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# MANUALS, TECHNICAL, ASSEMBLY AND TEST (EQUIPMENT TYPE)

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

## 1. SCOPE

1.1 General Scope. This specification covers the specific requirements for Assembly and Test (Equipment Type) Manuals; the general requirements are covered in MIL-M-81273A. This type of manual shall be written at the appropriate technical level in order that users of the manual can readily understand and perform the required assembly and test functions. Careful attention must be given to the level of education of the reader. Both the general educational level and specific areas of training will affect the scope of the publication.

1.2 Purpose. Assembly and Test Manuals are written for personnel responsible for assembly and test of equipment in preparation for use. This manual type is primarily applicable to complex deployable/expendable ordnance such as missiles, mines, torpedoes, etc., that undergo a build-up and test procedure prior to deployment. However, by appropriate variation of emphasis and minor alteration in organization, this manual type may be adapted to suit a variety of equipment types both simple and complex, and expendable or reuse able. The procuring activity will invoke appropriate portions of this specification to adequately define the required manual.

## 2. APPLICABLE DOCUMENTS

2.1 Latest issue of MIL-M-81273A - Military Specifications: Publications, Technical Manuals; General Specifications for.

## 3. REQUIREMENTS

3.1 Organization of Information. The Assembly and Test Manual is organized by subject matter type, i.e., Introductory, Descriptive, and Procedural.

3.2 Introductory Information. The following paragraphs enumerate the requirements for preparation of introductory information.

3.2.1 Purpose. Introductory information is intended to give the reader an overview of the subject equipment, the contents of the manual, and related general information.

3.2.2 Scope and Depth. The scope and depth of the introductory information will vary according to the size and complexity of the equipment. Included in the introduction should be a general discussion of the equipment and its operation, the purpose and scope of the manual, special and safety features, and a listing of related documents. Accompanying this material may be a discussion of differences between operational

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assemblies, drill or exercise versions of the equipment, and the effect of logistics on the manual.

### 3.2.3 Audience Consideration.

Needs of the audience must be considered; frequently, the introductory material is to be read not only by the specific user, but also by command or administrative personnel who must become familiar with the subject. However, in presenting information of interest to administrative personnel, the educational level of the specific user must not be ignored.

3.2.4 Approach. Information in this section may be described as summary-type; tables should be used to summarize various data, and illustrations should be of the overall type. Information should be arranged as to lead the reader from the general to the specific.

3.2.5 Detailed Specifications. The following paragraphs present the details for preparation of introductory material.

3.2.5.1 Introduction. The first few sentences or paragraphs should give the reader an adequate introduction to the subject. Included should be an overall generic description, e.g., "Mine Mk 83 Mod 4 is a 1000-lb., aircraft laid, bottom mine that responds to the electromagnetic influences of a passing vessel," or "Pistol, Cal. .45, MIAI is a semi-automatic, seven-shot, .45-calibre handgun weighing approximately 2.6 pounds." The introduction should give an over-view of the equipment with respect to its ultimate incorporation into the Navy stockpile. The introduction shall include a discussion of the operation of the equipment. For a simple device, such as a depth

charge, the operation may be so described as to be complete in and of itself; whereas, the operational sequence of a guided missile should only be discussed in terms of the major flight phases, with details thoroughly described in a later section or chapter entitled "Functional Description."

3.2.5.2 Purpose and Scope of Manual. This information is required to let the reader know quickly what is in the book. Included should be information such as the purpose of the manual, the intended user, format, unique features, etc., and a brief chapter-by-chapter discussion of how the subject matter is handled.

3.2.5.3 Logistics. The logistics of the equipment, as they may affect the organization and format of the manual, particularly the procedural portions, should be discussed briefly. For example, shipping configurations and required modes of handling may determine locations and sequence of assembly and test operations. The description of logistics may be supported by flow charts such as a stockpile-to-target sequence. More detailed logistic information may be presented with procedural material.

3.2.5.4 Equipment Layout. This discussion should indicate physical arrangement of equipment and other items such as a modular or color-coded system. This discussion should be supported by an illustration, usually of the phantom or exploded type, showing location of major components. An example is provided as Figure 3-1.

3.2.5.5 Assembly Differences. Some equipment is designed so that different assemblies are possible. Such variations in equipment are provided to adjust performance

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characteristics to specific needs. For such equipment, the differences in these assemblies shall be discussed. A tabular presentation may be utilized to compare characteristics.

#### 3.2.5.6 Weights and Dimensions.

A discussion of weights and dimensions of interest to the user is appropriate. Weights are usually given in tabular form; outline drawings should be used for dimensions. Examples are provided as Figures 3-2 and 3-3.

3.2.5.7 Safety Features. A summary should be given of those specific aspects of the equipment designed to ensure the safety of those who must handle it. Also included should be coverage of those additional features which provide safety for the deploying vehicle, etc. Such features are provided by devices such as hydrostatic or velocity switches, arming wires, intelligence settings, etc. Information of this type should be presented in a summary paragraph or table. The purpose is to call attention to those devices rather than to discuss them in detail. Detailed discussion should be placed in a later physical description portion of the manual.

3.2.5.8 Special Features. Significant, unusual, or novel features should be discussed briefly. Examples would be a special device for suppression of the effects of electromagnetic radiation, unique construction materials to gain special performance effects, etc.

3.2.5.9 Operational Information. Capabilities and limitations of the equipment may be discussed along with such information as speeds, depths, altitudes, and ranges, as applicable. This presentation of-

information should be complete unto itself; however, the treatment should be skeletal in nature where separate operational characteristic manuals exist. Operational information is normally of interest to command and administrative personnel and, as such, is primarily gained from other sources. Information in this section is normally presented to orient personnel as to the general characteristics of the equipment.

#### 3.2.5.10 Drill/Exercise Provisions.

Expendable ordnance usually has a drill or exercise version. Discussion of this version should be presented. The depth of this discussion shall depend on the complexity of the drill vehicle and the manner in which it is documented elsewhere. Major design features and capabilities may be presented, as well as a summary of differences between it and the parent equipment.

#### 3.2.5.11 Definition of Terms.

Various commonly used abbreviations, terms, and symbols peculiar to the equipment should be defined. In addition, seldom used general terms applicable to the equipment should also be covered. Often a table of brief definitions suffices in this area. An example is provided in Figure 3-4.

#### 3.2.5.12 Reference Documents.

Reference documents related to the subject equipment or items associated therewith should be listed. In most instances, a table of such documents is sufficient. An example is presented as Figure 3-5.

3.3 Descriptive Information. Descriptive information can be divided into two basic types, functional and physical. For complex equipments, these two are normally discussed separately; for simple equipments, the descriptive information may be

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covered in a single physio-functional treatment.

3.3.1 Functionl Description. The following paragraphs enumerate the requirements for preparation of functional descriptions.

3.3.1.1 Purpose. The functional description is intended to present an overall operational sequence of the equipment and to show the functional relationship between major components or units.

3.3.1.2 Scope and Depth. The functional description expands upon the introductory discussion of the equipment operation and usually appears as a chapter or section of a chapter. The overall operation should be analyzed in terms of its operational or intelligence phases. It may be necessary to break out the electrical, mechanical, or hydraulic systems and analyze them individually. Such is generally the case for complex equipment such as missiles which have complex electrical and hydraulic systems. The functional description should give such depth of understanding as to allow a technician to understand the effects of deviations in assembly and test procedures or changes in settings, and to be able to make more effective use of the equipment. The functional description should provide new personnel with a clear understanding of the operation of the equipment. The discussion should also provide a maintenance technician with such understanding to make more intelligent judgments in problematic situations and to diagnose faults. In large equipments, it is not generally feasible to cover all possible faults that may occur in the equipment. This section of the manual should provide sufficient information on which to base the use of judgement

in the diagnosis of a fault not explicitly covered in any troubleshooting information in the manual.

