containing the symbols for more than 100 parts shall be zoned. Diagrams shall be divided into equally spaced horizontal zones (ordinates) designated A, B, and so forth, from bottom to top along the outside left and right borders. Diagrams shall be divided into equally spaced vertical zones (abscissa) designated 1, 2, 3, and so forth, from right to left along the outside top and bottom borders. The zone size shall be as needed to clearly locate referenced points. The location of all circuit elements by zones shall be included in a table located on the apron.

F.6.10 Notes for diagrams. Notes on diagrams shall be confined to clear spaces of the image area. Notes for foldout diagrams, with the exception of installation control drawings, shall be placed on the apron. Notes shall be identified with the legends GENERAL NOTES and SPECIFIC NOTES, as applicable. General notes shall precede specific notes and shall be identified by capital letters (A, B, and so forth). Specific notes shall be identified by arabic numerals (1, 2, and so forth).

F.6.10.1 General notes. General notes shall apply to the entire diagram and shall appear only on the first sheet of multisheet diagrams. No reference shall be made to general notes from the diagram or from specific notes. Examples of general notes are: a warning that high voltage exists throughout the entire equipment, the general instructions for positioning switches, and a list of the test equipment needed to take measurements.

F.6.10.2 Specific notes. Specific notes shall apply only to a specific item on the diagram. Specific notes shall be repeated on each sheet of a multiple sheet diagram to which they apply and it shall not be required to refer to a specific note on another sheet of a diagram.

F.6.10.3 Apron notes. Apron notes for foldout diagrams should be placed in a final size image area of 7 by 10 inches with a minimum letter height of 0.060 inch. Notes shall be arranged to make best use of the available space. When notes for a given diagram foldout sheet require more than the 7 by 10 inch apron, the notes shall be extended with additional columns on the diagram image area if the space permits. If the space does not permit, single pages shall precede and shall contain the additional notes. When additional note sheets are required, the notes shall start on the first additional sheet and be printed as a right-hand page; note pages may be printed on both sides. Foldout sheets shall not be used for running text. Each sheet of the diagram, including the note sheets, shall contain the figure number, title, and sheet number.

F.6.10.3.1 Multiple page notes. For multiple page note pages, applicable to illustrations, each note page if used, shall be consecutively numbered front and back. Multiple note pages shall not

be delineated as being part of (or sheet XX of XX) an overall notes page, but illustrations shall be delineated as being sheet __ of __ an overall illustration, as applicable. Notes shall precede the illustration or appear on the illustration apron, as applicable. Notes pages shall be of the single sheet type.

F.6.11 Foldout page and multisheet illustration limitations.

F.6.11.1 Foldout pages. Foldout pages shall be developed only when approved by the Government. Multisheet illustrations should be used where possible, in lieu of foldouts, when usability will not be effected. Foldout-foldup pages are not permitted. If approved by the Government, foldout pages may be prepared for the 4 by 8, 5 1/2 by 7, 5 by 8 and 8 1/2 by 11 inch manuals. Foldout pages shall not be used in the 4 by 5 1/2, 4 1/2 by 7 or 17 by 11 inch manuals. Foldouts shall meet the following requirements:

a. All foldout pages shall be prepared for printing on one side only.
b. Full blank aprons shall be used.
c. Foldout pages shall not be spliced.
d. Foldout pages shall fall at the end of the manual. When specified, foldout pages shall fall at the end of chapters or be interspersed within text pages. When foldout pages fall at the end of the manual, such pages shall follow the last chapter, appendix or index, whichever forms the last portion.
e. Unless otherwise specified in the contract maximum foldout page sizes and maximum printable area for foldout pages shall be in accordance with table F-I.

TABLE F-I. Maximum foldout page size and printable area.

Manual Size	Foldout Maximum Page Size (including blank apron)(inches)	Foldout Maximum Printable Area(inches)
4 by 8	12 by 8	7 ½ by 7 ½ a\
5 ½ by 7	16 by 7	10 ½ by 6 ½ b\
5 by 8	15 by 8	9 ½ by 7 ½ a\
8 ½ by 11	26 by 11	16 by 10 \c
17 by 11	0	0

\a Minimum margins: 1/4 inch top, bottom and side opposite binding edge.
\b Minimum margins: 1/4 inch top, 1/2 inch bottom and side opposite binding edge.
\c Minimum margins: 1/2 inch top and bottom, 1/4 inch side opposite binding edge.

F.6.11.2 Multisheet illustrations. Whenever possible, to reduce the number of foldouts to the essential minimum, illustrations shall be divided between facing pages and identified "Figure sheet 1" and "Figure __ sheet 2" respectively. When more than two pages are required, and except for such illustrations as schematic, wiring and logic diagrams where the use of the diagram would be adversely effected, additional sheets may be continued on immediately succeeding pages

and similarly identified. Sheet 3, Sheet 4, and so forth, can be planned for succeeding pages when required and if this treatment will not effect the usefulness of the manual.

F.6.12 Multisection illustrations. Each section of a multisection illustration shall be identified by a capital letter. Sections may or may not be captioned, but if one section is captioned, all shall be captioned. Each caption, with the identifying letter as its first character, shall be centered with respect to the section to which it applies. Where captions are not used, the identifying letters shall be centered. Identifying letters and captions shall be larger and bolder than any other lettering on the illustration. Sections shall be separated by lines. Separation by shading shall not be used.

F.6.13 Cartoons. Generally the use of animated drawings and other visual techniques are permitted. Animated drawings shall not include copyrighted cartoon characters. Such presentations must serve a functional purpose.

F.6.14 Color in illustrations. The use of color illustrations is discouraged. Shadings, cross-hatchings and patterned lines shall be used instead of color.

F.6.15 Other types of illustrations. Depending on the type of information to be shown, a manual may contain illustrations such as frontispiece (assembled view), exploded, operational, procedural, functional, location view, lubrication, waveform, and so forth.

F.7. PHOTOGRAPHS AND LINE DRAWINGS

F.7.1 Photographs and line drawings. Line drawings shall be used in lieu of photographs (halftones), when practicable. The use of a photograph instead of a line drawing shall be determined by the practical considerations of the purpose and suitability of the illustration in the publication. Existing illustrations and engineering drawings shall be used where they meet the requirements of this document. In the early development of equipment, a line drawing may be prepared from the source data if the equipment is not available for photographing. Rendered drawings, either airbrush or wet-wash, are acceptable only if such preparation is the most efficient method available. Line tracings of photographs are also acceptable. The resulting line drawings shall be of high reproduction quality. A suitable material capable of maintaining consistent and permanent high density reproducible values shall be used for preparing the line drawings.

F.7.2 Photographic details. When specified for use, photographs shall be detailed and sharp, free of heavy shadows, distorted objects, cluttered foregrounds or backgrounds, and give good contrast from white, middle tones, and black.

F.7.2.1 Retouching. Photographic retouching shall be held to a minimum. Retouching shall be used only to emphasize detail, exclude unwanted detail, correct slight photographic defects and eliminate undesirable shadows for those portions of the photograph related to the text only. Quality of retouched photographs shall be such that tonal values are held when reproduced.

F.7.2.2 Prescreened photographs. When approved by the Government, prescreened photographs are acceptable as reproducible copy provided they will not be rescreened and are of proper quality, size, and mounted on the reproducible copy of the text page or margin data. When prescreened photographs are used, artwork will be clearly marked to indicate prescreening. Unscreened continuous tone photographs and original artwork shall be supplied, with reproducible copy, as specified by the contract.

F.7.3 Line drawing details.

F.7.3.1 Darkness and sharpness of lines. The darkness and sharpness of lines shall be sufficient to reproduce clearly at required reproduction size without additional treatment. Parallel lines on wiring and schematic diagrams shall in no case be less than 1/16-inch apart when reduced to printed size. Secondary lines, such as those used to indicate extensions or measurements, shall be lighter but strong enough to reproduce clearly at reproduction size. Shading may be used to give substance and form to the item depicted, to sharpen the contrast between the subject and its background or to increase effectiveness. Shadows shall be used only when necessary to provide a clear understanding of form, shape or depth. Shading effects shall not be used for decorative purposes. Accented lines may be used to emphasize detail. Lines, cross-hatching, or mechanical patterns used for coding shall remain clearly defined when reduced to reproduction size.

F.7.3.2 Designations, diagrams and symbols. Designations, diagrams, graphic symbols and letter symbols shall be consistent and the source or reference for these items shall be identified.

F.8. ARTWORK

F.8.1 Continuous tone artwork. When specified for use, such artwork, whether photograph or drawing, shall be clear in detail, sharp in contrast of tones and with light and shadow in proper relation to a consistent light source. The background shall be an intense white. It shall extend the full width and depth of the artwork.

F.8.2 Combination artwork. Presentation of a subject by combining photographs or continuous tone artwork with line drawings, shall be limited to where this presents the subject more accurately or more clearly.

F.9. CHANGES TO ILLUSTRATIONS

F.9.1 Illustration changes. When changes are made to illustrations, the original artwork shall be used unless the development of new artwork is less expensive. Sheets added to a set of multisheet illustrations which fall between existing sheets shall be assigned the preceding number plus a decimal number. For example: if a sheet is added between sheets 2 and 3, the added sheet becomes 2.1. If possible, the new sheet shall be added after the last sheet and be assigned the

next consecutive number. If a callout is deleted from an illustration, the word "(Deleted)" in parentheses shall be placed after the appropriate number in the legend.

F.9.1.1 Change symbols for illustrations. Changes to line drawings, charts prepared as illustrations, graphs, diagrams and schematics shall be indicated by shading and screening to highlight the area containing the changed information. Extensively changed presentations shall be indicated by a screen border around the effected area. For minor changes not suitable for shading or screening, a miniature pointing hand shall be used.

