

MIL-M-23305(Wep)  
5 June 1962

## MILITARY SPECIFICATION

MANUAL: TECHNICAL OPERATION, MAINTENANCE, AND OVERHAUL  
INSTRUCTIONS WITH ILLUSTRATED PARTS BREAKDOWN  
(FOR AIRCRAFT LAUNCHING AND RECOVERY EQUIPMENT);  
PREPARATION OF

(This specification has been approved by the  
Bureau of Naval Weapons, Department of the Navy.)

## 1. SCOPE

1.1 Scope. - This specification covers the requirements for the preparation of technical manuals for instructions of operation, maintenance, overhaul, illustrated parts breakdown, or any combination thereof, for aircraft launching and recovery equipment, and any related equipment designated by the Procuring Activity, such as bridle arresters, land-based expeditionary gear, etc.

1.2 When specified by the Procuring Activity the scope of this specification shall be enlarged to incorporate requirements as designated in 3.3.

## 2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on the date of invitation for bids, form a part of this specification to the extent specified herein:

SPECIFICATIONS:Military

MIL-H-5474	Handbooks and Breakdowns: General Preparation of
MIL-H-7863(Wep)	Handbooks and Breakdowns: Title Pages, "A" Pages, etc.
MIL-N-17792(Aer)	Negatives for Reproduction: General Preparation of
MIL-M-8910	Technical Manuals: Illustrated Parts Breakdown;
	Preparation of
MIL-B-22907(Wep)	Bulletins, Service: Catapult, Arresting Gear, and
	Catapult Deck Gear and Accessories: Preparation of
MIL-C-22908(Wep)	Changes, Service: Catapult, Arresting Gear, and
	Catapult Deck Gear and Accessories: Preparation of
MIL-D-70327	Drawings, Engineering and Associated Lists

STANDARDS:

MIL-STD-12	Abbreviations for Use on Drawings and in Technical
	Type Publications
MIL-STD-15	Electrical and Electronic Symbols
MIL-STD-16	Electrical and Electronic Reference Designations
MIL-STD-17	Mechanical Symbols
MIL-STD-28	Titles and Names on Drawings

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STANDARDS (continued):

MIL-STD-122	Color Code for Chassis Wiring for Electronic Equipment
MIL-STD-218-Part 1	General Outline for Technical Manuals
MIL-STD-218-Part 2	Production or Procurement of Artwork for Technical Manuals
MIL-STD-218-Part 3	Preparation of Manuscript (Final, Typed) for Technical Manuals

PUBLICATIONS:

ANA Bulletin No. 261	Abbreviations and Contractions for Use on Airborne Equipment: Approved List of
NAEL Engr. Dept. Instruc. 5215.1B	Technical Reports: Procedure for Preparation of
Cataloging Handbooks H4-1 and H4-2	Federal Supply Code for Manufacturers

Department of Defense

DD-441 (Attachment)	Industrial Security Manual for Safeguarding Classified Information
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(When requesting specifications, standards, drawings, and publications refer to both title and number. Copies of this specification and applicable specifications may be obtained upon application to the Commanding Officer, Naval Supply Depot, Philadelphia 20, Pennsylvania, Attention: Code DCI. Copies of DD-441 (Attachment) may be obtained upon application to the nearest Office of Inspector of Naval Material. Copies of NAEL Engineering Department Instruction 5215.1B may be obtained upon application to the Director, Naval Air Engineering Laboratory (SI), Attention: Technical Data Branch, Naval Air Material Center, Philadelphia 12, Pennsylvania. Cataloging Handbook H4-1 and H4-2 may be purchased from Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.)

## 3. REQUIREMENTS

3.1 Format

3.1.1 Manner of Preparation. - The manner of preparation of these technical manuals shall be in accordance with Specification MIL-H-5474, except as otherwise specified herein.

3.1.2 Form. - The technical manuals shall be prepared in the manner (manuscript copy with reproducible art, reproducible copy, negatives, etc.) as specified in the contract.

3.1.3 Text Content. - The technical manuals shall contain the essential instructions to properly operate, maintain, overhaul, and repair the complete item of equipment such as aircraft launching, recovery, and related equipment concerned. It shall include data necessary for trouble shooting, isolating trouble that may occur during operation, and any special procedures for operation of the main equipment and its components.

3.1.3.1 The information contained in these manuals is to be used by operating and maintenance personnel with limited technical education. Therefore, every effort shall be made to present the written material in a clear concise nontechnical language. Emphasis shall be placed upon the specific steps to be followed, results to be expected, and corrective measures required.

3.1.3.2 Special instructions shall also be included for inspection, operation, service, adjustment, maintenance, and emergency maintenance of accessories and items of special equipment installed with the main equipment.

3.1.3.3 The use of tables, charts, illustrations, and diagrams in lieu of text material is highly desirable and shall be employed whenever possible to portray operation, maintenance, and overhaul. Repetitious information shall be avoided except for clarity.

3.1.3.4 In the case of self-contained components such as electric motors, pumps, control panels, and similar items, which may be overhauled independent of the complete equipment, the technical manual shall include only the information needed to understand details of installation, removal, and relationship to the complete equipment (including final test of the equipment as a whole), provided that one of the following conditions applies:

- (a) The component is already covered in separate overhaul instructions issued by the Procuring Activity.
- (b) The component shall be covered by separate overhaul instructions prepared by the Contractor for issue by the Procuring Activity.

3.1.4 Security Classification. - The security classification of the technical manuals shall be specified by the Procuring Activity. Data shall not be included that is classified higher than the classification assigned the particular technical manual. Any data of a higher classification considered essential shall be brought to the attention of the Procuring Activity. (See DD-441 - Attachment.)

3.1.5 Abbreviations. - The use of abbreviations shall be held to an absolute minimum. Any abbreviations used shall be in accordance with Specification MIL-STD-12 and ANA Bulletin No. 261.

3.1.6 Flyleaf. - The flyleaf is a page that shall be inserted immediately following the "A", "B", "C", "D", etc. page. (See figure 1.) The purpose of the flyleaf shall be to contain a history and to list all information incorporated in the technical manual by means of Service bulletins, Service changes, design changes, and repair procedures. The word "Flyleaf" shall appear in the lower outside corner of the page. The basic flyleaf page shall not be numbered, but ensuing pages shall be numbered "Flyleaf-2", "Flyleaf-3", "Flyleaf-4", etc.

3.1.6.1 The flyleaf shall be permanent and remain as part of the manual history with Service change and Service bulletin numbers, design changes, and repair procedures. The number shall be recorded on the flyleaf simultaneously with the incorporation of the documents.

3.1.6.2 When revisions and modifications to the manual are made by Service Changes, Service Bulletins, Design Changes, and Repair Procedures, pages shall be revised with no change in context. A new service change and bulletin number will be added to the flyleaf to show the incorporation of such information.

3.1.6.3 With each subsequent change by means of Service Changes, Service Bulletins, Design Changes, and Repair Procedures, an asterisk (\*) shall be placed at the left of the newly added document identification number on the flyleaf to indicate the documents that have been incorporated into the manual in the current change. (See Specifications MIL-B-22907(Wep) and MIL-G-22908(Wep).)

3.1.7 Sections. - Section numbering shall be in accordance with Specification MIL-H-5474. Section numbering throughout this specification may be changed, as required, to conform with a revised table of contents and to avoid duplications of instructions in accordance with the additional requirements as specified in 3.3. When a section of a particular manual is not applicable, the section number and title, with a statement "Not applicable", shall be shown in the table of contents and at the top of the page of the next applicable section. Section titles shall be in accordance with the requirements listed in 3.3.

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**3.1.7.1 Section Introductory Paragraph.** - Each section of the technical manual shall contain an introductory paragraph describing the phase of instructions being covered in that particular section.

**3.1.8 Unified Coverage.** - Components or items of equipment shall be grouped in sequence for discussion within the manual under item headings according to their function, description, operation, and in relation to the system covered, even though the components or items themselves are hydraulic, electrical, pneumatic, electronic, or mechanical in nature.

**3.1.9 Drawing Graphic Symbols.** - Drawing graphic symbols for electric and electronic parts shall be in accordance with Standard MIL-STD-15. Drawing graphic symbols for mechanical parts shall be in accordance with Standard MIL-STD-17.

**3.1.10 Model or Type References (Designation).** - Text shall refer only to models or types of equipment covered by the publication. To facilitate later incorporation of additional models or types, reference to model or type designation shall be held to a minimum consistent with clarity. Any such reference made shall be expressed in definite terms such as model or type designation, serial number range, or similar means.

**3.1.11 Color Coding References.** - References to color coding of chassis wiring shall be in accordance with Standard MIL-STD-122.

**3.1.12 Nomenclature for Consumable Materials.** - Consumable materials used in maintaining and servicing equipment shall be consistent throughout the related publications. Proprietary names, proprietary specifications, or proprietary stock numbers shall not be used in the text. Such information shall be given in a "Consumable Materials List".

**3.1.13 Material References.** - All materials referred to such as lubricants, sealing materials, abrasives, etc., shall be identified by Federal stock or Government specification numbers, wherever applicable. When the contractor does not know the Federal stock or equivalent specification numbers, he shall request the information from the Procuring Activity, listing complete information concerning its composition, properties, characteristics, application, etc.

**3.1.13.1** Where design considerations require the use of a proprietary (non-Service) specification, a standard (Service) specification shall also be listed as an emergency alternate, if such an alternate specification exists.

**3.1.13.2** Identification of materials may be in the form of a table giving this information with such desirable information as points of application to the equipment.

**3.1.14 Reference Designation.** - Designations for electrical and electronic symbols shall be in accordance with Standard MIL-STD-16.

**3.1.15 Reference to Other Publications.** - References to other publications shall not be made except where it is absolutely necessary for complete coverage. However, such references shall be by publication numbers only and not by page or paragraph numbers.

**3.1.16 Illustrations.** - Illustrations (photographs, drawings, schematics, and diagrams) shall be prepared in accordance with Specification MIL-H-5474 and shall include only those which are essential for supplementing and clarifying instructions in the related text.

**3.1.16.1** An illustration of the complete equipment shall be shown on the page preceding the introduction of the manual. This illustration (or line drawing) shall be made from an angle that will convey a comprehensive impression of the complete equipment, in relationship to use and location.

3.1.16.2 Illustrations shall be used to show assembly or disassembly sequence, to illustrate adjustments, tolerances, etc., and shall be of the exploded type where it is necessary to identify detail parts which cannot be shown clearly by use of a single illustration. Line illustrations of exploded views are preferred and give the best results in showing intricate parts. However, if photographic or other methods are used, small intricate parts shall be clearly defined.

3.1.16.3 If the equipment is of such nature that it cannot be adequately illustrated by a single illustration, it may be presented as subassemblies in separate views. In such cases, a view showing the complete equipment exploded shall be shown first and parts serving to assemble the major assemblies shall be shown on the exploded view of the major assembly, whenever applicable.

3.1.16.4 Component parts of illustrations which relate to the text shall be identified by legends consisting of nomenclature keyed to the illustration by index numbers and, where applicable, section numbers.

3.1.16.5 Location. - All illustrations shall appear as close to the related text as possible.

3.1.16.6 In illustrated parts breakdown, exploded view illustrations shall be used to depict the breakdown of the equipment into sections, assemblies, subassemblies, and parts, as required. Requirements for these illustrations shall be in accordance with the latest issue of Specification MIL-M-8910.