3.3.1.3 Audience Consideration. The functional description is written primarily for the maintenance technician and, in some cases, the assembly and test personnel. In addition, the functional description is used widely for orientation of new personnel.

3.3.1.4 Approach. Functional information shall be presented and organized to enable the reader to understand the operation of the system. The discussion should also be presented so as to support troubleshooting material as it appears in procedural information. Operational sequences should proceed chronologically; systems operations may proceed chronologically, functionally, or from general to specific.

3.3.1.5 Detailed Specifications. The following paragraphs present the details for preparation of functional descriptions.

3.3.1.5.1 Introduction. The introduction should provide a generic description of the equipment and provide a brief discussion of the scope of the functional description.

3.3.1.5.2 Operational Sequence. This system-level discussion expands upon the skeletal operational sequence presented earlier in the introductory information of the manual. The operational sequence shall be presented chronologically in a phase-by-phase treatment. Operation of each phase is described in terms of the function of the series of systems and components within the equipment. The overall functional coverage should be supported by detailed schematics, or block diagrams,

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or a combination thereof showing electrical, mechanical, and hydraulic functional relationships. Schematics and block diagrams may need to be qualified by appropriate tabular data. Illustrations showing the overall chain of operational phases may prove also to be advantageous. An example of such an illustration would be a missile flight profile or the sequence of events in a drill mine operation which is presented as Figure 3-6. "Black box" treatment of components is preferred to a detailed approach at the system level; that is, discussion of component operations must indicate the result of the component operations rather than the manner in which the result is achieved. Coverage of the manner of operation is reserved for the physical description of the component.

**3.3.1.5.3 Sub-Systems Operations.** For complex equipment, the overall description may need to be supplemented with discussions of sub-systems operations and /or major components; however, for simple equipment, a discussion of the overall sequence of operations may be sufficient. Sub-systems that might be discussed would be electrical, hydraulic, and mechanical; major components might be firing mechanisms and control boxes. Supporting material such as mechanical or hydraulic diagrams or simplified schematics may be utilized.

**3.3.2 Physical Description.** The following paragraphs enumerate the requirements for preparation of physical descriptions.

**3.3.2.1 Purpose.** This portion of the manual shall contain the physical descriptions of the equipment and a brief description of the applicable test sets. The equipment descriptions are intended to give the reader

an understanding of the physical characteristics of the components and how they achieve their functions. The test set descriptions present a brief coverage to familiarize the assembly and test personnel with these items.

**3.3.2.2 Scope and Depth.** The physical description expands upon the basic equipment layout and physical characteristic: given in the introductory portion of the manual. Interest is concentrated upon basic components of the equipment; for complex equipment, consideration may also be necessary for various subsystems. The description of each component shall tell in terms of its function what the component is, where it's physically located in the equipment, how it performs its function, and of what the component consists. The description should contain a coverage of the component's parts and how they perform their function. In the test set descriptions, each test set description as a whole shall provide no more coverage than that given to a moderately complex component.

**3.3.2.3 Approach.** The physical description is a reference section; that is, it is primarily a compilation of component descriptions each of which is generally complete within itself. Three basic approaches toward organization of the component descriptions exist; they include arrangement by alphabetical listing of components, by physical location of components, and by functional position of the components within the equipment or system thereof.

**3.3.2.4 Audience Consideration.** The physical description is usually slanted toward the maintenance technician. Consequently, the descriptive material should complement the

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functional description and subsequent procedural information. The physical description portion is also widely used to supplement training and, therefore, should be prepared with the student in mind.

3.3.2.5 Detailed Specifications. The following paragraphs present the detailed specifications for preparation of physical descriptions.

3.3.2.5.1 Equipment Descriptions. The following areas of consideration shall be reflected in the equipment descriptions.

3.3.2.5.1.1 Organization. The physical description portion of the manual is primarily a collection of component descriptions. As mentioned previously, three approaches are commonly used for these descriptions: alphabetical listing, physical location, and functional position.

3.3.2.5.1.1.1 Alphabetical Listing. The alphabetical listing is commonly used for types of equipment such as mines or torpedoes, where the equipment is a member of a family and each member has its own manual. In such cases, the reader is usually familiar with the general structure of the family, and is concerned with the specific components of the equipment, especially those which make it differ with other members of the family.

3.3.2.5.1.1.2 Physical Location. In the physical location approach, the description begins with an overall presentation of the equipment, then proceeds to major divisions thereof, to subdivisions, and on down to components in a break-down sequence according to the physical arrangement of the equipment parts. This approach

is primarily applicable to complex hardware such as guided missiles; for this type of equipment, the first divisions could be the rocket motor, the guidance section, and the warhead section.

3.3.2.5.1.1.3 The functional position approach also proceeds in a break-down fashion. However, the equipment is divided according to its functional systems, such as hydraulic, electrical, etc.; these systems are then subdivided down to the component level. In many instances, the physical description portion of the manual is best presented by a combination of the physical location and functional position approaches. For instance, a missile might first be broken down by physical arrangement into the rocket motor, guidance section, and warhead section; then, the guidance section could be further broken down into its functional systems such as the guidance system and the power supply system, etc.

3.3.2.5.1.2 Stockpile Components Philosophy. In component descriptions, consideration must be given to whether or not a component, e.g., control boxes, arming devices, firing mechanisms, is a stockpile item and covered in a component manual. Such consideration will affect the depth of that component description. A component covered in a separate manual will be treated briefly and slanted toward its function in the weapon. A component that is peculiar to the weapon and is not described in a component manual will be described in the same detail as a component in a component manual.

3.3.2.5.1.3 Maintenance/Spares Philosophy. The level of description is usually determined by the maintenance/spares philosophy of the subject.



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For example, a component that is modularly stored and assembled into a weapon or equipment requires only sufficient description and illustration to give the reader a general understanding of its purpose and operation; however, a component that requires individual disassembly, adjustment, or overhaul must be covered in far greater detail so as to provide adequate support for specific procedural information.

#### 3.3.2.5.1.4 Support Information.

The most common type of support information used is an overall component illustration. In addition, illustrations such as exploded views are useful to help show spatial relationships between components. Cutaway illustrations can be used to help explain how components achieve their functions or to show locations of key parts. Material organized by physical location or functional position can be supported by diagrammatic break-down figures. An example of such a figure is provided as Figure 3-7.

#### 3.3.2.5.1.5 Test Information.

Where applicable, component descriptions shall include a brief statement of tests performed thereon. This statement shall tell what test equipment is used and briefly what the test accomplishes. Tests covered shall include only the field-type tests, not depot or acceptance tests.

3.3.2.5.1.6 Packaging Information and Shipping Configurations. Included in the component descriptions shall be a coverage of packaging information and shipping configurations as appropriate. In some instances, for safety or other reasons, shipping configurations may differ from operational configurations. Such differences

shall be explained for the benefit of personnel who must convert from the shipping to the operational configurations. The related subjects, stowage, handling, and maintenance, are normally not presented in physical descriptions but are grouped together in a separate portion of the manual. Requirements for the se items will be found under Procedural Information.

#### 3.3.2.5.1.7 Reference Manuals.

Manuals containing additional descriptive or procedural information shall be referenced at the appropriate place in the physical descriptions.