F.9.1.2 Index number changes. Where a change to an illustration adds index numbers between existing numbers, the added numbers shall be the same as the preceding index number with an added decimal number.

F.10. REVIEW

F.10.1 Review of illustrations. Illustrations shall not be furnished separately for review. If a publication is reviewed, illustrations forming a part of the publication shall be included in the review. Each illustration copy shall be approximately the same size as a page of text, except for those of foldout size which shall not exceed maximum foldout dimensions.

APPENDIX F

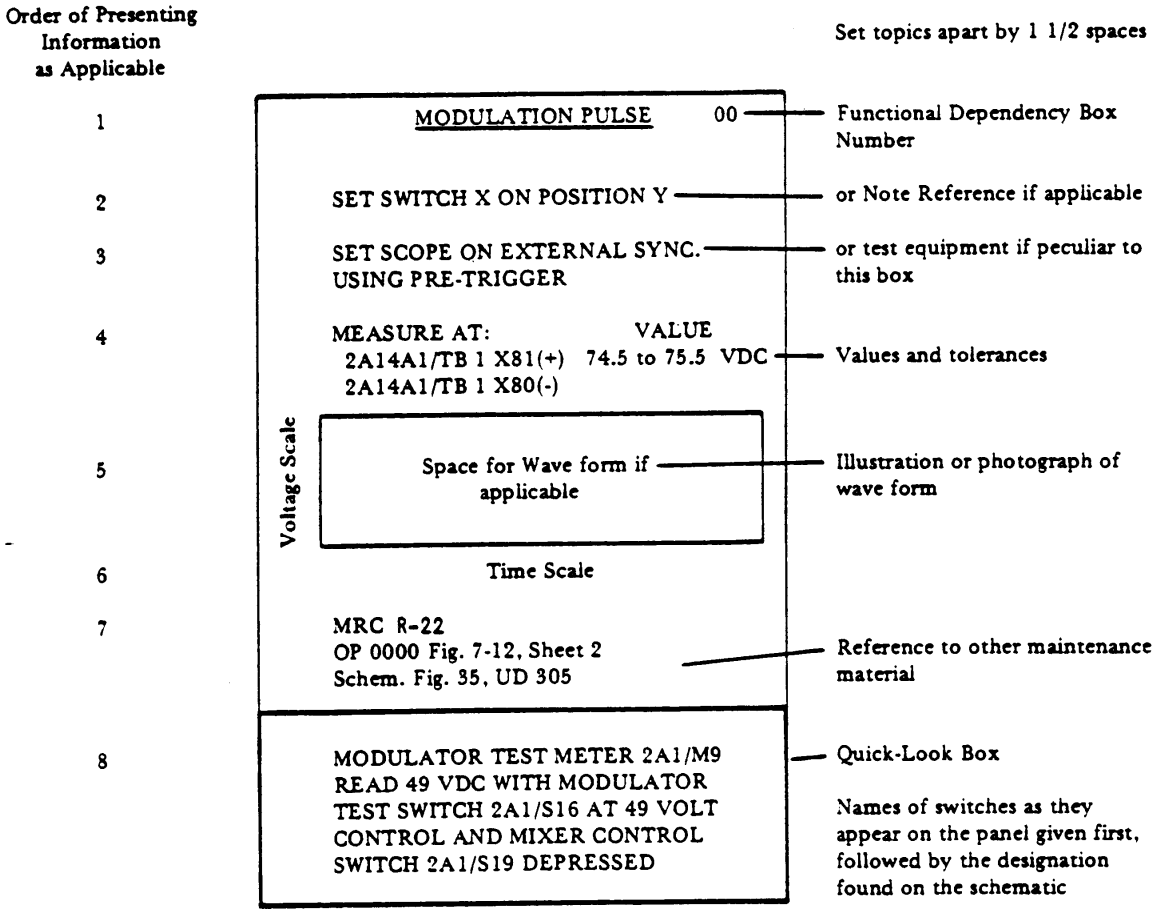

FIGURE F-1. Functional dependency format.

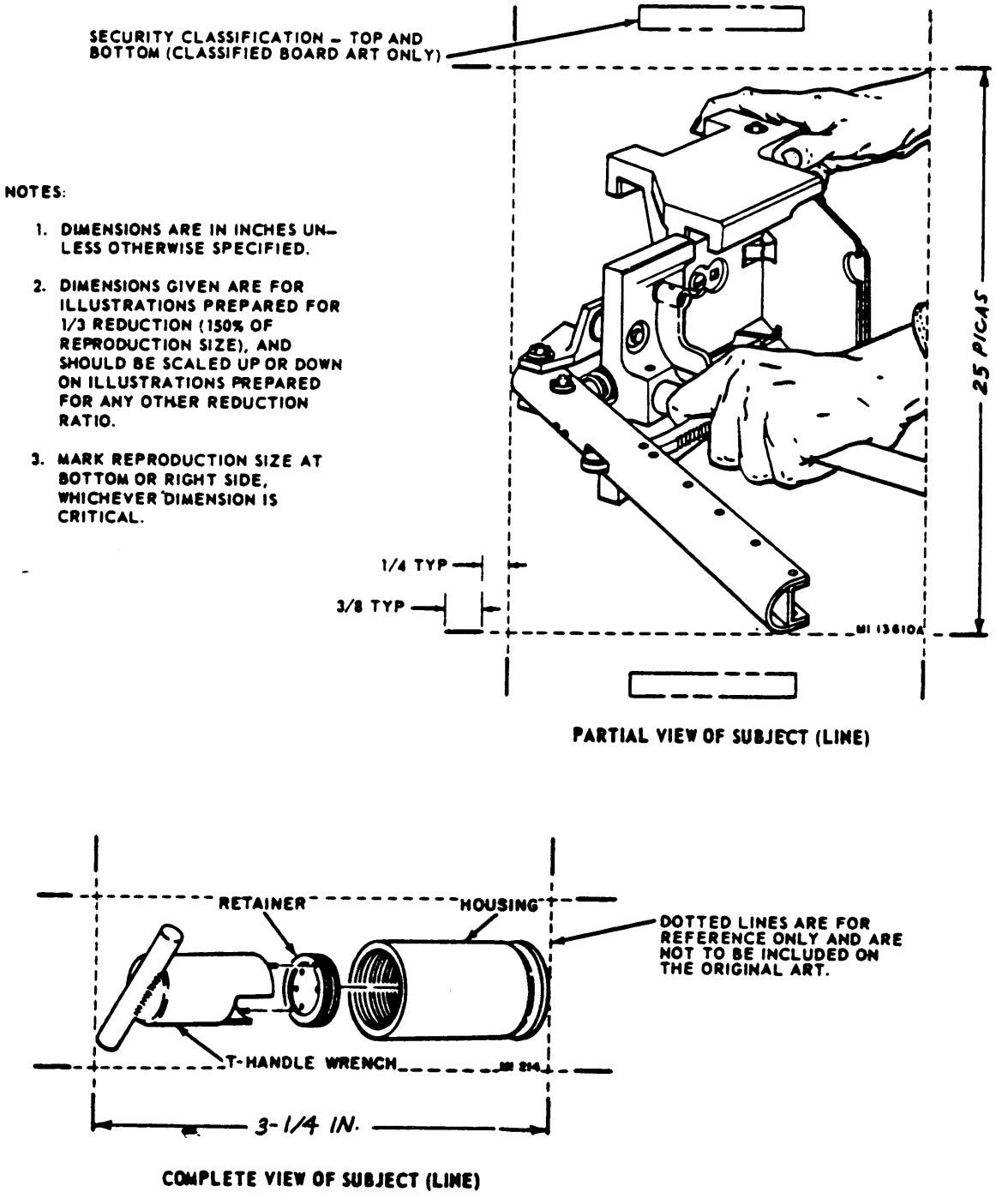

FIGURE F-2. Cropping and sizing of illustrations.

