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S9PHM-00-SPN-010/PHM-1 CL

SHIP SYSTEM SPECIFICATION FOR BUILDING PATROL COMBATANT MISSILE (HYDROFOIL) PHM 1 CLASS (PHM 3 SERIES)

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30 November 1977

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Patrol Combatant Missile (Hydrofoil)
(PHM-1 Class) (PHM 3) Series)

Ship Systems Specification

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1.0-0 GENERAL REQUIREMENTS

These Ship Systems, Specifications describe the technical requirements of the Patrol Combatant Missile (Hydrofoil), PHM 1 class (PHM 3 Series).

The configuration of the ship is identified by the contract and these Ship Systems Specifications, including the two categories of control data (listed in Table 1.0-3B). Government Controlled Baseline and Contractor Controlled Baseline, both as defined. MOD 1

Government Controlled Baseline - consists of the drawings and other data listed in Table 1.0-3B, Section I, II and III. Government Controlled Baseline drawings are NAVSEA drawings forming part of this specification which illustrate design features of the ship from which no departure by the Contractor is permitted unless such departure is specifically approved.

Contractor Controlled Baseline - consists of drawings listed in Table 1.0-3B, Section IV.

The Contractor shall design and construct the ship to the requirements contained in both the Government and Contractor Controlled Baseline. The configuration control of these baselines shall be in accordance with the contract.

Throughout these specifications, requirements which have been accomplished previously for the lead ship design or construction and are being utilized for the follow ships, such as calculations, analyses, shook testing, drawings, and technical publications shall not be repeated, except where the follow ship Contractor has deviated from the lead ship, or are necessary to demonstrate satisfactory workmanship.

The general requirements for design in this specification apply only to new designs : where PHM 1 designs are unchanged for production, the pre-existing design shall remain unchanged. The following requirements do not apply for equipment, components or systems which are duplicates of PHM 1.

(a) First article tests
(b) Development tests
(c) Design approval requirements
(d) Reliability and maintainability studies, calculations and reports, unless specifically stated in Section 1.0-1.4.4, or
(e) Qualification tests; except where specifically required within these specifications.

1.0-0.1 ORDER OF PRECEDENCE

In case of inconsistency between the Ship Systems Specifications and documents referenced therein, the following order of precedence applies:
(a) Ship Systems Specifications
(b) Government Controlled Baseline Documents/Data List and Government Designated Equipment and/or Components (GDE) MOD 6
(c) Contractor Controlled Baseline Data
(d) Referenced Government specifications and standards, NAVSHIPS standard and type drawings, industry standards, NAVSEA and other Government directives, and similar referenced documents not identified in Table 1.0-3B.

Silence of one document with respect to details shown in another shall not be considered as an inconsistency.

1.0-0.2 STANDARDIZATION AND INTERCHANGEABILITY

All ships of this design class shall have the same general ship arrangement and general layout of machinery, equipment and systems.

All ships of this design class under a single construction contract and authorized at one time shall have identical (same part number) machinery and equipment arranged and located identically except as specifically approved by the Supervisor (as defined in Section 1.0-1.3) and, for PHM-6 only, to reflect ship construction without weapons in accordance with schedule A. HMR 99

As used herein, the terms "machinery or equipment" refer to hull, mechanical, electrical, and electronics items that can be maintained by the replacement of parts; the term "functionally interchangeable" means that two or more items are sufficiently alike in all essential respects to permit replacement of one such item by the other in all applications where the item is used without modification of either the item or the system in which the item is used. Systems shall be designed to use the lowest practicable variety of types and sizes of multi-application items (such as valves, motors, and controllers).

1.0-0.3 GENERAL REQUIREMENTS FOR DESIGN AND CONSTRUCTION

1.0-0.3.1 General

This section is intended to serve as a general guide to the standards of design, materials, workmanship, and installation expected of the Contractor.

Requirements of other sections of these specifications, or of referenced industry and Government specifications, and drawings, which are in excess of the requirements of this section, shall have precedence over the requirements of this section.

1.0-0.3.2 Principles Of Design And Construction

1.0-0.3.2.1 Access To Equipment And Machinery. Equipment and machinery shall be designed and installed to facilitate access for use and access for purposes of maintenance, adjustment, or repair. All electronics equipment shall be installed to allow normal operation and in-place maintenance as specified in the equipment technical manuals or installation drawings. Easy removal of machinery is required, without removal of the prime movers except as specified in Section 1.290. Pipes, ducts, and other permanent fittings that require servicing shall not be installed in the space that will be

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inaccessible behind certain equipment (such as deck-mounted front-serviced electric and electronic equipment mounted adjacent to bulkheads). Permanent fittings and structures shall be kept clear of routes required for the removal of machinery.

1.0-0.3.2.2 Habitability. The arrangement drawings establish definite functional relationships which must be maintained in the development of the design.

Features affecting habitability include all elements of design and construction that make a ship more livable and comfortable. They include ventilation and air conditioning, lighting, access, color schemes, noise levels, sheathing, and furniture design. The arrangement of habitability areas shall be such as to maintain a pleasing appearance without compromising functional efficiency. The run of piping, wiring, ventilation ducts and installation of valves and fittings shall be minimized in living areas, staterooms, sanitary spaces, commissary spaces, recreation spaces, and lounges. Piping, wiring and ventilation ducts shall be located to provide maximum clear deck height.

Minimum clear deck height of 1.96 m (6.4 ft.) shall be maintained in working and walking areas throughout the living spaces, berthing spaces, messing and commissary spaces, deckhouse, pilothouse, magazine and passageways. Minimum clear deck height of 1.90 m (6.25 ft.) shall be maintained in working and walking areas of machinery spaces. All projections below this height or items, such as brackets, along walking areas shall be padded to prevent injury to personnel.

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Wherever requirements are specified for the crew and **for** enlisted personnel these terms shall have the following meanings :

"Crew" includes enlisted personnel other than chief petty officers.

"Enlisted personnel" includes chief petty officers in addition to the crew.

1.0-0.3

1.0-0.3.2.3 Nondestructive Testing And Inspection (NDT/I). The design and construction shall include provisions for the use of NDT/I techniques to insure maximum integrity of critical components and structures both in production and throughout the life of the ship. The two major areas to be addressed by the Contractor are:

(a) Struts and Foils - In addition to the production quality assurance provisions of Section 1.0-2.4, the Contractor shall use Foil System Service Life Assurance Requirements, as specified in Section 1.566.1.1, to identify the NDT/I requirements for post delivery inspection of struts and foils. The Contractor shall submit a foil/strut NDT/I production and post-delivery inspection plan based on the above. MOD 4 MOD 6 MOD 4

(b) Hull Structure - In addition to the production quality assurance provisions of Section 1.0-2.4, the Contractor shall identify components, foundations, and structures (exclusive of struts and foils) critical to ship operation, develop post-delivery NDT/I requirements, and submit a hull structure NDT/I production and post-delivery inspection plan based on the QA and NDT/I requirements developed.

The hull structure critical components analysis, hull structure NDT/I requirements and foil/strut and hull structure NDT/I production and post-delivery inspection plans shall be submitted to the Government for approval.

1-O-0.3.3 Materials, Equipment, And Machinery

All material, equipment, and machinery required by these specifications shall be installed or stowed, as appropriate, by the Contractor.

Materials. Except where alternative materials are authorized in accordance with the procedure outlined in the contract or in referenced specifications, all materials which are incorporated into the ship structure or any of the ship equipment or machinery shall conform to the requirements of the referenced specifications or the requirements herein. MOD 1

Instruments, equipment, fittings, paint, insulation, adhesives, or other items containing material or components that would give off noxious fumes at its operating temperature or at any temperature below 93.4 degrees C (200 degrees F) shall not be Installed or applied in manned spaces. For paint and adhesives, this requirement applies after drying or curing are complete.

1.0-0.3.4 Workmanship

1.0-0.3.4.1 Cleaning. All parts, especially those having working surfaces or passages, and all piping shall be kept clean and protected during manufacture and storage, during assembly, and after installation. Chips, shavings, refuse, dirt, and water shall be removed frequently from the ship during construction. Oil spillage shall be removed at the conclusion of each work day. Tanks, and voids shall be clean and pass inspection before being closed. Rubbish shall be removed from places which are to be permanently covered, or which may become inaccessible. Piping and castings shall be cleaned of sand, scale, metallic chips and turnings, and other foreign matter. After heat treatment, strut and foil external surfaces shall be cleaned of all oxide and scale.

1.0-0.3.4.2 Fillets. The provision of fillets, rounded corners, and avoidance of stress concentration in general are matters of proper design. Adequate fillets shall be provided at shoulders, offsets, collars, and other points where change of direction is made.

1.0-0.3.4.3 Arc Strikes And Weld Spatter. Precaution shall be taken to prevent random arc strikes and weld spatter on ship structure, machined surfaces, equipment, high pressure lines, and pressure containers (such as cylinders, flasks, and vessels). These items shall be temporarily shielded when in the vicinity of welding operations. Similar precautions shall be observed when using an oxyacetylene torch for welding or cutting.

1.0-0.3.4.4 Finish. The finish of all metallic surfaces shall be in accordance with the finish indicated on referenced drawings or in applicable Government specifications. If such specifications do not exist, the following is a general guide to the parts of machinery which shall be finish machined:

Bearing, mounting or faying surfaces of machinery bases and foundations which require accurate alinement.

Bearing surfaces for nuts and bolt heads.

Faying surfaces of all projections from the bodies of pedestals, blocks, or other supports meeting finished parts.

Sealing surfaces.

Working parts.

1.0-0.3.4.5 Inspection And Material Identification. All materials, equipment, and machinery purchased, manufactured, or assembled and all work performed under the contract shall be inspected by the Contractor prior to submission to the Government to verify conformance with specification requirements. The Contractor shall offer to the Government only those supplies determined by the Contractor to conform to specification requirements. The Supervisor will reject defective *or improper* materials, equipment, machinery, and workmanship.

The Contractor shall establish and maintain an inspection system in accordance with the contract. The Inspection system shall be set forth in writing and copies furnished to the Supervisor.

The Contractor shall establish and maintain a system of material identification, including handling and inspection, that will ensure the use of specified materials and components. The Contractor shall, upon request of the Supervisor, furnish samples of materials and information concerning their quality and use. Wherever the identity or quality of an item is in doubt, it shall not be installed until its identity or quality has been positively established by tests conducted by the Contractor.

Where certificates of compliance are presented as quality evidence, such certificates shall indicate that the material or equipment was previously tested and met all requirements and shall contain test data, refer to witnessing inspectors, or present other verifiable quality data.

Material, equipment, or machinery which has been inspected and passed shall not be diverted from its intended purpose without approval of the Supervisor.

TABLE 1.0-3B

CONTROLLED BASELINES

NOTES:

1. Table 1.0-3B consists of the following sections:

   I. Government Controlled Baseline - Document/Data List and Government Designated Equipments and/or Components (GDE).
   II. Government Controlled Baseline - Government Designated Equipment and/or Components (GDE). MOD 6
   III. Government Controlled Baseline - Federal Specs./Stds., Military Specs./Stds., NAVSHIPS Std. and Type Dwgs., NAVSHIPS Publications, NAVY Instructions, other Government Documents/Data, Industry Documents/Data List.
   IV. Contractor Controlled Baseline - Documents/Data List.

2. Revisions listed in TABLE 1.0-3B are applicable to this specification unless otherwise specified elsewhere in this specification.

3. Where equipment specifications listed in Section I require configuration control to MIL-STD-480, all class I changes initiated by vendors shall be forwarded by the Shipbuilder to the Navy as a class I ECP. All class II ECP's received from the vendors shall be submitted to the Navy for information. MOD 1

TABLE 1.0

I. GOVERNMENT CONTROLLED BASELINE- DOCUMENT/DATA LIST AND GOVERNMENT DESIGNATED EQUIPMENTS AND/OR COMPONENTS (GDE)

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.	
Gas Turbine Engine, F/B Propulsion	312-80001	G/10-11-78	1.234	HMR 51 & 95
Pump Assy., Foilborne Propulsion	See Section 1.245.2		1.245.2	
Power Unit Assembly, Ships Service	312-80005	J/2-6-80	1.312	HMR 74, 167
Gearbox Assy., Foilborne Propulsion	See Section 1.241.2		1.241.2	HMR 26
Static Frequency Converter 450V, 400 Hz to 450V and 120V, 60 Hz 20KVA	312-80127	L/11-1-79	1.314.1	HMR 47, 152
Reduction Gear Assembly, H/B Propulsion	312-80139	E/12-4-78	1.241.1	HMR 52 & 10[illegible]
Electric Generation System, 8,000 RPM, 450V 240KVA, 400 Hz, three phase	312-80173	L/4-24-78	1.311.1	HMR 44
Sea Water Pump	312-81377	E/1-17-79	1.520.3	HMR 53 & 109R1
Nav. Radar	312-81387	A/8-28-78	1.429.1	HMR 45 & 45R1
Gyrocompass	312-81391	D/2-12-79	1.426.3	HMR 60 & 92 & 109R1
Pump, Auxiliary Systems NATO PHM (-1, Chilled Water Pump)	312-81397	C/9-5-78	1.516	HMR 4 & 62
Test and Evaluation Plan, PHM-1 and PHM-2	D312-80016-2	H/5-10-77	1.0-1.3.11.1	HMR 55 HMR 109R1
Delivery & Acceptance Plan	D312-80056-2	c/4-3-73	1.0-1.3.11.1	HMR 92
PHM Structural Design Loads	D312-80100-1	F/5-9-78	1.0-1.5.3, 1.100-2, 1.566.1.1, 1.566.3.1	HMR 101 HMR 109R1
PHM Foil System Structural Analysis	D312-80143-1	A/5-26-78	1.566.2.3	
Hull Structural Analysis	D312-80144-1	B/5-28-76	1.0-1.5.3, 1.100-2	
Builder's Trials Test Requirements	D312-80243-1	/10-10-74	1.0-1.3.11.1, 1.0-1.3.12	HMR 55
Production PHM Test & Evaluation Program Plan	D312-80243-2	A/3-31-78	1.0-1.3.11, 1.0-1.3.12	HMR 55 HMR 55R2
Production Structural Design Criterion Loads and Allowances	D312-80251-1	/2-4-76	1.100-2, 1.566.1.1, 1.566.2.3	
PHM-3 Plan for Maintenance	D312-80258-2	/6-14-78	1.0-1.6.2.4	HMR 109R1
Quality Assurance Plan (Hull Structure)	D312-80414-1	C/10-25-78	1.0-2.4.1	HMR 42
Quality Assurance Plan (Struts and Foils)	D312-80415-1	B/10-24-78	1.0-2.4.3	HMR 92
Structural Design Loads	D312-80256-1	/2-10-76	1.100-2	HMR 92
Indicator Transmitter	1023D0001 (Ches. Inst. Co.)	N/A	1.426.2	HMR 55
Speed Converter	1023D0650 (Ches. Inst. Co.)	N/A	1.426.2	

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.	
Mid-Ship Section & Transverse Configuration of Frames 3, 15, 25, 30	802-5000457	H/9-25-79	1.100-3	HMR 7R1, 46, 88 119R1, 119R2
NATO PHM Hull Lines	802-5000458	Sh. 1 E/9-25-79 Sh. 2 E/9-25-79	1.100, 1.562	HMR 119R1, 119R2 HMR 119R1, 119R2
Coupling - Flexible	312-81560	/11-30-78	1.0-2.7	HMR 57R1
Production PHM Delivery and Acceptance Plan	D312-80056-3	B/5-29-78	1.0-1.3.12, 1.0-1.3.11.1	HMR 92

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General Arrangement, Machinery	802-5000459	F/10-14-80	1.200, 1.262.2, 1.312 1.551.2-2	HMR 7, HMR 186
Electrical Power System, One-Line Diagram	802-5000461	R/6-30-81	1.300.1, 1.320, 1.313	HMR 167, 21, 50, 80, 80R1 124,119,87,88,110,109R1,199
Generator Protection & Control Diagram	802-5000462	D/8-18-78	1.311.2	HMR 44 & 44R1
Shore Power Protection & Control Diagram	802-5000463	/2-27-76	1.315, 1.316	
Emergency Operation from Switchboards	802-5000464	B/6-12-78	1.322	HMR 20 HMR 167 37, 87 & 88, 119
Electrical System, Receptacles, One-Line Diagram	802-5000466	H/7-25-80	1.333	HMR 167 R1 & 88, 119,167
General Arrangement, Electronics Equipment Room	802-5000468	F/5-11-79	1.410, 1.415, 1.422.1, 1.472	HMR 54, 54R1 & 93 109R1
Topside Antenna System Arrangement	802-5000469	C/8-11-77	1.405, 1.410, 1.415, 1.423.3 1.429, 1.454, 1.571.2-2.3	HMR 7
Radar, IFF & ESM System	802-5000470	C/4-12-79	1.410, 1.429, 1.450, 1.454 1.480	HMR 8 & 93
Firemain and Sea Water System Diagram	802-5000472	E/8-23-79	1.256, 1.520.1-l	HMR 7R1, 12 & 81, 133
Bilge System Schematic Diagram	802-5000473	F/6-1-79	1.520.2	HMR 11 & 75R2
Sewage System Schematic Diagram	802-5000474	H/9-19-79	1.593.2	HMR 29, 133, 133R1
Wastewater System Schematic Diagram	802-5000475	B/8-23-79	1.520.3-l	HMR 133
Freshwater System Schematic Diagram	802-5000476	F/1-15-79	1.530.1	HMR 7R1, 57 & 88
Fuel System Schematic Diagram	802-5000477	D/8-9-78	1.540.1	HMR 61
Compressed Air System Schematic	802-5000478	B/8-30-78	1.551.1	HMR 57
Fire Extinguishing & Detection Schematic	802-5000479	C/8-4-78	1.555.2	HMR 4 8 55R1
Installation, Automatic Control System	802-5000480	A/2-27-78	1.561	HMR4
Forward Foil Structure	802-5000481	c/11-9-78	1.566.2.4	HMR 46 & 46R2
Forward Strut Retraction Yoke Structure	802-5000482	A/8-18-78	1.566.3.4	HMR 46
Forward Strut & Kingpost Structure	802-5000483	C/11-9-78	1.566.3.4	HMR 46, 46R2 & 13
Forward Foil Lines	802-5000484	C/8-18-78	1.566.2.1	HMR 46
Forward Strut Lines	802-5000485	D/11-9-78	1.566.3.1	HMR 46, 46R2 & 13
Forward Nacelle Lines	802-5000486	c/11-9-78	1.566.5.1	HMR 46 & 46R2
Aft Foil Structure	802-5000487	D/7-19-79	1.566.2.4	HMR 46 46R2, 119R1
Aft Strut Structure	802-5000488	C/10-3-79	1.566.3.4	HMR 46 & 46R2, 133R1
Aft Foil Lines	802-5000489	D/8-18-78	1.566.2.1	HMR 46
Aft Strut Lines	802-5000490	D/9-19-79	1.566.3.1	HMR 46 & 46R2, 133R1
Aft Nacelle Lines	802-5000491	D/11-9-78	1.566.5.1	HMR 40, 46 & 46R2
Foil System Arrangement	802-5000492	B/8-4-76	1.566.1	HMR 40, 46 & 46R2

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General Arrangement, Decks & Profile	802-5000493	P/7-25-79	1.0-1.2, 1.0-1.4, 1.513, 1.581.1-1, 1.582, 1.600, 1.641, 1.520	HMR 4, 56, 64, 81 101, 88, 107, 124
Hydraulic System Schematic	802-5000494	Sh. 1 C/7-13-79 Sh. 2 D/7-13-79	1.556.1, 1.556.2	HMR 21, 101, 119R1
Arrangement, Food Service Spaces	802-5000496	F/7-26-78	1.651.1, 1.651.2(a)	HMR 7, 56
Pilot House & External Conning Station - Arrangement of Equipment	802-5000499	F/8-30-78	1.410, 1.422.1, 1.423.1, 1.660	HMR 54, 54R1, 57
General Arrangement, CTC	802-5000500	M/8-9-79	1.410, 1.411, 1.415, 1.433 1.422.1, 1.429, 1.472, 1.660, 1.423.1	HMR 54, 54R1, 80, 92 93, 110, 126
Strut/Foil/Pod Contour Tolerances	802-5000501	D/8-18-78	1.566.1	HMR 40, 46
ICD/IFF System (AIMS-MK-XII)/PHM Ship	803-4596501-101	F/2-14-80	1.410, 1.454, 1.480.3	HMR 93, 132R1, 162
ICD-Harpoon Weapon System/PHM Ship	803-4596505-101	F/1-31-80	1.189.1, 1.410, 1.480.3, 1.700.1, 1.700.5	HMR 94, 132R1
ICD-Primary Gun System/PHM Ship	803-4596506-101	E/2-14-80	1.189.1, 1.480.3, 1.700.1, 1.700.5	HMR 65, 75, 92, 101 163
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ICD-AN/SRN-17 Radio NAV System/PHM Ship	803-4596512-101	E/3-5-80	1.410, 1.423.2	HMR 75, 132, 164
ICD-Chaff System/PHM Ship	803-4596515-101	D/2-16-79	1.189.1, 1.410, 1.474, 1.700.1, 1.700.5	HMR 57, 63R1, 101
ICD-MK92MOD1 Fire Control System/PHM Ship	803-4596516-101	C/1-31-80	1.189.1, 1.410, 1.454, 1.480.3, 1.700.1	HMR 57, 93, 118, 132R1
Stowages, Encapsulated Inflatable Lifeboat	804-5001024	/11-13-75	1.582	
Stowages, Encapsulated Inflatable Life - Cradle	804-5001025	/11-13-75	1.582	
				HMR 107
Arrangements & Details, Cath. Pro.	100-4596733	B/6-16-78	1.633	HMR 23
Arrangement Communications Room	445-4597402	Sh. 1 & 3 C/3-20-79 Sh. 2 B/9-8-78	1,410	HMR 54, 54R1, 133R1 HMR 87, 133R1
Painting Schedule	605-4596731	Sh. 1 E/1-19-79 Sh. 2 B/1-10-74 Sh. 3 & 4 E/1-19-79	1.631	HMR 109R1
Inlet Housing, Foilborne Propulsor	201-4596694	Sh. 1 & 2 E/11-3-78	1.245	HMR 5, 101R1
Inlet Housing, Foilborne Casting	201-4596667	Sh. 1 D/10-9-78 Sh. 2 C/3-29-78 Sh. 3 & 4 D/10-9-78	1.245	HMR 5, 101R1
NAVSEA Foil System Service Life Assurance Requirements	N/A	H/5-2-79	1.0-2.1, 1.0-0.3 1.566.1	HMR 46, 46R2, 114

TABLE 1.0-3B

II. GOVERNMENT CONTROLLED BASELINE - GOVERNMENT DESIGNATED EQUIPMENT AND/OR COMPONENTS

VENDOR	VENDOR PART OR CONTROL NUMBER	REVISION SYMBOL/DATE	EQUIPMENT OR PART TITLE	REF. SSS SECTION NO.	
General Electric	LM2500	NA	Gas Turbine	1.234, 1.241.2, 1.245.2	
Airesearch	681800-3-l	NA	Starting Air Compressor	1.234.2	HMR 26
Motoren-Turbinen Union Friedrichshafen	MB8V33ITC-81	NA	Diesel	1.238	HMR 4
Zahnradfabrik	BU25OW	NA	Hullborne Reduction Gear	1.241.1	
Aerojet Liquid Rocket Co.	1164000-39(PHM-3) or 1189440-9(PHM 4, 5,6,&2)	NA	Hullborne Propulsor	1.245.1	HMR 4,167
Airesearch	Model 606360-3-l	NA	Fan	1.251.3	(HMR 75
Electra-Development Corp.	9-180-02	NA	Foilborne Control System	1.252.2	HMR 167 HMR 55
Westinghouse Electric Corp.	977J031-3	NA	Ship Service Generator	1.311.1	(HMR 44
Westinghouse Electric Corp.	9002D46-1	NA	Differential Current Transformers	1.311.1	
Airesearch	ME831-800	NA	Power Unit (part of 3400850-l)	1.312	
Prestolite	7441x	NA	Battery	1.313	
Avtech Corp.	1266-1	NA	Battery Power Units	1.313.1	
Bendix	38B67-2-A	NA	Converter	1.314.1	HMR 47
Bendix	39B169-5A	NA	Inverter	1.314.3	
Jefferson Electric Co.	244-001-384	NA	Transformer	1.314.4	
Jefferson Electric Co.	221-001-279	NA	Transformer	1.314.5	
Jefferson Electric Co.	221-001-261	NA	Transformer	1.314.6	
Jefferson Electric Co.	244-001-114	NA	Transformer	1.314.7	
Avtech Corp.	1267	NA	Voltage Booster	1.314.8	
Crouse-Hinds	RPE 641-014-P12AT	NA	Shore Power Receptacle	1.315	
Boeing	301-5330889-i	NA	Switchboard	1.322	HMR 142
Boeing	301-5330888-l	NA	Switchboard	1.322	HMR 142
Avtech Corp.	1667	NA	Voltage Booster	1,314.8	HMR 199

NA - Not Applicable (Revision Column)

VENDOR	VENDOR PART OR CONTROL NUMBER	REVISION SYMBOL/DATE	EQUIPMENT OR PART TITLE	REF. SSS SECTION NO.	
Boeing	303-4597207-1	NA	Panel, Lighting, Plat. Dk.	1.322	
Boeing	303-4597208-14	Sh. 1 D/1-23-79	Dist. Panel - Lighting, Mn. Dk	1.3222	HMR 119
		Sh. 2 D/1-23-79			
		Sh. 3 A/5-8-74			
		Sh. 4 D/l-23-79			
		Sh. 5 D/1-23-79			
Boeing	303-4597209-34	NA	Dist. Panel, 60 Hz Power, Plat. Dk	1.322	HMR 167
Boeing	303-4597210-5	Sh. 1 D/2-23-79	Dist. Panel - 60 Hz., Mn. Dk.	1.322	HMR 119
		Sh. 2 c/11-9-76			
		Sh. 3 A/l-24-74			
		Sh. 4 D/2-23-79			
		Sh. 5 D/2-23-79			
Boeing	301-4597211-l	NA	Panel, D.C. Power	1.322	
Boeing	301-4597211-2	NA	Panel, D.C. Power	1.322	
Boeing	301-4597213-7	E/12-5-78	Panel, D.C., CIC Starboard	1.322	HMR 7, 109R1
Boeing	301-4597216-6	Sh. 1 W-14-79	Dist. Panel, D.C. Power CIC Port	1.322	HMR 119
		Sh. 2 G/3-14-79			
		Sh. 3 C/12-12-75			
		Sh. 4 G/3-14-79			
Boeing	301-5330770-l	NA	Dist. Panel, 400 Hz Power, CIC	1.322	HMR 167
Boeing	301-4597216-8	Sh. 1 E/3-13-79	Dist. Panel, 60 Hz. Power, CIC	1.322	HMR 119
		Sh. 2 D/3-18-77			
		Sh. 3 D/3-18-77			
		Sh. 4 E/3-13-79			
		Sh. 5 E/3-13-79			
Boeing	301-5330958-l	NA	Dist. Panel, D.C. Power, Emerg.	1.322	HMR 167
Boeing	301-4597225-5	NA	Panel, 60 Hz., Comm. Room	1.322	HMR 87
Boeing	302-4597226-1	NA	Panel, H/B Starter	1.322	
Danforth-White	C781BKA	NA	Magnetic Compass	1.421	HMR 55
Raytheon	Model DSF-600	NA	Acoustic Depth Sounder Sys.	1.424	HMR 80
Chesapeake Instrument Co.	MK6 Mod 4C	NA	Dead Reckoning Tracer/Plot	1.426.1	
Chesapeake Instrument Co.	1093D0120	NA	Foil Speed Sensor	1.426.2	
Chesapeake Instrument Co.	1094D0045	NA	Hull Speed Sensor	1.426.2	
Chesapeake Instrument Co.	1023D0652	NA	Speed Sensor Callbr. Unit	1.426.2	
Chesapeake Instrument Co.	1023D0045	NA	Remote Control & Indicator	1.426.2, 1.2521	HMR 19, 55
Chesapeake Instrument Co.	1023D0648	NA	Frequency/Digital Converter	1.426.2	

HMR 62

VENDOR	VENDORPART OR CONTROL NUMBER	REVISION SYMBOL/DATE	EQUIPMENT OR PART TITLE	REF. SSS SECTION NO.	
LITEF	103311	NA	Gyro, Stabilized Platform Unit	1.189.6, 1.426.3	HMR 34
LITEF	450-901-4465	NA	Syncro Signal Amplifier (Heading)	1.426.3	
LITEF	100744	NA	Control and Display Unit	1.426.3	
LITEF	104193	NA	Emergency Power/Power Junction Box	1.426.3	HMR 75, 109R1
LITEF	450-901-7556	NA	Ship Course Indicators, Type F	1.426.3	
Master Specialties	901A1B2RC1OD5H	NA	Ship Course Indicators, Digital	1.426.3	HMR 19, 75
SMA	(AN/SPS-63) SMA-3TM2OH (Modified)	NA	Navigation Radar Subsystem	1.429	

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VENDOR	VENDOR PART OR CONTROL NUMBER	REVISION SYMBOL/DATE	EQUIPMENT OR PART TITLE	REF. SSS SECTION NO.
Nelson Electric Co.	701670-101	NA	IC Switchboard	1.430 HMR 55
Chesapeake Instrument Co.	1023~0001	NA	Indicator/Transmitter	1.426.3
Vernitron Corp.	VSSC 231-46B2	NA	Synchro Signal Converter	
Vernitron Corp.	VSSC 123-44J10	NA	Synchro Signal Converter	1.430 HMR 19
Vernitron Corp.	VSSC 123-46H8	NA	Synchro Signal Converter	1.430
Chesapeake Instrument Co.	1023D0650	NA	Speed Converter	1.426.3, 1.430
Phillip's Elektronic Ind., GmbH.	MCS 2000	NA	Intercommunication System	1.433.1
Phillip's Elektronic Ind., GmbH.	LBD 3359/10	NA	Watertight Housing	1.433.2
Phillip's Elektronic Ind., GmbH.	3425/00	NA	Loudspeaker	1.433.2 HMR 32 HMR 7
Phillip's Elektronic Ind., GmbH.	LBD 3347/10	NA	Amplifier	1.433.2
Phillip's Elektronic Ind., GmbH.	LBD 3322/20	NA	Receptacle with Amplifier	1.433.2
Dynale Corp.	Model 6170-007A	NA	Loudspeakers	1.433.3
Pacific Electrodynamics, Inc.	Model 412-2	NA	Loudspeakers	1.433.3
Phillip's Elektronic Ind., GmbH.	Type 255-6	NA	P. A. Amplifier	1.433.3
Phillip's Elektronic Ind., GmbH.	LBD 3310/10	NA	Power Supply Cassette	1.433.3 HMR 32
Phillip's Elektronic Ind., GmbH.	LBD 3311/10	NA	Battery Cassette	1.433.3
Phillip's Elektronic Ind., GmbH.	LBD 3305/20	NA	Signal Generator Cassette	1.433.3 HMR 32
Phillip's Elektronic Ind., GmbH.	LBD 3359/20	NA	Watertight Housing	1.433.2 HMR 50
Phillip's Elektronic Ind., GmbH.	LBD 3408/10	NA	Remote Control Unit	1.433.2 HMR 50
Phillip's Elektronic Ind., GmbH.	LBD 3414/10	NA	Headset Microphone	1.433.2 HMR 50
Phillip's Elektronic Ind., GmbH.	LBD 3358/10	NA	Cassette Carrier	1.433.2 HMR 50
Phillip's Elektronic Ind., GmbH.	LBD 3315/10	NA	Automatic Cassette	1.433.2 HMR 75 HMR 50
Phillip's Elektronic Ind., GmbH.	LBD 3316/10	NA	Empty Cassette	1.433.2 HMR 50
Telectro Corp.	Type RD-219C/U	NA	Tape Recorder	1.439
				HMR 32
Collins Radio	622-1648-001	NA	HF/UHF Radio Set	1.441
Collins Radio	622-1649-001	NA	HF/UHF Radio Set	1.441
Remler	Type AM 505-9	NA	Speaker-Assy	1.441 HMR 19
Remler	AM-505-9	NA	Speaker-Assy	1.441
	TA-840/U	NA	Telephone Set	1.441
Remler	AM-505-9B	NA	Amplifier Assy	1.441
Anton Kaeser	7424.00201	NA	Multi-Zone Terminal Unit	1.512.3, 1.0-1.5.2.9 IHMR 133
Anton Kaeser	7385.00101	NA	Room Terminal Unit	1.512.4 IHMR 133
Anton Kaeser	7424.00101	NA	Outside Air Conditioning	1.512.4 IHMR 133
Anton Kaeser	8892.00101	NA	A/C Electrical Control Panel	1.512.7 HMR 133

VENDOR	VENDOR PART OR CONTROL NUMBER	REVISION SYMBOL/DATE	EQUIPMENT OR PART TITLE	REF. SSS SECTION NO.	
Aqua-Chem, Inc.	Model S37.5EM	NA	Distiller	1.530.3.1	
Facet	Model 670350-l	NA	Filter Separator	1.540.5	HMR 92
Boeing	VF-814MSX	NA	Pre-Filter	1.540.5	HMR 119, 199
Sundstrand	P/N 19400-5	NA	DC Fuel Pump	1.540.5	HMR 119
W.H. Nichols Co.	Model 31-75102-3024-4	NA	Pump	1.540.5	
Lear Siegler, Inc.	Model RR34080E	NA	Pump	1.540.7	HMR 119
Gast Manufacturing Corp.	PCD-15-G423	NA	Air Compressor and Tank	1.551.2-2	
Filter Engineering Co.	CD-38-20		Air Dryer	1.551.2-4	HMR 140
Bendix	312-80387	B/12-12-77	Static Inverter-Automatic Controls	1.561	HMR 81R1 HMR 32&55
Systron Donner	312-80390	A/8-16-73	Accelerometer	1.561	HMR 55
Lear Siegler	312-80391	C/11-8-73	Vertical Gyro Assembly	1.561	HMR 55
Sperry Rand	312-80392	A/6-1-73	Yaw Rate Gyro Assembly	1.561	HMR 55
Boeing	518-5330967-9	/3-26-79	Temperature Sensor	1.561	HMR 4, 122
Boeing	518-4596910-l	F/8-22-78	Power Supply Assembly	1.561	HMR 75
Boeing	581-4596920-1	NA	ACS Height Sensor Electronics	1.561	
Boeing	518-4596930-1	Sh.1&2 D/9-19-78	Self-Test Electronics Assembly	1.561	HMR 101
Boeing	518-4596940-1	NA	ACS Control Computer Assy.	1.561	
Boeing	518-4596970-7	Sh.1&2 C/10-5-78	Foilborne Trim Assembly	1.561	HMR 101, 167
Boeing	518-4596980-5	NA	Aft Junction Box	1.561	HMR 167
Boeing	518-4596980-6	NA	Forward Junction Box	1.561	HMR 167
Boeing	518-4596985-l	NA	Height Sensor	1.561	
Boeing	518-4597010-l	NA	ACS Control Panel	1.561	
Boeing	518-4597040-1	NA	ACS Checkout Panel	1.561	
Boeing	518-4597020-l	NA	ACS Status Panel	1.561	
Boeing	NFR 127-1	NA	Interference Filter	1.561	
Sargent Industries	7-3828	NA	Hullborne Steering Actuator Assembly	1.562	HMR 119
ABEX CORP.	M3F07-04C-053-3-NO 3-1A	NA	Thruster Motor	1.568.2	
Schottel of America, Inc.	21.029	NA	Gear Box	1.568.2	
Schottel of America, Inc.	S31L-000-310-05-l	NA	Propeller	1.568.2	

VENDOR	VENDOR PART OR CONTROL NUMBER	REVISION SYMBOL/DATE	EQUIPMENT OR PART TITLE	REF. SSS SECTION NO.	
Schottel of America, Inc.	S13L-000-310-03	NA	Gear Box Support	1.568.2	
Roylyn	0061-00791	NA	Valve Coupling	1.571.1-2.1	
Danforth	150H	NA	Anchor	1.581.1-l	
Marco	W 1936	NA	Capstan	1.581.2-1	HMR 101
Boeing	608-4596771		Anchor Line	1.581.2-4	
General American Transport	1-25-16671	NA	Macerator Pump	1.593.5	HMR 133
General American Transport	2-28-16513	NA	Evaporator	1.593.6	HMR 133
General American Transport	1-25-16673	NA	Hydraulic Sludge Pump	1.593.6	HMR 133
General American Transport	2-28-15299	NA	Catalytic Afterburner	1.593.7	
3M Co.	No. 2210	NA	Adhesive	1.637	
Formica Corp.	No. 140	NA	Adhesive	1.637	
Borden Chemical Co.	K-2, K-6	NA	Vinyl Sheathing	1.637	
The General Tire and Rubber Co.	GTR-L27	NA	Vinyl Sheathing	1.637	
3M Co.	Tartan Clad	NA	Vinyl Sheathing	1.637	
Masland Duraleather Co.	Duran Clad	NA	Vinyl Sheathing	1.637	
					HMR 57
EDO Western	Model 1272 Series (Modified)		Camera Control Unit	1.428	HMR 126
EDO Western	Model 1400 Series (Modified)		Camera, NAV Radar PPI	1.428	HMR 8,126
GEC	TD-1306-002		Vidicon	1.428	HMR 8,126, 148
VICON	V25-1.4		Lens	1.428	HMR 8
					HMR 8, 126
EDO Western	Model 1400 Series (Modified)		Camera, DRT	1.428	HMR 8, 126
Cannon	P/N 2-56202-00		Manual TV Zoom Lens	1.428	HMR 8, 19,
Cannon	P/N 5-43411-01		+1 Diopter	1.428	126, 140
Cannon	P/N S2-6100		49-48 Ring	1.428	
Dramalux	7644		Spotlight	1.428	HMR 8
					HMR 8, 126
					HMR 8, 126
Conrac	SNA 9/C		TV Monitor w/blue filter	1.428	HMR 8
Conrac	SNA 14/C		TV Monitor w/blue filter	1.428	HMR 8
American Marine Decking System	Colorflex #76	NA	Deck Covering Material	1.634	HMR 35
Akron	Style 2958		1-½" Eductor, 95 gpm	1.520, 1.555	HMR 81R1
Rockwood	1-½" SG-60		USCG Nozzle	1.520	HMR 81R1
Rockwood	510-1156-l		6 Ft. Applicator	1.520	HMR 81R1, 122, 186
Rockwood	510-1157-l		4 Ft. Applicator	1.520	HMR 81R1

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VENDOR	VENDOR PART OR CONTROL NUMBER	REVISION SYMBOL-DATE	EQUIPMENT OR PART TITLE	REF. SSS SECTION NO.	
Rockwood	10-04373		Piercing Type Fog Applicator	1.520	HMR 81R1, 186
Moon	No. 472		Wye Gate Valve	1.520	HMR 81R1
Moon	No. 431WT-3VB		4-Way Hydrant Valve	1.520	HMR 81R1

VENDOR	VENDOR PART OR CONTROL NUMBER	REVISION SYMBOL-DATE	EQUIPMENT OR PART TITLE	REF. SSS SECTION NO.	
Rockwood	s4373		Piercing Type Fog Applicator	1.520	HMR 81R1
Moon	No. 472		Wye Gate Valve	1.520	HMR 81R1
Moon	No. 431WT-3VB		4-Way Hydrant Valve	1.520	HMR 81R1

TABLE 1.0-3B

III. GOVERNMENT CONTROLLED BASELINE - FEDERAL SPECS./STDS., MILITARY SPECS./STDS., NAVSHIPS STD & TYPE DWGS., NAVSHIPS PUBLICATIONS, NAVY INSTRUCTIONS, OTHER GOVERNMENT DOCUMENTS/DATA, INDUSTRY DOCUMENTS/DATA LIST.

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.
FEDERAL SPECIFICATIONS			
Plastic Sheet, Laminated, Thermo	L-P-387	A/6-4-68	1.690.1
Coffee Maker, Electric, Automatic	W-C-500	/11-4-68	1.651.1
Plastic Sheet & Strip, Vinyl Chloride	L-P-535	D/6-6-73	1.690.1
Chairs, Aluminum, Office	AA-C-275	D/2-21-74	1.641
Bearings, Roller, Cylindrical, and Bearings, Roller, Self-Aligning	FF-B-185	/12-26-63	1.245.2 HMR 4, 43
Bolts & Screws	FF-S-86	D/11-6-72	1.0-2.5.7
Shredding Machine, Office Type, Class Waste	FF-S-1169	15-l-73	1.402.2
Dispenser, Bulk Milk	00-D-450	A/5-12-70	1.651.1
Aluminum Alloy, Bars, Rods	QQ-A-200/5	C/8-20-70	1.0-2.1.1
Aluminum Alloy, Bars, Rods	QQ-A-200/6	D/9-17-70	1.0-2.1.1
Aluminum Alloy, Bars, Rods	QQ-A-200/7	D/9-17-70	1.0-2.1.1
Aluminum Alloy, Bars, Rods	QQ-A-200/8	C/3-8-67	1.0-2.1.1
Aluminum Alloy, Plate & Sheet	QQ-A-250/10	C/3-17-67	l-0-2.1.1
Aluminum Alloy, Plate & Sheet	QQ-A-250/11	D/3-17-67	1.0-2.1.1
Aluminum Alloy, Plate & Sheet	QQ-A-250/19	/12-31-68	1.0-2.1.1
Aluminum Alloy, Plate & Sheet	QQ-A-250/20	/12-31-68	1.0-2.1.1
Journal Bearings	QQ-T-390		1.241.2
Aluminum Alloy, Sand Castings	QQ-A-601	E/7-14-69	1.0-2.1.1, 1.241.2
Brazing Alloy, Silver	QQ-B-654	/5-8-70	1.404.2
Brazing Alloys, Aluminum & Magnesium	QQ-B-655	C/l-29-67	1.404.2
Rods, Welding, Aluminum	QQ-R-566	A/3-10-64	1.0-2.1.1
Steel Bars, Shapes & Forgings	QQ-S-763	D/9-15-67	1.0-2.1.1, 1.0-2.4.3, 1.0-2.5.7
Steel Plate, Sheet & Strip	QQ-S-766	C/12-15-66	1.0-2.1.1, 1.0-2.4.3, 1.509.6
Enamel	TT-E-489	F/12-10-70	l-O-2.3.3
Primer, Paint, Zinc Chromate	TT-P-645	/4-12-62	1.0-2.5.7
Sealing Compound Dipcoating	VV-S-190	/10-26-61	1.404.1
Tube, Aluminum Alloy, Drawn	WW-T-700/5	D/3-13-67	1.0-2.1.1
Tube, Aluminum Alloy, Drawn	WW-T-700/6	D/10-5-67	1.0-2.1.1, 1.540.1

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.	
FEDERAL SPECIFICATIONS				
Artificial Leather, Vinyl Resin	CCC-A-680	A/5-26-66	1.640	
Artificial Leather	CCC-A-700		1.640	
Adhesive to Aluminum	MMM-A-130	B/12-9-74	1.637	
Hose, Fire	ZZ-H-451		1.530.2	
Dry Chemical Fire Extinguishing Agent, Potassium Bicarbonate	0-D-1407	/8-9-72	1.555.3	HMR 55
FEDERAL STANDARDS				
Glossary of Packaging Terms	FED-STD-75	c/12-9-74	1.0-1.6.5.8	HMR 55
Color	FED-STD-595	A/1-2-68 Ch. 3/4-28-72	1.690.1	
MILITARY SPECIFICATIONS				
Cables, Radio Frequency	MIL-C-17	E/7-12-74	1.404.3	
Waveguide, Rigid, Rectangular	MIL-W-85/1	E/7-2-74	1.404.2	
Methods of Preservation	MIL-P-116	F/2-1-73	1.0-1.6.5.6, 1.0-1.6.5.8	
Barrier Material	MIL-B-121	D/4-3-75	1.404.1	
Barrier Material, Water Vapor Proof	MIL-B-131	F/10-24-73	1.0-1.6.5.8	
Castings, Aluminum	QQ-A-601	E/4-15-74	1.241.2	HMR 75
Insulation Board, Thermal	M-IL-I-742	C/3-4-68	1.509.6	
Cable, Electrical	MIL-C-915	E/8-01-72	1.321	
Showerheads & Outfits	MIL-S-955	C/12-15-76	1.644.2	
Drawing, Engineering	MIL-D-1000/2	A/6-15-72	1.0-1.4.11.2, 1.0-1.4.11.3 1.0-1.4.11.4, 1.0-1.4.11.5, 1.241.2	
Pipe, Stainless Steel, Seamless or Welded	MIL-P-1144	C/12-26-72	1.0-2.1.1, 1.0-2.4.3	
Rivet, Solid	MIL-R-1150	A/6-4-72	1.0-2.1.1	
Telephone Equipment, Dial	MIL-T-1943	C/2-28-69	1.432.2	
Encl. for Elec/Elex, Equipment	MIL-E-2036	C/3-15-63	1.314.1	
Sink	MIL-S-2041	A/3-21-66	1.644.4	
Plates, Tags & Bands for Ident. of Eqpt.	MIL-P-15024	P/2-29-68	1.690	HMR 15

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	SYMBOL/DATE	REF. SSS SECTION NO.
Sealing Compound	MIL-I-3064	A/6-20-62	1.321
Adhesives, Fire-Resistant	MIL-A-3316	B/4-30-68	HMR 35 1.509.6
Connectors, Electric "AN" Type, Gen. Spec. For	MIL-C-5015	D/6-9-70	1.241.2
Rod and Wire	MIL-R-5031	B/7-15-66	1.0-2.1.1
Data, Engineering & Technical	MIL-D-5480	E/6-15-70	1.0-1.4.11.2, 1.0-1.4.11.5
Cylinder, Aeronautical, Hyd. Actuating	MIL-C-5503	C/4-26-72	1.241.2
Turbine Fuel, Aviation	MIL-T-5624	H/10-30-70	1.200, 1.241.2, 1.540.1, 1.245.2
Life Rafts, Inflatable, 4 and 7 Men	MIL-L-5567		1.582
Castings	MIL-C-6021	H/6-3-76	1.245.2 HMR 43
Steel Carburizing & Nitriding	MIL-S-6090	A/7-20-72	1.241.2, 1.245.2
Forgings, Steel	MIL-N-6414		1.241.2
Bolt, Aircraft	MIL-B-6812	B/8-23-67	1.0-2.5.7
Heat Treatment	MIL-H-6875	/1-14-72	1.241.2, 1.245.2
Impregnation Material Specification	MIL-I-6869	D/1-14-71	1.245.2
Tube, Aluminum Alloy	MIL-T-7081	D/8-9-67	1.0-2.1.1
Screw Threads, Standard	MIL-S-7742	B/2-2-68	1.0-2.8, (MOD 4 Deleted)
Anodic Coatings for Alum. & Alum. Alloys	MIL-A-8625	C/3-13-69(Amend.1)	1.241.2, 1.245.2
	MIL-M-7292		1.241.2
Sealing Compound	MIL-S-8802	D/8-14-72	1.631
Screw Threads, Controlled Radius	MIL-S-8879	A/12-8-66	1.0-2.8, (MOD 4 Deleted)
Lubricating Oil	MIL-L-9000	G/3-5-70	1.241.2, 1.245.2, 1.262.3
Quality Program Requirements	MIL-Q-9858	A/12-16-73	1.234, 1.234.2, 1.245.2. 1.311.1, 1.312, 1.314.1
Microfilming of Engr. Docu.	MIL-M-9868	D/10-1-70	1.0-1.4.11.8, 1.0-1.4.11.9
Microfilming of Engr. Docu.	MIL-M-9868/1	A/3-30-73	1.0-1.4.11.4, 1.0-1.4.11.8
Plate, Tags & Bands	MIL-P-15024	D/5-10-71	1.690-1, 1.430
Manual, Technical	MIL-M-15071	G/8-1-69	1.0-1.6.6.2, 1.0-1.6.6.3 1.0-1.6.6.9, 1.241.2 (MOD 6 Deleted)
Fuses	MIL-F-15160	E/7-12-72	1.303.3
Telephone Equipment, Sound Powered	MIL-T-15514	E/7-11-66	1.432.1
Boots, Dust & Water Seals for Toggle & Rotary Actuated Parts	MIL-B-5423	/11-23-49	1.333 HMR 42

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Matting, Floor, Rubber	MIL-M-15562	D/6-17-74	1.0-1.4.6(i)
Steel, Co Ni Mo	MIL-S-5000		1.241.2
	MIT,-S-6414		1.241.2
Manual, Technical	MIL-M-7298		1.241.2
Switch, Liquid Level	MIL-S-16032	K/12-5-69	1.520.2
Electrodes, Welding	MIL-E-16053	L/8-5-70	1.0-2.1.1
Fuel Oil, Diesel, Marine	MIL-F-16884	F/12-15-69	1.200, 1.241.2, 1.245.2, 1.540.1
Search Light, Incandescent Signalling-8	MIL-S-16938		1.422.2(f)
Table Top, Plastic	MIL-T-17171	C/8-23-74	1.640
Mount, Resilient	MIL-M-17185	A/10-27-59	1.0-1.5.2.9
Mount, Resilient	MIL-M-17191	D/9-22-70	1.0-1.5.2.9
Mount Resilient	MIL-M-17508	E/1-11-72	1.0-1.5.2.9
Pumps Centrifugal	MIL-P-17639	....	1.520.1-3
Plastic Sheet, Laminated, Thermosetting, Glass Fiber Base, Epoxy Resin	MIL-P-18177	C/5-25-60	1.0-2.5.7, 1.245.2 HMR 43
Tile, Plastic, Fire Retardant	MIL-T-18830	B/4-23-75	1.634
Mount. Resilient	MIL-M-19379	B/3-21-61	1.0-1.5.2.9
Heads, Sprinkler	MIL-H-19387	A/7-20-70	1.520.1-5
Marking of Commodities and Containers to Indicate Radioactive Material	MIL-M-19590		1.0-1.6.5.8
Fasteners, Screw Threaded	MIL-F-19700	/5-8-57	1.0-2.5.7
Propulsion and Auxiliary Steam Turbine and Gears, Packaging of	MIL-P-17286	C/2-9-68	1.241.2, 1.245.2 HMR 43
Mount, Resilient	MIL-M-19863	C/8-15-67	1.0-1.5.2.9
Dispenser Mechanically Refrig. Self-Contained	MIL-E-19933	A/4-15-64	1.0-2.1.1, 1.0-2.4.3
Coating Compound	MIL-C-19993	Ail-la-61	1.509.6
Cloth, Glass Tape	MIL-C-20079	D/2-21-63	1.509.6
Rubbersheets & Molded Shapes	MIL-R-20092	/7-20-70	1.640
Aluminum Alloy Castings	MIL-A-21180	C/12-4-69	1.0-2.1.1,
Mount, Resilient	MIL-M-21649	B/3-28-66	1.0-1.5.2.9
Insulation Felt	MIL-I-22023	C/5-10-68	1.508, 1.509.6

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.	
Fixture Lighting & Associated Parts	MIL-F-16377/11	1/15/79	1.332	HMR 88

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Nitrided, Steel Parts	MIL-N-22061	A/9-10-75	1.241.2, 1.245.2	HMR 43
Electrode, Welding, Covered	MIL-E-22200/2	B/9-15-70	1.0-2.1.1, 1.0-2.4.3	
Container, Aircraft Fire Ext. System	MIL-C-22284	A/9-7-65	1.555.2	
				HMR 55
Insulation, Pipe, Thermal	MIL-I-22344	B/8-6-63	1.509.6	
Switch, Push Button, Illuminated	MIL-S-22885	c/10-9-73	1.252.3	
Wind Direction & Speed Indic. Equip.	MIL-W-22900	A/7-26-70	1.422.1	
Recorder-Reproducer, Sound (mag.) type RD-219/u	MIL-R-22754		1.439	
Motor, 60 cyc., Alternating Current, Fract. H.P.	MIL-M-17059		1.520.1-3	
Motor, 60 cyc., Alternating Current, Int. H.P.	MIL-M-17060		1.520.1-3	
Motor, Direct Current, Integral H.P.	MIL-M-17413		1.520.1-3	
Motor, Direct Current, Fract. H.P.	MIL-M-17556		1.520.1-3	
Insulation Blanket	M-IL-I-23128	A/8-24-62	1.508, 1.234.5	HMR 120R1
Switch, Liquid Level	MIL-P-23236	/12-17-65	1.540.2	
Lubricating Oil	MIL-L-23699	B/9-25-70	1.241.2, 1.245.2, 1.262.3	
Liquid Level Indicating Equipment	MIL-L-23886	A/2-4-65	1.540.2	
Stern Mooring/Anchor Line	MIL-R-24050		1.581.2-2	
Extinguisher, Fire, Portable	MIL-E-24091	B/5-21-71	1.555.3	
Converter and Inverter	MIL-F-24122	A/3-15-73	1.314.1	
Cartridge Gas Pressure	MIL-C-24224	A/10-27-69	1.555.3	
Extinguisher, Fire, Carbon Dioxide	MIL-E-24269	A/10-4-68	1.555.1	
Enamel	MIL-E-24306	/8-1-67	1.422.2(f)	
Bow Anchor Line	MIL-R-24337	/6-17-68	1.581.2-2	HMR 75
Maintenance Engineering Analysis	MIL-M-24365	A/7-20-70	1.0-1.6.2.4	
Fire Extinguishing Agent	MIL-F-24385	/6-20-74	1.555.4	
Nozzle, Fire Hose	MIL-N-24408	/6-3-71	1.620.1-3, 1.555.4	
Switch, Liquid Level	MIL-P-24441	/11-27-74	1.540.2, l-O-1.4.6	
Engine, Diesel, Propulsion and Aux., High Speed	MIL-E-24455		1.238	
Harness, Safety	MIL-H-24460	/3-8-72	1.611	
Lifeboat, Inflatable	MIL-L-24489	A/6-14-74	1.582	
				HMR 107
Curtain Material	MIL-C-24500	/5-24-74	1.643	HMR 55
Food Container, Delivery & Storage	MIL-F-43392	A/10-13-69	1.651.1	
Vinyl Laminate	MIL-L-24518	/3-12-75	1.637	
Deck Covering, Spray On, Non-Slip	MIL-D-24483		1.634	

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.	
Nut, Self-Locking	MIL-N-25027	D/7-24-69	1.0-2.5.7	
Microfilm & Microfilm Frame Deck	MIL-M-38761	/10-1-70	1.0-1.4.11.7	
Microfilming & Photographing	MIL-M-38761/2	/9-13-68	1.0-1.4.11.7, 1.0-1.4.11.8	
Cloth & Strip Laminated	MIL-C-43006	D/4-19-74	1.621	
Calibration System Requirements	MIL-C-45662	A/2-9-62	1.241.2, 1.245.2	
Wire, Electric, Cross Link Polyalkene Insulated Tin Coated Copper, Medium Weight, 600V, 150° C	MIL-W-81044/9		1.321	
Wire, Electric, Cross Link Polyalkene Insulated Tin Coated Copper, Light Weight, 600V, 150° C	MIL-W-81044/12		1.321	
Barrier Materials	MIL-B-81705	B/8-15-74	1.0-1.6.5.8	
Bolts & Screws	MIL-S-81733	A/2-17-71	1.0-2.5.7	
Hydraulic, Fluid Fire-Resistant, Synthetic Hydrocarbon Base, Aircraft	MIL-H-83282	Amend. #1 (7-16-70)	1.241.2, 1.245.2	
Titanium and Titanium Alloy Sheet, Strip, and Plate	MIL-T-9046	H/3-14-74	1.0-2.1	HMR 17
Titanium and Titanium Alloy Bars and Forging Stock	MIL-T-9047	F/3-25-71	1.0-2.1	
Locks and Lock Sets, Exterior. Ordnance, High Security	MIL-L-29151	Amend. #1 (7-31-75)	1.700.7	HMR 49
Connector Assy Plugs & Recpt, Elect. Power Transfer Shore to Ship and Ship to Ship	MIL-C-24368	A/3-1-72	1.315	HMR 91
Coating, Metallic-Ceramic	MIL-C-81751	B/1-17-72	1.520	HMR 109R1

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	MILITARY STANDARDS		
Engineering Drawing Practices	MIL-STD-100	A/10-1-67	1.0-1.4.11.4
Def. & Basic Req't. for Enclosure for Elect./Elex Equip.	M-IL-STD-108	E/8-14-66	1.314.1, 1.320
Marking for Shipment & Storage	MIL-STD-129	E/4-20-70	1.0-1.6.5.8, 1.241.2, 1.245.2
Identification Marking	MIL-STD-130	D/3-5-71	l-0-2.3.1, 1.241.2, 1.245.2
Standards & Specifications, Order or Precedence for Selection of	MIL-STD-143	B/11-12-69	1.241.2, 1.245.2
Mech. Vibration of Ship Equip.	MIL-STD-167	B/8-11-69	1.0-1.5.2.2, 1.200 1.241.2, 1.245.2, 1.555.2
Welding 6 Brazing Procedure & Performance Qualification	MIL-STD-248	C/10-12/73	1.0-2.4.3(b)
Non-Destructive Testing Req'ts for Metals	MIL-STD-271	E/10-31-73* HMR 19 I & 57	1.0-2.1.1, 1.0-2.4.3, 1.241.2; 1.245.2
Impregnation of Parts, Non-Ferrous Metal Castings	MIL-STD-276	/2-2-56	1.245.2
Fabr. Welding & Inspection	MIL-STD-278	D/1-26-70	1.0-2.4.2, 1.0-2.6, 1.241.2, 1.245.2
	MIL-STD-418		1.2.4.3
EMI Characteristics Req't	MIL-STD-461	A/8-1-68 CH 6/6-3-73	1.0-1.5.2.8, 1.314.1
EMI Measurements	MIL-STD-462	/6-31-67 Ch 3/2-9-71	1.0-1.5.2.8
Maintainability Program Req't	MIL-STD-470	/3-21-66	1.0-1.4.5.1, 1.234.2, 1.241.2, 1.245.2, 1.312, 1.314, 1.429, 1.314.1
Maintainability Demonstration	MIL-STD-471	/2-15-66 HMR 43 & 70 HMR 19 Notice 1/4-9-68	1.0-1.4.6.2, 1.234.2, 1.241.2, 1.429.1, 1.426.3 1,312, 1.314.1
	MIL-STD-242		1.321

* Except that Rev D applies for Foilborne Gearbox.