3.1.17 Safety Precautions. - The technical manual shall list all safety precautions to be observed during operations. These shall include limited conditions of operation, warnings for safety of operation, necessary precautions to prevent faulty use of equipment, and precautions necessary to prevent injury to operating and overhaul personnel.

3.1.17.1 Notes, Cautions, and Warnings. - Notes, cautions, and warnings used within the text shall be prepared in accordance with the requirements of Specification MIL-H-5474.

3.1.18 Reference to Health Hazards, Precaution Data, and Protective Devices. - When hazardous chemicals, or adverse health factors in the environment or use of the equipment cannot be eliminated, appropriate precautionary requirements shall be included. Necessary personnel protective devices shall be indicated.

3.1.19 Extreme Weather Maintenance. - Instructions shall be included in applicable sections for operation and maintenance required under conditions of extreme cold, heat, dampness, and humidity.

3.1.20 Type of Instructions to Be Excluded. - Instructions of a general nature and instructions that are standard shop practice shall be excluded.

3.1.21 Diagrams. - Diagrams of fuel, oil, hydraulic, electrical, and other systems are essential and shall be included in the technical manual when required.

3.1.22 Tables. - Text material shall be presented in tabular form for ready reference purposes when listing weight, measures, condensed trouble shooting information, etc.

3.1.23 Negatives. - When negatives are required by contract, requirements shall be in accordance with Specification MIL-N-17792(Aer).

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3.1.24 Changes or Revisions. - Any changes or revisions authorized by applicable contracts shall be in accordance with Specifications MIL-H-5474 and MIL-H-7863(Wep).

3.2 General Arrangement. - The technical manual shall be arranged in the following main parts in the order indicated:

Title Page  
"A" Page  
Flyleaf  
Table of Contents  
List of Illustrations  
List of Tables  
Introduction  
Sections (See 3.3.)  
Glossary (if required)  
Alphabetical Index (if required)

3.2.1 Title and "A" Pages. - The title and "A" pages of the technical manual shall be prepared in accordance with Specification MIL-H-7863(Wep).

3.2.2 Flyleaf. - The flyleaf, when required (see 3.1.6), shall immediately follow the "A", "B", "C", etc. page and shall become a permanent page in the manual.

3.2.3 Table of Contents. - A table of contents for the entire manual shall precede the introduction, and shall list section numbers, paragraph numbers, section, and subsection title headings, part numbers, and the initial page numbers. A secondary breakdown under main headings may also be included. The table of contents shall be presented in single space and single column.

3.2.4 List of Illustrations. - The list of illustrations shall follow the table of contents and shall show the figure number, legend, and page number of each illustration in the manual. Listings shall be in consecutive order and shall be presented in single space and single column. The arrangement shall be in accordance with Specification MIL-H-5474.

3.2.5 List of Tables. - When there is more than one table in the manual, there shall be a list of tables. The list of tables shall follow the list of illustrations and the requirements shall be the same as for the list of illustrations.

3.2.6 Introduction. - (See 3.3.1.)

3.2.7 Sections. - (See 3.3.)

3.2.8 Glossary. - If required, technical terms, and/or abbreviations shall be shown in a glossary following the last section of the manual.

3.2.9 Alphabetical Index. - If required, an alphabetical index shall be included as the last item in the manual. It shall be entitled "ALPHABETICAL INDEX" and shall not be assigned a section number.

3.3. Detail Requirements. - The detail requirements for the type and arrangement of instructions will be specified by the Procuring Activity in accordance with the following chart:

TYPICAL SECTION ARRANGEMENT FOR TECHNICAL MANUALS

- (A) Technical Manual: Operation, Maintenance, and Overhaul Instructions with Illustrated Parts Breakdown (for Aircraft Launching and Recovery Equipment); Preparation of
- (B) Technical Manual: Operation Instructions (for Aircraft Launching and Recovery Equipment); Preparation of
- (C) Technical Manual: Maintenance and Overhaul Instructions (for Aircraft Launching and Recovery Equipment); Preparation of
- (D) Technical Manual: Illustrated Parts Breakdown (for Aircraft Launching and Recovery Equipment); Preparation of
- (E) Technical Manual: Operation, Maintenance, and Overhaul Instructions (for Aircraft Launching and Recovery Equipment); Preparation of
- (F) Technical Manual: Operation Instructions and Illustrated Parts Breakdown (for Aircraft Launching and Recovery Equipment); Preparation of
- (G) Technical Manual: Maintenance, Overhaul Instructions, and Illustrated Parts Breakdown (for Aircraft Launching and Recovery Equipment); Preparation of

SECTION TITLES	Page No.	A	B	C	D	E	F	G
Introduction	8	Introduc.						
Description	8	Section I	Section I			Section I	Section I	
Preparation for Use	8	" II	" II			" II	" II	
Operation Instructions	9	" III	" III			" III	" III	
Securing After Operations	10	" IV	" IV			" IV	" IV	
Safety Precautions	10	" V	" V			" V	" V	
Malfunctions	10	" VI	" VI			" VI	" VI	
Special Tools and Test Equipment	10	" VII		Section I		" VII		Section I
Maintenance Instructions	11	" VIII		" II		" VIII		" II
Maintenance Test Procedures	13	" IX		" III		" IX		" III
Special Tools and Test Equipment for Maintenance	13	" X		" IV		" X		" IV
Overhaul Instructions	14	" XI		" V		" XI		" V
Overhaul Test Procedures	16	" XII		" VI		" XII		" VI
Special Tools and Test Equipment for Overhaul	17	" XIII		" VII		" XIII		" VII
Illustrated Parts Breakdown - General	17	" XIV			Section I		" VII	" VIII
Group Assembly Parts List	19	" XV			" II		" VIII	" IX
Numerical Index	21	" XVI			" III		" IX	" X

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3.3.1 "INTRODUCTION". - The introduction shall be a brief explanation of the purpose of the technical manual including any relevant information that will be of assistance in using the manual. Identification of the equipment by Navy designation, manufacturer's type, or model designation shall be shown. Reference shall be made to the companion technical manuals in accordance with the requirements of this specification and the applicable contract.

3.3.1.1 Necessary paragraphs shall be included, indicating the responsibility of the operating command and personnel, for the correct use of information contained in the manual.

3.3.1.2 The introduction shall contain a general statement of the purpose and limitations of the equipment and how, in general, it accomplishes its mission. The scope of the manual, with a brief resume of the intent and purpose of each section, shall list any other publications that may be referred to for additional information.

3.3.1.3 To familiarize operating and maintenance personnel with the characteristics and physical make-up of the equipment, a table of leading particulars shall be included to provide the following type of information: minimum, maximum, and mean operating voltage, current and temperature capacity, length of stroke, operating pressures, duty cycle, weight, dimensions, etc.

3.3.1.4 The introduction shall be preceded by an illustration (or line drawing) which has been made from the point and angle that will best portray the equipment. (See 3.1.16.1.)

3.3.2 "DESCRIPTION" Section. -

3.3.2.1 General. - A description of the general physical and performance characteristics for which the equipment has been designed shall be included. The description shall be brief but in sufficient detail to provide equipment operators and maintenance personnel with a general understanding of the equipment from the point of view of operation.

3.3.2.2 Detail. - The detail description illustrated throughout shall consist of brief, readily understood descriptions of the components, component assemblies, specialized equipment, and accessories which comprise the complete equipment, presented in a manner indicating their relationship and function.

3.3.2.3 Illustrations (see 3.1.16) shall be referred to in the descriptive text and shall be in sufficient detail to enable personnel to understand the function and details of each part of the equipment.

3.3.2.4 The description of component systems (bridle arrester, etc.) shall be described in two phases. The first phase shall describe components which are located above deck level, and the second phase shall describe those components which are below deck level.

3.3.3 "PREPARATION FOR USE" Section. - This section shall provide step-by-step procedure instructions with illustrations, when applicable, for all adjustments, checks, preparations, precautions to be observed, and work necessary to prepare the equipment prior to the start of operations. This shall include any special procedures which must be followed in unpacking, removing protective coatings, assembly, and installation of auxiliary equipment, preoperational, breaking-in instructions, etc. These items shall be described in detail as component assemblies or systems.

**3.3.3.1 Preoperational Preparation.** - Preoperational preparation, prior to the start of operations of equipment shall be as follows:

- (a) Identification and status of valves and gauges.
- (b) Sequence of test procedures.
- (c) Sequence of test operations.
- (d) Miscellaneous accessory equipment.
- (e) Daily check-off list.
- (f) Preoperational check-off list. (See figure 10.)
- (g) Periodic inspections, various types of equipment.

**3.3.3.2 Detail diagrams, complete instructions in step-by-step procedures for the preparation, operation of equipment, and of all applicable control panels shall be included in the preoperational procedure.**

**3.3.4 "OPERATION INSTRUCTION" Section.** - This section shall contain complete instructions and step-by-step procedures required to successfully operate and adjust the equipment through its intended functions. Subjects to be treated shall include the following, with additions or deletions as necessary:

- (a) Preliminary adjustment, alignment, positioning, and warm-up procedures.
- (b) Means of connection between the equipment and the item being tested, including explanatory illustrations of the test equipment and of the item (accessory).
- (c) Purpose and use of all operating controls, auxiliary equipment, or attachments furnished with the equipment, with appropriate views consisting of photographs or line drawings. (See figures 2 and 3.)
- (d) Purpose, use, and interpretation of readings on all instruments.
- (e) How to prepare or start the equipment for operation; describe in detail the necessary precautions to be observed.
- (f) No-load test launching procedures.
- (g) Instructions for daylight or night operation.
- (h) Operating procedures in the event of malfunctions.
- (i) Safety precautions to be observed when operating the equipment.
- (j) Daily check-off lists for each station prior to the start of first launching of each operation, or first operation of the equipment. (See figure 10.)

**3.3.4.1 Preliminary Functional tests.** - Preliminary functional tests by all operating personnel, which shall include instructions on complete cycle operation of the control system, functions of the components, a list of safety precaution procedures, and emergency procedures not covered elsewhere in the manual. This information may be presented in tabular form.

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3.3.5 **"SECURING AFTER OPERATIONS" Section.** - This section shall include instructions necessary for securing the equipment after completion of operations, in preparation for inactive status. The instructions presented in step-by-step procedure shall designate the differences, dependant upon the expected length of the inoperative period.

3.3.5.1 Securing procedures shall be described under the following conditions of readiness:

- (a) "READY" - that condition where use is imminent.
- (b) "STANDBY" - that condition where use is probable within three hours.
- (c) "SECURE" - that condition where use is not probable within three hours.
- (d) "INACTIVE" - that condition where ship is temporarily not operational.

3.3.5.2 Preventive maintenance shall be accomplished at this time with proper lubrication recommendations listed in a chart in tabular form. (See figure 4.)

3.3.6 **"SAFETY PRECAUTIONS" Section.** - This section shall contain a list of precautions to be taken which effect the safety of all personnel involved in the overall operations (this includes pilots of aircraft and deck personnel concerned with the operation of the equipment). Safety precautions recommended elsewhere in the manual shall be repeated in this section for emphasis.