#### 3.3.2.5.2 Test Set Descriptions.

Test set descriptions are usually grouped together in the last portion of the physical descriptions. Each test set and its associated components shall be given a brief physical description. Following this shall be a brief description of what the test set tests within the equipment. The total coverage given to each test set shall be no greater than that given to a moderately complex component. In support of each test set description, a composite illustration is most often used. This figure shows the opened test set and its associated components. An example of such a figure is provided as Figure 3-8.

3.4 Procedural Information. Procedural information is best divided into introductory material and the actual procedural instructions.

#### 3.4.1 Procedural Introduction.

The following paragraphs enumerate the requirements for preparation of the procedural introduction.

3.4.1.1 Purpose. Prior to the presentation of specific procedural instructions, certain introductory information shall be gathered together

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to properly orient the user prior to beginning his work. In addition, it is desirable to break out certain information that might unnecessarily clutter the detailed instructions.

**3.4.1.2 Scope and Depth.** This introduction appropriately includes pertinent information on logistics, testing, and shop layout. Certain procedures of a repetitive nature are included to reduce the bulk of the instructional material. A coverage shall be presented of tools and handling gear, and miscellaneous subjects or items such as spare parts, bulk materials, etc. In addition, the various records required in performance of procedures shall be discussed. In short, the procedural introduction includes any information that illuminates or simplifies the procedures, or that is helpful in setting up a shop. This material may require an entire chapter for complex equipment or only a section of a chapter for simple equipment.

**3.4.1.3 Audience Consideration.** The procedural introduction is intended for use by the assembly and test personnel. It is also intended to aid supervisors in preparing and operating the assembly shop.

**3.4.1.4 Approach.** This material shall be presented as to best orient the user to the subsequent procedures. In short, this introduction "sets the stage" for the assembly operations. The information in this section tells the reader what he needs to know in order to properly perform the assembly and test procedures. This section also lets the shop supervisor know what is required in the assembly shop.

**3.4.1.5 Detailed Specifications.** The following paragraphs present the details for preparation of the procedural introduction.

**3.4.1.5.1 Logistics.** The logistics of the equipment, as they may affect the procedural material, should be discussed. For example, shipping configurations, required modes of handling, modern assembly line techniques, and personnel specialization may determine locations and sequences of assembly and test operations. This information is largely a reiteration of the introductory discussion of logistics with additional emphasis on procedural material. The description of logistics may be supported with flow charts such as an assembly flow chart. The ready-for-stowage and ready-for-strike configurations shall be defined within restrictions that may be imposed by security classification.

**3.4.1.5.2 Components and Assembly Tests.** This section shall contain a tabular summary of the component and assembly tests in a form similar to that shown in Figure 3-9. Other pertinent general testing information may also be discussed.

**3.4.1.5.3 Shop Layout Information.** A general discussion of shop layout shall be presented where applicable. This information is intended to aid the supervisor in preparing the shop for use. Specially designed shop layouts shall be illustrated by floor-plan type figures showing assembly and test areas, special equipment (including hoists, etc.), and electrical, gas or air, etc., outlets. In addition, special area requirements such as control of temperature, humidity, etc., shall be enumerated.

**3.4.1.5.4 Repetitive Procedures.** In order to reduce the bulk of procedures and make them more concise, operations which are repetitive in nature shall be covered in this section. Two approaches are possible, descriptive and procedural. The choice between these two is dependent upon



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subject matter. For such basic operations as lockwirings lubrication, painting and weatherproofing, O-ring installation, and torquing, the descriptive approach shall be used. In this approach, the' general considerations involved are enumerated. For more specific operations, usually unique to the equipment, such as repetitive operation of a special tool, the coverage shall be presented as a chronological sequence of procedural steps.

#### 3.4.1.5.5 Tools and Handling Gear.

Coverage shall be provided for standard and special tools and handling gear. Applicable documents enumerating standard tools shall be referenced. Special tool lists may be referenced when available; otherwise, descriptions, containing illustrations, of the special tools shall be provided. Handling gear (including dollies, etc. ) shall be treated in a similar manner, Procedures for preparing special tools or handling gear for use shall be included when applicable to avoid cluttering the instructional material involving their use.

3.4.1.5.6 Records. Two types of records exist which may be required during the assembly and test operations. These forms are particular to the equipment and are generated solely for use in connection with the instructional material. The two types of forms are the Check-Off Sheet and the Assembly/Test Record. These forms and their use shall be described in this section and a sample provided for each. Instructions for preparation of these forms appears in the latter portion of this specification.

3.4.1.5.7 Miscellaneous Information. This section shall cover all

other information which would serve to orient the user prior to beginning the assembly and test operations. This material might include such information as a referencing of documents for bulk materials required in assembly or documents listing spare and/or expendable parts. If no documentation exists on these subjects, they shall be listed in this section.

3.4.2 Procedures. The following paragraphs enumerate requirements for preparation of the procedures.

3.4.2.1 Purpose. The procedures are intended to present all that information required by fleet personnel to execute the necessary assembly, test, handling, maintenance, and overhaul required during the service life of the equipment.

3.4.2.2 Scope and Depth. The procedures are first divided according to overall operation such as sub-assembly, assembly, test, maintenance, handling, overhaul, recovery, and in some instances, deployment. Each of these sections are then subdivided into unit operations which can be performed at one sitting in one place. Each of these operations contains an introductory paragraph summarizing the procedures performed in that operation, followed by a list of all materials required including tools, components, handling and test equipment, and bulk materials. The procedures are then presented in such detail that no doubt is left to the intended user as to what or how he is to perform the unit operation. These procedures shall contain all required safety warnings, cautions, special notes, and references to appropriate check-off sheets and records.

3.4.2.3 Audience Consideration. These

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procedures shall be written for personnel who ready and maintain ordnance equipments for service use.

3.4.2.4 Approach. The procedures shall be presented in a chronological, step-by-step manner.

3.4.2.5 Detailed Specifications.. The following paragraphs present the details for preparation of the procedural material.

3.4.2.5.1 Primary Requirements. The following are primary requirements applicable to all unit operations. An example of a unit operation with all its component parts is provided as Figure 3-10.

3.4.2.5.1.1 Job Description. Each unit operation shall have an introductory paragraph summarizing the procedures performed.

3.4.2.5.1.2 Materials Required. All materials required to complete the unit operation shall be listed. The materials shall be grouped by type, such as components, tools, handling equipment, test equipment, and bulk materials. References shall be made to appropriate tool procurement documents.

3.4.2.5.1.3 Procedures. Procedures shall be written in the imperative mood. They shall be clear and concise, and presented in a numbered, chronological sequence. Each step in the procedures should present one thought; that is to say, steps should not be grouped together.

3.4.2.5.1.4 Warnings, Cautions, and Notes. Warnings, cautions, and notes shall be inserted in the procedures where applicable. A warning, preceding the step to which it applies, alerts the user to a personnel hazard. All warnings are listed

in the Safety Summary in the front matter of the manual. Consequently, they must be complete in and of themselves so as to be able to stand apart from the procedures. An example of properly and poorly worded warnings appears as Figure 3-11. A caution, preceding the step to which it applies, alerts the user to an equipment hazard. A note, normally following the step to which it applies, serves to highlight an operating procedure or condition. Cautions and notes are not listed or summarized in the procedural or any other portion of the manual.

3.4.2.5.1.5 Troubleshooting Information. Limited trouble shooting information may be presented in appropriate portions of the procedures. An example of such information would be a table of test set switch functions or partial equipment schematic wiring diagrams.