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Configuration Control-Engineering Changes, Deviations and Waivers	MIL-STD-480		1.0-0, 1.234, 1.234.2, 1.241.2, 1.245.2, 1.311.1 1.312, 1.314.1
Specification Practices	MIL-STD-490	/10-30-68	1.241.2
Electric Power Characteristics	MIL-STD-704	A/8-9-66	1.300.1, 1.313
Definition of Effectiveness Terms for Reliability, Maintainability Human Factors and Safety	MIL-STD-721		1.234.2, 1.241.2, 1.311.1 1.312
Reliability Prediction	MIL-STD-756	A/5-16-63 (HMR 43)	1.234.2, 1.241.2, 1.245.2, 1.312, '1.314.1, 1.429
Reliability Program System & Equipment	MIL-STD-758		1.241.2, 1.426.3 HMR 101
Machinery & Piping Insulation Req't	MIL-STD-769	D/4-1-71	1.508
Reliability Program Sys. & Equip.	MIL-STD-785	A/3-28-69 HMR 70	1.0-1.4.5.1, 1.234.2, 1.241.2, 1.245.2, 1.314.1 1.312, 1.426.3 HMR 19&101
Reliability Test	MIL-STD-781	B/	1.0-1.4.5, 1.429 HMR 101
Procedure for Packing Part & Equip.	MIL-STD-794	D/12-15-72, Ch2/12-18-75	1.0-1.6.5.8
Tabulating & Aperture Cards, Format	MIL-STD-804	B/8-15-66	1.0-1.4.11.8
Environmental Test Methods	MIL-STD-810	B/6-15-67	1.0-1.5.2.2, 1.555.2
System Safety Program for Systems & Associated Subsystems and Equipment	MIL-STD-882	/7-15-69	1.0-1.4.6, 1.241.2
Definition of Dissimilar Metals	MIL-STD-889	A/5-5-72	1.241.2, 1.245.2
Bonding & Grounding for EMC	MIL-STD-1310	c/11-30-73	1.0-1.5.2.8, 1.0-2.1.2(j) 1.300.2, 1.404.2, 1.406
Fitting Out Procedures	MIL-STD-1339	/3-31-69	1.0-1.6.4.2, 1.0-1.6.4.6.1
Provisioning, Initial Support	MIL-STD-1375	/11-23-70 Ch 1.11-29-74	1.0-1.6.4.2, 1.0-1.6.4.3.1 1.0-1.6.4.3.4
Training Operations & Data	MIL-STD-1379	/3-15-72	1.0-1.6.8.4
Interface Std., Electric Power	MIL-STD-1399, Sect. 103	/12-1-70	1.300.1, 1.314.1, 1.426.2 1.530.1 HMR 19
Interface Std., Potable Water	MIL-STD-1399 Sect. 104	/6-5-73	1.530.1
Human Engineering Design Criteria	MIL-STD-1472	B/	1.241.2, 1.245.2
tive Action and Disposition	MIL-STD-1520	A/	1.234, 1.234.2, 1.312

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System for Nonconforming Materials				
Materials Test Methods	MIL-STD.1601	/5-8-73	1.0-2.1.1	
Shipboard EMI Survey Methods	MIL-STD-1605	/4-20-73	1.0-1.5.2.8	
Fire Performance Req'ts	MIL-STD-1623	A/5-20-74	1.637	
Procedure for Performing a Failure Mode and Effects Analysis for Shipboard Equip.	MIL-STD-1629	/11-1-74	1.0-1.4.5.3, 1.234.2, 1.241.2 1.245.2, 1.312, 1.314.1	
Configuration Control	MIL-STD-1626	/1-1-74	1.0-1.6.4.2, 1.0-1.6.4.4.	
Installation Criteria for Shipboard Secure Electrical Info. Processing Sys.	MIL-STD-1680		1.402.1, 1.406, 1.433.3	HMR 39
Backshells, Electrical, Connector	MS 3188	/1-23-74	1.321	
Backshells, Electrical, Connector	MS 3189	/1-23-74	1.321	
Backshells, Straight, Cable Sealing & Shield Termination, Connector, Electrical	MS 3437	B/2-5-73	1.321	
Lens	MS-17127		1.332.6	
Folding Methods	MS-18267		1.0-1.4.11.3	
Insert, Screw Thread	MS-21208	B/10-15-69	1.0-2.5.7	HMR 43 (HMR43
Bosses, Fluid Connection Internal Straight Thread	MS-33649	12/14/66	1.245.2	

NAVSHIPS STANDARD & TYPE DRAWINGS

Electrical Plant Installation	9000-S6202-73980	10/1/75	1.321	HMR 7, 19
Switch	S6202-74207	C/	1.422.2f	
Switchbox	S6202-74094	D/	1.432.1	
Jackbox Assembly	S6501-74210	H/	1.432.1	
Air Test Fittings	810-1385791	/4-22-59	1.100-l	
Chair	805-1627072	E/	1.641	
Crew Berths	805-1630197	G/	1.643	
Berth, Double	805-1631103	J/	1.641	
Ash Receiver	805-1635298	E/	1.640	
Files and Drawers	805-1636402	C/	1.641	
Locker Details	805-1360106,	D/	1.700.7	HMR 49
Hatch	805-1360107	C/		
Hatch	805-1624094		1.624	HMR 55
	805-1624105		1.624	

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Wardrobe	805-1636403	C/	1.641	
Berth	805-1637197	B/	1.641	
Secretary and Drawers	805-1637639	F/	1.641	
Lockers and Wardrobes	805-1637731	A/	1.641	
Standard Card Holders	805-1639213	E/	1.690.1, 1.571.3	HMR 50
Equip. Requiring Operating & Safety Inst.	805-1640412		1.690.1	HMR 19
Locker and Wardrobe, Built-in	805-1641660	A/	1.641	
Curtain Rods	805-1646045	F/	1.644.2	
Visible Index File Frames	805-1749000	D/	1.690.1	
Inclined Ladders	805-1749113	C/	1.623	
Stowage Boxes, Telephone	815-1853040	B/	1.432.1	
Hooks, Telephone	815-1853041	B/	1.432.1	
Switchboard and Load Summaries	815-1853336		1.430	
Shields, Piping	803-2145518	E/11-17-76	1.0-2.7(b), 1.540.5	HMR 19
Mount, Resilient	810-2145600	A/12-21-65	1.0-1.5.2.9	HMR 19
Lapped Collars	805-2460264	B/6-2-70	1.120	HMR 19
Lavatories	805-4501628		1.641, 1.644.2"	HMR 19
Tables, Dining	MOD 3 calls for Frigitemp Model 2026 Tables		1.651	HMR 7, MOD 3
Functional Drafting	0283-145-000		1.0-1.4.11.4	HMR 19
Glass-Reinforced Plastic (GRP) Lifeline Assy	803-4354051	A/5-17-77	1.612	HMR 19
Lavatories	810-1383890		1.644	HMR 7 & 19
Temperature Indicator & Thermonell Selection	810-1385917	G/3-5-71	1.256	HMR 19
Hose Rack, 50 Ft. and 100 Ft.	805 -860089		1.520	HMR 81R1 & 122
Spanner Wrench	810-4444647		1.520	HMR 81R1

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	OTHER GOVERNMENT DOCUMENTS/DATA			
Fabrication, Welding & Inspection	0900-000-1000		1.0-2.4.3, 1.0-2.6	HMR 19
Technical Manual for Radio Frequency Radiation Hazards	0900-005-8000		1.407	HMR 19
Ultrasonic Inspection for Hull Structure Production and Repair Wells	0900-006-3010		1.0-2.4.1, 1.0-2.4.3	HMR 19
Fabrication, Welding & Inspection	0900-060-4010		1.0-2.4.1	HMR 19
Management Plan for Total Ship Test Program for Ship Production	0900-077-3010		1.0-1.3.11.1	HMR 19
Naval Ships Technical Manual	0901-004-0001, Ch. 9004		1.0-1.3.6	HMR 19 & 55
Thief Sampler	0901-550-003		1.540.3	HMR 19
Technical Manual, SOOM	0905-503-7010 thru 7070	/ June 77	1.0-1.6.6.1	HMR 7
Mirror	805-2253852		1.644	HMR 7 & 19
PHM Navy Training Plan	NTP S30-7301	C/May 76	1.0-1.6.8.4	HMR 19
Lifeline & Awning Stanchions, Glass-Reinforced Plastic (GRP)	803-5000938	/ 5-19-77	1.612	HMR 19

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Electrical Equipment List	0960-000-4000		1.332.4, 1.332.5, 1.332.7	HMR 19
Shipboard Antenna Systems Instl. Details Communications Ant. Sys.	0967-177-3020	Sept. 1973	1.405	HMR 19
Waveguide Fabr. & Installation	0967-000-0110		1.404.2	HMR 19
Technical Manual for Radio Freq. Burn Hazards Reduction	0967-317-7010		1.407	HMR 19
Elec. Test Equip. Index	0967-088-9000		1.0-1.6.4.2	HMR 19
Damage Control Book	0988-142-7010		1.0-1.6.6.1	HMR 19
Protective Device Appl.	DDS-311-3		1.303.3	HMR 19
NATO PHM Ship ILS Program Management Plan	ILSP 079	O/March 76	1.0-1.6.1.1, 1.0-1.6.1.3	HMR 19
Piping Installation	NSTM Ch. 9480		1.0-2.7	HMR 19
Standardization Manual Sliding Surface Bearings	0943-015-6010		1.241.2	
Design Data Sheet (Elect. Power Analysis)	DDS-310-1		1.300.2	HMR 55
Design Data Sheet (Elect. Cable)	DDS-304-2		1.321	HMR 55
DOD Engineering for Transportability Program	NAVMATINST 4600.5	A/12-29-64	1.241.2, 1.245.2	
"Assist" Users Manual		May 1977	1.241.2, 1.245.2, 1.312, 1.314.1	
Ship Trials	INSURVINST 9080.2	F/12-09-74	1.0-1.3.12	
Resilient Mount Requirements	NAVSEAINST 9110.62	A/10-04-72	1.0-1.5.2.9	
Contract Security Classification Guide	DD-254		1.0-1.4.11.1, 1.0-1.6.6.6	HMR 57
Supply Level Policy for Major Shipboard Equipments	NAVSEAINST 4410.1	/8-27-75	1.0-1.6.4.5.3	
				HMR 55, 122
Cataloging Handbook	H4-1		1.0-1.6.4.2	
Cataloging Handbook	H4-2		1.0-1.6.4.2	
Cataloging Handbook	H4-3		1.0-1.6.4.2	

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.
Screw Thread Standards	FED HDBK H 28	/1969	1.0-2.5.1, 1.0-2.5.2, 1.0-2.5.3, 1.0-2.8 1.241.2, 1.245.2, 1.530.2
Elex. Equip. Reliability Stress and Failure Rate Data	MIL-HDBK-217B	9-7-76	HMR 43 | 1.234.2, 1.312, 1.314.1. HMR 19 | 1.426.2, 1.429.1, 1.426.3 HMR 43 | 1.245.2
Maintainability Predictions	MIL-HDBK-472		1.234.2, 1.241.2, 1.245.2, HMR 19 1.312, | 1.314.1, 1.426, 1.429-1, 1.426.3
Waveguide Fabrication	MIL HDBK-660		1.404.2
Replenishment at Sea	CNO Publ. NWP 38G		1.571.1-1
Weight Estimates & Reports For Surface Ships	UDI-E-23254		HMR 55 I 1.0-1.1.1.2
Provisioning Screening	DOD Publ. 4100.38-M	/4-75	1.0-1.6.4.3.7
Industrial Security Manual	DOD Publ. 5220.22-M		1.0-1.6.6.5
Manual of Naval Prev. Medicine	NAVMED P-5010-5	/12-12-67	1.530.5
Weapons Equip. List	NAVSEA OD 45524		1.700.1, 1.700.5, 1.480.2
Equipment Code Numbers	NAVSEA 0900-001-2000		1.0-1.6.4.2
Elec. Equip. Application Guide	NAVSEA 0969-019-7000		1.0-1.6.3.2
Metal Boat and Craft Hulls	NAVSEA 0900-LP-060-4011		1.0-2.4.1
Fabrication Welding and Inspection	NAVSHIPS 0900-039-1010A		1.0-1.6.2.4
Lighting on Naval Ships	NAVSHIPS 0964-000-2000		1.332.3, 1.332.4, 1.332.5 1.422.2d
Catalog of Navy Material	NAVSEA 0941-047-3010		1.0-1.6.3.3
Industrial Plant Equip HDBK	DSAH Publ. 4215.15		1.0-1.6.3.2
Resilient Mounts	DTMB Report 880	/2-58	1.0-1.5.2.9
Resilient Mounts	DTMB Report 1480	/1-61	1.0-1.5.2.9
Hdbk., Sanitation of Vessel Const.	PHS Publ, No. 393		1.605.1
U. S. Code, Regulations for Prevention of Collision at Sea	usc33, 1051-1094	9/1/65	1.422.2d
International Shore Connection	USCG Spec. Sub. 162.034		1.520.1-8
SCC Procedures	NRL Report 7865		1.0-2.1.1
Corrosion Fatigue Crack Growth in Aircraft Structural Materials	AFML Report TR-73-204	/9-73	1.0-2.4.3 | HMR 73R1
NAVSHIPS Technical Manual Chapter 096 - Weights and Stability	NAVSEA 0901-LP-096-0000	/2-15-76	1.0-1.1.7 | HMR 121

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.	
	INDUSTRY DOCUMENTS/DATA			
	BAC 5436		1.241.2	
	BAC 5434		1.241.2	
Castings, Investment	AMS 5355		1.0-2.1.1, 1.0-2.4.3	
Castings, Sand	AMS 5398		1.0-2.1.1, 1.0-2.4.3	
Belts & Screws	AMS 5525	/1-29-71	1.0-2.5.7	
Corrosion, Resistant Steel	AMS 5735	H/8-30-74	1.0-2.5.7	
Corrosion, Resistant Steel	AMS 5737	E/8-30-74	1.0-2.5.7	
	AMS 6260		1.241.2	
	AMS 6265		1.241.2	
	AMS 6414		1.241.2	
	AMS 6444		1.241.2	
Forgings, Steel	AMS 6470		1.241.2	
	AMS 6490 .		1.241.2	
Bare Welding Electrodes	AMS 5825	B/4-15-67	1.0-2.1.1, 1.0-2.4.3(c)	
Covered Welding Electrodes	AMS 5827	A/4-15-67	1.0-2.1.1, 1.0-2.4.3(c)	
Metric Threads	IS0 Recom. R 68	/9-69	1.0-2.5.1, 1.0-2.8, 1.241.2, 1.245.2	
Standard Surface Roughness	ISO/R468		1.241.2, 1.245.2	
General Purpose Metric Screw Threads-General Plan	ISO/R261		1.241.2, 1.245.2	
General Purpose Metric Screw Threads-Basic Dimensions	ISO/R724		1.241.2, 1.245.2	
General Purpose Metric Screw Threads-Tolerances	ISO-R965/1		1.241.2, 1.245.2	
	ASTM B-286		1.321	
Belts and Screws	NAS 498	/6-14-74	1.0-2.5.7	
Cleanliness of Hydraulic System	NAS 1638		1.556.5	
Corrosion Resistant Steel	NAS 4003	/6-30-72	1.0-2.5.7	
Mechanical Fasteners	USAS STD B 18.12		1.0-2.5.1	
Foundation, Macerator Trans. Pump	us-4668918		1.593.5	
Foundation, Sludge Pump	113-4668919		1.593.6	
AFPRO Memorandum of Agreement		/4-14-76	1.234	
Drive Accessory, 8 inch bolt circle	AS 469	B/	1.241.2	
Enclosures, Watertight & Dusttight, Indoor & Outdoor	NEMA-4	/7-75	1.333, 1.561	HMR 42
Alloy Bars, Work-Strengthened Corrosion Resistant, 20Cr - 35Ni - 35Co - 10Mo, Solution Heat-Treated and Cold Drawn	AMS 5844A	/7-16-79	1.0-2.1	HMR 157

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.
Involute Splines and Inspection Metric Versions	ANSI B92.1	1970	1.241.2, 1.245.2
AGMA Publications Index	AGMA 000.68		1.241.2
Nonmenclature of Gear Tooth Wear and Failure	AGMA 110.03		1.241.2
Surface Durability (Pitting) of Helical and Herringbone Gear Teeth	AGMA 211.02		1.241.2
Surface Durability (Pitting) of Spur Gear Teeth	AGMA 210.02		1.241.2
Information Sheet-Gear Scoring Design Guide for Aerospace Spur and Helical Power Gears	AGMA 217.01		1.241.2
Rating and Strength of Helical and Herringbone Gears for Enclosed Drives	AGMA 221.02		1.241.2
Rating the Strength of Spur Gear Teeth	AGMA 220.02		1.241.2
Information Sheet for Strength of Spur, Helical, Herringbone and Bevel Gear Teeth	AGMA 225.01		1.241.2
Gear Classification Manual	AGMA 390.03		1.241.2
Design Procedure for Aircraft Engine and Power Takeoff Spur And Helical Gears	AGMA 411.02		1.241.2
Recommended Procedures for Carburized Aerospace Gearing	AGMA 246.01A		1.241.2

TABLE 1.0-2B

IV. CONTRACTOR CONTROLLED BASELINE - DOCUMENT/DATA LIST

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.	
Material Spec. Ti, 6 Al-4V	XBMS-7-266		1.0-2.1	HMR 17
Material Spec. 17-4PH	XBMS-7-239A		1.0-2.1.1, 1.0-2.4.3	HMR 19
Weld Filler Materials W17-4PH	XBMS-7-242		1.0-2.1.1	
Flame Retardant Rigid Urethane Foams	BMS-8-133	E/5-14-75	1.566.5	HMR 22R1
Polysulfide Sealant	BMS-5-95		1.0-2.5.7	
Gearbox Assy. Foilborne Propulsion	312-81379	E/8-10-78	1.0-1.4.6, 1.241.2, 1.245.2	HMR 32, 109R1
Envelope Drawing Environ. Control Sys.	312-80028	K/4-25-79	1.512.4, 1.516	HMR 75; 140
Actuator - Fwd. Flap & Steer, Cont.	312-80045	K/8-11-78	1.566.2	HMR 75
Pump, Hydraulic	312-80046	Sh. 1 D/12-13-78 Sh. 2 D/12-13-78	1.241, 1.556.3	HMR 75, 109R1
Actuator - Aft. Flap Control	312-80111	J/8-11-78	1.556.2	HMR 32 & 75
Pump Fuel, Hydraulic	312-80206	B/9-12-78	1.540.5	HMR 109R1
External Analyzer, Frequency Converter	312-80253	B/12-5-77	1.314.1	HMR 32
F/B Engine Control System	312-80322	M/10-10-78	1.252.2, 1.252.3.A.1, 1.252.3.A.2	HMR 57, 109R1
				HMR 109R1
Tank Assy., Storage, Bilge Water	312-81206	B/2-3-77	1.520.2	HMR 109R1
Pump Assy., Foilborne Propulsor	312-81380	F/9-12-78	1.241.2, 1.245.2	HMR 101R3
Contract Work Breakdown Structure	~312-80001-2	C/5-7-74	1.0-1.1.1.1	
Reliability/Maintainability Program Plan, PHM-3 Series Ships	D312-80275-1	B/4-13-78	1.0-1.6.6.1	HMR 57
				HMR 109R1
PHM Data Bank Index	D312-80055-1	AB/5-6-77	1.0-1.4.11.5	HMR 101
PHM Operational & Maintenance	D312-80074-1	B/3-1-74	1.0-1.6.6.1	HMR 92
EMC Control Plan for Production PHM	D312-80317-1	B/9-13-78	1.0-1.5.2.8	HMR 4 & 92
Fire Protection Plan	D312-80139-1	C/4-25-78	1.0-1.3.7	HMR 57, 140
Care of Ship Plan	D312-80141-1	B/4-21-78	1.0-1.6.6.1	
Ship Drawing index	D312-80148-1	/11-12-72	l-0-1.4.11.7	
Working Agreement: PHM Test & Eval. Working Group	D312-80179-1	/4-22-74	1.0-1.3.11.1	HMR 55
Working Agreement: Production PHM Test Working Group	D312-80179-2	A/2-7-78	1.0-1.3.11.1, 1.0-1.3.12	HMR 55
Engineering Test Document Definition and Index	D312-80200-1	A/1-2-74	1.0-1.3.11.1	
Production PHM Engineering Test Document Definition and Index	D312-80200-2	A/4-3-78	1.0-1.3.11.1	
Tech Manual Status & Schedules	D312-80221-2	C/1-31-79	1.0-1.6.6.1	HMR 109R1 HMR 57
Flammable Liquid Leak Fire Hazard	D312-80290-1	/8-31-76	1.0-2.7, 1.540	(HMR 19, 16, 55

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.	
Transition Plan inputs to the ILS Management Plan for PHM Production Phase	~312-80255-1	/11-7-78	1.0-1.6.1.1	HMR 19 & 92
Pump, Auxiliary Systems NATO PHM (-2, Bilge and Waste Water Pumps)	312-81397	C/9-5-78	1.520.2, 1.520.3-2	HMR 62
Motor Protection System, 400 Hz	312-81459	A/7-17-78	1.320	HMR 53
Production PHM Test Requirements	D312-80243-3		1.0-1.3.11	HMR 55R2
Boeing Process Spec. (Heat Treatment - Titanium)	BAC 5613	E/9-21-78	1.0-2.1	HMR 114
Electrical System, Receptacles, One-Line Diagram	802-5000465	J/5-19-80	1.331	HMR 37,876 88, 119,167
Silicone Sealant	RTV 106		1.432	HMR 202
Pump, Auxiliary Systems NATO PHM (-3, Fuel Pump)	313-81397	D/5-15-81	1.540.5	HMR 199

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					HMR 55
					HMR 92
Energy Absorber Forward Strut	800-4596524		/12-22-75	1.566.3.6	HMR 109R1
Main & Platform Decks, Scantling	800-4596528		/2-2-76	1.130, 1.180	HMR 109R1
Test - SSPU Lub. System	345-4596500		/9-18-74	1.262.4	
Deck Machinery Arrangement	520-4596503		A/7-23-75	1.581.1-1, 1.581.2-1	
Shell Expansion, Scantling	800-4596527		/1-30-76	1.110, 1.180, 1.246.1	HMR 109R1
Typical Frames and Bulkheads Scantling	800-4596533		/1-28-76	1.110, 1.120, 1.180	HMR 109R1
Doors, Hatches, Manholes, and Access Plates Scantling	800-4596529	Sh. 1	B/7-19-78	1.120	HMR 57, 75
		Sh. 2	B/6-26-78		
		Sh. 3	B/6-26-78		
		Sh. 4	A/4-21-78		
Bow Door Installation Scantling	800-4596530	Sh. 1-3	/12-22-75	1.120	HMR 75, 109R1
Foilbome Propulsion Ducts Scantling	800-4596534		/1-30-76	1.246.2	HMR 75, 109R1
Deckhouse & Pilot House Scantling Plan	800-4596531		/1-15-76	1.140	HMR 109R1
Deckhouse Framing Scantling Plan - PHM-3 Producibility Studies	800-4596532		/1-15-76	1.140	HMR 109R1
Bow Framing & Fwd. Strut Found. Scant.	800-4596535	Sh. l-6	/12-22-75	1.110, 1.120, 1.180	HMR 109R1
Hull Acoustics Insulation, Midships	800-4596542		/3-12-76	1.635	HMR 109R1
Foundations Instl. & Details - H/B Propulsor	112-4597049	Sh. 1	/8-15-78	1.246.1	HMR 109R1
		Sh. 2	/8-15-78		
		Sh. 3	/8-15-78		
Electrical Sys. - Equip. Location	831-4596577	Sh. 1	C/2-14-74	1.300.2, 1.322	
		Sh. 2	C/2-14-74		
Electrical Sys. - Wire Routing	831-4596578	Sh. 1	B/3-7-74	1.321	
		Sh. 2	B/3-7-74		
Assembly, Leveling Amplifier	401-4597579		A/12-1-78	1.433.3	HMR 109R1
Pump Assembly (Env. & Interface Con. Dwg.)	201-4596600	Sh. 1	C/9-5-78	1.245.2	HMR 32, 109R1
		Sh. 2	C/9-5-78		
Gearbox Assy. - Foilborne Propulsion	201-4596607	Sh. 1	F/1-12-79	1.241.2	HMR 32, 57, 75 92, 109R1
					HMR 46
Aft. Flap Linkage Instl.	526-4596662	Sh. 1	B/12-21-76	1.566.5	
		Sh. 2	B/12-21-76		
					HMR 46
Anchor Stowage Installation, Forward and Aft	520-4596700		/11-22-77	1.581.1-1	HMR 64

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				HMR 55
Label Marker Confg. Stds.	6054596702	A/11-25-78	1.690	HMR 109R1
Ship Name & Number	605-4596703	A/12-3-75	1.690	
				HMR 55
Rails, Stanchions & Lifelines	600-4596712	Sh. 1 B/1-7-77	1.612	
		Sh. 2 B/l-7-77		
		Sh. 3 B/1-7-77		
		Sh. 4 Not Used		HMR 109R1
		Sh. 5 B/1-7-77		
		Sh. 6 B/1-7-77		
		Sh. 7 B/1-7-77		
		Sh. 8 B/1-7-77		
		Sh. 9&10 B/1-7-77		
Handrail Detail and Assembly	600-5330570	Sh. l-3 /12-12-78	1.612	HMR 109R1
Mooring & Towing Fittings	600-4596713	Sh. 1 A/6-26-73	1.613	
		Sh. 2 A/6-26-73		
Rigging	602-4596714	Sh. 1 A/11-18-75	1.614	
		Sh. 2 A/11-18-75		
Rat Proofing	600-4596715	/8-20-74	1.605.1	
Locks, Keys & Tags	600-4596716	A/12-18-75	1.690	
Covers, Canvas	600-4596717	A/11-14-75	1.614	
Non-Structural BHDs & Doors	604-4596721	Sh. 1 C/11-17-75	1.621, 1.624	
		Sh. 2 C/11-17-75		
		Sh. 3 C/11-17-75		
		Sh. 4 C/11-17-75		
		Sh. 5 C/11-17-75		
		Sh. 6 C/11-17-75		
		Sh. 7 C/11-17-75		
Grating Instl. Boatswain Store-room Nos. 1 & 2	603-5330585	/3-5-79	1.622	HMR 122
Grating Instl. Bow Thruster Machinery Room	603-5330586	/3-2-79	1.622	HMR 122
Grating Instl. F/B Turbine Enclo-sure	603-5330588	Sh. 1 /3-5-79	1.622	HMR 122
		Sh. 2 /3-5-79		
Grating Instl. Auxiliary Machinery Room No. 3	603-5330590	Sh. 1 /3-2-79	1.622	HMR 122
		Sh. 2 /3-2-79		
		Sh. 3 /3-2-79		
Grating Instl. Auxiliary Machinery Room No. 2	603-5330587	Sh. 1 /4-23-79	1.622	HMR 122
		Sh. 2 /4-23-79		
		Sh. 3 /4-23-79		
		Sh. 4 /4-23-79		
		Sh. 5 /4-23-79		
Grating Instl. Diesel and Machinery Room	603-5330589	Sh. 1 /3-22-79	1.622	HMR 122
		Sh. 2 /3-22-79		

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Inclined & Vertical Ladders	603-4596723	Sh. 1 E/11-22-78	1.623	HMR 122
		Sh. 2 E/11-22-78		
		Sh. 3 E/11-22-78		
		Sh. 4 (X2-1-75		
		Sh. 5 C/12-1-75		
		Sh. 6 E/11-22-78		
Airports & Windows	600-4596725	Sh. 1 A/12-8-76	1.625	
		Sh. 2 A/12-8-76		
		Sh. 3 A/12-8-76		
Inclined Ladder Inst. Plat. Deck	603-5330975	/5-30-79	1.623	HMR 140
Curtain Installation - Bridge Ladder, Light Trap	504-5330584	Sh. 1 /5-9-79	1.621	HMR 140
		Sh. 2 /5-9-79		
Light Shield - Comm. Room	605-4596728	A/12-1-75	1.621	
Grommet - Insulation Blanket	607-5330734	/1-17-79	1.635	HMR 122
Deck Coverings	606-4596734	Sh. 1 C/10-1-76	1.634	HMR 19
		Sh. 4 B/10-17-75		
Insulation & Sheathing Instl., Bhd. 3-9, Magazine	607-5330598	Sh. 1 A/8-1-79	1.635, 1.637	HMR 140
		Sh. 2 A/8-1-79		
Insulation & Sheathing Instl., Bhd. 9-15	607-5330599	Sh. 1 B/7-23-79	1.635, 1.637	HMR 140
		Sh. 2 B/7-23-79		
		Sh. 3 B/7-23-79		
Insulation & Sheathing Instl. Bhd. 15-18, Hull	607-5330600	Sh. 1 B/7-16-79	1.635, 1.637	HMR 140
		Sh. 2 B/7-16-79		
		Sh. 3 B/7-16-79		
		Sh. 4 B/7-16-79		
		Sh. 5 B/7-16-79		
Insulation & Sheathing Instl., Bhd. 18-21, Hull	607-5330601	Sh. 1 A/5-31-79	1.635, 1.637	HMR 140
		Sh. 2 A/5-31-79		
		Sh. 3 A/5-31-79		
Insulation & Sheathing Instl., Bhd. 21-25, Port	607-5330602	Sh. 1 A/5-31-79	1.635, 1.637	HMR 140
		Sh. 2 A/5-31-79		
		Sh. 3 A/5-31-79		
Insulation & Sheathing Instl., Bhd. 21-25 Center	607-5330603	Sh. 1 A/6-8-79	1.635, 1.637	HMR 140
		Sh. 2 A/6-8-79		
		Sh. 3 A/6-8-79		
		Sh. 4 /3-19-79		
		Sh. 5 /3-19-79		
Insulation & Sheathing Instl., Hull Bhd. 21-25 Stbd.	607-5330604	/6-13-79	1.635, 1.637	HMR 140
Insulation & Sheathing Instl., Hull Bhd. 25-30	607-5330605	Sh. 1 /3-16-79	1.635, 1,637	HMR 140
		Sh, 2 /3-16-79		
		Sh. 3 'T-16-79		

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NCO Furnishings	612-4596742	Sh. 1 A/3-12-76	1.642	
		Sh. 2 A/3-12-76		
		Sh. 3 /6-27-74		
Enlisted Pers. Furnishings	612-4596743	Sh. 1 B/11-15-76	1.643	
		Sh. 2 A/1-15-76		
		Sh. 3 A/1-15-76		
Painting Schedule	605-4596731	Sh. 1 F/TBA		HMR 186
		Sh. 2 B/1-10-74		
		Sh. 3 F/TBA		
		Sh. 4 F/TBA .		

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DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.	
Insulation & Sheathing Instl., Hull Bhd. 30-33	607-5330606	/3-16-79	1.635, 1.637	HMR 140
Insulation & Sheathing Instl., Pilot House	607-5330607	Sh. 1 B/8-1-79	1.635, 1.637	HMR 140
		Sh. 2 B/8-1-79		
		Sh. 3 B/8-1-79		
		Sh. 4 B/8-1-79		
Insulation & Sheathing Instl., CIC	607-5330608	Sh. 1 B/8-1-79	1.635, 1.637	HMR 140
		Sh. 2 A/5-21-79		
		Sh. 3 A/5-21-79		
Insulation & Sheathing Instl., Comm. & Elec. Eqpt. Rooms	607-5330609	Sh. 1 B/7-19-79	1.635, 1.637	HMR 140
		Sh. 2 B/7-19-79		
		Sh. 3 B/7-19-79		
Insulation & Sheathing Instl., C.O. Stateroom & Passageway	607-5330610	Sh. 1 B/8-1-79	1.635, 1.637	HMR 140
		Sh. 2 B/8-1-79		
		Sh. 3 B/8-1-79		
		Sh. 4 B/8-1-79		
Insulation & Sheathing Instl., Turbine Air Intake	607-5330611	Sh. 1 /5-15-79	1.635, 1.637	HMR 140
		Sh. 2 /5-15-79		
Insulation & Sheathing Instl., Auxiliary Machinery Rm. No. 1	607-5330612	Sh. 1 /5-14-79	1.635, 1.637	HMR 140
		Sh. 2 /5-14-79		
		Sh. 3 /5-14-79		
		Sh. 4 /5-14-79		
		Sh. 5 /5-14-79		
Berth Curtain	612-4596755	Sh. 1 A/2-5-76	1.643	
		Sh. 2 /9-20-74		
Furnishings - EOS	613-4596762	Sh. 1 A/1-15-76	1.660	
		Sh. 2 A/1-15-76		
Damage Cont. Sta. & Equipment	608-4596764	Sh. 1 B/10-21-76	1.660	
		Sh. 2 B/10-21-76		
		Sh. 3 B/10-21-76		
		Sh. 4 B/10-21-76		
Chair Instl. - Pilothouse	613-5330674	Sh. 1 /2-1-79	1.421, 1.660	HMR 122
		Sh. 2 /2-1-79		
		Sh. 3 /2-1-79		
stow sp. - Flag Locker	608-4596770	Sh. 1 A/12-1-75	1.421, MOD 3&7 deleted,	
		Sh. 2 A/12-1-75	1.670	
stow sp. - Mooring Line Reels	608-4596771	D/11-16-76	1.581.2-4, 1.613, 1.670	
stow sp. - Liferings & Pike Poles	608-4596772	A/12-31-75	1.670	
Stow Sp. - Brow	608-4596773	B/11-16-76	1.623, 1.670	
stow sp. - Tools & Repair Equip.	608-4596774	Sh. 1 A/12-18-75	1.670	
		Sh. 2 A/12-18-75		
		Sh. 3 A/12-18-75		

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Stow Sp. Life-jackets & FWG	608-4596775	Sh. 1 B/10-21-76	1.670	
		Sh. 2 B/10-21-76		
stow sp. - Boatswain's Storeroom	608-4596776	Sh. 1 D/10-21-76	1.670	
		Sh. 2 B/10-21-76		
		Sh. 3 A/12-3-75		
stow sp. - Dry Prov. Store Room	608-4596777	Sh. 1 B/11-23-76	1.670	
		Sh. 2 B/11-23-76		
		Sh. 3 A/11-24-75		
stow sp. - Cleaning Gear Locker	608-4596778	/6-7-74	1.670	
stow sp. - Onboard Repair Parts	608-4596779	/8-30-74	1.670	
Name, Label-Plates-Ship Control sys.	605-4596790	A/12-9-76	1.690	
Hull Designation & Marking	605-4596791	Sh. 1 B/12-7-76	1.690	
		Sh. 2 B/12-7-76		
		Sh. 3 B/12-7-76		
		Sh. 4 B/12-7-76		
Draft Marks	605-4596792	Sh. 1 A/11-11-75	1.0-1.1, 1.690	
		Sh. 2 A/11-11-75		
List of Label Plates - C & S	605-4596793	F/5-15-79	1.690	HMR 140
Label Plate Instl., Prop. Sys.	605-4596794	/10-3-74	1.690	
List of Marker Plates - Elect. Plt.	605-4596795	C/11-16-76	1.690	
List of Nameplates - Aux. Sys.	605-4596796	E/12-16-76	1.690	
List of Label Plates - Armament	605-4596798	D/5-15-79	1.690	HMR 140
Air Cond., Vent & Heat Diagrams	501-4669108	/2-9-78	1.512.2	HMR 55
Air Cond., Vent & Heat Eqpt. Lists	501-4669109	/2-9-78	1.512.2	
Chilled Water Piping, Air Cond. sys.	501-4669110	/2-9-78	1.512.2	
Heater Instl. - Mach. Spaces	501-4596807	c/11-14-75	1.512.2	
				HMR 122
Sight Gauge Installation - Ship Displacement Measurement	113-4596514	/8-4-75	1.690	HMR 121

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A/C & Control Panel Instl. ECS	502-4668725	/2-27-79	1.512.2	HMR 122
Ducting & Fan Instl. Platform Deck, ECS	502-5330488	Sh. 1 /3-16-79 Sh. 2 /3-16-79	1.512.2, 1.512.6	HMR 122
Ducting Instl. Deck House ECS	502-4669138	Sh. 1 /2-19-79 Sh. 2 /2-19-79 Sh. 3 /2-19-79	1.512.2, 1.512.6, 1.512.7	HMR 122, 133
Terminal Unit Instl. - Pilothouse ECS	502-4668731	/4-16-79	1.512.2, 1.512.6	HMR 122
Ducting Instl. - Machinery Room No. 1	502-5330487	Sh. 1 /4-27-79 Sh. 2 /4-27-79	1.512.2, 1.512.6	HMR 122
Fan & Duct. Instl., Exhaust, Galley	502-5330524	/4-12-79	1.512.2, 1.512.6	HMR 122
Locker Fittings Prov. & Repair Parts	608-5330860	Sh. 1-47 A/6-11-79	1.670	HMR 140
Heater Instl. - Machinery Rooms & Sanitary Space	502-4669139	/6-4-79	1.512.2	HMR 140

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		Sh. 5 D/11-11-76		
		Sh. 6 D/11-11-76		
		Sh. 7 E/12-15-76		
		Sh. 8 D/11-11-76		
Ducting Instl. - Heat & Vent	501-4596811	Sh. 1 C/12-6-76	1.512.2, 1.512.6	
		Sh. 2 B/10-28-76		
		Sh. 3 B/10-28-76		
Term. Unit & Control Instl.	501-4596812	Sh. 1 B/11-17-76	1.512.2	HMR 133, 122
		Sh. 2 B/11-17-76		
Heater Instl. - Sanitary Spaces	501-4596813	B/12-7-76	1.512.2	
Piping & Equip. Instl. - Bilge	501-4596829	Sh. 1 E/12-15-76	1.520.2, 1.520.3-1, 1.530.1	
		Sh. 2 E/12-15-76		
		Sh. 3 D/11-15-76		
		Sh. 4 D/11-15-76		
		Sh. 5 C/11-20-75		
		Sh. 6 D/11-15-76		
		Sh. 7 C/11-20-75		
		Sh. 8 E/12-15-76		
		Sh. 9 C/11-20-75		
Piping & Equip. Instl. - Platform Deck	505-4596 830	Sh. 1 D/12-15-76	1.520.1-1, 1.520.3-1, 1.530.1	
		Sh. 2 D/12-15-76	1.551.1, 1.555.2	
		Sh. 3 D/12-15-76		
		Sh. 4 C/11-12-76		
		Sh. 5 B/6-6-74		
		Sh. 6 D/12-15-76		
		Sh. 7 D/12-15-76		
		Sh. 8 C/11-12-76		
		Sh. 9 D/12-15-76		
Fire Ext. Bottle & Hdwr. Instl,	507-4596831	Sh. 1 B/12-7-76	1.555.5	
		Sh. 2 B/12-7-76		
		Sh. 3 B/12-7-76		
		Sh. 4 A/11-12-76		
Piping & Equip. Instl. - AMR 1 & D.H.	505-4596833	Sh. 1 B/12-15-76	1.256, 1.520.1-1, 1.520.3-l	
		Sh. 2 B/12-15-76	1.530.1, 1.551.1, 1.555.2	
		Sh. 3 B/12-15-76		
		Sh. 4 B/12-15-76		
		Sh. 5 A/1-15-76		
		Sh. 6 B/12-15-76		
Tank & Pump Inst. Waste Water	505-5330529	/12-13-78	1.520.2	HMR 122
Piping Instl. - User & Vent, Waste Water	505-5330531	Sh. 1 A/6-25-79	1.520.3-l	HMR 140
		Sh. 2 A/6-25-79		
Piping Instl. - Condensate Drains	502-5330545	Sh. l-3 /5-31-79	1.520.3-4	HMR 140

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Piping & Equip. Instl. - AMR 2	505-4596834	Sh. 1 B/12-2-76	1.256, 1.520.1-1, 1.520.2	
		Sh. 2 B/12-2-76	1.520.3-1, 1.530.1, 1.551.1	
		Sh. 3 B/12-2-76	1.555.2	
		Sh. 4 B/12-2-76		
		Sh. 5 /4-2-74		
		Sh. 6 B/12-2-76		
		Sh. 7 B/12-2-76		
		Sh. 8 B/12-2-76		
		Sh. 9 B/12-2-76		
Piping & Equip. Instl. - Diesel Machinery	505-4596835	Sh. 1 B/12-2-76	1.256, 1.520.1-1, 1.520.2,	
		Sh. 2 B/12-2-76	1.530.1, 1.551.1, 1.555.2	
		Sh. 3 B/12-2-76		
		Sh. 4 B/12-2-76		
		Sh. 5 B/12-2-76		
		Sh. 6 B/12-2-76		
Piping & Equip. Instl. - AMR 3	505-4596836	Sh. 1 D/12-23-76	1.256, 1.520.1-1, 1.520.2,	
		Sh. 2 D/12-23-76	1.530.1, 1.551.1, 1.555.2	
		Sh. 3 B/1-15-76		
		Sh. 4 D/12-23-76		
		Sh. 5 C/11-16-76		
		Sh. 6 A/8-29-74		
		Sh. 7 D/12-23-76		
		Sh. 8 C/11-16-76		
		Sh. 9 C/11-16-76		
Bilge Pump & Level Indic. Instl.	508-4596837	Sh. 1 A/10-29-75	1.520.2	
		Sh. 2 A/10-29-75		
Plumbing Instl. - Tank Fuel Sys.	511-4596839	Sh. 1 C/12-13-76	1.540.1	
		Sh. 2 B/5-16-74		
		Sh. 3 C/12-13-76		
		Sh. 4 B/5-16-74		
		Sh. 5 A/4-4-75		
		Sh. 6 B/5-16-74		
		Sh. 7 A/4-4-74		
Sndg. & Gaging Instl. - Fuel Tank	511-4596840	Sh. 1 A/12-6-76	1.540.1	
		Sh. 2 A/12-6-76		
Pump, Plumbing Instl. Str. Sys. Fuel	511-4596844	Sh. 1 A/11-1-76	1.540.1	
		Sh. 2 A/11-1-76		
		Sh. 3 A/11-1-76		
Piping Instl. - Voids Waste Water	505-5330530	Sh. 1 /3-6-79	1.520.2	HMR 122
		Sh. 2 /3-6-79		
Bilge Mains Piping Instl.	508-5330534	/3-8-79	1.520.2	HMR 122
HALO" Piping Instl. Above Platform De[illegible]	507-5330378	/5-31-79	1.555.2	HMR 1[illegible]

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Plumbing Instl. - Fuel Vent	511-4596845	Sh. 1 A/11-11-76	1.540.1	
		Sh. 2 A/11-11-76		
		Sh. 3 A/11-11-76		
Plumbing Instl. - H/B Fuel Supply	511-4596847	Sh. 1 B/11-17-76	1.540.1	
		Sh. 2 A/10-29-75		
		Sh. 3 /6-24-74		
Plumbing Instl. - Fuel Fill	511-4596848	Sh. 1 A/11-1-76	1.540.1, 1.571-2.1	
		Sh. 2 A/11-1-76		
Plumbing Instl. - AC Pump-Fuel Trans.		Sh. 1 4-27-81	1.540.1	HMR 199
		Sh. 2 4-27-81		
		Sh. 3 4-27-81		
		Sh. 4 4-27-81		
Plumbing Instl. - DC Pump Fuel Trans.	511-4596850	Sh. 1 B/11-17-76	1.540.1	
		Sh. 2 B/11-17-76		
		Sh. 3 B/11-17-76		
Bottle Instl. - CO_2 & Dry Chemical	507-4596851	A/11-11-76	1.555.1, 1.555.3	
Hydr. Piping & Equip. Instl. - BHD 3	516-4596858	Sh. 1 B/11-24-75	1.556.4	
		Sh. 2 B/11-24-75		
		Sh. 3 B/11-24-75		
		Sh. 4 B/11-24-75		
		Sh. 5 B/11-24-75		
		Sh. 6 /2-21-74		
		Sh. 7 B/11-24-75		
Hydro. Piping & Equip. Instl. - Mach. Sp.	516-4596859	Sh. 1 E/1-5-77	1.556.1 *	
		Sh. 2 E/1-5-77		
		Sh. 3 C/11-17-76		
		Sh. 4 E/1-5-77		
		Sh. 5 /4-1-74		
		Sh. 6 B/11-14-75		
		Sh. 7 B/11-14-75		
		Sh. 8 C/11-17-76		
		Sh. 9 A/12-18-74		
		Sh. 10 B/11-14-75		
		Sh. 11 B/11-14-75		
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		Sh. 13 C/11-17-76		
Hydraulic Tubing & Equipment Instl. - Bhd. 3	516-4596815	Sh. 1-5 /5-16-79	1.556.4	HMR 140

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		Sh. 14 B/11-17-75		
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		Sh. 16 C/11-17-76		
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		Sh. 18 C/11-17-76		
		Sh. 19 A/12-18-74		
		Sh. 20 C/11-17-76		
		Sh. 21 B/11-14-75		
		Sh. 22 B/11-14-75		
		Sh. 23 D/11-29-76		
		Sh. 24 C/11-17-76		
		Sh. 25 E/1-5-77		
		Sh. 26 C/11-17-76		
		Sh. 27 D/11-29-76		
H/B Steering Sys. Instl.	518-4596862	Sh. 1 C/12-16-76	1.562	
		Sh. 2 C/12-16-76		
Bow Thruster Instl.	518-4596863	B/3-1-78	1.568.2	HMR 32
Hydraulic System Schematic Diagram NATO PHM	516-4596864	Sh. 1 A/11-23-76	1.562	
		Sh. 2 A/11-23-76		
		Sh. 3 A/11-23-76		
Foundation - Anchor Billboard	520-4596869	Sh. 1 A/12-18-75	1.581.2-3	
		Sh. 2 A/12-18-75		
Fitting Instl. - Pad Eyes, Cleats, UNREP	516-4596875	B/10-2-75	1.571.1-2.3	
Windshield Wash System	505-4596891	/12-13-76	1.530.1	
Electronics Cabinet Instl. - Con-troi System	518-5331006	/5-1-79	1.561	HMR 122
Equip. Instl. - Control System, Remote	518-5330967	Sh. 1 /3-26-79	1.561	HMR 122
		Sh. 2 /3-26-79		
		Sh. 3-13 /3-26-79		
Tubing Instl. - Hydr. Bilge Area Bulkhead 3-25	516-4596788	Sh. 1 /1-2-79	1.556.4	HMR 109R1
		Sh. 2 /1-2-79		
		Sh. 3 /1-2-79		
		Sh. 4 /1-2-79		
		Sh. 5 /1-2-79		
		Sh. 6 /1-2-79		
Hydraulic Pump Instl.	516-4597061	B/5-1-79	1.556.3	HMR 140

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Hydraulic Piping & Eqpt. Instl., Bhd. 25-30.025	516-4596782	/5-24-79	1.556.1	HMR 140
Hydraulic Piping & Eqpt. Instl., Bhd. 30.025-33	516-4596783	/5-24-79	1.556.1	HMR 140

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Fwd. Strut Fdn. - Retr. & Lock Fittings	113-4597115	Sh. 1 C/11-16-76	1.180	
		Sh. 2 C/11-16-76		
Compartment Testing Diagram	126-4597116	Sh. 1 D/8-6-75	1.631	
		Sh. 2 D/8-6-75		
Main Mast - Details & Instl.	128-4597125	Sh. 1 C/11-29-76	1.170	
		Sh. 2 B/8-27-75		
		Sh. 3 C/11-29-76		
		Sh. 4 B/8-27-75		
Radar Pylon - Details & Instl.	128-4597126	Sh. 1 C/12-6-76	1.170	
		Sh. 2 C/12-6-76		
		Sh. 3 B/5-21-76		
Fresh Water Tank	114-4597131	A/10-29-75	1.530.1	
Component Instl. Pilot House Main Console	410-4597140	Sh. 1 D/9-1-78	1.421, 1.429, 1.560	HMR 89
		Sh. 2 D/9-1-78		
		Sh. 3 D/9-1-78		
		Sh. 4 D/9-1-78		
		Sh. 5 D/9-1-78		
		Sh. 6 D/9-1-78		
		Sh. 7 D/9-1-78		
		Sh. 8 D/9-1-78		
		Sh. 9 D/9-1-78		
Pilothouse Mn. Console - Instl.	410-4597141	A/11-18-75	1.560	
Pilothouse Ohd. Console - Instl.	410-4597143	Sh. 1 D/11-14-78	1.560	HMR 109R1
		Sh. 2 D/11-14-78		
		Sh. 3 D/11-14-78		
		Sh. 4 D/11-14-78		
Pilothouse Mn. Console - Structure	410-4597145	Sh. 1 C/12-7-78	1.560	
		Sh. 2 C/12-7-78		
		Sh. 3 C/12-7-78		
		Sh. 4 C/12-7-78		
		Sh. 5 C/12-7-78		
		Sh. 6 C/12-7-78		
		Sh. 7 C/12-7-78		
		Sh. 8-10 C/12-7-78		
Panel Assy., Pilothouse Alarm Control	410-4597154	Sh. 1 B/9-28-78	1.433.3	HMR 89
		Sh. 2 B/9-28-78		
		Sh. 3 B/9-28-78		
Structure Assy. Pilothouse Overhead Console	410-4597164	Sh. i c/i-lo-n	1.560	HMR 89 & 109R1
		Sh. 2 C/1-10-79		

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Bracket Details Pilothouse Console Instl.	410-4597168	Sh. 1 C/3-13-79	1.560	HMR 122
		Sh. 2 C/3-13-79		
Electrical Plant Instl.	345-4597200	/7-22-74	1.300.2	
Receptacle System Instl.	303-4597203	Sh. 1 B/11-10-76	1.333	
		Sh. 2 A/10-23-75		
		Sh. 3 B/11-10-76		
		Sh. 4 B/11-10-76		
		Sh. 5 A/10-23-75		
Panel Assy., Ckt. Bkr. DC Power	302-4597205	Sh. 1 D/2-27-79	1.252.3.D	HMR 122
		Sh. 2 D/2-27-79		
Panel Assy., Ckt. Bkr. DC Power	302-4597206	Sh. 1 E/2-27-79	1.252.3.D	HMR 122
		Sh. 2 E/2-27-79		
Elect. Equip. Instl., CIC	301-4597220	Sh. 1 A/11-15-76	1.314.3, 1.314.4, 1.314.6	
		Sh. 2 A/11-15-76		
Elect. Equip. Instl., AMR 1	301-4597244	Sh. 1 D/6-9-79	1.313, 1.313.1, 1.314.1	HMR 140
		Sh. 2 D/6-9-79		
		Sh. 3 D/6-9-79		
Elect. Equip. Instl., Platfm. Deck	301-4597245	B/11-10-76	1.314.5, 1.314.8	
Elect. Equip. Instl., Lower Machy. Rooms	301-4597246	Sh. 1 A/11-11-76	1.313, 1.313.1, 1.314.1	
		Sh. 2 A/11-11-76	1.314.7	
Power Unit Instl., SSPU Fwd.	300-459 7362	Sh. 1 C/11-9-76	1.311.1, 1.312.8, 1.530.1	
		Sh. 2 C/11-9-76		
		Sh. 3 B/12-18-74		
		Sh. 4 C/11-9-76		
		Sh. 5 B/12-18-74		
Air Inlet Instl., SSPU Fwd.	300-4597365	D/5-15-78	1.251.1	HMR 57
Exhaust Instl., SSPU Fwd.	300-4597367	Sh. 1 C/3-9-78	1.259.3	HMR 57
		Sh. 2 C/3-9-78		HMR 92
		Sh. 3 C/3-9-78		HMR 92
		Sh. 4 C/3-9-78		HMR 92
Lube Sys. Instl., SSPU	300-4597370	Sh. 1 A/6-19-75	1.312.2	
		Sh. 2 /6-12-74		
Power Unit Instl., SSPU Aft	300-4597372	Sh. 1 C/11-4-75	1.311.1, 1.312.8, 1.530.1	
		Sh. 2 C/11-4-75		
Air Inlet Instl., SSPU Aft	300-4597375	Sh. 1 C/1-12-79	1.251.1	HMR 57, 109R1
		Sh. 2 C/l-12-79		

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Exhaust Instl., Power Unit Aft Ship Service	300-4597378	Sh. 1 D/6-22-79	1.259.3	HMR 55, 109R1, 140
		Sh. 2 B/11-23-76		
		Sh. 3 A/3-14-74		
		Sh. 4 B/11-23-76		
		Sh. 5 A/3-14-74		
		Sh. 6 D/6-22-79		HMR 140
Bushing, Cushioned, SSPU	300-4597383	B/2-21-79	1.0-1.5.2.9	HMR 122
Junction Box Instl. (Below Main Deck)	303-5330499	h/7-12-79	1.333	HMR 140
Switch and Receptacle Instl. - Deck House	303-5330507	Sh. 1 A/6-7-79	1.333	HMR 140
		Sh. 2 A/6-7-79		HMR 140

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Arrgmt., 76mm Gun & Magazine	745-4597404	Sh. 1 B/11-4-75	1.700.5	
		Sh. 2 A/10-10-74		
		Sh. 3 A/10-10-74		
Index - Armament	745-4597406	/2-14-74	1.700.5	
Small Arms Locker	711-4597408	B/11-10-76	1.700.7	
Pyrotechnics Locker	711-4597410	B/5-18-79	1.700.7	HMR 140
Comm. Equip. Shelves, Instl.	4094597425	Sh. 1 A/11-21-75	1.445	
		Sh. 2 A/11-21-75		
		Sh. 3 A/11-21-75		
		Sh. 4 A/11-21-75		
Exterior Comm. Console Instl.	409-4597426	A/12-8-75	1.445	
Gyro Compass Instl.	410-4597436	B/5-4-79	1.189.1	HMR 140
Installation - Secure Equipment Deck	409-4597428	A/11-10-76	1.446	HMR7
Dead Reck. Tracer Table Instl.	400-4597448	Sh. 1 B/11-10-76	1.421	
		Sh. 2 A/10-3-75		
Yard Arm Blinker Control Instl.	410-4597454	Sh. 1 B/5-18-79	1.443	HMR 140
		Sh. 2 B/5-18-79		
Megaphone in Pilothouse Instl.	400-4597461	A/11-10-76	1.443	
Announcing AMP/Alarm Gen. Assy.	401-4597464	Sh. 1 D/12-11-78	1.433.3	HMR 109R1
		Sh. 2 D/12-11-78		
		Sh. 3 D/12-11-78		
		Sh. 4 D/12-11-78		
		Sh. 5 D/12-11-78		
		Sh. 6 D/12-11-78		
Radar Instl.	401-4597465	Sh. 1 B/11-11-76	1.429	
		Sh. 2 B/11-11-76		
		Sh. 3 B/11-11-76		
Announcing Sys. insti.	401-5330400	Sh. i /4-14-79	1.433.3	HMR 140
		Sh. 2 /4-14-79		
		Sh. 3 /4-14-79		
Clocks Instl.	400-4597476	Sh. 1 A/11-11-76	1.421	
		Sh. 2 A/11-11-76		

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Whistle & Whistle Control Instl.	400-4597477	B/3-20-79	1.443	HMR 140
Depth Sounder Instl.	410-4597479	Sh. 1 B/11-10-76	1.424	
		Sh. 2 B/11-10-76		
		Sh. 3 A/11-24-75		
Underwater Log Instl.	410-4597480	Sh. 1 C/11-11-76	1.426.2	
		Sh. 2 C/11-11-76		
		Sh. 3 /5-23-74		
				HMR 19
Installation Combined Antenna Sys. Eqpt & Navigation Radar Antenna	408-4597485	A/9-7-75	1.189.1	HMR 57
Installation Wind Direction and Speed Detector	400-4597502	/11-1-75	1.422.1	HMR 19
Nav. Lights on Mast Instl.	404-4597504	Sh. 1 A/9-19-75	1.443	HMR 57
		Sh. 2 A/9-19-75		
Combat Sys. Elect. Cable Inter Dia.	845-4597508	Sh. 1 A/l-14-77	1.424, 1.441	
		Sh. 2 A/l-14-77		
		Sh. 3 A/1/14-77		
Secure Equip. Cabinet Assy.	409-4597512	Sh. 1 B/1-15-76	1.445, 1.446	
		Sh. 2 B/1-15-76		
Instl. - Signal Searchlight	400-4597523	Sh. 1-2 B/5-18-79	1.443	HMR 140
Alarm Controller Gen. Assy.	401-4597535	R/2---21-79	1.433.3	HMR 122
Ship's Bell Inst.	400-4597542	A/11-10-76	1.443	
				HMR 19
Propulsion System Instl.	245-4597700	A/10-3-75	1.200	HMR 4
Engine Instl. - F/B Propulsion	201-4668872	Sh. 1 /8-24-78	1.234	HMR 95
		Sh. 2 /8-24-78		HMR 95
		Sh. 3 /8-24-78		HMR 95
		Sh. 4 /8-24-78		HMR 95
		Sh. 5 /8-24-78		HMR 95
Foilborne Propulsion Engine Support Assembly	201-4597703	Sh. 1 E/9-5-78	1.234.1, 1.0-1.5.2.9	HMR 75&109R1
		Sh. 2 D/7-27-78		
		Sh. 3 A/10-10-75		
		Sh. 4 D/7-27-78		HMR 75
		Sh. 5 A/10-10-75		
		Sh. 6 B/11-2-76		
		Sh. 7 A/10-10-75		
		Sh. 8 A/10-10-75		
		Sh. 9 A/10-10-75		
		Sh. 10 A/10-10-75		

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DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.
Wash & Drain Instl. - F/B Engine & Ships Service Power Unit	201-4668873	Sh. 1 A/1-5-79 Sh. 2 A/1-5-79	1.297, 1.312.8, 1.530.1 HMR 55 & 122

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.	
Instl. - Foilborne Propulsor	201-4668748	Sh. 1 /3-29-79	1.241.2, 1.245.2, 1.246.2	HMR 122
		Sh. 2 /3-29-79	1.200	
		Sh. 3 /3-29-79		
Support Mount - F/B Propulsor	201-4597713	Sh. 1 B/11-27-79	1.0-1.5.2.9	HMR 101
		Sh. 2 B/11-27-79		
		Sh. 3 B/11-27-79		
F/B Prop. Inlet Duct Instl.	201-4597718	Sh. 1 C/12-2-76	1.246.2	
		Sh. 2 C/12-2-76		
		Sh. 3 C/12-2-76		
F/B Engine Air Intake Instl.	204-4597726	Sh. 1 D/8-16-78	1.251.1	HMR 57, 92
		Sh. 2 D/8-16-78		
		Sh. 3 D/8-16-78		
		Sh. 4 C/5-15-78		
				HMR 140
Cooling Air Instl. F/B Engine	204-4597732	Sh. 1 C/3-22-78	1.251.3	HMR 55
		Sh. 2 C/3-22-78		
		Sh. 3 C/3-22-78		
		Sh. 4 C/3-22-78		
Air Systems Instl. - Engine Start & Intake De-Icing	201-4597734	Sh. 1 D/4-18-79	1.234.2, 1.251.2	HMR 140
		Sh. 2 C/11-4-76		
		Sh. 3 A/11-14-74		
		Sh. 4 A/11-14-74		
		Sh. 5 D/4-18-79		HMR 140
		Sh. 6 C/11-4-76		
		Sh. 7 A/11-14-74		
		Sh. 8-15 D/4-18-79		HMR 140
F/B Engine Exhaust Instl.	205-4597736	A/11-2-76	1.259.2	HMR 7
Lubo System Instl. - F/B Engine	211-4668876	Sh. 1 /2-14-79	1.262.2	HMR 122
		Sh. 2 /2-14-79		

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.	
Equipment Instl. - Lubo System, Foilborne Propulsor	211-5330969	Sh. 1 /4-20-79	1.262.2	HMR 140
		Sh. 2 /4-20-79		
Engine Instl. - Hullborne Propulsion	201-4669024	Sh. 1 A/4-24-79	1.238	HMR 4, 122
		Sh. 2 A/4-24-79		
Propulsor Instl. - Hullborne	201-4597754	Sh. 1 F/2-21-79	1.245.1	HMR 122
		Sh. 2 E/12-23-76		
		Sh. 3 E/12-23-76		
		Sh. 4 F/2-21-79		
		Sh. 5 F/2-21-79		
		Sh. 6 F/2-21-79		
Duct Instl. - Exhaust Hullborne Engine	205-4597759	Sh. 1 D/11-6-78	1.259.1	HMR 7, 101
		Sh. 2 D/11-6-78		
		Sh. 3 D/11-6-78		
F/B Prop. Lubo Cleaning	245-4597784	A/11-16-76	1.262.4	
Panel & Module Instl. Console & Cabinet EOS	206-5330877	Sh. 1 A/7-30-79	1.252.3, 1.252.2	HMR 140
		Sh. 2 A/7-30-79		
		Sh. 3 /6-28-79		
		Sh. 4 /6-28-79		
		Sh. 5 A/7-30-79		
		Sh. 6 A/7-30-79		
		Sh. 7 A/7-30-79		
		Sh. 8 A/7-30-79		
		Sh. 9 A/7-30-79		
		Sh. 10 A/7-30-79		
		Sh. 11 A/7-30-79		
		Sh. 12 A/7-30-79		
		Sh. 13 A/7-30-79		
		Sh. 14 A/7-30-79		
Panel & Moduie Assemblies - H/B Engine System Indication and Control	206-4597903	Sh. 1 C/1-16-79	1.252.3(b)1	HMR 122
		Sh. 2 C/1-16-79		
		Sh. 3 C/1-16-79		