3.3.7 **"MALFUNCTIONS" Section.** - This section shall contain a description of malfunctions that may occur during a normal sequence of operations, which could render the equipment inoperative; and shall include necessary corrective measures, a guide to assist personnel in analyzing the malfunctions that may occur, and a list of the causes of the malfunctions. The guide shall also include recommendations for preventive or corrective measures. This information shall be presented in a clear, concise manner so that responsible personnel may take immediate action in making corrections without undue loss of time. (See figure 9.)

3.3.7.1 Malfunctions, their causes, and corrections may be presented in tabular form in the following suggested columns:

TABLE (number)

## MALFUNCTION

Malfunction	Probable Cause	Correction
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3.3.8 **"SPECIAL TOOLS AND TEST EQUIPMENT" Section.** - This section shall contain a list presented in tabular form of all special tools and test equipment recommended by the contractor for use in performing work described in the manual. The column arrangement shall be as follows:

TABLE (number)

## SPECIAL TOOLS AND TEST EQUIPMENT

Item No.	Nomenclature	NAEL Part No.	Figure and Index No.	Application
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3.3.8.1 Special tools and test equipment shall be assigned item numbers, beginning with number one, for use in referencing throughout the manual. Nomenclature shall be identical with that on engineering drawings with the addition of brief terms to show use when such information is lacking or not obvious.

3.3.8.2 Illustrations of tools and equipment shall be provided when the items cannot be clearly identified in the illustrations showing operational procedures.

3.3.8.3 Items of test equipment, to the greatest extent practicable, shall be chosen from the list of standard equipment. All other items shall be held to a minimum as necessary to maintain the prime equipment.

3.3.8.4 Application shall specify the operation to be performed; whether the tool or test equipment is recommended for assembly, disassembly, or testing; and nomenclature, part number, and/or index number of the applicable part.

3.3.8.5 If there are no special tools or test equipment recommended, this section shall contain a statement to that effect.

3.3.9 "MAINTENANCE INSTRUCTION" Section. - This section shall include complete instructions for maintenance of the equipment in the following phases:

- (a) General maintenance.
- (b) Preventive maintenance.
- (c) Corrective maintenance.

3.3.9.1 General. - This section shall contain essential information and instructions for maintenance that can be performed by the personnel that operate and maintain the equipment; Maintenance shall be limited to service, replacement, adjustment, and minor repair. Maintenance, including minor repair, shall be confined to work which may be accomplished without disassembly, or partial disassembly of the equipment, and which does not require the use of calibration equipment and specialized shop testing.

3.3.9.1.1 Maintenance instructions for the equipment shall be given on the basis of the equipment as a whole. For more complex equipment, instructions shall be presented by main divisions, systems, and components, as applicable. Thus, when the system consists of multiple components, the text shall discuss separately the overall system and each component that is part of the system. For example:

- (a) Complete system (equipment).
- (b) First component.
- (c) Second component, etc.

3.3.9.2 Maintenance Procedures. - Maintenance instructions for the complete equipment, a major division, a system, or a component shall be presented in the order and to the extent indicated in the following subparagraphs. Headings that are not applicable shall be omitted and additional items added, as appropriate, to provide all information for the specific equipment. Procedures for maintenance shall be as follows:

- (a) Trouble shooting.
- (b) Removal of, or detaching a component.
- (c) Cleaning and inspection.
- (d) Minor repair or part replacement.
- (e) Reinstallation.
- (f) Adjustment.
- (g) Periodic inspection.
- (h) Lubrication.

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**3.3.9.2.1 Trouble Shooting.** - A method of presentation shall be used to describe the deficiencies, failures, or faulty operation which may occur; the probable causes of each item, and an outline of a definite procedure of correction to be employed to remove the cause of the trouble. (See figure 5.) A columnar or tabular arrangement of this information is preferred and shall be presented in the order of likelihood of occurrence in the following format:

TABLE (number)

TROUBLE SHOOTING CHART

Reference to Figure Number	Part	Trouble	Probable Cause	Correction
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Those of infrequent and complex nature shall also be shown. When corrective measures involve complex procedures and are too long to be stated briefly in the column, appropriate reference shall be made to other paragraphs such as "minor repair" or "adjustment" instead of placing the actual instructions in the "correction" column.

**3.3.9.2.2 To Remove or Detach a Component.** - When special instructions are necessary or special precautions should be observed, give a sequence of step-by-step procedures required to detach or remove a component or unit.

**3.3.9.2.3 Minor Repair, Parts Replacement, Cleaning, and Inspection.** - Instructions shall be included for minor repair, parts replacement, cleaning, and inspection, which may be accomplished by organizational activities, and shall consist of the following:

- (a) Removal of equipment and parts necessary to gain access to the unit.
- (b) Draining.
- (c) Cleaning methods to be used specifying Service approved compounds.
- (d) Checking parts for damage or wear.
- (e) Minor repair.
- (f) External parts replacement.
- (g) Any lubrication or adjustments necessary.
- (h) Reinstallation of external parts originally removed to gain access to the unit, and the precautions to be observed in this procedure.

**3.3.9.2.4 Installation.** - Unless the installation is the reverse of removal, include step-by-step procedures required to install a unit or component when special instructions are necessary, or when special precautions are to be observed. If this information has been covered elsewhere in the manual, reference may be made to same.

**3.3.9.2.5 Adjustment.** - Instructions shall be listed for step-by-step procedures required to regulate and adjust the equipment, system, or component to its proper operating condition including applicable tolerances. If necessary, refer to illustrations for points of adjustment.

**3.3.9.2.6 Periodic Inspection.** - Applicable instructions shall be listed for periodic maintenance inspections including visual, mechanical, and operational (see 6.2.6). Schedules and procedures required for regular periodic inspections of the equipment, including required

preventive maintenance procedures for standardized components, such as lubrication, adjustments, tightening, etc., shall also be given. (See figure 6.) This list shall be presented in tabular form and shall be itemized in columns as follows:

TABLE (number)

PERIODIC INSPECTION CHARTS			
Reference Figure Number	Part	Nature of Inspection	*Inspection Time
* (A key may be employed in the "Inspection Time" column.)			

3.3.9.2.7 **Lubrication.** - If periodic lubrication of the equipment is required, the contractor shall list in tabular form the parts of equipment which require lubrication, the lubricants to be used, and time periods when they should be applied; shall include explanation of the use of charts, and special instructions to be observed. (See figure 4.) Lubricants specified shall be approved Government specification materials. If periodic lubrication is not necessary, it shall be so stated. The information may be shown in columns as follows:

TABLE (number)

LUBRICATION CHART AND SCHEDULE				
Figure and Index Number	Part	*Lubricant	Fitting	*Period
* (A key may be employed for these columns.)				

3.3.10 **"MAINTENANCE TEST PROCEDURE" Section.** - To assure that equipment is in satisfactory condition, this section shall contain information for testing the equipment as installed, to isolate malfunction, and to bench test equipment prior to reinstallation.

3.3.10.1 Test procedures indicated in this section shall be limited to those tests necessary for maintenance performed by operating organizations with as much of the test equipment available.

3.3.10.2 Test values and accepted tolerances shall be given for each test, as applicable.

3.3.11 **"SPECIAL TOOLS AND TEST EQUIPMENT FOR MAINTENANCE" Section.** - This section shall contain a tabulated list of special tools and test equipment for maintenance. (See figure 7.) Only complex tools and test equipment shall be illustrated. Connections for test purposes shall be listed in appropriate sections to clarify proper test procedures.

3.3.11.1 Instructions for the proper care and use of tools and test equipment shall be included.

3.3.11.2 If special tools and test equipment for maintenance are not required the section number shall be shown, with the statement "Not applicable".

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3.3.11.3 The required special tools and test equipment for maintenance shall be listed in the following format:

TABLE (number)

SPECIAL TOOLS AND TEST EQUIPMENT FOR MAINTENANCE			
Figure and Index Number	Part Number	Nomenclature	Application

3.3.12 "OVERHAUL INSTRUCTIONS" Section. - This section of the manual shall contain instructions essential for the periodic overhaul of the equipment and shall include procedures for renovation, careful examination of, functioning of all parts, inspection for damage due to wear and corrosion, and component replacement as required. The overhaul procedure shall incorporate all equipment changes, and any special instructions on new equipment installed shall be submitted at that time. Overhaul of equipment and components shall be accomplished in the following manner:

- (a) Preoverhaul conference.
- (b) Preoverhaul inspection and test of equipment.
- (c) General overhaul.
- (d) Component overhaul.
- (e) Post overhaul inspection, test, and adjustment.
- (f) Shipboard field tests.

3.3.12.1 Glossary of Terms. - Definitions of miscellaneous terms describing kinds of damage for which parts should be inspected during inspection, trouble shooting, and overhaul shall be listed in this section.

3.3.12.2 Overhaul Procedure. - The step-by-step procedure for overhaul shall be as follows:

- (a) Frequency of overhaul.
- (b) Preoverhaul inspection.
- (c) Fluid system drainage.
- (d) Disassembly.
- (e) Cleaning.
- (f) Inspection.
- (g) Testing.
- (h) Repair or replacement.
- (i) Lubrication.
- (j) Reassembly or reinstallation.
- (k) Miscellaneous.
- (l) Overhaul reports.

3.3.12.3 Frequency of Overhaul. - This section shall contain the time designation and frequency of overhaul to be accomplished on the equipment.

3.3.12.4 Preoverhaul Inspection. - A preoverhaul inspection shall be accomplished prior to the disassembly of the equipment. (See figure 11.)

3.3.12.5 Fluid System. - Special instructions shall be presented for draining the fluids from the system prior to disassembly.

3.3.12.6 Disassembly. - During overhaul, exploded view illustrations shall provide the basic information required to disassemble the equipment. An outline in brief form of instructions shall be included.

3.3.12.6.1 Any test required shall provide special instructions on procedures that are not apparent in the exploded view. Reference shall be made to the exploded view illustration stating that disassembly of the equipment follows (or follows except as noted) the sequence of the assigned key index numbers.

3.3.12.7 Cleaning. - Describe the specific cleaning method recommended for the particular equipment, including numbers of Government specifications for cleaning agents required, and precautions to be observed.

3.3.12.8 Inspection. - Instructions shall be given for the inspection of damage and wear of the disassembled equipments. This information shall be in tabular or chart form, wherever practicable, with emphasis upon the allowable Service limits, wear, backlash, end play, balance, length and depth of scoring, etc. These tolerances are not to be confused with manufacturing tolerances; they are tolerances that may or may not exceed manufacturing tolerances, yet will not impair performance. This information shall be sufficiently comprehensive and adequate to serve as standards by which experienced technicians may determine when parts may continue in use or be replaced. The following format is suggested for an inspection chart (see figure 11):

TABLE (number)

INSPECTION CHART

Reference Figure Number	Nomenclature of Part	Inspect for	Action to be Taken
----------------------------	-------------------------	-------------	-----------------------

3.3.12.9 Testing. - Instructions for testing component parts while disassembled shall be included. This requirement should not be confused with 3.3.13 wherein test procedures for the equipment as an entity are provided.

3.3.12.10 Repair or Replacement. - Instructions shall be furnished for the repair or replacement of worn or damaged parts to bring the equipment up to standard.

