

MIL-M-23530A (SH)
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 SUPERSEDING
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 (See 6.5)

MILITARY SPECIFICATION

MOCK-UPS OF MAIN AND AUXILIARY SHIPBOARD MACHINERY SPACES

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

1. SCOPE

1.1 Scope. This specification covers the requirements for the development and presentation of mock-ups of main and auxiliary shipboard machinery spaces and the requirements for mock-up booklet and other supporting documentation. Mock-ups will normally be required for spaces such as the engine room, fire room, auxiliary spaces, fairwater, uptakes, fan rooms, countermeasure launcher room, torpedo room, or other spaces or stations, as specified (see 6.2.1).

1.2 Classification. Mock-ups of machinery spaces and equipment components shall be of the types and classes specified in 1.2.1 and 1.2.2, as specified (see 6.2.1).

1.2.1 Types. Machinery space mock-ups shall be of the following types:

- Type I - Reduced scale.
- Type II - Full scale.

1.2.2 Classes. Equipment components and systems shall be of the following classes:

- Class 1 - Exact reproduction of shape and external dimensions.
- Class 2 - Reproduction of general shape and major external dimensions in sufficient detail to permit easy identification and to ensure arrangements compatible with all adjacent equipment, components, and systems.
- Class 3 - Reproduction to show volume occupied by an item by use of blocks, other simple shapes, or combinations of shapes.

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following document, of the issue in effect on date of invitation for bids or request for proposal, forms a part of this specification to the extent specified herein:

STANDARD

MILITARY
 MIL-STD-129 - Marking for Shipment and Storage.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of the specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Ship Engineering Center, SEC 6124, Department of the Navy, Washington, DC 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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NATIONAL FIRE PROTECTION ASSOCIATION
National Electric Code.

(Application for copies should be addressed to the National Fire Protection Association, 470 Atlantic Avenue, Boston, Massachusetts 02210.)

UNIFORM CLASSIFICATION COMMITTEE
Uniform Freight Classification Ratings, Rules and Regulations.

(Application for copies should be addressed to the Uniform Classification Committee Agent, G. F. Earl, Tariff Publication Officer, Room 1106, 222 South Riverside Plaza, Chicago, Illinois 60606.)

NATIONAL CLASSIFICATION BOARD
National Motor Freight Classification Classes and Rules.

(Application for copies should be addressed to the ATA Tariff Section, 1616 P Street, N.W., Washington, DC 20036.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 General. Unless otherwise specified in the contract (see 6.2.1), mock-up construction, including any required approvals, shall be completed prior to release of construction drawings for ship construction. Mock-up construction shall be based on drawings developed by the contractor, and shall reflect NAVSEA direction and guidance provided by submission to the contractor of documents such as drawings, specifications, schedule of equipment requirements, Design Work Studies (DWS), and other details as required to reflect design concepts, including shipboard compartmentation, passageway configuration, space allocation, and major structural interferences. Drawings required for Government-furnished equipment and material will be provided by NAVSEA or a NAVSEA-authorized source. In areas where NAVSEA direction and guidance is not provided, the contractor shall assume responsibility for development of such areas.

3.2 Design. Contractor shall design the mock-up to facilitate evaluation of the proposed design in order to determine suitability with respect to functional and operational requirements in conformance with 3.2.2. Components shall be reproduced to the detail required to enable such functions to be readily simulated.

3.2.1 Details. Mock-up shall be in sufficient detail to correctly depict actual shipboard heights, clearances, and other dimensional requirements. Space perimeters shall be defined by inclusion of false decks, decks, overhangs, bulkheads, and interfering stanchions, beams, and girders. All items of machinery and equipment shall be shown, and perimeters shall be defined by reproduction to the detail required as specified herein and shall include foundations, shock mounts, and items such as interconnecting conduit, pipe, tanks, manifolds, panels, gageboards, gratings, and cables, and access requirements for operation, control, and maintenance. Component dimensions shall include insulation where used over equipment and piping. Where applicable, and significant for operation, flow direction of material (such as in pipes and valves) and of personnel (from a human factors viewpoint) shall be shown. For type II, flushing breaks, test connections, transition welds, and control and sensing elements shall be identified. Additionally, obstructions or intrusions into the space of items such as ventilation, piping, lighting, insulation, and wireways shall be modeled or simulated as required for evaluation of impact.