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.	
Panel & Modules Assemblies SSPU Indication & Control	206-4597904	Sh. 1 C/2-14-79	1.252.3(c)	HMR 122
		Sh. 2 C/2-14-79		
		Sh. 3 /2-1-74		
		Sh. 4 C/2-14-79		HMR 122
		Sh. 5 C/2-14-79		
Module Assy. Bilge Flooding Indication & Pump Control	206-4597905	Sh. 1 E/1-3-79	1.252.3(g)4	HMR 122
		Sh. 2 E/l-3-79		
		Sh. 3 D/2-14-77		
		Sh. 4 E/l-3-79		
		Sh. 5 E/1-3-79		
Panel Assy. - Water Data System Remote Control Indicator	206-4597908	B/12-20-78	1.252.3(g)3, 1.252.3(i)	HMR 55, 122
A/C Vent. Fans Indic. & Control Mod.	206-4597907	Sh. 1 B/11-3-76	1.252.3(g)2	
		Sh. 2 B/11-3-76		
		Sh. 3 B/11-3-76		
Module Assembly Hullborne Gearbox and Propulsor Indication	206-4597909	Sh. 1 C/8-14-78	1.252.3(b)2	HMR 75
		Sh. 2 C/8-14-78		HMR 75
		Sh. 3 C/8-14-78		HMR 75
Module Assy. Battle Override & Caution/Warning	206-4597910	Sh. 1 D/2-27-79	1.252.3(h)1	HMR 122
		Sh. 2 D/2-27-79		
		Sh. 3 D/2-27-79		
Module Assembly Propulsion Throttle Transfer Indication and Control	206-4597911	Sh. 1 C/8-14-78	1.252.3(h)2	HMR 75
		Sh. 2 A/12-1-75		HMR 75
		Sh. 3 C/8-14-78		
Freshwater Sys. Indic. & Cont. Mod.	206-4597912	Sh. 1 C/10-28-76	1.252.3(g)5	
		Sh. 2 A/11-29-73		
		Sh. 3 A/11-29-73		
Electrical Sys. Indic. & Cont. Mod.	206-4597913	Sh. 1 D/1-16-79	1.252.3(d)	HMR 109R1
		Sh. 2 D/1-16-79		
		Sh. 3 D/i-i6-79		
		Sh. 4 A/11-1-75		
		Sh. 5 /4-5-74		
		Sh. 6 A/11-1-75		
		Sh. 7 D/1-16-79		
		Sh. 8-14 D/1-16-79		
Module Assembly Hydraulic System Indication & Control	206-4597914	Sh. 1 E/1-18-79	1.252.3(e)	HMR 122
		Sh. 2 E/1-18-79		
		Sh. 3 D/12-7-77		
		Sh. 4 E/1-18-79		
		Sh. 5 E/l-18-79		
		Sh. 6 E/1-18-79		
		Sh. 7 E/1-18-79		
		Sh. 8 E/1-18-79		

DOCUMENT/DATA TITLE	DOCUMENT/DATA NO.	REVISION SYMBOL/DATE	REF. SSS SECTION NO.	
Module Assy., Fuel System Indication and Control	206-4597915	Sh. 1 D/8-28-78	1.252.3(f)	HMR 89
		Sh. 2 D/8-28-78		
		Sh. 3 D/8-28-78		
		Sh. 4 B/11-17-75		
		Sh. 5 D/8-28-78		HMR 89
		Sh. 6 D/8-28-78		
		Sh. 7 D/8-28-78		
Module Assy., Fire Mains Fwd. Control	206-4597916	C/3-6-79	1.252.3(g)1	HMR 122
Module Assy., Fire Shut Down Control	206-4597917	Sh. 1 C/3-6-79	1.252.3(g)1	HMR 122
		Sh. 2 A/11-24-75		
		Sh. 3 C/3-6-79		HMR 122
		Sh. 4 C/3-6-79		
		Sh. 5 C/3-6-79		
EOS Console & Cabinet Instl.	206-4597920	Sh. 1 A/11-11-76	1.252.3	
		Sh. 2 A/11-11-76		
Frame Assy. Main Console, EOS	206-5330959	Sh. 1 /2-20-79	1.242.3	HMR 122
		Sh. 2 /2-20-79		
		Sh. 3 /2-20-79		
		Sh. 4 /2-20-79		
		Sh. 4-10 /2-20-79		
Main Console & Control Assy.	206-5330961	Sh. 1 /2-22-79	1.252.3	HMR 122
		Sh. 2 /2-22-79		
		Sh. 3 /2-22-79		
		Sh. 4 /2-22-79		
H/B Engine Lubo Sys. Cleaning	245-4668755	A/10-10-74	1.262.4	
Emergency Fuel Pump & Pump Instl.	511-4668763	Sh. 1 A/12-6-76	1.540.1	
		Sh. 2 A/12-6-76		
Plumbing Instl., Primary Supply Loop, Fuel System	511-4668766	Sh. 1 A/11-17-66	1.540.1	
		Sh. 2 A/11-17-66		
		Sh. 3 /5-20-74		
Diesel Engine, Hullborne Propulsion PHM	312-80141	G/4-18-78	1.238, 1.311.3	HMR 4, 55
Power Units Installation, Ships Service	300-4597360	/5-1-74	1.312	HMR4
Propulsor Assy., Hullborne Propulsion	312-80140	K/9-11-78	1.245.1	HMR 924, 55, 75,
Compressor Assembly, Foilborne Engine Starting	312-80107	E/7-26-78		HMR 26, 75R1

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The following is a part of the Contractor Controlled Baseline

VENDOR	VENDOR PART OR CONTROL NUMBER	REVISION SYMBOL/DATE	EQUIPMENT OR PART TITLE	REF. SSS SECTION NO.
LaMotte Chemical Products	CL-1001N	N/A	Chlorine Block Comparator	1.530.2
Elkay Mfg. Co..	*Model LK 304		Drain Assy.	1.651
F. S. Lang Mfg. Co.	Model 435-1M		Range-Oven	1.651
FSN5965-940-8699	Type A-567-l		Extension Cord	1.432.1**
Gaylord Industries, Inc.	*Model NA 3879B		Range Hood & Plumbing Enclosure	1.651 HMR 57
General Electric	*Model CT24A		Toaster	1.651
General Fire Profit	*Model 40/40G/N (MOD 2 changed)		Chair, Dining	1.651.1
The Hobart Mfg. Co.	*Model KCS100		Trash Compactor	1.651
The Hobart Mfg. Co.	*Model N-50		Food Mixer	1.651
The Hobart Mfg. Co.	*Model WM-1D		Dish Washer	1.651
J&F Industrial, Inc. Mfg. Dwg.	JF5269-11		Service Counter	1.651
J&F Industrial, Inc. Mfg. Dwg.	JF5269-2		Scullery Dresser	1.651
J&F Industrial, Inc. Mfg. Dwg.	JF 5269-3		Pan Storage 6 Chop Board	1.651
J&F Industrial, Inc. Mfg. Dwg.	JF5269-4		Food Prep. Overhead Cupboard	1.651
J&F Industrial, Inc. Mfg. Dwg.	JF5269-5		Range Equip. Overhead Cupboard	1.651
J&F Industrial, Inc. Mfg. Dwg.	JF5269-7		Utensil Storage	1.651
J&F Industrial, Inc. Mfg. Dwg.	JF5269-8		Scullery Prep. Counter	1.651
J&F Industrial, Inc. Mfg. Dwg.	JF5269-9		Food Prep. Counter	1.651
J&F Industrial, Inc. Mfg. Dwg.	JF5269-12		Food Prep. Under Counter Store	1.651
Progressive Mfg.	*Model FUDS		Service Stand with Drain	1.651.1
Scotsman Mfg.	*Model FD-4		Dispenser, Flake Ice/Water	1.651.1
Sears R.ebuck and Co.	Model 6526		Garbage Grinder	1.593.9
Trauisen & Co., Inc.	*Model GDT-1-26-WUT		Freezer/Refrig.	1.651
Traulsen & Co., Inc.	*Model GHT-l-26-WUT		Refrigerator	1.651
Cookson Co.	Model CD 10-l SS		Roller Curtain Panel	1.651
Hayes			Mesurflow Flow Control Valve	1.530 HMR 133
Griswold Controls	Models 3281H, 35315 35215		Flow Balancing Valve	1.530 HMR 133

NA - Not Applicable (Revision Column)

* - or Equal

** - Deleted by MOD

1.0-1 SHIP SYSTEM DEFINITION

1.0-1.1 WEIGHT AND STABILITY LIMITS

The ship as delivered by the Contractor shall not exceed the full load values of displacement and height of the ship's center of gravity (KG) specified in the Accepted Weight Estimate, and list and trim (or the associated tolerances of list and trim) specified herein, as modified by the resultant weight and moment effect of the values agreed upon for contract modifications and weight and moment changes in the Government-furnished material.

List shall not be more than 1/4 degree to port or starboard in the full load condition. In no case, however, shall the forward or aft limiting drafts specified in NAVSHIPS Drawing No. 605-4596792 be exceeded.

In determining Contractor responsibility, the values of displacement, KG, list, and trim of the ship at full load shall be based on the inclining experiment, supplemented by calculated values to bring the ship to its required calculated full load condition. Although total weights for line items of the load summary of the Accepted Weight Estimate may not be changed, except for fuel, load items making up the load summary may be arranged at the discretion of the Contractor, subject to loading instructions and prior NAVSEA approval, as an aid in meeting the above KG, list and trim limits. MOD 6

Weight of the fuel load line item used in determining Contractor responsibility, shall be in the amount necessary to meet the endurance requirements. MOD 6

The use of ballast is not acceptable as a corrective measure to deliver the ship within the KG, list and trim values as required above.

1.0-1.1.1 Weights

Weight, Lever, and Moment Data. All reports shall be reported in the metric system. The weight and moment data shall be carried to the nearest kilogram (kg) and kilogram-meter **(kg-M)** at all detail levels. In addition, the one and three digit CWBS summary groups shall be converted to and reported at the nearest one 'hundredth of a metric ton and to the nearest metric ton-meter. All levers shall be carried to the nearest one hundredth of a meter.

1.0-1.1.1.1 Definitions:

Light Ship Condition (Condition A). Ship complete, ready for service in *every* respect, including **onboard** repair parts, and liquids in machinery at operating levels, excluding all free flooding liquids but without any items of variable load. This condition represents the ship under wartime conditions with ultimate armament. MOD 7

Minimum Operating Condition (Condition B). A condition in which the ship has the **minimum** stability characteristics likely to be obtained in normal operation. It represents, approximately, conditions which would be obtained toward the end of an engagement, after a long period at sea. Liquids are included in amounts and locations which will provide satisfactory stability and trim, a measure of under-' water protection and limitation of list in case of underwater damage. The components of load which are included in Condition B will be determined by referring to NAVSHIPS Technical Manual Chapter 9290, Weights and Stability. MOD 6

Full Load Condition (Condition D). Ship complete, ready for service in every respect. It is Condition A (light ship) plus the following variable loads: authorized complement of officers, *men,* and their effects; full allowance of ammunition in magazine and ready service lockers; full supply of provisions and stores *for* the periods specified in the design characteristics; fuel in amount necessary to meet endurance requirements; all other liquids in tanks to required capacity in accordance with **characteristics** and existing liquid loading instructions.

Capacity Load Condition. Ship complete, ready for service in every respect. It is Condition A (light ship) plus the following variable loads: maximum number of officers, men, and their effects; maximum stowage of ammunition in magazines and ready service lockers; maximum amount of provisions and stores that can be carried in the assigned spaces; maximum capacity of liquids in tanks. Fuel oil shall not exceed 95 percent **of** tank capacity.

Full Load Cruise Dynamic Lift Condition. Ship complete and ready in every **respect** to fly at the normal flying waterline. It is Condition D (full load **condi-**tion) with the following adjustments: foilborne propulsion water and strut water to the normal flying waterline are added and the foil system buoyancy to the normal flying waterline, excluding the **effect** of foaming the pod cavities, is deducted. MOD 7 HMR 22 HMR 22 HMR 22

Ultimate Full Load Cruise Dynamic Lift Condition. Ship complete and ready- every respect to fly at the normal flying waterline. It is Condition D (full load condition) with the following adjustments: foilborne propulsion water and strut water to the normal flying waterline are added, and the foil system buoyancy to the normal flying waterline, including the effect of foaming the pod cavities, is deducted. HMR 22

Contract Design Weight Estimate. The beat available in-house weight data.

Contractor's Design Weight Estimate. The weight estimate prepared by the Contractor at the beginning of the detail design and construction **phase, baaed on** these specifications and all documents referenced herein.

Accepted Weight Estimate. The beat evaluation of the ship with respect to weight and the vertical, longitudinal, and transverse location **of** the center of gravity. It **is derived by** comparison and analysis of the Contract Design Weight Estimate and the Contractor's Design Weight Estimate.

Weight Control. All **the action necessary (e.g.,** predicting, estimating, reporting, weighing, calculating, **analy**zing, and evaluating) to ensure that the ship's weight and moment are *consistent* with the values agreed upon for displacement, KG, list and trim in the Accepted Weight Estimate.

<u>Weight **Reporting.**</u> That part of weight **control** which constitutes the technical presentation of the best known weights and moments at periodic designated times throughout the design and building processes.

Quarterly Weight Report. A summarized weight report based on the Accepted Weight Estimate. It reflects accumulated values for estimated, calculated, and scale weights and moments for design development, and net weight and moment changes for adjudicated and unadjudicated contract modifications for GFM.

Space and Weight Reservation Report. A list of weights and moments of all space and weight reservation items at the time of award of the contract which is updated to indicate weight and moment changes.

GFM Report. A list of weights and moments of GFM at the time of award of the contract which is updated to indicate weight and moment changes. The net weight and moment changes in GFM are adjudicated prior to performance of the inclining experiment and are used to modify the displacement and KG of the Accepted Weight Estimate.

Contract Modification Report. A complete listing of contract modifications that supplements the Quarterly Weight Report, Accepted Ship Report, and Final Weight Report. It constitutes a statement of adjudicated, and currently unadjudicated, weights and moments that will be used to modify the displacement, KG, list, and trim of the Accepted Weight Estimate.

Accepted Ship Report. A report which includes the displacement, KG, trim, and list values of the inclining experiment preliminary report, from which the net weight and moment effect of adjudicated and unadjudicated Contract Modifications and weight and moment changes due to GFM have been algebraically subtracted.

Calculated Weight. Weight computed from the ship construction drawings.

Estimated Weight. Weight based on these specifications and preliminary data, including weights of Government-furnished material.

Scale Weight. Weight obtained by actual weighing of material on a scale.

Vertical Lever. The perpendicular distance from a horizontal plane through the molded baseline of the ship to the center of gravity of an item.

Longitudinal Lever. The perpendicular distance from a transverse plane through the forward perpendicular of the ship to the center of gravity of an item.

Transverse Lever. The perpendicular distance from a longitudinal plane through the centerline of the ship to the center of gravity of an item.

Current Weight. The sum of a combination of the latest estimated, calculated, or scale weights for all items.

Percent Completion. The ratio of the current weight less the current estimated weight portion to the current weight, expressed as a percentage.

Group. A fundamental unit of ship weight classification, identified by one numeric digit or an alphabetic designator.

Three-Digit System. A system for ship weight classification defined and illustrated in Contract Work Breakdown Structure (CUBS), Boeing Document No. D312-80001-2. MOD 1

Density Factors. Factors by which the weights of variable loads may be computed.

Design Data Package. A package of design information, usually containing curves of form, endurance requirements, density factors, a summary of the Contract Design Weight Estimate without margins, Bonjean Curves, and similar data, which is furnished to the Contractor after award of contract.

Detail Design and Building Margin. A weight and moment allowance shall be included in the Contractor's Design Weight Estimate and Accepted Weight Estimate. This allowance accounts for design changes to the current weight due to Contractor Controlled Baseline drawing development, growth of Contractor-furnished material, and omissions and errors in the Accepted Weight Estimate, as well as differing shipbuilding practices, omissions and errors in the ship construction drawings, unknown mill tolerance, outfitting details, variations between the actual ship and its curves of form and similar differences . Weight changes to the Contractor Controlled Baseline caused by contract modifications will not be charged to this margin. This margin is to compensate for all Contractor responsible discrepancies between the Accepted Weight Estimate and the results of the inclining experiment, as well as tolerances for experimental variation in the inclining experiment. Departures from the Accepted Weight Estimate are reflected by concurrent adjustments to this margin.

NAVSEA Margin. A weight and moment allowance included in the accepted weight estimates to account for weight and moment changes caused by contract modification changes to Government-Furnished Material and Future Growth Margin. Government responsible departures from the accepted weight estimates are reflected by concurrent adjustments to this margin. MOD 6

1.0-1.1.1.2 Weight Estimates And Reports. All estimates and reports are to be reported in the metric system. Data shall be presented for foils extended and foils retracted for each required ship condition.

The form and format for the estimates, reports, and other specified data and documentation shall be in accordance with DID No. UDI-E-23254.

Calculation and weighing shall be terminated for each report and the preparation of each report begun sufficiently early so that the required submittal date of the report is not compromised.

Where two or more ships of the same class are being built from the same ship construction drawings at the same shipyard under the same contract, the weights, levers, and moments of all items shall be determined for only the first ship. Deviations in design or construction from the first ship (including different manufacturers of material or components from the first ship), shall be reported in Quarterly Reports and a Final Weight Report of these deviations shall be prepared and submitted.

Contractor's Design Weight Estimate. The Contractor's Design Weight Estimate shall be prepared in detail and shall include vertical, longitudinal, and transverse levers and moments for each item of the estimate, including all known MOD 1 space and weight reservation items. It consists of the Contractor's estimate, foils up and foils down, of the light MOD 4 ship, full load, and capacity load dis- MOD 7 placements, and their associated drafts (forward, aft, and mean), list, trim, height of ship's center of gravity above the bottom of the keel (KG) and metacentric height (GM), uncorrected and corrected for free surface effect of liquids in tanks. Items shall be grouped in accordance with the three-digit system established under the contract.

The estimate for the light ship condition shall contain estimated values for detail design and building margin. The Contractor shall be prepared to substantiate weight values proposed for this margin by realistic comparisons with recent similar ships or technical analysis.

The variable load shall be distributed realistically throughout the ship in appropriate spaces. The weight of material stowed or of liquid loaded in any one space or tank shall not exceed the capacity, based on the density factor for the space or tank.

In addition to the above loading condi- MOD 4 tions, the report shall contain takeoff weight, takeoff dynamic lift, cruise weight, and cruise dynamic lift for both the minimum operating and full load conditions.

Accepted Weight Estimate. After submittal of the Contractor's Design Weight Estimate, the Contractor and NAVSEA shall agree on the Accepted Weight Estimate. To expedite this agreement, the Contractor shall, upon request, visit NAVSEA after submittal of the Contractor's Design Weight Estimate. The Accepted Weight Estimate shall be prepared and shall include all details, summaries, and margins required for the Contractor's Design Weight Estimate.

<u>Space and Weight Reservation Report.</u> In addition to recording weights and moments of all space and weight reservation items in the proper three-digit group in the Contractor's Design Weight Estimate, a separate report of space and weight reservation weights, levers and moments shall be prepared.

Where these Space and Weight Reservation Reports are submitted as supplemental information to the quarterly and final weight reports, they shall reflect concurrent weight and moment information for the period of the report they accompany.

<u>GFM Report.</u> In addition to recording weights and moments of GFM in the proper three-digit group in the Contractor's Design Weight Estimate, a separate report of GFM weights (excluding that of any Government-furnished structural material), levers, and moments shall be prepared.

Where these GFM Reports are submitted as supplemental information to the quarterly and final weight reports, they shall reflect concurrent weight and moment information for the period of the report they accompany.

Changes of line items in the GFM list or inadvertent omission or inclusion of a GFM item from the Accepted Weight Estimate shall not be grounds for making additions, deletions, or substitutions of line items of the GFM Report. Any change to the GFM list must be accomplished by a contract modification. The corresponding weight and moment changes shall be part of the Contract Modification Report and not be reported in the GFM Report.

Deletions from the GFM Report shall be accomplished by using the Accepted Weight Estimate values as current weight and moment values at the time of deletion and in all subsequent GFM Reports. The reduced weight and moment resulting from such deletions shall be reflected in the adjudication of the contract modification.

Also, if procurement responsibility passes from Government to Contractor, the

Accepted Weight Estimate value shall be used as the current weight and moment in the GFM Report, and the contract modification shall be adjudicated to reflect any net weight and moment change. If procurement responsibility passes from Contractor to Government, the GFM Report shall remain unchanged and the contract modification shall be adjudicated to reflect any net weight and moment change.

Where no contract modification is involved, but a discrepancy is revealed between the actual weight and moment of a GFM item and its weight and moment as listed in the Accepted Weight Estimate column, the actual weight and corresponding moment shall be listed under the "current" columns of the above tabulation. Any weight and moment changes to such items due to contract modification shall be excluded from the GFM Report.

Contract Modfication Reports. Prior to, or concurrently with, each claim for equitable adjustment in price and delivery asserted pursuant to the change clauses of the contract, an estimate of the net weight and moment change resulting from the contract modification shall be prepared and submitted to the Supervisor.

A separate summary listing of adjudicated and unadjudicated contract modifications (including Field Changes) shall be prepared.

Where these Contract Modification Reports are submitted as supplemental information to the quarterly and final weight reports, they shall reflect concurrent weight and moment information for the period of the report they accompany.

The report that supplements the Accepted Ship Report shall include those changes accomplished at the date of the inclining experiment.

Supporting details for each change shall be incorporated into the body of the Quarterly Weight Reports and the Final Weight Report in accordance with the three-digit system. Each item shall be marked to indicate whether the information is based on estimating, calculating, or weighing, and whether or not the item is GFM. These detail line items shall be referenced in the reason for change listing included with the weight reports. Prior to adjudication of the contract modification, the effect of weight and moment changes to these line items shall also be incorporated into the contract modification summary listing. After the contract modification has been adjudicated, any weight and moment changes to those details shall be treated as any other detail line item in the weight report. The values for the contract modification, as reflected in the summary listing, shall not be changed after the contract modification has been adjudicated.

Quarterly Weight Report. This report shall be prepared and shall reflect the latest evaluation of the ship's full load displacement, KG, trim, and list, and their relationship to Accepted Weight Estimate values for displacement and KG, and specified limits for trim and list. Each report shall contain current values for displacement, drafts (forward, aft and mean), trim, list, GM, and KG, with and without the net effect of adjudicated and unadjudicated contract modifications and weight changes in GFM, along with the status of the detail design and building margin. These values shall be for light ship and full load conditions. Values for the above items shall also be reported for the capacity load condition with the net effect of adjudicated and unadjudicated contract modifications, and weight and moment changes in GFM.

In addition to the above loading conditions, the report shall contain takeoff weight, takeoff dynamic lift, cruise weight, cruise dynamic lift and ultimate cruise dynamic lift conditions for both the minimum operating and Full Load conditions. HMR 22

Each Quarterly Report shall be accompanied by a GFM Report and a Contract Modification Report, each current through the same reporting period.

The Quarterly Weight Reports shall include reasons for weight and moment changes (in accordance with the three-digit CWBS system) from the prior report, with supporting details if requested, and shall also include recommendations for reversing unsatisfactory trends toward exceeding the established margins or limits.

Final Weight Report. A final report of weights, levers (vertical, longitudinal, and transverse), and momenta (vertical, longitudinal, and transverse) for the light ship, full load, and capacity load conditions shall be prepared. In addition to the above loading conditions, the report shall contain takeoff weight, takeoff dynamic lift, cruise weight, cruise dynamic lift and ultimate cruise dynamic lift conditions for both the minimum operating and Full Load conditions. This report shall contain current values for displacement, drafts (forward, aft, and mean), trim, list, GM and KG, with and without the net effect of adjudicated and unadjudicated contract modifications and weight changes in GFM. Items in this report shall be grouped and detailed as in the Accepted Weight Estimate. Each item shall be marked to indicate whether the information given is baaed on weighing or calculating. Descriptions of items shall include the types, sizes, ratings or capacities, and the number of units or items reported so that unit weights may be obtained. The Final Weight Report shall reflect accurately the condition of the ship as built. HMR 22

Input Data Cards. Input Data Cards shall be prepared and shall reflect the same data used in the preparation of the estimate or reports they accompany.

Design and Weight Data Sheet. A Design and Weight Data Sheet shall be prepared and shall include such load and machinery items as are appropriate to the ship.

Accepted Ship Report. The Accepted Ship Report shall be prepared. If the final inclining experiment report differs significantly from the preliminary report, the Accepted Ship Report will be revised by NAVSEA to reflect these differences.

1.0-1.1.1.3 Determination Of Weights. A3 ship construction drawings are prepared and as material is procured or received, the weights and centers of gravity of all items that comprise the ship shall be determined and reflected in the weight reports. In addition, the weights, levers, and moments of all components and material, and their overall effect on the ship's displacement, center of gravity, list, and trim, shall be determined.

These weights may be obtained by a combination of estimation or calculation from ship construction drawings, and by weighing items.

Where requested by the Supervisor, or reliable information on weights and centers of gravity of GFM is not available, items shall be weighed and centers of gravity estimated.

Material and components shall be weighed on a selective or sampling basis, as determined by the Contractor, to establish the accuracy of calculated weights and to provide unit weights for items such as insulation, steel, sheathing, and piping. Where factors or percentages are utilized, such as for calculating paint and welding weights, the Contractor shall be prepared to substantiate values by realistic background information, if requested.

Where development has occurred to a component, system, or portion of structure and reliable information or completed ship construction drawings are not available for the specific area of development, a re-estimate shall be made to obtain the most accurate available weight.

To minimize the amount of weighing necessary by the Contractor in order to comply with these specifications, the Contractor shall, in his procurement documents, require vendors to submit information on the current weight and location of the center of gravity of all major assemblies, equipment, fittings, or components to be installed on the ship. It is suggested that information be submitted by vendors in the following sequence:

Estimate of weight shall be contained in the proposal by vendors for a particular component, major assembly, equipment or fitting.

Calculated weight of the component, major assembly, equipment, or fitting when its design is completed.

Scale weight of the component, major assembly, equipment, or fitting with adequate description to identify what was actually weighed.

It is the Contractor's responsibility to determine whether any or all the weights in the Accepted Weight Estimate will require a new determination because of development during the design and construction of the ship. This, however, does not relieve the Contractor of his responsibility to deliver the ship within the weight and stability limits specified herein under paragraph 1.0-1.1.

1.0-1.1.1.4 Weight Control Plan. The Contractor shall prepare a written plan outlining the procedures which are intended to be followed in meeting his weight control responsibilities described in these specifications.

1.0-1.1.1.5 Load Cell Weighing The Contractor shall conduct a load cell weighing for determination, in accordance with Section 1.0-l .3.11, of each ship's displacement to be used in conducting the inclining experiment required by Section 1.0-1.1.7. The load cell weighing shall be conducted just prior to the inclining. An accurate inventory shall be conducted at the as-weighed condition for calculation of Light Ship and Full Load conditions. No change in the ship weight status shall be allowed between the weighing and the inclining. NAVSEA shall be notified two weeks prior to the weighing.

1.0-l .1.7 Inclining Experiment

HMR 121

The Contractor shall conduct an inclining experiment on each ship, in accordance with Section 1.0-1.3.11, when the ship is substantially complete and as soon after the load cell weighing as practicable, and prior to any at-sea testing. NAVSEA shall be notified two weekspriorto the inclining. The inclining shall be conducted for determination of the height of the ship's center of gravity by observation of inclination produced by a known transverse heeling moment equated to a righting moment based on the as-built hydrostatic data of paragraph 1.0-1.4.12. HMR 121 The experiment shall be conducted and reports shall be prepared by the Contractor in accordance with the procedures for surface ships outlined in Chapter 096, Section II of NAVSHIPS Technical Manual, NAVSEA 0901-LP-096-0000 and shall include determination of the ship's period of roll. Fore-and-aft position of the center of gravity and displacement shall be determined by observation of the ship's drafts. After the experiment, the foils shall be lowered and the drafts read to determine strut and foil buoyancy. All inclining weights, equipment for observations, cribbing, and other material required for the experiment shall be furnished by the Contractor. The Contractor shall also provide all labor for preparing the ship for inclining, for installing apparatus for handling lines and shifting inclining weights during the experiment, and for taking observations.

1.0-1.1.8 Reports

The final report shall consist of Part 1, Inclining Experiment Report, and Part 2, Stability Data. Part 2 shall include Conditions A, B, D, and capacity load.

Trim and list shall be calculated for the operating conditions.

1.0-1.2 DIMENSIONS

The principal dimensions of the ship shall be as shown in Table 1 .0-3A. These dimensions are nominal and the actual ships measurements shall be as permitted by the applicable construction and lines drawings and the tolerances thereon. The HMR 121 hull lines survey shall be conducted to check these tolerances by measuring hull offsets, as built, at a minimum of twenty sections. This shall be completed and analyzed as required by Section 1.0-1.4.12, before the inclining experiment is performed.

The basic hull compartments shall consist of a forward area for the retracted forward strut, the unmanned engine and machinery spaces at the aft end of the ship, and the area in between which is used for manned living compartments and ammunition storage. Watertight bulkheads shall be located as shown in NAVSHIPS Drawing 802-5000493. MOD 2

TABLE 1.0-3A: IMPORTANT DIMENSIONS

Length (Meters)		
Overall, Foils Up	44.7	
Overall, Foils Down	40.2	
Between Perpendiculars	36.0	
Beam (Meters)		
Main Deck Maximum	8.6	
Design Waterline	7.44	
Overall Foil Span	14.51	
Draft (Meter from Design Waterline)		
Hullborne, Foils Down (Lowest Point on Foil System)	7.1	
Hullborne, Foils Up (Lowest Point on Stability Fins)	2.2	
Foilborne	2.6	HMR 92
Height (Meters from Design Waterline)		
Masthead Light, Hullborne	17.0	
Bridge, Windows (Centerline) Hullborne	6.8	

1.0-1.3 GENERAL ADMINISTRATIVE REQUIREMENTS

1.0-1.3.1 General

It is inappropriate in procurement documents to incorporate any section(s) of these specifications by reference. Such incorporation imposes an unnecessary burden on manufacturers. If one or more paragraphs of these specifications are considered applicable for a particular procurement, they shall be expressly quoted in the purchase specifications or other procurement documents.

The Government is the United States Government.

NAVSEA is the Headquarters of the Naval Sea Systems Command.

Where the terms Naval Ship Systems Command (NAVSHIPS) or Naval Ordnance Systems Command (NAVORD) are used, they mean the Naval Sea Systems Command, except where used as a part of the designation for reference documents.

NAVSEC is the Naval Ship Engineering Center.

The term Supervisor as used in these specifications means the AFPRO/and his designated representatives. MOD 2

Wherever such terms as "as approved", "for approval", "as directed" are used without further qualification, the approval, decision, or direction of the Supervisor is intended.

A Contractor is a firm holding a prime contract with the Government for design or construction of ships, or both.

Installation shall mean that the Contractor shall provide all materials and equipment, perform all tests and insure a complete and operable system in accordance with these specifications and the documents/data listed herein.

1.0-1.3.2 Specifications, Standards, And Standard And Type Drawings

Government specifications and standards, OPNAV and NAVSEA publications, listed in the SSS in Table 1.0-3B, Section III, Government Controlled Baseline drawings listed in Table 1.0-3B, Section I and Contractor Controlled Baseline drawings listed in Table 1.0-3B, Section IV form a part of the SSS to the extent specified.

1.0-1.3.3 Construction Schedules And Reports

The Contractor shall prepare construction schedules and reports necessary for the purpose of establishing an orderly and systematic construction program as required by the CDRL.

1.0-1.3.4 Not Used.

1.0-1.3.5 Changes

Proposed changes shall be submitted in accordance with the contract.

1.0-1.3.6 Care Of Ship During Construction

General. All parts of the ship including, but not limited to, structure, deck coverings, fittings, equipage, outfit, furniture, insulation, paint work, machinery, auxiliaries, systems, appliances, and apparatus shall be maintained in a new condition except for normal wear occasioned by testing during the entire period the ship is in the Contractor's possession. The Contractor shall prevent wear and damage incident to construction, and corrosion or other deterioration, especially to unpainted, polished, and moving parts. Piping, machinery, and equipment subject to freezing shall be kept drained, except during trials and tests.

Equipment, prefabricated parts, furniture, and items such as lines and canvas, which are stowed in warehouses or on piers during construction of the ship, shall be thoroughly examined for the ridding of vermin before being placed on board.

Machinery and equipment. The Contractor is responsible for the care of all machinery and equipment, whether furnished by him or by the Government. Electric and electronic equipment and machinery shall at all times be protected against dust, moisture, or other foreign matter and shall not be subjected to rapid temperature changes. Any item allowed to deteriorate, due to lack of care in storage as indicated above, may be subjected to tests at the Contractor's expense to determine its condition and, if necessary, replacement.

All preservative applied by the manufacturer shall be left intact (or replaced if necessary) until activation of the machinery or equipment on the ship. If removal of the preservative is necessary for testing the machinery or equipment the Contractor shall represerve and protect the machinery or equipment until activated. All preservative on working parts shall be thoroughly removed prior to operation of the machinery or equipment.

Fresh water in diesel engine cooling systems, from initial activation until the ship is accepted by the Government, shall be chemically treated in accordance with engine manufacturers specified coolants MOD 2, MOD 7
or their U.S. equivalents.

The Contractor shall prepare and maintain a material history for Contractor-furnished and Government-furnished equipment in accordance with NAVSHIPS 0901-004-001 the Naval Ships Technical Manual, Chapter 9004, Section IV. The material history shall be turned over to the ship's force at time of delivery of the ship. Appropriate NAVSHIPS forms will be provided by the Supervisor upon request.

Launching and docking. The Contractor shall provide building and launching ways or jigs adequate for ship construction. The method of launching and degree of completion of the ship at the time of launching shall be mutually agreed upon by the Contractor and the Supervisor. The Contractor shall be responsible for the safe launching of the ship and its condition of stability when waterborne.

Should there be any evidence that the ship has been strained or damaged during launching, the ship shall be drydocked immediately. After launching, the ship shall be drydocked at intervals not exceeding one year to inspect, preserve, and repair such items as bottom, appendages, and sea chests, as required. In addition, the ship shall be drydocked not earlier than 60 days prior to delivery for purposes of inspection of the items delineated above.

Launching information. The Contractor, prior to launching of the ship, shall submit to the Supervisor, to the extent considered necessary by the Supervisor, the following drawings and data for information and review.

A description of the method of and facilities for launching.

Arrangements for letting go, precautions to insure starting ship, and arrangements for snubbing.

A brief statement of degree of completion of hull and machinery at launching.

Procedure and schedule for letting go.

Customary launching calculations, indicating:

Estimated weight and center of gravity of ship.

Expected depth of water at the end of the launching ramp and minimum safe depth of water.

Drop of bow.

Estimated drafts and metacentric height when ship is waterborne.

Where a number of ships of the same class are building at one yard, the information referred to above is required only for the first ship launched, provided that the remaining ships are launched in the same manner, and provided further that the launching weights of the ships and other launching details are approximately the same.

Grounding. Precautions shall be taken to ensure that the ship does not ground at any time. Should grounding occur, the Supervisor shall be notified promptly, and the ship shall be drydocked, if requested by the Supervisor, for thorough examination. A detailed report shall be made in accordance with Data Item Description No. UDI-A-26360. If the ship is grounded, precautions shall be taken to ensure safety of the ship and crew. MOD 2

1.0-1.3.7 Fire Protection During Construction

General. A Fire Protection Plan shall be prepared by the Contractor, based on Boeing document D312-80139-1.

Stability control. After the ship is afloat, the Contractor shall be prepared to take stability control measures, such as removal and shifting of liquids. Upon request, NAVSEA will furnish basic stability guidelines to 'allow the Contractor to place the ship in the best practicable stability condition to resist the effects of fire-fighting water.

1.0-1.3.8 Not Used. MOD 6

1.0-1.3.9 Purchase Orders

All purchase orders and changes thereto shall be furnished to the Supervisor. Purchase orders shall contain complete information as to applicable specifications and drawings, firm name, address of Subcontractor or vendor, the location of the material, time of completion, all tests and inspections required, and similar information.

A purchase order index shall be prepared. The index shall contain, but not be limited to, a listing of all Contractor-furnished equipment and components which could be maintained by the replacement of parts or by a like component. For each item listed, the index shall include the purchase order number, date of issue, nomenclature and MOD 2 end use of equipment, name of manufacturer, manufacturer model or type number, and APL number, as available. The index shall be updated at least every three months and distributed in accordance with the CDRL.

Communications relative to purchase orders from a Contractor shall refer to the number and date of such order and shall give the name or Government designation of the ship for which the material is intended.

1.0-1.3.10 Government-Furnished Material (GFM)

1.0-1.3.10.1 General. All material that will be furnished by the Government will be included in a list separate from these specifications. This list will be made a part of the contract.

All material required by these specifications that is not included in the list of GFM shall be furnished by the Contractor.

GFM shall be inspected by the Contractor upon receipt in accordance with Contractor's quality assurance program.

The Contractor shall unload GFM shipped to him by the Government, shall do cleaning necessitated by exposure in transportation, shall remove temporary preservative at appropriate time, shall handle, care for, assemble when disassembled for shipping purposes, and store such GFM.

All articles and equipment furnished by the Government and designated for installation or stowage aboard the ship in accordance with Schedule A, shall be installed by, or have satisfactory stowage aboard ship provided by, the Contractor. The Contractor shall furnish all labor and material, including wiring, piping, and accessories necessary for their installation and performance or stowage. MOD 2

Where an item furnished by the Government is intended as a part of a system or assembled equipment, the Contractor is responsible for satisfactory operation of the system or assembly as a whole provided the item furnished by the Government meets the requirements in terms of interface compatibility and performance.

1.0-1.3.10.2 Government-Furnished Information. Upon Contractor request to the Supervisor, the Government will furnish reproductions of drawings of Government-furnished equipment as necessary.

Naval Sea Systems Command standard and type drawings are also available upon request.

Items fully illustrated by drawings of Government-furnished equipment, or manufacturer equipment drawings shall not be redrawn by the Contractor. When these drawings apply, they shall be referenced by a drawing number on the applicable arrangement drawing, assembly drawing, or drawing list.

The documents/data listed in Table 1.0-3B form part of these specifications (see Section 1.0-O).

1.0-1.3.10.3 Government-Furnished Property. The ship system shall contain Government-furnished equipment and be provided with Government-furnished services of the type and characteristics as specified in: Schedule A and Schedule B, respectively, of the Contract.

1.0-1.3.11 Requirements For Testing

1.0-1.3.11.1 General Requirements For Testing. This section specifies the requirements for the test program to be developed and conducted by the Contractor. The requirements of this section are supplemented by specific Test requirements in Section 1.0-1.3.11.2 and Trials requirement in Section 1.0-1.3.12.

The test program shall include factory, dockside and at-sea *testing* for all Contractor and Government-furnished equipment, subsystems, and systems to demonstrate compliance with specification and contract requirements. MOD 1

Factory testing is that system level testing to verify the proper installation and functional operability of the ship's equipment at a system or integrated subsystem level. This testing is to be accomplished after installation checkout of subsystem level interfaces which are accomplished in accordance with the applicable system installation drawings, and after functional operability checks at the individual equipment and subsystem level. Installation drawings are specified within the individual technical sections of these specifications. The functional operability checks are specified in Section 1.0-1.3.11.2. The installation checkouts and operability checks will be accomplished under the Quality Assurance verification process in accordance with the provisions of the contract.

MOD 2
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MOD 2

<u>Test Program Structure.</u> The test program shall be organized and accomplished in general accordance with the intent of publication NAVSEA 0900-077-3010 as delineated in the Test and Evaluation Program Plan, PBM-I (Boeing D312-80016-2), this Section and Sections 1.0-1.3.11.2 and 1.0-1.3.12.

MOD 2

<u>Test and Evaluation Working Group (TWG).</u> A T&E Working Group shall be established to facilitate the T&E program by reducing documentation and documentation-approval flow-times in accordance with Working Agreement; Production PHM Test Working Group D312-80179-2. The group will be composed of two individuals; one from the Supervisor's Office, who will act as the NAVSEA's "on-site" representative and one from the Contractor, who shall act as liaison between the Contractor's internal organizations or individuals and the Navy's "On-Site" Representative (NOSR). Basic responsibilities of the T&E Working Group shall be to:

HMR 55
MOD 2

(a) Assign priorities to the testing when necessary,

(b) Approve test documentation (except as otherwise required) including Test Change Proposals (TCP's) and Test Problem Reports,

MOD 2

(c) Resolve problems when deficiencies are discovered and document corrective action.

(d) Coordinate Government/Contractor joint test activities, MOD 2

(e) Approve/accept successfully completed test results, MOD 2

(f) Authorized changes to or deviations from the Production PHM test requirements (D312-80243-3) which do not impact cost, delivery schedule, nor modify, add to, or delete from, the requirements contained within these specifications. MOD 2 HMR 55 & 55R2

(g) Review and monitor additional tests required for new or substitute systems or equipment,

The 'Working Agreement: PHM Test and Evaluation Working Group' (D312-80179-1) shall be modified as required to reflect the above, the circumstances of the production program, and the concept that changes to documents D312-80243-1 and D312-80243-2 must be processed in accordance with the changes clause of the contract. HMR 89

The Contractor member of the T&E Working Group shall arrange for the various specialists, engineers, and technicians to consult with the NOSR during the preparation of the documents and will otherwise be the NOSR's chief point-of-contact with the Contractor.

Test Documentation.

General. This section describes test documentation which shall be developed and used by the Contractor during the implementation of the test program. Form and format shall be in general accordance with Engineering Test Document Definition and Index, Boeing D312-80200-2. Test documentation provided to the Contractor as GFI may be used in the form and format provided by the Government. HMR 55 & 106R1

The following test documentation requirements do not apply to installation checkouts as identified in the Production PHM Test and Evaluation Program Plan. These installation checkouts shall be accomplished as part of the Contractor's quality control program and Government approval of the test documentation does MOD 6 not apply. Test Change Proposals and Test Problem Reports will not be required for Contractor installation and checkout testing.

Production PHM Test and Evaluation Program Plan. The PBM-1 Test and Evaluation HMR 55 Program Plan, Boeing D312-80016-2 and Buiiders Trials Test Requirements, Boeing D312-80243-1 shall be used as a basis to develop the production ship test program and shall be submitted as a single document Production PHM Test and Evaluation Program Plan Boeing Drawing D312-80243-2 with a second volume, Production PHM Test Requirements Boeing D312-80243-3 which shall contain detailed test requirements.

Production Ship 'Delivery and Acceptance Plan. Boeing D312-80056-2 Rev. C has HMR 92 been revised to reflect the production ship delivery and acceptance and is titled Production PHM Delivery and Acceptance Plan D312-80056-3.

Working Agreement; PHM Test and Evaluation Working Group. Boeing D312-80179-1 shall be revised to reflect the production ship test program.

Engineering Test Document Definition and Index. Boeing D312-80200-1 shall be revised to reflect the production ship test program.

Test Procedure Index. The Contractor shall prepare a Test Procedure Index which shall be a complete listing of all tests to be conducted by the Contractor to meet the requirements of Production PHM Test Requirements D312-80243-3, and this index HOD 2 shall be included in the Production PHM Test and Evaluation Program Plan (D312-80243-2). The index shall list by test MOD 2 number and title all test'procedures which will be conducted by the Contractor and shall indicate the responsibility for the preparation of each test procedure as Government or Contractor. The test index shall also indicate during which of the MOD 1 following test phases each test shall be conducted:

Ship Build Up
Builder Trials
Acceptance Trial

Test Sequence Networks. Test Sequence Networks (TSN's) similar to those con- MOD 2 tained in Boeing D312-80016-2, provide a recommended sequence for the conduct of tests based upon prerequisites for the test ***program*** as shall be identified in the Production PHM Test and Evaluation Program Plan, D312-80243-2. The TSN's shall be used by the Contractor in preparing the MOD 2 initial test schedule for each ship.

Test Procedures. Test Procedures shall provide the method and procedural details by which tests shall be conducted. Their satisfactory completion shall serve to demonstrate compliance with the technical requirements of those specifications.

For test procedures which the Contractor has preparation responsibility as indicated in the test procedure index, the MOD 2 Contractor shall use the PHM 1 Test Procedures, as a basis, and update them to reflect any equipment and systems differing from the PHM 1 and to incorporate any corrections to the procedures uncovered during their conduct on PHM 1.

Test procedures shall be prepared for all tests.

The Contractor may utilize PHM 1 lead MOD 2 ship test procedures previously approved by the Government in lieu of new test procedures provided the following condi- MOD 2 tions are met:

(a) The test criteria are applicable in all respects. If not, modifications shall be made to suit the requirements of these specifications.

(b) New Title/Cover, Revision Record, and Prerequisite Check-off pages shall be added to each test memorandum.

(c) The New Title/Cover page shall identify the old test memorandum and new test procedure numbers, and shall identify the ship for which the test memorandum was previously approved and used.

Test Reports. Test reports shall document the overall test results and findings in relation to technical specification requirements. The reports shall provide the details and results of analysis of raw data records taken at the time of test. A test report shall be provided for each test, including retest, conducted during the *test* program. A final test report shall be provided at the conclusion of the test program.

Test Schedule. The Contractor shall prepare, maintain and revise as necessary MOD 2
to reflect any changes to ship production schedules, a Test Schedule depicting the logical flow and planned dates for the conduct of the Ship Test Program. The Test Schedule shall serve as a planning document for both the Contractor and the Government. The Test Schedule shall be fully integrated with the Contractor's ship production schedule.

Test Change Proposal. The Contractor shall prepare Test Change Proposals (TCP) to document modifications to approved test procedures in accordance with Working Agreement, PHM Test Work Group, Boeing D312-80179-2 prior to the conduct of the HMR 55
test. A TCP shall be submitted with each test procedure being modified. Multiple changes to a single test procedure may be documented by *a single* TCP. The TCP will be used by the Supervisor to approve/disapprove modifications to the test procedures.

Test Problem Reports. Test Problem Reports (TPR) shall document discrepancies and problems encountered in equipment, test documentation and testing. The MOD 2
Contractor shall prepare Problem Reports MOD 2
in accordance with the revision of Boeing D312-80179-1 for all faulty or damaged GFM/CFM and defective GFI/CFI whether the responsibility is Government or Contractor. The Contractor shall troubleshoot the problem to the extent of determining that the problem is caused by defective GFM/GFI or CFM/CFI. The test problem report required from the Contractor shall include a proposed resolution of the problem when defective CFM/CFI is involved. A proposed resolution may be HMR 55

included if appropriate, when defective | HMR 55
GFM/GFI is involved.

Test Conduct. The Contractor shall be
responsible for the testing of all Govern- MOD 2
ment and Contractor-furnished equipment,
as specified in the production PHM Test MOD 2
and Evaluation Program Plan, D312-80243-
2.

The Contractor shall ensure that all
necessary materials, labor, power, equip-
ment, instrumentation, and personnel are
available to support the test.

Each test shall be performed using the MOD 2
most current approved version of the test
procedure. The Contractor shall notify MOD 2
the Supervisor, so that he or his repre-
sentatives may witness the test, within 36
hours prior to conduct of the test. Each
test shall be conducted in accordance with
the step-by-step instructions contained
in the test procedure. Except as required
by the test procedure, adjustments on
equipment being tested shall not be made
during test conduct. Deviations or
changes from the test procedure shall be
avoided during test conduct. Changes to
the test procedure made during test con-
duct shall be submitted to the Supervisor
by Test Problem Report in accordance with MOD 2
Boeing document D312-80179-2 for review ! HMR 55
and approval. If the change is not
approved by the Government, the Contractor
shall be required to reconduct the test in
whole or in part as directed by the Super-
visor.

The Supervisor can, at his discretion, MOD 2
halt a test if a hazardous condition
occurs during conduct of a test which
might result in equipment damage, or
jeopardizes the safety of the ship or its
personnel.

To minimize rescheduling and reconduct
of test, the Contractor shall ensure that
the equipment to be tested and all re-
quired support and test equipment are
ready for the test. Instruments that
require calibration shall have current
calibration certification when used in
performing any test.

MOD 2

Tests shall be performed in accordance with the Test Schedule planned, prepared and maintained by the Contractor. The Contractor shall provide weekly confirmation to the Supervisor of the intent to conduct tests as scheduled for that week.

Once a test has been confirmed and is subsequently cancelled or deferred for any reason, the Supervisor shall be immediately notified. Cause of cancellation or deferral, current or planned corrective action, effect on other tests, and rescheduling information shall be provided to the Supervisor within 48 hours of the cancellation.

Test data shall include any marked-up pages of the test procedure, all completed data and comment sheets, and all supporting data such as computer printouts, strip charts, oscillograph recordings, magnetic tapes, and photographs. All test data such as tapes, charts, recordings, which are not an integral part of the test procedure shall be annotated with the test number, date and any other pertinent information.

The Contractor shall retain the master copy of each test procedure by which a test was conducted and on which the test results were recorded. The Contractor shall retain the originals of all test data, such as computer printouts, magnetic tapes, and oscillograph recordings. The original test data shall be available to the Supervisor for inspection. These records shall be delivered to the Supervisor at the conclusion of the guarantee period.

Maintenance and calibration of equipment used for testing shall be provided by the Contractor, with the exception of unique special purpose test equipment which may be provided by the Government.

Government Test Support. For tests which require Government support services, the Contractor shall request such services from the Supervisor. Requests for Government support services shall be forwarded to the Supervisor not less than three weeks prior to the time when the installation, equipment, or system is ready for tests. The costs related to these Government services will be borne by the Government.

1.0-1.3.11.2 Specific Requirements For Test. This section contains the specific test requirements for the ship test program. The specific tests are contained in the Test Procedures required by Section 1.0-1.3.11.1. The Test Procedures shall demonstrate that the test requirements of the following documents have been met: (HMR 55

Production PHM Test and Evaluation Program Plan Boeing D312-80243-2.

Production PHM Test Requirements, Boeing D312-80243-3. MOD 2

The following tests shall be included in the above two documents.

The following test listing identifies those tests that shall be included in the above two documents, in order that Test and Evaluation Program Documentation can provide a complete picture of shipboard testing.

TEST TITLE

TEST NUMBER		NON RECURRING (FIRST SHIP OF PHM 3 SERIES ONLY)	RECURRING (ALL PROD. PHMs)	MOD 2
301	Fuel Piping Hydrostatic		X	
302	Compartment Pressurization		X	
304	MOD 6 Eliminated			
305	Hydraulic Lines Hydrostatic (Hull)		X	
306	MOD 6 Eliminated			
307	MUD 6 Eliminated			
308	Seawater Supply Piping Hydrostatic		X	
309	MOD 6 Eliminated			
310	Halon System Pressure		X	HMR 75
311	Foil & Struts Pressure Test		X	
312	Hydraulic Lines Hydrostatic Test - Struts & Swivels		X	
313	Ship Weight		X	
314	Light Level Surveys (CIC only with configuration change)	X		
315	Main & Maintenance Lighting Demo	X		MOD 6
316	Emergency Lighting Demo		X	
317	MOD 6 Eliminated			
318	MOD 6 Eliminated			
319	MOD 6 Eliminated			
320	Foilborne Pump/Gearbox Lube Oil System Flush, Fill, and Hydrostatic		X	HMR 75
324	The requirements of this test have been incorp. into Test 422			HMR 75
328	MOD 6 Eliminated			
334	Announcing System Levels	X		MOD 5
337	Intercom Sound Levels	X		MOD 5
338	Interior Communications System Demonstration		X	
340	Communications Lights Demo		X	
341	The requirements of this test have been incorp. into Test 308			HMR 75
344	MOD 6 Eliminated			
345	Halon Release	X		MOD 2 HMR 75
346	Fire Extinguishing Systems Factory Test		X	
349	MOD 6 Eliminated			
350	Teletype (TTY) Operation		X	
351	Chaff Launchers (RBOCS) Operation - Simulated (ICD)		X	
352	MOD 6 Eliminated			
353	Radio-Nav. Functional Operation (ICD)		X	
354	Harpoon Launcher Mechanical Alignment (ICD)		X*	HMR 99

*Except for PHM-6 HMR 99

TEST TITLE

TEST NUMBER		NON RECURRING (FIRST SHIP OF PHM 3 SERIES ONLY)	RECURRING (ALL PROD. MOD 2 PHMs)	
355	IFF Functional Operation (ICD)		X*	HMR 99
356	Gun Weapon System Alignment (ICD)		X**	
358	SSPU Hydraulic Pumps Inlet Suction Press	X		MOD 2 HMR 75, 151
359	Insul. Resistance Tests of Motors, etc.		X	MOD 2
360	Mast Refueling Fittings Proof Test		X	HMR 85R1
363	Hull Lines survey	X		HMR 121

400 SERIES - ENGINEERING EVALUATIONS IN FACTORY OR POST-LAUNCH PRIOR TO READY-FOR-SEA DOCK TRIALS

401	AFFF Fire Extinguisher Operation		X	MOD 2 | HMR 75
403	MOD 6 Eliminated			
405	Foilborne Propulsion Controls Operability		X	
407	Foilborne Turbine Initial Operation		X	MOD 2 | HMR 75
409	Main Deck Switchboard Checkout		X	
410	Platform Deck Switchboard Checkout		X	
411	MOD 6 Eliminated			
415	Electrical Cable C/O - Power Distribution and Control		X*#	HMR 99 | HMR 2C
416	Electrical Cable C/O - Lighting and Receptacle		X#	HMR 208
417	Aft Strut Retraction & Lock System Functional C/O		X	
419	Test renumbered to Test 728		X	HMR 75
420	Fwd Strut/Bow Doors Retraction & Lock System Functional C/O		X	
421	MOD 6 Eliminated			
422	Electric Plant Power-Up: Shore Power		X	
424	Test requirements incorporated into Test 524		X	MOD 2 | HMR 75
425	Navigation Lights Demo			
426	MOD 6 Eliminated			
427	TANCAV Adjustment and Functional C/O			HMR 8
428	Depth Sounder Functional Checkout		X	
429	Gyrocompass, Vert. Ref., & Ship's Course Indicators		X	
431	Gyrocompass & Vert. & Ref. Alignment		X	
432	Speedlog System Functional Checkout		X	
433	DRT Functional Checkout		X	
434	Navigation Radar Functional Checkout and Alignment		X	
438	Pelorus Alignment		X	
439	MOD 6 Eliminated			
440	ECS Operability and Balance	X		HMR 75

*Reduced scope for PHM-6
**Except for PHM-6
#PHM-3 and PHM-4 only

HMR 99

TEST TITLE

TEST NUMBER		NON RECURRING (FIRST SHIP OF PHM 3 SERIES ONLY)	RECURRING (ALL PROD. PHMs)	MOD 2
442	Fuel System Operability		X	
443	Bilge Water Systems Functional Test		X	
447	MOD 6 Eliminated			
448	Hyd. Systems Cycling - Ship Service Power		X	
451	Damage Control Pump Operation		X	
452	Harpoon HCE C/O & System Integration		X*	HMR 9 9
453	ACS Functional Test & Adjustment-Dockside		X	
454	Aft Flap System Alignment and Operability		X	
455	MOD 6 Eliminated			
456	MOD 6 Eliminated			
457	ACS Displays Calibration Check		X	
458	ACS Self-Test Signal Verification		X	MOD 7
459	Hydraulic System Fill, Bleed, and C/O		X	
460	MOD 6 Eliminated			
461	Ship Alignment Survey		X	
464	Fwd. Flap & Strut Steering Systems Alignment and Operability		X	
465	MOD 6 Eliminated			
470	On-Board Data System C/O and Calibration		X	HMR 75
471	Magnetic Compass Alignment		X	
475	Test requirements incorporated into Test 728			MOD 7 HMR 75
476	MOD 6 Eliminated			
477	Electrical Cable C/O-C&S & Armament		X*#	HMR 75,99,208
478	Pilot House Main & Throttle Consoles C/O		X	
479	PH Overhead Panel C/O		X	MOD 7
480	Pre-Installation C/O, EOS Console Cabinet		X	MOD 7 HMR 75
481	Radar Repeater/RDS Operability and Integration		X*	HMR 99
483	Test requirements incorporated into Test 338			HMR 75
486	External Communication Integration: Switching		X	
487	HF Simops Tuning (if modified)	X		MOD 7
488	MOD 2 Eliminated			
489	GFCS Checkout		X*	HMR 93 & 99
490	FCS Antenna Foundation Alignment		X	HMR 75
491	Gun Mount Foundation Alignment		X	
493	VHF Radio Set Operability		X	

*Reduced scope for PHM-6 — HMR 99

#PHM-3 and PHM-4 only

TEST NUMBER	TEST TITLE	NON RECURRING (FIRST SHIP OF PHM 3 SERIES ONLY)	RECURRING (ALL PROD. PHMs)	MOD 2
494	Primary Gun Checkout		X*	HMR 99
497	Ship Safety & Damage Control Checks		X	
498	Post Launch Ship Safety and Damage Control Checks		X	HMR 75
500 SERIES - DOCKSIDE TRIALS				
501	Displacement		X	
502	Inclining Experiment		X	
504	Liferaft Launching		X	MOD 2
507	Temperature Humidity Control Analysis Validation	X		
509	Ventilation System Test		X	
511	Deck House Spray Test		X	
512	Foilborne Engine Wash Demonstration		X	
513	Foilborne Engine Emergency Shutdown		X	MOD 2
515	Hullborne Engine Run Up and Overspeed		X	
521	EMC -Phase I	X		HMR 55, 75, 99, 15
524	D.C. System Test		X	
526	Fresh Water and Waste Water System Servicing & c/o		X	HMR 75
527	Sewage System Servicing and Checkout		X	HMR 75
528	Electric Plant Protection		X	
530	Engine Cranking and Starting (Hullborne and SSPU)	X		HMR 151
531	Fuel Tank Fill and Vent Overflow Piping Adequacy and Ship Defueling	X		HMR 151 MOD 7
533	Ship Fueling and Fuel System Operational Test		X	
536	Hydraulic System Preflight Checkout		X	
538	Hydraulic Auto Transfer		X	HMR 75
544	Electromagnetic Radiation Levels		X*	HMR 99
548	SS Gen. Sets Operational Checkout		X	
549	Gyro/Pelorus/SCI Accuracy Checks		X	HMR 75
550	MOD 2 Eliminated			
551	Exterior Radio Comm. VSWR/Attenuation		X	MOD 6
552	Nav. Radar VSWR		X	MOD 6
557	Seawater System Performance		X	
563	Test requirements incorporated into new Test 755			HMR 75
564	Bilge Water Drainage System Demo		X	
567	Primary Gun Arc-of-Engagement		X**	MOD 2 (HMR 95
568	MOD 6 Eliminated			
569	Compressed Air/Whistle Operability		X	
				HMR 99

*Reduced scope for PHM-6
**Except for PHM-6

TEST TITLE

TEST NUMBER		NON RECURRING (FIRST SHIP OF PHM 3 SERIES ONLY)	RECURRING (ALL PROD. PHMs)	MOD 2
570	Harpoon W/S Functional Operability		X**	HMR 99
571	Gun/GFCS Functional Operability		X**	
572	Foilborne Ready & Warning System Test		X	
573	Hullborne Ship Control C/O		X	
576	Dockside Alignment Check - Gun/FCS		X**	HMR 75,HMR 186
	700 SERIES - CALM WATER			
701	Hullborne Speed		X	
702	Hullborne Continuous Operation		X	MOD 2
703	Minimum Diameter Turn - Hullborne		X	
708	Hullborne Fuel Economy	X		MOD 2
710	Foilborne Speed/Fuel Flow		X	
711	Test requirements incorporated into Test 710			HMR 75
712	Foilborne Fuel Economy		X	
713	Foilborne Turn Rate - Calm Water		X	
				HMR 151
723	Noise and Vibration in Manned Areas	X		HMR 75
725	ECS Underway Operation	X		HMR 75
727	Propulsion System Operation		X	
728	Foilborne Propulsion System Low Speed C/O		X	HMR 75
729	MOD 2 Eliminated			
732	MOD 2 Eliminated			
740	Intentionally Left Blank			HMR 75
743	EMC-Phase II		X*	HMR 75 & 99
744	C&S Operability	X		HMR 75
746	Magnetic Compass Deviation		X	
749	Speed Log Accuracy		X	HMR 75
750	Dead Reckoning Accuracy	X		HMR 75
				HMR 151
755	Anchor System Demo		X	HMR 75
758	Foilborne Control Adjustment		X	HMR 75
762	Sewage System Demo		X	
763	Gun Cooling and Flushing		X*	HMR 99
788	Combat System Underway Operability	X		
789	MK 92 Underway Operation		X**	MOD 2|HMR 99
	900 SERIES - ROUGH WATER			
901	Hullborne Automatic Heading Hold	X		MOD 6
902	Foilborne Speed - Design Sea	X		
907	Take-off Design Sea	X		
908	Strut Extension/Retraction	X		HMR 75
912	Ship Motion Design Sea	X		
916	Foilborne Turn Rate - Design Sea	X		HMR 75
917	Foilborne Automatic Heading Hold	X		
919	C&S Operability	X		

*Reduced scope for PHM-6

**Except for PHM-6

HMR 99

1.0-1.3.12 Ship Trials

Dock and sea trials shall be conducted to demonstrate performance of the ship to prove construction in conformity with these specifications. Trial requirements specified herein are supplementary to the general requirements for testing in Section 1.0-1.3.11.1 and to specific test requirements in Section 1.0-1.3.11.2. MOD 2

The following trials shall be conducted:

- Builder Trials (BT): Dock (BDT) and Sea(BST)
- Acceptance Trials (AT)
- Final Contract Trials (FCT)
- Performance and Special Trials

Except as otherwise specified herein, the Contractor shall conduct and bear expense of BT and AT. The Government will conduct and bear the expense of FCT and Performance and Special Trials.