3.4.2.5.2 Types of Procedures. The following paragraphs describe the various types of procedural material.

3.4.2.5.2.1 Subassembly. The logistics of equipment assembly often requires the subassembly of units in areas removed from the main assembly location. Examples of such separated areas are "clean rooms" and explosive equipment assembly areas. Modern assembly line techniques also dictate the subassembly of modules prior to the assembly of a complete unit.

3.4.2.5.2.2 Assembly. The assembly procedures cover those operations required to bring the equipment to the "ready" configuration. In the ready configuration, the equipment may be stored with only those items removed as required by safety or security regulations.

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3.4.2.5.2.3 Test. Tests are performed on the equipment as required at various points prior to, during, or after the subassembly and assembly operations. These tests are normally grouped together in a separate portion of the procedures to keep assembly procedures free of non-assembly type information and to isolate test procedures which may be required apart from or in conjunction with both assembly and non-assembly operations. In some instances, however, assembly and test information may be integrated into a single flow of procedures. In normal cases where testing is removed, references in assembly procedures or indication by other means such as assembly-test flow charts is required.

3.4.2.5.2.4 Overhaul. Overhaul procedures involve disassembly of previously assembled equipment to a certain required level, disposal of expended or faulty components at that level, and reassembly to the ready configuration. The required level of disassembly in overhaul is determined by the "lowest spared" concept; that is, disassembly does not go below the level of the lowest spared item. However, for such cases as cleaning, lubrication, painting, weatherproofing, etc., disassembly may go below the lowest spared item.

3.4.2.5.2.5 Recovery. Drill exercise versions of equipment are normally reusable and, therefore, recovered after use. These procedures are generally skeletal in form due to variation in recovery techniques or vehicles.

3.4.2.5.2.6 Preparation for Use. Instructions for preparation for use of the equipment are normally contained in a separate manual for users other than assembly and test personnel; however, for equipment of a

simple nature, this information may be included as a portion of the assembly and test manual. Specifications for preparation of this material will be found in MIL-M-81273/2A.

3.4.2.5.3 Maintenance, Stowage, and Handling Procedures. Maintenance, stowage, and handling information are closely related and generally grouped in a portion of the manual apart from the assembly and test procedures. Stowage information, while not procedural in nature, is covered in this portion because of its close relationship to maintenance and handling. Stowage requirements shall be described, supported as necessary by tabular information such as temperature, humidity, and grounding requirements. Special stowage layouts shall be discussed; this discussion shall be supported by layout diagrams where applicable. Many stowage requirements are reflected in maintenance and handling procedures such as 30-day testing intervals, limitations on lifting and grounding, etc. Maintenance procedures may include such information as periodic stowage inspections, hydraulic fluid changes, pressure checks, etc. In addition to basic requirements such as temperature control, etc., covered in stowage information, special handling procedures should be presented to cover such cases as transfer of explosive -loaded high-yield ordnance or large delicate equipment to and from stowage.

3.4.2.5.4 Records. This section presents requirements for preparation of the check-off sheets-and assembly/test record.

3.4.2.5.4.1 Check-Off Sheets. Check-off sheets are records intended to ensure proper completion of procedures and to assign

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responsibility; therefore, check-off sheets are summaries of completed tasks with provision for initialing by the user at each task. Check-off sheets are worded in the past tense to preclude appearing as instructions - the sheets are not instructional and do not contain all procedures. Check-off sheets are normally presented as reproducible appendices to the manual and are to be filled out as the procedures are completed. These sheets shall always accompany assembly and test procedures and may accompany maintenance and handling procedures where deemed necessary. The check-off sheets shall cover all critical and major steps in the procedures. Notes should also be reiterated. All entries on the check-off sheets shall be called for in the accompanying procedures. It is the responsibility of the cognizant writer to determine that the check-off sheet contains all the required material and that the procedures contain all the proper references to these check-off sheets. An example of a check-off sheet is provided as Figure 3-12. The check-off sheets may be better utilized if divided corresponding to the equipment's main assembly units.

3.4.2.5.4.2 Assembly/Test Record. The assembly/test record provides a compilation of such information as assembly numbers, component mark, mod, and serial numbers, operational settings, and other significant data. The record is normally presented as a reproducible appendix to the manual and is to be filled out as the assembly and test procedures are completed.

In addition, the record must be appropriately modified during overhaul procedures wherein entries on the record are subject to change. The record shall always accompany assembly and test procedures. All entries on the record shall be called for in the accompanying procedures. It is the responsibility of the cognizant writer to determine that the record contains all the required material and that the associated procedures contained all the proper references to the assembly/test record. An example of a record is provided as Figure 3-13. In some instances, the record may be best utilized if divided into portions corresponding to the equipment's main assembly units.

3.4.2.5.4.3 Associated Logs and Records. In complex weapon systems, other records and/or logs may require entries during various procedures. For example, a test set operating time may be required in the test set log. In these cases, such entries shall be called for in the appropriate procedures.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 All requirements outlined in Section 4 of MIL-M-81273A shall be followed. In addition, the provisions of on-site review (4.3.2) shall be met.

#### 5. PREPARATION FOR DELIVERY

5.1 All requirements outlined in Section 5 of MIL-M-81273A shall be followed.

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## 6. NOTES

## 6.1 Two Part Manual Concept. To

facilitate ease of handling by Fleet personnel, an assembly and test manual may be prepared in two parts due to such reasons as physical size of the manual or complexity of the weapon. Part 1, a reference manual, would include all introductory and descriptive material; Part 2, a procedural document, the procedural introduction and all procedures. **If the two-part format is elected, the manual shall be physically prepared in two volumes to facilitate stocking and reordering.**

6.1.1 Two Part Manual Format.

The procedural introduction is that which is described in paragraph 3.4.1. The check-off sheet and the assembly record become appendices to Part 2. All procedures are prepared in Instruction Sheet format.

6.1.2 Instruction Sheets. An Instruction Sheet is a removable pamphlet of procedural instructions. The individual pamphlet has no cover and is kept intact by staples through the center fold of all sheets for each set of instructions. The Instruction Sheets are verbatim repetitions of the material that would be contained in the unit operations. The Unit Operation of Figure 3-10 is presented in Instruction Sheet format in Figure 6-1.

6.1.2.1 Format Differences. The following format differences between unit operations and Instruction Sheets exist.

a. The unit operation title is the Instruction Sheet title.

b. The Instruction Sheets have the weapon designation indicated.

c. The Instruction Sheets are coded.

d. The job description paragraph, titled in the unit operation, is titled in the Instruction Sheet.

e. The materials required paragraph, untitled in the unit operation, is titled in the Instruction Sheet.

f. In the Instruction Sheet, the listing of materials is divided into Components, Tools, Bulk Materials, etc., and each division is titled.

g. The Instruction Sheet has a line dividing the introductory material from the procedures.

h. The procedures are so titled in the Instruction Sheet but not in the unit operation.

i. Each Instruction Sheet starts on page 1.

j. The first illustration of each Instruction Sheet is designated Figure 1; the first table, Table 1.

k. The Instruction Sheet code appears at the top of each page of the Instruction Sheet.

6.1.2.2 Format Similarities. The following similarities exist.

a. The job description paragraphs are identical except where figure or table references exist.

b. The materials required listed are identical.

c. The procedures are identical.

d. The Instruction Sheets and the unit operations contain the same warnings, cautions, and notes.

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e. The Instruction Sheets and the unit operations are illustrated in an identical manner.