3.3.12.11 Lubrication During Overhaul. - The requirements for lubrication during overhaul shall be covered in this section in charts or in tabular form. (See figure 4.) The text referring to the charts shall be brief and include any necessary explanation for use of the charts and any special instructions to be observed.

3.3.12.11.1 Reference shall be made to figures which identify applicable lubrication areas and shall indicate type and specification number of lubricant to be used.

3.3.12.11.2 The format for the lubrication chart used in this section shall be as follows:

TABLE (number)

LUBRICATION CHART

Figure and Index Number	Part	*Lubricant	Fitting	*Period
* (A key may be employed for these columns.)				

3.3.12.12 Reassembly or Reinstallation Instructions. - Text describing reassembly or reinstallation procedures shall be presented in brief practicable form, and shall supplement the maximum use of exploded view illustrations. This text shall be used mainly as a check list of important items over and above those obvious in the exploded views. If reassembly is essentially the reverse of disassembly, a statement to that effect shall be made.

3.3.12.13 Miscellaneous. - Any miscellaneous items of overhaul required may be covered in this section.

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3.3.12.14 Overhaul Report. - At the completion of overhaul of the equipment a report shall be made to the Bureau of Naval Weapons; with information copies forwarded to the Director, Naval Air Engineering Laboratory (SI), Naval Air Material Center, Philadelphia 12, Pennsylvania; the Commander of the Carrier Division to which the ship is attached; and to the Commanding Officer of the particular carrier concerned. The report shall be in accordance with the requirements of the NAEL Engineering Department Instruction 5215.1B and shall contain the following:

- (a) A full report of all work done during overhaul.
- (b) A complete post overhaul check-off list.
- (c) A copy of the certification report.
- (d) Comments and recommendations.
- (e) Photographs illustrating particular recommendations.

3.3.12.15 Table of Limits. - Table of limits and limits illustrations to show required clearances, backlash limits, torque values, and various classes of tolerances shall be placed at the end of this section. (See figure 8.)

3.3.12.15.1 Limits data shall indicate maximum and minimum limits allowable for parts to be continued in service, rather than original manufactured tolerances. Text material shall not mention actual limit dimensions, but shall refer to the appropriate reference number in the table of limits, such as "See table 2-1, reference 25".

3.3.12.15.2 The table of limits shall be used in connection with inspection, repair and reassembly of the various components during overhaul. They may also be used to determine whether worn parts are dimensionally serviceable and to determine the extent of wear by comparison with original dimensions. The following format shall be used for the table of limits:

TABLE (number)

(type of) TABLE OF LIMITS

Reference Figure Number	Nomenclature of Part	Design Dimensions		Beyond this Dimension, Repair or Replace, As Indicated
		Max.	Min.	

3.3.13 "OVERHAUL TEST PROCEDURES" Section. - This section shall contain essential instructions for testing the complete equipment after reassembly.

3.3.13.1 Instructions shall include pretest checks and procedures covering the electrical system, use of fluids other than customary propellants for pressure and leakage tests, recommended safety precautions, particularly with reference to proximity and protection of personnel under fleet test conditions.

3.3.13.2 The instructions for test after overhaul shall include specific information relative to test data required and a recommended test schedule.

3.3.13.3 Recommendations shall be given relative to an appropriate test setup for accomplishing the required tests, including listing in tabular form specific equipment items required, and characteristics of the equipment (make, model, type, range, capacity tolerance, etc.).

3.3.13.4 Test values and accepted tolerances shall be given for each test, as applicable. Remedial action shall also be described for equipment failures in meeting the necessary tests. This information may be presented in the form of a trouble shooting chart, showing trouble, probable causes, and correction procedures (see 3.3.9.2.1). As far as possible the correction procedures shall specify adjustments which may be made without disassembly.

3.3.13.5 Instructions covering a recommended inspection of the equipment shall be made following the completion of the post overhaul test, and shall be included in this section.

3.3.13.6 This section shall also include procedures for preparing the equipment for preservation and storage following the inspection after test.

3.3.14 "SPECIAL TOOLS AND TEST EQUIPMENT FOR OVERHAUL" Section. - The special tools and test equipment for overhaul required to perform the overhaul test and calibration procedures described in 3.3.12 and 3.3.13 shall be listed in this section. Only the complex tools and test equipment shall be illustrated and connections for test purposes shall be shown in appropriate sections to avoid misunderstanding of proper test procedures. (See figure 7.)

3.3.14.1 Instructions for the proper care and use of tools and test equipment shall be included.

3.3.14.2 If special tools and test equipment for overhaul are not required the section number shall be shown with a statement "Not applicable"

3.3.14.3 The format of the list of required special tools and test equipment for overhaul shall be as follows:

TABLE (number)

SPECIAL TOOLS AND TEST EQUIPMENT FOR OVERHAUL

Figure and Index Number	Part Number	Nomenclature	Application
-------------------------	-------------	--------------	-------------

3.4 Illustrated Parts Breakdown. -

3.4.1 General. - The illustrated parts breakdown technical manual shall include a group assembly parts list and a numerical index prepared in accordance with the latest issue of Specification MIL-M-8910, with sections as specified below.

3.4.1.1 The illustrated parts breakdown manual shall cover a complete breakdown of all parts of the equipment, including a group assembly parts list of all installations, assemblies, and subassemblies that can be disassembled, reassembled, or replaced. Listing of parts shall be in single column form.

3.4.1.2 This manual shall begin with the general arrangement number of the equipment and list the breakdown order of all installations, assemblies, subassemblies, and detail parts which can be disassembled, reassembled, or replaced.

3.4.1.3 The parts, assemblies, or units required for the modification, alteration, adoption, etc., of standard equipment or components covered by the manual, shall be listed and illustrated together with such other parts as are necessary to show relationship.

3.4.1.4 Items which lose their identity by being welded or fabricated into a permanent unit shall not be broken down into details unless specifically requested by the Procuring Activity, but shall be listed as end items capable of separate supply and replacement.

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3.4.1.5 Commercial (vendor's) items shall be listed. However, breakdowns of these items shall be shown only by vendor's part number and nomenclature or as designated by the Procuring Activity.

3.4.2 Arrangement of Illustrated Parts Breakdown Manual. - The illustrated parts breakdown technical manual (both combined and single), shall be prepared in the following format:

	Table of Contents
	List of Illustrations
Section I	Introduction and Description
Section II	Group Assembly Parts List
Section III	Numerical Index

3.4.2.1 Table of Contents - Illustrated Parts Breakdown. - The table of contents for the illustrated parts breakdown shall follow the "A" page or flyleaf page and be presented in a single column. (This requirement is applicable in both the combined and single manuals.) The number and title of each section shall be shown with identifying page numbers. Under group assembly parts list, the part number and initial page number of all assemblies and subassemblies shall be arranged by name in alphabetical breakdown. The following format shall be used for the table of contents:

TABLE OF CONTENTS			
Section			Page
I	INTRODUCTION AND DESCRIPTION		1
II	GROUP ASSEMBLY PARTS LIST		
	<u>Name</u>	<u>Part Number</u>	
	Accumulator Assembly	24-60528-2	125
	Anchor and Guide Installation	11-60491-1	41
	Base Assembly	20-60401-1	151
	Box Assembly, Relay	63-60049-1	197
	Box Assembly, Relay	63-60049-1	201

3.4.2.2 List of Illustrations (Combined Manual). - For the combined manual, the list of illustrations shall indicate the section number, figure number, the legend on each illustration, and the page number. The following format shall be used:

LIST OF ILLUSTRATIONS (Combined Manual)					
Section & Figure Number	Title	Page	Section & Figure Number	Title	Page
7-1	General Arrangement.....	240	8-1	Deck Arrangement.....	285
7-2	Arresting Engine Assembly..	241	8-2	Dual Pendant Assembly.....	287
7-3	Arresting Engine Assembly..	242	8-3	Release Assembly.....	288
7-4	Arresting Engine with Cooler System.....	243			

3.4.2.2.1 List of Illustrations (Single Manual). - For the single manual the list of illustrations shall indicate the figure number, legend, and page number. The following format shall be used:

LIST OF ILLUSTRATIONS (Single Manual)					
Figure Number	Title	Page	Figure Number	Title	Page
1	Arresting Engine Assembly.....	9	9	Engine Assembly.....	88
2	Arresting Engines.....	10	10	Crosshead, Fixed Lubepoints...	89
3	Arresting Engine Cooler System.....	11	11	Constant Runout Control Valve.....	90

3.4.3 "INTRODUCTION AND DESCRIPTION" Section. - The introduction to the illustrated parts breakdown manual shall contain information pertaining to the identification, purpose, and shall assist in the understanding and use of the manual. Explanations of columns, illustrations, groupings, and other information pertinent to the group assembly parts list and numerical index shall be included with a short description of each item. An exploded view of the complete equipment to serve as an index to the group assembly parts list shall be shown following the list of illustrations.

3.4.4 "GROUP ASSEMBLY PARTS LIST" Section. - This section shall contain a complete listing and description of the equipment arranged in assembly breakdown order, and shall be in accordance with the latest issue of Specification MIL-M-8910. The illustration for each breakdown shall be placed in a facing position or as near the breakdown as possible. Each assembly shall be broken down under its listing and the components shall be properly indented to show relationship. Attaching parts shall not occur in the breakdown as separately identified parts or groups. Parts in every detail are directly applicable to the next higher assembly and are called out in the breakdown of each such assembly.

3.4.4.1 Group Assembly Parts List (Combined Manual). - For the combined manual including a group assembly parts list, the format shall be as follows:

GROUP ASSEMBLY PARTS LIST (Combined Manual)				
Section Figure and Index Number	Part Number	Description	Units Per Assy	Usable on Code
		0 1 2 3 4 5 6		
9-1-	609421-1	. Crosshead Assembly		
-1	301021-1	.. Sheave		
	301021-2	... Bearing		
	301021-3	... Ring, Retainer		
-2	301022-1	.. Shaft		
-3	301022-2	.. Nut		

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3.4.4.2 Group Assembly Parts List (Single Manual). - For the single manual the format for the group assembly parts list shall be as follows:

GROUP ASSEMBLY PARTS LIST					(Single Column)				
Figure and Index Number	Part Number	Description						Units Per Assy	Usable on Code
		0	1	2	3	4	5		
1-	20-607111-1	Engine Installation							A
	20-607111-2	Engine Installation							B
	20-607111-3	Engine Installation							C
-1	609421-1	. Crosshead Assembly						Ref	AB
	609421-2	. Crosshead Assembly							C
-2	607524-1	. Track Assembly						Ref	AB
	607524-2	. Track Assembly							C
-3	502114-1	. Cushion Assembly						Ref	ABC

3.4.4.3 "Figure and Index Number" Column. - Figure and index numbers shall contain the number of the illustration in which the assembly or part is shown. Requirements shall be in accordance with the latest issue of Specification MIL-M-8910. In a combined manual, the "section" shall be added to the heading and the section number shown with the figure and index numbers. When an assembly has not been assigned an index number, only the figure number (and section number when applicable) shall appear in this column.

3.4.4.4 "Part Number" Column. - This column shall contain the manufacturer's drawing numbers, including dash numbers, assigned to each part in accordance with contract drawing specifications.