BT will be witnessed by the Supervisor and other Government observers. The AT will be witnessed by the U.S. Navy Board of Inspection and Survey (INSURV) and other Government observers. Subject to NAVSEA approval, representatives of manufacturers who have furnished ship components may be invited by the Contractor to witness trials. The Contractor shall furnish subsistence for Government representatives and observers while the ship is at sea. When a ship is deployed overnight, berthing accommodations shall also be provided. Where transportation between ship and shore is required, the Contractor shall furnish such transportation. MOD 2

During trials conducted by the Contractor, representatives of the Government will exercise no actual control over the navigation or operation of the ship, its machinery plant, or its equipment except for control of the weapons systems and operating stations during Navy Crew Underway Training. However, such representatives may bring to the Contractor's attention any method of operation that conflicts with the requirements of the contract.

The Contractor shall provide for administration, supervision, and conduct of trials, also for tug service, dockside personnel, and other services as necessary to dock and undock the ship. For Builders Sea Trials and Acceptance Trials a competent trial crew, including a licensed master certificated for the waters navigated and the ship tonnage and an engineer licensed to a level required by the U.S. Coast Guard and certificated for the type and horsepower of the propulsion plants, shall be provided by the Contractor for the Builder's Trials and the Acceptance Trial. Operation of the ship and its machinery, equipment, and systems shall be in a safe manner and in accordance with operating instructions. The Contractor shall record data and compute trial performance and results. Trial data shall be readily available to Government observers, and trial results shall be readily available to the Supervisor. MOD 2 MOD 2

If any part of the ship or its equipment fails to meet contractual requirements during BT or AT, the Contractor shall conduct additional trials as directed by the TWG. TWG designated deficiencies shall be corrected prior to scheduling of additional trials which would be affected by the deficiency. The number, scope, and scheduling of such additional builder trials shall be mutually agreed upon by the TWG and,in the event of a re-scheduled AT, as approved by INSURV.

Where sea trials are conducted by the Contractor, operation in navigable waters is intended. The actual location of trials will be at the discretion of the Contractor. During BST and AT the ship shall be operated in a manner and in waters suitable for collection of data for the approved trial agenda. If, during the course of trials, sea, wind, or visibility conditions are such that damage could result which would endanger the ship by pounding or collision, the trial shall be terminated for later re-scheduling. The trial shall be re-scheduled by the TWG. MOD 2

Trials shall also be terminated for later re-scheduling in cases where scheduled trial time is not sufficient to determine the performance of the ship.

Temporary rigging, industrial equipment, and debris shall be removed from the ship before sea trials. The Contractor shall insure that all paint will be dry at time of trials. MOD 2

The ship shall be in a state of material readiness for any possible emergency at sea, including collision, grounding, fire or any other catastrophe. The minimum readiness prior to any trial shall include:

Inflatable lifeboats shall be properly stowed, and the Contractor shall verify that the latest inspection of the boat has occurred within the past twelve months.

Life rings and marine markers shall be in stowage brackets.

Life jackets for all personnel embarked plus five percent spares shall be on board and properly distributed.

A first aid kit provided by the Supervisor shall be stowed on board during trials.

Fire fighting system shall have been thoroughly demonstrated and all associated items on board and properly stowed for the trials.

Fire and abandon ship bills shall be prepared and simulated drills held within three days prior to Builder's Sea Trials. Underway drills shall be held as part of Builders Sea Trials and AT.

All navigation-at-sea devices and equipment shall have been tested and be on board.

All compartments whose integrity is essential to the safety of the ship shall have been satisfactorily tested.

The above shall be certified in writing by the Contractor, verified by the Supervisor, and provided to INSURV upon arrival at the ship for the AT.

The Government will provide special or unique Government services necessary for the demonstration of various electronic equipments. Shore, ship, or airborne assistance will be provided for demonstration of IFF, ordnance, and communications equipment. The Contractor shall assist the Supervisor in the preparation of the requirements for such special or unique Government services; that is, in the instance of aircraft, requirements such as the functions that the aircraft must perform, operational radio frequencies, flight plan, *and* aircraft *on-station* time and date.

After delivery of the ship to the Government, neither the Contractor representatives nor his subcontractor representatives shall exercise control over the navigation or operation of the ship, its machinery plant, or its equipment. Such representatives will be afforded reasonable opportunity to witness, inspect, and comment on the operation of the ship and its components during the guarantee period. The Contractor shall bring to the attention of NAVSEA any operation that conflicts with the requirements of the contract.

Instrumentation and Equipment

Temporary trial instrumentation and equip&t necessary for BT and AT shall be provided by the Contractor, except as otherwise specified herein, or in Schedule "A", List of Government-furnished Material.

The Contractor shall install all temporary trial instrumentation and equipment required to support the Builders Trials. After satisfactory completion of BT and AT, all temporary trial instrumentation and equipment shall be removed by the Contractor. Government-loaned equipment shall be maintained in proper working order by the Contractor.

Shaft horsepower shall be measured and computed with the use of installed trial instrumentation required by applicable test procedures.

Fuel consumption shall be measured on the Production Ships by calibrated flow meters. Calibrations may be witnessed by the *Government.* MOD 2

Flow meters will be calibrated before and after fuel consumption trials.

Other instrumentation, either temporary or permanent, furnished by the Contractor and used to collect data for trials, shall be calibrated and tested by the Contractor to assure the Supervisor that such instrumentation provides reliable data. This calibration data shall be available for review by the Supervisor. MOD 2, 7

Builder Trials

General. Builder's Trials (BT) shall be conducted in accordance with Boeing D312-80243-2 to demonstrate compliance with contractual requirements for performance of the ship and to assure the Supervisor that the ship is ready for Acceptance Trials. The Contractor shall prepare a notification of trial dates and the trial agenda. After approval, the Supervisor will forward a copy to INSURV so that INSURV may observe such tests as desired.

Test reports and duplicate magnetic tapes resulting from these trials shall be furnished to the Supervisor as evidence of contract fulfillment and for analysis.

Documentation of completion of these trials and tests is a prerequisite to the conduct of AT.

All tests that can be properly conducted dockside as mutually agreed by the Test Working Group shall be satisfactorily completed, deficiencies corrected, and tests re-run where necessary. Should it be impractical to conduct any of these prerequisite tests dockside, the Supervisor may authorize the test to be conducted during Builders Sea Trials, except where deficiency could jeopardize the safety of the ship or ship personnel.

A Government/Contractor review shall be conducted in accordance with the working Agreement: Working Agreement: Production PHM Test Working Group, D312-80179-2 prior to underway trials. The following systems shall be included in this review: HMR 55

Ventilating, heating and air conditioning systems
Firefighting systems
Alarms and safety devices
Interior communications systems
Radio and navigation systems
Hullborne propulsion systems
Foilborne propulsion system
Steering system
Anchor gear
Electrical ship service generating and distribution system

The Contractor shall conduct a Builder Sea Trial. Tests shall be included in the trials agenda with appropriate test procedures for each test.

Prior to the start of BST, the following prerequisites shall have been met:

1. All installation of equipment, furniture, and systems necessary to the conduct of the trial shall be completed and in operating order.
2. The inclining experiment shall have been performed and the results certified by the Supervisor that the ship meets stability requirements and is safe for sea.
3. All Contractor-responsible deficiencies shall be corrected or Supervisor permission obtained to conduct the trial prior to completion of the item. The Contractor, prior to BST, shall certify to the Supervisor that the ship is ready for sea trials. The certification shall identify and schedule for completion all Contractor-responsible items that will be incomplete at BST.

Acceptance Trials (AT)

A written certification by the Supervisor, that Builder's Trials have been completed and that deficiencies have been corrected and all ship systems are operational, shall be prerequisite to the conduct of Acceptance Trials.

AT shall be conducted in accordance with Boeing D312-80056-3 to demonstrate to INSURV compliance with contractual requirements necessary for preliminary acceptance of the ship by the Government. The Contractor shall use INSURV instruction 9080.2F of 9 December 1974, as a guide for trials. HMR 92

All items of safety required for the Builder's Sea Trials shall be implemented prior to beginning the Acceptance Trial. The ship shall be clean and free of all industrial debris. Data recorded on earlier trials and tests, together with analysis of these data, shall be made available to INSURV at AT.

Any tests specified under Builder Trials which are requested by INSURV, shall be repeated during AT. Successful completion of these trials, as specified herein, is a prerequisite to preliminary acceptance of the ship by the Government. All compartments shall be complete, including lagging, insulation, deck tile, labeling and painting.

If the Supervisor considers that AT should proceed without completion of minor non-safety deficiencies, the deficient items shall be documented, NAVSEA notified, and procedures for waivers, if necessary, started at least two weeks before AT. All deficiencies shall be reported to INSURV upon arrival for trials.

A trial agenda shall be prepared and forwarded to the Supervisor for INSURV approval (with copies to NAVSEA), at least 60 days in advance of the proposed trial date.

At least 70 days in advance of the proposed trial date, the Contractor shall notify the Supervisor in writing of the date he desires to conduct the trials.

The Supervisor will make arrangements with other activities, as requested by the Contractor, for services necessary to demonstrate satisfactory operation of installed ship equipment and systems.

Copies of each complete equipment test procedure shall be available for use by

INSURV, the Supervisor, and NAVSEA. A tabulated list of tests not completed shall be provided.

Before AT, the Contractor shall have completed tests, adjustments, alinements, and interference surveys on all electronics equipment as required. Maintenance Standard Books, Part 1, and Performance Standard Sheets with the appropriate measurements entered, in conformance with the Performance, Operational, and Maintenance Standard of Electronics Equipment (POMSEE) program, shall be made available to INSURV during the trials. All electronics equipment shall be operational at time of trials. Before the trials, the Contractor shall arrange to have onboard qualified electronic technicians and data recorders, as necessary, to conduct conclusive performance tests of electronic systems during the trials. Electronic systems (such as communication, radar, IFF, UHF, and such other systems as determined by the Supervisor) whose performance is affected by a restricted environment of the ship, shall be scheduled for testing during the underway portion of the trials. Other electronic systems shall be tested at an appropriate time during the trials.

Electronics equipment shall be energized using ship power, for a period of time sufficient to reach steady state conditions prior to commencement of trials.

The Contractor shall provide accommodations and facilities for the Board as delineated in INSURVINST 9080.2F of 9 December 1974.

Post Trial Examination. After AT has been completed, the ship shall be returned to the Contractor's plant, and (as requested by INSURV and directed by the Supervisor) equipment shall be opened at the expense of the Contractor, for post trial examination by INSURV. Correction of defects or deficiencies shall be accomplished as specified in the contract. Following the examination and correction of defects or deficiencies, the equipment shall be closed and made ready for service at the expense of the contractor.

Final Contract Trials (FCT)

The Government will conduct FCT prior to the expiration of the ship guarantee period to determine performance of the ship after service operation. Tests and inspections will be conducted to demonstrate to INSURV full compliance with contractual requirements.

Successful completion of the Final Contract Trials is prerequisite to final acceptance of the ship by the Government. The Contractor may have representatives on board during these trials.

Performance and Special Trials

Performance and special trials, such as standardization trials, tactical trials, and noise and vibration trials will be conducted by and at the expense of the Government and will be conducted either during or after the ship guarantee period.

1.0-1.3.13 Photographs

The following (negatives and prints) shall be taken in accordance with the contract:

1. Progress photographs
2. Launching photographs
3. Trials Photographs MOD 6
4. Inclining Experiment Photographs

IHMR 89

1.0-1.4 SHIP SYSTEM CHARACTERISTICS

The ship's general arrangement and inboard profile shall be as shown on NAVSEA Drawing 802-5000493.

1.0-1.4.1 Maximum Displacement

It is the intent of these specifications to define a ship whose systems can support a foils-up full load displacement of 241.3 metric tons and full load cruise dynamic lift of 243.5 metric tons. MOD 4 MOD 7

1.0-1.4.2 Military Load

The ship shall have provisions for the installation of a Command and Surveillance Suit and an Armament Suit. The specific **requirements** for installation are specified in Sections 1.400 and 1.700.

1.0-1.4.3 Manning

The ship shall be manned by a total of 21 personnel as shown below:

1	Commanding Officer
3	Officers
3	Chief Petty Officers
14	Other Enlisted Men
21	Total

1.0-1.4.4 Operational Performance

The ship shall be capable of hullborne and foilborne operation as specified on the following page:

Design Sea - The design sea (sea state 5) shall have the following characteristics:

Wave Heights (Peak to trough)	Average ------	1.91 m	HMR 89
	Significant (Average 1/3 highest)	3.05 m	
	Average 1/10 highest	3.88 m	
Wave Periods	Average ------	6.20 sec	
	Significant (Average 1/3 highest)	6.73 sec	HMR 89
	Max Energy ------	8.30 sec	
Wave Length	Average	41.0 m	
Wind Velocity	22 knot3		

Wave amplitude spectral density defined by the following long-crested spectral form relation. (A special case of the lower equation with $H_{1/3} = 3.05$ m, $\tau = 6.73$ sec) HMR 89

$$S(\omega) = \frac{0.780\, e^{-0.3356/\omega^4}}{\omega^5}$$

Where $S(\omega)$ = Wave Amplitude Spectral Density, in meter^2 - Second

ω = Wave Frequency in radians per sec

e = The exponential constant, 2.71

0.780 = An empirical constant, meter^2 - sec^{-4}

0.3356 = An empirical constant, sec^{-4}

An additional design sea spectral density is defined by the following general spectral form relation: HMR 89

$$S(\omega) = 0.11 \left(\frac{2\pi}{\tau}\right)^4 \cdot \frac{1}{\omega^5} \left(H_{1/3}\right)^2 e^{-0.44 \left(\frac{2\pi}{\tau}\right)^4 \frac{1}{\omega^4}}$$

where:

$\omega = 2\pi f$

f = Frequency in Hertz

$H_{1/3}$ = Significant Wave Height (2.4 m)

τ = Significant Wave Period (5.0 sec)

1.0-1.4.4.1 Hullborne Operation. While operating in the hullborne mode under the conditions of Item (a) below, the ship shall be capable of performance specified in Items (b) through (e) below.

(a) Conditions

1. Calm sea except for (c) 2 below
2. Ambient air temperature 38° C (100.4°F)
3. Design full load displacement, except for (c) 4 and (e)

(b) Speed

1. Design speed with foils extended and hullborne propulsion operating at cruise power shall be 11 knots. The cruise power shall be less than or equal to the hullborne maximum continuous power in accordance with Section 1.238.
2. With the hullborne propulsion system operating and the foils extended, the ship shall be capable of continuously operating at all speeds from at least 5 knots astern to 11 knots ahead, including dead in the water.

(c) Maneuverability

1. With foils retracted and hullborne propulsion operating ahead at cruise power, the ship shall be able to turn with a diameter not exceeding C meters (C feet).
2. With foils extended and hullborne propulsion operating ahead at cruise power, the ship shall have the capability of automatically controlling mean heading within plus or minus five degrees of the ordered heading in the design sea state.

C Deleted. See Addendum for Classified Data

3. The ship with the foils retracted shall be capable of being docked or **undocked** within a restricted docking area of two times the overall length (foils retracted) and twice the ship's maximum beam at the main deck. This requirement shall apply with a **25-knot** beam wind opposing the maneuver, see Figure **1.0-** 1.
4. The ship shall be capable of maintaining position within plus or minus 15 meters (49.2 feet) in an **11.5-knot** beam wind, and shall be capable of maintaining heading within plus or minus 15 degrees of ordered heading, using manual heading hold, in a 25-knot beam wind in sheltered *water*, with foils extended, at zero speed over the ground and minimum operating displacement.
5. The ship shall be capable of maintaining position within plus or minus 15 meters (49.2 feet) in a l-knot beam current and heading within plus or minus 15 degrees of ordered heading, using manual heading hold, in a **3-knot** beam current, in sheltered water, with foils retracted at zero speed over the ground and full load displacement.
6. With foils extended and hullborne propulsion operating astern at cruise power, the ship shall be capable of maintaining heading within plus or minus 10 degrees of ordered heading using manual heading hold.

(d) Endurance

While operating at the design speed and full load displacement minus service life margin, the

V FOR UNDOCKING

25 KNOT BEAM WIND

FOR DOCKING

a

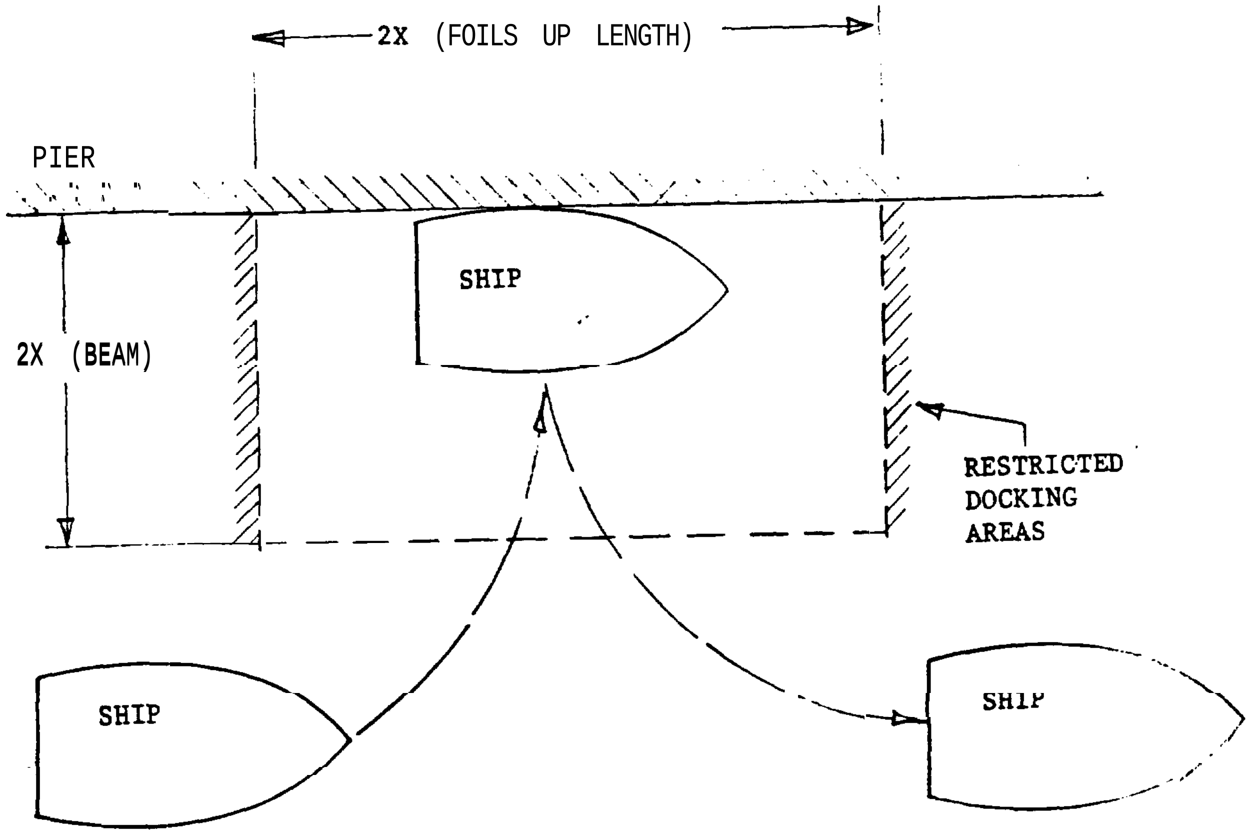


Figure **1.0-1** DOCKING REQUIREMENTS'

hullborne endurance shall be at least C nautical miles with foils extended.

(e) Emergency Mode

It shall be possible to operate the foilborne propulsion system in the hullborne mode with the foils extended as a normal backup system and with the foils retracted as an emergency backup system.

1.0-1.4.4.2 Foilborne Operation. While operating in the foilborne mode under the applicable conditions of Item (a) below, the ship shall be capable of the performance specified in Item (b) through (g) below.

(a) Conditions

1. Design full load displacement.
2. Design foilborne navigational draft for requirements (b)1 and (d) below, only.
3. Ship at zero degree trim, plus or minus one degree, and zero degree list for requirements (b)1 and (d) below, only.

(b) Speed

1. The foilborne design speed when operating at cruise power in a calm sea and ambient air temperature of MOD 7
$38^{\circ}C$ ($100.4^{\circ}F$) shall be at least C knots. MOD 1
2. The foilborne design speed when operating at cruise power, in the design sea and ambient air temperature of $27^{\circ}C$ ($80.6^{\circ}F$) shall be at least C knots. MOD 1
3. The minimum foilborne speed in the calm sea condition shall be less than 34 knots at a constant throttle setting.

C Deleted, See Addendum for Classified Data

(c) Takeoff
The ship shall be capable of takeoff on all headings using only foilborne propulsion at 27°C (80.6°F) ambient air temperature in the design sea.

(d) Endurance
At the foilborne design speed and full load displacement minus service life margin, the endurance range shall be at least ▷ nautical miles, in a calm sea. MOD 1

(e) Ship Motion
At design speed (foilborne), and at any heading in sea states up through design sea, the RMS angular displacement shall not exceed 1.0 degree pitch, 1.0 degree roll and RMS acceleration in the living and command and control spaces shall not exceed 0.15g vertical nor 0.075g lateral. MOD 6; MOD 2, MUD 1, HOD 4, 6; HMR 131

(f) Maneuverability
At design speed (foilborne), and at any heading in sea states up through design sea the ship shall be capable of a turn rate of at least ▷ degrees per second in a coordinated turn. MOD 1

▷ **Delete,** see ADDENDUM for classified data MOD 2

(g) Heading Hold
At design speed (foilborne), and at any heading in the design sea, the heading shall be maintained automatically within 2.0 degrees RMS taken about the mean heading. In addition, the mean heading shall be maintained within plus or minus 3.0 degrees of the ordered heading.

1.0-1.4.4.3 Endurance Away From Base. The ship shall be capable of remaining hullborne at sea or at a remote site for 5 days without logistics support or replacement.

1.0-1.4.4.4 Operational Response Time.

(a) The ship shall be able to get underway and obtain design hullborne speed with foils extended within C minutes starting with the following initial conditions: MOD 1
1. Foils retracted.
2. Crew onboard.
3. Fuel tanks filled.
4. Propulsion engines cold.
5. Electrical power supply in operation
6. Environmental control system in operation.
7. Ambient air temperature not exceeding 38°C (100.4°F) nor less than -15°C (+5°F).
8. Calm sea.

(b) The ship shall be able to get underway and obtain design foilborne speed within C minutes starting with the following initial conditions: MOD 1
1. Foils retracted.
2. Crew onboard.
3. Fuel tanks filled.
4. Propulsion engines cold (lube oil pre-heated).
5. Electrical power supply in operation.
6. Environmental control system in operation.

C Delete, see ADDENDUM for classified data

7. Ambient air temperature not exceeding 38°C (100.4°F) nor less than -15°C (+5°F).
8. Calm sea.

1.0-1.4.4.5 Foil Retraction And Extension. The foils shall be capable of being extended and locked or retracted and locked within a minutes at temperatures above 15°C (59°F) ambient under the following conditions:

(a) Under the design sea condition while operating in the hullborne mode at the initial speed of 5 knots.
(b) Under the calm sea condition while operating in the hullborne mode initially at the hullborne design speed as per paragraph 1.0-1.4.4.1(b)1.

1.0-1.4.4.6 Continuity Of Foilborne Operation (Battle Conditions). While foilborne, should a casualty occur which results in the loss of power from any one ship service generator, with the other ship service generator operating and the electrical load split, the ship must be capable of remaining in the foilborne condition.

1.0-1.4.4.7 Continuity Of Foilborne Operation (Wartime Cruising). While foilborne, should a casualty occur which results in the loss of power from the operating ship service generator, with the other ship service generator cold, the ship must be capable of remaining foilborne while the other ship service generator is started and assumes the electrical load.

1.0-1.4.5 Reliability and Maintainability (R&M)

1.0-1.4.5.1 R&M Program.

(a) Program Requirements MOD 4
The Contractor shall develop, maintain, and implement a comprehensive reliability and

maintainability (R&M) design assurance program to assure that R&M considerations are applied throughout all phases of designs and construction. The R&M program shall comply with the requirements of MIL-STD-785 for reliability and MIL-STD-470 for maintainability and shall include preparation of a program plan to define the tasks necessary to assure compliance with the R&M requirements specified herein. The R&M program shall be prepared with tasks assigned in a manner to permit technical audits. The maintainability program plan shall be combined with the reliability program plan.

The R&M Program Plan shall be implemented to provide feedback to the production design and construction efforts.

(b) Failure Reporting

System feedback procedures shall be established and reports shall be prepared to provide operation, design, logistics, and production activities feedback on failures, corrective maintenance actions, and technical problems relating to R&M for those Contractor-furnished items with a Maintenance Criticality Code through level III as identified for the Maintenance Engineering Analysis, (MEA) HMR 119 Candidate List and Schedule, PHM-3, (D312-80066-12) during all inspections and tests performed by the Contractor from manufacturer (or receipt in case of a supplier item) to delivery of the ship for all items on the ship except those in Table 1.0-1.4; feedback shall be provided on all items in Table 1.0-1.4 from initial manufacture to delivery of the ship, even if that is accomplished by Subcontractors.

	Equipment	MTBF (Hrs) Goal	MTBF (Hrs) Heqmt	MTTR (Hrs) Goal	MTTR (Hrs) neqmt	FMEA	R&M Design Review	Rel. Anlys	Main. Anlys	MTTR Demo	MTBF Demo	
1.	SSPU	1600	800	1	2	(A)		(A)	(A)	(D)	(B)	
2.												MOD 5 HMR 70
3.	F/B Propulsor (Pump, thrust bearing and Y-duct)	3200	1600	40 10.5***	80 21***	X	X	X	X	(F)	(C)	HMR 92 HMR 92 & 92R1
4.	F/B Gearbox	6400	3200	40 1	80 2	X	X	X	X	(F) (D**)	(E)	HMR 19
5.	Frequency Converter	3400	2500	0.5	1	X	X	X	X	(D)	(G)	
6.	Sea Water Pump	7100	3550	1	2	X	X	X	X	(F)	MIL-STD 7818, VIII	
7.	Chilled Water Pump	7100	3550	1	2	X	X	X	X	(F)	MIL-S-781B,VIII	
8.	Struts & Foils (H)					(I)		(I)	(I)			
9.	Gyro Compass (GSPU and CDU)	1400	700	1.1	2.2	X	X	X	X	(D)	MIL-S-781B,VIII	HMR 109R1
10.	Nav. Radar Indicator (SCD 312-81387-4)	1500	750	1	2	X	X	X	X	(D)	MIL-S-781B,VIII	

(A) The requirements in Section 1.312 apply unless satisfied as a result of analyses made under the lead ship contract.
(B) MTBF demo will be considered satisfied by successful completion of the 1100-hr. accelerated endurance test specified in Section 1.312. Number of cycles and time at 160 percent power to be at least as severe as 3000-hr. endurance test of Boeing QT-5066. HMR 90R2
(C) MTBF demonstration not required.
(D) Demonstrate selected on-board removal, replacement, and maintenance actions in accordance with MIL-STD-471; this demonstration may be accomplished concurrently with the technical manual validation specified in 1.0-1.6.6.10. MOD 6
(E) MTBF demo will be considered satisfied by successful completion of the 400-hr. endurance testing on a single unit IAW SCD 312-81379 plus the gearbox test specified in paragraph 1.200. HMR 90R2 HOD 6
(F) Demonstrate removal; replacement-and realinement one time.
(G) Demo per Para. 1.314 of SSS (4.4 reliability test).
(H) Struts/Foils shall be designed to the following goals & requirements:

	Design goal*	Requirement
Fatigue life	18,000 hrs.	12,000 hrs.
Flaw growth, visible	6,000 hrs.	6,000 hrs.
Flaw growth, hidden	18,000 hrs.	18,000 hrs.

● q55 confidence 95% probability

(I) In accordance with Section 1.566.1.

** Demonstration of all maintenance actions except the removal, replacement and realinement of entire gearbox. MOD 6

● ** This goal and requirement applies to all maintenance actions except the removal, replacement and realinement of the entire equipment. HMR 92R1

Table 1.0-1.4 R&M EQUIPMENT REQUIREMENTS

Analysis of each failure and technical problem, with emphasis on recurring failures, shall be provided. The procedures shall include determination, implementation, and verification of corrective action.

1.0-1.4.5.2 Maintainability. All normal shipboard maintenance actions performed by the crew (organizational level) will be capable of being performed with standard hand tools, portable test equipment, or built-in test equipment. Repair tasks primarily will be remove and replace actions.

Care and preventive maintenance shall not 'be required more often than once every 5 days, and with a capability to satisfy tactical emergencies by an extension to 7 days without damaging consequences. All scheduled preventive maintenance shall be based upon the 5 day mission cycle.

All newly designed PHM ship subsystem equipment shall be capable of simple repair. The desired mean-time-to-repair (MTTR) for all organizational level corrective maintenance shall not exceed 2.0 hours for 90% of all repair actions including the time required for troubleshooting and disassembly, using the tools and test equipment onboard ship or the MLSG as appropriate.

Equipment requiring corrective maintenance shall be replaced unless the time required for replacement exceeds the time required for repair in place by greater than 33%. The time required for removal and replacement includes operational checkout of the item requiring maintenance, and the removal and replacement of interference items (including their checkout to a full operational status). The personnel assumed available to complete the removal and replacement or repair in place shall be those available from the ship's crew and the MLSG.

1.0-1.4.5.3 R&M Tasks. The Contractor shall perform R&M tasks, as specified for equipment listed in Figure 1.0-1.4, in accordance with the following task descriptions.

R&M Analysis. - Analyses shall be conducted by R&M trained personnel working with design personnel to effect a complete exchange of information to assure compliance with R&M requirements. Analyses shall include, where applicable, reliability block diagrams, maintainability functional block diagrams, mathematical models, predictions, assumptions, and definitions of failure. This permits a continuing evaluation of predicted or achieved R&M results versus specified R&M requirements. Equipment **mean-time-between-failure** (MTBF) and mean-time-to-repair (MTTR) statements shall have the data sources identified and explained.

Failure Mode And Effects Analysis (FMEA). - The FMEA shall be an organized procedure for identifying, evaluating, and analyzing all known potential failure modes for the item, together with the causes and Contractors action to inhibit such failure. The FMEA format and report shall be prepared using MIL-STD-1629 as a guide.

Design Reviews. - Formal R&M design reviews shall be scheduled and conducted at planned design checkpoints in consonance with the production design, test, and construction schedules. These design reviews may be a part of a design review held for other purposes. Design review participants shall include personnel from the design, reliability, maintainability, integrated logistics support, quality assurance, and other appropriate areas of the Contractor organization. Government representatives will also be in attendance. R&t4 design review schedules and agendas shall be prepared and distributed to the Government at least 30 days prior to any review. Typical topics to be reviewed and discussed at each review are:

R&M requirements and estimates.

Component/Parts Selection & Application Program (incl. stress analysis).

Dimensional tolerance studies - For system integrated equipments.
Failure mode and effects analysis.
Environmental effects.
Data sources.
Built-In Test Equipment/Automatic Test Equipment.
Storage and non-use effects.
Test Data.
Trade-off Studies.
Human Factors and Safety Implications.
Maintenance Accessibility.
Reliability Design Criteria.
Maintainability Design Criteria
Maintenance Engineering Analysis (MEA) Interfaces.

R&M Design Review reports shall be prepared by the Contractor to document each event including status, action items, and future activities.

R&M Test And Demonstration Plans and Reports. - Detailed R&M test demonstration plans and procedures to demopstrate the achievement of the quantitative requirements specified herein shall be prepared and submitted to the Government for approval. Test Plans shall be in conformance with requirements of Table 1.0-1.4 and as further detailed within these specifications.

These test requirements are intended to be performed on the specific equipments listed in Table 1.0-1.4 and are in addition to any testing required by the T&E Plan specified in Section 1.0-1.3.11.

The maintainability demonstrations for each equipment listed in Table 1.0-1.4 shall be conducted with the equipment installed aboard ship in the operating configuration. The demonstrated mean-time-to-repair (MTTR) shall be the weighted average of the task times considering the average predicted failure rate. The demonstration tasks shall be those that have been recommended for the organizational and onboard intermediate levels of corrective maintenance. The MTTR demonstrations may be satisfied if performed in conjunction with the validation of the PHM Ship Operating and Onboard Maintenance Manual.

There shall be no MTTR demonstration for the struts and foils.

In case of conflict between these specifications and an equipment SCD, the SCD shall be revised to conform with these specifications and submitted to the Government for approval.

1.0-1.4.5.4 Design Changes. Design changes made to a test item as a result of deficiencies revealed during R&M testing shall be reflected in revisions to the applicable engineering drawings, technical manual, or recommended specification changes for the item. Any such changes shall be controlled and implemented into production assemblies in accordance with the Contractor Configuration Control Plan.

1.0-1.4.5.5 Refurbishment Of R&M Test Items. Upon completion of testing, parts and components subject to wear, corrosion and contamination shall be inspected to determine that they are within tolerance requirements of the applicable specification, drawing, or technical manual. All parts or components which are out of tolerance, or which require replacement in accordance with the planned maintenance schedule for the equipment, shall be replaced to restore the equipment to like-new condition.

1.0-1.4.6 Safety Requirements

The objective of the system safety effort shall be to produce a ship capable of maintaining the highest level of operational mission effectiveness through the conservation of human and material resources by the early identification, evaluation and correction of hazards. Specifically, this objective is attained by insuring that: MOD 1

Safety requirements of these specifications are fulfilled in the detail design and ship production. MOD 7

New hazards resulting from the detail design process, are identified and eliminated or controlled adequately to protect both personnel and hardware.

Operational safety requirements are determined, and integrated into operating and maintenance software.

The contractor shall up-date and implement the PHM 1 System safety plan in accordance with the requirements of MIL-STD-882.

The following specific safety requirements apply:

(a) See Section 1.582.

(b) Every watertight manned compartment and C.I.C. shall be provided with two means of access or egress and these shall be as far apart as possible on opposite sides or ends of the compartment. No passageway shall deadend without a means of egress at the deadend. The magazine shall have means of vertical access and egress. In addition, each pair of fore and aft adjacent watertight compartments shall have at least one means of vertical access for personnel escape and for dewatering. The location of accesses shall permit dewatering of the compartment below by means of the portable damage control pump. Vertical access closures shall be of the quick acting type. With the exception of main companionway, escapes shall be served with vertical ladders.

(c) A portable damage control pump shall be supplied as GFE. See Section 1.0-1.3.10.

(d) Items of equipment whose misoperation could impose a safety hazard on the ship (i.e., pressure, volume, and speed limits) shall have dials, instrumentation, and warning plates with operating safety limits in both U.S. Standard and metric units.

(e) Any equipment which in normal operation exposes personnel to surface temperatures in excess of 60°C (140°F) as a result of inadvertent contact or 49°C (120.2°F) during handling, shall be appropriately guarded or thermally insulated.

(f) The operation of switches or controls which initiate hazardous operations shall require the prior operation of a related or locking control. The critical position of such a locking or related control shall activate a visual and auditory warning device in the affected work area.

(g) Where access area must be located over dangerous mechanical or electrical components, the access door or cover shall be designed to actuate an internal light when opened, and a highly visible warning label shall be provided on both sides of the door or cover.

(h) Exposed edges and corners shall be rounded.

(i) ELECTRICAL GRADE DECK COVERING conforming to MIL-SPEC MIL-M-155623, type I, shall be installed on decks located in compartments designated as electrical or electronic spaces. Prior to installing the deck covering, the deck shall be primed with 2 to 4 mils dry film thickness of an anti-corrosive paint, formula 150 of MIL-P-24441 or equivalent. MOD 1

If the compartment is used for more than one purpose and is basically a non-electrical area, a portable mat, conforming to type II of MIL-M-15562E may be installed over the deck covering designated for the space (assuming that is not type I) in lieu of the sheet covering, type I. The mat shall be installed in way of insulated work benches, operating and servicing areas of electrical panels and switchboards. The mat shall be installed over a minimum area necessary to prevent the hazards of electrical shock but not less than three feet wide. Cementing of the mat is optional. EXPOSED corners shall be rounded off.

MOD 1

(j) Fueling stations shall be grounded to the ship's structure.

(k) Rat proofing of the ship shall conform to the requirements of Section 1.605.

(l) In any compartment, it shall be a design objective that the after side of bulkheads be smooth. This may be accomplished by placing stiffeners on the forward side of the bulkhead or by sheathing as specified in Section 1.637.

(m) All items must be secured to withstand a crash stop of magnitude in accord with the wave impact criteria specified in Section 1.0-1.5.3(b). without dislodgement.

(n) All lockers must be secured at the deck to withstand vertical loads and at the top or the back to withstand fore and aft loads *as* well as transverse loads.

(o) Provide secure stowage of all tool boxes and similar loose items.

(p) At control stations where the operator is seated, all operating controls of the station must be easily and conveniently accessible when the operator is seated with the **lap** belts fastened.

(q) For piping spray shields, see Section 1.0-2.7.

1.0-1.4.7 Ship Protection Requirements

A heating, ventilating and air conditioning system shall be provided which has space provisions for a nuclear, biological and chemical (NBC) protection system.

(a) Space provisions (1.4 cubic meters (49.4 cubic feet)) shall be reserved on the 01 level aft of pilothouse for NBC filters.

(b) Space for an airlock at the entrance to the deckhouse including space provisions for a self-limited activated solution of hypochlorite (SLASH) shower shall be provided. Provision for a sea water shower immediately outside the airlock shall be included. Space allocated for the airlock and shower shall be 1x1x2.4 meters (3.3 x 3.3 x 7.9 feet).

1.0-1.4.8 Small Arms Fire Protection

Small arms fire protection shall be provided as follows:

(a) When foilborne, as per Paragraph 1.0-1.4.4.2(b)1, and struck by a 0.30 calibre armor piercing round in the automatic control system or the critical electrical system components, then the ship shall remain foilborne or execute a safe landing and be capable of continuous hullborne operation.

(b) The above requirements may be met by design redundancy, protective material, or in the case of the ACS computer, by utilizing adjacent equipments. MOD 2

1.0-1.4.9 Radar Cross Section

The effect of any design changes on PHM-3's radar cross section shall be minimized as follows: MOD 2 |HMR 55

(a) Intersections between major surfaces shall be non-orthogonal.

(b) All ship vertical surfaces shall be contoured or tilted not less than 5 degrees excepting the hull sides in way of aft foil system retraction.

1.0-1.4.10 Infrared (IR) Signature

For the purpose of establishing the IR signature criteria, MOD 2, |HMR 151 the ship shall have a relative radiance of source to background (R) of less than C measured in the horizontal plane with the ship in the foilborne condition of Paragraph 1.0-1.4.4.2.(b)1. Relative radiance of source to background (R) is defined as follows: HMR 151

$$R = \frac{P_S - P_B}{P_B} \times 100$$

Where

P_S = Apparent source radiance for K above K

P_B = Apparent background radiance

K = Absolute temperature, degrees Kelvin

MOD 2, HMR 151

1.0-1.4.11 Drawings

1.0-1.4.11.1 General. This section contains requirements pertaining to type, preparation, indexing, and microfilming, of drawings, ship drawing index, microfilm, and drawing booklets.

Unless otherwise specified, tolerance on linear and angular dimensions shall be in accordance with good commercial practice.

The requirements of this section for ship construction drawings apply only to new drawings or lead ship construction drawings with modifications produced by the Contractor for application to one or more follow-ships.

Maximum use shall be made of existing F'HM 1 drawings. Existing drawings shall not be redrawn to meet format or title block requirements. Any changes in ship design for the follow-ship shall be reflected in new or modified drawings, meeting the requirements specified herein. The Contractor shall update the

C Deleted. See ADDENDUM for Classified Data.

Interface Control Drawings (ICD) listed in Table 1.0-3B, Section I, to reflect the PHM 1 as delivered, the requirements of these specifications and other changes as directed by the Government. Initial revision shall be within 120 days after award of contract.

Supplementary requirements for specific installations, structure, machinery and equipment systems, and technical manuals and publications are contained in other sections of these specifications and referenced specifications.

The Government reserves the right to inspect Contractor prepared drawings and associated lists at any time.

Drawings submitted for Government review or approval shall be sufficiently complete to assure that:

The drawings conform to the contractual requirements, including compatibility with the ship systems requirements.

Maintenance and repair capability is provided.

Shipyard installation can be accomplished without supplier assistance.

Naval ships and shore activities can repair and maintain the items without assistance from the original supplier.

Drawings, including reproducibles and prints, required to be furnished by the Contractor to NAVSEA or its representatives shall become the property of the Government.

Drawings shall be annotated with a distribution limitation statement in accordance with Contract Security Classification Guide, DD-254 located above the title block so that it will be visible when print is folded. HMR 57

If defects develop in machinery or equipment during the guarantee period, and if corrections of such defects are determined to be the responsibility of the Contractor, he shall revise the Government set of drawings to show modifications made to correct such defects; or if preferred by the Contractor, new correct drawings may be furnished.

1.0-1.4.11.2 Definitions.

Government Controlled Baseline See Section 1.0-O.

Contractor Controlled Baseline See Section 1.0-O.

Standard drawings are NAVSEA drawings illustrating arrangement and details of equipment, systems, materials, or components from which no departure in the manufacture of parts or intent of use is permitted without NAVSEA approval.

Type drawings are NAVSEA drawings illustrating systems or components which may be subject to development by the Contractor, to assure full compliance with these specifications.

Ship construction drawings as defined in Mil. Spec. MIL-D-1000/2 are Contractor Working drawings which are necessary for construction of the ship and as required by these specifications.

Selected record drawings are a designated group of drawings made applicable to an individual ship and illustrate final shipboard installations of important features, systems, and arrangements. They are prepared by the Contractor and are maintained correct throughout the life of the ship by the Government.

Onboard drawings are a designated group of drawings (prints, or microfilm, or both) illustrating those features considered necessary for shipboard reference.

Manufacturer equipment drawings are drawings prepared by manufacturers of Government or Contractor-furnished equipment which are identified by a manufacturer drawing number.

Reproducible drawings are drawings from which prints can be made.

Certification data sheets are supplemental manufacturer equipment drawings containing the manufacturer equipment data, procurement data, ship applicability, drawing references and other data as required by Mil. Spec. MIL-D-1000/2 and equipment specifications.

Final drawings are ship construction drawings which have been corrected to illustrate final ship and system arrangement, fabrication and installation.

Photographic reproductions are those containing silver halides or silver salts as the sensitizing process as specified in Mil. Spec. MIL-D-5480, class 4.

1.0-1.4.11.3 Correspondence And Drawing Forwarding Procedure. Large shipments of Contractor drawings designated for delivery to a Government activity may be sent directly to that activity provided a copy of the forwarding letter and a list of the drawings sent are enclosed; however, this original forwarding letter shall be sent via the Supervisor.

Where practicable, correspondence regarding drawings shall be limited to the coverage of a single subject corresponding with the breakdown structure used in these specifications and in the contract Work Breakdown Structure.

Correspondence forwarding' drawings, and lists accompanying drawings forwarded separately from correspondence, shall list each drawing forwarded, indicating its title, drawing number, and latest revision letter. Drawing lists shall reference the forwarding letter.

Correspondence forwarding drawings for Government action shall be separate from correspondence forwarding drawings for information and file.

Prints forwarded to the Government or stowed onboard the ship shall be folded in accordion pleated form to a size not greater than 215 by 355 mm (8-1/2 by 14 in.3 with the title block clearly visible, except that copies of the Booklet of General Drawings shall be folded as shown on MIL-STD-18267.

Drawings and reproductions shall be prepared for mailing or shipping in accordance with Mil. Spec. MIL-D-1000/2.

1.0-1.4.11.4 Drafting And Drawing Reproduction Requirements. The provisions of this paragraph do not constitute a requirement to provide drawings. Drawings shall be provided when and as required elsewhere herein or by invoked equipment or material specifications.

Unless otherwise specified, hull, machinery, electrical, and electronic Contractor-furnished equipment drawings, parts lists, and material lists, shall comply with Mil. Spec. MIL-D-1000/2, Form 2, Categories A, B, D, G and H. Hull construction drawings shall comply with Category E.

In addition to the above, the following categories will also be required: .

C - if special service test is intended

E or I - if Government should buy design

F - if drawing to portray form, fit, and function only, is needed for procurement

J - if the contract explicitly identifies which parts are to be controlled.

NAVSEA drawing numbers shall be assigned to all type I ship construction drawings.

Drawings assigned NAVSEA drawing numbers shall have title block formats conforming to MIL-STD-100.

Functional drafting (as in publication, NAVSHIPS 0283-145-0000) and other drafting practices associated with marine engineering and naval architecture and necessary for adequate delineation of the subject may be used to supplement applicable Government specifications and standards.

Pencil drawings reproduced on cloth or polyester film are acceptable whenever this procedure will assure a clear and reliable record of the work involved. Selected record drawings (furnished as final drawings) shall be inked on cloth or polyester film or be photographic reproductions thereof on cloth or polyester film.

Graphite pencils shall not be used to revise or correct an inked or photographically reproduced drawing on cloth or polyester film. Plastic pencils of the type designed for use on polyester film or other approved film base drafting material may be used for making revisions on film, providing the microfilm image of the revised drawing meets the quality assurance provisions of Mil. Spec. MIL-M-9868/1. Revisions made to selected record drawings shall be in black drawing ink.

The 100 mm (4 in.) margin to the right of the title block (see MIL-STD-100) may be used by the recipients of reproducible copies thereof to record distribution information or other data. MOD 7

All prints shall be clear and distinct. All reproducible prints shall be direct-reading.

1.0-1.4.11.5 Ship Construction Drawings.

General. Drawings listed in Boeing Document D312-80055-1, which have been assigned NAVSEA numbers, shall be considered ship construction drawings. The Contractor shall modify these drawings or prepare new drawings, as defined below, to depict the PHM-3 design. Ship construction drawings for the ship and the ship systems shall be lead ship working drawings to the maximum extent possible.

Differences in configuration between PBM-3 design and PHM-6 shall be documented by modification kit drawings to avoid the necessity of modifying the PHM-3 series production drawings. HMR 99

New and modified ship construction drawings shall be supported by engineering analysis to assure compliance with contract requirements. MOD 7

The requirement of Section 3.7 of MIL-STD-1000/2A for indicating weights and centers of gravity on drawing is not applicable.

If new drawings are prepared which supersede or supplement previously prepared follow-ship drawings in whole or in part, reference to the superseded or supplemented follow-ship drawings shall be made on the new drawings, and vice versa.

Traceability of all changes to PHM-1 class working drawings is required, during the construction period. Follow-ship drawings shall be a reproducible copy of the PHM-1 drawing, unless the Contractor elects to prepare a new drawing, or MOD 7 changes from the PHM-1 drawing are minor enough to be made without destroying the accuracy of the drawing for PHM-1. Therefore all lead ship working drawings shall retain the same drawing number for follow-ships. The original revision block information shall be retained and continued with the follow-ship changes indicated as appropriate.

If the Contractor elects not to use a lead ship drawing, a new drawing number shall be assigned, and the first submittal of the drawing shall be accompanied by a brief explanation of the significant differences from the corresponding lead ship drawing.

For multi-sheet drawings, changes shall be made as follows:

If the entire sheet is impacted the original sheet shall be deleted and a new sheet added.

If only a detail or partial sheet is impacted, the detail portion shall be crossed out and the new detail added on a new sheet.

Stress diagrams. - Where stress diagrams are prepared, the diagram shall incorporate the following data: MOD 1

Limit or ultimate load, test load, assumptions as to manner of loading (live, dead, alternating), assumed friction, materials (including specification number), maximum stresses in each part (compressive, tensile, shearing, bearing, and torsional) developed by the limit or ultimate load, and the factor of safety in each part.

Information regarding characteristics under dynamic loadings, where applicable. This shall include calculations *for* natural frequencies of vibration and for resistance to shock loadings, together with pertinent data.

Stress diagrams shall be submitted in a complete and rational form so that each step can be verified without difficulty. Pertinent work sheets, such as for calculation of section modulus of an irregular section, shall be submitted with the stress diagram. The format of these work sheets may be of any form convenient to the Contractor.

Interference control. The use of interference control drawings, overlay drawings, composite drawings, or computerized interference-elimination systems does not reduce or eliminate the requirements for system drawings specified elsewhere herein.

Final drawings. Final drawings shall be complete; for example, sketches which may have been issued in lieu of drawing revisions shall be incorporated on the drawings. These drawings and all drawings including system diagrams shall be consistent with the final shipboard installations.

Either the original tracings (ink or pencil) or photographic reproductions of these tracings on cloth or polyester film will be satisfactory provided they meet the quality and legibility requirements of Mil. Spec. MIL-D-5480 and are in such condition when delivered to the Government as to be capable of producing legible prints and satisfactory microfilm copy.

After all ships of a design class are built at one shipyard, one complete set of drawings shall be furnished by the Contractor. Should a drawing not apply either in whole or in part to all ships of the class, such drawings shall be properly marked for the applicable ships, or additional sketches shall be incorporated thereon to indicate differences which affect replacement or repair; if this is impracticable, a separate drawing shall be furnished for such ship.

1.0-1.4.11.6 Selected Record Drawings

General. - One complete set of selected record drawings shall be furnished by the Contractor for each ship.

Full use of existing drawings shall be made. The Contractor shall make revisions to these selected record drawings as necessary to reflect approved changes.

Drawings covering the following items shall be designated Selected Record Drawings:

Booklet of General Drawings

Docking drawings '

Running, signal, and anchor lights, and searchlights (location drawing) (Note 1)

Schedule of watertight integrity tests and inspections

Tank capacity curves

Booklet of Tank Sounding Tables.

Note 1: In lieu of separate drawings, running, signal, anchor lights, and searchlights, may be incorporated in the antenna or rigging arrangement drawings.

Preparation. Drawings and Booklets of General Drawings shall be inked or photographically reproduced on cloth or polyester film. Bach drawing shall show the official number of that ship only. Separate NAVSHIPS drawing numbers shall be assigned to each drawing for each ship.

Approval and marking. - All drawings will be examined by the Supervisor. When found to be correct they shall be stamped or marked SELECTED RECORD DRAWING adjacent to the title block. As, each drawing is completed, the last revision shall indicate that the drawing has been checked and corrected to show conditions actually existing on that ship.

1.0-1.4.11.7 Ship Drawing Index (S.D.I.)

General. - The Contractor shall prepare a separate S.D.I. for each ship, in tabulating card and tabular listing form using the Boeing Ship Drawing Index D312-80148-1. This list shall be revised to reflect approved changes.

Contents and preparation. - Working drawings, system diagrams, and selected record drawings having a NAVSEA drawing number and all manufacturer equipment drawings designated as certification data sheets, equipment drawing lists, and assembly drawings which list detail drawings, shall be included in the S.D.I.

Ships drawing index cards shall be prepared in accordance with Mil. Spec. MIL-M-38761/2 and shall be furnished by the Contractor. One tabulating card shall be prepared for each drawing applicable to the ship for which the S.D.I. is being prepared.

The Contractor shall maintain the S.D.I. tabulating cards up-to-date throughout construction of the ship. The cards shall be filed in numerical sequence according to their functional 3-digit consolidated index number,

The quality assurance provisions of Mil. Specs. MIL-M-38761 and MIL-M-38761/2 apply. In the event the Government inspects the cards and they do not meet those provisions, the cards will be returned to the Contractor who shall recheck the cards, eliminate all descrepancies, and resubmit the cards.

1.0-1.4.11.8 Microfilm

General. - The Contractor shall prepare one set of type I, class 1 (camera copy) microfilm and copies of type II, class 2 (diazo copy) microfilm in aperture cards of all drawings listed in the S.D.I.

Microfilm shall be revised to indicate the ship as delivered. The type I, class 1, microfilm will be used to prepare additional type II, class 2, kind N, (diazo copy) microfilm.

Prior to microfilming the Contractor-furnished equipment drawings, the Contractor shall request NAVSEA, via the Supervisor, to furnish one set of type I, class 1, microfilm, in aperture card form, of applicable Government-furnished equipment drawings. This microfilm shall be combined with the Contractor set of type I, class 1, microfilm and forwarded to the NAVSEA designated activity.

Provide a set of tabulating cards punched and interpreted for each frame of microfilm produced under the above paragraphs.

Provide a punch card accounting machine (PCAM) tabular listing, in drawing number sequence, of the set of aperture cards furnished.

Aperture and tabulating card formats. - The Engineering Data Tabulating Cards, NAVSHIPS FORM 9020/27 of Mil. Spec. MIL-M-38761/2 shall be provided. Dual Purpose Document Cards (aperture) shall be prepared in accordance with MIL-STD-804.

Security classification. - The security classification of each complete roll of microfilm, prior to mounting in aperture cards, shall correspond with the highest classification marking indicated on any of the drawings contained on that particular roll. Rolls of microfilm containing all drawings which are unclassified shall show no security marking. Title targets indicating the appropriate security classification shall be inserted as the first and last frame of each classified roll of microfilm.

In addition, the applicable security warning note shall be added in accordance with Mil. Spec. MIL-M-9868. Microfilm mounted in aperture cards shall be protected as specified in Mil. Spec. MIL-M-38761/2.

Quality assurance provisions, inspections, marking of microfilm and other data. - Quality assurance provisions, inspection, packing and marking shall be in accordance with Mil. Spec. MIL-M-9868/1 and MIL-M-38761/2.

The Contractor shall maintain the microfilm in aperture cards and the associated tabulating cards with corrections completed of all drawings through the guarantee period.

1.0-1.4.11.9 Onboard Drawings

General. - The Contractor shall be responsible for the preparation of onboard drawings.

One set of type II, class 2, kind N of Mil. Spec. MIL-M-9868 microfilm in aperture cards, of all drawings listed in the S.D.I., and all final manufacturer equipment drawings of Contractor and Government-furnished equipment, shall be prepared (See 1.0-1.4.11.8) for each five ships, suitably boxed for delivery to the MLSG. Berthing data, closure, classifications, piping system schematics, required lubricants and lubrication fittings shall be included in the ships operation and Onboard Maintenance Manual. Updated aperture cards of revised drawings shall be furnished at the time of issuing the revised drawings. All drawings shall be revised and distribution completed 30 days prior to the end of the guarantee period. A copy of the S.D.I. shall be maintained to indicate the status of the onboard drawings, and the completed S.D.I. shall indicate those drawings furnished.

1.0-1.4.11.10 Booklet Of General Drawings General. - The Booklet of General Drawings shall be prepared.

1.0-1.4.11.11 Manufacturer Equipment Drawings. Prints of equipment drawings shall be provided by the Contractor to permit the Government to determine compliance with the applicable specifications and standards, and the adequacy of the component and its parts for the service intended.

Unless otherwise specified, drawings of all components shall be provided in sufficient detail to enable Naval ship and shore activities to reproduce parts without assistance from original suppliers.

The Contractor shall prepare or procure microfilm in aperture card form, in accordance with paragraph 1.0-1.4.11.8, of all final Contractor-furnished equipment drawings required for installation, maintenance and repair.

1.0-1.4.12 Curves Of Form, Cross Curves Of Stability, And Bonjean Curves MOD 7

Curves of Form, Cross Curves of Stability, and Bonjean curves shall be prepared by the Contractor, and adjusted as necessary to reflect changes in the molded offsets, free-flooding spaces, or external fittings and appendages which may occur during the construction period. A three part drawing shall be prepared. The curves shall be in metric units. Part 1, the curves of form, relates the ships draft to various naval architectural quantities, such as: displacement, the center of buoyancy (VCB, LCB), the transverse metacenter (KM), the moment to trim 1 cm

(MTCM), the tons per cm immersion (TPCM) and the longitudinal center of flotation **(LCF),** and shall cover the anticipated draft range. Both the foils up and foils down conditions shall be included. Part 2, the cross curves of stability, relates the ships displacement to the righting arms at various angles of heel and shall cover the anticipated displacement range. Both the foils up and foils down conditions shall be included. Part 3, the Bonjean Curves - plot of areas from the keel to the bulkhead deck at stations shown on the Lines drawings. Only the foils up condition shall be included. 4 table showing the volume and location of the center of buoyancy for each appendage (both positive and negative) shall be included along with the Bonjean Curves.

Curves of Form, Cross Curves of Stability, and Bonjean Curves shall also be prepared, as described above, after the taking of as-built hull offsets as required by Section 1.0-1.2. HMR 121

1.0-1.4.13 Not Used.