6.1.2.3 Codes. Instruction Sheets are coded, usually with a letter-number symbol designating such items as type of operation, sequence within the type, mod of the weapon, and alternate operations. As an example, an Instruction Sheet for a tail cover assembly coded S-7da could mean the seventh Subassembly operation, Mod 3 of the weapon (Mod 0 is a, Mod 1 is b, etc.), first alternate assembly. The Instruction

Sheet code facilitates handling and refiling of the sheets by the user and facilitates construction and use of an assembly flow chart.

6.2 Manual Outline. A sample outline of a single volume mine assembly manual is provided as Figure 6-2. The outlined manual includes (as Chapter 6) users-type information. If the assembly manual appears as a tie-part manual, Part 1 would be Chapters 1 through 3 (4, 5, 6, and 7 would be eliminated). The outline for Part 2 appears as Figure 6-3.



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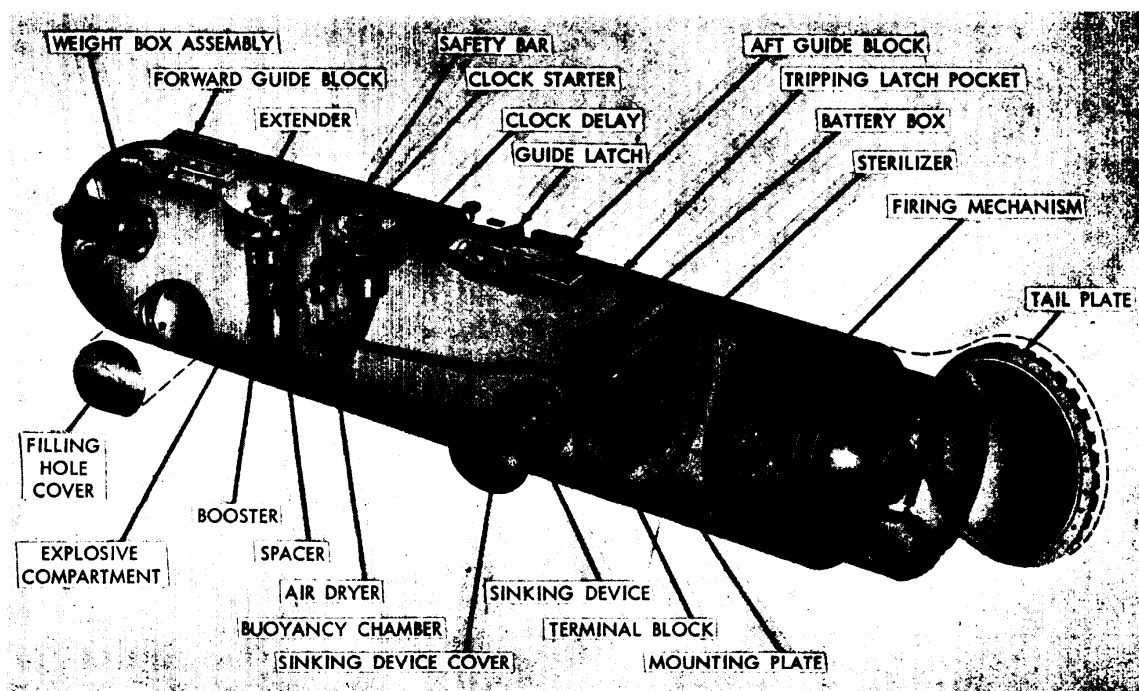


Figure 3-1 Sample Illustration; Location of Components

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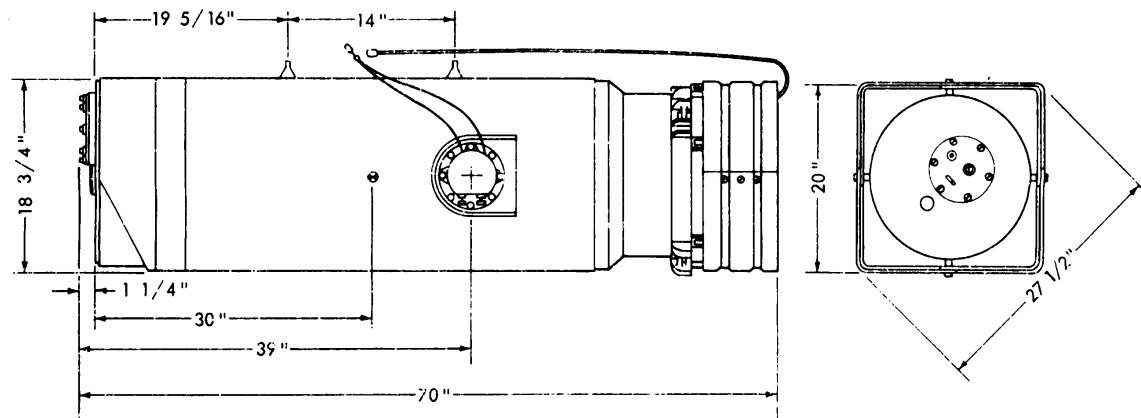


Figure 3-2 Sample Illustration; Dimensional Outline

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SERVICE MINE WEIGHTS			
Item	Operational Assembly		
	A	B	C
Explosive HBX-1	600	600	600
Case, Loaded	900	900	900
Instrument Rack (Assembled) and Flight Gear (Assembled)	150	155	165
Assembled Mine	1050	1055	1065
Mine Crate	150	150	150
Total Gross Weight	1200	1205	1215
Note: All weights in pounds			

Figure 3-3 Sample Table of Weights

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TERMS AND ABBREVIATIONS		
Term	Definition	
EMR	Electromagnetic Radiation	
HERO	Hazards of Electromagnetic Radiation to Ordnance	
RADHAZ	Radiation Hazards	
Look	Closure of the firing mechanism switch caused by a possible ship's signal coming in from the detector	
SYMBOLS		
Symbol	Quantity Represented	Definition
B	Relative target bearing	Angle between vertical plane through own ship centerline and vertical plane through line of sight to present target position, measured in a horizontal plane clockwise from reference axis.
Cc	Consort course	Angle between north-south vertical plane and vertical plane through consort speed vector, measured in horizontal plane clockwise from north.
Co	Own ship course	Angle between north-south vertical plane and vertical plane through own ship centerline, measured in horizontal plane clockwise from north.
Ct	Target course	Angle between north-south vertical plane and vertical plane through target speed vector, measured in horizontal plane clockwise from north.

Figure 3-4 Sample Table; Definition of Terms

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REFERENCE PUBLICATIONS	
Number	Title
OD 28642	General Requisites for Mine Mk 52 Mod 8 (U)
NOLR 1247	Operational Characteristics of Mine Mk 52 Mod 8 (U)
NAVWEPS OP 3232	Mine Loading in Aircraft (U)
NAVWEPS TECH MANUAL 16-1-529	Radio Frequency Hazards Manual (U)
NAVWEPS OP 1452	Mine Accessories; Description and Instructions for Testing (U)
NAVWEPS OP 1860 Vols. 1, 2, and 3	Mine and Depth Charge Test Sets; Description and Maintenance Procedures (U)
NAVWEPS OP 2567 Vol. 1, Chap. 13	Firing Mechanism, Underwater Mine, Mk 35 Mod 0; Description and Instructions for Testing (U)
NAVSHIPS 92051	Instruction Book for Multimeter AN/PSM-4A