3.4.4.4.1 Identifying part numbers shall be prefixed with manufacturer's code or name, for all parts not identified with a Naval Air Engineering Laboratory number as indicated on the contract drawings.

3.4.4.5 "Description and Name of Parts" Column. - Names of parts listed in columns "0" to "6" shall be arranged as follows:

3.4.4.5.1 A single identifying noun (or item name) description, followed by the words "General Arrangement", "Assembly", "System", "Installation", etc., where applicable, plus modifiers limited normally to single line presentation shall be used for all parts.

3.4.4.5.2 Column "0". - The general arrangement of each applicable model shall be listed in column "0".

3.4.4.5.3 Column "1". - All parts (main assemblies, installations, systems, etc.) indicated on the general arrangement shall be listed in column "1".

3.4.4.5.4 Column "2". - All parts (subassemblies and detail) assembled into the items listed in column "1" shall be listed in column "2".

3.4.4.5.5 Columns "3" to "6" Inclusive. - These columns shall be used as required to complete the equipment breakdown. Additional columns may be added if necessary.

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3.4.4.6 "Units per Assembly" Column. - The "Units per Assembly" column shall list the requirements of each individual part in the previously listed assembly. Items listed for reference purposes shall be indicated by the term "Ref." inserted in the column.

3.4.4.7 "Usable on Code" Column. - This column shall be used to indicate part variations within the general arrangements. The variations are indicated by a letter symbol or combination of symbols.

3.4.4.8 Vendor's Codes. - A list of names and addresses of all manufacturers supplying items or articles not carried under contractor's parts numbers, together with their code symbols, shall be shown. The list shall be in tabular form and shall be prepared code-to-name in numerical sequence, and shall be in accordance with Cataloging Handbook H4-1 and H4-2, Federal Supply Code for Manufacturers.

3.4.5 "NUMERICAL INDEX" Section. - The numerical index section shall consist of an alpha-numerical listing and revision of drawings used in breakdown prepared in tabular form for quick reference of all items in the group assembly parts list. The format for the combined and single manuals shall be as follows:

NUMERICAL INDEX				(Combined Manual)			
PART NUMBER	DRAWING REVISION	SECTION FIGURE AND INDEX NUMBER	QTY	PART NUMBER	DRAWING REVISION	SECTION FIGURE AND INDEX NUMBER	QTY
AN636-1016	2	7-15-10	6	10-61316-1	2	3-1-15	
AN636-1016	2	7-8-6	8	10-50221-1	4	3-3-20	
AN636-1016	2	7-1-2	44	60-60693-1	4	6-5-12	
A902101-1	A	7-15-11		9-S-3848-L		7-10-2	
		7-15-12					
D606191-2		8-5-1					

NUMERICAL INDEX				(Single Manual)			
PART NUMBER	DRAWING REVISION	FIGURE AND INDEX NUMBER	QTY	PART NUMBER	DRAWING REVISION	FIGURE AND INDEX NUMBER	QTY
AN636-1016	2	15-10	6	10-61316-1	2	15-4	
AN636-1016	2	8-6	8	10-50221-1	4	3-6	
AN636-1016	2	1-2	44	60-60693-1	4	1-10	
A902101-1	A	9-6		9-S-3848-L		12-9	
		11-9					
D606191-2	6	15-14					

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3.4.5.1 "Part Number" Column. - The part number column shall contain all part numbers that appear in the assembly parts breakdown section and shall be arranged alpha-numerically. The order of presentation shall be as follows:

- |   |   |
|---|---|
| <p>a. Letters A through Z</p> <p>Example: AN560-816<br/>A301021-1<br/>B87775-14</p> | <p>b. Numerals 0 through 9</p> <p>Example: 00-42916-1<br/>20-41600-1<br/>606225-1</p> |
|---|---|

The order of preference for the second and succeeding positions to the right is as follows:

- |   |  |
|---|--|
| <p>a. Space (blank column)</p> <p>Example: *6 62918-2<br/>6-65814-20<br/>9-21383-2<br/>21-28972-1</p> | <p>c. Letters A through Z</p> <p>Example: 891501-1<br/>891502-1R<br/>891502-1R</p> |
|---|--|

\*This type number is generally used by vendors.

- |  |  |
|--|--|
| <p>b. Dash (-)</p> <p>Example: 31-61460-1<br/>31-61570-1<br/>312014-1<br/>313292-1</p> | <p>d. Numerical 0 through 9</p> <p>Example: 9-S-4838-1<br/>90056-1</p> |
|--|--|

(NOTE: Alphabetical 0's are listed as numerical zeros.)

3.4.5.2 "Drawing Revision" Column. - This column shall list by number or letter, changes to drawings which have been revised to improve the configuration of equipment and reflect any drawing changes incorporated into the manual.

3.4.5.3 "Section, Figure, and Index" Column. - This column shall contain the section, figure, and index numbers of the illustration or illustrations on which the part listed may be found. When an assembly has not been assigned an index number, only the figure number shall appear. In the single manual, the section number shall not be listed.

3.4.5.4 "Quantity" Column. - This column shall list the number of pieces required to make the next higher assembly.

3.4.5.5 Identifying Parts. - If a part number is known and the illustration is needed for identification or placement of the part, the part number shall appear in the numerical index together with the figure, index, and page number of the illustration on which it appears. If this figure shows the part in a section or system of the unit other than the one desired, refer to the other figures listed in the numerical index. Only those parts with a figure and index number shall be shown.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to the prescribed requirements. Government inspection and approval of any portion of the material during the course of preparation shall not be construed as acceptance of the completed product.

4.2 Material furnished in accordance with this specification shall be inspected by the supplier for conformance to the applicable requirements of the governing documents.

4.2.1 Information and instructions, both textual and illustrative, originated and furnished by the supplier shall be reviewed and approved by the supplier for technical and engineering accuracy and adequacy, and for conformance to the requirements of this specification. Evidence of such review and approval shall be made available to the Government inspector, upon request, at the time the material furnished hereunder is presented for Government acceptance.

4.3 Material furnished in accordance with this specification shall be subject to inspection, verification, and approval or disapproval by the Government prior to acceptance.

## 5. PREPARATION FOR DELIVERY

5.1 Proof copies of reproducible copy shall be delivered concurrent with reproducible copy and/or negatives.

5.1.1 Prior to delivery, reproducible copy shall be collated numerically with superseded material eliminated. Reproducible material shall be marked, packed, and delivered in accordance with the requirements of Specification MIL-N-5474.

5.1.2 All reproducible copy and lithographic negatives used in printing shall become and remain the property of the United States Government and shall be delivered in accordance with the terms of the contract.

5.1.3 Prior to delivery, lithographic negatives shall be removed from flats and collated numerically with superseded material eliminated. All negatives shall be delivered flat and packed in accordance with Specification MIL-N-17792(Aer). Negatives delivered shall be in top quality condition; damaged negatives will be rejected.

## 6. NOTES

6.1 Intended Use. - Technical manuals prepared to this specification are intended to provide all necessary instructions and procedures necessary for use in operation, maintenance, and overhaul of the equipment concerned.

6.1.1 The illustrated parts breakdown technical manual covered by this specification is intended for use by the equipment manufacturers and operating activities as a guide for requisitioning, storing, issuing parts, illustrating assembly and disassembly relationship of the equipment involved.

6.2 Definitions. - The following definitions apply to the terms as they are used in this specification:

6.2.1 Calibration. - Calibration is defined as a check of the reliability of the indications or readings provided by the tools and test equipment, and any work necessary to restore the original accuracy of such indications or readings.

6.2.2 Change. - A change is any alteration in a portion of a manual already in existence, which is not large enough to require issuance of a revision. (Formerly BuAer revision.)

6.2.3 Exploded View. - A drawing or picture of any article or piece of equipment in which the component parts are separated but so arranged as to show their relationship to the whole.

6.2.4 Mechanical Inspection. - Mechanical inspection consists of pulling, prying or shaking of parts; exercising of the equipment; manipulating the controls. It is a check for looseness, excessive play, improper operation of hidden parts, lack of lubrication, or any abnormal resistance to motion. This inspection is also performed while the equipment is at rest.

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- 6.2.5 Operational Inspection. - An operational inspection consists of running all operable systems through a full cycle of operation to check smoothness of operation, proper timing, and synchronism.
- 6.2.6 Periodic Inspection. - An inspection repeated either at regular intervals of calendar time, or in reference to certain equipment, after a given number of hours of operation.
- 6.2.7 Preventive Maintenance. - The day-to-day maintenance that is performed to keep equipment in good working order and prevent breakdown due to neglect.
- 6.2.8 Revisions. - A revision is a second or subsequent edition of a manual which supersedes the preceding edition. (Formerly a BuAer reissue.)
- 6.2.9 Safety Precautions. - Measures to insure the safety of equipment, aircraft, and personnel.
- 6.2.10 Special Test Equipment. - Special test equipment is defined as those items of test equipment not specifically designated as preferred standard by the Bureau of Naval Weapons. All other items shall be listed as "Special" and shall be held to a minimum as necessary to maintain prime equipment. Special test equipment may include commercial as well as military items.
- 6.2.11 Special Tools. - Special tools are defined as those tools not commonly available and include test equipment, support equipment, jigs, fixtures, handtools, and any other tools required for maintenance, assembly, disassembly, overhaul, repair, and test of the end item.
- 6.2.12 Table of Limits. - A table of limits shall be defined as a table to be used in connection with inspection, repair, and reassembly (where an assembled dimension is stipulated), of the various components during overhaul. The table of limits may also determine whether worn parts are dimensionally serviceable or determine the extent of wear by comparison with the original dimensions. (See figure 8.)
- 6.2.13 Visual Inspection. - Visual inspection consists of trained appraisal of the equipment while at rest. This reveals signs of wear, scoring, corrosion, incorrect alignment or positioning, presence of dirt or foreign matter, leakage, or any abnormal condition of the engine, deck gear, or controls.

NOTICE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specification, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

### LIST OF DESIGN CHANGES AND CATAPULT REPAIR PROCEDURES

The following Design Changes and Catapult Repair Procedures have been incorporated in this handbook. † Indicates that the manual incorporates an altered or up-dated version of the Service Bulletin, Change or Repair Procedure.

\* Asterisk indicates additions included by current revision.

#### DESIGN CHANGES FOR C13 CATAPULT

2	17	32	45	57	72
3	19	33	46	58	73
5	20	34	47	59	*74
6	22	35	48	60	75
7	23	37	49	61	76
8	24	38	50	63	77
9	25	39	51	65	78
12	26	40	52	66	79
13	27	41	53	*68	80
14	28	42	54	69	84
16	30	44	55	71	

The following Design Changes and Catapult Repair Procedures have not been incorporated in this handbook, as they are not applicable.

#### DESIGN CHANGES FOR C13 CATAPULT

1. Cancelled and Superseded: 18, 31, 43, 62, 67

2. Not applicable:

1	21
4	29
10	36
11	56
15	64

3. Not yet issued: 70, 81, 82, 83

#### CATAPULT REPAIR PROCEDURES:

1	11
2	12
4	13
7	14
10	*16

1. Cancelled and/or superseded: 5, 6, 8, 9, and 15.

2. Never issued, therefore cancelled: 3.

3. Not applicable: 18.

FLYLEAF

FIGURE 1. TYPICAL FLYLEAF PAGE INCORPORATING A HISTORY RECORD OF SERVICE BULLETINS, SERVICE CHANGES, DESIGN CHANGES, AND REPAIR PROCEDURES.