3.2.2 Function. Mock-ups shall be capable of demonstrating compliance with ship design and functional requirements by consideration of the following:

- (a) Functional operability, including human factors engineering concepts, manning, personnel requirements, and general safety features.
- (b) Elimination of interferences by indication of actual operating space requirements.
- (c) Provision of optimum control area arrangement and operating facilities (gages, instruments, thermometers, valves, controls, telephones, indicators, and other items requiring visual, sound, or manual observations or attention in the operation of the plant).
- (d) Capability for continued system operation with shutdown or removal of a duplicate unit for repair.

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- (e) Provision of safety features such as shields around high pressure fuel joints, flanges, and equipment with hot surfaces.
- (f) Consideration of environmental conditions, such as not locating equipment sensitive to high temperatures and humidity where adverse effect on life or performance would result and not locating small piping where it can be damaged by being stepped on or struck.
- (g) Provisions for maintainability, including access and spatial requirements and methods of removing equipment from machinery spaces for maintenance or replacement, and access in all bilge regions for maintenance of all piping, foundations, and ship's structure.
- (h) Obtaining the most direct run of piping and wiring.
- (i) Consideration of interface compatibility, including interrelationships with other equipments, systems, and spaces.
- (j) Ability to identify new or alternative material or equipment requirements.
- (k) Provide for checking accuracy of Government-Furnished Information (G.F.I.).
- (l) Ability to demonstrate that systems, subsystems, and components (such as cabinets, cables, valves, piping, foundations, lighting, and ventilation) can be installed, operated, maintained, adjusted, and repaired within allocated spaces and without interference.
- (m) Efficiency of flow path sequences to facilitate operation, maintenance, and overhaul and identification of potential problems.

3.2.3 Type I. Type I mock-ups shall be in reduced scale. Unless otherwise specified (see 6.2.1), type I shall be constructed to a scale of 1-1/2 inches equal to 1.0 foot.

3.2.3.1 General. Unless otherwise specified (see 6.2.1), type I shall be class 2 or better reproductions. Piping 3 inches in diameter and larger measured over the insulation, shall be shown. Gage piping, details of gage dials, instrument faces, and moving parts are not required to be shown. Class 1 may be designated for specific items where critical simulations are required to be demonstrated. Where mock-ups are required to be shipped from the point of fabrication, they shall be constructed in sections subdivided as required to accommodate road or rail transport limitations.

3.2.3.2 Space relationship. Where mock-ups are required for contiguous spaces, mock-up sections shall be arranged in the same relationship. Where an adjacent space is not required to be fully mocked-up as specified herein, but where functional and operation relationships to the mocked-up space is important, such spaces or compartments shall be roughed in by modeling decks, bulkheads, and doorways as specified (see 6.2.1).

3.2.3.3 Visibility. A clear view of the mock-up compartment may be provided by the elimination of the simulated overhead decking; beams, girders, piping, and ducting shall be shown, however, and shall be removable as a unit or as sub-units. Openings representing partial removal of plating from bulkheads and shell shall be used to the degree necessary to provide visibility to all parts of the mock-up and accessibility during construction and modification. Alternative means to accomplish these objectives may be used.

3.2.4 Type II.

3.2.4.1 General. Type II shall be developed to permit actual demonstration of arrangement features as required to comply with 3.2.2. Mock-up equipment need not be electrically operable. When available, the type I mock-up shall be used as a guide for design of a type II mock-up. All structure, equipment, systems, and all other items which occupy space in the shipboard compartment represented by the mock-up shall be included in the mock-up, unless otherwise specified herein or otherwise specifically approved by NAVSEA.