1.0-1.5 ENVIRONMENTAL REQUIREMENTS

1.0-1.5.1 External Environments

The ship system shall be designed for operation in accordance with other requirements of this specification in the marine and external environments specified below:

(a) Minimum air temperature for design of equipment in exposed locations: $-29^{o}C$ ($-20.2^{o}F$) with concurrent wind velocity of 60 knots, 6 meters (19.7 feet) above the waterline.

(b) Minimum air temperature for design of heating system: $-15^{o}C$ ($+5^{o}F$).

(c) Maximum air temperatures: $+38^{o}C$ ($100.4^{o}F$) and concurrent 65 percent relative humidity for design of the air-conditioning and ventilation system.

(d) Seawater temperature: $-2^{o}C$ ($+28.4^{o}F$) minimum, $+29^{o}C$ ($84.4^{o}F$) maximum.

1.0-1.5.2 Induced Environment

All equipment and machinery shall operate satisfactorily under all conditions of motion, oscillation, and other induced environments caused by ship operation from calm water through the design sea state on all headings and at all speeds in either the hullborne or foilborne modes, including transition. MOD 1

1.0-1.5.2.1 Noise. Noise levels at work and living stations shall not exceed those specified in Table 1.0-1, PHM Noise Level Requirements, under the following conditions:

(a) Foilborne or hullborne engines operating at cruise power.

(b) Heating, ventilation, air-conditioning and split electrical power plant operation appropriate for battle conditions with the attendant closures properly set, shall be operating.

1.0-1.5.2.2 Vibration. Vibration levels within manned compartments with ship operating per the conditions of paragraph 1.0-1.5.2.1 in the calm sea shall not transmit wholebody vibrations to personnel in excess of those specified in Figure 1.0-1 (PHM Vibration Requirement Manned Compartments), for an 8-hour time duration. In the case of multi-directional vibration, each direction is to be evaluated independently with respect to the limits presented. Where wholebody vibrations of the human operator or parts of his body are not a factor, equipment should be designed so that oscillations will not impair human performance with respect to control manipulations or the readability of numerals or letters. Such equipment shall be designed to preclude vibrations in the shaded area of the upper curve of Figure 1.0-1. MOD 6

The ship and all ship components shall be free from excessive vibration. Vibration is excessive when it interferes or threatens to interfere, with the proper operation of any ship component.

Any unsatisfactory conditions resulting from the excitation of a resonant frequency in any equipment by any exciting force shall be corrected by local stiffening of

TABLE 1.0-1 PHM NOISE LEVEL REQUIREMENT

ALLOWABLE AIRBORNE NOISE LEVELS - db RELATIVE TO 0.0002 dyn/cm^2

	OCTAVE BAND CENTER FREQUENCIES, HERTZ								
	32	63	125	250	500	1000	2000	4000	8000
CIC Pilothouse Communications Room 1	90	84	79	76	(SIL REQUIREMENT)			69	68
EOS Staterooms Office's Bunk Room Crew Berthing Mess Room Galley CPO Living Space	90 to 94 4	84 to 91	79 to 89	76	73	71	70	69	68
WC & SH & WR	90 to 100 4	84 to 97	79 to 94	84	82	79	78	75	74
Machinery Spaces Except for Foilborne Enclosures	119	120	121	111	108	110	117	115	115

1 Teletypewriter not operating.

4 The exact value for the noise requirement, within this spectrum, will be the highest values measured in the listed spaces on the first production configuration PHM.

NOTES:

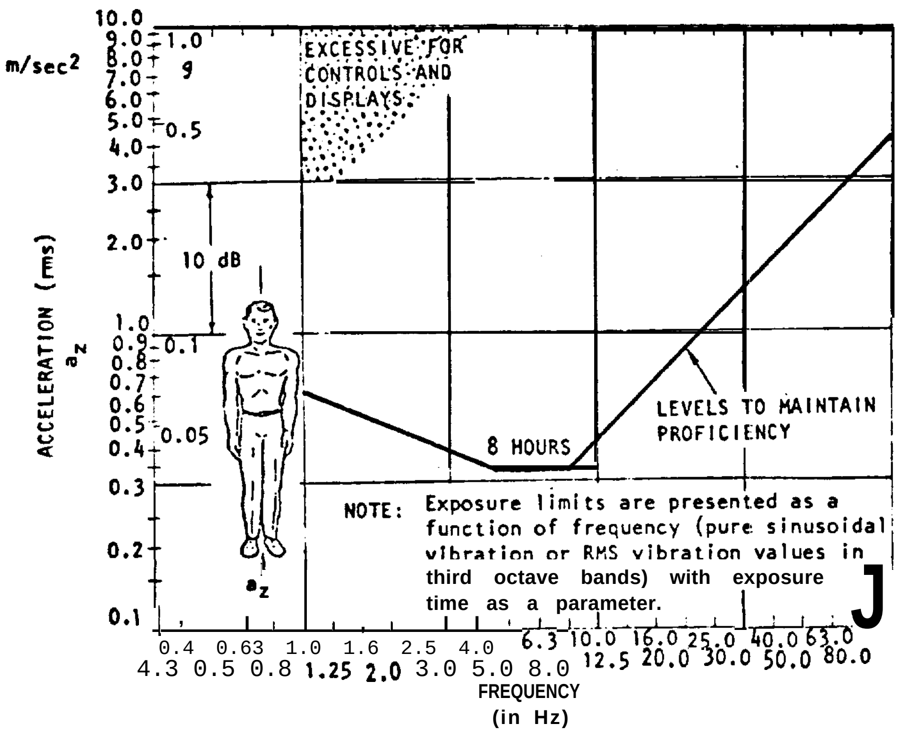
(1) Speech Interference Level (SIL) is the measure of the effect of airborne background noise on intelligible speech. Numerically, it is the arithmetical average of sound pressure level, in decibels, in the octave bands with center frequencies of 500, 1000, 2000 Hz. The SIL requirement is 64 db maximum.

(2) Noise requirements apply at head level of seated positions at the pilothouse and engineering operating stations. Noise requirements apply at head levels of each sleeping crew member in the berthing areas. Noise requirements apply at head level of seated positions in the Mess Room, Staterooms, and WR, WC and SH.

(3) Noise requirements apply at head level of standing positions in the Galley. In other areas the requirements apply at the geometric center of the space.

(4) Main engine room and auxiliary engine room allowable noise levels permit a maximum exposure time of 2 hours within 24-hour period provided that ear muff protection is worn. Without protection these levels are hazardous to hearing. Suitable warning plates shall be posted at entrances to and throughout compartments where other than unlimited exposure with no ear protection is allowed.

(5) The noise level in any one octave band may exceed 'the requirement by 2 db. HMR 101



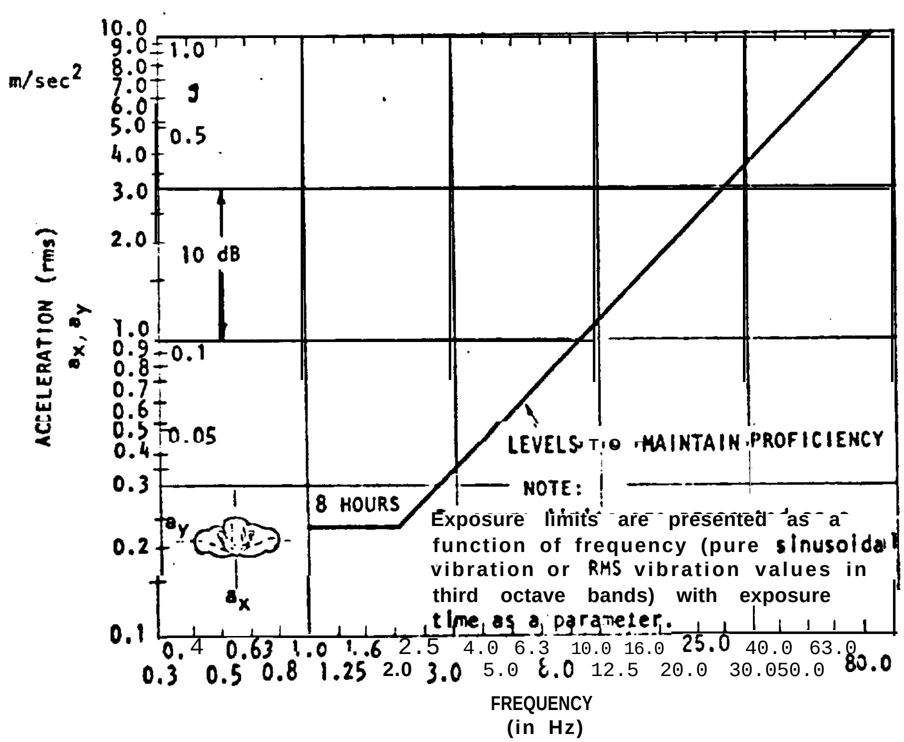


FIGURE 1.0-1 PHM Vibration Requirement Manned Compartment

structure, installation of suitable mountings, modification of components, or other effective means. Means to prevent excessive vibration during normal ship operating conditions shall be incorporated in the construction of the ship.

Where braces must be employed to afford stability under vibration, the braces shall be designed to fail under a load caused by a force not greater than five times the weight of the unit. This load shall be assumed to be acting at the center of gravity of the unit.

Hull foundations, supports for equipment, and components shall be designed for satisfactory operation for all operating conditions.

All equipment and machinery shall comply with MIL-STD-167B, in accordance with Table 1.0-2.

Means shall be provided to prevent rattling of removable plates, ladders, gratings, and similar items.

1.0-1.5.2.3 Temperature. The compartment. temperature shall be controlled in accordance with Section 1.512.

1.0-1.5.2.4 Humidity. The compartment humidity shall be controlled in accordance with Section 1.512.

1.0-1.5.2.5 Ventilation. Compartment ventilation shall be in accordance with Section 1.512.

1.0-1.5.2.6 Attitude. Equipment and machinery shall operate satisfactorily to maintain satisfactory lubrication, and to avoid loss of oil from machinery or hydraulic systems under the following conditions:

(a) Permanent Trim - 5 degrees maximum down by bow or stern
(b) Permanent List - 15 degrees maximum, to either side
(c) Momentary Pitch - 15 degrees maximum for 6 seconds, up by bow or stern. Foil retraction/extension system is excepted

TABLE 1.0-2 EQUIPMENT VIBRATION

(MIL-STD-167B Type)	Applies To	MIL-STD-167B Requirement	PHM Application
I. Environmental	Equipment and Machinery	Test to frequencies given in MIL-STD-167B, Table 1.	All machinery and equipment units shall be designed to meet the requirements of MIL-STD-167B, Type I vibration. All machinery and equipment units shall be tested to the requirements of MIL-STD-167B, Type I vibration except those exempted under exemptions below.
II. Self-Induced	Rotating Machinery	Test and-Balance	MIL-STD-167B, Type II applies to all rotating machinery.
III. Torsional	Propulsion Systems and reciprocating machinery	Analysis and Test*	Propulsion systems, and all reciprocating machinery
IV. Longitudinal	Propulsion Systems	Analysis	Investigation for existence of excitation. If such is present, MIL-STD-167B, Type IV applies.
V. Lateral	Propulsion Shafting	Analysis	Propulsion Systems

* Based on results of analysis, the torsiograph test may be waived.

TABLE 1.0-2 EQUIPMENT VIBRATION (Continued)

EXEMPTIONS:

1. Units weighing more than 4,536 Kg (10,000 lbs.) or of unusual shape or size which are impractical to test on available testing machines. Integral components of such equipment shall be tested where possible. Units authorized for exception from testing shall be designed to withstand the test.

2. Units previously qualified per MIL-STD-167, Type I.

3. Test equipment and equipment for dockside use only.

4. Miscellaneous equipment which has been previously tested in accordance with requirements specified in applicable specifications, e.g., commissary space equipment, laundry space equipment, garbage and trash disposal equipment.

5. Units previously designed and tested per MIL-STD-810B of 15 June 1967, Method 514, Procedure I.

6. Commissary equipment which has never been formally qualified but has demonstrated satisfactory MOD 2 performance in the vibration environment of the PBM-1 lead ship.

7. Units not in the above categories which the Government has exempted from the test requirement. Such exemptions will be considered providing the Contractor identifies each equipment and submits a detailed rationale for the exemption request. For units impractical to test while fully loaded, consideration will be given to waiving the equipment loading requirement during testing provided the units are subjected to simple rotation.

(d) Momentary Roll - 45 degrees maximum for 10 seconds, to either side. Foil retraction/extension system excepted.

Exceptions to the above shall be the foilborne propulsion system which shall be capable of operating as follows: Exceptions (e) and (f) shall also apply to the distiller and refrigeration machinery.

(e) Momentary Roll - ± 30 degrees for 30 seconds, ± 20 degrees for 2 minutes

(f) Momentary Pitch - ± 10 degrees for 10 seconds

(g) Permanent Trim - 5 degrees bow up to one degree bow down

(h) Permanent List - 5 degree maximum to either side

The hullborne diesel engines shall meet requirements (a) through (c) and shall be capable of meeting performance requirements under a roll of 30 degrees maximum, to either side, for ten seconds. HMR 4

1.0-1.5.2.7 Electromagnetic Radiation. The Command and Surveillance Suit shall not induce electromagnetic radiation greater than as specified in Section 1.407.

1.0-1.5.2.8 Electromagnetic Interference. The functions of all electronic equipment shall be influenced neither in single function nor in the dominating system function in such an amount that the specified tolerances of performance are exceeded.

(a) Equipment shall be grounded and bonded for EM1 reduction and safety to personnel in accordance with the requirements of MIL-STD-1310.

(b) Equipment shall meet the requirements of MIL-STD-461A and MIL-STD-462 on a selective basis. The selection of equipment, limit deviations, and extent of compliance, shall be made by the Contractor and approved by the Government.

(c) EM1 controls for cable routing, cable shielding, and shield terminations shall be handled in accordance with appropriate sections of the approved EMI Plan D312-80317-1, EMC Control Plan for Production PHM. HMR4 HMR 19

(d) Electrical equipment and sub-systems installed onboard shall be tested in accordance with the procedures specified in MIL-STD-1605 (SHIPS) procedures for conducting a shipboard electromagnetic interference survey (Surface Ship).

(e) An EM1 Control Plan must be prepared covering EM1 Control Program for production PHM's. HMR 19

1.0-1.5.2.9 Resilient Mountings. Resilient mountings on machinery shall be used when they are required to reduce vibration and noise to the allowable levels specified by paragraphs 1.0-1.5.2.1 and 1.0-1.5.2.2.

Mountings. Resilient type. Mountings, if required, shall comply with Mil. Specs. MIL-M-17191, MIL-M-17508, MIL-M-19379, MIL-M-19863, MIL-M-21649, *or* Drawing, NAVSHIPS No. 810-2145600, as applicable. The equipment listed below makes use of the resilient mounts shown. These mounts are in use on PHM-1 and shall be used on production ships. MOD 2 & 6

Foilborne Engine and Exhaust Collector	201-4597703	
Foilborne Propulsor	201-4597713	
CIC Cabling	SL2751-3S(Shur-Loc Corp.)	HMR 143
SSPU	300-4597383	
ECS Shock Isolators	28015-l (Barry)	
ECS Fans	A43-051 (Barry)	
ECS Fans	A22-031 (Barry)	HMR 133
Diesel Engine	Part of MB8V331 T081	HMR 55
Air Conditioning Fans	Part of 7424.00201 Part of 7424.00101	HMR 133

Selection of mountings and design of the mounting arrangement shall be such that when any of the six natural frequencies corresponding to the rigid body mode of vibration of the installed unit falls within the frequency range of propulsion plant excitation, the frequencies shall not also coincide with hull criticals or the natural frequencies of its foundation.

Mountings shall be used only for the specified application, or, where approved, for machinery and equipment which fail to meet noise or vibration requirements.

All resiliently mounted equipment shall have flexible connections.

Reports No. DTMB 880 of February 1958, and No. DTMB 1480 of January 1961, may be used as guides for the selection and application of resilient mountings for shipboard equipment.

Mountings shall not be used where the temperature at the mounting exceeds 51.7 degrees C (125 degrees F) without prior NAVSEA approval. MOD 7

All units installed on resilient mountings shall have sufficient stability to prevent excessive motion under all ship motions.

Sufficient clearance shall, be provided to prevent the unit from striking structure, adjacent fixed or resiliently mounted units, or other fixed objects during maximum deflections of the unit. The portions of piping rigidly attached to a resiliently mounted unit and extending to the flexible connection shall be considered as integral with the unit.

Maximum deflection of the resilient mountings which can be expected are as follows :

MIL-M-17191 -25.4 mm (1 in.) in any direction along a principal axis.

MIL-M-17508 - 31.75 mm (1-1/4 in.> in any direction along a principal axis 28.58 mm (1-1/8 in.) for type 6E100 and 8E150 mounts).

MIL-M-19379 - 25.4 mm (1 in.) in the axial direction, 15.88 mm (5/8 in.> in the radial direction.

MIL-M-19863 31.75 mm (1-1/4 in.> in any direction along a principal axis 19.05 mm (3/4 in.) when auxiliary snubbers are used).

MIL-M-2 1649 - 22.23 mm (7/8 in.> in the axial direction, 15.88 mm (5/8 in.) in the radial direction.

Resilient elements shall not be painted.

All welding *or* flame cutting in way of mounting shall be finished before installation of the mountings.

The date that mountings are installed shall be stamped on metal parts adjacent to mountings identification data, and shall be visible without removing the mounting from its installed position.

Resilient mounts shall have a shelf life of seven years and shall not be installed after this date per NAVSEA instruction 9110.62A of October 4, 1972.

If, in an installation required to be MOD 7 placed on resilient mountings, there is a possibility of misalinement between two or more components connected by shafting, the components shall be mounted on a common subbase with the resilient mountings installed between the subbase and the ship structure. The subbase shall be of sufficient strength to prevent misalinement of the attached units when the, subbase is rigidly supported at three extreme corner points.

Distributed Isolation Material (DIM).- "Pad type" mountings of distributed isolation material (DIM) shall be designed into the ship and employed where specified elsewhere herein, and otherwise may be used if suitable for the service. The DIM shall be "Isomode" manufactured by MB Electronics co., Inc., "Fabcel" manufactured by Fabreeka Products Co., or equal. DIM shall be selected based on its successful completion of environmental performance testing under Mil. Spec. MIL-M-17185 simulating the environment for the shipboard application, on its ability to attenuate noise and vibration in the equipment operating frequency range, and to avoid objectionable vibration amplification outside this range.

DIM shall be loaded to the degree specified by the manufacturer *for proper* isolation and shall be provided with means to prevent excessive loading resulting from overtightening of mounting bolts. **Bolts** shall have bushings of material similar to the DIM or neoprene "O"-rings to prevent metal-to-metal contact.

Mounting drawings. Whenever resilient mountings are installed, the type and quantity of these mountings shall be listed in the bill of material on the installation drawing and the following information shall be shown on a drawing under the heading "Mounting Installation Design Data": HMR 7

HMR 7

Speed range of the mounted unit.

Total weight of the mounted unit in the operating condition. This shall include the weight of the subbase, fluids, piping and any other weight that may contribute to loading of the mountings.

Location of the center of gravity of the mounted unit in the operating condition.

The moments of inertia and products of inertia of the mounted unit in the operating condition about three mutually perpendicular axes with the origin at the center of gravity of the mounted unit and the orientation of the axes indicated with respect to the equipment and the ship.

The six natural frequencies of the mounted unit in the operating condition.

List of assumptions made in calculating the natural frequencies.

1.0-1.5.3 Shock Environment

All shipboard equipment shall not be damaged and shall be capable of operation while subjected to only the following shock loads:

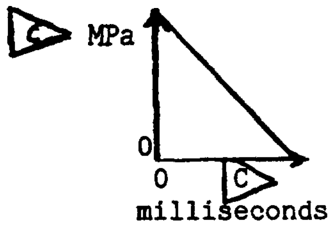
(a) Firing of 76 mm gun, including recoil forces and the shock motions from gun blast induced shock, obtained by calculating dynamic response of weather decks and bulkheads in the vicinity of the gun.

(b) Wave impacts, in design head seas, with the ship operating in the foilborne mode at design speed, with dynamic loads as specified in Boeing Document No. D312-80100-1 as modified by Section 1.566.1, MOD 4 using analysis techniques as specified in Boeing Document No. D312-80144-1, as modified by Section 1.100-2.

(c) Selected ship elements shall be designed in accordance with Boeing Document D312-80100-1 as modified by Section 1.100-2 and 1.566.1 and to be capable of sustaining effects of underwater explosives (UNDEX) while foilborne as described *below.* Plastic deformation is acceptable if it is controlled in the design such that disabling damage will not result. MOD 4

1. All struts and the strut/hull interfaces shall be capable of withstanding a static equivalent load of g vertical, without plastic deformation.
2. Operating equipment, mechanisms, and components of the foils, pods, and struts (including all of the struts except the hull/strut interface) shall be capable of withstanding the following:
   (a) A g static equivalent acceleration and the resulting structural deflections for attachments and foundations.
   (b) Equipment/component tests (actuators, etc.) to the loads defined by *a* velocity shock spectrum defined by mm deflection, meter/see velocity, and g acceleration for the frequencies shown in Figure 1.0-5.
3. All air backed structure, which is underwater during foilborne operation, shall be capable of withstanding (without collapse or **severe** local permanent deformation), the

Deleted. See Addendum for Classified Data following free field water shockwave, from any direction.



4. In lieu of item 1.0-1.5.3(c)3 above, the Contractor may provide for flooding with a fluid of not less than specific gravity, of all normally air-backed foil structure below the foilborne waterline. No air pockets shall exist in the flooded structure that would allow UNDEX shock wave pressures to significantly deform the structure.

NOTE: There are no UNDEX requirements for the ship as a whole, externally mounted transducers, nor for any machinery or equipment within the hull. MOD 3

1.0-1.6 INTEGRATED LOGISTIC SUPPORT

1.0-1.6.1 General Requirements MOD 2

The Contractor shall develop and implement an ILS Program under this contract that identifies the requirements herein of each logistics element, that integrates these requirements into a coherent program, and that assures the program's consistency with the Government-provided Plan for Use and Maintenance Concepts for the ship. The key element to be considered in developing requirements to satisfy these criteria is the concept of consolidated ILS utilizing a squadron vis-a-vis individual hull considerations. The

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Deleted. See Addendum for Classified Data extrapolation from a hull to a series of hulls (a squadron) is invariably logarithmic rather than geometric. Whenever an item furnished by the Government (GFE or GFI) is a part of a Contractor-furnished (CFE) system or equipment, the Contractor shall include the logistic support information provided by the Government in Contractor-prepared documents required for the system or equipment, regardless of whether the logistic support resources are provided by the Government or by the Contractor.

1.0-1.6.1.1 Management. The Contractor shall establish and carry out an ILS Program implementing the ILS requirements specified herein and assuring that ILS products comply with the contract requirements for that product. He shall provide an ILS Plan to include the Contractor's procedures for implementing ILS requirements. This ILS Plan shall include the ILS planning approach, major ILS work statements, a plan to control ILS activities of vendors and Subcontractors, and provisions for NATO logistic support. Guidance relative to organization and content is contained in NAVSEA ILSP 079 Rev 0, NATO PHM ship ILS Program Management Plan. The Contractor shall revise this ILS Plan as necessary to assure its currency, e.g., updates of schedules and milestones of each applicable ILS element or change in procedures. The Contractor's ILS program shall assure: MOD 2

(a) that all ILS tasks to be performed are identified in terms of the steps required to accomplish the contract requirements,

(b) that these tasks are, in fact, being carried out

(c) that schedules for accomplishing ILS tasks fulfill requirements during the ship design and production phases

(d) that procedures for controlling the ILS activity of vendors and Subcontractors are identified and being carried out

(e) that all ILS products to be provided by the Contractor are being developed and will be available for scheduled delivery,

(f) that data and recommendations emanating from the Maintenance Engineering Analysis performed in accordance with the detailed requirement herein are incorporated into the applicable logistic element documentation such as technical manuals, MIP/MRC's, and provisioning technical documentation, and

(g) that the ILS Plan include provisions to updating Boeing Document No. D312-80255-1 for Contractor-furnished equipment (CFE) for inclusion in PHM 3 Transition Plan (See Section 16, NAVSEA ILSP 079).

1.0-1.6.1.2 Integrated Logistic Support Management Team (ILSMT). The purpose of the ILSMT is to manage and direct the Contractor/Government actions necessary for timely achievement of ILS requirements. The Contractor (or his authorized agents) shall attend and participate in meetings of the ILS Management Team as scheduled by NAVSEA PMS 303's ILS Manager. As an ILSMT member the Contractor shall propose agenda items, be prepared to discuss any and all agenda items, receive meeting minutes, and develop data and reports for succeeding meetings. MOD 2

1.0-1.6.1.3 System Design and Support Interface. The Contractor shall establish and incorporate into his ILS Program and implementing ILS Plan, a review of the ship's engineering design, including changes from the PHM- 1 design, for interfacing functions specified in NAVSEA ILSP 079 REV 0. This review shall address the impact of the following disciplines on ILS: Reliability/Maintainability, Human Factors, Safety, Standardization, Quality Assurance (of ILS documentation), Configuration Management, Life Cycle Costing, and Design Accessibility. The results of this review will be integrated into the appropriate ILS functional data base.

1.0-1.6.2 Maintenance

1.0-1.6.2.1 General. The overall ship design requirements established by this specification dictates the maintenance philosophy for the PHM. The key elements are: the constraint placed on **shipboard-at-sea** maintenance by personnel, and weight limitation required to conform to U.S. Plan for Use dated 15 December **1971.**

1.0-1.6.2.2 Maintenance Concepts

(a) All normal shipboard maintenance actions performed by the crew (organizational level) will be capable of being completed with standard hand tools, portable test equipment **onboard** and/or built-in test equipment. Repair tasks primarily will be remove and replace actions. MOD 2

(b) All preventive maintenance actions other than the daily operating and care inspections will be accomplished by the maintenance team of the **MLSG** with assistance from the ship's crew and should not be required more than once every five days (normal mission duration).

(c) Availabilities for Intermediate level maintenance and repair normally will be scheduled approximately once a month and once each 3 months as outlined in the PHM Plan for Use.

(d) Refurbishment and overhaul will not be required more frequently than once each 1.5 years. Maintenance schedules for individual pieces of equipment should be compatible with the above cycles. MOD 2

1.0-1.6.2.3 Maintenance Requirements. There are three levels of maintenance for the PHM. These levels of maintenance are:

(a) Organizational - Performed **onboard** by the ship's crew;

(b) Intermediate - Performed by Mobile Logistics Support Group (MLSG) personnel onboard the PHM or a tender, or at a shore station; and

(c) Depot - Performed at a shipyard, overhaul depot, or at a Contractor's plant.

Provisions for both scheduled and unscheduled maintenance will be provided at each level, commensurate with complexity and force availability requirements.

Care and preventive maintenance shall normally not be required more often than once every 5 days and with a capability to satisfy tactical emergencies by an extension to 7 days without damaging consequences. All scheduled preventive maintenance shall be based upon the 5-day mission cycle. All newly designed PHM ship subsystem equipment shall be capable of simple repair. The mean time to repair for all organizational level corrective maintenance shall not exceed 2.0 hours for 90% of all repair actions including the time required for troubleshooting and disassembly, using the tools and test equipment onboard ship or the MLSG as appropriate.

Equipment requiring corrective maintenance shall be replaced unless the time required for replacement exceeds the time required for repair in place by greater than 33%. The time required for removal and replacement includes operational checkout of the item requiring maintenance, and the removal and replacement of interference items (including their checkout to a full operational status). The personnel assumed available to complete the removal and replacement or repair in place shall be that available from the ship's crew and the MLSG.

1.0-1.6.2.4 Plan For Maintenance. The Contractor shall prepare for Government approval a Plan for Maintenance (PFM) in accordance with the CDRL (AO2W) and the "Progressive Overhaul" concept. The PFM narrative shall address the "Progressive Overhaul" concept and the maintenance periods by incorporating the following in the Introductory section of the document. MOD 2 HMR 181

"Progressive Overhaul"

"Progressive overhaul is characterized by work segmentation, scheduling, selected restricted availability (SRA), and intermediate maintenance availability (IMAV).

The implementing document for progressive overhaul is the Class Maintenance Plan (CMP). This book consists of a set of preplanned maintenance actions performed during IMAVs and SRAs over a period of time, leading to a complete overhaul of the ship and its component systems. Under this concept, the ship and its equipment will be undergoing continuous overhaul. Some systems will be beginning a cycle of maintenance actions, and others will be just completing overhaul at any given point in the ship's maintenance schedule. Progressive overhaul is designed to maintain the ship at a high level of readiness and increase the availability of the ship for required operations.

A key feature of progressive overhaul is that each equipment selected for maintenance during an IMAV or SRA is removed and replaced or restored to such condition that satisfactory performance can be expected until the next scheduled maintenance action.

There will be no time when the ship, inclusive of all equipments, will be in a completely restored or "just overhauled" condition. Under progressive overhaul, the material readiness of the ship will be kept at a consistently high level rather than be subjected to peaks and valleys created by long periods between conventional overhauls."

"Maintenance Cycles"

"The Class Maintenance Plan (CMP) will be implemented by regularly scheduled availability periods for each maintenance level. A PHM may be assigned five maintenance periods defined as follows:

1. The Post Operational Inspection and Maintenance period is an eight hour period after each sortie during which PMS is conducted and corrective maintenance is accomplished to repair minor failures which occurred during the sortie. HMR 181
2. An upkeep period is scheduled by the Type Commander to be an inport period dedicated to PMS and accomplishing minor deferred maintenance and required corrective maintenance. The upkeep period is normally two days duration and scheduled 14 times each year after equivalent operating periods.
3. Restricted Availability (RAV) periods are assigned to accomplish specific major repairs which cannot be postponed to the regular upkeep periods and which would seriously impair performance if not accomplished. An RAV may also be assigned by the Type Commander, prior to an extended deployment away from homeport, to correct major material during the predeployment material inspection.
4. <u>SRA</u>. To maintain the level of material readiness that is planned in the progressive overhaul concept, an upkeep period of approximately 8 weeks will be scheduled every 2 years. This period is called SRA. It differs from the conventional regular overhaul in the duration of the period and in the requirement for stringent advance planning of the scope of work to be accomplished.
5. <u>IMAV.</u> Every 3 months between SRAs, an upkeep period of approximately 2 weeks will be scheduled at an Intermediate Maintenance Activity (IMA). Normally there are 6 IMAVs between SRAs. Requirements similar to SRA planning exist for advance planning of the scope of work to be accomplished. The IMAVs are conducted by the MLSG."

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The "Progressive Overhaul" concept and the maintenance periods described in the Class Maintenance Plan (CMP) and in NAVSEA-ILSP-079-3 REV A W/CH-1 (23 August 1979) shall not be imposed upon the MEAs, MRC/MIPs, or other ILS documentation or tasks which are produced or conducted per this specification. All tasks, other than the PFM, shall be accomplished in accordance with the maintenance concepts defined in 1.0-1.6.2.4(a) below and using Boeing Document No. D312-80258-1 as the baseline.

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(a) Maintenance concepts. - The production PHM maintenance concepts shall retain the essential elements of the U.S. Navy PHM Plan for Use dated 15 December 1971 and the ILSMP for PHM. They shall be consistent with Section 1.0-1.6.2.2 herein.

(b) Levels of Maintenance. -Maintenance planning shall include maintenance for Organization, Intermediate, and Depot levels.

(c) Maintenance Engineering Analyses (MEA). - The Contractor shall update existing MEA's in accordance with MIL-M-24365A, as may be modified to accommodate Electronic Data Processing, on approved PHM equipment/components. New equipments shall be subject to MEA using the criteria contained in Boeing Document D312-80258-2, PHM-3 Plan for Maintenance. The MEA process shall include the following: MOD 2 HMR 109R1

1. Provisionsforincludingthedata developed to meet the requirements of Section 1.0-1.4.5 (R&M) herein.
2. Integration of relevant CFE as listed in schedule "A" of the contract in the total PHM MEA process. HMR 109R1
3. Integration of MEA's into the PHM equipment design and procurement process.
4. The Contractor shall review all design changes involving new or modified equipment previously subjected to (Level of Repair) LOR/MEA. Whenever a significant data change is indicated, the Contractor shall submit such updated data to the Government.

(d) In Process Review. - The Government shall conduct in-process reviews of Maintenance Engineering Analysis and Provisioning to determine the need for changes to existing MEA's developed under Contract N00024-73-C-0257. The Contractor shall provide MEA work-sheets, provisioning lists, engineering data, and available technical manuals to support such reviews. The Contractor and his vendors shall make technical representation available, upon request, to support this review process.

(e) This paragraph number intentionally not used. MOD 6

(f) Planned Maintenance Subsystem (PMS). - The Contractor shall develop, update, and revise the Planned Maintenance Subsystem (PMS) for CFE in accordance with Chapter 4 of NAVSHIPS 0900-039-1010A. The Contractor shall review Maintenance Requirements Cards (MRC's) and Maintenance Index Pages (MIP's) appropriate to approved ECP's and revise MRC/MIP's as may be needed. The Maintenance Engineering Analysis (MEA) shall form the principal data source for development and revision of the Planned Maintenance Subsystem requirement. The Contractor shall provide copies of the PMS for all CFE in accordance with the CDRL. MOD 2

(g) Component Repair and Overhaul. - The Contractor shall recommend components for inclusion in the Component Repair and Overhaul (CR&O) Program in accordance with the CDRL. Items nominated by the Contractor shall be those that the Contractor believes to be sufficiently complex that additional skills, training, support and test equipment, facilities or technical data must be acquired concurrently to assure repair/rework capability for support of the PHM. MOD 6

1.0-1.6.3 Support and Test Equipment (S&TE)

1.0-1.6.3.1 General. The Contractor shall prepare and provide a support and test equipment list identifying the special and general purpose support and test equipments required at the organizational, intermediate, and depot levels for proper operation, test, and repair of all CFE. This list shall be prepared and delivered in accordance with the CDRL. The Contractor in the development of this list will ensure consistency with Section 1.0-1.6.2 Maintenance Planning. Particular attention will be given to the concept of "Squadron" support. When selecting S&TE the Contractor shall select equipment in this order:

(a) Standard items in Navy Inventory
(b) Standard items in DOD Inventory
(c) Modification of Standard Items
(d) Commercial off-the-shelf items
(e) PHM Peculiar.

The Government shall determine the support and test equipment required for GFE and shall provide a listing of such equipment to the Contractor. The Contractor shall include this listing in the support and test equipment list.

1.0-1.6.3.2 General Purpose Support and Test Equipment. The publications, Test and Equipment Application Guide, NAVSEA 0969-019-7000, and the Industrial Plant Equipment Handbook, DSAH 4215.15, list support and test equipment already in use within the DOD. The Contractor shall use these publications as basic guides to what is general purpose support and test equipment and shall select such general purpose equipment for use with CFE whenever the general purpose equipment will perform required tasks satisfactorily.

1.0-1.6.3.3 Special Purpose Support And Test Equipment. In addition to other special purpose test and support equipment, all gages, thermometers and thermocouples which are required for organizational maintenance or operation and which are not listed in the Catalog of Navy Material, NAVSEA 0941-047-3010, shall be considered special purpose support equipment. Concurrent with delivery/installation of CFE, the Contractor shall provide all special purpose support and test equipment, including test cables, accessories, and extender cards , required for organizational and intermediate levels of maintenance and operation of CFE. See, for example, Sections 1.290 Machinery Removal and Section 1.314, Power Conversion Equipment.

1.0-1.6.3.4 Calibration. The Contractor shall develop and provide calibration procedures and data for support and test equipment that he provides, as specified in the CDRL. Moreover, the Contractor shall assure that all support and test equipment he provides, whether delivered to or installed onboard the ship, is currently calibrated, ready for use, and carries an up-to-date calibration record:

1.0-1.6.4 Supply Support

1.0-1.6.4.1 General. The Contractor shall provide data, material and services to the Government in accordance with this section for the development of supply support for the ship and the MLSG. The detail and scope of such data and material shall be based on the Navy's supply support concept for the ship and be compatible with the maintenance concept, stated herein. This section specifies requirements for provisioning, development of the ship's PECI, spare and repair parts, fitting out, and monitoring the status of both provisioning and fitting out. HMR 7

Supply Support Concept. - The support concept that will be used to develop supply support for the ships under this contract is as follows:

(a) The ship(s) will carry sufficient Onboard Repair Parts (OBRP) to support its operations on five day missions.

(b) An MLSG will carry a stock of OBRP to replenish the shipboard OBRP and to support planned ship maintenance, its own support operations, and 90 percent of probable ship corrective maintenance for a 90 day period for six PHM ships. HMR 7

1.0-1.6.4.2 Definitions, Abbreviations, And Acronyms.

AAP (Allowance Appendix Page). - An allowance document developed by the SUPSHIP to be included in the Allowance Appendix Package to a ship's COSAL to state the authorized allowance of repair parts and equipage for an equipment or component not already covered by the ship's/MLSG load COSAL. It serves the same purposes as APLs/IOLs/AELs. It is complete in itself and, when a current APL/IOL/AEL is available for the subject equipment/component, may consist of an AAP cover sheet and the applicable APL/IOL/AEL. MOD 2

ACN (Activity Control Number). - Now NICN, Navy Identification Control Number.

ACL (Allowance Component List). - A listing of the maximum items that could comprise a system of a variable configuration, e.g. AN/USQ-20(V). The Government provides such lists to the Contractor who in turn identifies the particular equipments and components of a system planned for installation onboard a ship(s) under contract.

AEL (Allowance Equipage List). - Categorized listings of durable items authorized and required onboard a ship to support its assigned missions and crew, e.g. safety, life saving, towing, refueling, cargo handling and general messing. The listings include tools, special support equipment, test equipment, and non-installed equipage (See also "equipage").

APL (Allowance Parts List). - Coded listings of maintenance significant repair parts for specific shipboard equipment or components.

Asset Deck. - A series of keypunched and interpreted 80-column EAM cards that represent by line item the status of storeroom items and fitting out material for the ship under contract, e.g. on hand or due. in the Contractor's facilities. Coding on the cards shows whether the line item is Contractor-Furnished Material (CFM) or Government-Furnished Material (GFM).

CDRL. - Contract Data Requirements List.-

CFE. - Contractor-Furnished Equipment.-

CFM. - Contractor-Furnished Material.

CID (Component Identification Number). - An identifying number that the Navy Ships Parts. Control Center assigns to an equipment. See RIC.

COI. - Certificate of Identicality.

Common Support Equipment. - The support equipment currently in use to support systems and equipment of the Navy and the Department of Defense. See "Support" equipment.

Component (or unit). - An assembly or any combination of parts, subassemblies, and assemblies that are mounted together and normally capable of being operated independently in a variety of situations.

COSAL (Coordinated Shipboard Allowance List). - An official document prepared for a Navy ship and listing: the equipment and components required for the ship to perform its missions, the support equipment and repair parts required for test, operation, and repair of those equipment, and the miscellaneous portable items and consumables necessary for the care and upkeep of the ship itself. The COSAL is both a technical and a supply document, and it is prepared and issued by the Navy SPCC in three parts:

Part I is an index of equipments, components, and equipage tailored to a specific ship.

Part II is a display of the equipment APLs and the equipage AELs applicable to the ship.

Part III, Sections A and B, is consolidated SNSL of authorized repair parts and equipage listed in the APLs and AELs of Part II and of consumables that SPCC prepares and issues prior to the ship's contract delivery date.

CPS. - Certificate of Prior Submission.

DIDS (Defense Integrated Data System). - A centralized and automated data bank of descriptive, technical, and management data covering all items that the Government stocks or buys recurringly. It forms the basic file of the Federal Catalog System.

DLSC (Defense Logistics Services Center). - The activity in the Department of Defense that supervises and maintains the data file for items cataloged under the Federal Cataloging Program. DLSC assigns all NSNs.

EAM (Electric Accounting Machine). The term identifying the 80-column code punched and interpreted cards, processing machines, and processing procedures or systems.

Electronic/Ordnance Fire Control Systems Program Support Index (includes data formerly in ESO Publication No. 9). An index on microfilm of electronics/Ordnance equipments, by programs, that are supported by a Navy ICP. The index identifies the equipments by APL's, PAL's, ABL's, ACL's, and nomenclature and gives the Navy's method of support and degree of onboard support.

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Equipage. Portable materials and articles that make up the outfit of items authorized and required on board a ship for proper performance of its missions, e.g. bore scopes, damage control equipment, support equipment, tools, and safety gear. In naval usage only non-installed items of a durable nature are listed on AEL's.

FLSIP (Fleet Logistic Support Improvement Program). The Navy Program that establishes the criteria used to compute the allowed quantities of items listed in a ship's COSAL and AAP Package.

FMSO. U.S. Navy Fleet Material Support Office.

FOMIS (Fitting Out Management Information System). A management information program the Navy may use under a ship construction, modernization, or conversion program. It represents system/equipment configuration baselines, monitors the development of logistics support elements, and provides current status of the supply support and fitting out processes. The FOMIS baseline becomes the input for the ISNSL.

FRS. Fitting Out Management Information System (FOMIS) Requirements Statement. The contractual document by which the Government notifies the-contractor of the Specific FOMIS requirements applicable to the contract selected from available options in MIL-STD-1626.

FSCM (Federal Supply Code for Manufacturers). A five digit numeric code assigned under the Federal Cataloging System to identify the manufacturers which have produced or are currently producing items used by Government. The list of manufacturers and the code assigned to each is published in Cataloging Handbooks H4-1, H4-2, and H4-3.

GFE. Government-furnished Equipment.

GFI. Government-furnished Information.

GFM. Government-furnished Material.-

GFP. Government-furnished Property.-

GUCL (General Use Consumables List). The COSAL, Part III, Section E lists those general purpose consumable materials and non-durable items required on board a ship for upkeep and the performance of routine shipboard functions, e.g. soap, rags, rubber sheeting, and metal stock.

HM&E. Hull, Mechanical, and Electrical.

ICP (Inventory Control Point). An activity assigned to manage a segment of Navy inventory and to assure overall Federal Supply System support of assigned categories of equipments and components.

ISNSL (Incremental Stock Number Sequence List). An SNSL which contains a computed range and depth of Storeroom Items/Operating Space Items (SRI/OSI) at a designated point in time during the ship's construction, based upon the installed equipment/component or equipage population recorded in FOMIS at that designated time. Each ISNSL reflects separate range and depth of SRI/OSI requirements for Government-furnished and Contractor-furnished items and necessary supply and processing aids. Each subsequent ISNSL reflects the net difference in range and depth (increase or decrease) from the previous ISNSL totals submitted.

The final ISNSL is produced concurrently with the ships load COSAL.

LAPL (Lead Allowance Parts List). Navy master plans for homogeneous families of HM&E components. The upper part of a LAPL sheet provides engineering characteristics, in generic terms, of the component family. The lower part provides the nomenclature, in generic terms, of the parts and non-repairable sub-components in a family and displays maintenance codes for each listed item.

MCL (Maintenance Capability Level). A series of codes used in the "MAINT" column of an APL/LAPL to indicate the fleet's lowest maintenance echelon capable of installing an item or of repairing an equipment/component by using the item. The code's second digit indicates whether the item is a consumable or a repairable and the maintenance echelon authorized to repair it.

MIAPL (Master Index of Allowance Parts Lists). An index of all APL's for HM&E equipments and components. It cross-references CID numbers to equipment nomenclature, to (Government or Manufacturer) drawing number, to applicable technical manuals, and to the NSN.

Miscellaneous Allowance Parts List (APL) Item. A low cost or simple item that is documented in one of five ship system APL's, i.e. Machinery, Piping, Electrical, Electronics, and Hull Systems, rather than in the APL for a specific system/equipment or in a separate APL. Such items are characterized by their low probability of failure, their repair being accomplished with GUCL material, their replacement parts being readily obtainable from commercial sources or by the item's assignment of an Allowance Support Code (ASC) that specifies no supply system support. Such items were formerly called Non-APL Worthy Items or items on 89000 Series APLs.

MLSG. Mobile Logistic Support Group.

MLSS. Mobile Logistic Support Ship.

Modular Assembly or Module. An assembly constructed on the basis of a standard pattern or standard dimensions and capable of being easily joined to or arranged with other parts or units or into a next higher assembly.

MRU (Minimum Replacement Unit). The minimum quantity of an item required to effect a repair, considering the item's unit of issue, e.g. replacing the brushes in an electric motor usually requires more than one brush and the MRU would be the number to replace one set of brushes.

MSV. Mobile Support Van.

NSA. Naval Support Activity (i.e. Supervisor of Shipbuilding).

NSN (National Stock Number). A code number the Government. assigns to identify items of supply that it stocks or buys recurringly.

OBRP (On Board Repair Parts). Assemblies, subassemblies, and parts carried on board a ship for maintenance and repair of shipboard equipments and components.

PECI (Preliminary Equipment and Component Index). An index of a ship's configuration and a cross-reference list relating equipment RIC's (e.g. CID, APL/AEL numbers) of components, equipage, and support and test equipment to their service application on board ship. It identifies purchase order and purchase order item numbers for all equipments and components and cites applicable drawings and piece numbers. A ship's PECI is one source of data used to develop the ship's COSAL.

Provisioned Item. Any support-type item selected through provisioning procedures to support an end item of equipment. Support-type items include (but are not limited to) spares, and Contractor requirements for provisioning screening.

Provisioned Items Order. An unpriced order issued under a contract which sets forth the Government's requirements for provisioned items. (Provisioned items for which firm prices have not been established are procured by supplemental agreement or by separate contract.)

PTD. Provisioning Technical Documentation.

Reference Number. Any number, other than a Government stock number, used to identify an item of production or supply. An item of supply's reference number may be the same number assigned for production identification or may be combined with other reference numbers to identify conclusively the item of supply. Reference numbers include manufacturer's part, drawing, model, type, source controlling numbers, and the manufacturer's trade name ; specification or standard numbers ; specification or standard part, drawing, or type numbers, and circuit symbol numbers.

Repair Part. Any individual part, subassembly or assembly required for the maintenance or repair of an equipment or component.

Repetitive Use Parts. Parts having a predicted usage of at least once in 90 days.

RIC (Repairable Identification Code). The identifying code assigned to each repairable within each level of a system, equipment or component. It uniquely identifies a repairable to which something in a lower level is related, e.g. component to assembly. Some currently constructed and known RIC's are as follows: SPCC (ELEX)'s Cog 8N items use Equipment Identification Codes (EIC), SPCC (HM&E)'s Cog 1N items use APL numbers, and SPCC (HM&E)'s Cog 9N items use CID's.

SCAT (Sub-Category) Code. A series of 4-number codes (with an optional alpha suffix) that identify the test requirements of electronics equipments and the test equipments that satisfy the requirements. The codes are structured by functional categories and measurement parameters. All items of test equipment that are capable of satisfying a stated test requirement are coded alike. NAVSHIPS Publications 0900-001-2000 and 0967-088-9000 presents lists of test equipments satisfying each SCAT code.

SCL (Standard Component Listing). A listing of shipboard equipments and components that have become standard in use on board Navy ships. This list is provided Contractors for use in selecting standard equipment and components as CFM in lieu of non-standard ones.

Service Application Code. Codes used in a ship's PECI to identify the service in which a shipboard equipment or component is installed or used.

Spare. A support item that is coded to be repairable (i.e. Repairable Item).

SPCC (Ships Parts Control Center). The Navy ICP assigned program support responsibility for the following types of equipment and components: HM&E, Ordnance, special propulsion, electronics, (weapons) fire control systems, and electronic ground support. It maintains the ship's PECI, the FOMIS file (when used), and prepares and issues the COSAL.

SPETERL. Ship's Portable Electrical/Electronic Test Equipment Requirements List.

STEP. Ship Type Electronic Plan.

Support Equipment. Portable and transportable devices such as hand tools, jigs, fixtures and other accessories which are necessary to accomplish installation, repair, operation or overhaul of a prime equipment. Facilities and test equipment are excluded from this definition. Support equipment includes both special and

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general purpose types. The term "special" indicates that the item is required for a specific equipment type, while "general purpose" indicates that the item may be required for two or more equipments of basically different functional design.

System. A combination of two or more equipments which may be physically separated when in operation, and such other assemblies and parts as may be necessary which altogether perform an operation or function.

Test Equipment. Portable and transportable devices such as instruments and monitoring and checkout equipment used for inspection, diagnosis, measurement, or calibration of a prime equipment. Test equipment includes both special and general purpose types. The term "special" indicates that the item is required for a single specific equipment type, while "general purpose" indicates that the item may be required for two or more equipments of basically different functional design.

WEL. Weapons Equipment List.

Other definitions. As defined in **MIL-STD-1339,** MIL-STD-1375, and MIL-STD-1626.

1.0-1.6.4.3 Provisioning Requirements.

1.0-1.6.4.3.1 General. The Contractor shall provide PTD or an approved CPS/COI for repair parts and equipment related consumables, for CFE in accordance with the Provisioning Requirements Statement (PRS) and MIL-STD-1375 as supplemented by this specification. He shall update and resubmit such PTD whenever changes occur to previously submitted PTD. The exact reports, data, and other record material delivered shall be in accordance with the CDRL. MOD 6 MOD 2

1.0-1.6.4.3.2 PRS Conference. The Contractor shall participate in the PRS Conference which will be convened by the Naval Supervising Activity (NSA) within 90 days after contract award. The primary purpose of this conference is the exchange of information leading to a mutual understanding of the requirements, procedures, and schedules imposed by the PRS and this contract specification.

1.0-1.6.4.3.3 Other Supply Support Conferences. The Contractor shall participate in other provisioning conferences and FOMIS requirements conferences to the extent specified in the **Provisioning/FOMIS** Requirements Statements of the contract.

1.0-1.6.4.3.4 Provisioning Technical Documentation. For all CFE, the Contractor shall prepare PTD, or a Government accepted CPS or COI, for repair parts and equipment related consumables, in accordance with the following requirements. PTD shall be updated and resubmitted whenever variations occur. MOD 6

(a) HM&E and Ordnance Equipment and Components Previously Provisioned. The only provisioning technical documentation required for SCL M&E or ordnance equipment or components is a CPS, prepared in accordance with MIL-STD-1375.

(b) HM&E and Ordnance Equipment or Components Not Previously Provisioned. The Contractor shall prepare PTD in accordance with **MIL-STD-1375** for all **Contractor-**furnished and non-standard **HM&E** **or** ordnance equipment and components as per the CDRL. The Contractor may obtain PTD from the equipment manufacturer, *or* shall prepare PTD from configuration data supplied by the equipment manufacturer under the terms of the Contractor's purchase order. In addition, the Contractor shall prepare PTD for (1) any non-standard equipment or component obtained from any source of supply unable to furnish PTD and for **(2) any** equipment which the Contractor manufactures.

(c) Miscellaneous APLs. The Contractor shall recommend to the NSA in PPL format, those Contractor-furnished equipments/components for inclusion in the ship's Miscellaneous APLs. The NSA will approve or disapprove the recommendation. If approved, the only PTD required will be component characteristic and identification data.

(d) Category I and II Electronic Equipment or Components Not Previously Provisioned. The Contractor shall prepare PTD in accordance with MIL-STD-1375 for all such electronic equipments or components.

(e) Category III Electronic Equipment or Components or Parts Listed on Electronic System Drawings. The Contractor shall prepare PTD in accordance with MIL-STD-1375. The provisioning Parts List shall be in order of circuit symbol number. Primary sort shall be by drawing number, secondary sort by sheet number (unless a consecutive item numbering sequence is utilized throughout the drawing), and tertiary sort by item (find or piece) number. A separate Provisioning Parts List shall be prepared for each system drawing. The Contractor shall address this specific requirement and present his method of compliance at the PRS Conference.

1.0-1.6.4.3.5 Supplementary Data Provided by the Contractor.

(a) HM&E Equipment. The Contractor shall furnish SPCC additional documents, as developed, applicable to a mechanical or electrical equipment, in accordance with the CDRL, as follows:

1. One copy of each new or revised ship construction drawing.

2. Two copies of the Ship Drawing Index with *revisions* as issued.
3. One copy of each purchase order, with revisions as issued.
4. Two copies of the Purchase Order Index with revisions as issued.

(b) Electronic Equipment. The Contractor shall notify SPCC via the NSA of all Contractor-furnished electronic equipment, components, and systems including those which are listed in the Electronic/Ordnance Fire Control Sys terns Program Support Index, as soon as the procurement data is *firm.* The notification shall include the Federal Manufacturers Code (if assigned) or manufacturer name and equipment model number, with a listing of the accessories (if any) and the ship drawing numbers for Category II and III electronics. Subsequently, as the equipment serial numbers are known and as changes (additions or deletions) occur, the Contractor shall notify SPCC via the NSA of the equipment serial numbers and of the changes.

1.0-1.6.4.3.6 Intentionally Not Used. MOD 6

1.0-1.6.4.3.7 Provisioning Screening. Submit to DLSC for provisioning screening all known reference numbers for each line item included in PTD delivered to the Government, for all items recommended as spare or repair parts, and for CFE support and test equipment. Follow the requirements of the CDRL and DOD 4100.38-M April 1975 for submissions. Do not deliver provisioning screening output data to the Government. Instead, incorporate acceptable NSNs identified through the screening process (and their management coding) into the PTD and related products *concerning* CFE. Whenever screening output data shows that more than one NSN has been assigned to an item of supply, select the single NSN to use for the end item application. Whenever possible, the selected NSN should be one managed by SPCC.

1.0-1.6.4.3.8 Support and Test Equipment PTD. The Contractor shall include in the remarks column of the Support and Test Equipment Lists the SCAT Code and/or Allowance Support Code. MOD 6

1.0-1.6.4.3.9 Incremental Stock Number Sequence Lists (ISNSL) and Other Provisioning GFI. The Government shall furnish the Contractor copies of ISNSLs computed by FLSIP rules. The Contractor shall use these ISNSLs as a reference aid for the timely identification and procurement of OBRPS. The ISNSLs shall be provided with applicable supply aids, e.g., NSN update listings, validation cards, and supply availability cards. The schedule for preparing and delivering ISNSLs shall be fixed at the PRS Conference. Therefore, at the beginning of that conference, the Contractor shall submit to the conference chairman his recommended ISNSL publication schedule. The schedule shall be based on due consideration of the Contractor's schedule for accomplishing related provisioning and configuration identification actions and on the cut-off time frames for COSAL preparation. At the Contractor's request, the Government will provide copies of the following information:

Approved PTD for CFE,
ACL's,
AEL's,
ACN's,
APL's,
STEP requirements for Pack, Portable, and Mobile type Radio Transmit/Receive Equipment, InfraRed Equipment, and Radiac Equipment,
SPETERL requirements,
WEL,
ISNSL User's Guide,

FOMIS/ISNSL Catalog of Reports,
and
FOMIS User's Guide.

1.0-l. *6.4.4* FOMIS and CFE Provisioning Monitoring. As stated in the FRS, the Contractor shall establish and maintain a configuration record, including changes thereto, in accordance with MIL-STD-1626. The Contractor shall prepare the FOMIS Management Plan and Schedules and the FOMIS Input Data as specified by the FRS and described in the CDRL.

1.0-1.6.4.5 Provisioned Items.

1.0-1.6.4.5.1 OBRP. The Contractor shall develop lists of OBRP that he recommends the Government acquire, as follows: MOD *6* MOD *6*

(a) OBRP to be carried on board the ship to support operations on five day missions, except outfit and furnishings (on board repair parts) shall be stored at the MLSG. MOD 2

In developing this list, the Contractor shall consider and use as guides the following data sources shown in order of precedence: PBM-l's COSAL, MEA's, **APLs** and **LAPLs** in effect and certified by the Supervisor for *use,* **AAPs** certified by the Supervisor for use, and Manufacturers' parts lists. MOD *6*

1.0-1.6.4.5.2 Spare and Repair Parts. When ordered by the Government under the options in the schedule, the Contractor shall provide spare and repair parts for CFE sufficient to fill the support requirements as shown in the load COSAL *for* the squadron. This load COSAL shall be accompanied by a concurrent ISNSL which will identify that portion of the load COSAL that the Contractor shall furnish. During the construction period the Government will prepare and provide the Contractor copies of the ISNSL as stated herein and as scheduled at the PRS conference. The Contractor shall make maximum use of these **ISNSLs,** as stated in **1.0-1.6.4.3.9** herein, to initiate necessary MOD *6* MOD *6*

procurement/production of the required
allowance items for CFE in a timely manner
that assures availability of the items at
the **Contractor's** plant for their orderly
binning and loading **onboard** the ship or
for the MLSG at the scheduled time. MOD 6
Should the constraints of administrative,
manufacturing, or procurement lead time so
dictate, the Contractor shall use other
available data as buying guides, e.g., (in
order of precedence) **APLs** and **LAPLs** in
effect and certified by the Supervisor for
use, **AAPs** certified by the Supervisor for
use, and manufacturers' parts lists.

1.0-1.6.4.5.3 Insurance Items. The Con-
tractor shall provide a recommended list
of insurance items (stock spares) for all
CFE items using criteria contained in
NAVSEA instruction 4410.1 of 15 August
1975. After approval by the Government,
the Contractor will provide the insurance
items in accordance with **the option** item
in the contract.

1.0-1.6.4.5.4 Spare and Repair Parts for
SCL Items. Unless otherwise specified or
mutually agreed upon, the Contractor shall MOD 2
be required to provide **OBRPs** for the ship
and MLSG for Contractor-furnished equip- MOD 6
ment or components listed in the SCL. MOD 2

1.0-1.6.4.5.5 Timely Availability of
Contractor-Furnished Spare and Repair
Parts. The Contractor shall make every
reasonable effort to provide all allowance
items for CFE that are listed in the load
COSAL and the AAP Package prior to the
scheduled date of loading the items on the
ship. The Contractor's performance in
this matter will be evaluated by reviewing
and comparing the Preliminary Shortage
List and subsequent shortage lists with
the load COSAL and AAP Package. Any devi-
ation greater than 5 percent in the
availability (range and depth) of
Contractor-furnished allowance items for
CFE for the lead ship and 3 percent for MOD 6
any follow ships at the time of the **De-**
parture Shortage List shall be considered

inadequate performance under the terms of the contract. Items recommended for procurement which were not ordered by the Government before the listed lead times shall not be included in this calculation.

1.0-1.6.4.5.6 Replacement of Used CFE. During construction and prior to delivery of the last ship, the Contractor may have MOD 6 used items of CFE or Contractor-furnished spare and repair parts for repair or test purposes. The Contractor shall replace all such items and shall report their use and subsequent replacement to the Supervisor.

1.0-1.6.4.6 Fitting Out. MOD 2

1.0-1.6.4.6.1 General. The Contractor shall accomplish proper receipt, identification, prebinning, binning, loading, and stowage of all GFM and CFM for the ship and the MLSG in accordance with the MOD 6 requirements of MIL-STD-1339.