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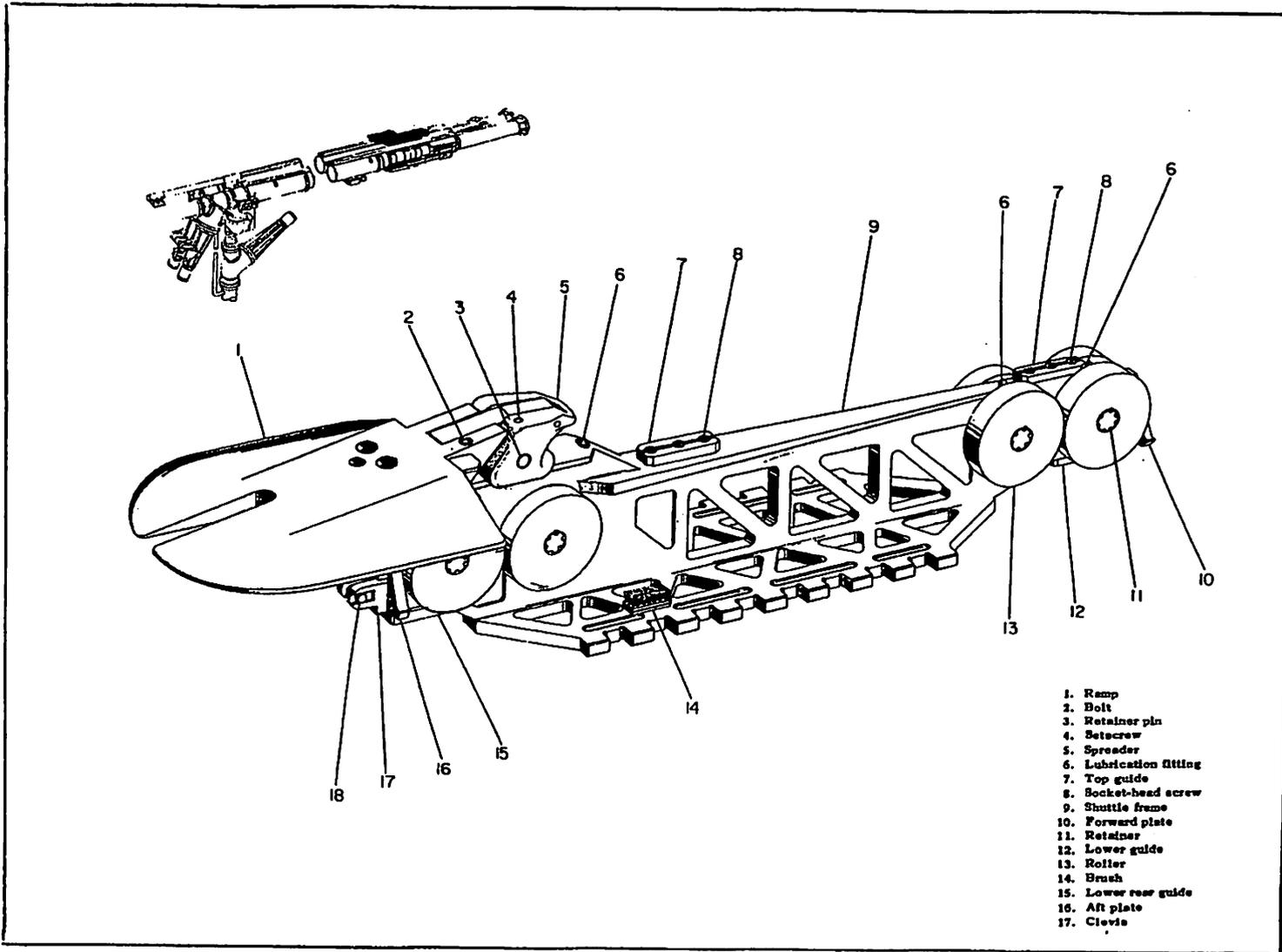
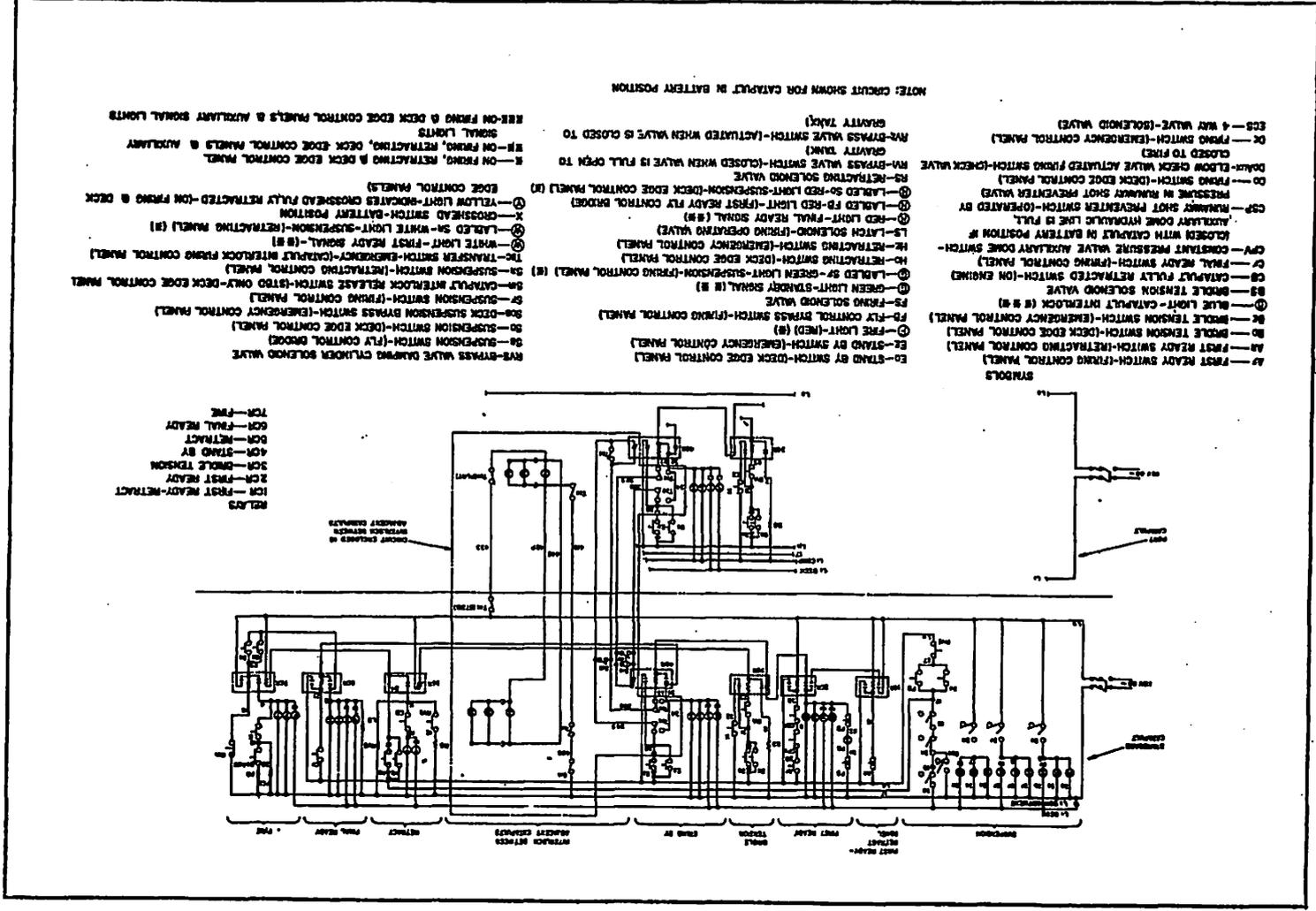


FIGURE 2. SHUTTLE ASSEMBLY.

FIGURE 2. SAMPLE OF A LINE DRAWING WITH SHADING.

FIGURE 3-1. SIGNAL SYSTEM - SCHEMATIC DIAGRAM

MIL-M-23305 (Rev)