APPENDIX F

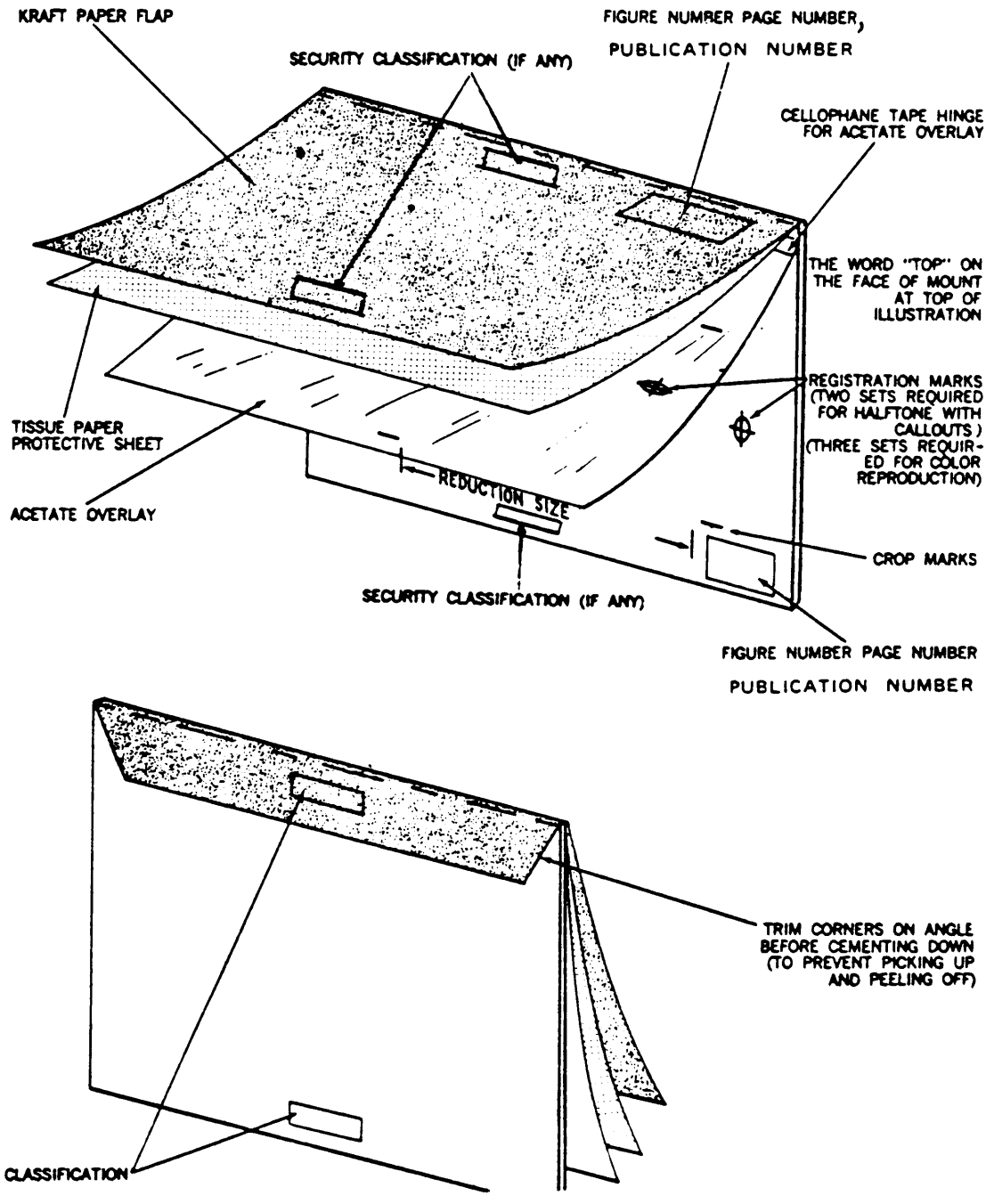

FIGURE F-3. Identification, marking, and protective covering of artwork.

APPENDIX G

NUMBERING: PARAGRAPHS, PROCEDURES, PAGES, DIVISIONS, ISSUES, CHANGES, AND PUBLICATIONS

G.1. SCOPE

G.1.1 Scope. This appendix documents the methodologies for numbering paragraphs, procedures, pages, divisions, issues, changes and the technical manual. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

G.2. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

G.3. DEFINITIONS

G.3.1 Definitions and acronyms. The definitions and acronyms used in section 3 of this specification apply to this appendix.

G.4. PARAGRAPHS

G.4.1 Decimal paragraph numbering. Format for the decimal numbering method shall be as outlined below and on figure G-1. Paragraphs shall be numbered consecutively within the chapter. All paragraph numbers shall be preceded by the chapter number and a period.

a. Primary sideheads shall be numbered consecutively within the chapter. The paragraph number shall be preceded by the chapter number and a period, for example, the first primary paragraph of Chapter 3 would be 3.1, the second primary paragraph would be 3.2, and so forth.
b. All subordinate sideheads shall begin two spaces below the preceding paragraph at the left margin.
c. Procedural steps shall begin two spaces below the preceding text and indented two spaces from the left margin. Substeps shall begin two spaces below the preceding step and indented an additional two spaces.

G.5. PROCEDURES

G.5.1 Procedural steps. Procedural steps shall be used to provide step-by-step instructions, such as disassembly, assembly and alignment procedures. Steps may be further divided into substeps. Procedural steps and checklist items shall be numbered. The text shall begin on the same line as the step number and be separated by two spaces. Carry over lines shall not return to the left margin but shall start under the first letter of the preceding line (blocked).

APPENDIX G

G.6. PAGES, TABLES, AND ILLUSTRATIONS

G.6.1 Pages, tables, and illustrations. Pages, tables, and illustrations shall be numbered consecutively within each chapter. Manuals divided into chapters and in turn into sections, shall contain consecutively numbered pages, tables and illustrations for the entire chapter. Page, table, and illustration numbers shall consist of two part Arabic numerals separated by a hyphen. The first part shall be the chapter number with the second part being the order within the chapter. When specified, the volume number shall be included with the page number. For example:

Number	Meaning
2-17	Chapter 2, page 17
3-12-10	Volume 3, Chapter 12, page 10
Table 2-17. (Title)	Chapter 2, table 17
Figure 2-17. (Title)	Chapter 2, figure 17
Figure 2-17. (Title) (Sheet 1 of 3)	Chapter 2, figure 17 is a multisheet (3 total) illustration. Remaining sheets shall be numbered in consecutive order; (Sheet 2), (Sheet 3), and so forth.

Note that a manual may contain both a table and a figure, that is, 2-17. Only the first sheet of a multiple sheet illustration shall contain the total number of sheets, that is, Sheet 1 of 3. If a chapter is so short that the chapter can be completed on one page, permitting another chapter to start on the same page, both chapter numbers shall be indicated by the page number. For example: "3-1/4-1."

G.6.2 Cover and title pages. Cover and title page shall not be numbered; however, the first page of a brief manual that uses an abbreviated title, below which the beginning text is placed, shall be assigned an Arabic numeral 1.

G.6.3 Front matter. Lower case Roman numerals (in sequence i, ii, iii, and so forth) shall be used in numbering front matter pages following the list of effective pages and precede Chapter 1.

G.6.4 List of effective pages. The list of effective pages shall be numbered using the letter "A" in the lower left-hand corner. When the list of effective pages otherwise begins as a right-hand page, the letter "A" shall be in the lower right-hand corner. When additional pages are required, they shall be identified as "B", "C", and so forth.

G.6.5 Blank pages. A blank page shall be assigned a number but it shall appear on the preceding or following page. For example: if page 10 of Chapter 1 is blank, page 9 shall bear the number 1-9/(1-10 blank); if page 9 of Chapter 1 is blank, page 10 shall bear the number (1-9 blank)/1-10. When applicable, an added page, such as 1-10.1, shall show that 1-10.2 is blank.

G.6.6 Foldout figure numbers. The figure numbers for foldouts which fall at the end of the manual shall be "FO-1", "FO-2", and so forth, and shall be placed preceding the figure title under the illustration. The figure numbers for foldouts which fall at the end of a chapter or are interspersed with the text shall follow normal figure numbering sequencing. When a foldout consists of several sheets, the sheets shall be numbered in consecutive order following the figure title.

G.6.7 Foldout page numbers. The page numbers for foldout pages which fall at the end of the manual shall be FP-1/(FP-2 blank), FP-3/(FP-4 blank), and so forth. The page numbers for foldout pages which fall at the end of a chapter or are interspersed with the text shall follow normal page numbering sequence.

G.6.8 Glossary pages. The page numbers for an independent glossary shall be consecutively numbered in Arabic numerals with the word "Glossary" preceding the page number. For example: "Glossary 1."

G.6.9 Index pages. Unless otherwise specified, page numbers for indexes shall be consecutively numbered in Arabic numerals with the word "Index" preceding the page number. For example: "Index 1."

G.7. FOOTNOTES

G.7.1 Footnotes. Numbering of footnotes to tables shall be independent of that of footnotes to the text. Consecutive superior numbers beginning with "1" shall be used (in tables, superior lowercase letters, asterisks or other designation may be used where numbers would cause confusion). Footnote numbers and text shall be separated by two spaces. The numbering system shall be per chapter or table, as applicable. Footnotes to the text shall be placed at the bottom of the page on which they appear.

G.8. DIVISIONS

G.8.1 Volumes. Unless otherwise specified, volumes shall be used and numbered consecutively in Arabic numerals. Two or more volumes shall be identified sequentially by volume numbers and subtitles indicative of volume content and have a unique Technical Manual Identification Number assigned as provided by the Government.

G.8.2 Chapters. Arabic numerals shall be used to number chapters consecutively throughout all volumes of the publication. Chapters shall begin on a right-hand page.

G.8.3 Sections. Roman numerals shall be used to number sections consecutively within each chapter.

G.8.4 Appendix. Appendices shall be identified by capital letters, for example, APPENDIX A, APPENDIX B and so forth. Pages, paragraphs, illustrations and tables for appendixes shall be consecutively numbered in Arabic numerals preceded by the capital letter of the appendix. For example:

Number	Meaning
A-17	Appendix A, page 17
Figure B-17	Appendix B, figure 17
Table C-17	Appendix C, table 17

G.9. ISSUES AND CHANGES

G.9.1 Review draft copy. Page numbering techniques shall approximate that to be used in the final reproducible copy. These page numbers are used only to establish the continuity of the RDC and have no bearing on page numbers which will appear later in the final reproducible copy.

G.9.2 Preliminary technical manual and final reproducible copy. The page number shall be placed as specified in this specification. However, when all the information for a 4 by 5 1/2, 4 1/2 by 7, 5 1/2 by 7, 4 by 8 or 5 by 8 inch manual is placed horizontally on all pages, and all pages are arranged head to foot, the page number shall be placed in the lower right corner of all pages.

G.9.3 Numbering of changes. Each change package to a manual shall be lettered, as specified by the Government, in sequence and dated. Identification of changes after each revision of a manual shall begin over again with letter A as applicable. The change date shall be the date of approval.