The Contractor shall prepare, maintain and provide required records, listings, EAM cards, and other items in accordance with the CDRL. In the event the Contractor wishes to produce such records and meet the same accountability and inventory requirements by utilizing automatic data processing programs and associated computer tapes, he shall forward his proposal to the Supervisor for review and acceptance. Any proposal of this nature should include a definitive statement regarding compatability with the Navy's existing ICP programs and input requirements. The Contractor shall prepare A stock Record Card MOD 6 Afloat, in accordance with the CDRL, for all parts that he stows onboard ship, and for the MLSG. MOD 6

1.0-1.6.4.6.2 Loading Plan. The Contractor shall develop a plan for loading and stowage of material onboard the ship. MOD 6 The plan shall include stowage proposals for the material required onboard ship for a five-day mission. MOD 6 The plan shall provide written procedures for the transfer of material and its accountability from the Contractor to the ship and to the MLSG. MOD 6, MOD 7

1.0-1.6.4.6.3 Prebinning, Binning, Stowage, and Loading. In accordance with the Loading Plan and schedule approved and, as circumstances warrant, modified by the Supervisor, the Contractor shall:

(a) bin, stow, and load onboard the ship all required material received at the Contractor's plant prior to 15 days of the delivery of the ship, MOD 6 MOD 6

(b) load and stow onboard ship only those spare and repair parts, equipments, or components shown on material control listings provided or approved by the Supervisor,

(c) bin the Load COSAL SRI material not stowed aboard the ships, MOD 6

(d) turnover the SRI/OSI material designated for the MLSG in accordance with the Loading Plan, MOD 6

(e) place OSI onboard the ship in accordance with applicable AEL/AAP/APL in locations designated by the Prospective Commanding Officer or, in his absence, the Supervisor, MOD 6

(f) turnover to the ship's crew that GUCL material required onboard the ship, MOD 6

(g) turnover to the ship's crew those forms and publications received at the Contractor's plant and required onboard the ship, MOD 6

(h) require signed receipts from designated personnel for all issues, receipts, movement, or transfer of drugs.

1.0-1.6.4.6.4 Disposition of Material Not Loaded. All storeroom items and operating space items, both those identified to an NSN and those without an NSN that are received by the Contractor or charged to the contract but not loaded onboard the ship in accordance with the MOD 6 above loading requirements, shall be utilized as initial assets for a follow ship of the contract. Items not utilized to fill loading requirements of follow ships shall be identified to the Supervisor in accordance with CDRL. The Supervisor will provide disposition instructions for such material. The Contractor shall dispose of the material, including shipment of all or part of the items to destinations within the continental United States at a distance not to exceed the distance to the nearest Naval Supply Center.

1.0-1.6.4.6.5 Asset Deck. The Contractor shall prepare and provide Asset Decks of all material that he delivers, including GFM delivered to his plant. The Asset Decks shall be prepared and delivered in accordance with the CDRL with separate Asset Decks for ship material, and MLSG material. MOD 6

1.0-1.6.4.6.6 Shortage List., On completion of the COSAL and Asset Deck updating, the Contractor shall match the final COSAL SNSL and AAP requirement decks against the Asset Deck. The Contractor shall then prepare a preliminary listing of allowance shortages in accordance with the CDRL, followed by a final Departure Shortage List for the ship and the MLSG respectively, in accordance with CDRL. MOD 6

1.0-1.6.4.7 Quality Assurance (Of Provisioning And Fitting Out Data).

1.0-1.6.4.7.1 General. The Contractor shall accept responsibility for the completeness, concurrency, and accuracy of all data that he provides. The Government reserves the right to implement a quality control program for provisioning and fitting out data which will include:

(a) Selective review of Contractor purchase orders to assure compliance with the provisioning procedures.

(b) Selective review of the PTD quality and status.

(c) Sight validation of installed equipments against Contractor purchase orders, PTD, and ship construction or equipment drawings.

(d) A periodic check of the Contractor's Asset Deck after updating comparison check of its entries against allowance items on hand and on order.

(e) A check of allowance item marking against stock numbers appearing in Stock Number Sequence Lists produced by the ICP's.

1.0-1.6.5 Packaging, Handling, Storage, And Transportation

1.0-1.6.5.1 General. The Contractor shall provide appropriate and secure warehousing for the receipt, inspection, interim storage, binning operations, and issue of GFE and GFM delivered to him for ultimate installation or loading onboard ship or for the MLSG. He shall take MOD 6 appropriate action, as specified elsewhere herein, to install onboard ship those GFE earmarked for installation. He shall preserve and maintain GFE and GFM in his custody as may be appropriate for such items. He shall preserve, package, pack, MOD 6 and mark repair parts and equipments for storage onboard ship, for the MLSG or at shore facilities as stated herein. He shall assemble, integrate with similar CFE, and bin GFE and GFM and load it onboard the ship integrating within the established binning system all such material that he receives not later than 15 days prior to delivery of the ship or turnover to the MLSG respectively. MOD 6

1.0-1.6.5.2 Accounting And Security Of Government Property. In accordance with the provisions of Appendix B, Control of Government Property in Possession of Contractors, of the Armed Services Procurement Regulation (ASPR), the Contractor shall establish an inventory control system, including reports specified therein, to account. and provide for the security of Government property in his possession. The Government shall review and approve the Contractor's system as provided in ASPR's Appendix B.

1.0-1.6.5.3 Receiving Reports. The Contractor shall inspect for injury during shipment all GFE/GFM delivered to his premises in damaged containers. He shall initiate claims on behalf of the Government for all such injury, furnishing the Supervisor a copy of the claim. In addition, the Contractor shall report the receipt of GFE/GFM as follows:

(a) Items Received from Contractors. Use DD Form 250, Material Inspection and Receiving Report for material received from all Contractors. Instructions for completing the form are given in the Armed Services Procurement Regulation (ASPR), Appendix I, Material Inspection and Receipt Report.

(b) Items Received from the Government. Use DD Form 1348-l (Single Line Item Release/Receipt Document), Standard Form 1104 (U.S. Government Bill of Lading-Shipping Order), or DD Form 1149 (DOD Requisition and Invoice/Shipping Document), as available, for material received from Government sources. If these documents are not received with the material or if the documents received do not list all the material that is actually received, then the Contractor shall list all items received in a shipment on a DD Form 1149.

(c) Distribution of Receiving Reports. Except for the original of Standard Form 1104, which should be surrendered to the carrier when completed, the Contractor shall distribute the original and copies of receiving reports as directed by the Contracting Officer.

MOD 6

1.0-1.6.5.4 Government Audit. The Government shall audit the Contractor's property control system as frequently as conditions warrant. Any such audit or audits may take place at any time during the performance of the contract, upon completion *or* termination of the contract, or at any time thereafter during the period that the Contractor is required to retain records. The Contractor shall make available to such auditors all records, including related correspondence, concerning the property control system.

1.0-1.6.5.5 Missing Parts Of CFM. The Contractor shall take effective action to obtain replacements for those missing or damaged parts of CFE/CFM scheduled for MOD 6
installation or loading on board the ship or for the MLSG. MOD 6

1.0-1.6.5.6 Maintenance Of GFE/GFM. The Contractor shall maintain all material in his custody under the proper packaging and storage at all times. Mil. Spec. MIL-P-116 provides guidance for the methods of preservation (unit protection). The following storage criteria, based on levels of protection and packaging methods, apply to various types of material:

(a) Unless otherwise specified, equipment preserved-packaged by Method I, IA, IB, IC, and II shall be placed in covered warehouse storage. Outdoor storage is acceptable for bulky material preserved-packaged by Methods I and III.

(b) Controlled environmental storage (45 $\pm$ 5) percent relative humidity) shall be provided for equipment preserved-packaged by Method II, unless periodic inspection is provided. If inspection reveals the humidity indicator to be pink in color or if the package is opened, the contents shall be repackaged to its original packaging requirements (as received). If not practical to repackage material, it shall be placed in a controlled environmental storage.

(c) Equipment in pressurized metal containers may be stored out of doors. Periodic inspection shall be performed to assure pressure retention, effective desiccation and integrity of all seals and closures.

1.0-1.6.5.7 Preservation, Packaging, Packing, And Marking Items For Storage And Shipment. The Contractor shall develop, establish, and carry out a packaging program for CFE and CFM that may be stored onboard ship, for the MLSG, or at a shore facility. MOD 6 This packaging program shall use approved packaging concepts for standard items and Contractor specially developed packaging concepts for all significant, non-standard CFE that the Contractor provides under this contract as OBRP, MLSG outfit and stock. , MOD 6 This packaging program shall incorporate the following Packaging Concepts for preservation, packaging, packing, and marking equipment, components, and repair parts.

1.0-1.6.5.8 Packaging Concepts. The Contractor shall:

(a) develop, prepare and provide packaging and transportation support data as per the CDRL for each item of CFE that he provides,

(b) develop, prepare and provide Special Instruction Sheets and packaging concept drawings as per the CDRL for significant, non-standard CFE that he provides,

(c) follow the guidance of MIL-STD-794 in the absence of a commodity specification to select the method of preservation-packaging, the interior container, the exterior shipping container, and the validation tests for packaging design,

(d) base packaging concepts on Level "A" for preservation-packaging and Level "B" for packing of equipment and repair parts in general and Level "C" packing for those OBRP whose commodity specification authorizes such level of packing,

(e) use Level "A" preservation-packaging as required by applicable product or packaging procedural specifications or, in the absence of such instructions, in accordance with the criteria and guidelines of MIL-p-116,

(f) package parts individually, except when they are used *in* sets or quantities greater than one at a time,

(g) preserve-package in flexible barrier material meeting the requirements of MIL-B-131 or MIL-B-81705 those parts which can be damaged by static electricity or electromagnetic force, e.g., solid state components containing diodes, transistors, and integrated circuits, and make barrier closures by heat sealing methods,

(h) use transparent packaging material and procedures as specified in MIL-P-116 for repair parts to reduce package size and product identification,

(i) cushion or wrap, as applicable with transparent materials those parts packaged in transparent barrier materials,

(j) not repackage items unless the unit package is punctured or torn, has a damaged closure, or is of improper materials,

(k) follow the original packaging requirements when repackaging items,

(1) use domestic type shipping containers, Level "C", for parts which will be removed from their shipping container and placed in rack, bin, shelf or drawer type storage, except for specially designed metal or plastic reusable shipping and storage containers,

MOD 2

(m) use overseas, Level "A" or domestic Level "B" shipping and storage containers for parts which will be stored in their containers after receipt,

(n) select shipping containers as per the applicable product or packaging procedural specification for the item being shipped or, in the absence of such instructions, as per the instructions of MIL-STD-794, striving in every case to select a container of the minimum weight and size consistent with anticipated handling and storage hazards,

(o) use liners, pads, separators, cells, trays, diecuts, or similar media to convert difficult packing loads of items for storage on-board ship or at a shore facility into "average" or "easy" loads, as defined by FED-STD-75,

(p) make container closure, waterproofing, and reinforcing of fiberboard boxes in accordance with the applicable container specification, or carrier or postal service rules and regulations,

(q) use pressure sensitive, reinforced tape to reinforce fiberboard boxes,

(r) cushion items to prevent their damage or damaging the packaging media, using materials conforming to MIL-P-7 16 and applicable carrier regulations, unless otherwise specified in the applicable product or general specification,

(s) not use loosefill polystyrene cushioning material to pack items,

(t) seal into waterproof pads all the loose excelsior or newspaper used for cushioning or as a filler of container voids,

(u) mark interior (unit and intermediate) packages, shipping containers, and unpackaged items as per MIL-STD-129,

(v) mark packages and shipping containers with radioactive items as per MIL-STD-129 and the requirements of MIL-M-19590 and the Department of Transportation Regulations, Title 49.

1.0-1.6.6 Technical Publications

1.0-1.6.6.1 <u>General.</u> The Contractor shall provide for each ship those technical publications necessary to operate and maintain the PHM Systems/Equipments in accordance with CDRL. The Contractor shall make changes as necessary to the following referenced documents and major publications for new and substitute equipments/components:

Boeing documents:

D312-80012-1, Maint. (M) Prog. Plan for NATO PHM Ship Prog.

D312-80074-1, NATO PHM Oper. and Maint. (C)

D312-80141-1, Care of Ship Plan

D312-80221-2, Tech. Manual Status and Sched. HMR 109R1

Technical Manual, System Operation and Onboard Maintenance Manual (SOOMM) PHM-1 0905-503-7010 MOD 6

Damage Control Book 0988-142-7010

Compartment Check-off Lists MOD 2

System and Equipment Technical Manuals for Contractor-furnished Equipments (CFE), as listed in the Technical Manual Status and Schedules. MOD 6

MOD 6

1.0-1.6.6.2 Unless otherwise specified, new and the following PHM 1 Equipment/System manuals shall comply with MIL-M-15071: MOD 6

0958-LP-032.5010 Vapor Compression Distilling Plant MOD 6

0924-LP-064-5010 Marine Navigation System - Vol. I

0924-LP-064-5020 Marine Navigation System - Vol. II

0965-LP-120-3010 Intercommunication Equipment

0967-LP-582-6010 Satcom Preamplifier and Switching Unit
0936-LP-038-9010 Evaporative Toilet System

The use of existing, modified, or newly developed commercial manuals that meet the commercial manual requirements of MIL-M-15071 are acceptable.

1.0-1.6.6.3 Equipment manuals for such items as Machine Tools, Industrial Shop Equipment, Commercial Test Equipment, Commissary Equipment are not subject to requirements of MIL-M-15071 or approval by the Government. All such manuals, however, will have NAVSEA TM numbers and Approval Procurement Record (APR) pages when delivered. MOD 2

1.0-1.6.6.4 The various types of technical manuals specified in this section and other sections are intended to be ready references for use by operating, maintenance, and overhaul personnel, and suitable for use in the training of such personnel in Navy Schools and onboard ship.

1.0-1.6.6.5 Classified material shall be included in these manuals only where necessary and in the following manner:

(a) When the classified contents so dictate, or if references to separate classified drawings, addenda, or other classified publications are not practicable and this material must be included in the basic publication, the entire manual, book or volume shall be classified.

(b) When the classified contents are minimized, such classified material shall be placed in an addendum and the basic publication shall not be classified. The addendum shall be a separate volume and shall be classified appropriately.

(c) Classified material shall be handled and marked in accordance with the Industrial Security Manual for Safeguarding Classified Information (DOD 5220.22-M).

(d) Classification of one volume of a manual shall not be the cause for classifying other volumes of the same manual.

1.0-1.6.6.6 Each technical manual provided shall incorporate on the title page the appropriate distribution control statement from Contract Security Classification Guide, DD-254. HMR 88 HMR 57

1.0-1.6.6.7 No manual specified herein shall be copyrighted. The Government shall have the right to reproduce in full, or in part, any manual specified herein.

1.0-1.6.6.8 The Contractor shall make maximum practicable use of existing technical manuals. The Government will accept any existing Government-approved technical manual that meets one of the following conditions:

(a) The manual was bought under a previous Government contract and the system or equipment supported by the manual is identical with the system or equipment furnished by the Contractor. MOD 6

(b) The manual was bought under a previous Government contract and has been modified by the Contractor to reflect the configuration of the system or the equipment being furnished by the Contractor. Modifications shall be prepared in accordance with the specifications to which the manual was originally written.

1.0-1.6.6.9 Technical manuals for Contractor-furnished equipment will be provided by the Contractor unless otherwise specified herein. Technical manuals for Government-furnished equipment shall be provided by the Government. If a manual meets the criteria in 1.0-1.6.6.8a only, an approval and a procurement record page are required, in HMR 88 accordance with Mil. Spec. MIL-M-15071 paragraph 3.9. If the manual meets the requirements of 1.0-1.6.6.8b only, change pages and an approval and a procurement record page are required, in accordance with Mil. Spec. MIGM-15071 paragraphs 3.9 and 3.10.

1.0-1.6.6.10 Intentionally not used. MOD 2

1.0-1.6.7 Facilities MOD 6

1.0-1.6.7.1 Intentionally not used. MOD 6

1.0-1.6.8 Personnel And Training

1.0-1.6.8.1 General. The Contractor shall provide instructional services, facilities, training data, instructional evaluation and instructional administration: HMR 141

(a) To qualify new PHM crews in the areas of PHM Familiarization, PHM Underway Team Training and PHM Operation and On-board Maintenance Training.

(b) To train Navy personnel to perform selected maintenance tasks that are identified in PHM-3 Series Maintenance Engineering Analyses of paragraph 1.0-1.6.2.4. Intermediate level maintenance training course descriptions will be updated to PHM-3 series MEAs during course development.

The Government will review and approve all submittals and/or proposals.

1.0-1.6.8.2 Instructional Services. The Contractor shall provide and assign an adequate number of qualified instructors to: prepare the instructional materials and aids, conduct the training courses and provide the instructor advisory services required: HMR 141

(a) The underway training for each ship's crew would include a minimum of 6 days per ship leading to certification of individual crews by the ship's master. The number of each ship's crew members to be trained shall be as follows: MOD 6

SHIP STATION	NUMBER
OOD	2
HELMSMAN	2
EOS	2
SURFACE SEARCH	2
NAVIGATOR	1
COMM OPERATOR	1

(b) Navy personnel maintenance training shall be provided as classroom training for ships systems and equipment. IMR 141

SUBJECT	NUMBER
Navigation Radar	7
Environmental Control	5
Frequency Converter	4
Automatic Control System	7
F/B Propulsion Control	5
Interior Communications	4
Navigation Gyro	3
Ship's Service Power Unit	11
H/B Engine	4

On-board "hands-on" training will augment ships systems and equipment training. Training will be scheduled after PHM-3 ship delivery.

To implement maintenance training, the contractor will provide:

Classroom space, tools, equipment, power and materials for training conducted at the contractor's facilities.

Course documentation, student evaluation and certification.

Schedule, time and place of student availability 120 days prior to class start.

The Government will provide, as related to maintenance training:

A PHM-3 ship with tools and equipment.

Classroom/shop space, power and equipment for training not at the contractor's facility.	HMR 141
Equipment repair, inspection, handling and records.	
Schedule and plans confirmation 90 days prior to class start.	

1.0-1.6.8.3 Instructional Facilities. The Contractor shall provide or make arrangements for adequate classroom and laboratory/work experience facilities for the required training courses. MOD 7

1.0-1.6.8.4 Training Data. The Contractor shall develop, prepare and provide instructional data to satisfy the areas in the general requirements. Specific guidance is provided in MIL-STD-1379 (Navy) and the DID's listed below:

TITLE	NUMBER	
Learning Objectives	DI-H-2027	
Instructor's Guide	DI-H-2028	
Learner's Guide	DI-H-2029	
Learner Progress Report	DI-H-2033	MOD 6
Training Aids	DI-H-2034	
Report Form, Student Evaluation	DI-H-23387	
Certificate, Course Completion	'DI-H-23388	

Additional guidance is contained in:

(a) PHM Navy Training Plan (NTP S30-7301)

(b) PHM Special Report covering Training Human Engineering and Manning and Skill Levels.

The PHM System Operation and Onboard Maintenance Manual will be used to complement the Instructor's Guide, the Learner's Guide and Training Aids for systems/equipment training.

1.0-1.6.8.5 Instructional Evaluation. The Contractor shall prepare and administer periodic examinations to demonstrate that the learner has achieved both the theoretical and practical aspects of each major equipment or system indicated by the learning objectives.

1.0-1.6.8.6 Intentionally not used. MOD 6

1.0-2 SHIP SYSTEM DESIGN AND CONSTRUCTION

1.0-2.1 MATERIAL, EQUIPMENT AND MACHINERY

1.0-2.1.1 Materials

Any Contractor-furnished material, previously accepted or not, which proves defective and unfit for service either before or after incorporation into the ship or any of its equipment or machinery shall be replaced with satisfactory material without extra cost to the Government. The Contractor will not be responsible for Government-designated material which meets specification requirements. MOD 2 **MOD** 1

The material used for the PHM hull and foil structure shall be in accordance with Tables 1.0-3 and 1.0-4, unless specifically authorized by NAVSEA.

Aluminum Alloys. Aluminum alloy 5456 shall be the basic material for hull primary structure consisting of shell plating and stiffeners, framing, bulkheads, and foundations for foil systems and propulsion machinery.

The deckhouse and pilothouse shall be 6061 T6 aluminum alloy sheet and stiffeners riveted to welded 5456 aluminum alloy framing.

Unless authorized by the Supervisor, threading directly unto aluminum alloys shall be avoided, except as noted in Section 1.0-2.5.7.

Requirements for attachment of aluminum alloy fittings to structure, or of fittings of other material to aluminum alloy structure, are contained in paragraph **1.0-2.4.**

Certain secondary structural elements such as pods and water inlet fairings are of a **356** cast aluminum alloy as identified on the respective **scantling** drawings.

Stainless Steel. The basic hydrofoil system structure shall be made of welded stainless steel, heat treated after welding to the condition specified in

1.0-1.6.8.3 Instructional Facilities. The Contractor shall provide or make arrangements for adequate classroom and laboratory/work experience facilities for the required training courses. MOD 7

1.0-1.6.8.4 Training Data. The Contractor shall develop, prepare and provide instructional data to satisfy the areas in the general requirements. Specific guidance is provided in MIL-STD-1379 (Navy) and the DID's listed below:

TITLE	NUMBER
Learning Objectives	DI-H-2027
Instructor's Guide	DI-H-2028
Learner's Guide	DI-H-2029
Learner Progress Report	DI-H-2033
Training Aids	DI-H-2034
Report Form, Student Evaluation	DI-H-23387
Certificate, Course Completion	'DI-H-23388

MOD 6

Additional guidance is contained in:

(a) PHM Navy Training Plan (NTP S30-7301)

(b) PHM Special Report covering Training Human Engineering and Manning and Skill Levels.

The PHM System Operation and Onboard Maintenance Manual will be used to complement the Instructor's Guide, the Learner's Guide and Training Aids for systems/equipment training.

1.0-1.6.8.5 Instructional Evaluation. The Contractor shall prepare and administer periodic examinations to demonstrate that the learner has achieved both the theoretical and practical aspects of each major equipment or system indicated by the learning objectives.

1.0-1.6.8.6 Intentionally not used. MOD 6

1.0-2 <u>SHIP SYSTEM DESIGN AND CONSTRUCTION</u>

1.0-2.1 MATERIAL, EQUIPMENT AND MACHINERY

1.0-2.1.1 Materials

Any Contractor-furnished material, previously accepted or not, which proves defective and unfit for service either before or after incorporation into the ship or any of its equipment or machinery shall be replaced with satisfactory material without extra cost to the Government. MOD 2 The Contractor will not be responsible for Government-designated material which meets specification requirements. MOD 1

The material used for the PHM hull and foil structure shall be in accordance with Tables 1.0-3 and 1.0-4, unless specifically authorized by NAVSEA.

<u>Aluminum Alloys.</u> Aluminum alloy 5456 shall be the basic material for hull primary structure consisting of shell plating and stiffeners, framing, bulkheads, and foundations for foil systems and propulsion machinery.

The deckhouse and pilothouse shall be 6061 T6 aluminum alloy sheet and stiffeners riveted to welded 5456 aluminum alloy framing.

Unless authorized by the Supervisor, threading directly unto aluminum alloys shall be avoided, except as noted in Section 1.0-2.5.7.

Requirements for attachment of aluminum alloy fittings to structure, or of fittings of other material to aluminum alloy structure, are contained in paragraph 1.0-2.4.

Certain secondary structural elements such as pods and water inlet fairings are of a 356 cast aluminum alloy as identified on the respective scantling drawings.

<u>Stainless Steel.</u> The basic hydrofoil system structure shall be made of welded stainless steel, heat treated after welding to the condition specified in

Table 1.0-3. Certain secondary structural elements are of 300 series stainless steel as identified on the respective scantling drawings.

MOD 2

Titanium. 6Al-4V alloy as listed in Table 1.0-3 shall be used for the designated components of the hydrofoil system, within the limits of the foil system service life assurance requirements of section 1.566.1.1.

HMR 17
HMR46

Titanium. Commercially pure Titanium as listed in Table 1.0-3 may be used for the fuse pins in the energy absorber within the limits of the foil system service life assurance requirements of section 1.566.1.1.

Brittle Material. Brittle material is material showing less than ten percent elongation in two inches for the standard tensile test. For the static loading case (normal ship operation) brittle material is material being used below its NDT (Nil Ductility Transition) temperature as measured by the NRL drop-weight test. Brittle material shall not be used unless specified otherwise herein, or where the Supervisor approves its use for a particular application, or where its suitability is proven by mechanical shock tests. This requirement for brittle material does not apply in the following cases:

MOD 3

1. Existing PHM-1 designs
2. Producibility designs
3. Government-designated equipment
4. PBM-1 components (purchased by PHM-1 vendor part number) used in a system which as been redesigned for PHM-3.
5. Strut and foil components made from titanium.

HMR 17

Electrolytically Dissimilar Materials. To prevent destructive electrolysis, direct contact of electrolytically dissimilar metals shall be avoided as far as practicable.

Magnesium. Magnesium and its alloys shall not be used for structural members or for equipment under the cognizance of NAVSEA, except for antennas that are installed in the open.

In certain cases, other Bureaus or Corn- **mands** may furnish equipment composed of magnesium or its alloys, the **onboard** repair *parts* for which require below-deck stowage. In selecting stowage arrangements and locations for these **onboard** repair parts , their flammability characteristics must be considered, particularly the hazard of concentrated stowages. Stowage locations near flammable liquid stowages and/or near magazines shall be avoided.

Approval shall be obtained for installations and stowages involving magnesium and its alloys.

General Applications of Metals Temperature Limits. The normal maximum sustained temperature for each of the following metals shall be limited as follows:

MATERIALS	Degrees C T1	Degrees C T2	Degrees F T1	Degrees F T2
Aluminum alloys, except 5454	65	65	149	149
Aluminum alloy 5454	65	204	149	399
Cast iron	221	221	430	430
Copper, brasses, bronzes	121	232	250	450
Copper-nickel: 70:30	232	372	450	702
90: 10	177	316	353	601
Aluminum bronze	121	316	250	601
Monel	344	483	651	901
Steel, carbon	344	411	651	772
Steel, carbon molybdenum	372	466	702	871
Steel, 1-1/4 percent chromium, 1/2 percent molybdenum	372	538	702	1,000
Steel, 2-1/4 percent chromium, 1 percent molybdenum	372	566	702	1,051

The above materials may be used up to the temperature T1 assuming properties equal to those at room temperature. At temperatures above T1, the design stresses shall be based upon the stress for rupture or the stress corresponding to one percent creep (both in 100,000 hours), whichever is lower, and an adequate safety factor consistent with the application. The materials shall not be used at temperatures exceeding T2, except that for the steels listed above, fluctuations of not more than 14 degrees C (25.2 degrees F) in excess of T2 for short durations are permissible.

TABLE 1.0-3

SPECIFICATIONS FOR 17-4PH AND WELDING MATERIALS FOR USE IN PHM FOIL SYSTEM

MATERIAL	FORM		SPECIFICATION	CONDITION
7-4PH	Sheet Strip, Plate, Bars Forgings and Rings		XBMS 7-239	A
	Castings		AMS 5355 (Investment) AMS 5398 (Sand)	a
ISI 321 and IS1 347	Sheet Strip & Plate		QQ-S-766	
	Bars, Forging Rings		QQ-S-763	
	Pipe		MIL-P-1144	
Weld iller Materials	W17-4PH Bare Wire		AMS 5825 XBMS7-242	
	W17-4PH Covered Electrode		AMS 5827	
	AISI 347	Bare Wire	MIL-R-5031B Class 7A (or 5A per amendment 2) MIL-E-19933, Type MIL-347	
		Covered Electrode	MIL-E-2220012 Type MIL-347-XX	
	AISI 308L	Bare Wire	MIL-E-19933 Type MIL-308L MIL-R-5031B, Class 2	
		Covered Electrode	MIL-E-2220012 Type MIL-308L-XX	
356 535	Casting (Sand)		MIL-A-21180 QQ-A-60 1	T6 F

MOD 4, 6

TABLE 1.0-3 (Cont'd)

SPECIFICATIONS FOR TITANIUM ALLOYS
FOR USE ON PHM FOIL SYSTEM

MATERIAL	FORM	SPECIFICATION	CONDITION	
Titanium Alloy 6 Al-4V (Damage Tolerant Grade) (Note 3)	Sheet, Plate, Bar, Forgings, and Heavy Wall Tubes	XBMS-7-266	Note 2	HMR 17
Titanium Alloy 6 Al-4V (Std) (Note 5)	Sheet, Strip, and Plate	MIL-T-9046 (Note 5)		HMR 114 HMR 92
	Bar and Forging Stock	MIL-T-9047 (Note 5)		HMR 114
		AMS 4928 (Note 5.a only)		
	Bars, Forgings & Rings	AMS 4967 (Note 5.a only)		
Titanium Alloy 6 Al-4V (ELI) (Note 4) (Note 5)	Sheet, Strip and Plate	MIL-T-9046		
	Bar and Forging Stock	MIL-T-9047		
Titanium CP [Unalloyed] (Note 6)	Sheet, Strip and Plate	MIL-T-9046	2	HMR 46
	Bar and Forging Stock	MIL-T-9047	2	

SPECIFICATIONS FOR OTHER MATERIALS
FOR USE ON PHM FOIL SYSTEM HMR 157

MATERIAL	FORM	SPECIFICATION	CONDITION
MP 35N (Note 7)	Bar	AMS 5844A	

1. Postweld heat treatment shall be the solution-age H1100 condition unless specifically approved on a case basis by the Government. Prior to its use in fabrication, sample material shall receive a solution-age heat treatment to the H1100 condition, and shall demonstrate conformance to the following requirements: MOD 6

(a) For each heat lot of material the yield strength in the long transverse direction (Type 1 material) shall be between 896 and 1102 MN/m^2 (130 and 160 ksi) for product form thickness up to 76 mm. For product forms 76 mm or thicker the yield strength in the short transverse direction (Type 2 material) shall be between 896 and 1102 MN/m^2 (130 and 160 ksi). Test specimens shall be taken in accordance with XBMS-7-239A. MOD 6 R ECP002/HMR 1 R ECP002/HMR 1 R ECP002/HMR 1 R ECP002/HMR 1

Tensile testing is required, as a minimum from each air-melt heat of Type 1 and Type 2 material. Samples shall be selected from the first and last VAR ingots produced from each air melted heat. In no case will the minimum thickness dimension of the test or product form bars be smaller than the maximum thickness of any product form fabricated from the air-melt heat being tested. Specimen coupons to be tested in the longitudinal or long transverse grain direction shall be obtained approximately 1/4T (thickness) in from the test bar surface. All test specimens shall be forwarded to NAVAL SHIP ENGINEERING CENTER Code 6101 after completion of test results analysis. ECP002/HMR 1

(b) Fracture toughness: The strut and foil system material from each heat lot for the components listed in Section 1.0 of the NAVSEA Foil system service life assurance requirements document shall exhibit MOD 4 a fracture toughness of 2000-foot pounds minimum in the longitudinal direction (Rolling Direction) for 25 mm (1 inch) specimens as measured by the Dynamic Tear Test. The standard method for 25 mm (1 inch) Dynamic Tear Test shall be as specified in NRL report 6851. Where 16 mm (5/8 inch) test specimens are used, testing shall be in accordance with MIL-STD-1601 (SHIPS); values obtained shall be multipled by 8 to obtain equivalent 25 mm (1 inch) results. [Test specimens shall be taken in accordance with XBMS-7-239A. Dynamic tear testing is required, as a minimum, from each air-melt heat of Type 1 and Type 2 material. Samples shall be selected from the first and last VAR ingots produced from each air-melted heat. In no case will the minimum thickness dimension of the test or product form bars be smaller than the maximum thickness of any product form fabricated from the air-melt heat being tested. Specimen coupons to be tested in the longitudinal or long transverse grain direction shall be obtained approximately 1/4T (thickness) in from the test bar surface.] All test specimens shall be forwarded to NAVAL SHIP ENGINEERING CENTER Code 6101 after completion of test results analysis. R ECP002/HMR 1

(c) Stress Corrosion Cracking: The strut and foil system material for each product form and each supplier shall not exhibit stress corrosion crack growth as determined by SCC testing. SCC test procedures shall be in general accordance with NRL Report 7865. Testing shall be specifically conducted one time for each product form as follows: MOD 4 MOD 6

1. Cantilever Beam: specimens shall be designed so that at

100 ksi $\sqrt{in}$ they are plane strain valid where the thickness of the product form permits and below net section yielding. MOD 6

2. Specimens shall be processed to final heat treatment before the test.
3. A 1000 hour SCC test shall be performed with the crack area fully immersed in a solution of 3-1/2 percent NaCl. The initial stress intensity shall be 100 ksi $\sqrt{in}$.
4. Successful completion of these tests shall consist of the absence of measurable crack growth.
5. Specimens shall be tested in the longitudinal and long transverse directions (for castings only one direction).
6. All test specimens shall be forwarded to NAVAL SHIP ENGINEERING CENTER Code 6101D after completion of test result analysis.

(d) All 17-4PH wrought material 13 mm or more in thickness shall receive ultrasonic inspection at the vendor's facility, per the continuous scanning method per "MIL-STD-271", for internal soundness. Mapping of the material to the following criteria by the vendor will be required: HMR 19 R ECP002

1. The material shall be mapped to show any single indication response which exceeds that of an 5/64 inch diameter flat bottom hole equivalent.
2. The material shall be mapped to show any multiple indications, any two of which have an indicated distance between centers of less than one inch and whose responses equal or exceed that of a 3/64 inch diameter flat bottom hole equivalent.

3. The material shall be mapped to show any stringer indications whose response exceeds 3/64 inch diameter flat bottom hole equivalent and length exceeds 1 inch.

Acceptance of the material from the vendor will be in accordance with Boeing Material Specification **XBMS-7-239A.** However, the final product form in the ship as delivered shall meet the criteria of (1), (2) and (3).

(e) Two types of 17-4 material shall be permitted. Type I material, under 76 mm thickness shall be used for applications without significant short transverse loading. Chemical composition is standard 17-4 PH chemistry per the governing AMS specification with the added requirement that nitrogen shall not exceed 0.045 percent and the Columbium plus Tantalum content shall be greater than 5 times the carbon content. HMR 1

Type 2 material shall be used for applications which require short transverse properties. The chemical composition of Type 2 is the same as Type 1 except for the following: HMR 25

Phosphorus Maximum = 0.03
Sulphur Maximum = 0.015
Chromium Min = 14.4 Max.= 15.0
Nickel Min. = 4.5 Max.= 5.0

The added requirements for Nitrogen, Columbium and Tantalum for Type 1 also apply to Type 2. In addition, for Type 2 material, 76 mm thick and over, short transverse charpy specimens shall be taken from each VAR ingot and shall exhibit 20 ft/lb energy minimum. HMR 25

Type 2 material procured less than 76 mm thick shall be used only for the following components: HMR 25

Aft Strut	Forward Strut	
• Strut aft spar • Fairing spar	• Forward spar • Mid spar • Aft spar • Trailing edge spar • Upper leading edge cap • Center leading edge cap	HMR 25

(f) Two long transverse base metal tensile specimens shall be heat treated with each heat treat load of production strut and foil assemblies and shall exhibit yield strength between 896 and 1102 MN/m^2 (130 and 160 ksi) to validate the heat treated process.

(g) The percent delta ferrite shall not exceed 8 percent in the product. Determination of delta ferrite content shall be in accordance with procedures of AMS 2315 except that the examination shall be accomplished at five view locations on a long transverse (looking at a surface in the plane of the plate side) cross section at 100 x magnification. The cross section shall be taken at approximately the 1/4T (thickness) location. Samples shall be taken in accordance with XBMS-7-239A. For Type 1 materials, samples shall be selected from the first and last VAR ingots produced from each air-melted heat. For Type 2 materials, samples shall be selected from each VAR ingot. HMR 1 HMR 1

Note 2. Material shall be beta-annealed 6Al-4V titanium with a max. oxygen content of 0.11% by weight. Chemical composition, mechanical properties, fracture toughness, microstructure and stress corrosion resistance shall conform to the following requirements: HMR 88 HMR 17

(a) Chemical Composition Limits

Element	Composition (Weight Percent) HMR 17
Titanium	Remainder
Aluminum	5.7-6.2
Vanadium	3.6-4.4
Iron	0.25 max.
Carbon	0.05 max.
Hydrogen	0.0125 max.
Oxygen	0.11 max.
Nitrogen	0.03 max.
Yttrium	0.005 max.
Other Impurities (1)	0.40 max.

Footnote (1): Need not be reported. Any individual element shall not exceed 0.10 percent. No deliberate additions shall be made. HMR 88

(b) Tensile Properties - The tensile properties of the material shall conform to the requirements specified below when tested in accordance with ASTM E-8. One longitudinal (L-T), one transverse (T-L), and for material over 2.500 inches in thickness one short transverse (S-T) tensile test shall be conducted on specimens cut from each plate until such time as a statistical sampling plan is approved by the Supervisor. Note: No transverse or short transverse specimen is required on round or tubular products. The specimens shall be cut from the mid-thickness position of the plate. The average results of the tensile tests for each lot shall show a maximum difference between the transverse and longitudinal directions of 4.0 ksi for the ultimate strength and 5.0 ksi for the yield strength.

TABLE II - Minimum Tensile Properties HMR 17R1

Thickness (in)	Ultimate Strength (ksi)	Yield Strength (0.2% Off-set) (ksi)	Elong. % in 2 in. or 4D Long. & Trans.
Sheet, Plate, Bar, & Forgings			
0.188- 0.500	130	117	10.0
0.501- 1.000	127	115	10.0
1.001- 2.000	124	112	8.0
2.001- 4.000	120	110	8.0
4.01 - 6.00	115	105	8.0
6.01 - 8.00	110	100	8.0
8.01 -10.00	105	95	8.0
10.01 -12.00	100	90	6.0
12.01 -14.00	95	85	6.0
14.01 -16.00	90	80	5.0
Heavy Wall Tubes up to 6	100	90	8.0

(c) Fracture Toughness - Material 0.5 inch and thicker shall meet a K_{IC} or K_Q of 85 ksi $\sqrt{in}$ minimum when tested in accordance with ASTM E-399-74. Two tests shall be made in the transverse direction (T-L) for each lot of plate material. Heavy wall tube and bar products shall be tested in the longitudinal (L-R) direction. All tests shall meet the minimum K_{IC} or K_Q requirements. HMR 17

(d) Stress Corrosion - Material shall meet a sustained load stress intensity factor (K_{SL}) of 55 ksi $\sqrt{in}$ when tested in 3.5% NaCl solution for 120 minutes with no measureable crack growth. One test per lot shall be conducted in the transverse (T-L) direction for plate and the longitudinal (L-R) direction for heavy wall tube and bar products until such time as a statistical test plan is approved by the Supervisor. HMR 17R1

(e) Microstructure - Microstructure shall be examined on each processing lot, for each of the three principal directions. The mircro-structure shall show no surface oxygen contamination as evidenced by a different microstructure morphology (stabilized alpha phase) at the surface. The microstructure shall be uniform and consist of basketweave or Widmanstatten morphology and shall not contain primary or equiaxed alpha phase. Prior beta grains exceeding 0.050 inch in width or 0.100 inch in length shall constitute no more than 10 percent of the microstructure when examined at 10X magnification. A prior beta grain is a region of basketweave morphology which has transformed from a single beta grain. No banding is permitted.

HMR 17

(f) NDT Inspection - Beta-annealed 6A1-4V titanium 13mm or greater in thickness and round bar 19mm or greater in thickness shall be ultrasonically inspected by the continuous scanning method of MIL-STD-271E for internal soundness. Acceptance criteria shall be as follows:

(1) Single indication - the material response which exceeds that of a 2mm (5/64 inch) diameter flat bottom hole equivalent.

(2) Multiple indications -the material shall not have any multiple indications, any'two of which have an indicated distance between center of less than one inch and whose responses equal or exceed that of a 1.2mm (3/64 inch) diameter flat bottom hole equivalent.

(3) Stringers - the material shall not have any stringer indications whose response exceeds 1.2mm (3/64 inch) diameter flat bottom hole equivalent and length exceeds one inch.

(g) Workmanship - The material shall be uniform in quality and condition, free from harmful alloy segregation and surface contaminations by oxygen, nitrogen, or other contaminants, and foreign material. It shall be clean, sound, smooth, and free from buckles or oil cans in excess of flatness tolerances, cracks, seams, grind marks, and other injurious defects detrimental to the fabrication or performance of parts.

HMR 17

(h) Quality Assurance Provisions -The Contractor shall be responsible to assure that material suppliers meet the requirements of the applicable specification.

The following quality conformance test procedures shall be utilized:

(1) Chemical Analysis - Chemical composition for all elements except hydrogen and oxygen shall be determined using ASTM E-120. Analysis for hydrogen shall be performed using a process calibrated against the NBS standard for hydrogen in titanium. Analysis for oxygen shall be per ASTM E-385. Any other analysis methods having equivalent or better accuracy and precision than the above methods may be used provided they are approved by the Supervisor. Analysis for oxygen content shall be performed by a technique having an accuracy standard deviation of 50ppm or better. Check analysis shall be according to AMS 2249.

(2) Mechanical Properties Testing Tensile testing shall be done in accordance with ASTM E-8. The strain rate shall be 0.003-0.007 inch per inch per minute through 0.2 percent offset plastic strain and then increased to 0.075-0.125 inch per inch per minute to failure.

(3) Fracture-Toughness Test -Fracture toughness test shall be performed in accordance with ASTM E-399-74. The specimen used shall be the compact tension specimen specified in ASTM E-399-74.

The tolerances of Figure 5 in ASTM E-399-74 apply except in the instance of $W/2 \pm 0.010 = B$. Material may be machined 0.010 inch maximum from each side. B shall be full or maximum useable thickness for material<2" thick. For material-over 2" thick, B shall be 2". HMR 17

In order to establish a measured level of K_Q as a valid K_{IC} value, all of the validity criteria of ASTM E-399-74 must be satisfied. Otherwise, the value reported shall be K_Q. HMR 17R1

Test Data - At the time of testing, the following data shall be recorded on the load-displacement test record.

(1) Date
(2) Specimen identification HMR 17R1
(3) Load scale calibration (lb/in. chart) HMR 17R1
(4) Displacement scale calibration (in/in/-chart
(5) Loading rate in terms of K per ASTM E-399-76 HMR 17R1
(6) P_Q (lb)
(7) P_{MAX} (lb)
(8) Temperature
(9) Relative humidity
(10) Testing laboratory
(11) Test machine
(12) Operator

Test data shall be reduced as specified in ASTM E-399-74 to calculate a K_Q value and to determine if a valid K_{IC} property value has been measured. Tensile test coupons shall be provided for validity verification wherever fracture toughness coupons are called out. In checking for validity, the yield strength shall be measured for the same material as the fracture toughness specimen. A minimum of one tensile specimen taken immediately adjacent to the location of the fracture toughness specimen and of the same orientation is required. If a value of K_Q is invalid solely on the basis of either of the following criteria, (1) $B < 2.5\ (K_Q/TYS)^2$, or (2) $P_{max}/P_Q > 1.10$, then such value K_Q may be compared to the minimum level specified in Section 3.4.1 for qualification purposes. Otherwise (i.e., in the case of K_Q value invalid on the basis of other ASTM E-399-74 criteria - e.g., crack front curvature, etc.), a minimum of a single retest shall be required. HMR 17

(4) <u>Stress Corrosion Testing</u> - This testing procedure covers the determination of resistance to stress corrosion cracking for Ti-6Al-4V beta processed material in an environment of 3.5 percent NaCl solution. Stress corrosion test appratus shall meet the requirements of ASTM E-399-74 for compact tension speciments with the addition of a salt water reservoir.

Compact tension speciments shall be prepared in accordance with (3) above. Test specimens shall be plain strain. The specimens shall be precracked in accordance with ASTM E-399-74. Post test examination shall be made to ensure that the crack front (as precracked) meets the criteria of ASTM E-399-74.

Test Procedure shall be as follows:

a. Calculate the load required to develop $K_{SL} = 55\ \text{ksi}\sqrt{\text{in}}$ using the calculations for compact tension specimens of ASTM E-399-74, where K_{SL} is a stress intensity factor sustained at a specific level for 120 minutes in an aqueous 3.5% NaCl solution.

b. Assemble a saltwater reservoir enclosing the precracked area. Fill the reservoir with saltwater making sure that the crack tip. is completely immersed

c. Load the speciment to K_{SL} = 55 ksi $\sqrt{in}$ at a load rate in terms of K per ASTM E-399-74. Hold the load at K_{SL} for 120 minutes. If no measurable crack growth occurs after 120 minutes at K_{SL}, raise the load at the same rate as used initially until fracture.

d. Calculate K at fracture per ASTM E-399-74.

HMR 17

(5) Determination of Microstructure One microstructural determination shall be made for each lot. The specimen surface shall be parallel to the working direction and perpendicular to the material surface (transverse section). Examination shall be made by traversing the entire thickness of the material at a magnification of 500x. Etching shall be by immersion in Kroll's etch (2 percent HF, 10 percent HNO_3, 88 percent H_2O) for approximately 15 seconds with a water rinse followed by immersion in 0.5 percent HF solution for 5-10 seconds. A photograph of the typical microstructure at the center and both surfaces of the plate shall be taken at 200X magnification and one photograph at 10X magnification showing representative microstructure.

(6) Beta Transus Determination The beta transus shall be determined by heating the samples in the furnace meeting the thermal controls requirement below to three temperatures that bracket the expected beta transus temperature. The three temperatures shall be the expected beta transus temperature (T_{BT}) and $T_{BT} \pm 20^{o}F$. The specimens shall be water quenched and examined metallographically. The beta transus temperature will be extrapolated within the $20^{o}F$ range of the two samples that show a complete basketweave structure and

a mixture of primary alpha and basketweave. If the three temperatures chosen do not bracket the T_{BT}, a second set of samples shall be run using a revised estimate for T_{BT}, using the above procedure. Any alternative methods for determining the T_{BT} must be approved by the Supervisor. Thermal controls and readouts shall be calibrated to an accuracy of $\pm 5^{o}F$. The beta transus determinations from the same lot shall be repeatable with $\pm 15^{o}F$.

(7) Determination of Flatness Variation - The amount of variation from flat shall be determined by measuring the distance from a straight edge laid in any direction upon the material, to the material surface at the point of greatest deviation. Both sides of each plate shall be inspected for flatness. Bars and heavy wall tube products shall be measured for camber and sweep. HMR 17

Note 3. Acceptable titanium alloy for any strut/foil component listed in Note 4 or 5 below HMR 88 HMR 114

Note 4. Acceptable titanium alloy for the following components except that material shall be beta annealed in accordance with BAC 5613 (Beta I Condition) prior to production usage: HMR 88 HMR 114

(a) Aft pivot shafts
(b) Yoke pivot pins

Note 5. Acceptable titanium alloy for the following components: HMR 88

(a) Spherical bearings, bushings, inner and outer races, and journal bearings
(b) Forward and aft strut upper fairings.

	(c) Forward and aft linkages (d) Aft strut uplock and downlock (e) Energy absorber (f) Forward strut downlock (g) Lateral restraint fittings (h) Miscellaneous pins (i) Forward and aft pod covers	HMR 114
Note 6.	Acceptable titanium for the following component: (a) Fuse pins in the energy absorber, Boeing drawing 800-4596524.	HMR 46 & 88
Note 7.	Acceptable material for outboard hinge pins for two outer hinge blocks on forward flap linkage system.	HMR 157

TABLE 1.0-4

SPECIFICATIONS FOR ALUMINUM ALLOYS AND WELDING MATERIALS FOR USE IN PHM HULL STRUCTURE

FORM	MATERIAL SPECIFICATION	ALLOY	TEMPER	NOTES	
Sheet and Plate	QQ-A-250/20	5456	Hl16, H117	1, 2	
	QQ-A-250111	6061	T6	3	
	QQ-A-250/10	5454	H34	4	
	QQ-A-250/19	5086	Hl16, H117	8	
Shapes					
Extrusions	QQ-A-200/7	5456	H111	1	
Extrusions	QQ-A-200/6	5454	H111	4	MOD 6
Extrusions	QQ-A-200/8	6061	T6	3	
Extrusions	QQ-A-200/5	5086	Hlll	8	
Tubing					
Drawn .025 to 1.143 mm wall thickness	WW-T-700/5	5086	H32	5	
Extruded over 1.143 mm wall thickness	QQ-A-20015	5086	HI11	5	
Drawn .6 to 13 mm wall thickness	WW-T-700/6 or	6061	T6	3	MOD 6
Castings (Sand)	QQ-A-601	535	F	6	
	MIL-A-21180	A356	T6	6	
Rivets	MIL-R-1150	6061	T6(F)		MOD 1
Welding Rod	84-R-566 - Inert gas tungsten-arc welding (GTAW), - Inert gas metal arc welding (GMAW).				HMR 27 HMR 57
	MIL-E-16053 - Inert gas tungsten-arc welding (GTAW), and Inert gas metal-arc welding (GMAW).				
Hand & Die Forgings	QQ-A-367	5456	0, H111	1, 9	HMR 57
		5083	0, H111, H112	1	
		5086	0, H111	1, 9	
		6061	T6	3	

NOTES: MOD 2

1. For use in hull primary structure. Not for elevated temperature use (over 65 degrees C (149 degrees F)).
2. For thicknesses 4.8 mm (0.188 in), the following minimum mech. properties apply:
   - (a) Tensile Ult. - 317 MN/m^2 (46 ksi)
   - (b) Tensile Yield - 228 MN/m^2 (33 ksi)
   - (c) Elongation in 50.8 mm (2 in.) - 10 percent MOD 6
   - (d) Corrosion Tests for H116 and H117 Temper per QQ-A-250/20 or ASTM B209, Appendix X5 are applicable MOD 6
3. Non-welded applications only.
4. For use in structure subject to elevated temperature in 65 to 205 degrees C (149 to 401 degrees F) range.
5. For stability-designed structural elements such as masts, stanchions, etc.
6. QQ-A-601 except tensile test bars cut from castings shall be equal or exceed:
   - (a) F_{tu} = 138 MN/m^2 (20 ksi)
   - (b) F_{ty} = 93 MN/m^2 (13.5 ksi)
   - (c) Elongation in critical areas (as defined by drawing) - Average elongation shall equal or exceed 4.5 percent with no single specimen less than 3 percent.
   - (d) Elongation in all other areas of casting shall have a minimum of 3 percent.
7. Not Used MOD 6
8. All material in Table 1.0-4 may be used, with their corresponding notes for Secondary Structure, i.e., miscellaneous equipment foundations.
9. Not listed in QQ-A-367, chemical analysis to be per applicable plate or extrusion specification listed in Table 1.0-4. Properties shall be as specified in the contract or purchase order. HMR 57

HMR 89

1.0-2.1.2 Installation Of Equipment, Machinery, And Materials

Installation of equipment and machinery shall consider operating efficiency and ease of maintenance and shall be as follows:

(a) Location. Equipment and machinery, and handling and lifting gear for such items, shall be located so that **onboard** repair parts can be installed or removed without interference with the ship's structure and minimum interference with other equipment or machinery. The arrangement shall permit making repairs in a seaway.

(b) Weather Deck. Fittings and equipment on the weather deck shall be kept to a minimum. Wherever these are installed on the weather deck, the following shall apply:

They shall be located where they will be protected from blast and heavy seas.

Particular attention shall be given to detail and strength of deck connections.

They shall be attached clear of the stringer strake where possible.

Brackets for equipment installed in the weather shall be configured to prevent accumulation of water.

(c) Bilge Regions. The design of machinery, systems, and equipment in machinery spaces, shall, in addition to requirements appearing herein, be such that firefighting and dewatering capability will not be affected when the bilge regions, as defined below, are flooded. Machinery, equipment, or material which would be damaged by bilge water shall not be installed in such regions unless it can be suitably protected from the bilge water.

The bilge region is that volume between the shell plating and a horizontal plane 127 mm (5 inches) above the center vertical keel (CVK) at the center line of the ship and measured at bulkheads 25, 30 and 33 for the Gas Turbine Machinery Room, Diesel and Pump Machinery Room and Auxiliary Machinery Room No. 3 respectively. There shall be no bilge region in the Auxiliary Machinery Rooms No. 1 and No. 2.

(d) Rotating Machinery. Unless otherwise specified or approved by the Supervisor, all rotating machinery shall be installed with the axis of rotation as nearly horizontal and parallel to the center line of the ship as practicable, except machinery designed specifically for vertical axis rotation.

(e) Interference With Line of Sight. The view and the lines of sight as shown on the arrangement drawing, from the pilothouse and external conning stations shall be maintained or improved. MOD 2

(f) Interference With Rotating and Traversing Equipment. Rotating or traversing equipment shall not strike structure, fittings, or other installed equipment throughout the entire range of movement.

(g) Protection of Personnel. Protection of personnel against operating hazards shall be provided. Shafting, couplings, gears, flexible shafts and similar items shall have adequate guards installed for protection of personnel. Such protective guards shall be removable without dismantling the machinery surrounded. Guards shall be constructed of sheet or expanded metal as light as is consistent with required protection. Guards fitted on parts requiring frequent attention shall have doors, covers, or other ready means for access, secured by wing nuts or other simple fastenings.

Protection of personnel from electrical hazards shall conform to 1.300, 1.322, 1.406 and 1.407.

(h) <u>Protection of Equipment Machinery.</u> Enclosures shall be provided where required to prevent inadvertent operation of, mechanical injury to, gages, control buttons, starting buttons, valves, and similar equipment. Operating gear and electric cables that pass through refrigerated spaces, or storage spaces, shall be encased or otherwise protected where required.

(i) <u>Installation in Vicinity of Magnetic Compass.</u> Magnetic compass readability in the smallest division (resolution) shall be ± 1 degree; a deviation card shall be provided. Compass inaccuracy, as corrected by the deviation card shall not exceed 1/2 degree rms at cardinal and intercardinal points. The compass shall be installed so as to be readable by the helmsman from his seated position under all normal external lighting conditions. MOD 7 | HMR 55

(j) <u>Reduction of Radio Frequency (RF) Interference.</u> Methods of bonding topside metallic devices to ground potential shall be as specified in MIL-STD-1310, which contains a complete listing of those topside devices which require bonding to ground potential. MOD 7

Portable metallic devices (such as hand tools and those shackles and turnbuckles that are not associated with masts) shall be provided with stowage facilities which are located in an inside area, if feasible. If location in an inside area is not practicable, the stowage facility shall be located below the main deck.

Topside devices which tend to cause, radiate, or intensify RF interferences (such as doors, hatches, scuttles, storage containers, ladders, supports, window frames, stanchions, handrails, tackle, and rigging) shall preferably be constructed of a non-metallic material if practicable. Non-metallic devices shall be designed with adequate strength to perform their functions. Where flexibility or the joining of dissimilar metals is not a requirement, all joints shall be welded. Where the device must be constructed of metallic materials and flexibility or the joining of dissimilar metals is a requirement, the device shall be bonded to ground potential. Methods of bonding such metallic devices to ground potential shall be as specified in MIL-STD-1310, which contains a complete listing of those topside devices which require bonding to ground potential. MOD 7

For below deck RF interference bonding to ground potential, see Sections 1.300, and 1.406.

1.0-2.2 METRIC DESIGN

(HMR 89

The PHM ship design and construction shall employ metric units of measure to the following extent:

(a) Ship- Structure. The basic ship structure, including hull and support structure, bulkheads and closures, decks and platforms, superstructure and foundations, shall be defined in metric units and dimensions. This includes the material size and gage of the raw material used in the construction of the ship.

MOD 1

(b) Custom Designed Equipment. - Equipment designed specifically for PHM application shall have dimensions, interfaces and performance data defined *in* metric units. Exceptions are in the design of gearing, where, to achieve optimum performance, the gear standard used (metric or inch) is the option of the manufacturer.

(c) Existing Equipment. Non-metric equipment shall be used in its existing condition with interface dimensions translated to metric units. Installation of non-metric equipment shall be accomplished with the largest metric fastener permitted by the existing mounting hole.

(d) Purchased Part Standard. Metric standard parts shall be used wherever possible; however, the use of U.S. Standard Parts are permitted when equivalent *metric* parts are not available *or* are metric translation of U.S. Standard Parts. In the case of threaded fasteners, the metric standard shall be as developed specifically for PHM application.

(e) Where practical, tools such as scales, micrometer calipers and dial indicators used to fabricate metric parts will be graduated in metric units.

(f) Tooling such as drills, wrenches, and taps will be provided in the International System of Units preferred metric sizes.

1.0-2.3 IDENTIFICATION AND LABELING

Hull designation and marking, identification and labeling of all machinery, piping, tubing, instrument dials, placards and instruction plates shall be provided as required in 1.690.

1.0-2.3.1 Definitions

Identification Plate. A plate installed by a manufacturer on his machinery or equipment which bears essential identification data. MIL-STD-130 applies.

Information Plate. A plate installed by a manufacturer or contractor that bears essential warning, operating, and maintenance instructions.

Label Plate. A plate installed by a contractor which designates the component as part of a shipboard system, designates basic location number of a component, or provides other necessary identification or information in addition to that appearing on identification plates or information plates.

Basic Location Number. A series of three numbers, separated by hyphens, designating in the following sequence the vertical, longitudinal, and transverse location of a component in the ship.

1.0-2.3.2 General

(a) Equipment label plates shall be as provided by the manufacturer.
(b) Instruction and warning plates shall be installed to minimize the possibility of injury to personnel, or damage to equipment resulting from lack of information. Load carrying or lifting gear shall have label plates identifying their use and load capacity, test load and date of last test.
(c) Instrument dial markings, placards, and instruction plates, the understanding of which is necessary for operation and safety of personnel and the ship, shall be in English with units in the metric system.

(d) Items of equipment whose misoperation could aggravate a safety hazard on the ship (i.e., pressure, volume, speed limits) shall have dials, instrumentation and warning plate operating safety limits in both U.S. standard and metric units.

(e) Not Used. MOD 1

(f) Metal label plates to indicate the type of fluid, volumes, pressures, or other pertinent data, shall be provided on tanks and heat exchangers.

(g) Provisions for displaying the ships name boards shall be installed on the 01 level, however, the name boards shall be stowed on the MLSG. MOD 2

1.0-2.3.3 Piping Systems Designation and Marking

Piping in tanks and voids shall not be painted unless required by Section 1.631 for preservation of the piping material. Piping on weather decks, except valves (such as hose valves) shall be painted the same color as the surrounding structure.

Fire plugs and AFFF foam-discharge valves shall be painted red, Color No. 11105 of Fed. Spec. TT-E-489.

1.0-2.3.4 Piping Color Code

Piping, except for lines within tanks, shall be color-banded as specified below and labeled to indicate the direction of flow.

FLUID	BAND COLOR
Fuel	White
Lube Oil	Yellow
Compressed Air	Tan
Fresh Water	Blue
Sea Water	Green
Hydraulic System 1	Orange/Black
Hydraulic System 2	Orange/White
Hydraulic System 3	Orange/Blue
Hydraulic System 4	Orange/Yellow
Chilled Water	Blue Green

1.0-2.4 WELDING AND MECHANICAL FASTENING

This section contains the requirements for welding, mechanical fastening, and associated inspection to insure quality and reliability of ship structural and machinery fabrication.

1.0-2.4.1 Hull Structural Welding And Mechanical Fastening

Fabrication, welding, mechanical fastening, and inspection of hull structure shall be in accordance with publication NAVSHIPS 0900-060-4010, including Change, 1 (NAVSEC 0900-LP-060-4011 dated 1 July 1975) except as specified herein:

Separate quality assurance plan based upon Boeing Doc. D312-80414 shall be submitted for NAVSEA approval. MOD 2

NAVSHIPS 0900-060-4010, Change 1 Section 4 shall be amended by adding the following:

4.7 Ultrasonic Inspection of Welds. Qualification of ultrasonic inspection procedures for inspection of welds shall be in accordance with NAVSHIPS 0900-006-3010, incorporating Advance Change Notice 1 (ACN-1) of July 25, 1966, previously approved procedures shall be resubmitted for approval. HMR 97

4.8 Qualification of Ultrasonic Inspection Personnel for Welds. Personnel engaged in ultrasonic inspection (UT) of welds shall be qualified and certified in accordance with NAVSHIPS 0900-006-3010, incorporating Advance Change Notice 1 (ACN-1) of July 25, 1966, except that Section 4.3 thereof shall be changed to read as follows: Ultrasonic Inspection personnel shall be level II per ASNT-TC 1A. HMR 97 MOD 6

4.9 Ultrasonic Test Equipment Qualification. UT equipment used for weld inspection, shall meet the requirements of NAVSHIPS 0900-006-3010, incorporating Advance Change Notice 1 (ACN-1) of July 25, 1966, as modified by Para. 1.0-2.4.3(i). HMR 97

4.9.1 Records. Records of nondestructive test equipment qualification are not required except as specified in NAVSHIPS 0900-006-3010, incorporating Advance Change Notice 1 (ACN-1) of July 25, 1966. HMR 97

NAVSHIPS 0900-060-4010, Change 1 Section 5 shall be amended by adding the following:

5.3.6 Nondestructive Test Procedure Qualification. These records shall be as required by NAVSHIPS 0900-006-3010 for ultrasonic test.