- SYMBOLS**
- A1—FIRST READY SWITCH-(FIRING CONTROL PANEL)
  - A2—FIRST READY SWITCH-(DECK EDGE CONTROL PANEL)
  - B1—SHOCK TENSION SWITCH-(EMERGENCY CONTROL PANEL)
  - B2—SHOCK TENSION SWITCH-(DECK EDGE CONTROL PANEL)
  - B3—SHOCK TENSION SOLENOID VALVE
  - C1—CAPPUIT FULLY RETRACTED SWITCH-(ON ENGINE)
  - C2—CAPPUIT FULLY RETRACTED SWITCH-(FIRING CONTROL PANEL)
  - C3—CONSTANT PRESSURE VALVE AUXILIARY DOME SWITCH
  - C4—CLOSED WITH CAPPUIT IN BATTERY POSITION #
  - C5—NUMERARY DOME HEADLAMP LINE IS FULL
  - C6—PRESSURE IN NUMBER 2 SHOT PREHEATER VALVE
  - C7—FIRING SWITCH-(DECK EDGE CONTROL PANEL)
  - C8—DECK EDGE CHECK VALVE ACTUATED FIRING SWITCH-(CHECK VALVE CLOSED TO FIRE)
  - C9—FIRING SWITCH-(EMERGENCY CONTROL PANEL)
  - ECS—4 WAY VALVE-(SOLENOID VALVE)
- NOTE: CIRCUIT SHOWN FOR CAPPUIT IN BATTERY POSITION**
- E0—STAND BY SWITCH-(DECK EDGE CONTROL PANEL)
  - E1—STAND BY SWITCH-(EMERGENCY CONTROL PANEL)
  - E2—FREE LIGHT-(RED) (R)
  - F3—FIRING CONTROL BYPASS SWITCH-(FIRING CONTROL PANEL)
  - F4—GREEN LIGHT-(STANDBY SIGNAL (R))
  - F5—FIRING SOLENOID VALVE
  - F6—LAMPED BY GREEN LIGHT-(SUSPENSION-FIRING CONTROL PANEL)
  - F7—RETRACTING SWITCH-(DECK EDGE CONTROL PANEL)
  - F8—RETRACTING SWITCH-(EMERGENCY CONTROL PANEL)
  - F9—LATCH SOLENOID-(FIRING OPERATING VALVE)
  - F10—RED LIGHT-FINAL READY SIGNAL (R)
  - F11—LAMPED SO-RED LIGHT-(FIRST READY FLY CONTROL BRIDGE)
  - F12—RETRACTING SOLENOID VALVE
  - F13—RETRACTING SWITCH-(CLOSED WHEN VALVE IS FULL OPEN TO BATTERY BANK)
  - F14—BYPASS VALVE SWITCH-(ACTUATED WHEN VALVE IS CLOSED TO BATTERY BANK)
  - F15—BYPASS VALVE SWITCH-(ACTUATED WHEN VALVE IS CLOSED TO BATTERY BANK)
- RELAYS**
- 1CR—FIRST READY-RETRACT
  - 2CR—FIRST READY
  - 3CR—SHOCK TENSION
  - 4CR—STAND BY
  - 5CR—RETRACT
  - 6CR—FINAL READY
  - 7CR—FIRE
- RELAY CONTACTS IN CIRCUIT**
- 1A—FIRST READY SWITCH-(FIRING CONTROL PANEL)
  - 1B—SHOCK TENSION SWITCH-(DECK EDGE CONTROL PANEL)
  - 1C—RETRACT SWITCH-(EMERGENCY CONTROL PANEL)
  - 1D—EMERGENCY SWITCH-(DECK EDGE CONTROL PANEL)
  - 1E—FLY CONTROL SWITCH-(FIRING CONTROL PANEL)
  - 1F—DECK SUSPENSION BYPASS SWITCH-(EMERGENCY CONTROL PANEL)
  - 1G—DECK EDGE CONTROL PANEL
  - 1H—SUSPENSION SWITCH-(FLY CONTROL BRIDGE)
  - 1I—RELEASE SWITCH-(STRO ONLY-DECK EDGE CONTROL PANEL)
  - 1J—EMERGENCY SWITCH-(CAPPUIT INTERLOCK FIRING CONTROL PANEL)
  - 1K—RETRACT SWITCH-(RETRACTING CONTROL PANEL)
  - 1L—EMERGENCY SWITCH-(CAPPUIT INTERLOCK FIRING CONTROL PANEL)
  - 1M—RETRACT SWITCH-(RETRACTING CONTROL PANEL)
  - 1N—EMERGENCY SWITCH-(CAPPUIT INTERLOCK FIRING CONTROL PANEL)
  - 1O—RETRACT SWITCH-(RETRACTING CONTROL PANEL)
  - 1P—EMERGENCY SWITCH-(CAPPUIT INTERLOCK FIRING CONTROL PANEL)
  - 1Q—RETRACT SWITCH-(RETRACTING CONTROL PANEL)
  - 1R—EMERGENCY SWITCH-(CAPPUIT INTERLOCK FIRING CONTROL PANEL)
  - 1S—RETRACT SWITCH-(RETRACTING CONTROL PANEL)
  - 1T—EMERGENCY SWITCH-(CAPPUIT INTERLOCK FIRING CONTROL PANEL)
  - 1U—RETRACT SWITCH-(RETRACTING CONTROL PANEL)
  - 1V—EMERGENCY SWITCH-(CAPPUIT INTERLOCK FIRING CONTROL PANEL)
  - 1W—RETRACT SWITCH-(RETRACTING CONTROL PANEL)
  - 1X—EMERGENCY SWITCH-(CAPPUIT INTERLOCK FIRING CONTROL PANEL)
  - 1Y—RETRACT SWITCH-(RETRACTING CONTROL PANEL)
  - 1Z—EMERGENCY SWITCH-(CAPPUIT INTERLOCK FIRING CONTROL PANEL)
- EDGE CONTROL PANELS**
- 1—ON FIRING, RETRACTING & DECK EDGE CONTROL PANEL
  - 2—ON FIRING, RETRACTING & DECK EDGE CONTROL PANELS & AUXILIARY SIGNAL LIGHTS
  - 3—ON FIRING, RETRACTING & DECK EDGE CONTROL PANELS & AUXILIARY SIGNAL LIGHTS
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FIGURE 3 (SHEET 1). TYPICAL SCHEMATIC DIAGRAM

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FIGURE 3-8. POWER PLANT AND SIGNAL SYSTEM - ELECTRICAL.

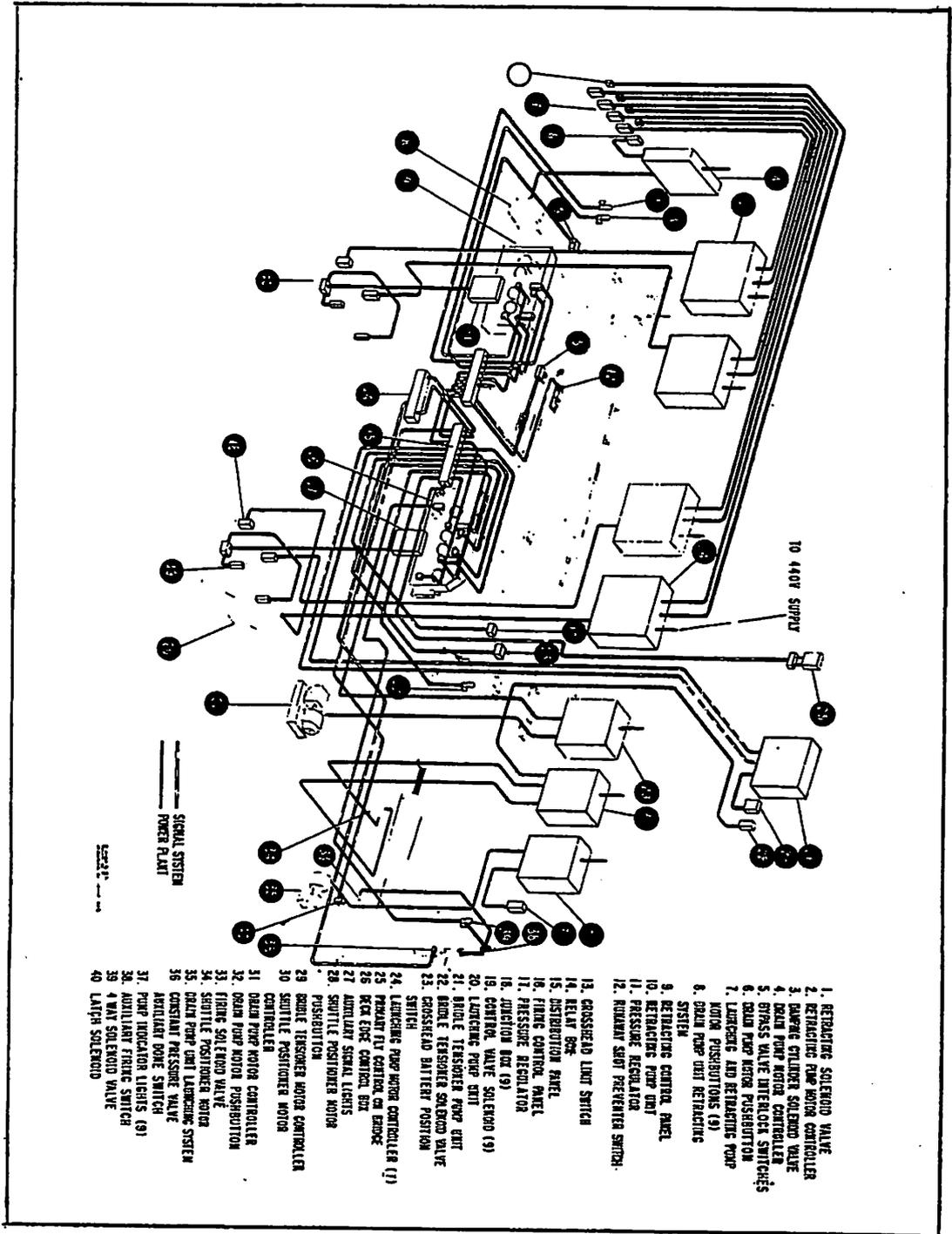


FIGURE 3 (SHEET 2). SAMPLE OF A TYPICAL ISOMETRIC DIAGRAM.

TABLE 12-1

## LUBRICATION CHART

FIGURE AND INDEX NO.	PART	*LUBRICANT	FITTING	*PERIOD
	<b>Launching Engine System</b>			
10, Fig. 3-1	Shuttle Track	H	See Note 1 below	D
9-26, Fig. 3-2	Bearing Pads - Trough	L	Lubricator	M
Not shown	Bearing Pads - Steam Receivers	L	Lubricator	M
8, Fig. 3-6	Scrip Tensioner	H	Oil Cup	F
7, Fig. 3-8	Shuttle	K	Lubricator	D
Not shown	Water Brake Filters		See Note 2 below	
	<b>Lubrication System</b>			
14, Fig. 3-18	Lube Oil Supply Tank	C	Supply Tank	F
See Note 3 below	Pump-Motor Set Filters		Grease Fitting See Note 4	
	<b>Steam System</b>			
31, Fig. 3-25	Flow Control Valve	H	Oil Cup	F
6, Fig. 3-28	Launching Valve Operating Cylinder	H	Oil Cup	F
4, Fig. 3-30	Launching-Valve Control-Valve	H	Oil Cup	F
Same as LVCV above	Exhaust-Valve Control-Valve	H	Oil Cup	F
5, Fig. 3-31	Exhaust Valve Operating Cylinder	H	Oil Cup	F
4, Fig. 3-37	Butterfly Valves	L	Lube Port	D
40, Fig. 3-35	Hydraulic Actuator Buffer	H	Air Vent	F
19, Fig. 3-34	Operator Assembly	L	Pin	M
	<b>Retraction System</b>			
15, Fig. 3-40	Cylinder and Piston	H	Advance Port	F
9, Fig. 3-58	Crosshead (Sheaves and Rollers)	L	(24) Lube Fitting	D
40, Fig. 3-47	Retraction Engine Rails	H	See Note 1 below	D
Fig. 3-50	All Sheaves	L	Grease Fittings (See Note 5)	D

## \*KEY

L - Lubelplate Type 630AA (Fiske Refining Co., Newark, N.J.)

C - (MIL-C-6529 Type 2)

S - Houghco Safe 271 (E.F. Houghcon Co., Phila, Pa.)

A - Graphite Grease (MIL-G-7187)

D - After Day's Operation or Weekly

F - Keep Full

M - Monthly

B - Before or After Use

H - Navy Symbol No. 2190

## NOTES

1. Wipe daily or after days's operation.
2. Remove and clean Water Brake Filters as necessary.
3. Lubricate the Pump-Motor Set in accordance with the Manufacturers' Instruction Manual.
4. Remove hydraulic filters or strainers and clean as necessary.
5. Turn all sheaves one full revolution (360°) in each direction, this will determine if sheaves are free to rotate. Then grease.
6. Grease Drive System Cables with soft graphite grease MIL-G-7187 (if necessary).
7. To lubricate bearings squirt oil into annulus between flange and retainer. Use similar procedure for other bearings.

FIGURE 4. TYPICAL LUBRICATION CHART.

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TABLE 9-3 ARRESTING ENGINE TROUBLE SHOOTING CHARTS				
Reference Figure	Part	Trouble	Probable Cause	Correction
9-1	Engine	Unusual engine noise.	Loose, broken, or vibrating members.	Inspect for loose or broken parts. Tighten or replace as necessary.
			Does not operate freely and smoothly.	Insufficient operating clearance between engine parts and ship's structure.
			Engine not properly aligned.	Re-align engine.
			Lack of lubrication.	Lubricate as required.
			Purchase cables not properly reeved.	Correct or replace reeving.
			Binding of moving components.	Inspect for binding and remove cause.
			Engine not properly secured to galley deck.	Secure properly.
			Sheaves do not rotate freely.	Check lateral clearance between sheaves. Correct.
			Rust on crosshead tracks.	Remove rust. Lubricate.
			Does not operate.	Jamming of movable components.
TABLE 9-4 CYLINDER AND RAM ASSEMBLY TROUBLE SHOOTING CHART				
Reference Figure	Part	Trouble	Probable Cause	Correction
3-4	Cylinder and ram	Ram (7) loose.	Head (4) not tightly threaded in ram.	Tighten head in ram.
			Head bolts to cross-head loose.	Tighten head bolts.
		Cylinder (1) loose.	Cylinder not tightly threaded in fixed sheave flange.	Tighten cylinder.
	Engine fluid flows past ram head (4).	Defective ram packing (3).	Replace.	