Figure 3-5 Sample Table; Reference Publications





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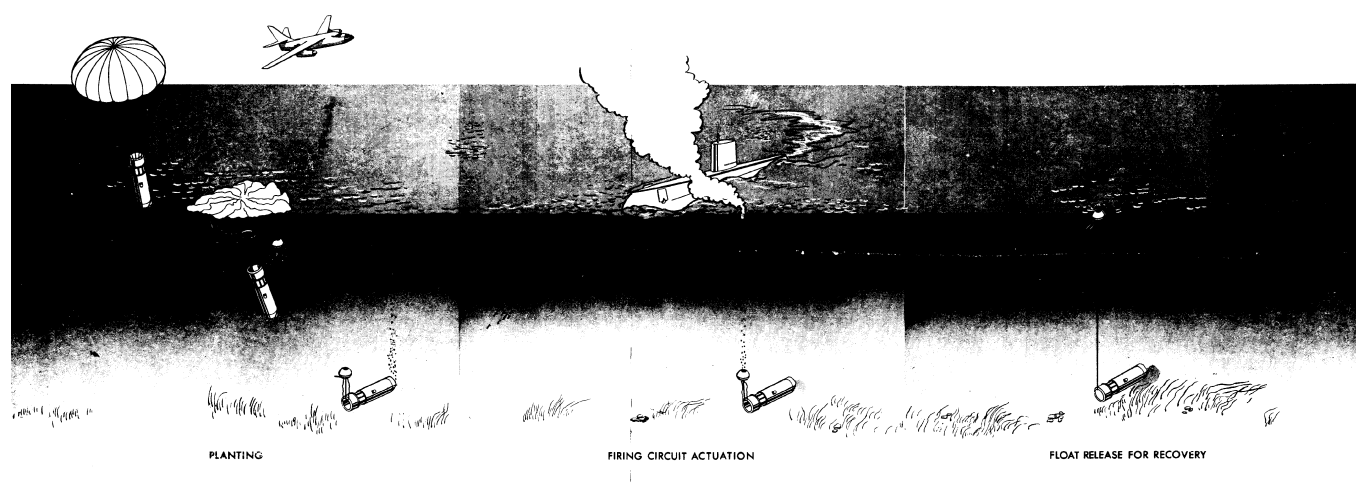


Figure 3-6 Sample Illustration; Drill Mine Sequence of Operation

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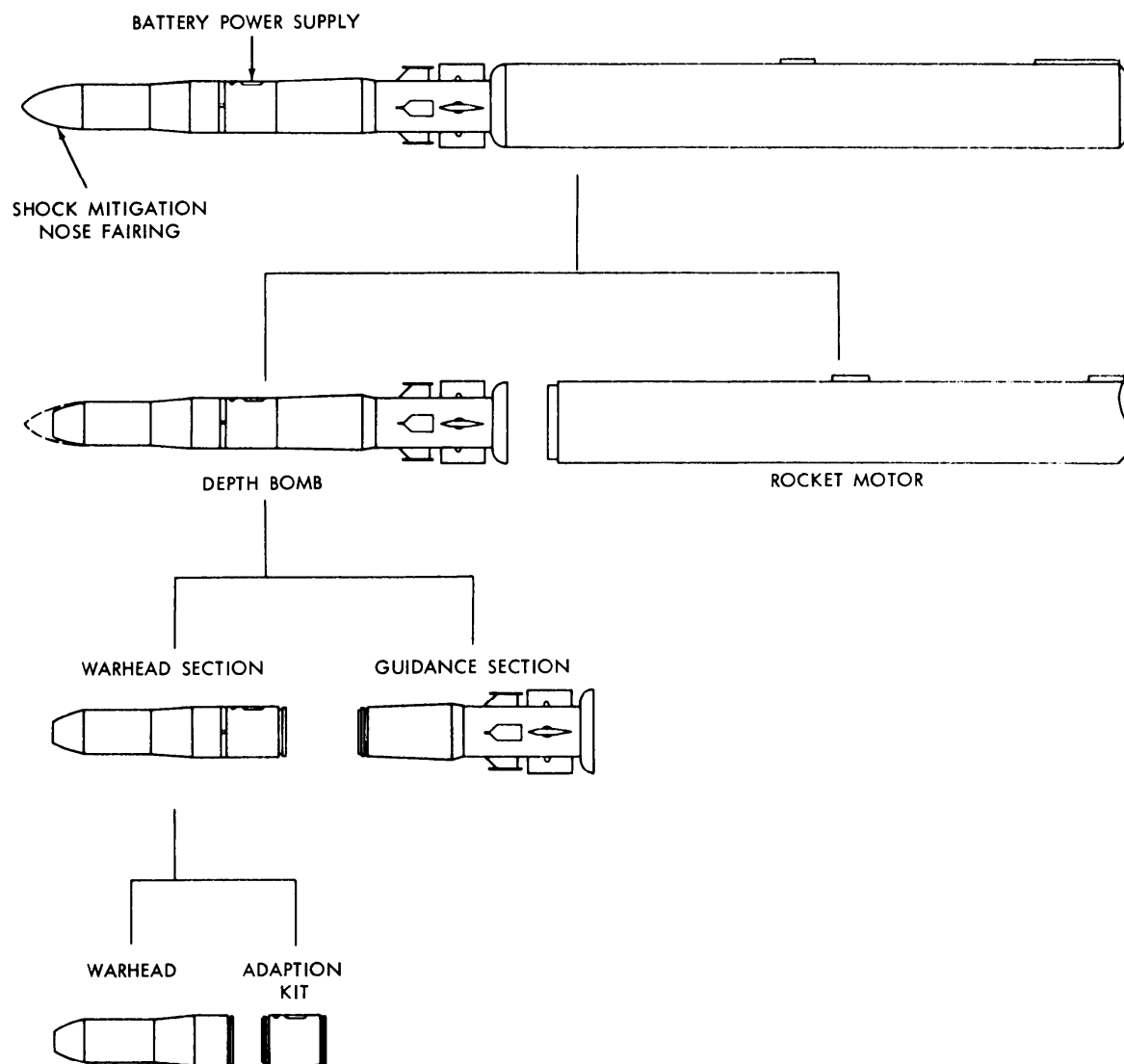


Figure 3-7 Sample Illustration; Diagrammatic Break-Down

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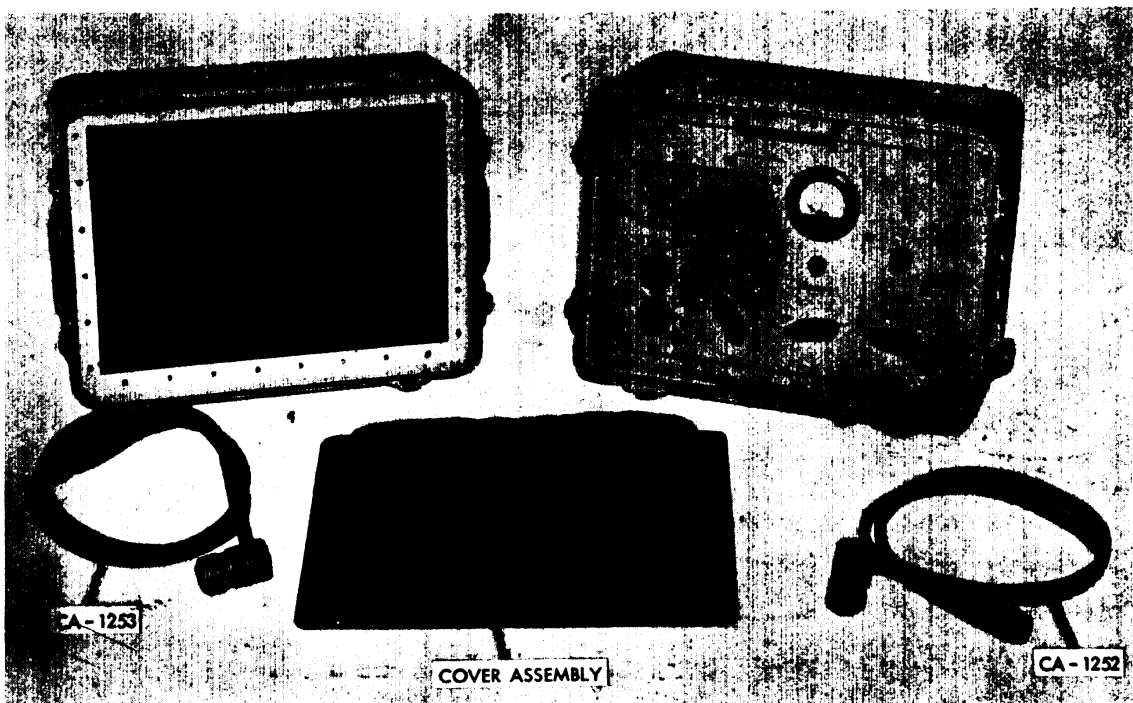