G.10. PUBLICATIONS

G.10.1 Technical manual identification number. The technical manual identification number assigned by the Government shall be located on each page. However, when all the information for a 4 by 5 1/2, 4 by 8, 4 1/2 by 7 or 5 by 8 inch manual is placed horizontally on all pages and all pages are arranged head to foot, the technical manual identification number shall be placed in the upper right corner of all pages. If the publication is jointly used, each Service's number shall be prefixed with the word Army, Navy (NAVSEA) (NAVAIR), (SPAWAR), Marine Corps or Air Force as applicable. The Government's technical manual identification number shall be placed above the using activity's technical manual identification number. The using activity's numbers shall be in alphanumeric sequence following the Government's number. For example:

ARMY	TM 11-1510-204-34
AIR FORCE	TO 21M-LGM30G-12

APPENDIX G

MARINE CORPS	TM-12345/1
NAVY (NAVAIR)	AI-F18AA-WRM-070
NAVY (NAVSEA)	SE211-FA-MMA-010/SPS-10A
NAVY	EE211-FA-MMA-010/SPS-40

1.9 PRIMARY SIDEHEAD.

1.9.1 First Subordinate Sidehead. Text following a subordinate sidehead to fill two lines of output. Text following a subordinate sidehead to fill two lines of output.

1.9.1.1 Second Subordinate Sidehead. Text following a subordinate sidehead to fill two lines of output. Text following a subordinate sidehead to fill two lines of output.

1.9.1.1.1 Third Subordinate Sidehead. Text following a subordinate sidehead to fill two lines of output. Text following a subordinate sidehead to fill two lines of output.

1.10 PRIMARY SIDEHEAD FOLLOWED BY PROCEDURAL STEPS.

a) First Level Procedural Step. No. title. Block indented under first word of paragraph.

(1) Second Level Procedural Step. No title. Block indented under first word of paragraph.

(a) Third Level Procedural Step. No. title. Block indented under first word of paragraph.

1 Fourth Level Procedural Step. No. title. Block indented under first word of paragraph.

a Fifth Level Procedural Step. No. title. Block indented under first word of paragraph.

(1) Sixth Level Procedural Step. No Title. Block indented under first word of paragraph.

(a) Seventh Level Procedural Step. No title. Block indented under first word of paragraph.

1.11 PRIMARY SIDEHEAD.

1.11.1 First Subordinate Sidehead. Followed by procedural steps.

a. First Level Procedural Step. No title. Block indented under first word of paragraph

(1) Second Level Procedural Step. No title. Block indented under first word of paragraph.

(a) Third Level Procedural Step. No title. Block indented under first word of paragraph.

1.12 PRIMARY SIDEHEAD.

1.12.1 First Subordinate Sidehead. Followed by a paragraph with text.

1.12.1.1 Second Subordinate Sidehead. Followed by procedural steps.

a. First Level Procedural Step. No title. Block indented under first word of paragraph.

(1) Second Level Procedural Step. No title. Block indented under first word of paragraph.

(a) Third Level Procedural Step. No title. Block indented under first word of paragraph.

1.13 PRIMARY SIDEHEAD.

1.13A INSERT PRIMARY SIDEHEAD.

1.13B INSERT PRIMARY SIDEHEAD.

1.14 PRIMARY SIDEHEAD.

1.14.1 First Subordinate Sidehead. Text following a subordinate sidehead to fill two lines of output.

1.14.1A Insert First Subordinate Sidehead. Text following a subordinate sidehead to fill two lines of output.

1.14.1B Insert First Subordinate Sidehead. Text following a subordinate sidehead to full two lines of output.

1.14.2 First Subordinate Sidehead. Text following a subordinate sidehead to fill two lines of output.

1.14.2.1 Second Subordinate Sidehead. Text following a subordinate sidehead to fill two lines of output.

1.14.2.1A Insert Second Subordinate Sidehead. Text following a subordinate sidehead to fill two lines of output.

1.14.2.1B Insert Second Subordinate Sidehead. Text following a subordinate sidehead to fill two lines of output.

1.14.2.2 Second Subordinate Sidehead. Text following a subordinate sidehead to fill two lines of output.

FIGURE G-1. Decimal paragraph numbering. (Example) (Sheet 1 of 2)

T.O. XX-XXX-X-XX

1.14.2.2.1 Third Subordinate Sidehead. Text following a subordinate sidehead to fill two lines of output.

1.14.2.2.1A Insert Third Subordinate Sidehead. Text following a subordinate sidehead to fill two lines of output.

1.14.2.2.1B Insert Third Subordinate Sidehead. Text following a subordinate sidehead to fill two lines of output.

1.14.2.2.2 Third Subordinate Sidehead. Text following a subordinate sidehead to fill two lines of output.

a. First Level Procedural Step. No title. Block indented under first word of paragraph.

a1. Insert First Level Procedural Step. No title. Block indented under first word of paragraph.

a2. Insert First Level Procedural Step. No title. Block indented under first word of paragraph.

b. First Level Procedural Step. No title. Block indented under first word of paragraph.

(1) Second Level Procedural Step. No title. Block indented under first word of paragraph.

a) First Level Procedural Step. No. title. Block indented under first word of paragraph.

(1) Second Level Procedural Step. No title. Block indented under first word of paragraph.

(1A) Insert Second Level Procedural Step. No title. Block indented under first word of paragraph.

(1B) Insert Second Level Procedural Step. No title. Block indented under first word of paragraph.

(2) Second Level Procedural Step. No title. Block indented under first word of paragraph.

(a) Third Level Procedural Step. No title. Block indented under first word of paragraph.

(a1) Insert Third Level Procedural Step. No title. Block indented under first word of paragraph.

(a2) Insert Third Level Procedural Step. No title. Block indented under first word of paragraph.

(b) Third Level Procedural Step. No title. Block indented under first word of paragraph.

1 Fourth Level Procedural Step. No title. Block indented under first word of paragraph.

1A Insert Fourth Level Procedural Step. No title. Block indented under first word of paragraph.

1B Insert Fourth Level Procedural Step. No title. Block indented under first word of paragraph.

2 Fourth Level Procedural Step. No title. Block indented under first word of paragraph.

a Fifth Level Procedural Step. No title. Block indented under first word of paragraph.

a1 Insert Fifth Level Procedural Step. No title. Block indented under first word of paragraph.

a2 Insert Fifth Level Procedural Step. No title. Block indented under first word of paragraph.

b Fifth Level Procedural Step. No title. Block indented under first word of paragraph.

(1) Sixth Level Procedural Step. No title. Block indented under first word of paragraph.

(1A) Insert Sixth Level Procedural Step. No title. Block indented under first word of paragraph.

(1B) Insert Sixth Level Procedural Step. No title. Block indented under first word of paragraph.

(2) Sixth Level Procedural Step. No title. Block indented under first word of paragraph.

(a) Seventh Level Procedural Step. No title. Block indented under first word of paragraph.

(a1) Insert Seventh Level Procedural Step. No title. Block indented under first word of paragraph.

(a2) Insert Seventh Level Procedural Step. No title. Block indented under first word of paragraph.

(b) Seventh Level Pro-cedural Step. No title. Block indented under first word of paragraph.

FIGURE G-1. Decimal paragraph numbering. (Example) (Sheet 2 of 2)

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APPENDIX H

TECHNICAL MANUAL CHANGE PACKAGE REQUIREMENTS

H.1. SCOPE

H.1.1 Scope. This appendix sets forth the development requirements for changes to technical manuals in support of modifications to weapon systems and equipments, and correction of technical deficiencies. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

H.2. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

H.3. DEFINITIONS

H.3.1 Definitions and acronyms. The definitions and acronyms used in section 3 of this specification apply to this appendix.

H.4. REQUIREMENTS

H.4.1 General. The change package shall conform to the format of the basic manual, and shall incorporate all approved information (for example, engineering change proposals, ship alterations, ordnance alterations, machine alterations, field changes, and so forth). The changes shall also incorporate all advance change notices (see 6.5.3) and outstanding deficiencies that have been resolved by the Government. A change package shall not affect more than 25 percent of the total pages in the published manual.

H.4.2 Change package content. Each change package shall include the following:

a. A replacement title page.
b. A replacement list of effective pages.
c. An instruction sheet.
d. As applicable, replacement pages for the table of contents, general information page(s), lists of abbreviations or symbols, system and component diagrams, and text.

H.4.3 Cover and title page. In accordance with Appendix C, the title page (and cover, if required) of changed manuals shall be updated to:

a. Reflect the current distribution statement, warning, and destruction notice. A new title page shall be supplied with the distribution statement centered, one-fourth inch below the SYSCOM seal.

b. Indicate the change letter and date in addition to the original date of the publication, that is, CHANGE A 15 July 1994. The change identification shall be entered below the original publication date in the lower right-hand corner of the page.
c. Indicate the current supersession notice.

H.4.4 List of effective pages. On the list of effective pages, above the listing of pages contained in the manual, shall be a list of all published change identification numbers, letters, and dates. The current change shall be included in this list.