3.2.4.2 Class. Unless otherwise specified (see 6.2.1), components shall be fabricated in accordance with the following designations or better, as applied to general representative items:

- (a) Class 1: Lighting.
- (b) Class 2: Hull equipment, machinery, valves, piping, gageboards.
- (c) Class 3: Ladders, gratings, ducts, cabling, wireways, junction boxes, connectors, electrical switchboards, panels, controllers, telephone booths, water fountains.

3.2.4.3 Lighting. Actual lighting conditions as proposed for shipboard installation shall be provided. Where instrument panels, scope faces, and other instrumented surfaces are normally illuminated by internal lighting, simulated lighting methods may be used.

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3.2.4.4 Hull. Hull structure shall include shell plating, frames, bulkheads, stiffeners, and support structures.

3.2.4.5 Piping. Piping shall be shown except for gage piping downstream of the root cutout valve. Gage piping downstream of the root cutout valve shall be shown when necessary to ensure adequate arrangements. Gageboards and gages shall be shown in all cases. Pipe hangers for systems subject to stressing shall be shown in proper locations.

3.2.4.6 Gageboards. Gageboards shall be oriented in accordance with manufacturer's drawings. Instrument faces may be photographs or free hand sketches.

3.2.4.7 Stowages, work benches, and preventive maintenance work centers. Stowage lockers, cabinets and brackets for storing items such as repair parts, tools, rags, grease, life jackets, masks, first aid kits, instruments, lifting gear, manuals, and other items required to be stored in the space to support operation and maintenance shall be shown. In addition, work benches and preventive maintenance work center furniture such as desks and file cabinets shall be shown.

3.3 Departure notice. During the development of mock-up drawings and during construction, the contractor shall perform a continuing evaluation of the proposed design and arrangements and make such changes considered necessary for a successful design. For each change or deviation incorporated, the contractor shall prepare and submit a departure notice to NAVSEA. The notice shall cite the specific departure from the guidance furnished, describe the departure in detail, and provide reasons for these departures (see 6.2.2).

3.4 Construction.

3.4.1 Material. Material selection shall be made by the contractor, and may be wood, plastic, metal, cardboard, or other material consistent with the mock-up type and class requirements, satisfy mock-up objectives, and be economical in construction and maintenance costs. Structural envelopes shall be capable of supporting attachments, where required, and maintaining design configuration without distortion. For type II mock-ups, decks, platforms, walkways, ladders, and similar items shall be capable of supporting equipment and personnel without failure or otherwise presenting a hazard during inspections. Also, for type II mock-ups, actual equipment, piping, gear, and fixtures representing the proposed design may be used in the event such items are readily available and their use will result in reproduction cost savings.

3.4.2 Machinery and equipment. Where space limitations are critical and where machinery and equipment components require "pull space" for disassembly and maintenance, models shall be constructed so that such requirements can be simulated or demonstrated. Large components which require special handling gear shall be constructed so that they may be disassembled to demonstrate handling. The contractor shall submit for NAVSEA approval a list of handling demonstrations to be conducted in the mock-up.

3.4.3 Identification. Identification labels shall be used to identify the applicable ship, mock-up scale for type I, compartment or space, and spaces immediately adjacent to a mock-up space. Areas within the mock-up space shall be identified by function and labeled accordingly. Shipboard locations such as frame numbers and ship's centerline shall be identified and marked. Equipment items shall be identified by function, with nomenclature included when space is available. Identification may consist of identification plates or labels. Piping shall be identified and marked with function, size, insulation thickness, and direction of flow.

3.4.4 Painting. Painting the mock-up or parts thereof will not be required. Colored paints may be used, however, as an aid to identification and to enhance the ability to simulate functional, operational, or maintainability requirements.

3.4.5 Safety.

3.4.5.1 Electrical wiring used in mock-ups for lighting and other purposes shall be in accordance with National Electric Code and local government and industrial regulations.