NAVSHIPS 0900-060-4010 Change 1 Section 6.5.2 shall be deleted and replaced with the following:

"6.5.2 Extent. Radiography and/or ultrasonic inspection plans, procedures and extent of testing shall be documented in the PHM Quality Assurance Plan. RT of critical areas where foil loads are induced into hull structure shall be included. For the weld areas requiring non-destructive testing, either radiography (RT) or ultrasonic inspection (UT) may be used, provided the same method is used for any required reinspections. Ultrasonic inspection shall be accomplished in accordance with NAVSHIPS 0900-006-3010, Class III." HMR 57

NAVSHIPS 0900-060-4010, Change 1 Section 6 shall be amended by adding the following:

6.6 Ultrasonic Inspection (UT). Ultrasonic inspection shall be performed using techniques, procedures, operators, and inspectors qualified as required in Section 4 of NAVSHIPS 0900-006-3010 Inspection of welds shall be performed to procedures in accordance with NAVSHIPS 0900-006-3010 and acceptance standards specified therein. Inspection of materials other than welds shall be performed in accordance with Section 6 to Class III of the acceptance standards outlined in Section 7. Records shall be maintained as required in Section 8 of NAVSHIPS 0900-006-3010. MOD 6 MOD 6 MOD 6

NAVSHIPS 0900-060-4010, Change 1 Section 7 shall be amended by adding the following:

7.5 Liquid Penetrant Inspection. Liquid Penetrant inspection procedure and technique shall be as specified in MIL-STD-271, except delete reference to Group I in Para. 5.3.1, Line 5 through Line 7 and in Para. 5.4, Line 4 through Line 6 and add reference to Group III or Group IV. HMR 19R1

7.7 Ultrasonic Inspection of Welds. Ultrasonic test methods and techniques for inspection of welds shall be in accordance with NAVSHIPS 0900-006-3010. NAVSHIPS 0900-060-4010, Change 1 Section 8 shall be amended by adding the following:

In 8.2, General, add "(e) Ultrasonic." Add 8.7 Ultrasonic Inspection (UT) of Welds. Welds which have been ultrasonically inspected in accordance with Section 6 shall meet the acceptance standards of NAVSHIPS 0900-006-3010, Class III.

NAVSHIPS 0900-060-4010, Change 1 Section 11.3 shall be amended by deleting "nondestructive testing symbols in accordance with AWS A2.2 "Nondestructive Testing Symbols."

NAVSHIPS 0900-060-4010 Change 1 Section 11.3.3.2.1 shall be amended by adding to the end of the paragraph "smaller fillet sizes may be used when stress analysis permits." MOD 2

NAVSHIPS 0900-060-4010 (Basic) Section 12.4.7.1 shall be amended as follows: Add to the end of the first sentence: "unless accomplished with an approved qualified procedure. Essential elements of flame-straightening procedures shall include maximum number of passes, maximum allowable temperature, temperature measuring and quality control provisions, operator qualification requirements, and method of plate repair where critical parameters have been exceeded. Qualification test data must demonstrate absence of sensitization to exfoliation and stress corrosion cracking, and absence of degradation of material tensile properties below specified requirements, under the most severe conditions of heat input to be employed.

HMR 27

MIL-STD-248C, Figure 17, Note 2 shall be revised to add the following: "this limitation shall apply to tack welder performance qualification, but not fillet welder performance qualification."

1.0-2.4.2 Machinery Applications

Machinery, piping, and pressure vessels procured to procurement controlled drawings shall be fabricated and inspected in accordance with MIL-STD-278. Equipment of existing design shall be in accordance with revision C or subsequent revision of MIL-STD-278. Equipment of new design shall be in accordance with MIL-STD-278D.

Liquid Penetrant inspection procedure and technique shall be as specified in MIL-STD-2'71, except delete reference to Group I in Para. 5.3.1, Line 5 through Line 7 and in Para. 5.4, Line 4 through Line 6 and add reference to Group III or Group IV.

HMR 109

1.0-2.4.3 Strut And Foil Applications

Fabrication, Welding and Inspection shall be in accordance with publication NAVSHIPS 0900-000-1000 except as specified herein.

(a) A separate quality assurance plan, based upon Boeing Doc. D312-80415, shall be submitted for NAVSEA approval. MOD 2

(b) MIL-STD-248C Table I shall be amended to add a new "S" class of materials as follows:

TABLE I MOD 2

GROUPING OF BASE MATERIALS (WELDING) 1*

ETTER UMBER	DOCUMENT	CLASS OR TYPE	SPEC 2* (min) YIELD X1000
S-XX	17-4 PH steel in condition H1100 (Postweld solution treated and aged 4 hours at 1100 F, 593 C		
	AMS 5355	17-4 PH investment cast	130
	AMS 5398	17-4 PH sand cast	130
	XBMS 7-239	17-4 PH plate, sheet, strip	130
	XBMS 7-239	17-4 PH bars, forgings, rings	130
	XBMS 7-239	17-4 PH bars, plate, forgings	130

HMR 2

* All notes are the same as they now exist in Table I of MIL-STD-248C.

(c) MIL-STD-248C Table II shall be amended to add W17-4PH filler material as follows:

TABLE II

Applicable Document	Filler Metal Type
PH stainless steel (bare electrode and rod)	
A-XXA	
AMS 5825	W17-4PH
XBMS 7-242	W17-4PH
PH stainless steel (covered electrode)	
A-XXB	
AMS 5827	W17-4PH

(d) MIL-STD-248C, Table III shall be amended to add 17-4PH steel and filler.

TABLE III

GROUPING OF BASE/FILLER MATERIAL COMBINATIONS
FOR WELDING PROCEDURE CROSS-QUALIFICATION 1*, 2*, 9*

Category	Base Material 3* A	Base Material 3* B	Filler Material	Qualified for Categories 4*	
PH stainless steels/gas metal-arc[10], gas tungsten-arc and plasma arc					
I	S-XX	S-XX	A-XXA	I	
II	S-XX	S-XX	A-8B-1	II	
PH stainless steels/shield metal-arc					
I	S-XX	S-XX	A-XXB	I	
II	S-XX	S-XX	A-8A	II	
PH stainless steels/electron beam					
I	S-XX	S-XX	A-XXA	I	MOD 6
II	S-XX	S-XX	NONE	II	MOD 6
PH stainless steel to austenitic stainless steel/gas metal-arc, gas tungsten-arc and plasma arc					
I	S-XX	S-8	A-8B-1	I II	
II	S-8	S-8	A-8B-1	II	
PH stainless steel to austenitic stainless steel/shielded metal-arc					
I	S-XX	S-8	A-8A	I II	
II	S-8	S-8	A-8A	II	

• All notes are the same as they now exist for Table III in MIL-STD-248C.

10 See 4.7.4(c).

(e) With respect to procedure qualification for welding similar and dissimilar metal combinations involving PH stainless steel, MIL-STD-248C, Table VII shall be amended as follows: HMR 27

TABLE VII
WELDING PROCEDURE QUALIFICATION ASSEMBLY TEST REQUIREMENTS

		Destructive Testing 1/*, 3/* 4/*, 15/, 16/, 17/, 19/			Nondestructive Testing		
Material Type	"S" Number Group	Ultimate & Yield Strength Tensiles 6/*	Transverse Side Bends 7/*	Macro Etch 8/* 13/*	Radio-Graphic or Ultra-sonic	Liquid Pene-trant	Mag-netic Parti-cle
Precipitation Hardening Stainless Steel	S-XX	2	3		X		X
Dissimilar Metals	-	2	2 18/	2	X	X	-

• These notes are the same as they now exist for Table VII in MIL-STD-248C

15. For similar and dissimilar base metal combinations involving type S-XX material, five (5) dynamic tear specimens shall be tested from each qualification test assembly except that dynamic tear testing shall be limited to gas metal-arc welded (GMAW) qualification test assembly when type A-8 filler metal is employed. Where the welding procedures within a given process have been previously qualified for PHM-1 Class ships, dynamic tear testing may be limited to one qualification test assembly for the given process. Dynamic tear tests shall be performed in accordance with the methods specified in, and shall meet the acceptance criteria of Table 1.0-3, Note 1 (b), except that the test (notch) location shall be in the weld for specimens welded with type A-XX filler metal and, insofar as practical, at the S-XX fusion line for specimens welded with type A-8 filler metal. All test specimens shall be forwarded to Naval Ship Engineering Center, Code 61010, after completion of test result analysis.

16. For similar and dissimilar base metal combinations involving type S-XX material, two (2) K_{Iscc} specimens shall be tested from each qualification test assembly except that SCC testing shall be limited to gas metal-arc welded (GMAW) qualification test assembly when type A-8 filler metal is employed. Where the welding procedures within a given process have been previously qualified for PHM-1 Class ships, SCC testing may be limited to one qualification test assembly for the given process. All test specimens shall be forwarded to Naval Ship Engineering Center, PHMR 73R1

Code 6101D, after completion of test result analysis. Testing shall be specifically conducted as follows;

(One Cantilever Beam test and one Wedge-Opening Loaded (WOL) test for type A-XX filler metals) HMR 73R1

(a) For Cantilever Beam specimens welded with type A-XX filler metals; SCC test procedures shall be in general accordance with NRL Report 7865: HMR 73R1

(1) Cantilever beam specimens shall be designed so that at 100 KSI $\sqrt{in}$ they are plane strain valid and below net section yielding. Where specimen thickness in excess of qualification test assembly thickness is required to achieve these conditions, double groove joint configurations may be used, in the fabrication of the SCC test specimens only.

(2) Specimens shall be processed to final heat treatment before the test.

(3) A 1,000 hour SCC test shall be performed with the crack area fully immersed in a solution of 3½% NaCl. The initial stress intensity shall be 100 KSI $\sqrt{in.}$

(4) Specimens shall be tested in the weld.

(5) Successful completion of these tests shall consist of the absence of measurable crack growth.

(b) For WOL specimens welded with type A-XX filler metals, SCC test procedures shall be in general accordance with AFML Report TR-73-204, with specimen dimensions and loading methods described in Section 2.3.2, Figure 20, (for titanium alloys). HMR 73R1

(c) For specimens welded with type A-8 filler metal two WOL specimens shall be tested in general accordance with AFML Report TR-73-204, with specimen dimensions and loading methods described in Section 2.3.2, Figure 20, (for titanium alloys) except the 3.00 dimension shall be 3.6 inches. HMR 73R1&73R2

(1) The minimum thickness of the welded specimens shall be 15.9 mm (5/8 inch).

(2) Specimens shall be tested, insofar as practical, at the fusion line of the welds. The initial stress intensity shall be 100 KSI $\sqrt{in}$ minimum.

(3) Specimens shall be processed to final heat treatment, if applicable, before the test.

(4) Duration of the SCC tests shall be 1,000 hours. The crack area shall be fully immersed in a solution of 3½% NaCl.

(5) Successful completion of these tests shall consist of no measurable crack growth at stress intensities of 100 KSI $\sqrt{in}$ minimum.

17. For similar and dissimilar base metal combinations involving type S-XX material, one (1) general corrosion specimen shall be tested from one (1) qualification test assembly for each type filler metal employed. The process used in welding the qualification test assembly is optional. The general corrosion test shall consist of tidal seawater exposure for a period of 45 days. Successful completion of this test shall consist of the absence of measurable pitting attack on the surfaces of the specimen.

18. A single longitudinal face bend may be used in lieu of two side bends.

19. All testing shall represent the weld wire composition which will be used in production, except that XBMS-7-242 and AMS 5825 shall be considered equivalent for qualification purposes.

(f) **MIL-STD-248C,** Table IX shall be amended to add filler materials A-**XXA** and A-XXB for welding PH-PH and PH-Austenitic stainless steels in the PHM foil system as follows:

TABLE IX MOD 2

GROUPING OF FILLER MATERIALS FOR WELDER OR WELDING OPERATORS (PERFORMANCE) QUALIFICATION 1*

Category 2*	Filler Material Group	Categories for Which Test Qualify Welders and Welding Operators 3*		
		Shielded Metal Arc		MOD 6
I	**A-5A,** 5D	I through III		
II	**A-2A, 3A, 4A, 6A, 7A1, 7A2**	II and III		
III	A **1A**	III		
IV	**A-8A,** 43A	IV		
V	**A-34A, 41A,** 42A	**V**		
VI	**A-XXB**	**IV** and VI		
Category 2*	Filler Material Group	Gas Metal Arc 6	Gas Tungsten Arc	MOD 6
I	A-5B	I through II	I through II	
II	**A-1B, 2B1**	**II**	II	
III	**A-8B,** 43B	III	III	
IV	**A-34B, 41B,** 42B	IV	IV	
V	**A31B, 32B, 33B, 35B, 36B, 37B**	V	V	
VI 4'	**A21B, 22B,** 23B	VI	VI	
VII	**A-6B, 7B, 2B-2**	--	VII	
VIII	A-XXA	III and VIII	III and VIII	
Category 2*	Filler Material Group	Electron Beam (Mechanized)		
I	None or A-XXA	I		MOD 4
Category 2*	Filler Material Group	Plasma-Arc (Mechanized)		
I	A-XXA	I and II		
II	A-8B	II		

*All **notes** are the same as they now **exist** for Table IX in MIL-STD-248C and footnote 6, See **5.6(c)** MOD 6

(g) NAVSHIPS ogoo-000-1000 Section 11.3.3.1 shall be amended by adding Item **(d)** as **follows:** MOD 6

"(d) In lieu of the above requirements double fillet weld sizes may be of a smaller size when the stress analysis permits." MOD 1

(h) NAVSHIPS 0900-000-1000 Table 13.2 Paragraph E second sentence shall be deleted and replaced with the following:

"Heat treatment of PHM struts and foils will be accomplished in accordance with a qualified and approved procedure."

(i) Ultrasonic inspection of welds shall be accomplished in accordance with NAVSHIPS 0900-006-3010, incorporating Advance Change Notice 1 (ACN-1) of 25 July 1966, except as modified below: HMR 97

Par. 2.1, delete "..and NAVSHIPS. 0900-006-8010."

Par. 4.2. through Par. 4.2.3, delete and substitute "Equipment qualification shall be based on ASTM E 317-68."

Par. 4.3.1, delete all references to "inspector trainee." In (b), delete "....Section 7" in line 5 and substitute "PHM-3 SSS."

Par. 4.3.2.1, delete in entirety and substitute, "Personnel certification shall be based on SNT-TC-1A".

Par. 4.3.2.3, delete in entirety.

Par. 4.4.2, after first sentence add, "Acceptance/rejection criteria based upon using notch standards and signal amplitude can be used when the recorded depth of the discontinuity is less than 1.0 mm."

Par. 5.2.4., delete "Section 7" and substitute "PHM-3 SSS".

Par. 5.2.5, delete "3" and substitute "6".

Par. 6.3.3, delete first two sentences and substitute, "Transducer size shall not exceed ½" x ½".

"Nominal frequency shall be 5 MHZ."

The fourth sentence shall read, "The primary considerations for selecting the resulting angle of shear wave shall be that the search angle shall not equal the "prep" angle in any case and the thickness of the plate as follows:"

(a) Delete and substitute, "For plate thicknesses up to and including ½" - a 60° or 70° shear wave." HMR 97

(b) Delete and substitute, "For thicknesses over ½" - a 45° or 60° shear wave."

(c) Delete in entirety.

Par. 6.3.5.2, delete in entirety.

Par. 6.3.5.4, delete in entirety.

Par. 6.3.6.1 and 6.3.6.2, delete in entirety.

Par. 6.3.6.6, add, "The recorded depth of a discontinuity shall be the minimum and maximum perpendicular distances of the discontinuity from a plate surface. This should be determined in the following manner:

(a) Maximize the indication from the discontinuity.

(b) For discontinuities extending to a surface, move the search unit toward the discontinuity. When the indication begins to drop rapidly to the baseline, record the depth from the viewing screen. HMR 97R1

(c) In addition, for discontinuities which do not extend to the surface, repeat the above and move the search unit away from the discontinuity to determine the other limit of depth."

Par. 6.4.1.2, delete entirely and substitute: "The size of the transducer used for inspection shall not exceed ½" x ½". The nominal frequency shall be 5 MHz."

Par. 6.4.1.3, delete entirely and substitute the last two sentences of Par. 6.4.3.3. Also delete Figure 6-8.

Par. 6.4.1.4, after the last sentence, add the first two sentences of Par. 6.4.3.5.2.

Par. 6.4.1.4.1 and 6.4.1.4.2, delete entirely. Also delete Figures 6-9 and 6-10.

Par. 6.4.1.5, in the first sentence delete, "....or mechanical means."

Par. 6.4.2.1, add, "The inspection zone can be expanded as necessary to determine the extent. of the discontinuity."

Par. 6.4.2.3, in the first sentence, delete "one inch" and substitute "½ inch x ½ inch". In the second sentence, delete in entirety and substitute, "The nominal frequency shall be 5 MHz." In the third sentence delete "60°" and substitute "70°".

Par. 6.4.2.5, delete second and third sentences.

Par. 6.4.2.6, delete second and third sentences. Delete "6-12" from fourth sentence. HMR 97

Par. 6.4.3, delete the second sentence and substitute, "The half amplitude method shall be used."

Par. 6.4.3.1, delete "....may have primer not to exceed 4 mils, and ....".

Par. 6.4.3.2, delete "....a minimum of 2 mc" and substitute "....5 MHZ."

Par. 6.4.3.3, delete entirely. Substitute, "The calibration standard for the half amplitude method is the through member plate, see Figure 6-7."

Par. 6.4.3.4, delete in entirety and substitute the first two sentences of Par. 6.4.3.5.2.

Par. 6.4.3.5.1, delete in entirety. | HMR 97

Par. 6.4.3.5.3, third line, delete "6.4.3.5.1" and substitute "6.4.3.5.2".

Section 7, delete entirely and substitute, Weld acceptance/rejection criteria shall be in accordance with PHM-3 SSS."

In all cases, delete "the Bureau" and substitute "NAVSEA".

In all cases, delete "the Bureau of Ships" and substitute "NAVSEA".

HMR 97

Accept/reject weld defect size shall be as follows: HMR 97

1. Standard Welds:
   - (a) Indicated defects less than or equal to 0.5 mm deep are acceptable.
   - (b) Indicated defects between 0.5 mm and 0.76 mm deep and over 7 mm long shall be rejected.
   - (c) Indicated defects greater than 0.76 mm deep shall be rejected.
   - (d) Adjacent indicated defects with a measured separation of less than 2L of sound metal shall be considered as a single defect for the criteria of (a) through (c) above. HMR 97R1 Where L is the measured length of the longest adjacent defect and sound metal is that which passes the criteria of (a) above. HMR 97R1 If the total

accumulated length of defects that pass (b) and (c) above in any 300 mm length of weld exceeds 2t the length of weld shall be rejected. Where t is the material thickness. HMR 97R1

2. Blind Welds: HMR 97
   - (a) Indicated defects less than or equal to 0.5 mm deep are acceptable.
   - (b) Indicated defects between 0.5 mm and 1.25 mm deep and over 50 mm long shall be rejected.
   - (c) Indicated defects greater than 1.25 mm deep shall be rejected.
   - (d) Adjacent indicated defects with a measured separation of less than 2L of sound metal shall be considered as a single defect for the criteria of (a) through (c) above. Where L is the measured length of the longest defect and sound metal is that which passes the criteria of (a) above. If the total accumulated length of defects that pass (b) and (c) above in any 300 mm length of weld exceeds 2t the length of weld shall be rejected. Where t is the material thickness. HMR 97Rl HMR 97R1 HMR 97R1

NAVSHIPS 0900-006-3010 incorporating ACN- 1, Section 5.2.3.2 shall be ammended by adding: "except that the 8 hour delay shall apply only to final weld inspections." HMR 97

(j) NAVSHIPS 0900-000-1000, Section 6.6.1 shall be amended by adding:
"Inspection requirements for strut and foil production

assemblies shall be as specified in the PHM Quality Assurance Plan for Foils and Struts (D312-80415-1)."

(k) MIL-STD-248C, Section 4.7.8 Item C, shall be amended to read as follows:

"Requalification of PH stainless steel welding procedures is not required when the weldments are stress relieved at temperatures up to 1150°F prior to solution treating and aging."

(l) NAVSHIPS 0900-000-1000 Section 12.4.6.6 shall be amended to permit qualification of flame straightening: "To qualify flame straightening of weldments incorporating 17-4 PH steel postweld treated to condition H1100 at temperatures in excess of 593°C (1100°F), qualification testing of one assembly shall be required. Testing shall comprise RT and MT inspection of the test assembly, and destructive testing corresponding to that required for GMA welding procedure qualification, including dynamic tear, stress corrosion cracking, and general corrosion tests. The two SCC test specimens shall be loaded to produce a crack tip stress intensity of 100 ksi$\sqrt{\text{in}}$, but the plane strain validity requirement of section (a) (1) of Note 16 to Table VII of MIL-STD-248C shall not apply. The test assembly shall be 15.9 mm thick 17-4 PH base metal welded by GMA process using production 17-4 PH filler metal. Test assembly shall receive solution-age

MOD 6 HMR 88

treatment to condition H1100 prior to flame straightening. Test straightening shall be conducted in accordance with a written straightening procedure, which shall be submitted with test data. The test straightening operation shall comprise the maximum number of passes at the maximum temperature permitted by the production procedure." HMR 88

(m) MIL-STD-248C, Section 4.4.1.9, shall be amended by changing the parenthetical exception to read: MOD 4 & 6

"(Except weld metals which are subjected to a postweld heat treatment above the critical range shall be limited to 1.1T, where T is the thickness of the procedure qualification test assembly)."

(n) MIL-STD-248C shall be amended by adding the following new section 4.4.1.10.

"4.4.1.10 <u>Combination of Welding Process or Procedures</u>. More than one process or procedure may be used in a single production joint. Each welding process or procedure shall be qualified either separately or in combination with other processes or procedures for the base metal thickness and for the deposited weld metal thickness range for each of the processes or procedures to be used in the production joint. For multiprocess or multiprocedure applications, the qualified thickness of each process or procedure shall <u>not</u> be additive in determining the maximum thickness of the production joint to be welded. One or more processes or procedures may be deleted from a production joint qualified by a combination of processes or procedures provided each remaining process or procedure has been, in the specific HMR 57 combination welding process or procedure qualification, qualified for the deposited weld metal thickness range for each of the processes or procedures to be used in the production joint."

(o) For S-XX materials welded with type A-XX filler materials, Section 4.5.2.1 of MIL-STD-248C shall be revised to add:

"(d) Transverse weld tensile speciments of S-XX base metals, welded with type A-XX filler metals, shall be tested for indicated yield strength (0.2 percent offset) using a 4D or 2 inch extensometer. For acceptance, the indicated yield strength shall be 896-1102 MN/m^2 (130-160 ksi).

(p) With respect to strut/foil welding procedure qualification, NAVSHIPS 900-000-1000, Section 4.3 shall be revised to read:

"Before production application on strut/foil structures, welding procedures shall be qualified. Type 2, 17-4PH steel per XBMS 7-239A should be used in the fabrication of qualification test assemblies involving S-XX base metals. Material procured to other specifications may be used for procedure qualification tests provided the chemical composition and delta ferrite content of the material are verified and conform to the requirements for 17-4PH steel per XBMS 7-239A. Welding procedures shall be qualified in accordance with MIL-STD-248C except: HMR 27

(a) For production and repair welding of S-XX/S-XX base metal combinations, welded with type A-XX filler metal and post-weld heat treated employing a full solution treatment and aging cycle, qualification testing in the vertical and horizontal positions shall qualify for all position shielded metal-arc welding (SMAW) and gas tungsten-arc welding (GTAW).

(b) For production and repair plasma-arc welding (PAW) of S-XX/S-XX base metal combinations welded with type A-XX filler metal and postweld heat treated employing a full solution treatment and aging cycle, qualification testing of a multipass welded test assembly shall qualify **multi-** pass plasma-arc welding (PAW) of thicknesses up to **1.1T,** when T is the thickness of the test assembly. Multipass qualification and the approval of test data from one single pass PAW test assembly shall qualify single pass PAW up to a thickness limit of **1.1T.** Use of a cosmetic pass to correct minor undercut or underfill conditions in a single pass weld is optional and shall not be considered an essential variable which would require requalification. Destructive testing of single pass qualification test assemblies. shall be limited to the performance of tensile and bend tests. HMR 27

(c) To qualify electron beam welding **(EBW),** qualification tests shall be conducted on test assemblies representing the thinnest and thickest gages to be welded in production. The welding position(s) shall be representative of the production application(s). Destructive testing of the thinner qualification test assembly shall be limited to the performance of tensile and bend tests.

(d) Use of melt-thru (open root, single groove, welded from one side) tee and corner joints in S-XX/S-XX base metal combinations to be welded with type A-XX filler metal shall required qualification testing of one such representative joint. The qualification test assembly shall be at least 19 mm thick and shall be welded using manual **gas** tungsten-arc **(GTAW)** root passes and semiautomatic gas metal-ARC (GMAW) fill passes. This qualification test shall qualify the use of manual GTAW for root pass welding of **melt-**thru tee and corner joints in production. Use of other manual or semiautomatic processes for root passes in production melt-thru tee and corner joints shall require requalification of that process as described in this paragraph. Destructive testing of the qualification test assembly may be limited to the performance of two tensile tests and two each, root bends and face bends. The simulated web section of the test assembly shall be machined flush with the tee cap prior to testing, but root undercut, burnthrough and lack of fusion shall not be removed if present. HMR 27

(e) For repair and rework welding **of** s-xx/s-xx base metal combinations, welded with type A-XX filler metal and not **postweld** heat **treated** employing a full solution treatment and aging cycle, qualification testing in the direct aged and as-welded conditions will be required, as applicable. Two (2) qualification test assemblies, one (1) representing a fullthickness repair and the other simulating a halfthickness repair, shall be prepared for each welding procedure to be qualified. Welding of the test assemblies shall be performed in the position, HMR 27 and employ welding parameters representative of the highest heat input for each process to be qualified. Simulated half-thickness repairs shall be made on qualification test assemblies which were originally gas metal-arc welded (GMAW), using a standard joint, and postweld heat treated employing a full solution treatment and aging cycle to condition H1100. Qualification testing, including dynamic tear and stress corrosion cracking tests, shall be performed on qualification test assemblies representing both full-thickness and half-thickness repairs for each major weld process to be qualified. Where repair welding procedures within a given process have been previously qualified for PHM-1 Class Ships, the dynamic tear and SCC testing requirements may be limited to *one* procedure qualification for the given process.

(f) A qualification for S-XX to S-XX base metal using type A-8 filler metal also qualifies production, repair and rework welding procedures for S-8 to S-XX and S-8 to S-8 base metal combinations welded with Type A-8 filler metal. Where the welding procedures within a given process have been previously qualified for PHM-1 Class Ships, qualification testing may be limited to one procedure qualification test for the given process. Welding of the test assemblies shall employ welding parameters representative of the highest heat input for each

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procedure. Qualification test assemblies shall be postweld heat treated to the condition to be qualified prior to testing. Full qualification testing of assemblies in both the as-welded and direct aged conditions may be used to qualify a procedure for weldments in the following final heat treat conditions: "As welded, Welded and Stress Relieved, Direct Aged, and H1100."

(g) Procedure qualifications prepared for Government agencies, American Bureau of Shipping (ABS), American Society of Mechanical Engineers (ASME), or other regulatory codes for the welding of 15-5PH or 17-4PH stainless steel base metals with Type A-XX filler metals shall be considered acceptable proof of Level II requalification for the welding of S-XX to S-XX base metals with A-XX filler metal. They shall not be used for Level I qualification. HMR 27

(q) MIL-STD-248C, Table VII, Note 7, and MIL-STD-418C, Figure 6, shall be revised to permit fabrication and testing of side bend specimens from test plates having a minimum thickness (T) of 3/8 inch (minimum side bend specimen width (W) of 3/8 inch). MIL-STD-418C, Figure 6, Note 3 shall be further revised to permit double-groove weld plate thicknesses (T) over 1½ inch thick to be cut into an odd number of approximately equal strips to provide bend test specimens having a width (W) between 3/8 inch and 1½ inch and a thickness (T) that satisfies the requirements of MIL-STD-418C, Figure 6, Note 2 and the nomograph of MIL-STD-418C, Figure 15. The specimen HMR 27 sectioning and thickness dimensions shown on the double-veeweld sketch of MIL-STD-418C, Figure 6 shall be deleted. HMR 27

(r) Revise MIL-STD-248C, Section 3.2.3, to add the following clarification to the definition of dissimilar metal welds:

> "The dissimilarity may be a result of the base metal combination present, or the base metal/filler metal combination."

(s) For purposes of the Specification NAVSHIPS 0900-000-1000; Section 10 shall be amended to include Table 10-8.

HMR 19R2
HMR 19R1 & 19R2

Table 10-8. Welding Electrodes And Processes For PHM-3 Series Strut/Foil System

Base Material	Base Material Type: Alloy Type	Base Material Type: Specification	Welding Process	Filler Metal: Mil-type	Filler Metal: Spec.	Joint Type	Welding Position
High Strength, Martensitic Steel to Itself	17.4	XBMS 7-239 AMS 5398 AMS 5355	SMA	W17-4 PH	AMS 5827	Butt Tee Corner	ALL
			GMA, GTA	W17-4 PH	AMS 5825 XBMS 7-242		
			PA	W17-4 PH	AMS 5825 XBMS 7-242	Butt	
			EB	W17-4 PH	AMS 5825 XBMS 7-242	Square Butt	
High Strength Martensitic Steel to Type 321 High Alloy Steel, austenitic	321	QQ-S-766 QQ-S-763 MIL-P-1144	SMA	MIL-347-XX	MIL-E-22200/2	Butt Tee Corner	ALL
			GMA, GTA	MIL-347	MIL-E 19933		
			PA EB	MIL-347	MIL-E 19933	Butt	

(t) Paragraph 4.5.2 of MIL-STD-248C shall be revised to permit guided bend testing to be performed using the guided bend wrap around test jig specified in Section IX, ASME Boiler and Pressure Vessel Code. HMR 27

(u) MIL-STD-248C, Table VI, Note 3 shall be revised to read: "When a postweld heat treatment above the critical range is to be employed, the maximum thickness qualified is l.lT, where T is the thickness of the procedure qualification test assembly."

(v) MIL-STD-248C, paragraph 4.8, shall be revised to the extent indicated below:

"(g) For processes other than electron beam welding, a change of more than plus or minus 25 percent from the welding current or voltage qualified for machine and automatic welding.

(h) For electron beam welding, a change in the beam current of more than plus or minus 5 percent; or voltage of more than plus or minus 2 percent; or welding speed of plus or minus 5 percent or 12.7mm (1/2 inch) per minute, whichever is greater; or beam focus current of more than plus or minus 5 percent; or gun-to-work distance of more than plus or minus 5 percent; or a change in oscillation length or width of more than plus or minus 20 percent; or any change in the beam pulsing frequency duration from those previously qualified.* HMR 57

(w) NAVSHIPS 0900-000-1000, Table 13-1, shall be revised as noted following: HMR 57

TABLE 13-1

Preheat and Interpass Temperatures for Joint Welding, Tacking, Overlaying or Gouging HMR 27

Material	Thickness	Preheat and Interpass Temp. °F Minimum	Preheat and Interpass Temp. °F Maximum	Preheat and Interpass Temp. °F For Air-Arc Gouging Minimum	Preheat and Interpass Temp. °F For Air-Arc Gouging Maximum
Austenitic Stainless (CRES)	All	60	350	60	550
Precipitation Hardening Stainless	All	60	Note (4)	60	450

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HMR 57

(x) "MIL-STD-248C, Figure 17, Note 2 shall be revised to add the following:
This limitation shall apply to tack welder performance qualification, but not fillet welder performance qualification."

(y) For purposes of the Specification NAVSHIPS 0900-000-1000, Section 7.5 shall be amended to read as follows:
7.5 Liquid Penetrant Inspection. Liquid penetrant inspection shall be as specified in MIL-STD-271, except delete reference to Group I in Para. 5.3.1, line 5 thru line 7 and in Para. 5.4 line 4 thru line 6 and add reference to Group III or Group IV. HMR 19R2

(z) Revise NAVSHIPS 0900-000-1000 as follows:
(1) Paragraph 9.3.3, delete and substitute "9.3.3 Repairs. All repairs to cold formed material surfaces may be made after forming." HMR 123

HMR 123

(2) Figure 12-2, in the two sketches for weld No. 1 and in Note 1, delete "9" and substitute "3".

(3) Paragraph 13.3.1, add the following at the end of the paragraph. "Except for high hardenable steels, double-bevel and weld joint designs may be prepared by beveling one side prior to any welding with the second side being beveled after sufficient welding on the first side. For HY-80, HY-100, and high hardenable steels, back-gouging of the second side after welding the first side will require grinding the gouged surface to bright metal prior to welding the second side."

(4) Table 13-2, Item A, line 6, delete "shall" and substitute "should", and in line 7, insert "possible" between "and" and "scaling".

(5) Paragraph 14.2.2.2, line 4, after "surfaces", add approximately".

(6) Paragraph 14.8 line 5, delete "3/8" and substitute "3/4".

1.0-2.5 THREADED FASTENERS

1.0-2.5.1 Definitions

Definitions shall be as given in the following:

HANDBOOK H28 (Screw-Thread Standards for Federal Services).

USAS STD. B18.12 (Glossary of Terms for Mechanical Fasteners).

Where conflicting definitions occur, those of HANDBOOK H28 govern, except as follows:

<u>Bolt</u>. A fastener with a head on one end and the body threaded as required. It is a THROUGH BOLT where a nut is used on the threaded portion, or a TAP BOLT (or SCREW) where the threaded portion is turned into a tapped hole other than a nut.

<u>Bolt-stud</u>. A fastener threaded with the same form and fit of thread on both ends or throughout its length. It is used with a nut on each end.

<u>Stud-bolt or stud</u>. A fastener threaded on each end; the driven or setting end is usually threaded with an interference fit, or with special threads suitable for the application.

Metric threads shall conform to International Standards Organization (ISO) recommendation R68 and associated standards referenced therein.

Inch screw threads shall comply with the standards of HANDBOOK H28 for the unified series.

For pipe threads and special threads (such as Acme threads and electric socket and lamp base threads), the standards in HANDBOOK H28 are applicable.

For unified threads, the coarse thread series shall be used unless the component design indicates a necessity for use of the fine thread series. In the selection of pitches finer than 16 threads to the inch, use shall be made of 20, 28,36,44, or 56 threads to the inch.

1.0-2.5.2 Thread Fits

Metric threaded fasteners shall have threads to 4h/5H and 6g/6H tolerances for the precision and commercial grades of fasteners, respectively.

Unified 2A/2B fit shall be used on all important stationary machinery parts such as nut ends for studs of cylinder heads, casing and housing joints, and as the machinery fit generally used.

Unified 3A/3B fit shall be used only for high strength fasteners and for interchangeable screw thread work where the accuracy of lead and angle of thread is required.

Unless otherwise specified in a referenced equipment specification, Class 5 fit shall be used for the setting end of studs and for special fitted work where thread interference is required and disassembly is unlikely. Interferencefit external threads shall be NC5HF in accordance with HANDBOOK H28.

1.0-2.5.3 Threaded Fastener Assemblies

For a threaded fastener, not less than one thread shall protrude beyond the crown of the nut except where torque - controlled, pre-stressed bolts and nuts are used. With self-locking nuts, the end of the thread runout shall be at least one thread above the top of the nut. Washers shall not be used under the nut for the sole purpose of lessening thread protrusion.

Thread engagement for the setting end of a stud shall be such that the shear load strength of the engaged threads is more than the tensile load strength of the stud.

For materials having similar mechanical properties, the full thread engagement shall be not less than one major diameter (1D). For materials having dissimilar mechanical properties, the minimum engagement of stud setting threads shall be computed in accordance with HANDBOOK H28, Part 1, Appendix 5, using the maximum expected tensile strength of the stud material and minimum specified (or expected, where no minimum is specified) tensile strength of the body material, plus one thread; but in no instance less than 1D.

Bottom tapping is permissible only where metal thickness is insufficient for 1.5D full thread engagement plus thread run-out and beveled end. Bottomtapped holes shall have sufficient complete threads to insure full engagement of the mating fastener threads.

Foundation bolts or studs shall not be less than 5 mm (0.2 in.> in diameter.

Through bolting shall be used, wherever possible. Where use of such bolting is not possible, studs, tap bolts, or machine screws may be used.

Thread lubricants or anti-seize compounds shall be selected for use on threads on the basis of the one best suited for the application and environment.

For additional requirements for foundation bolting, see Section 1.100.

1.0-2.5.4 Bolting For Shock Resistance.

Where alinement must be maintained fitted bolting in accordance with Table 1, or other positive-interference methods shall be used.

For services involving integrity of the hull against the sea, mounting bolts or studs of essentially uniform strength throughout their length shall be provided.

Where an application requires the development of the full mechanical property capabilities of externally threaded fasteners threads shall be rolled after the material has reached its full heat treated condition.

Externally-threaded fasteners having changes in cross section area, such as shouldered bolts, may be used provided such changes are accomplished by generous fillet radii.

Self-locking nuts of a distorted top type shall be used to prevent loosening due to shock or vibration. Material shall be A-286 corrosion resisting alloy; for service

I HMR 55

up to $232^{\circ}C$ ($450^{\circ}F$) nuts shall be solid film lubricant coated. For service above $232^{\circ}C$ ($450^{\circ}F$) nuts shall be silver plated.

Bolt hole edges shall be leveled as required to clear the bolt head radius.

1.0-2.5.5 Intentionally Left Blank HMR 88

1.0-2.5.6 Bolting For Services Involving Integrity Of The Hull Against The Sea.

Fastener material and strength shall be dictated by the application strength, material compatibility requirements and environmental requirements.

1.0-2.5.7 Material For Bolting

Materials for structural and equipment mounting fasteners for the ship environmental areas as specified shall be as shown in Table 2.

Bolting in piping systems shall be as specified below. All threaded fasteners in the struts and foils shall be made from materials listed in Table 1.0-2.5.7. MOD 6 HMR 17

Non-magnetic screw fasteners shall be in accordance with Mil. Spec. MIL-F-19700.

Aluminum and aluminum alloy parts shall be assembled with corrosion resistant steel per QQ-S-763 (or DIN fastener possessing equivalent characteristics) or A 286 corrosion resistant steel per AMS 5735 or 5737. HMR 117 MOD 6

Where the connection is exposed to moisture, other than seawater, bolts of corrosion-resistant steel Fed. Spec. W-S-763 (or DIN fastener possessing equivalent characteristics), shall be used. Where throughbolting is not possible, corrosion resistant steel inserts to take fasteners shall be turned into the aluminum or aluminum alloy using wet zinc chromate primer TT-P-645. The insert shall be collar-, key-, pin-, ring-, or swagelocked, or nylon-element locked to prevent backing out. Where bolting HMR 117 HMR 55

TABLE 1.0-2.5.7

BOLTING MATERIALS FOR STRUTS AND FOILS

MATERIAL	FORM	SPECIFICATION	CONDITION
A 286	Fasteners	ASTM A638, Gd 660 AMS 5735 AMS 5737 AMS 5525	
MP 35 M	Fasteners	SPS-M-573	
INC0718	Fasteners	AMS 5662	
T1, 6Al-4V	Fasteners	AMS 4928 AMS 4967	Note 1
Monel K-500	Fasteners	W-N-286 MIL-N-17506 AMS-4676	A
Monel 400	Nuts	CR-N-281	A or B
300 Series CRES	Washers	MIL-S-5059 MIL-S-6721	

HMR 17

HMR 167

NOTE 1. Stress Corrosion Cracking (SCC)

Titanium bolts shall not exhibit stress corrosion as determined by SCC testing. Testing shall be conducted one time for fasteners ½ inch nominal or larger diameter, for each supplier as follows: HMR 17

1. At least three bolt samples shall be pre-flawed by machining and fatigue precracking an initial surface flaw defect .762mm deep by 2.54mm long and tested.

2. Specimens shall be processed to final heat treatment before the test.

3. A 100-hour SCC test shall be performed with the crack area fully immersed in a solution of 3½ percent NaCl. The specimen shall be loaded in axial tension at a stress level equal to 100% of the limit stress for that bolt.

4. Successful completion of these tests shall consist of the absence of measureable crack growth and no failure of the bolt.

5. All test specimens shall be forwarded to Naval Ship Engineering Center, Code 6101D, after completion of test result analysis.

stress is primarily in tension, solid wall (bushing) type inserts shall be used. Where bolting stress is primarily in shear and tension stress is negligible, either solid wall (bushing) type or helical coil type (Mil. Std. MS-21208).

Alloys of copper (brass, bronze, copper-nickel) shall not be used in threaded contact with aluminum or aluminum alloys. On the ship exterior, or where exposed to sea water or spray, corrosion resistant steel washers shall be fitted below all nuts and bolt heads which adjoin aluminum or aluminum alloys. In addition, a fiberglass washer shall be installed between the aluminum material and the steel washers. In sea air interior applications, aluminum washers or CRES plus fiberglass washers may be used.

HMR 167

Fasteners fabricated by powder-metallurgy process shall not be used.

Thread sealing or thread locking compounds shall be selected on the basis of compatibility with the environment in which they will be used.

The basic externally threaded fasteners will be:

MOD 6, HMR 117

Metric fasteners of A286 corrosion resistant steel to the requirements of National Aerospace Standards (NAS) 4003 modified for metric sizes.

Metric fasteners of American Iron and Steel Institute (AISI) 300 series corrosion resistant steel to the requirements of MIL-B-6812 modified for metric sizes or corresponding German industrial standards (Deutsche Industrie Normen - DIN) possessing equivalent characteristics.

Nuts will be of the same materials to the requirements of MIL-N-25027 modified for metric sizes and the specified strength levels, or corresponding DIN possessing equivalent characteristics.

TABLE 1 - BOLTING FIT LIMITS FOR SHOCK RESISTANCE

Nominal Size (MM)	Max. Clearance (+) (mm) Max. Interference (-)
6 to 10	+0.010 -0.025
12 to 24	+0.013 -0.028
30 to 42	+0.015 -0.031

TABLE 2

MATERIALS FOR FASTENERS

Item	Application	Specification & Material	Galvanic Isolation and Corrosion Protection Reqmt.	
1	Sea Water Immersion Areas include: - bilge (continuously wet) - below waterline (exterior) - struts and foils (exterior)	NAS 4003, Bolts (except metric sizes); A286 Matl. MIL-N-25027, Nuts (except metric sizes); A286 Matl. BMS 5-95 (MIL-S-81733), Polysulfide Sealant HIL-B-6812 Bolts (except metric sizes) or DIN fasteners possessing equivalent characteristics. FF-S-86 Bolts (except metric sizes) A286 MIL-P-18177, type GEE NEMA G10 or Rexnord Duralon Washer and Ferrule Matl.	CRES to CRES, CRES to Titanium and Titanium to Titanium -Bolting materials per Table 1.0-2.5.7 installed with wet sealant Aluminum to Aluminum -A286 Bolt, Nut, CRES washers. Isolate fastener with Fiberglass Washer and ferrule. Installed with wet sealant. Non-Metal to Aluminum A286 bolt k nut, CRES washers. Isolate fastener with a fiberglass washer against aluminum and ferrule. Install with wet sealant.	HMR 17 HMR 17 HMR 167
	Components requiring galvanic isolation in machinery spaces Struts and foils (interior)	Bolting material per Table 1.0-2.5.7. 300-series CRES Washers per MIL-S-5059 or MIL-S-6721 or DIN Washers possessing equivalent characteristics.	Aluminum to CRES A286 bolt k nut, CRES washers. Isolate fastener with a fiberglass washer k ferrule. Install with wet sealant. Aluminum to CRES A286 bolt k nut, CRES washers. Installed with a fiberglass washer k wet sealant. Ferrule may be omitted where its bearing strength is inadequate provided the dissimilar metal joint is thoroughly sealed; i.e., wet sealant is to be used on all faying surfaces.	HMR 17 HMR 167
2	Spray and Occasional Immersion in Sea Water Areas include: - on and below main deck (exterior) - machinery rooms above bilge (where occasionally exposed to sea water or spray) - Bilge (occasionally wet).	NAS 4003, Bolts (except metric sizes); A286 Matl. HIL-N-25027, Nuts (except metric sizes); A286 Matl. BMS 5-95 (MIL-S-81733), Polysulfide Sealant. HIL-B-6812 Bolts (except metric sizes) or Din fasteners possessing equivalent characteristics. FF-S-86 Bolts (except metric sizes) A286 MIL-P-18177, type GEE NEMA G10 or Rexnord Duralon Washer and Ferrule Matl.	CRES to CRES, CRES to Titanium and Titanium to Titanium Bolting materials per Table 1.0-2.5.7 installed with wet sealant. Aluminum to Aluminum A286 bolt k nut, CRES washers. Install with fiberglass washers k wet sealant. Non-Metal to Aluminum A286 bolt k nut, CRES washers. Installed with fiberglass washer against aluminum and wet sealant. Aluminum to CRES A286 bolt and nut, CRES washers. Installed with fiberglass washer against aluminum and wet. sealant.	HMR 17 HMR 17 HMR 167 HMR 167 HMR 17
	Components not requiring galvanic isolation in machinery spaces.	Bolting materials per Table 1.0-2.5.7. 300-Series CRES Washers per MIL-S-5059 or MIL-S-6721 or DIN Washers possessing equivalent characteristics.		HMR 167

TABLE 2

MATERIALS FOR FASTENERS

(CONTINUED)

ITEM	APPLICATION	SPECIFICATION 6 MATERIAL	GALVANIC ISOLATION AND CORROSION PROTECTION REQMT.	
3	Sea Air. Exterior Areas include: • above main deck (exterior) • doorways (exterior)	MIL-B-G812 Bolts (except rtrlc sizes) 300 Series CRES Matl, or DIN fasteners possessing equivalent characteristics. FF-S-86 Bolts (except metric sizes) A286 or 300 series CRES otl. 300 Series CRES Washers per MIL-S-5059 or ML-S-6721 or DIN Washers possessing equivalent characteristics. NAS 498 Screws (except metric sizes) 300 Series CRES Matl. or DIN fastener possessing equivalent characteristics. MIL-M-25027 Nuts (except metric sizes) 300 CRES or A266 Matl., or DIN fasteners possessing equivalent characteristics. n-P-641 Zinc Chromate Prim m-5.95 (m-s-aim) Polysulfide Sealant MS 4003 Bolt5 (except metric sizes) A286 Matl. QQ-S-763; 300 Series Corrosion Resisting Steel or DIR material possessing equivalent characteristics. MIL-P-18177, Type GEE NEMA G10 w Rexnord Durrlon Washer Matl. A286 material is used for all applications that require high strength (1100MPa), hiqh temperature (650°C) and non-magnetic applications.	CRES to CRES • CRES/A286 bolt, nut and washers installed with wet primer or sealant Aluminum to Aluminum • CRES/A286 bolt, nut a washers with fiberglass washers against aluminum installed with wet primer or sealant. Non-Metal ta CRES • CRES/A286 bolt, nut & washers installed with wet primer or sealant. Non-Metal to Aluminum • CRES/A286 bolt, nut • d washers with fiberglass washer against aluminum installed with wet primer or sealant. Aluminum to CRES • CRES/A286 bolt. nut and washers with fiberglass washer against aluminum. Installed with wet primer Primer w sealant a dissimilar metal faying surfaces.	an 117 HMR 167 HMR 117 HMR 117' HMR 117
4	Sea Air. Interior Area5 Include: · wheelhouse (interior) • fuel tanks • crew Interior • interior void5 6 below deck compartments	MIL-B-6812 Bolts (except metric sizes) 300 Sever CRES Mâtl, or DIN fasteners possessing qulvrlent characteristics. FF-S-66 Bolts (except metric sizes) A286 or 300 Series CRES ktl. 3C0 Series CRES Washers per MIL-S-5059 or MIL-S-6721 or DIN washers possessing equivalent characteristics. NAS 498 Screws (except metric sizes) 300 Series CRES ktl. or DIR fasteners possessing equivalent characteristics. ML-W-25027 Nuts (except metric sizes) 300 CRES or A286 Matl, w DIN fastener possessinq equivalent characteristics. n-F-645 Zinc Chromate Primer BMS-5-95 (MIL-S-81733) Polysulfide Sealant NAS 5003 Bolts (except rtrlc sizes) A266 ktl. QQ-S-763; 300 Series Corrosion Resisting Steel or DIN material possessing equivalent characteristics. A266 material 15 used for all applications that require high strength (1100MPa), high temperature (650°C) and non-magnetic applications. 6061 Aluminum	CRES to CRES • CRES/A286 bolt, nut and washers installed with wet primer or sealant. Aluminum to Aluminum • CRES/A286 bolt and nut, aluminum washers. Installed with wet primer or sealant. • 6061 Aluminum Non-Metal to CRES • CRES/A286 bolt, nut & washers installed with wet primer w sealant. Non-Metal to Aluminum • CRES/A286 Bolt. and nut with aluminum washer against aluminum and CRES washer against non-metal. Install • ith set primer or sealant. Aluminum to CRES to Titanium • CRES/A286 bolt. • d nut with aluminum washer against aluminum and CRES washer against CRES. Insulating tape, wet primer, or se4lant on dissimilar metal faying surfaces.	HMR 117 HMR 167 HMR 117 HMR 117 HMR 117 HMR 167

TABLE 2

MATERIALS FOR FASTENERS

Item	Application	Specification & Material	Galvanic Isolation and Corrosion Protection Reqmt.	
1	<u>Sea Water Immersion</u>	NAS 4003, Bolts (except metric sizes): CRES/A286 MIL-N-25027, Nuts (except metric sizes); CRES/A286	CRES to CRES, CRES to Titanium and Titanium to Titanium -Bolting materials per Table 1.0-2.5.7 installed with wet sealant	HMR 17 HMR 167 R1
	Areas include:			
	• bilge (continuously wet)	BMS 5-95 (MIL-S-81733), Polysulfide Sealant	Aluminum to Aluminum -A286 Bolt, Nut, CRES washers. Isolate fastener with Fiberglass Washer and ferrule. Installed with wet sealant.	HMR 17 HMR 167 HMR 167 R1
	• below waterline (exterior)	ML-B-6812 Bolts (except metric sizes) or DIN fasteners possessing equivalent characteristics.*		
	• struts and foils (exterior)	ML-B-6812 Bolts (except metric sizes) 300 Series CRES Matl, or DIN fasteners possessing equivalant characteristics. FF-S-86 Bolts (except metric sizes) A286 or 300 Series CRES Matl.* MIL-P-18177, type GEE NEMA G10 or Rexnord Duralo" Washer and Ferrule Matl.	Non-Metal to Aluminum A286 bolt & nut, CRES washers. Isolate fastener with a fiberglass washer against aluminum and ferrule. Install with wet sealant.	HMR 167 R1
	<u>Components requiring galvanic isolation in machinery spaces</u>	Bolting material per Table 1.0-2.5.7. 300-series CRES Washers per MIL-S-5059 or HIL-S-6721 or DIN Mashers possessing equivalent characteristics.	Aluminum to CRES A206 bolt & nut, CRES washers. Isolate fastener with a fiberglass washer & ferrule. Install with wet sealant. Aluminum to CRES A286 bolt & nut, CRES washers. Installed with a fiberglass washer & wet sealant.	HMR 17 HMR 167
	<u>Struts and foils (interior)</u>		Ferrule may be omitted where its bearing strength is inadequate provided the dissimilar metal joint is thoroughly sealed; i.e., wet sealant is to be used on all faying surfaces.	
2	<u>Spray and Occasional Immersion in Sea Water</u>	NAS 4003, Bolts (except metric sizes); CRES/A286 HIL-N-25027, Nuts (except metric sizes); CRES/A286	CRES to CRES, CRES to Titanium and Titanium to Titanium Bolting materials per Table 1.0-2.5.7 installed with wet sealant.	HMR 17 HMR 167 Al
	Areas include:	BMS 5-95 (MIL-S-81733), Polysulfide Sealant.		
	• on and below main deck (exterior)	MIL-B-6812 Bolts (except metric sizes) or Din fasteners possessing equivalent characteristics.*	Aluminum to Aluminum A286 bolt & nut, CRES washers. Install with fiberglass washers & wet sealant.	HMR 17 HMR 167 R1
	• machinery rooms above bilge (where occasionally exposed to sea water or spray)	MIL-B-6812 Bolts (except metric sizes) 300 Series Cres Mat'l, or DIN fasteners possessing equivalent characteristics.	Non-Metal to Aluminum A286 bolt & nut, CRES washers. Installed with fiberglass washer against aluminum and wet sealant.	HMR 167 R1 HMR 167
	• Bilge (occasionally wet).	FF-S-86 Bolts (except metric sizes) A286 or 300 series CRES Matl.* MIL-P-18177, type GEE NEMA G10 or Rexnord Duralon Washer and Ferrule Matl.	Aluminum to CRES A286 bolt and nut, CRES washers. Installed with fiberglass washer against aluminum and wet sealant.	HMR 17
	<u>Components not requiring galvanic isolation in machinery spaces.</u>	Bolting materials per Table 1.0-2.5.7. 300-Series CRES Washers per ML-S-5059 or ML-S-6721 or DIN Washers possessing equivalent characteristics.		HMR 167

*Note : 300 Series CRES may be substituted for A206 in applications where the lower yield strength of 300 Series CRES is unimportant. 300 Series CRES may not be substituted for A286 in primary structural applications. HMR 167 R1

TABLE 2

MATERIALS FOR FASTENERS

(CONTINUED)

ITEM	APPLICATION	SPECIFICATION 6 MATERIAL	GALVANIC ISOLATION AND CORROSION PROTECTION REQMT.	
3	**Sea Air, Exterior** Areas include: - above main deck (exterior) • doorways (exterior)	MIL-B-6812 Bolts (except metric sizes) 300 series CRES Matl, or DIN fasteners possessing equivalent characteristics. FF-S-86 Bolts (except metric sires).- or 300 sales CRES matl. 300 Series CRES Washers per MIL-S-5059 or MIL-S-6721 or DIN Washers possessing equivalent characteristics. NAS 498 Screws (except metric sizes) 300 Series CRES Rtl. or DIN fastener possessing equivalent characteristics. MIL-M-25027 Nuts (except metric sizes) 300 CRES or A286 Matl., or DIN fasteners possessing equivalent characteristics. TT-P-645 Zinc Chromate Primer BMS-5-95 (MIL-S-81733) Polysulfide Sealant NAS 4003 Bolts (except metric sizes) A286 Matl. QQ-S-763: 300 Series Corrosion Resisting Steel or DIN material possessing equivalent characteristics. MIL-P-18177, Type GEE NEMA 610 or Rexnord Duralon Washer Matl. A286 material is used for all applications that require high strength (11COMPa), high temperature (650°C) and non-magnetic applications.	CRES to CRES • CRES/A286 bolt, nut and washers installed with wet primer or sealant Aluminum to Aluminum • CRES/A286 bolt, nut & washers with fiberglass washers against aluminum installed with wet primer or sealant. Non-Metal to cm • CRES/A286 bolt, nut & washers installed with wet primer or sealant. Non-Metal to Aluminum • CRES/A286 bolt, nut and washers with fiberglass washer against aluminum installed with wet primer or sealant. Aluminum to CRES • CRES/A286 bolt. nut and ushers with fiberglass washer against aluminum. Installed with wet primer Primer or sealant on dissimilar metal faying surfaces.	HMR 117 HMR 167 HMR 117 HMR 117 HMR 117
4	**Sea Air. Interior** Areas include: - wheelhouse (interior) • fuel tanks • crew interior • interior voids 6 below deck compartments	MIL-B-6812 Bolts (except metric sizes) 300 Series CRES Matl, or DIN fasteners possessing equivalent characteristics. FF-S-66 blts (except metric sizes) A266 or 300 Series CRES Matl. 3CO Series CRES Washers per MIL-S-5059 or MIL-S-6721 or DIN washers possessing equivalrnt characteristics. NAS 498 Screws (except metric sizes) 300 Series CRES Matl, or DIN fasteners possessing equivalent characteristics. MIL-M-25027 Nuts (except metric sizes) 300 CRES or A286 Matl, or DIN fastener possessing equivalent characteristics. TT-F-645 Zinc Chromate Primer M-S-66 (MIL-S-81733) Polysulfide Sealant NAS 4003 Bolts (except rtrlc sizes) A286 Matl. QQ-S-763; 309 Series Corrosion Resisting Steel or DIN material possessiq equivalent characteristics. A2216 material is used for all applications that require high strength (1100MPa), high temperature (650°C) and non-magnetic applications. 6061 Aluminum	CRES to CRES • CRES/A286 bolt, nut and washers Installed with wet primer or sealant. Aluminum to Aluminum • CRES/A286 belt and nut, aluminum washers. Installed with wet primer or sealant. - 6061 Aluminum Non-Metal to CRES • CRES/A286 bolt. nut & washers installed with wet primer or sealant. Non-Metal to Aluminum • CRES/A286 bolt. and nut with aluminum washer against aluminum and CRES washer against non-metal. Install with set primer or sealant. Aluminum to CRES to Titanium • CRES/A286 bolt, and nut with aluminum washer against aluminum and CRES washer against CRES. Insulating tape, UK primer, or sealant on dissimilar metal faying surfaces.	HMR 117 HMR 167 HMR 117 HMR 117 HMR 117 HMR 167

1.0-2.6 CASTINGS AND FORGINGS

The requirements of the applicable portions of the following documents shall be met when performing work under this paragraph:

Structure:

NAVSHIPS 0900-000-1000, as modified by Paragraph 1.0-243(z), page 217c, and as modified below: HMR 123

(a) Paragraph 17.3.2, lines 5 and 8, delete "dynamic loads" and substitute "blast loading or Grade A shock".

(b) Table 17-1, subcategory H-l, under Applicable Rules column, line 4, insert "primary" between "ship" and "hull". At the end of line 5, delete the period and add "and those areas designed for blast loading or Grade A shock".

(c) Table 17-1, subcategory H-3, under Applicable Rules column, delete "Towing . . . tested." and substitute "Towing and rigging fitting casting areas designed to be stressed as outlined in subcategory H-4(a) and (b) below when the fitting is not proof load tested".

(d) Table 17-1, subcategory H-4, under Applicable Rules column, delete "H-3" in line 2 and substitute "H-2".

(e) Page 248, paragraph 1, make the following changes: In (c), line 5, insert "or any adjacent film area which contains a continuing defect" between "area" and "shall". In (f), line 6, insert "single" between "a" and "produc-". In (g), line 5, delete "shrinkage". In (i), line 6, delete "castings" and substitute "cast".