H.4.5 Change instruction sheets. The change instruction sheet shall provide instructions for inserting new and revised pages, and for disposing of superseded pages (see figure H-1). The instruction sheet shall be the first page of a change package. The instruction sheet shall include the following, as applicable:

a. "Change Instruction Sheet" shall appear at the top of each page (below the basic technical manual identification number).
b. The technical manual change identification number shall appear on the top-left of each change instruction sheet page, but below the page identifier (that is, "Change Instruction Sheet"). The change shall be identified with a permanent identification number assigned by the Government (see H.4.12 for interim changes).
c. The security classification shall be located on all pages of classified interim or permanent changes and shall appear on the top (above the manual identification number) and bottom center of each page.
d. The total number of pages included in the change shall be indicated on the first page for the instruction sheet.
e. If other than the change date, a statement shall be included indicating when the change is in effect. If it supersedes an earlier change, a statement of that fact shall be given.
f. If an equipment change is involved (field or production change), a statement shall be included indicating the purpose of the change and the extent (serial numbers or conditions of application) to which it applies to the equipment population and identify the alteration by number.
g. When the equipment nomenclature has been changed because of a production or field change to the equipment, the nomenclature references in the text and illustrations need not be modified merely to include the new nomenclature providing that information equivalent to the following is included as general information:

   "Unless otherwise specified, all references in the manual to Radar Set AN/SPS-10 apply equally to Radar Set AN/SPS-10A."

h. If an equipment change does not effect the entire equipment population, the change shall be developed so that it will describe both the effected and uneffected equipment.
i. When the change applies to the entire equipment population, the change shall cover only the modified equipment. A note shall be included in the first paragraph of the instruction sheet to the effect that maintenance support activities shall not dispose of the superseded pages until it is established that all of the equipment population has been modified.

j. Instructions shall be concise and clear, illustrations and diagrams corrected, as applicable, and replacement pages provided.
k. The instructions shall be followed by a statement that the change instruction sheet shall be inserted in the manual immediately following the front cover and title page for reference purposes.
l. The instructions shall specify the deleted or added pages and include information for completing the change record page.
m. The method used to identify new and changed material shall be explained.
n. For changes pertaining to equipment modifications, the user shall be instructed not to insert a change in a manual until the modification has been accomplished.
o. Printed matter shall be arranged on the page so that all copy is readable when bound in the manual.
p. A bar-coded stock number for the change package shall appear in the lower left-hand corner of the first page.

H.4.6 Replacement pages. Changes to an existing manual shall be issued in the form of replacement pages. The changes shall be developed in accordance with this specification, and style, format and content of the applicable associated specification. Pages shall be revised only when significant technical changes are required.

a. Replacement pages shall include all corrections issued in previous changes in addition to all other outstanding corrections required.
b. Changes made to any given page of the manual shall require a complete check and correction of associated pages that reflect the subject change.
c. A change letter for the change shall be used to identify changes and will be assigned by the Government.
d. When the published change package is available, the change pages shall be inserted (by the supplier) into the basic manuals to be shipped with the equipment.
e. The publication identification number shall appear at the top of each replacement page and shall remain the same as the basic manual.
f. When the RDC of the change is submitted for review and acceptance, the new change package publication identification number and change letter shall be requested from the Government.
g. When a change is made to a maintenance dependency chart, the entire chart shall be reprinted, including the backup page. Markings shall be the same as for all changed pages.
h. As necessary, indices shall be updated to reflect changes and shall be issued as replacement pages.
i. Change pages shall be developed and punched or drilled to the exact size and dimensions of the pages they replace.

H.4.6.1 Additions. All paragraphs and pages shall be added and numbered as follows:

H.4.6.1.1 Numbering of added material. When paragraphs, illustrations, tables, and pages are added by a change, existing paragraphs, illustrations, tables, and pages shall be renumbered. If this involves renumbering more than 10 paragraphs or will effect more than five pages, the following method shall be used:

a. When paragraphs are added at the end of a sequence, the next consecutive number shall be used.
b. When paragraphs are added in the middle of a sequence, paragraphs shall be numbered by adding an alpha character (for example, 2.4A, 2.4B, 2.4.1A, and so forth), to the preceding paragraph number.
c. Added illustrations, tables, and pages shall be numbered by adding a decimal (for example, figure 3-2.1, page 3-26.1, and so forth).
d. When it is necessary to add an illustration, table, and page between items which have already been added by the preceding method, an alpha character shall be used (for example, a page added between 3-26.2 and 3-26.3 would be 3-26.2A).
e. Pages shall not be added between a right-hand (odd numbered) and a left-hand (even numbered) page.
f. When new material is to be added to a right-hand page, any overrun shall be carried to the left-hand page. The overrun from the left-hand page shall be placed on the added page.
g. Where material is to be added to a right-hand page (for example, 2-5) and adequate blank space is available on the preceding left-hand page (for example, 2-4), material at the top of 2-5 shall be moved to the bottom of 2-4 and the new material added to 2-5.

H.4.6.1.2 Multisheet illustration. Sheets added to a set of multisheet illustrations which fall between existing sheets shall be assigned the preceding number plus a decimal number. For example: if a sheet is added between sheets 2 and 3, the added sheet becomes 2.1. If possible, the new sheet shall be added after the last sheet and be assigned the next consecutive number.

H.4.6.1.3 Index number. Where a change to an illustration adds index numbers between existing numbers, the added numbers shall be the same as the preceding index number with an added decimal number, for example, 22.1, 22.2, and so forth.

H.4.6.2 Deletions.

H.4.6.2.1 Deleted paragraphs, steps, illustrations, tables. Where a change deletes a paragraph, step, substep, illustration, or table without substituting another, the space formerly occupied by the paragraph, step, substep, illustration, or table can be used for other instructions, allowing for sufficient space to provide 1/4 inch above and below a sentence such as "4-2 (Deleted.)". The table of contents, list of illustrations, list of tables and index shall be changed as necessary.

H.4.6.2.2 Deleted pages. When page number continuity is broken by deletion of a page and a blank page results, a statement indicating the deletion shall be placed in the bottom margin (right

or left corner, or centered, as space permits) of the preceding page or top margin of the succeeding page. For example:

"All data on page ....., including Figure ..... deleted."

This also applies when two back to back pages are deleted. The statement shall be used only if the same manual change affects a preceding or succeeding page. A preceding or succeeding page shall not be changed merely to add this statement. In such instances, the list of effective page listings will be adequate.

H.4.6.3 Changes to illustrations. When changes are made to illustrations, the original artwork shall be used unless the development of new artwork is less expensive. Sheets added to a set of multisheet illustrations which fall between existing sheets shall be assigned the preceding number plus a decimal number. For example: if a sheet is added between sheets 2 and 3, the added sheet becomes 2.1. If possible, the new sheet shall be added after the last sheet and be assigned the next consecutive number. If a callout is deleted from an illustration, the word "(Deleted)" in parentheses shall be placed after the appropriate number in the legend.

H.4.6.4 Change symbols for illustrations. Changes to line drawings, charts, illustrations, graphs, diagrams, and schematics shall be indicated by shading and screening to highlight the area containing the changed information. Extensively changed presentations shall be indicated by a screen border around the effected area. For minor changes not suitable for shading or screening, a miniature pointing hand shall be used.

H.4.6.5 Change page numbering and sequence. Change pages which replace pages in the manual shall carry the same number as the page they replace. Where the reverse side of the page in the manual is unaffected by the change, the replacement page shall carry both the change page and its unchanged back-up page. Added pages shall be numbered by adding sequential decimal numbers to the preceding page number (for example, 22.1, 22.2). Added pages may be printed on one side only if the addition of a back-up page would disrupt the sequence of the presentation within the volume or part.

H.4.6.6 Blank page number. A blank page shall be assigned a number but it shall appear on the preceding or following page. For example: if page 10 of Chapter 1 is blank, page 9 shall bear the number 1-9/(1-10 blank); if page 9 of Chapter 1 is blank, page 10 shall bear the number (1-9 blank)/1-10. When applicable, an added page, such as 1-10.1, shall show that 1-10.2 is blank.

H.4.7 Change designator. Each page containing changed or added material shall bear the words "Change __" placed at the bottom of the page in the same corner and on the same line as the page number. The change designator shall begin approximately 1/2-inch to the right of the page number for an even numbered page, and end approximately 1/2-inch to the left of the page number for an odd numbered page (see figure H-2). This change designator requirement is also applicable to all added pages, including those placed at the end of a manual.

H.4.8 Change symbols for text and tables. Changes (except as noted below) to the text and tables (including new material on added pages) shall be indicated by a vertical line in the margin extending the entire area of the material effected (outer margin for double column material, margin opposite binding edge for single column material) (see figure H-2). Exception: pages with emergency markings (black diagonal lines around three edges) shall have the vertical line symbols placed along the inner margins for single column; for double column, the vertical line symbols which apply to the outside column shall be placed in the gutter between columns. Previous change symbols on a page shall be deleted when a page is subsequently changed. Symbols shall show current changes only. The vertical line change symbol shall be 6-point in width. It may be reduced 10 percent in width to allow for automatic composing equipment use providing it remains legible and obvious. If the composing equipment used is incapable of producing a vertical line, change symbols such as a number sign "#", plus sign "+", black circle or black square, or the letter "C", "R", or "X" may be used in lieu of the vertical line, if approved by the Government. The meaning of these symbols shall be explained in the change instruction sheet or foreword, preface or introduction of the manual. Change symbols are not required for:

a. Introductory material.
b. Indexes where the change cannot be identified.
c. Blank space resulting from the deletion of text, an illustration or part of an illustration, or a table.
d. Correction of minor inaccuracies such as spelling, punctuation, relocation of material, renumbered paragraphs, and so forth, unless such correction changes the meaning of instructive information or procedures.
e. Replacement or addition of a complete part, chapter, or section.

H.4.9 Numbering of changes. Each change package to a manual shall be lettered, as specified by this specification, in sequence and dated. Identification of changes after each revision of a manual shall begin over again with the letter A as applicable. The change date shall be the date at which the final material to be included was approved.

H.4.10 FRC. FRC shall be furnished for altered and additional pages. Copy shall be furnished for both sides of the page on which the change is made.