3.4.5.2 Plastic and composition material used in the construction of mock-up shall be of fire-retardant and non-toxic fume types.

3.4.5.3 Where combustible materials (such as plywood, wood, or fiberboard) are used in construction, such materials shall be impregnated with fire-retardant chemicals to the extent feasible.

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3.4.5.4 Adequate fire prevention and protection measures shall be immediately available at the site or in close vicinity of the mock-up. These measures shall be in accordance with local fire regulations for the area in which the mock-up is being built.

3.5 Technical data. The contractor shall prepare the following technical data in accordance with the data ordering documents included in the contract or order (see 6.2.2) and as specified in 3.5.1 through 3.5.3.

3.5.1 Mock-up booklet. A mock-up booklet shall be prepared and be completed with completion of the mock-up. Five copies of the booklet shall be shipped with the mock-up, when applicable, or one copy provided for each participant during formal presentations in accordance with 3.6.3 (see 6.2.2). The booklet shall be subtitled "Detailed Design and Rationale" and should be unclassified if feasible. The booklet shall be in type-written form on 8 X 10-1/2 inch paper with stapled binding. Foldouts, if required for clarity, may be used but shall be held to a minimum. The booklet shall include the following as a minimum:

- (a) Table of contents.
- (b) General characteristics of the ship.
- (c) Plan and elevation view sketches showing the relationship of mock-up spaces to adjacent shipboard spaces.
- (d) Rationale for any recommended deviations from characteristics, contract drawings, or contract guidance drawings.
- (e) Flow path drawings depicting all machinery flow paths from their installed position to their logistic hatch.
- (f) Latest machinery arrangement drawings for each mock-up space to be inspected.
- (g) The latest diagrammatics for the systems to be inspected.
- (h) Rationale for any unusual design features.
- (i) Manning chart for applicable spaces.
- (j) Copies of drawings prepared as specified herein (see 3.5.2).

3.5.1.1 Revisions. Within 30 working days following the completion of a formal presentation, the contractor shall update the mock-up booklet to conform to recommended NAVSEA changes (see 3.6.3.3) and submit five copies as specified (see 6.2.2).

3.5.2 Drawings. Sets of drawings shall be prepared showing plan, elevation, and section views as required. Drawings shall be delivered to NAVSEA at least 10 working days prior to a scheduled mock-up inspection (see 6.2.2). Drawings shall reflect the current design development or otherwise identify specific differences or lags in implementing changes to the mock-up. Drawings submitted shall also comply with the following:

- (a) A reproducible and two prints shall be submitted.
- (b) A listing shall be submitted with drawings, showing all changes in design implemented during mock-up development, including identity of source of proposed or directed change; origination, approval, and implementation dates; and status of currently proposed or pending changes.
- (c) Photographs, as required, shall be submitted with drawings.
- (d) Selected portions of the drawings may be incorporated in the mock-up booklet as required for illustration, reduced in size for convenience.

3.5.2.1 Revisions. Within 30 working days following completion of a formal presentation, the contractor shall update drawings to conform to NAVSEA-directed changes and submit copies as specified in 3.5.2.

3.5.3 Photographs. Photographs shall be provided to record the process of mock-up development (see 6.2.2). Photographs shall show all items of machinery and equipment. Unless otherwise specified (see 6.2.1), five sets of photographs shall be taken at each interval equivalent to mock-up completion milestones of 50, 75, and 100 percent. Additional photographs shall be provided as required following completion of formal presentations for inspection (see 3.6.3). Unless otherwise specified (see 6.2.1), one complete set of photographs shall be provided following the final inspection and acceptance of the mock-up.

3.6 Formal presentations for inspections. The contractor shall conduct formal mock-up presentations for inspections. Presentations shall address and include demonstrations of compliance with 3.2.2. Presentations will be sponsored by NAVSEA by designation of attending personnel which shall include contractor and shipbuilder representatives. Contractor shall coordinate invitations with NAVSEA. Presentations shall be conducted at the location specified by the contract (see 6.2.1).