FIGURE 5. SAMPLE OF TYPICAL TROUBLE SHOOTING CHARTS.

TABLE 9-11 ARRESTING ENGINE PERIODIC INSPECTION CHART			
Reference Figure	Part	Nature of Inspection	Inspection Time
3-1	Structure	Inspect for security of components, deformation, alignment and cleanliness.	D
	Purchase Cable	Inspect for wear and broken wire, soundness of poured terminals, soundness of terminal attachment to anchor and presence of proper lubrication.	A
	Engine	Visually check for external fluid leakage. Visually check for dirt, wear, proper lubrication, misalignment, security and damage.	D A
TABLE 9-12 ARRESTING ENGINE PIPING PERIODIC INSPECTION CHART			
Reference Figure	Part	Nature of Inspection	Inspection Time
3-3	Unions, Elbows and Nipples	Check for leakage and security.	D
	Bracing	Visual check for alignment.	V
		Check for security.	V
	Air Charging Valves	Check for leakage and ease of operation.	D
	Pressure Gages	Check for proper reading.	B
	Manifolds	Inspect for leakage, security, alignment and cleanliness.	D
	Water Valves	Inspect for leakage and ease of operation.	D
	Vent Valves and Plugs	Check for leakage and soundness.	D
TABLE 9-13 ACCUMULATOR PERIODIC INSPECTION CHART			
Reference Figure	Part	Nature of Inspection	Inspection Time
3-14	Fluid Replenishing system	Visual check for external fluid leakage, security of valves and cleanliness.	D
	Gaskets between head and cylinder, head and air expansion flask, cylinder and nozzle, and nozzle and manifold.	Visual check for leakage.	D
	Mating Surfaces	Check for tightness.	D
	Vent Valves and Plugs	Check for security and external fluid leakage.	D

FIGURE 6. TYPICAL PERIODIC INSPECTION CHARTS USED FOR PREVENTIVE MAINTENANCE.

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TABLE 9-1

SPECIAL TOOLS AND TEST EQUIPMENT  
FOR MAINTENANCE

REFERENCE FIGURE NO.	PART NUMBER	NOMENCLATURE	APPLICATION
11-5	02-5327-1	Ram fixture.	To remove crosshead or ram.
11-1	315414-1	Wrench-cam shaft spanner nut-control valve.	To remove and replace lock nut on cam shaft.
11-7	315426-1	Wrench-drive shaft cam- adjusting assembly.	To actuate drive shaft when adjust- ing control cam.
11-2	315448-6	Pliers,retainer ring.	Used for control valve assembly and control valve and retracting valve installation.
11-2	315448-8	Pliers,retainer ring.	
11-4	315454-2	Cable tension indicator, control valve drive system.	For reading cable tension on 1/4 to 3/8 diameter cables.
11-1	316431-1	Wrench-quick detachable coupling.	For quick detachable coupling, drawings 62-40542, 62-40701, 62-41865, 62-41870.
11-2	315967-1	Glass remover - remote indicator.	To remove remote indicator glass.
11-1	403227-1	Wrench-valve seat 402787-1 control valve.	To remove and replace valve seat
11-3	403787-1	Insertion fixture-accumulator piston.	To insert piston packing rings.
11-1	404143-1	Spanner wrench.	To remove and replace retractable sheave bearing retainer.
	501271-1	Die and tap set.	For 1-3/8 wire rope fittings.
11-5	606231-1	Cylinder support assembly.	To support cylinder when replacing packing.
11-2	90594-1	Funnel	For accumulator filling.
11-4	91717-1	Cutter assembly	For cutting wire cable.
11-4	91717-3	Disc, abrasive.	For cutter assembly.
11-3	92611-1	Portable pyrometer.	To check zinc temperature for poured terminals.
11-7	316183-1	Jacking block assembly.	To back up jack on cylinder when replacing packing.
11-2	404808-1	Ram and pump assembly.	To move cylinder when replacing packing.
11-6	316033-1	Ladle.	To pour cable terminals.

FIGURE 7. TYPICAL CHART WITHIN A PAGE DESIGNATING SPECIAL TOOLS AND  
TEST EQUIPMENT REQUIRED FOR MAINTENANCE (OR OVERHAUL).

TABLE 5-59  
OPERATOR ASSEMBLY TABLE OF LIMITS

Reference Figure 5-25	Part	Design Dimensions		Beyond this dimension, repair or replace as indicated	
		Max.	Min.		
5	Restrictor valve spring guide				
	O.D.	.330	.325	.320	Replace
6	Restrictor valve spool				
	O.D.	.999	.998	.996	Replace
	I.D. hole through side	.376	.375	.379	Replace
10	Restrictor valve body				
	I.D.	1.001	1.000	1.004	Replace
	I.D. two smaller cham- bers which are outside the two larger width smaller chamber	1.242	1.240	1.245	Replace
		.280	.275	.290	Replace

TABLE 5-60  
FLOW CONTROL VALVE TABLE OF LIMITS

Reference Figure 5-26	Part	Design Dimensions		Beyond this dimension, repair or replace, as indicated	
		Max.	Min.		
16	Ring				
	O.D.	.875	.873	.870	Replace
	I.D.	.2503	.2497	.2507	Replace
6	Pin				
	O.D.	.623	.621	.618	Replace
67	Spring free length	1 1-32	31-32	Replace if beyond limits 1 3/32 - 29/32	
2	Scraper retainer				
	I.D.	2.335	2.325	2.345	Replace
17	Piston				
	O.D. (adjacent to	3.872	.3870	3.867	Replace
Note					
Both sides must be concentric within .006 F.I.R. If this cannot be held, re- place piston.					
34,46	Cover				
	I.D. larger end	3.877	3.875	3.880	Replace

FIGURE 8. SAMPLE OF A TABLE OF LIMITS USED FOR OVERHAUL PROCEDURES.

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Table 8-1		
MALFUNCTION		
MALFUNCTION	PROBABLE CAUSE	CORRECTION
<b>WIRE SUPPORTS:</b>		
1. Failure to raise or lower.	Cable or housing jammed. Cams or followers sticking.	Clear jam and clean housing. Lubricate cam and followers.
2. Failure to raise or lower to full position or sluggish movement.	Slack in cables. Air leakage. Insufficient piston travel.	Tighten cables. Correct leakage. Check packings in air cylinder.
<b>DECK PENDANTS:</b>		
1. Sagging between wire supports.	Low accumulator pressure. Improper fluid level. Low engine cylinder pressure.	Maintain correct operating pressure. Maintain correct fluid level. Open and close retraction valve.
2. Sagging with one terminal jammed in sheave.	Extreme off-center loading.	Pull out deck pendant with deck tractor on side with jammed terminal.
3. Slow retraction.	Low accumulator pressure. Purchase cable jamming or binding.	Check for pressure leak. Check for cause of binding or jamming of purchase cable, and correct.
	Fluid leak.	Check fluid system for leaks especially at ram packings.
	Insufficient opening of retraction valve.	Check for jamming and correct.
4. Fast retraction.	High accumulator pressure.	Maintain correct accumulator pressure.
	Retraction valve faulty.	Check retraction valve setting.
5. Failure to retract.	Retracting valve operating cable broken. Jammed retracting valve.	Replace cable. Repair retracting valve.
<b>BARRICADE STANCHIONS:</b>		
1. Failure to rise.	Air failure.	Correct air failure.
2. Failure to lower.	Air failure.	Correct air failure.
3. Failure to rise or lower fully.	Low air pressure. A weak counterbalancing spring.	Adjust the speed control valves. Tension or replace spring.
4. Stanchions are "slamming" into final position.	Maladjustment of speed control valves.	Adjust the speed control valves.

FIGURE 9. TYPICAL MALFUNCTION CHART SHOWING MALFUNCTION, PROBABLE CAUSE, AND CORRECTION.

**Table 4-3**  
**PRE-ENERGIZATION CHECK OFF LIST**  
**(Controls)**

ITEM	CHECK POINTS	PARAGRAPH REF.
( ) Main Control Panel	Air supply valve open. Energize all electrical circuits. Open shut-off valve in service water supply line to upper and lower manifold. Accumulator pressure should read 400 psi, auxiliary air flasks, 3,000 psi.	9.6.2 9.6.5
( ) Weight Indicator	Synchro indicators at all stations should respond with and be calibrated for coincident readings with weight selector at engine.	9.6.4
( ) Retraction Lever	Operable and pendant responsive to control.	9.6.8
( ) Wire Support Controls	Air pressure and valves open.	9.6.6
( ) Retractable Sheave	Electrical controls energized and functioning. Limit switches operable.	9.6.5
<p><b>Note</b></p> <p>All control units have Emergency Manual Control Units. All manual controls should be checked to insure they are operable, well lubricated and capable of functioning.</p>		

**FIGURE 10. SAMPLE OF A TYPICAL CHECK OFF LIST**

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TABLE 12-6			
ENGINE CROSSHEAD ASSEMBLY INSPECTION CHART			
Reference Figure 12-12	Part	Inspect for	Action To Be Taken
13, 19	Sheave Guards	Cracks, wear.	Replace if worn thin or cracked.
11	Sheaves	Shear or ridges in groove surface dimension of groove width.	Clean, rework if high limit exceeded, replace if rework not possible.
		Cracks.	Dye-check, discard if cracked and replace.
14	Sheave outer bearing race	Cracks.	Magnetic particle inspection, discard if cracked and replace.
	Bearing Assembly	Cracks, defects, wear.	Steam clean, magnetic particle inspection, discard if unserviceable or out of tolerance.
9	Outer Spacer	Ring groove on both sides, dimension, surface finish.	Discard if groove is missing or dimensions or surface finish out of tolerance.
10	Inner Spacer	Cracks.	Magnetic particle inspection, discard and replace if cracked.
3	Crosshead Shaft	Cracks, surface finish, burrs, scoring or corrosion.	Clean, blow out lubrication channels after fittings are removed. Magnetic particle inspection.
		Size & out of roundness.	Discard and replace if cracked. Remove other defects if tolerance can be held.
31	Lubricator fittings		Discard & replace.
5	Screws	Damaged threads, cross threading shear.	Replace if damaged.
29	Bolts	Damaged threads, cross threading shear.	Replace if damaged.
17	Crosshead Body	Squareness, using surface plate, cracks.	Magnetic particle and a liquid penetrant. Repair if possible.
		Distorted or stripped threads in threaded holes and studs.	Plug, redrill and tap defective holes, replace defective studs.
26	Liners		Discard and replace.
28	Slipper Retainer	Cracks, distorted or oversize threaded holes.	Discard if damaged.
18	Shaft Retainer	Cracks.	Magnetic particle inspection, discard if cracked and replace.
6	Fairleads	Chafing, cracks.	Magnetic particle inspection discard if cracked or unserviceable.

FIGURE 11. SAMPLE OF A TYPICAL INSPECTION CHART  
USED FOR VARIOUS TYPES OF INSPECTION.

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