H.4.11 Rapid action changes. When specified, rapid action changes shall be provided. Printed pages from the manual may be used for the changed and unchanged pages, if legible and applicable. Only changed paragraphs, tables, or illustrations need to be developed and mounted in the proper place (size permitting) on the existing printed page. Pages removed from the printed manual to be used without change shall be pasted to bond paper of the same size as the manual. Unchanged portions of pages may also be mounted and used in conjunction with the new material. Unless otherwise specified, front matter (title page, list of effective pages, change instruction sheet, and so forth) shall be provided as a part of the change package.

H.4.12 Interim changes. Interim changes are temporary changes. Each interim change package shall be provided with a complete set of front matter. Interim changes shall be followed up by the issue of a permanent change page package.

H.4.12.1 Pen-and-ink corrections. Pen-and-ink corrections are interim changes and are not acceptable unless this change process is specified by the Government. Unless specified elsewhere, pen-and-ink corrections for a minor change is prohibited.

H.4.12.2 Advanced changes. As specified, change pages or pen-and-ink corrections shall be developed to correct an urgent deficiency.

H.4.12.3 Change instruction sheet. A "T" shall be entered in the front of the interim change package identification number. This change number shall be assigned by the Government.

H.4.12.4 Deleted paragraph. When a paragraph is to be deleted, the number of the page on which it appears shall be stated, followed by a statement that the paragraph is rescinded. For example:

"Page 3. Paragraph 2-1 is rescinded."

H.4.12.5 Changes to tabular material. When interim changes are made in lengthy tabular material, deletions, additions, and substitutions shall be listed in page sequence and the page number on which each change occurs shall be shown. For example:

"Page B-15, Appendix B.

The following are deleted from the list of classes:

Page B-15	5133 Drills, Counterbores and Countersinks 5905 Resistors
Page B-16	6115 Generators and Generators Sets

The following changes are made in the columns indicated:

Page B-21	The description of class 4010 is changed to read "Chain and Wire Rope".
Page B-27	Class number "2960", appearing between class 2930 and 2940, is corrected to read "2935"."

H.4.12.6 Interim additions. The number of the page where the added material would appear if it were incorporated into the existing manual shall be stated, followed by a statement to the effect that the material is being added. This shall be followed by the number, title, and text of the new paragraph. For example:

APPENDIX H

"Page 3-14. Paragraph 3.5.1A and 3.5.1B are added after 3.5.1.
Paragraph 3.5.1A - Refer to S0005-XX-XXX-XXX for coaxial connector repair procedures.
Paragraph 3.5.1B - Refer to S0005-XX-XXX-XXX for LRU checkout and trouble-shooting procedures."

H.4.12.7 Text supersession. The number of the page on which the paragraph appears shall be stated, followed by a statement to the effect that the paragraph is superseded. This shall be followed by the number, title, and text of the superseding paragraph. For example:

"Page 1-6. Paragraph 1.2 is superseded as follows:

1.2 RECORD AND REPORT FORMS.
1.2.1 Depreservation Guide. STD Form XXXX, Depreservation Guide for Engineer Equipment.
1.2.2 Other Forms. For other record and report forms applicable to operator, crew and organizational maintenance, refer to S0005-XX-XXX-XXX."

APPENDIX H

TM9-4931-334-14/2
Change Instruction Sheet

C1

CHANGE NO. 1

HEADQUARTERS DEPARTMENT OF THE ARMY WASHINGTON, D.C. 6 June 1972

Operator's Organizational, Direct Support

and General Support Maintenance Manual

TEST SET

RADAR AN/TPM-22

(4931-707-1229)

TM9-4931-334-14/2, 9 June 1970, is changed as follows:

1. Remove old pages and insert new pages as indicated below:
2. New or changed material is indicated by a vertical bar in the margin of the page.
3. Added or revised illustrations are indicated by a vertical bar adjacent to the illustration identification number.

Remove Pages	Insert Pages	Remove Pages	Insert Pages
5-13 through 5-16	5-13 through 5-16	6-113 and 6-114	6-113 and 6-114
6-1 and 6-2	6-1 and 6-2	6-151 and 6-152	6-151 and 6-152
6-23 and 6-24	6-23 and 6-24	6-167 and 6-168	6-167 and 6-168
6-25 and 6-26	6-25 and 6-26	6-177 and 6-178	6-177 and 6-178
6-27 through 6-38	6-27 through 6-38	6-183 through 6-192	6-183 through 6-192
6-43 through 6-46	6-43 through 6-44.3 through 6-46	6-195 through 6-196	6-195 through 6-196
6-51 through 6-56	6-51 through 6-56	6-199 and 6-200	6-199 and 6-200
6-75 through 6-80	6-75 through 6-80, 6-80.1 and 6-80.2	6-213 through 6-216	6-213 through 6-216
6-81 through 6-88	6-81 through 6-88	6-219 through 6-224	6-219 through 6-224
6-95 and 6-96	6-95 and 6-96	B3 and B4	B3 and B4

File this change sheet in front of the publication for reference purposes.

FIGURE H-1. Change instruction sheet. (Example)

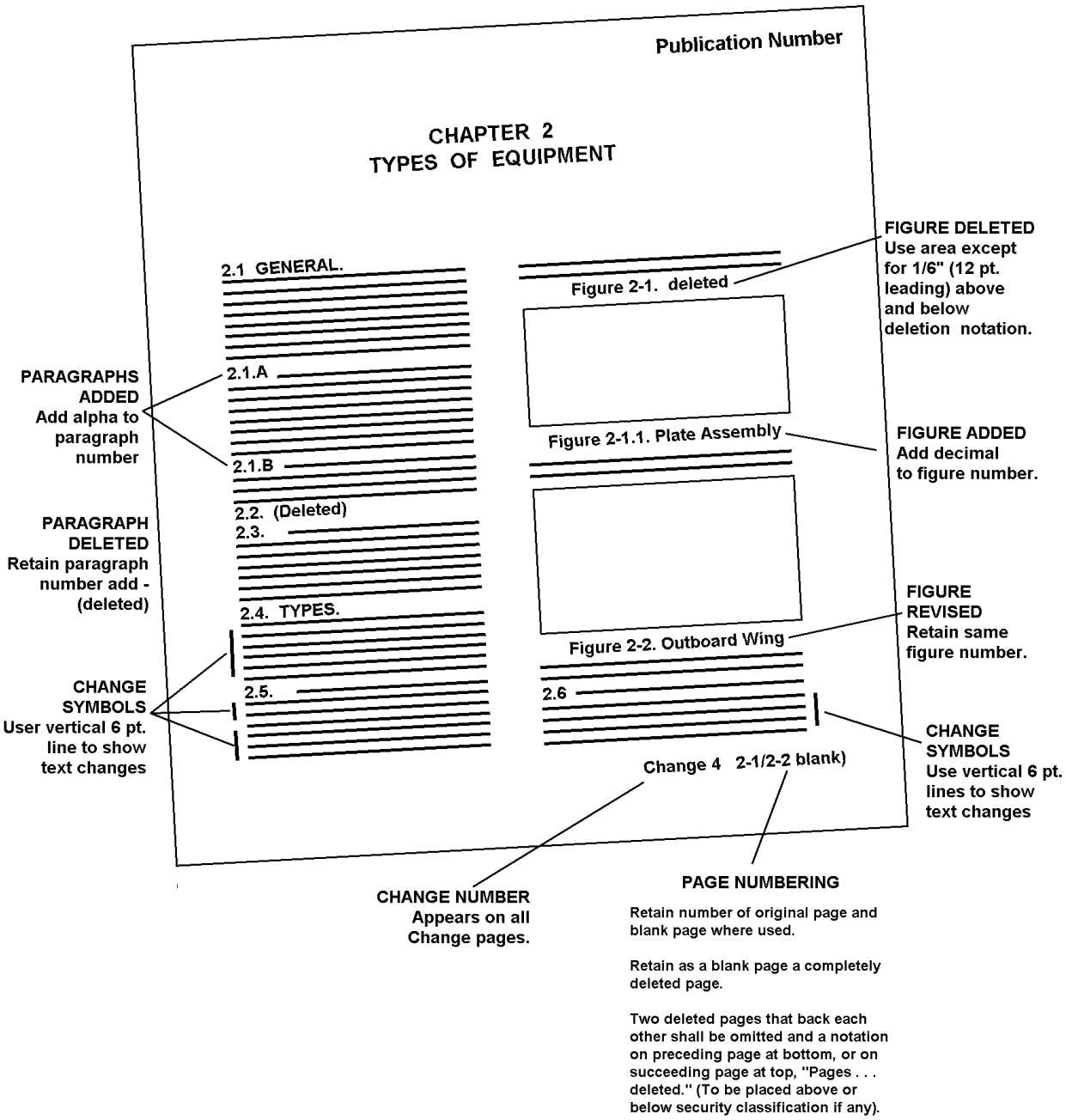

FIGURE H-2. Marking for change page. (Example)

APPENDIX I

TECHNICAL MANUAL REVISION REQUIREMENTS

I.1. SCOPE

I.1.1 Scope. This appendix sets forth the development requirements for revisions to technical manuals in support of modifications to weapon systems and equipments. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

I.2. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

I.3. DEFINITIONS

I.3.1 Definitions and acronyms. The definitions and acronyms used in section 3 of this specification apply to this appendix.