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3.6.1 Mock-up availability. In general, mock-up availability for presentations shall be scheduled so as not to delay production of ship construction drawings or ship construction. Unless otherwise specified (see 6.2.1), the mock-up shall be available upon completion and at the following times:

- (a) Type I shall be available at or prior to elapse of the 40 percent point of the contract period covering detailed ship design.
- (b) Type II shall be available prior to release of ship construction drawings. If the ship and mock-up construction schedules are such that the entire mock-up cannot be completed before release of any ship construction drawings, the mock-up shall be available and approved in parts as required to support the ship construction drawing schedule.

Following completion, the mock-up shall be made available for additional presentations as required by NAVSEA and as specified (see 6.2.1).

3.6.2 Notification. Contractor shall notify NAVSEA of mock-up availability no less than 3 weeks prior to time when a mock-up will be available for a forthcoming formal presentation.

3.6.3 Services. Contractor shall plan presentations to function as forums wherein potential design deficiencies may be discussed and explored and possible changes may be considered. The contractor shall document noted deficiencies and recommended changes, coordinate recommended changes (as directed by NAVSEA) to determine impact on a dependent discipline (such as human factors versus safety, or operation versus maintainability), and incorporate approved changes in the mock-ups and applicable data such as drawings, photographs, and mock-up booklet. Contractor shall also provide the following:

- (a) Technically qualified personnel at the mock-up site to answer questions.
- (b) Copies, at the mock-up site, of the applicable Ship Specifications and the latest machinery arrangement drawings for the spaces to be inspected.
- (c) Personnel to rearrange the mock-up as recommended by NAVSEA.
- (d) Clerical assistance for taking notes during the formal presentations and for preparation of inspection reports as required.
- (e) Copies of mock-up booklets at the mock-up site in conformance with 3.5.1.

3.6.3.1 For type II mock-ups, contractor shall provide the following additional services:

- (a) Qualified personnel available to man representative portions of the mock-up, as requested by NAVSEA.
- (b) A conference room in the vicinity of the mock-up site.

3.6.3.2 Presentation personnel. Presentation personnel shall be individuals familiar with the detail design, design development history and rationale, and relationship or impact of design on operational requirements.

3.6.3.3 Inspection report. Within three working days following completion of a formal presentation for inspection, contractor shall prepare and submit to NAVSEA an inspection report listing participating personnel, command or company affiliation, attendance dates, and including minutes providing a summary of covered topics and applicable action to be taken as directed by the NAVSEA representative (see 6.2.2).

3.7 Informal inspections. Following receipt of due notice, contractor shall provide for informal inspections to be conducted by NAVSEA technical personnel. Informal inspections will be conducted to monitor development of detailed engineering aspects of the mock-up such as structure, equipment, machinery, cables, ventilation, and piping components, and to re-inspect, when applicable, corrective actions taken to remedy previously-noted discrepancies. Informal inspections will normally be performed prior to scheduled formal presentations for inspections. During informal inspections, contractor shall furnish the services of personnel specialists in each functional area as required for NAVSEA to conduct inspections to the desired depth of coverage.

3.8 Disposition of mock-ups. Mock-ups shall be retained by the contractor and maintained intact until receipt of notification by NAVSEA that mock-ups may be destroyed or dismantled.

4. QUALITY ASSURANCE PROVISIONS

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4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Informal inspections. Contractor personnel shall conduct informal inspections as defined in 3.7 to monitor progress and development of the mock-up. Contractor shall also provide for informal inspections to be conducted by NAVSEA personnel in conformance with 3.7.

4.3 Formal presentations for inspection. Formal presentations in accordance with 3.6 shall be conducted to demonstrate compliance with the requirements of this specification.

4.4 Inspection of preparation for delivery. Preservation-packaging, packing, and marking shall be inspected for compliance with section 5 of this specification.

5. PREPARATION FOR DELIVERY

(The preparation for delivery requirements specified herein apply only for direct Government procurements. For the extent of applicability of the preparation for delivery requirements of referenced documents listed in section 2, see 6.4.)