Figure 3-8 Sample Illustration; Composite Test Set Illustration

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Table 4-3 COMPONENT AND MINE TESTS			
Component	Test	Test Set	References
Arming Device Mk 5 Mod 1*	Pressure, electrical testing	Mk 250 Mod 0	NAVWEPS OP 1452
Assembled Mine Battery Test**	Voltage tests	Mk 451 Mod 0	NAVWEPS OP 3210
Assembled Mine System Test**	System test, voltage tests on battery, and verification that the arming device and clock delay switches are open	Mk 464 Mod 0	NAVWEPS OP 3210
Clock Delay Mk 21 Mod 0	Insulation resistance, continuity	Mk 454 Mod 0	NAVWEPS OP 9406
Control Unit Mk 66 Mod 1	Continuity, battery leakage	Mk 246 Mod 0	NAVWEPS OP 1452
Explosive Fitting Mk 1 Mod 1	Bridge wire resistance	Mk 303 Mod 0	NAVWEPS OP 1452
Firing Mechanism Mk 35 Mod 0	Operational test	Mk 480 Mod 0	NAVWEPS OP 8762
Sterilizer Mk 10 Mod 0	Current drain and continuity	Mk 204 Mod 0	NAVWEPS OP 1452
<p>*The explosive-loaded arming device has been tested; no testing is required or permitted in the field.</p> <p>**The assembled mine tests are identical to the instrument rack tests except that the signals are provided through the detectors.</p>			

Figure 3-9 Sample Table; Component and Assembly Tests

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**MINE CASE PREPARATION**

The mine case is uncrated, placed on a dolly, and disassembled to receive mine components and subassemblies. All items removed in the following procedures are set aside for reuse.

The following materials are required to perform this job.

1. One Mine Case Mk 81 Mod 0
2. One mine dolly
3. One hoist, with capability of at least 1500 lbs
4. One two legged sling with hooks
5. One speeder handle,  $\frac{1}{2}$ -inch square drive
6. One socket, 9/16-inch,  $\frac{1}{2}$ -inch square drive
7. One universal joint,  $\frac{1}{2}$ -inch square drive

**UNCRATING THE MINE CASE.**

Orient the mine case so that the suspension lugs are up. Perform the following steps to remove the mine case from the crate. Refer to Figure X-X as required.

**WARNING**

The booster should be installed in the arming device well. Since the booster is an explosive-loaded device, exercise extreme caution when removing the shipping cover.

1. Unscrew the shipping cover

screw securing the end of the ground strap, and disconnect the ground strap from the mine case and push it aside.

2. Remove the four bolts and washers that secure the sections of the mine crate together.

3. Remove the upper section of the mine crate.

4. Move the mine case from the lower section of the crate and onto a mine dolly.

**PREPARING THE MINE CASE.**

Proceed as follows to prepare the mine case for mine assembly. Refer to Figure X-X as required.

1. Unscrew the remaining blanking plate screws and carefully remove the shipping cover and gasket from the arming device well.

2. Inspect the arming device well and well flange for any obvious damage. Check for a positioning pin on the flange, and for the presence of any gasket material, weld splatter, oil, or any other foreign material. Inspect the booster to be sure the tapped end is out. Verify the presence of a booster pad by gently pushing on the booster. Reinstall the shipping cover and gasket to retain the booster; install the securing screws handtight.

3. Initial and date the proper step on the CHECK-OFF SHEET.

Figure 3-10 Sample Unit Operation

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PROPERLY WORDED, SELF-CONTAINED WARNINGS

When operating rammers,  
be certain that all personnel  
are clear and are aware that  
the rammer is being moved,  
Rammer striking personnel  
could cause serious in-  
jury.

Ensure safing hardware  
(lanyard cover, safety tee,  
and arming tool) is installed  
on the blow-off cover prior  
to dud-ejection of the missile  
to prevent accidental ignition  
of the motor.

POORLY WORDED WARNINGS

During the following operations,  
be certain that personnel are  
clear of rammers.

Ensure safing hardware is  
installed prior to ejection of  
missile.

Figure 3-11 Sample Warnings



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CHECK-OFF SHEET	
Mine Mk 86 Mod 0 Mine Serial _____	Mine Case M k Mod ____ Serial _____
Unit Operation and Job Performed	Initials and Date
Mine Case Preparation 1. Booster and pad installed 2. O-ring surfaces good 3. No missing or damaged parts 4. Case Prepared <div style="text-align: right;">Inspected</div>	<div style="border-bottom: 1px solid black; height: 15px; width: 100%;"></div> <div style="border-bottom: 1px solid black; height: 15px; width: 100%;"></div> <div style="border-bottom: 1px solid black; height: 15px; width: 100%;"></div> <div style="border-bottom: 1px solid black; height: 15px; width: 100%;"></div> <div style="border-bottom: 1px solid black; height: 15px; width: 100%;"></div> <div style="border-bottom: 1px solid black; height: 15px; width: 100%;"></div>
Tail Cover Assembly 1. Blanking plate O-ring installed	<div style="border-bottom: 1px solid black; height: 15px; width: 100%;"></div>

Figure 3-12 Sample Check-Off Sheet

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ASSEMBLY RECORD		
Mine Mk 86 Mod 0 Mine Serial _____		Mine Case Mk _____ Mod _____ Serial _____
Unit Operation	Component	
	Identification	Data
Mine Case Preparation	Mine Case	Mk _____ Mod _____ Serial _____ Explosive Load _____ lbs. Case Weight _____ lbs. Loading Date _____ mo. _____ yr.
Tail Cover Assembly		