I.4. REQUIREMENTS

I.4.1 General. When specified in the TMCR, an update or complete revision shall be developed. Each revision shall incorporate all outstanding approved changes of the previous issue, as well as approved changes proposed by the change record that creates the need for revision. When a revision is procured to cover a separate equipment model or a different system application, and the basic issue is not to be superseded, the revision shall be identified as a nonsuperseding updated revision. The nonsuperseding update revision shall be classified as "original", have a unique Government identification number on the cover and all pages, and shall not include a supersession notice. A complete revision shall supersede a basic manual when a major portion of the manual is designated inadequate because of obsolescence, method of presentation, arrangement, or any other reason detrimental to the user. Revisions shall conform to the contract requirements, applicable specification sheet and this specification. A RDC, shall be submitted to the Government for review prior to development of the FRC.

I.4.2 Revision determination. The acquiring activity will determine the type of revision. The following information shall be presented to the acquiring activity for consideration in approving the type of revision to be developed:

a. Percent of change.
b. Reason for revision; such as, change in equipment configuration, new technical manual specification to be complied with, and so forth.

I.4.3 Update revision. An update revision shall be developed when the number of pages required to supply corrected and additional information for the manual is more than 25 percent of the total pages of the manual but less than 50 percent. (This does not include previously issued change packages, but does include outstanding interim change pages.) Blank pages shall not be included as part of the basis for determining the 25 percent figure. An updated revision is required when

the current manual is adequate both in format and accuracy, but does not completely cover the equipment because of production or field changes or modification made to the equipment after the manual was issued. An update revision shall incorporate configuration modifications and all previous and outstanding data issued as changes to the existing manual. An update revision shall be in accordance with the size, content, and format arrangement of the basic manual. Pages shall not be changed for non-technical reasons such as a change in equipment model or source data drawing number. Information of this type, whenever possible, shall be summarized and included in the general information pages (for example, all references to Model B apply equally to Model C). Material for the updated revision shall be in the same manner as replacement pages.

I.4.4 Complete revision. A complete revision shall be developed when the number of pages required to correct and provide additional information for the manual exceeds 50 percent of the total pages of the manual and when the existing style and format is adequate. (This does include previously issued and outstanding interim and permanent change pages.) A complete revision shall be a completely rewritten manual incorporating all previous corrections and changes, and shall comply with all style, format, and content requirements of this specification, and the preparation details of MIL-DTL-24784.

I.4.5 Revision change symbols. When specified in the TMCR, after all previous change symbols have been eliminated, new change symbols shall be inserted to identify technical changes in text, illustrations and tables that differ in the revision from those contained in the latest previous edition of the manual.

I.4.6 Renumbering and removal. In a complete revision, all pages, paragraphs, illustrations and tables shall be renumbered, as necessary, to eliminate all number suffixes and to establish correct sequence. Complete revisions shall be developed to current specifications and standards. In an update revision, suffixed paragraph, illustration and table numbers shall be retained when use of the manual will not be substantially improved by renumbering. All change numbers and change dates shall be removed from pages. All partial pages, miniature pointing hands, shading, screening, vertical lines in margin and other change symbols shall be eliminated.

I.4.7 Supersession notice. Unless otherwise specified by the Government when a revision is issued, the following supersession notice shall be included on the title page: "This publication supersedes (Guard, Marine Corps, or Navy as applicable, volume and manual number), date (day, month, year)."

I.4.8 FRC for revisions. FRC for revisions shall be in accordance with the associated specification. The revision date shall be the date at which the material to be included was approved. FRC for update revisions shall be such that it can be reprinted in its entirety and issued as a revised manual as opposed to being assembled by the user.

I.4.9 Revision designator. The latest revision number shall be placed on the cover and title page as follows: "Revision No. 1" or "Revision 1".

APPENDIX J

QUALITY ASSURANCE

J.1. SCOPE

J.1.1 Scope. This appendix establishes the requirements for the quality assurance provisions for the technical manuals. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

J.2. APPLICABLE DOCUMENTS

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

J.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.

DEPARTMENT OF DEFENSE

S0005-AA-PRO-010	NAVSEA / SPAWAR Technical Manual Operations, Procedures and Life Cycle Support Handbook.

(Application for copies should be addressed to the Government Printing Office, Attention Superintendent of Documents, Washington, D.C. 20402.)

J.2.3 Non-Government publications. The following documents 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 specified 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.

AMERICAN SOCIETY OF QUALITY CONTROL (ASQC)

ASQC Q9003	Quality Systems - Model for Quality Assurance in Final Inspection and Test.

(Application for copies should be addressed to the American Society of Quality Control, 611 East Wisconsin Ave., Milwaukee, WI 53202-4606.

J.2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document,

however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

J.3. DEFINITIONS

J.3.1 Definitions and acronyms. The definitions and acronyms used in section 3 of this specification apply to this appendix.

J.4. QUALITY ASSURANCE PROVISIONS

J.4.1 Responsibility for inspection. Unless otherwise specified in the TMCR, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

J.4.1.1 Responsibility for compliance. All items shall meet all requirements of this specification and its associated performance specifications. The inspections set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

J.4.1.2 Government inspection. Material furnished in accordance with this specification shall be subject to inspection, verification and approval or disapproval by the Government as specified by the terms of the contract. Inspection and verification will be performed by the Government prior to acceptance. The Government reserves the right to conduct a guidance and quality planning conference and quality program reviews throughout the term of the contract to ensure compliance with the quality assurance program plan, applicable technical manual specifications, the contract, and the production of a quality product.

J.4.1.2.1 Government inspection at subcontractor facilities. Government inspection, verification and acceptance of a preliminary material at a subcontractor facility shall not constitute Government acceptance of the manual. Such Government actions shall not in any way relieve the prime contractor of his responsibilities for inspection and validation or of his responsibility to furnish an acceptable manual. When the Government requires inspection or verification at the subcontractor location, the prime contractor shall include in the purchasing document a statement equivalent to the following:

> "Government inspection and verification is required prior to shipment from your plant. Upon receipt of this order, promptly notify and provide a copy of this order to the

Government representative servicing your plant so that Government inspection and verification may be planned. If the Government representative cannot be identified, the prime contractor shall be notified immediately."

The prime contractor shall report to his Government representative any nonconformance of subcontractor's manuals and shall require the subcontractor to coordinate corrective action with the appropriate Government representative.

J.4.2 TMQA program plan. When directed by the TMCR, the contractor shall document it's technical manual quality assurance program in a plan that shall describe the scope and approach of the TMQA program. It shall detail the organization, planning, and data control to be performed on each technical manual. The plan shall also provide evidence of the contractor's intent and methods for complying with the quality facets of this specification The plan shall reflect the requirements in this appendix and shall require Government review for acceptability. The Government will furnish written notice of the acceptability of the contractor's TMQA program plan.

J.4.3 TMQA program. The contractor shall establish a TMQA program to ensure the development of technically accurate and complete technical manuals. The Quality Assurance program shall be in accordance with the ASQC Q9003 or other documented quality assurance procedures submitted by the contractor and approved by the procuring activity. Review requirements for the quality assurance program developed by the contractor will be specified by the acquisition documents. The contractor's quality assurance program shall encompass the accountability for and development of quality control functions required for the management of the following technical manual program elements:

a. Source data collection.
b. Intermediate product.
c. Graphics and illustrations.
d. Validation.
e. Internal coordination.
f. Records.
g. Verification support.
h. Final product.

J.4.3.1 Quality assurance responsibilities. The contractor shall be responsible for the implementation of the TMQA program plan and for product quality.

J.4.3.2 TMQA program plan organization. The contractor's quality assurance program organization shall have well defined responsibility, authority, and the organizational freedom to identify and evaluate quality assurance problems and to recommend and initiate solutions.

J.4.3.3 Quality assurance program functions. All technical manual elements and processes shall be evaluated by contractor and Government quality assurance personnel at various stages of development, by any or all of the following quality assurance program functions:

a. Guidance and quality planning conferences.
b. Adequacy reviews.
c. In-process reviews.
d. Quality program reviews.
e. Quality reviews.
f. Validation.
g. Verification.

J.4.3.3.1 Guidance and quality planning conference. The guidance and quality planning conference is conducted to ensure the contractor's understanding of applicable specifications, TMCR, formal instructions, established policies, and program requirements. Such conferences may be requested by either the contractor or Government.

J.4.3.3.2 Adequacy reviews. Adequacy reviews will be authorized and convened by the procuring activity to monitor the preparation of IPB and documentation in support of the planned maintenance system (PMS) and may be conducted on maintenance manuals to determine adequacy prior to verification. Adequacy reviews will be conducted on IPBs to ensure that the coverage is in accordance with the approved source, maintenance, and recoverability (SM&R) codes; PMS documentation will be reviewed to ensure it is ready for Fleet evaluation.

J.4.3.3.3 In-process reviews (IPR). IPRs will be authorized and convened as deemed necessary by the Government. The contractor shall support IPRs and provide access to TM materials, intermediate, and final products. As a minimum, IPRs will include evaluation of source data, TM plans/outlines, presentation methods, modes of preparation, TMCR compliance (if applicable), completed text and artwork, and readability.

J.4.3.3.3.1 IPR and adequacy review location. IPRs and adequacy reviews will be held at the contractor's facility but can be held at a designated Government facility. IPR and adequacy reviews intended for locations other than the contractor's facility must be approved by the Government. The contractor may request IPR and adequacy reviews at any time during the term of the contract when assistance or clarification is desired. The Government will request additional IPR and adequacy reviews when it appears the program is not proceeding according to schedule.

J.4.3.3.3.2 IPR and adequacy review records. The Government will act as recorder and record decisions, results, and findings during the IPR and adequacy review evaluation utilizing the Technical Manual Evaluation Record. The Government will provide a copy of all recorded IPR and adequacy reviews to the contractor.