5.1 Packing.

5.1.1 Type I mock-ups.

5.1.1.1 Level C packing. Type I mock-ups shall be packed in containers acceptable to the common carrier, which will insure safe delivery at destination in a satisfactory condition at the lowest applicable rate. Container packing, or method of shipment shall comply with Uniform Freight Classification Ratings, Rules, and Regulations or National Motor Freight Classification Classes and Rules or other rules as applicable to the mode of transportation. Containers shall be able to withstand storage, rehandling, and reshipment without the necessity of repacking.

5.1.1.2 Marking. In addition to any special marking required by the contract or order, marking of shipping containers shall be in accordance with MIL-STD-129.

5.1.2 Type II mock-ups. Type II mock-ups will be inspected at the location where constructed, and no delivery is required.

6. NOTES

6.1 Intended use. Mock-ups are intended to be used as a tool to assist in the development of the construction drawings during the detail design of a new ship or class of ships or during major overhauls. Mock-ups also function as an aid in development of improved ship production techniques.

6.2 Ordering data.

6.2.1 Procurement requirements. Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Space to be mocked-up (see 1.1).
- (c) Type and class required (see 1.2).
- (d) Completion date when other than specified (see 3.1).
- (e) For type I, whether scale is other than 1-1/2 inches equal to 1.0 foot (see 3.2.3).
- (f) For type I, whether class is other than class 2 (see 3.2.3.1).
- (g) For type I, whether adjacent spaces shall be roughed in and, where required, level of required detail (see 3.2.3.2).
- (h) For type II, whether classes are other than as specified for specific components (see 3.2.4.2).
- (i) Whether number of sets of photographs is other than as specified (see 3.5.3).
- (j) If one set of photographs need not be provided following final inspection and acceptance (see 3.5.3).
- (k) Location where formal presentations shall be conducted (see 3.6).
- (l) Whether mock-up availability is other than specified completion times (see 3.6.1).
- (m) If additional presentations of mock-up are required (see 3.6.1).
- (n) Classification of data if other than unclassified (see 6.3).

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6.2.2 Data requirements. When this specification is used in a procurement which invokes the provision of the "Requirements for Data" of the Armed Services Procurement Regulation (ASPR), the data identified below, which are required to be developed by the contractor, as specified on an approved Data Item Description (DD Form 1664), and which are required to be delivered to the Government, should be selected and specified on the approved Contract Data Requirement List (DD Form 1423) and incorporated in the contract. When the provisions of the "Requirements for Data" of the ASPR are not invoked in a procurement, the data required to be developed by the contractor and required to be delivered to the Government should be selected from the list below and specified in the contract.

<u>Paragraph</u>	<u>Data requirements</u>	<u>Applicable DID</u>	<u>Option</u>
3.3	Notice of revision/specification change notice	DI-E-1126	-----
3.5.1	Manual, technical, preliminary	DI-M-2043	MIL-M-15071 type I
3.5.2	Drawings, engineering and associated lists	DI-E-7031	Level 1 (conceptual and developmental design)
3.5.3	Photographs/movies, model tests	UDI-A-26152	-----
3.6.3.3	Report, inspection	UDI-T-23738	-----

(Copies of data item descriptions required by the contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.)

6.2.2.1 The data requirements of 6.2.2 and any task in section 3, 4, or 5 of the specification required to be performed to meet a data requirement may be waived by the procuring/purchasing activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item procured to this specification. This does not apply to specific data which may be required for each procurement regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 Security classification. Mock-ups, mock-up booklet and drawings, and photographs of the mock-ups will be unclassified unless otherwise specified (see 6.2.1).

6.4 Sub-contracted material and parts. The preparation for delivery requirements of referenced documents listed in section 2 do not apply when material and parts are procured by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.5 Changes from previous issue. The symbol "#" is not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Preparing activity;
Navy - SH
(Project 2090-N074)

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