Figure 3-13 Sample Assembly/Test Record

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MINE MK 86 MOD 0 MINE CASE PREPARATION	INSTRUCTION SHEET S-1a								
<p><u>JOB DESCRIPTION</u></p> <p>The mine case is uncrated, place on a dolly, and disassembled to receive mine components and subassemblies. All items removed in the following procedures are set aside for reuse.</p> <p><u>MATERIALS REQUIRED</u></p> <p>The following materials are required to perform this job.</p> <p><u>COMPONENTS.</u></p> <ol style="list-style-type: none"> <li>1. One Mine Case Mk 86 Mod 0</li> </ol> <p><u>TOOLS.</u></p> <table style="width: 100%;"> <tr> <td style="width: 50%;">1. One speeder handle, ½-inch square drive</td> <td style="width: 50%;">3. One universal joint, ½-inch square drive</td> </tr> <tr> <td>2. One socket, 9/16-inch, ½-inch square drive</td> <td></td> </tr> </table> <p><u>HANDLING EQUIPMENT.</u></p> <table style="width: 100%;"> <tr> <td style="width: 50%;">1. One mine dolly</td> <td style="width: 50%;">3. One two legged sling with hooks</td> </tr> <tr> <td>2. One hoist, with capability of at least 1500 lbs</td> <td></td> </tr> </table>		1. One speeder handle, ½-inch square drive	3. One universal joint, ½-inch square drive	2. One socket, 9/16-inch, ½-inch square drive		1. One mine dolly	3. One two legged sling with hooks	2. One hoist, with capability of at least 1500 lbs	
1. One speeder handle, ½-inch square drive	3. One universal joint, ½-inch square drive								
2. One socket, 9/16-inch, ½-inch square drive									
1. One mine dolly	3. One two legged sling with hooks								
2. One hoist, with capability of at least 1500 lbs									
<p><u>PROCEDURE</u></p> <p><u>UNCRATING THE MINE CASE.</u> Orient the mine case so that the suspension lugs are up. Perform the following steps to remove the mine case from the crate. Refer to Figure 1 as required.</p> <p style="text-align: center;"><b>WARNING</b></p> <p>The booster should be installed in the ramming device well. Since the booster is an explosive-loaded device, exercise extreme caution when removing the shipping cover.</p> <ol style="list-style-type: none"> <li>1. Unscrew the shipping cover screw securing the end of the ground strap, and disconnect the ground strap from the mine case and push it aside.</li> <li>2. Remove the four bolts and washers that secure the sections of the mine crate together.</li> <li>3. Remove the upper section of the mine crate.</li> </ol>									

Figure 6-1 Sample Instruction Sheet

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NAVWEPS OP 8701 VOLUME 1	
Mine Mk 86 Mod 0; The Service Mine; Description and Instructions for Assembling, Testing and Planting (U)	
Chapter 1 - INTRODUCTION	Delay Arming
General	Arming Circuit
Scope of Publication	Detection and Firing
Logistics of Mine Handling	Sterilization
Modular Component System	
Operational Assemblies	Chapter 3 - DESCRIPTION OF COMPONENTS
Weight and Dimensions	AND TEST EQUIPMENT
Safety Features	General
Concept of Electromagnetic	Section 1 - Service Mine Components
Radiation (EMR)	General
Versatility	Air Dryer
Planting Speeds and Altitudes	Arming Device
Planting Depth	Arming Wires
Bottom Conditions	Batteries
Reference Publications	Booster
	Cable Assemblies
	Case
	Clock Delay
	Crate
	Explosive Fittings
	Flight Gear
	Instrument Rack
	Spacers
	Sterilizer and Resistor Plug
	Thermostatic Switch
	Water Filter
	Section 2 - Test Equipment
	General
	Test Set Mk 451 Mod 0
	Test Set Mk 464 Mod 0
	Multimeter (F6625-643-3399)
Chapter 2 - FUNCTIONAL DESCRIPTION	
AND FIRING SYSTEM	
General	
Section 1 - Firing System	
General	
Firing Mechanism, Magnetic	
Search Coil	
Firing Mechanism, Pressure	
Pressure Detector	
Control Box	
Actuation Counter	
Section 2 - Functional Description	
General	
Mine Cycle	
Operation During Planting and Arming	

Figure 6-2 Sample Assembly and Test Manual Outline (One Part Manual) (Part A)

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<b>Chapter 4 - ASSEMBLY INFORMATION</b>	<b>Flight Gear Assembly (Operational Assembly 02)</b>
Section 1 - General Information	<b>Flight Gear Assembly (Operational Assembly 03)</b>
General	<b>Flight Gear Assembly (Operational Assembly 04a)</b>
Logistics of Mine Handling	Section 2 - Assembly of Components
Check-Off Sheet	General
Assembly Record	Search Coil Installation
Component and Assembly Tests	Instrument Rack Installation
Shop Equipment	Air Dryer and Tail Cover Installation
Tools	Flight Gear Installation
Spare Parts	Section 3 - Tests
Bulk Materials	General
O-rings	Assembled Instrument Rack Battery Test
Painting	Assembled Instrument Rack System Test
Lubrication	Assembled Mine Battery Test
Section 2 - Reproducible Forms	Assembled Mine System Test
General	Chapter 6 - PREPARATION FOR PLANTING
Mine Assembly Flow Chart	General
Check-Off Sheet	Control Unit Mk 66 Mod 2 Installation
Assembly Record	Control Unit Mk 112 Mod 0 Installation
Chapter 5 - MINE ASSEMBLY AND TEST	Arming Device Installation
General	Arming Device Arming Wire Installation
Section 1 - Subassembly Operations	Control Unit (Mk 66 Mod 2) Arming Wire Installation
General	Control Unit (Mk 112 Mod 0) Arming Wire Installation
Mine Case Preparation	Preloading Installation
Battery Pack Assembly	Arming Wire Attachment to Aircraft at Loading
Instrument Pack Assembly	Arming Device Soluble Washer Installation
Operational Settings	Prelaunch Inspection
Assembled Instrument Rack Battery Test	
Assembled Instrument Rack System Test	
Tail Cover Assembly (New)	
Tail Cover Assembly (Old)	

Figure 6-2 Sample Assembly and Test Manual Outline (One Part Manual) (Part B)

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NAVWEPS OP 8701 VOLUME 1 PART 2		
Mine Mk 86 Mod 0; The Service Mine; Description and Instructions for Assembling, Testing, and Planting; Instruction Sheets (U)		
PROCEDURAL INTRODUCTION	ASSEMBLY	A-1a A-2a A-3a A-4a
Section 1 - General Information	Search Coil Installation	
General	Instrument Rack Installation	
Logistics of Mine Handling	Air Dryer and Tail Cover	
Instruction Sheets	Assembly Installation	
Check-Off Sheet	Flight Gear Installation	
Assembly Record		
Component and Assembly Tests	TEST	
Shop Equipment	Assembled Instrument Rack	T-1a
Tools	Battery Test	
Spare Parts	Assembled Instrument Rack	T-2a
Bulk Materials	System Test	T-3a
O-rings	Assembled Mine Battery Test	T-4a
Painting	Assembled Mine System Test	
Lubrication		
Section 2 - Reproducible Forms	PREPARATION FOR PLANTING	
General	Control Unit Mk 66 Mod 2	P-1aA
Mine Assembly Flow Chart	Installation	
Check-Off Sheet	Control Unit Mk 112 Mod 0	P-1aB
Assembly Record	Installation	P-2a
	Arming Device Installation	
	Arming Device Arming Wire	P-3a
	Installation	
	Control Unit (Mk 66 Mod 2)	P-4aA
	Arming Wire Installation	
	Control Unit (Mk 112 Mod 0)	P-4aB
	Arming Wire Installation	P-5a
	Preloading Inspection	
	Arming Wire Attachment to	P-6a
	Aircraft at Loading	
	Arming Device Soluble Washer	P-7a
	Installation	
SUBASSEMBLY		
Mine Case Preparation	S-1a	
Battery Pack Assembly	S-2a	
Instrument Pack Assembly	S-3a	
Operational Settings	S-4a	
Tail Cover Assembly (New)	S-5aA	
Tail Cover Assembly (Old)	S-5aB	
Flight Gear Assembly (02)	S-6aA	
Flight Gear Assembly (03)	S-6aB	
Flight Gear Assembly (04)	S-6aC	

Figure 6-3 Sample Assembly and Test Manual Outline (Second Part of a Two-Part Manual)





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