J.4.3.3.3.3 Disposition of IPR and adequacy review findings. The Government and the contractor shall resolve IPR and adequacy review findings that involve problem areas or findings that require further evaluation before final disposition. Any discrepancy or deficiency found as the result of the IPR and adequacy review shall be corrected prior to certification and acceptance of the technical manual.

J.4.3.3.4 Quality program reviews. The contractor shall support quality program reviews as requested by the Government and provide access to QA records as specified in the TMQA program plan. During the TMQA program review, the contractor shall demonstrate to the Government the operation of the TMQA program. This shall include review of data generated during contractor quality reviews and quality related reports and records. TMQA program reviews chaired by a Government representative will be conducted at the contractor's facility. All quality review results will be documented by the Government.

J.4.3.3.5 Quality reviews. The contractor's QA organization shall conduct quality reviews to ascertain compliance with the TMQA program plan and provide for corrective action. Quality reviews shall be conducted to evaluate the availability and adequacy of materials, processes, procedures, and intermediate products which constituent technical manual development. Sampling plans shall be as specified in the TMQA program plan.

J.4.3.3.5.1 Quality records. The contractor shall maintain objective records of all quality reviews. The contractor's compliance will be determined by the accuracy, currency, and the completeness of records as specified in the TMCR and the TMQA program plan. Objective evidence shall be demonstrated by the ease of retrieval of specific information from records and their accuracy, currency, and completeness at the time of the Government representative's request.. The records shall document quality problems and disposition recommendations. The records shall adequately identify the items in the manual(s) to which the comments and recommendations apply.

J.4.3.3.5.2 Corrective action. The contractor shall initiate a process of corrective action for all recorded and detected deficiencies. The contractor shall implement preventive action programs to counter any apparent deficiency trends. The detection of deficiencies which are recognized and are not cited in the classification of defects (CD) shall be added to the CD in the TMQA program plan. Objective evidence of the effectiveness of the corrective action program for each deficiency shall be maintained.

J.4.3.3.5.3 Data base control. The contractor shall ensure that the most current source data is available and utilized for technical manual development.

J.4.3.3.5.4 Task identification matrix or equivalent. The TM content and organization shall be consistent with a task identification matrix or equivalent. The task identification matrix or its equivalent shall ensure that all required levels of maintenance are sufficiently detailed and complete. The task identification matrix or equivalent shall be in agreement with the LSA task analysis data, approved maintenance plan, and approved SM&R codes. The requirements shall be reviewed to determine that all levels are sufficiently detailed and completed. Evaluation shall include a comparison of the tasks identified to the current configuration of hardware.

J.4.3.3.5.5 Control of subcontractors and vendors. The contractor shall ensure the quality of technical manuals developed by subcontractors and suppliers. The contractor's quality program shall not be deemed acceptable to the Government unless that contractor requires from his subcontractor a quality control program satisfying the requirements of this specification, or equivalent control over the subcontractor.

J.4.3.3.5.6 Sampling plans. All technical manual products, regardless of percentage of completion, shall be sampled and evaluated as a method of determining the acceptability of product in development. Sampling plans shall be as specified in the quality assurance program plan.

J.4.3.3.5.6.1 Classification of defects (CD). The CD table associated with the contractor sampling plans shall be made available during the guidance and quality planning conference. The CD shall be patterned after the CD listed below for product evaluation. The contractor and the Government may jointly classify additional defects applicable to the specific products being acquired.

a. Major defects (incorrect, incomplete, missing):

1. Maintenance procedures.
2. Values and tolerances.
3. Illustrations, schematics, wiring diagrams.
4. Part numbers.
5. References and indices.
6. Safety - notes, cautions, warnings, dangers.
7. Technical content (source dates and hardware comparison).
8. Classified matter (incorrect identification and handling).
9. Charts and tables.
10. An excess of any one or combination of the following:
    Unfamiliar words, inconsistent vocabulary, long sentences, long paragraphs, noninformative headings, organization not based on immediate needs of the user, and complex or unclear illustrations.

b. Minor defects (incorrect, incomplete, missing):

1. Typographical errors.
2. Collated pages.
3. SM&R codes.
4. Style and format (Guide errors).

J.4.3.3.6 Validation plan. A validation plan shall be developed and shall be acceptable to the government. It shall reflect compatibility with the overall maintenance and support plan, outline the contractor’s recommended validation procedure, and indicate the scope of the validation effort. It shall also include manuals for which requirements have yet to be defined, such as equipment component and support equipment manuals. The plan shall reflect the requirements of this specification. The plan shall include recommendations for simultaneous validation or verification as appropriate. The validation plan shall ensure there is a system for inspection, validation, and correction of the manual. Validation shall provide a measure of the overall quality of the manual. When the Government performs an inspection at a contractor's plant, such inspection shall not be used by the contractor as evidence of effective control of quality. When

revisions or corrections are required after any inspection, validation, or review, there shall be reinspection, revalidation, or re-review by the contractor, and if necessary, by the Government of all data affected. The validation plan shall include:

a. Validation by which the technical manual is tested for technical adequacy and accuracy and compliance with the provisions of the specifications and other technical contractual requirements.
b. Detailed review of FRC to ensure that this material is identical to the authorized, validated, verified, corrected, and accepted draft or preliminary manuals and complies with legibility and reproducibility requirements.

J.4.3.3.7 Validation. Validation is a contractor quality assurance responsibility which shall be accomplished for all technical manuals, changes, and revisions thereto. A technical manual shall not be considered validated until the following conditions have been fulfilled:

a. Contractor's engineering technical review has been completed.
b. Information reflects configuration of the systems and equipment and includes all engineering changes.
c. Procedural instructions are readily understandable by the intended user and adequate to perform all operations and maintenance functions.
d. Adequacy of data is checked to ensure that it supports the approved maintenance and support plan.
e. Hardware of the proper configuration is available for the validation effort.

J.4.3.3.7.1 Validation performance. Theory and principles of operation, system and component description, SM&R codes (when applicable), schematic, and wiring data shall be validated against engineering source data in accordance with the validation plan. Operating and maintenance procedures including checkout, alignment, scheduled removal and replacement instructions, and associated checklists shall be validated against the system and equipment by actual demonstration. Malfunctions shall not be introduced into the system or equipment for the purpose of validation unless specifically required for certification of procedural tasks or system tests. Destructive malfunctions shall not be introduced into the system or equipment for any purpose.

J.4.3.3.7.2 Support equipment. Government approved support equipment shall be utilized in the performance of validation. Simulation or substitution of support equipment shall be approved by the Government. It is the responsibility of the contractor to request Government furnished equipment in order to support the validation effort.

J.4.3.3.7.3 Validation of readability. Narrative text shall be validated for conformance to readability standards specified in Appendix B. If the OGL (including tolerance) is exceeded, the manual shall be rewritten as required to meet the specified RGL. If a sample GL is exceeded, the entire text surrounding each sample must be rewritten as required. Automated equipment may be used to compute RGL provided the computation meets the requirements of this document.

J.4.3.3.7.4 Validation Records. Records of all validations performed shall be maintained. These records shall indicate the affected manuals, weapon system, component part number, or serial number. The records shall be maintained by the contractor and be available for Government review.

J.4.3.3.7.5 Disposition of validated data. Corrections and significant comments resulting from validation shall be incorporated prior to issue of the validation certification.

J.4.3.3.8 Validation certification. The contractor shall prepare a validation certification attesting to the technical manual adequacy and accuracy by actual performance or simulation. Individual validation certification reports shall be prepared for each technical manual validation by the contractor, using NAVSEA Form 4160/3 from S0005-AA-PRO-010 as the certification document.

J.4.3.3.9 Verification. When specified in the TMCR, verification shall be accomplished under the jurisdiction of the Government and may include contractor support. Verification is a responsibility of the approval authority or authorized representative. The purpose of verification shall be to ensure that the contractor's products and services are in conformity with the requirements of this specification.

J.4.3.3.9.1 Verification support requirements. Contractor support of verification shall consist of the following:

a. Serve as verification recorder, if required. Record and maintain records of changes associated with performance of verification.
b. Provide assistance in performing verification tasks, if required.

J.4.3.3.9.2 Verification disposition records. The contractor shall maintain records (that document the contractor’s analyses of verification comments) and correct manual discrepancies recorded during verification. The Government will review and indicate acceptance of verification dispositions.

J.4.3.3.9.3 Verification incorporation certification. Upon completion of all verification actions, the contractor shall certify that all discrepancies and deficiencies recorded during verification have been corrected or resolved. The certification shall reflect the requirements of this specification. Final acceptance of the technical manual will be in accordance with terms of this specification.

J.4.3.3.10 Combined validation and verification. When authorized by the Government, verification shall be performed concurrently with validation. Final acceptance of the technical manual will be made upon receipt of the validation and verification incorporation certifications.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4,5,6, and 7 and send to preparing activity.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-DTL-24784B (SH)	2. DOCUMENT DATE *(YYYYMMDD)* 15 February 2002

3. DOCUMENT TITLE
MANUALS, TECHNICAL: GENERAL ACQUISITION AND DEVELOPMENT REQUIREMENTS

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

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) DSN *(if applicable)*	7. DATE SUBMITTED *(YYYYMMDD)*

8. PREPARING ACTIVITY

a. NAME SEA 05Q	b. TELEPHONE *(Include Area Code)* (1) Commercial (202) 781-3726 (2) DSN
c. ADDRESS *(Include Zip Code)* Commander, Naval Sea Systems Command ATTN: SEA 05Q, 1333 Isaac Hull Ave SE Stop 5160, Washington Navy Yard DC 20376-5160	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman Road, Suite 2533, Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888