Machinery, piping and pressure vessels procured to procurement control drawings shall be fabricated and inspected in accordance with MIL-STD-278. Equipment of existing design shall be C or subsequent revision of MIL-STD-278. Equipment of new design shall be in accordance with MIL-STD-278D.

Liquid Penetrant inspection procedure and technique shall be as specified in MIL-STD-271, except delete reference to Group I in Para. 5.3.1, Line 5 through Line 7 and in Para 5.4, Line 4 through Line 6 and add reference to Group III or Group IV. HMR 109

1.0-2.6.1 Intentionally Not Used MOD 6

1.0-2.7 PIPING SYSTEMS

General Requirements For Piping Systems Piping systems shall comply with the following general requirements:

(a> Pressurized flammable liquids shall not be piped through uptake spaces, electronic equipment rooms, communication rooms, or CIC.

(b) Piping containing flammable fluid shall be installed at least 460 mm (18 in.) away from any hot surface. A hot surface is defined as a surface in excess of 204.4°C (400°F) under the insulation with respect to fuels, and in excess of 343.3°C (650°F) with respect to lubricants and hydraulic fluids. Flammable fluid piping connections in machinery spaces installed in accordance with protection criteria of Flammable Liquid Leak Fire Hazard Report, D312-80290-1, fittings equipped with soft material "O" rings and packing gland (Victaulic), and union fittings do not require spray shields. For all other types of flammable fluid piping connections, spray shields shall be installed as follows: HMR 16

1. Installation Criteria

(a) In machinery spaces, all flanged joints, take-down couplings , and flanged valve bonnets in piping containing flammable fluids, except piping listed in paragraphs (d) and (e) , shall be provided with shielding to prevent oil spray in the event of a gasket leak or loose connection. HMR 16 HMR 16

(b) In areas outside machinery except as noted in paragraph (e), the criteria contained in NSTM Chapter 9480 shall be used to determine where spray shields are required on flammable liquid piping. The shielding may be limited to areas where there is 20 feet or less of unobstructed clear space between the flammable liquid pipeline flange and the hot surface or piece of electrical equipment. Submersible motors or motors in which the electrical elements are incapsulated in a *manner* which precludes contact by spray excluded as hazards. HMR 16 MOD 4 & 5

(c) Bare incandescent light bulbs or bulbs covered with plastic shields or other nongas-tight covers are considered hot surfaces. Incandescent light bulbs which are covered with gas-tight globes are not considered to be hot surfaces.

(d) Spray shields are not required on piping connections in the Gas Turbine Machinery Room. HMR 16

(e) Spray shields are not required on joints in the following pipelines:

(1) Flammable liquid gravity piping not subject to pump pressures (e.g., lube oil storage tank gravity fill lines). HMR 88

(2) Flammable liquid piping located *in* voids or cofferdams.

(3) Bilge pump suction and discharge piping, except where the pump is part of the tank stripping system.

(4) Sounding tubes, air escapes/vents on fuel, diesel, and lube oil tanks and sumps. HMR 88

(5) Cage line piping downstream of a root valve. HMR 16

(6) Joints located within shielding enclosures for duplex strainers.

(7) Piping on weather decks.

(8) Flanges which are self-shielded (e.g., a lip) outside the gasket and the gasket is positively captured.

(9) Shields are not required where the sole hazard is a submersible motor or a motor in which the electrical elements are incapsulated in a manner which precludes contact by spray. MODS 3 & 4

2. <u>Fabrication Criteria</u>

(a) The purpose of a spray shield is to prevent the release of a flammable fluid spray from a leaking joint. Spray shields shall be designed to eliminate the possibility of direct fluid spray and/or atomized mist from being released from the joint.

(b) Spray shields shall be fabricated of aluminized glass cloth.

(c) Aluminized glass cloth spray shields for flanges shall be made in accordance with NAVSEC Std. Drawing 803-2145518. Copies of the drawing may be obtained from Portsmouth Naval Shipyard; attention code 244.2. Spray shields for other than flange joints shall be designed using NAVSEC Std. Drawing 803-2145518 for guidance. Shields shall consist of three layers of aluminized glass cloth. The construction and installation shall be such that the two layers of cloth closest to the joint will have the aluminized side facing toward the joint. The outermost layer of cloth shall have the aluminized side facing outward so that external oil spills onto the shield can be simply wiped off. Glass thread stitching used to construct the shield shall be limited to only those representative seam areas illustrated on NAVSEC Std. Dwg. 803-2145518. The sewing shall be located so that when the shield is installed on the joint, needle penetrations and stitching will not be situated over the periphery of the joint. The overriding consideration for spray shields is that needle holes shall not penetrate through the three layers of glass 'cloth in the area of the joint. Smaller sizes grommets shall be used in fabricating small spray shields.

(d) The material requirements for the aluminized glass cloth to be used in the manufacture of all spray shields shall be in accordance with NAVSEC Std. 803-2145518.

(e) Shields shall be installed to cover perimeter of the joint with a 2-1/2 inch minimum peripheral overlap situated at the lowest point of the joint. The side overlap shall extend down to cover all possible sources of leaks on either side of the joint. The side drawstring shall be pulled tightly, and securely fastened so that the leak sources are overlapped completely. This may or may not bring the shield into contact with the pipe. In cases where flanges are solidly butted against machinery such as lube oil piping flanges mounted on reduction gear casings, the shield shall. be tightly secured to the flange by fitting a metal band or hose clamp arrangement around the shield over the perimeter of the flanged joint. The wire draw-strings should be pulled as tight as possible in the normal manner of installing shields. A good pictorial representation of a typical flange shield is shown on page 42 of NSTM Chapter 9480.

(f) Shields do not require painting, and such practice shall be avoided.

(c) Seawater and freshwater piping shall not be led through electronic equipment in those spaces.

(d) Thermal insulation shall be provided in accordance with Sect. 1.508.

(e) Definitions

Damage Control Valve. - Certain piping system valves are designated as Damage Control Valves. Damage Control Valves may be inherently present in a piping system in order to achieve a performance function of the system itself or may be added to the basic system. Damage Control Valves are required for one or more of the following functions:

1. To prevent progressive flooding between main watertight subdivisions, where progressive flooding is defined as flooding in adjacent subdivisions resulting from spreading of flooding occuring in a given main watertight subdivision.
2. To isolate sections of piping in the event of a casualty or damage to machinery or part of the system.
3. To provide segregation of portions of system(s) during normal operation of the ship,

and to achieve Material Conditions of Readiness. Damage Control Classifications are defined in General Specifications for Ships of the United States Navy, Section 602.e.

<u>Open Piping Path</u>. - An open piping path provides a path for the free flow of water between a compartment or boundary containing the piping and the interior of the piping. A path, otherwise open, shall be considered not open if it contain3 valves or other type closures which are closed during normal ship operation and which, if left open during normal ship operation, would result in escape of fluid or system performance indication which would be detectable by operating personnel. A path, otherwise open, shall be considered not open if it embodies special piping arrangements such a3 loop seals which will prevent the flow of water assuming a head of FWL-I (Flooding Water Level I).

<u>Flooding Water Level - I (FWL-I)</u>. - The highest level that can be expected on any particular intact main transverse watertight bulkhead when that bulkhead serves as a confining boundary to flooding which the ship is expected to be capable of surviving.

<u>Damage Control Systems.</u> Shipboard system3 such a3 fire main, bilge drainage systems, magazine sprinkling systems, fire extinguishing system, and emergency de-watering systems (portable damage control pump and hose) whose primary function is the control of shipboard damage.

(f) The following general requirements apply to Damage Control Valves:

1. If the piping associated with a bulkhead penetration has open path in only one of the

two main watertight sub-divisions separated by that bulkhead, the progressive flooding prevention valve shall be located on the side of the bulkhead on which the open piping path exists, unless this requirement conflicts with other requirements herein.

2. A Damage Control Valves used for progressive flooding prevention shall be located as close to the bulkhead as possible, as a design goal. System valves shall be utilized as Damage Control Valves to the maximum extent practicable as a design goal.
3. Damage Control Valves used for isolation and segregation shall be easily accessible, as a design goal, for manual or manual remote operations.
4. Remote control for piping system damage control valves used for progressive flooding prevention shall be from the platform or main deck.

(g) Where a piping system serves more than one piece of equipment, equipment isolation valves shall be provided to permit securing without necessitating shutdown of other equipment.

(h) Not Used.

(i) Not Used.

(j) See Section 1.0-2.3 for labeling stenciling, and color-coding of piping systems.

(k) Hydraflow flexible couplings are permitted for use as flexible takedown connections in piping systems, in addition to Gamah, Victaulic and Wiggins fittings, provided the following requirements are satisfied: HMR 57R1 MOD 7

The Hydraflow couplings shall conform to the requirements of

Boeing SCD 312-81560. Design calculations of Hydraflow coupling service life shall be developed and submitted to the Government for review and approval. The Contractor shall develop, implement and maintain an Assembler Performance Qualification and Certification Program. Installation Procedures for bonding in the piping system shall be submitted to the Government for approval.

(1) Where the material composition of these take down connections is aluminum or another low melting temperature material, heat shields shall be installed according to the following guidelines: "

HMR 57R1

1. Heat shields shall be required where the melting failure of the take down connection would create a safety hazard by feeding a fire or would adversely affect the operation of a fire fighting system. MOD 6
2. The following systems would not normally require the heat shields: fresh water, drainage, waste water, bilge drainage, sewage, hydraulic, lube oil systems which are integral with equipment, or sea water cooling branches which are isolatable from the fireman.
3. Firemains in their entirety and fuel system sections which would normally contain or constrain a significant amount of fuel oil shall be equipped with heat shields. The shields shall be configured of fiberfrax insulation covered by a moisture resistant constraining device which will protect the insulation from contact with fluids, or from damage caused by vibration and abrasion. HMR 57R1

(m) Drain lines and similar lines terminating to the atmosphere shall be provided with an isolation valve for positive isolation from the atmosphere. HMR 57R1

(n) Where systems are cross-connected, an isolation valve shall be installed in the cross-connect piping. HMR 57R1

(o) Stop-check valves, or combinations valves, shall be installed in systems where there is a possibility that reversal of flow could flood a space. HMR 57R1

(p) Sea connected piping (that is, piping in any system that has a connection or connections open to the sea below the maximum hullborne displacement water line under a roll condition of 45 degree port and 45 degree star- HMR 57R1 board) shall be fitted with a cut-out valve at the hull, sea chest or overboard discharge fitting, as applicable.

(q) Chlorinated Polyvinylchloride (CPVC) or Polyvinylchloride (PVC> piping materials shall not be used without approval of the Government. MOD 6 HMR 57R1

1.0-2.8 THREADS

In all new design where metric threads are required, threads shall be in accordance with IS0 Recommendation R68 and associated standards referenced therein except thread gage wear beyond the normal limits of the threads shall not be permitted. Threads per Handbook H-28, MIL-S-7742 and LUGS-8879 will be used if they are on existing equipment, except that single element gaging of Class 3A threads will be used only for referee purposes. MOD 7

1.100 HULL STRUCTURE

This section contains general requirements for material, tightness, design and construction for the hull structure. MOD 1, MOD 6

1.100.1 HULL STRUCTURE GENERAL REQUIREMENTS

The hull lines shall be in accordance with NAVSEA Dwg. 802-5000458. The hull shall be an all welded structure with the exception of the platform deck and outboard of fuel tanks and bow doors. The minimum gage used for welding under production condition shall be 3 mm.

Compartments, voids and tanks shall be watertight or oiltight as shown on the drawings.

Air test fittings shall be permanently installed in accordance with NAVSHIPS Dwg. 810-1385791, except materials shall be compatible with aluminum.

A compartment testing diagram shall be prepared based on the following:

This diagram will contain the requirements for pre-delivery and operational testing.

Compartments, voids and tanks in the hull which are designated watertight or oiltight shall withstand an air pressure of 140 gf/cm^2 (2 psi) with a pressure drop during a stated period not exceeding the following values:

COMPARTMENT	ALLOWABLE PRESSURE DROP
Fuel Tanks	Zero in 10 minutes
All Other Spaces	As tabulated below

Where a zero pressure drop is required for the air test, the temperature within the compartment shall be measured at the beginning and end of the test period and the observed pressure corrected for any temperature variation. The pressure drop shall be measured with an accuracy of $\pm$0.069KPa. Temperature change shall be measured with an accuracy of $\pm$0.2 degrees C.

COMPARTMENT	INITIAL PRESSURE (kPa)	FINAL PRESSURE (kPa)	MINIMUM ELAPSED TIME (MINUTES)	
Aux. Mach. Room #3 3-33-0-Q	13.8	12.0	10	
Diesel and Pump Mach. Room 3-30-0-Q, Air Intake & Exhaust Assembly not Installed	13.8	12.0	6	
Engr. Oper. Station & Void 2-21-2-C plus 3-21-2-V	13.8	12.0	11	
Crew Storeroom & Void 2-21-1-L plus 3-21-1-V	13.8	12.0	11	HMR 101
Crew Living Quarters & Void 2-18-0-L, plus 3-18-2-v and 3-18-l-v	13.8	12.0	10	HMR 101
Combined Compartments 2-21-2-C, 2-21-1-L, 3-21-2-v, 3-21-1-v, 2-18-0-L, 3-18-2-V, and 3-18-l-v	13.8	1.2 .0	10	
CPO Living Quarters & Voids 2-15-2-L, 2-15-0-L, 2-15-1-L, plus 3-15-2-V & 3-15-1-V	13.8	1.2.0	10	
Officers Living Quarters/ Galley & Voids 2-11-1-L, 2-9-2-L, 2-9-0-Q, plus 3-9-2-V and 3-9-l-V	13.8	12.0	22	HMR 101
Voids 3-3-0-V	13.8	12.0	11	
Boatswain Storeroom 3-C-2-A	13.8	12.0	11	
Boatswain Storeroom 3-C-l-A	13.8	12.0	11	MOD 2
Pre-delivery Test, Magazine & Bow Thruster Machinery Rm. 2-3-0-M plus 3-4-0-Q, Gun not installed	13.8	12.0	20	MOD 2 & 7

HMR 167

Sealing covers over the following deck openings may be used during compartment tests:

(1) Gun ring, when gun not installed in Magazine and Bow Thruster Machinery Room.

(2) Air intake and exhaust assembly opening, Diesel and Pump Machinery Room.

(3) Companionway hatch opening, compartment 2-15-O-L.

After installation of Air Intake and Exhaust Assembly in the Diesel and Pump Machinery Room an air hose test shall be conducted to verify the leak tightness of Bulkhead 30 in lieu of a compartment pressure test.

After installation of the gun in the Magazine and Bow Thruster Machinery Room an air hose test shall be conducted to verify the leak tightness of the compartment sidewalls in lieu of a compartment pressure test. .

The time for the pressure of decay from the initial pressure to the specified final pressure shall be measured and shall be greater than the minimum time. If the final pressure is not reached at the end of 30 minutes, record the actual pressure and terminate the test.

1.100.2 HULL STRUCTURE DESIGN LOADS

The hull shall be designed in accordance with the methodology documented in Boeing Document D312-80144-1 as modified to add sections 2.1.1, 2.2.13.1.1,2.3,2.4 and Figure 3.2.13 of D312-80251 and by D312-80256-1 to resist hullborne and foilborne girder bending loads, hydrostatic loads while operating as a displacement ship, and dynamic loads resulting from foilborne wave impact. Shell plating below L.W.L. shall be designed to permit a limited amount of permanent deformation between longitudinal stiffeners not to exceed .125 mm per 25.4 mm (.005 in per in) under an applied limit load. Shell and deck plating above L.W.L. shall be designed to have a permanent deformation no greater than those permitted as construction deformation as specified in Section 1.0-2.4.1.

Structural bulkheads shall be designed to withstand a static head of water to the main deck, and in areas where the bulkheads provide boundaries for fuel tanks, the structural members shall be designed for fuel loads of no less 'than overflow height.

In addition, bulkheads shall be designed to support longitudinal framing loads resulting from foilborne wave impact.

The hull shall be designed for ultimate loads which include a factor of safety at 1.5 times limit load, except in those areas as specified in Hoeing documents D312-80144-1 (Rev. 11/19/73) and D312-80100-l. The resulting stresses from ultimate foil system foundation loads shall not exceed material yield.

1.100.3 GENERAL CONSTRUCTION REQUIREMENTS

Hull construction shall be in accordance with NAVSEA Dwg. 802-5000457 and the appropriate Contractor Controlled dwgs . as specified in subsequent sections.

All materials shall be in accordance with Section 1.0-2.1.1 with details called out on applicable scantling drawings of Section 1.100. Fabrication, welding, mechanical fastening and inspection shall be in accordance with Section 1.0-2.4 of this specification.

Drain holes - In nontight structure, drain holes shall be cut and ground smooth and water courses provided to prevent the accumulation and retention of liquids and to permit their free flow to drains, scuppers, sumps, and suction pipes. In nontight portions of bottom longitudinal3 and the vertical keel, drain holes shall be located to insure drainage of each bay formed by longitudinals and transverse frames. In compartments fitted with suction piping, the total area of drain holes through any frame or longitudinal shall be at least twice the area of the largest suction pipe.

The number and size of drain holes may be reduced by Including the area of cutouts for shell seams and butts where they are available for drainage.

In large structural castings and weldments, drain holes shall be provided to insure complete drainage.

Air holes - In nontight structure of tanks and bottom compartments that are fitted with filling and drainage arrangements, air holes shall be provided to prevent the formation of air or gas pockets and to provide clear passage to air escape pipes.

1.110 SHELL AND SUPPORTING STRUCTURE

The shell and supporting structure shall be fabricated as shown on the following NAVSHIPS drawings and as specified herein:

NAVSHIPS DWG NUMBER	DRAWING TITLE	EFFECTIVITY	APPLICATIONS
800-4596527	Shell Expansion Scantling	PHM-3 Series	Shell plate and stiffening keel to sheer and stem to stern. Keelsons and CVK. MOD
800-4596533	Typical frames and Bulkheads Scantling	PHM-3 Series	All transverse framing MOD 7
HMR 7 800-4596535	Bow framing and forward Strut Foundation Scantling	PHM-3 Series	All transverse framing MOD 7

Side Keelsons CVK and shell longitudinal stiffening shall be continuous through transverse framing and bulkhead structure.

Shell plating and keelsons in way of tanks shall have the same degree of tightness as the tanks.

1.120 STRUCTURAL BULKHEADS AND CLOSURES

Bulkheads and closures shall be watertight or fueltight and fabricated as shown on the following drawings and as specified herein:

NAVSHIPS DWG NUMBER	DRAWING TITLE	EFFECTIVITY	APPLICATIONS
800-4596533	Typical frames and bulkheads scantling	PHM-3 Series	Bulkheads 9, 15, 18, 21, 25, 30.025, 33 and transom
800-4596535	Bow framing and forward strut foundation scantling	PHM-3 Series	Bulkhead 3 MOD 6
800-4596533	Typical frames and bulkhead scantling	PHM-3 Series	Longitudinal Bulkhead 21 to 25
800-4596529	Doors, hatches, manholes and access plate scantling	PHM-3 Series	All locations

Fuel tank ends shall be Tee section stiffeners welded to sheet. The fuel tank shall be fabricated as a complete unit and air tested for tightness prior to installation.

Lapped collars used around continuous members that intersectoiltight and watertight bulkheads in locations identified on NAVSHIPS Dwgs. herein, shall be similar to NAVSHIPS Dwg. 805-2460264.

The bow enclosure shall be fabricated as shown on NAVSHIPS Dwg. 800-4596530 "Bow Door Installation Scantling".

The doors at frames 21, 25, 30 and 33 (total of 8) on the platform deck shall be quick acting watertight.

The hatch from the main deck to the magazine shall be operable from inside the magazine and from the weather deck with provision for a lockable cover over the weather deck operating mechanism.

A raised quick-acting water-tight scuttle, 534 mm in diameter, shall be installed in the main deck, between frames 30 and 33, over the Diesel and Pump Machinery Room (3-30-O-Q). The scuttle shall be located so as to provide an adequate means of emergency egress; the criteria to be used in locating the scuttle shall include:

(a) Minimum inpact on fore and aft structural stresses.

(b) Minimum impact on lateral structural stresses.

(c) Minimum impact on diesel exhaust or other systems.

1.130 DECKS AND PLATFORMS

Decks and platforms shall be fabricated as shown on NAVSHIPS drawings and as specif ied herein:

NAVSHIPS DWG NUMBER	DRAWING TITLE	EFFECTIVITY	APPLICATIONS
800-4596528	Main And Platform Decks Scantling	PHM-3 Series	All Structure (FRG VARIANT details excluded)

MOD 6

Both main deck and platform deck shall have no camber and shall utilize stiffened plating with longitudinal stringers and outboard of BL 1500 for main deck, and inboard approximately BL 1750 for platform deck shall be continuous through transverse frames and bulkheads as shown on the drawings. Transverse deck beams shall be supported by main deck girders and hull side frames.

The deck in the area of fuel tanks shall be continuous through transverse structure as shown on the drawings. MOD 2

A lightweight aluminum doubler plate shall be installed around the 76 mm gun mount on the main deck to resist scuffing and gouging from ejected ammunition cases. The doubler shall be installed in a manner to prevent moisture being trapped between it and the main deck and fastened in a manner suitable for overhaul replacement.

False decks in the area of CIC are undesirable and will not be allowed without specified Government approval.

Equipment sensitive to distortions, or vibrations, which would damage the equipment or impair its performance, shall be supported without direct connection to the shell or other structure exposed to wave impact, gun blast, missile blast, or similar loadings.

Foundations shall be constructed so as not to contain pockets which can retain liquids.

The rigidity of foundations and supporting structure shall prevent misalignment which would interfere with operation of the machinery and equipment, and to preclude excessive vibratory motion or rocking on the foundation.

For electronic equipment, top sway-bracing shall be installed if the ratio of height to the smaller base dimension is three to greater. These braces shall not restrain the equipment vertically.

1.140 Deck House Including Pilot House

The deck house shall be fabricated in accordance with NAVSHIPS Dwg. 8004596531 and 800-4596532 "Deck House And Pilot House Scantling Plan" and as specified herein.

The external boundaries of the deck house shall be watertight.

Deck house sides shall be free of sharp re-entrant corners or pockets. MOD 3

The peripheral bulkheads and supporting stiffeners with the exception of 01 Level and the pilothouse above the window sill shall be mechanically fastened. MOD 7

The 01 Level shall be of welded construction using stiffened plating as also shown on the NAVSHIPS Dwg. 8004596532.

Door openings and other large openings shall be kept to a minimum of 150 mm from the intersection of structural bulkheads except that turbine air inlet opening and bolted cover plate for engine removal located between bulkhead 21 and 23 may be less than 150 mm where analysis indicates there would be no detrimental effect to the structural integrity of the deck house.

The deck house shall be considered non-structural with respect to the hull girder.

The deck house skin shall be 2.0 mm thick 6061-T6 aluminum. HMR 59

The main deck coaming shall have sufficient height to allow an additional row of rivets to be added during service.

1.170 MASTS

The main mast and radar pylon shall be fabricated and installed in accordance with NAVSHIPS Dwg. 128-4597125 "MAIN MAST DETAILS AND INSTALLATION" and 1284597126 "RADAR PYLON DETAILS AND INSTALLATION" and as apecified herein, except detail parts may be revised if a more cost effective approach to fabrication can be established. A ladder and platform shall be provided to the Mobile Logistics Support Group (MLSG) for temporary installation on the Combined Antenna System (CAS) pylon to allow maintenance access to the CAS. The pylon, ladder, and platform shall be designed to allow easy installation and removal of the ladder and platform. The permanently installed platform supports shall protect the radar wave guides in way of the maintenance access. MOD 3

Masts shall be weather tight. Drainage shall be provided. Masts shall be provided with means of vertical access to all components installed on the mast and yardarms.

Masts shall be sufficiently stiff to prevent vibration in excess of the limits as specified in Section 1.0 1.5.2.2 of this specification.

1.180 FOUNDATIONS

Major foundations Shall be fabricated as shown on the following NAVSHIPS drawings and as specified herein.

Foundations for Ship Service Power Units (SSPU) for PHM-3 Series shall be integrated with the ships primary hull structure during the production design phase. MOD 6

To minimize weight, structural members of the hull, reinforced as necessary, shall be used as parts of foundations, wherever practicable, however, the primary hull shall have precedence whenever structural arrangement between two systems conflict. Harpoon launcher foundations shall utilize machined plate pedestals so as to minimize weight. MOD 4

Equipment sensitive to distortions, or vibrations, which would damage the equipment or impair its performance, shall be supported without direct connection to the shell or other structure exposed to wave impact, gun blast, missile blast, or similar loadings.

Foundations shall be constructed so as not to contain pockets which can retain liquids.

The rigidity of foundations and supporting structure shall prevent misalignment which would interfere with operation of the machinery and equipment, and to preclude excessive vibratory motion or rocking on the foundation.

For electronic equipment, top sway-bracing shall be installed if the ratio of height to the smaller base dimension is three to greater. These braces shall not restrain the equipment vertically.

NAVSHIPS DWG NUMBER	DRAWING TITLE	EFFECTIVITY	APPLICATIONS
800-4596527	Shell Expansion Scantling	PHM-3 Series	Main propulsion MOD 6 turbine, Hullborne engines (fwd supt). Foilborne propulsor. Aft strut drag fitting. Aft strut trunnion - outboard. Aft strut uplock.
800-4596533	Typical Frames & Bulkheads Scantling	PHM-3 Series	Hullborne engines (aft supt). Aft strut trunnion - inboard. Aft strut lateral restraint.
800-4596535	Bow Framing & Forward Strut Foundation Scantling	PHM-3 Series	Forward strut foundation, retraction and lock fittings.
800-4596528	Main & Platform Decks Scantling	PHM-3 Series	Gun Ring above the MOD 6 main deck.
800-4596535	Bow Framing & Forward Strut Foundation Scantlings	PHM-3 Series	Gun support stanchions at Frames 4 and 6.

1.189 COMBAT SYSTEM ALINEMENT

1.189.1 GENERAL

This section covers the requirements for the mechanical alinement of specified elements considered to be part of the ship combat system. MOD 2

The objective of these requirements is to achieve precise mechanical alinement of the combat system elements when the ship is waterborne and in the full load condition. MOD 2

Alinement tolerances are specified on the following NAVSHIPS Drawings: MOD 2 & 6

803-4596506-101	Gun MK 75 Mod 1
803-4596516-101	FCS MK 92 Mod 1
803-4596505-101	Harpoon
803-4596515-101	Chaff Launcher
410-4597436	Gyro Compass
408-4597485	Navigation Radar

Refer to Section 1.0-1.3.11 for reporting the tolerances achieved. Refer to Section 1.480 for the requirements for inter-element electrical alinement. MOD 2

1.189.2 PRELIMINARY REQUIREMENTS

Machining of element foundations and verification of tolerances shall be performed under the following conditions:

1. Installation and final welding of structural elements of the ship in the general area of the foundations shall have been completed.
2. The ship is resting on the horizontal hull erection cradle.
3. The ship construction base plane is established and a master level block representing this plane has been installed.
4. The ship's centerline plane has been established and defined by permanently installed bench marks located on the main deck forward and in the gyrocompass compartment.
5. During the time period beginning three hours after sunset and end-

ing at sunrise unless the ship is in a temperature controlled building.

1.189.3 INTERMEDIATE REQUIREMENTS (NOT APPLICABLE TO PHM-6) HMR 99

Intermediate roller path inclination (RPI) and/or levelling, and train and elevation zero alignment requirements for combat system elements shall be conducted under the following conditions: MOD 2

1. All combat system elements requiring alignment shall have been installed while the ship is still resting on the horizontal hull erection cradle. MOD 2
2. The same as 1.189.2-S.

1.189.4 FINAL REQUIREMENTS (NOT APPLICABLE TO PHM-6) HMR 99

Final RPI and train and elevation zero alignment requirements for combat system elements shall be confirmed under the following conditions: MOD 2

1. The ship is waterborne at a displacement approximating light ship displacement, plus a full load of fuel, ammunition and with foils down. MOD 1
2. The same as 1.189.2-5.
3. Conducting and recording element tram and/or bench mark readings shall follow the above confirmation, but only on those elements so equipped.

1.189.5 REFERENCE PLANES

Combat system alinement requirements shall be established and confirmed using the following reference planes: MOD 2

1. <u>Ship Construction Base Plane (SBP)</u> The SBP shall be established by the permanent installation of a master level block located in an accessible place at a point of minimum angular deflection. The level block shall be made of non-corrosive material, HMR 19

treated and suitably covered such
that the flat surface from which
measurements are taken will be
useful for alinement purposes MOD 2
throughout the life of the ship.
The level block shall be marked
such that at least 18 equally MOD 1 & 2
spaced bearings are readily
indicated. The level block, when
installed, shall be alined such MOD 2
that a line through the zero
degree and 180 degree bearing
marks is parallel to the ship's
centerline within +1 arc minute
and the flat measuring surface is
parallel to the SBP within 30
seconds of arc.

2. <u>Ship Centerline Plane (SCP)</u> The
SCP shall be defined by the per-
manent installation of alinement MOD 2
bench marks to be used to aid in
the accurate alinement of combat MOD 2
system elements. There shall be
two bench marks on the main deck
forward and two centerline or off-
set centerline bench marks in the
gyrocompass compartment.

3. <u>Weapon Control Reference Plane (WCRP)</u> The WCRP is defined by the
roller path plane (RPP) of the
installed MK 75 gun mount.

1.189.6 SPECIAL NOTES

The gyrocompass, LITEF Model PL-41 (see
Sect. 1.426), is considered to be properly
aligned when installed on the LITEF Mount-
ing Plate which itself has been alined MOD 2
using the special optical alignment
fixture.

1.200 PROPULSION PLANT

The propulsion plant shall consist of two independent propulsion systems in accordance with NAVSHIPS Dwg. 2454597700. The system for use while hullborne shall consist of twin diesel powered waterjets and the system for use while foilborne shall be a single gas turbine driven waterjet. The hullborne systems are located port and starboard in the two aft machinery spaces. The foilborne system shall be located on the ship centerline passing through all machinery compartments. The propulsion plant shall be arranged in accordance with NAVSEA Dwg. No. 802-5000459.

During normal underway operations, the machinery spaces shall be unmanned. The hullborne and foilborne propulsion plants shall be capable of concurrent operation without requiring that the ship be stopped when changing from one propulsion mode to the other. The propulsion plant shall be capable of providing emergency propulsion with any one machinery compartment flooded to the sea. The hullborne propulsion system shall be capable of providing both ahead and astern thrust as well as zero ship speed without stopping the engine. The foilborne engine shall provide ahead thrust only. It shall be possible to operate propulsion systems prime movers dockside without operation of propulsors. It shall be possible to start and operate the hullborne propulsion system in an emergency mode without the simultaneous operation of a ship's generator set. The entire propulsion plant shall be capable of operating within the applicable environments specified in Sect. 1.0-1.5.

The foilborne propulsor shall be self priming at all ship displacements above minimum operating condition in the hullborne mode with the foils extended. The propulsor system shall be capable of emergency operation at idle speed with the diesel machinery compartment flooded. The system shall be capable of self priming in less than three minutes. The propulsor shall be installed in accordance with NAVSHIPS Drawing, 201-4668748.

MOD 6

HMR 122

All freewheeling equipmentormachinery shall have positive means of lubrication. The propulsion engines shall be capable of operating on fuels described by the following, or any combination thereof, without modification to the prime movers:

Diesel Fuel, Marine MIL-F-16884 (NATO F-75) or JP-5 (NATO F-44) - MIL-T-5624.

In addition to the endurance tests invoked in the foilborne gearbox specifications there shall be a test of the gearbox assembly for 200 hours at 100 percent continuous power, utilizing the instrumentation and data plans of the foilborne gearbox endurance test. Torsion meter installation shall be utilized in ship underway trials of Section 1.0-1.3.12. HMR 90R2

Graphical plots of power vs. fuel consumption shall be submitted for the full range of foilborne, hullborne and ship service power unit (SSPU) operational modes defined in the applicable project documents. The plots should be based on full scale trial data. The graphical plots shall also include an upper and lower tolerance band which account for atmospheric conditions such as temperature and wind velocity as well as variations in ship displacement and machinery degradation. The adjustment technique used to define the tolerance band plus the rationale for the technique shall be submitted together with the graphical plots. Metric units shall be used in all calculations and graphical plots which are submitted. Percent power shall be plotted on the abscissa and fuel consumption (expressed in kg/hr) shall be plotted on the ordinate. MOD 3

The foilborne and hullborne propulsion systemsmustsatisfythetorsionalvibration analyses in accordance with requirements of MIL-STD-167B, as identified in the Contract Data Requirement List. MOD 6

The Contractor will hold separate critical design reviews of the foilborne propulsor gearbox, and the foilborne propulsor during the detailed design period prior to engineering release of design details to be manufactured. The critical design reviews will be held with Government Representatives at the Contractor/Supplier facilities for the purpose of a technical exchange and review of design decisions and features. Details of format, agenda, and reporting are contained in the CDRL.

1.234 FOILBORNE ENGINE

The foilborne propulsion prime mover shall be a General Electric LM 2500 gas turbine engine in accordance with Boeing Procurement Drawing 312-80001. HMR 51

The unit shall be installed in accordance with NAVSHIPS 201-4668872. HMR 95

1.234.1 Mounting

The foilborne engine shall be attached to the ship structure by a strut-isolator mount system to limit engine noise and vibration transmitted into the hull and maintain shaft alinement with the driven equipment. The engine mount shall be installed in accordance with NAVSHIPS Dwg. 201-4597703. MOD 2 HMR 4

1.234.2 Starting

The engine shall be started and motored for water washing by an engine mounted pneumatic starter motor which is supplied air from either of two start compressors mounted on the ship's service power units. The starting air compressors shall be Airesearch 681800-3-1, per Boeing Spec. 312-80107 with the following modifications: HMR 26

1. Section 2.1 - under "MILITARY STANDARDS", add HMR 26

   MIL-STD-480, Configuration Control - Engineering Changes, Deviations and Waivers MIL-STD-1520A, Corrective Action and Disposition System for Nonconforming Material.

2. Section 2.2 - under "MILITARY SPECIFICATIONS" and "MIL-Q-9858A Quality Program Requirements" MOD 1 & 4
3. Section 2.4 under "BOEING DOCUMENTS AND DRAWINGS", delete "D18010127-1 Quality Control Requirements for Boeing Suppliers".

HMR 26

4. Add Section "3.3 CONFIGURATION CONTROL The configuration control program established by the Contractor shall include both Class I and Class II engineering changes in accordance with MIL-STD-480."

5. Add Section "3.3.6.1 Identicality/Parts List". The parts list for the unit which successfully completes the Qualification Tests shall constitute the approved parts list for subsequent units of the same model. Changes to the approved parts list shall be governed by the requirements specified in MIL-STD-480 "Configuration Control - Engineering Changes, Deviations and Waivers". HMR 26

6. Section 4, prior to the first sentence add "The quality assurance program established by the Contractor for the compressor shall be in accordance with MIL-Q-9858A, Quality Program Requirements, and MIL-Q-1520A, Corrective Action and Disposition System for Nonconforming Materials. HMR 26

7. Section 4.1, delete "The supplier shall provide and maintain a quality control system in accordance with D180-10127-1." HMR 26

HMR 26

The starting air compressor shall incorporate certain features which are identical to the FFG-7 compressor, as follows: HMR 26

1. The compressor shall utilize a 224-T7 aluminum casting alloy scroll identical to that used on the FFG-7 compressor. HMR 57

2. The compressor shall utilize a high-speed ring gear and coupling housing identical to those used on the FFG-7 compressor. NOTE: A plug shall be inserted in the speed pickup boss.

3. The compressor high-speed star gear journal bearings shall have an oil feed groove at the center of the bushings and axial clearance at the thrust bearings of .019 and .031 inch like the bearings on the FFG-7 compressor.

The starting *system* shall be installed as shown on NAVSHIP Dwg. 201-4597724.

(INTENTIONALLY BLANK)

HMR 26

1.234.3 SAFETY DEVICES

The engine shall be provided with an automatic engine shutdown in the event of power turbine overspeed or engine flame-out. This automatic engine shutdown shall not be equipped with a battle by-pass.

Foilborne engine automatic shutdown, in conjunction with an alarm, and battle by-pass, shall be provided for the following abnormal conditions:

High lube oil sump temperatures (5)
Low lube oil pressure
High power turbine inlet temperature
High vibration gas generator
High vibration power signal turbine
Overspeed switch signal loss.

Upon loss of electrical command signal or PLA actuator system failure, the engine shall reduce power to idle.

1.234.4 WASH AND DRAIN

An engine wash and drain system shall be provided to internally water wash the engine compressor. (See Sect. 1.530.5.) The drains shall collect wash water, fuel as a result of engine shutdown, and oil from engine seals. (See Sect. 1.297.)

1.234.5 FUEL TANK PROTECTION HMR 120

The fuel tank section shall be shielded against compressor section fires. This fuel tank protective system shall consist of the following:

A shield of 5456 H 116 aluminum alloy, approximately 1220 mm wide by 1650 mm long shall be installed approximately 12.0 mm above the tank top between approximately bulkhead 23 and bulkhead 25, approximately WL 1700 and shall be 4.0 mm nominal thickness.

The protective shield shall be bolted to supports from the tank top to allow removal of the shield and blanket.

The fuel vent line shall also be protected.

A thermal insulation blanket per MIL-I-23128, 12 mm thick and sealed in a mylar bag, shall be installed between the tank top and the protective plating. HMR 120R1

HMR 120R1

1.238 HULLBORNE ENGINE

This section contains requirements for the hullborne propulsion prime movers.

The hullborne engines shall be **Motoren-**Turbinen Union Friedrichshafen diesels, model **MB8V331TC81,** per Boeing Spec. 312-80141, with cbunter-clockwise output **shaft** rotation facing the flywheel. HMR 4 MOD 7 MOD 6

The hullborne engines shall be installed in accordance with NAVSHIPS Dwg. 201-4669024. Each hullborne engine shall **have** a maximum continuous rating of 815 (+2.5 percent) metric horsepower **qualified in** accordance with the &lowing **paragraphs** of MIL-E-24455: MOD 6 & 7 HMR 4 & 122

3.3	4.3	4.4.2	4.5	4.6	4.7	4.8
	4.3.1	4.4.3	4.5.1	4.6.1		
3.6.2	4.3.1.1	4.4.4***	4.5.2			
3.13	4.3.1.2	4.4.6'	4.5.3			
3.22	4.3.1.3**	4.4.7				
		4.4.7.1				
		4.4.9				
		4.4.9.1				
		4.4.9.2				
		4.4.9.3				

1.238.1 *except that line 4 of paragraph 4.4.6, change "5 seconds" to "10 seconds".

**except that NATO F75 fuel per MIL-F-16884F or NATO F76 fuel per MIL-F-16884G may be used. HMR 122

***except that glow plugs may be used.

Packaging of engines shall be in accordance with MIL-E-24455, Section 5, Level A for engines to be stored longer than 3 months after shipment."

1.238.1 HULLBORNE ENGINE SAFETY DEVICES

The hullborne engines shall be provided with automatic engine shutdowns, without battle by-pass, that will stop the engine if 115 percent of engine speed is exceeded. Automatic shutdown shall be accomplished by shutting off both fuel and air supply to the engine.

1.238.2 HULLBORNE ENGINE STARTING

Each hullborne engine shall be started by a 24 volt d.c. electric starter motor.

1.241 REDUCTION GEARS

1.241.1 HULLBORNE REDUCTION GEAR

The hullborne reduction gear shall be Zahnradfabrik Model BU250W per Boeing Spec 312-80139 mounted directly to the hullborne engine. The maximum continuous power is 815 mhp. The gear shall incorporate a clutch to de-couple the engine from the propulsor for dockside engine checkout. MOD 6

Port and starboard gears are to be identical. See Sect. 1.238 for installation.

A shaft seal in BLKD 33 shall be provided to allow emergency operation of the hullborne system with the aft machinery compartment flooded.

MOD 2

1.241.2 FOILBORNE REDUCTION GEAR

The unit shall include four accessory drive pads for hydraulic system pumps as specified in Section 1.556.2. A means shall be provided to allow operation of the engine without the propulsor. MOD 4

Shaft seals shall be provided to allow emergency operation at engine idle power with the hullborne engine compartment flooded. The gear shall be directly mounted to the propulsor pump with the input shaft rotation counter-clockwise looking aft and is direct driven by the engine coupling.

The foilborne reduction gear shall be in accordance with the following procurement specification:

CONTENTS

PARAGRAPH MOD 4

LIST OF FIGURES

1.0 SCOPE

This drawing defines the performance, operation, design and test requirements for a Gearbox Assembly. MOD 4

1 .1 APPLICATION

The article is used in a hydrofoil ship propulsion system to transmit power from a General Electric LM 2500 gas turbine engine to a waterjet pump defined by Boeing Specification Control Drawing 312-81380.

1.2 ARRANGEMENT

The arrangement of the propulsion system is shown on Boeing Drawing 201-4668748. HMR 122

2.0 APPLICABLE DOCUMENTS

Unless otherwise specified, the following documents of the exact issue shown, form a part of this specification to the extent specified herein. In the event of differences between this specification and the documents referenced herein, this specification shall be considered the superseding requirement.

Subsidiary documents to those listed below form a part of this specification only to the extent that they are referenced within applicable portions of the below referenced documents and in context with the original reference contained in this specification.

The effective issue of referenced subtier documents shall be the exact issue shown therein and if not shown, the effective issue shall be the latest issue in effect on the date of invitation for bid. Effective dates for military specifications and standards shall be as listed and published in DOD Index of Specifications and Standards dated 1 March 1972.

2.1 MILITARY SPECIFICATION

MIL-L-23699B	Lubricating Oil, Aircraft Turbine Engines, Synthetic Base	MOD 4
MIL-P-17286	Propulsion and Auxiliary Steam Turbine and Gears (including repair parts, tools, accessories and instruments), packaging of	
MIL-C-5015D	Connectors, Electric "AN" Type, General Specification for	MOD 4
MIL-A-8625C	Anodic Coatings for Aluminum and Aluminum Alloys, Amendment 1, 13 March 1969	
MIL-H-83282	Hydraulic, Fluid Fire-Resistant, Synthetic Hydrocarbon Base, Aircraft, Amendment 1, 6 June 1970	
MIL-C-46522	Calibration System Requirements	

MIL-L-9000G	Lubricating Oil, Shipboard Internal Combustion Engine High - Output Diesel		
MIL-S-5000	Steel, Chrome-Nickel-Moly-bdenum	MOD 4	
MIL-S-6414			
MIL-M-15071	Manuals, Equipment and Systems		
QQ -A-601	Castings, Aluminum		
MIL-T-5624	Fuel Oil		
MIL-F-16884	Fuel Oil		
MIL-D-1000	Drawings		
MIL-M-7298	Manual, Technical		
MIL-L-45662	Calibration System Requirement	MOD 4	
MIL-Q-9858A	Quality Program Requirements		
		MOD 4	

2.2 MILITARY STANDARDS

MIL-STD-889B	Metals Definition of Dissimilar		
MIL-STD-271	Non-destructive Testing Requirements'for Metals	MOD 4	/HMR 19
MIL-STD-278D	Fabrication, Welding and Inspection of Machinery, Piping, and Pressure Vessels for Ships of the United States Navy		
MIL-STD-167B	Mechanical Vibrations, Order or Precedence for the Selection of		
MIL-STD-1472B	Human Engineering Design Criteria		
MIL-STD-882	System Safety Program for Systems and Associated Subsystems and Equipment		
MIL-STD-470	Maintainability Program Requirements	MOD 4	
MIL-STD-471	Maintainability Demonstration		
MIL-STD-756	Reliability Prediction		
MIL-STD.758	Reliability Program System and Equipment		
MIL-STD-1629	Procedure for Performing a Failure Mode and Effects Analysis		
MIL-HDBK-472	Maintainability Prediction	MOD 4	
MIL-STD-480	Configuration Control		
MIL-STD.721	Reliability Maintainability		

MIL-STD-490	**Specification** Practices
MIL-STD-278	Fabrication Welding and Inspection

2.3 SOCIETY OF AUTOMOTIVE ENGINEERS

<u>SAE Aerospace</u>	
AS 469B	Drive Accessory, 8 inch bolt circle
<u>SAE</u>	
ANSIB92.1-1970	"Involute Splines and Inspection Metric Version"

2.4 AEROSPACE MATERIAL SPECIFICATION

AMS 6470	(NITRALLOY) MOD 4
AMS 6414	**(4340)**
AMS6444	**(52100)**
AMS 6490	**(M50)**

2.5 DRAWINGS

201-4596607	Gearbox Assembly **(Envelope** and Interface Control Drawing)
312-80046	Pump Hydraulic
312-81380	Pump Propulsion **Waterjet**

2.6 OTHER PUBLICATIONS

The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the **issue** in **effect** on date of invitation for bids or requests for proposal shall apply:

AMERICAN GEAR MANUFACTURERS ASSOCIATION **(AGMA)**

AGMA	American Gear **Manufacturers** Association
ooo.68	AGMA Publications Index
110.03	Nomenclature **of** Gear Tooth Wear and **Failure**
211.02	Surface Durability (Pitting) **of** Helical and Herringbone Gear Teeth
210.02	Surface Durability (Pitting) of Spur Gear Teeth

217.01	Information Sheet - Gear Scoring Design Guide for Aerospace Spur and Helical Power Gears
221.02	Rating the Strength of Helical and Herringbone Gears for Enclosed Drives
220.02	Rating the Strength of Spur Gear Teeth
225.01	Information Sheet for Strength of Spur, Helical, Herringbone and Bevel Gear Teeth
390.03	Gear Classification Manual
411.02	Design Procedure for Aircraft Engine and Power Takeoff Spur and Helical Gears
National Bureau of Standards	
Handbook H-28	Screw Thread Standard for Federal Service
INTERNATIONAL STANDARDS ORGANIZATION	
ISO/R68	General Purpose Screw Threads - Basic Profile
ISO/R468	Standard Surface Roughness
ISO/R261	General Purpose Metric Screw Threads - General Plan
ISO/R724	General Purpose Metric Screw Threads - Basic Dimensions
ISO/R965/1	General Purpose Metric Screw Threads - Tolerances

NAVMATINST 4600.5A (ASTIC 068958) Department of Defense Engineering for Transportability Program, 29 December 1964.

MIL-HDBR-472 Maintainability, Prediction, 24 May 1966 MOD 2 & 4

Assist Users Manual dated May 1977 | HMR 19

3.0 REQUIREMENTS

3.1 PERFORMANCE

The article is required to transmit power from the input shaft to dual concentric output shafts with the following characteristics:

3.1.1 Functional Characteristics

3.1.1.1 Primary Performance. - The article primary performance design point shall be:

a. Continuous (100% Continuous Power)

Input Shaft Power	17,000 Metric Horsepower	MOD 2
Input Shaft Speed	To be determined by the supplier RPM	MOD 2
Dual Concentric Output Shafts		
Output Speed: Outer Shaft	Inner Shaft	
to be matched to the propulsor Section	1.245	MOD 2
Efficiency at 16,350 metric horsepower input power	98.5%	MOD 2

3.1.1.2 Secondary Performance. -

a. Accessory Drive. - The article shall be provided with four (4) accessory drives. Each drive shall have the following capability:

Steady State Torque	,147 Newton-Meters
Stall Torque	506 Newton-Meters
Continuous Speed	3600 RPM at the continuous input shaft speed

b. Waterjet Pump Oil Supply. - The article shall provide lubricating oil to the waterjet pump via the following two separate paths:

(1) From an external boss on the gearbox

(2) Axially through the gearbox output concentric shafts

3.1.1.3 Duty Cycle. - The article shall be capable of operation within the following load spectrum:

Condition	Percent Continuous Power	Percent Input Speed	Hours 1
Battle Override (max intermittent)	115.8	105	150
Rated (continuous)	100.0	100	5880
Cruise	90.0	97	6100
Under Replenishment	35	70	600
Idle Speed 2	1.5	25	8000
Static	--		99870

1 There is one start cycle for every 2 hours of operation

2 Lowest steady state speed. Engine start time to reach this speed is 60 seconds maximum

3.1.2 Operability

The article operability shall be based on the article being installed in a non-manned machinery space.

3.1.2.1 Reliability. - The article shall have a Mean Time Between Failures (MTBF) goal of 6400 hours, and a MTBF requirement of 3200 when operated within the specified environment and duty cycle. MOD 4

3.1.2.2 Maintainability. - The article shall be capable of being maintainable in the ship by personnel with basic engineman or machinery repairman training. Accessibility to parts to allow in-place inspection and routine maintenance shall be provided, with minimum requirements for special tools or test equipment. The article shall be provided with lift lugs, eyes or pads to allow handling for removal and realinement in the normal installed attitude. Components weighing more than 20 Kgs on the article, which are removable for maintenance or in-place repair, shall be provided with lift lugs, eyes or pads. MOD 4 MOD 4

The article shall have a Mean Time To Repair (MTTR) goal of 1 hour and a MTTR requirement of 2 hours for all maintenance actions except the removal and replacement and realinement of the entire gearbox; the goal and requirement for the removal, and MOD 4 replacement with realinement of the entire gearbox shall be 40 hours and 80 hours, respectively.

3.1.2.2.1 Inspections. - Access shall be provided to inspect gear teeth, shafts, bearings and major wear internal components, in the form of boroscope or visual inspection ports. Gear mesh inspection ports shall be equal to the gear mesh width as a minimum, located on the leaving side of gear mesh.

3.1.2.2.2 Scheduled Maintenance. -The article shall require no preventive maintenance task, other than visual inspection more often than once each day of seven days or 72 hours of operation, at which time 8 hours of preventive maintenance is permitted.

3.1.2.2.3 Unscheduled Maintenance. - In-place unscheduled maintenance capability shall be provided, to the extent possible, to preclude article removal from the ship. The mean time to repair (MTTR) shall be 2 hours or less for all in-place shipboard corrective maintenance. MOD 6

3.1.2.3 Useful Life. - The article useful life shall be 20,000 operational hours in an interval of 15 years, when operated within the duty cycle and the environmental envelope. Concurrently, the mean time between overhauls (MTBO) shall be 4500 hours. The useful life applies to main gears, shafts and housing. Acceptance of Endurance Test 4.1.2.3 shall constitute verification of these requirements. MOD 6

3.1.2.4 Environment. - The article shall be capable of operating throughout its duty cycle in a humid marine environment. It shall be capable of operating while partially submerged in bilge water due to diesel room compartment flooded, to a level one meter above the output shaft centerline. Bilge water is defined as either seawater, oils, or a variety of emulsions of oils and seawater, engine MOD 2 lube oils (per MIL-L-9000, MIL-L-236991, hydraulic fluid (per MIL-H-832821, and fuel oils (per MIL-T-5624 and MIL-F-16884).

3.1.2.4.1 Ambient Air. -

Machinery space ambient air temperature range	10°C to 49°C
Relative humidity	20 to 60%

3.1.2.4.2 Accelerations and Rotational Rates. - The article shall be capable of withstanding the following acceleration and rotational rates at the article center of gravity without yielding or failure of the article or attachments.

Vertical accelerations	6.0 g's upward or 1.0 g's downward
Lateral acceleration	2.0 g's to either side
Longitudinal accelerations	0.5 g's forward or 0.5 g's aft
Pitch rate	15° per second
Yaw rate	10° per second

These accelerations and rates are considered to act simultaneously and will occur less than 100 times in the useful life.

3.1.2.4.3 External Vibration. - During non-operating conditions, the article shall withstand externally induced vibrations per MIL-STD-167B, Type I, Table I.

3.1.2.4.4 Dynamic Loading. - The article shall withstand the following dynamic loads as a result of being supported by the waterjet pump: MOD 4

Excitation from the waterjet pump at the gearbox support flange with a random frequency broad band spectrum vibration from 10 to 5000 Hz along the longitudinal, vertical and lateral axes. The response shall be characterized by a band limited white noise with RMS G levels as follows:

$$\left.\begin{array}{ll}\text{Longitudinal Axis} & \text{10 g's}\\ \text{Vertical Axis} & \text{6.5 g's}\\ \text{Lateral Axis} & \text{8 g's}\end{array}\right\}\ \text{100\% input shaft speed}$$

For other input shaft speeds the excitation spectrum can be considered to vary linearly with speed down to zero at idle speed.

3.1.2.4.5 Operating Attitudes. - The article shall be capable of continuous operation in any combination of the following variations from the installed attitude:

Permanent trim -	5 degrees input shaft up to 5 degree input shaft down
Permanent list -	5 degree maximum to either side
Momentary roll -	± 30 degrees for 30 seconds, ± 20 degrees for 2 minutes
Momentary pitch -	10 degree input shaft up or down.

3.1.2.5 Transportability. - The article shall be capable of being transported by air, rail, sea, or truck in accordance with NAVMAT INST. 4600.5A, consistent with standard military packaging for minimum cost, cube, and weight.

3.1.2.6 Human Performance. - The article shall be designed for ease of operation, inspection, maintenance and handling using the human engineering requirements of MIL-STD-1472 as a guide.

3.1.2.7 Safety. - The article shall be capable of an input shaft speed of 120 percent when unloaded, and it shall be designed with MIL-STD-882 as a guide.

3.2 ARTICLE DEFINITION

The gearbox shall meet the dimensional requirements defined in Boeing Drawing 201-4596607 except the main element center distance shall be 520 $\pm$ 3 mm. The pump interface flange to engine interface flange distance shall not exceed 1505 mm. Consideration of an in-line spool piece within this dimension is not required.

MOD 2, MOD 4

MOD 5 JHMR 147

MOD 6

3.2.1 Interface Requirements

The article interface requirements not specified herein shall be as specified by the shipbuilder. MOD 4

3.2.1.1 Deleted. MOD 6

3.2.1.1.1 Lubrication System Interfaces. - The article lube oil system shall be capable of operation with oil having the following characteristics:

a. Type	MIL-L-9000G
b. Contamination	
(1) Water content (fresh)	0.1% (max)
(2) Entrapped air	5% by volume (max)
(3) Solid Particles	2.5 mg/liter after passing through a 10 micron nominal, 25 micron absolute filters.
(4) Fibrous Material	One 0.2 mm x 6.0 mm in 4 liters

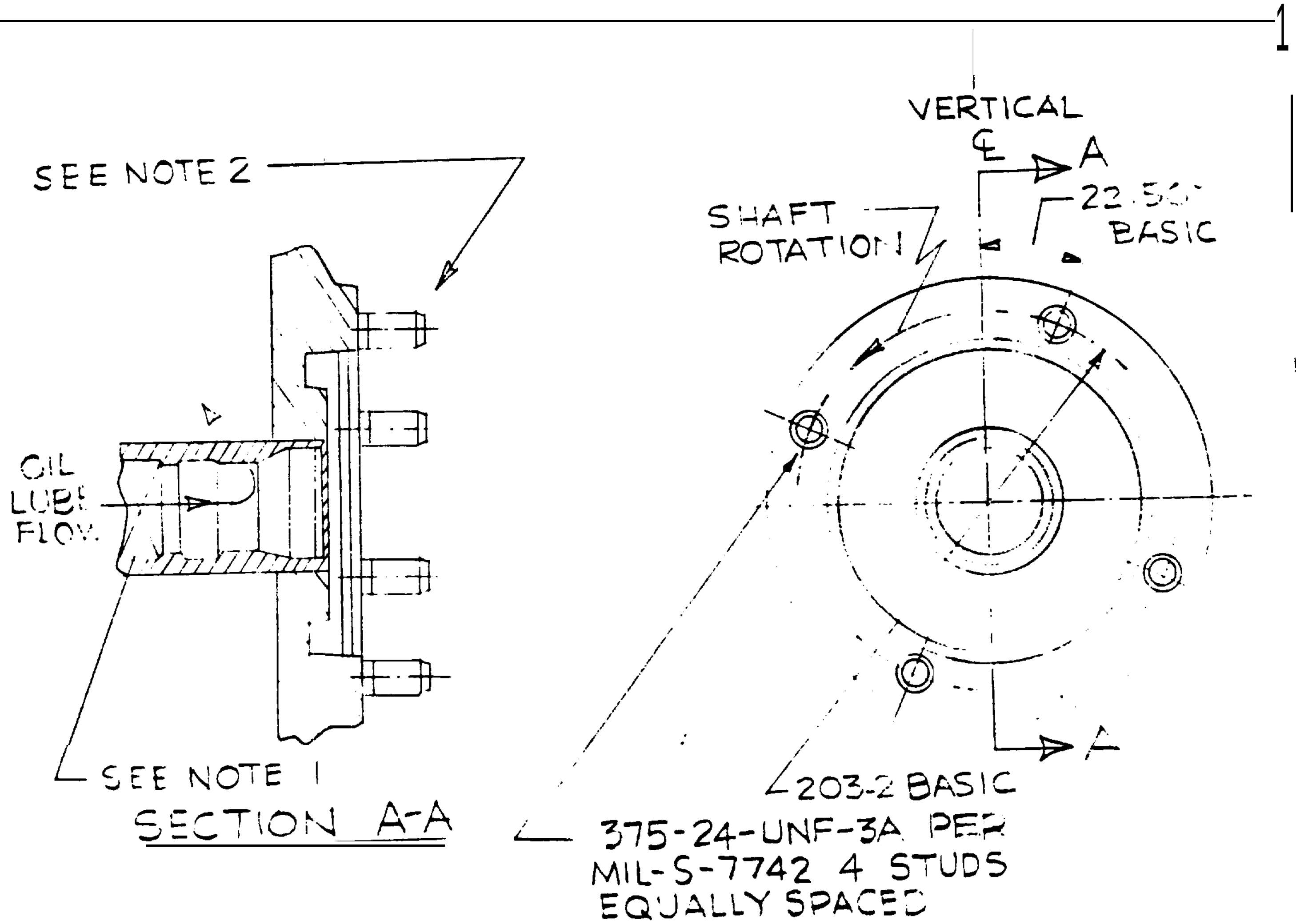
c. Lube oil drained from the article shall pass through a screen with one millimeter clear openings prior to passing through the scavenge pump. The screen clear opening area shall be at least four times the drain outlet area.

MOD 2

3.2.1.2 Detail Interface Definitiion

3.2.1.2.1 Accessory Drive. - Accessory drives shall be provided with access and removal envelopes around each drive of 150 mm radius around the centerline by 440 mm long, to permit installation by the Buyer of hydraulic pumps per Boeing SCD 312-80046. HMR 19

The accessory drives shall comply with Figure 3.2.1.2-1.



NOTES
1. INTERNAL CAVITY MUST BE SEALED
2. DRIVE PAD PER ASA4698V-2 EXCEPT AS NOTED.
3. FLOW THRU LUBRICATION SHALL BE PROVIDED FOR THE SPLINE

ACCESSORY DRIVE

FIGURE 3.2.1.2-1

3.2.1.2.2 Condition Sensors. - Rolling element bearings in the main drive train shall be provided with bearing temperature MOD 4 sensor provisions per Figure 3.2.1.2-3 to allow installation of Buyer-furnished bearing sensors.

Journal bearings in the main drive train shall be provided with imbedded platinum tipped resistant temperature sensors in the bearing shells. The electrical leads shall be routed to the housing exterior and terminated with an electrical connector per MIL-C-5015D.

Installation provisions shall be per table below:

Condition Sensor Provisions
Table 3.2.1.2-2

MOD 2

PARAMETER	LOCATION
Temperature	Main drive shaft bearings
Temperature	Oil into gearbox
Temperature	Oil out of gearbox
Pressure	Lube oil into gearbox

3.2.1.2.3 Support Attachments. - Article support attachment points shall be provided as specified by Boeing Drawing 201-4596607.

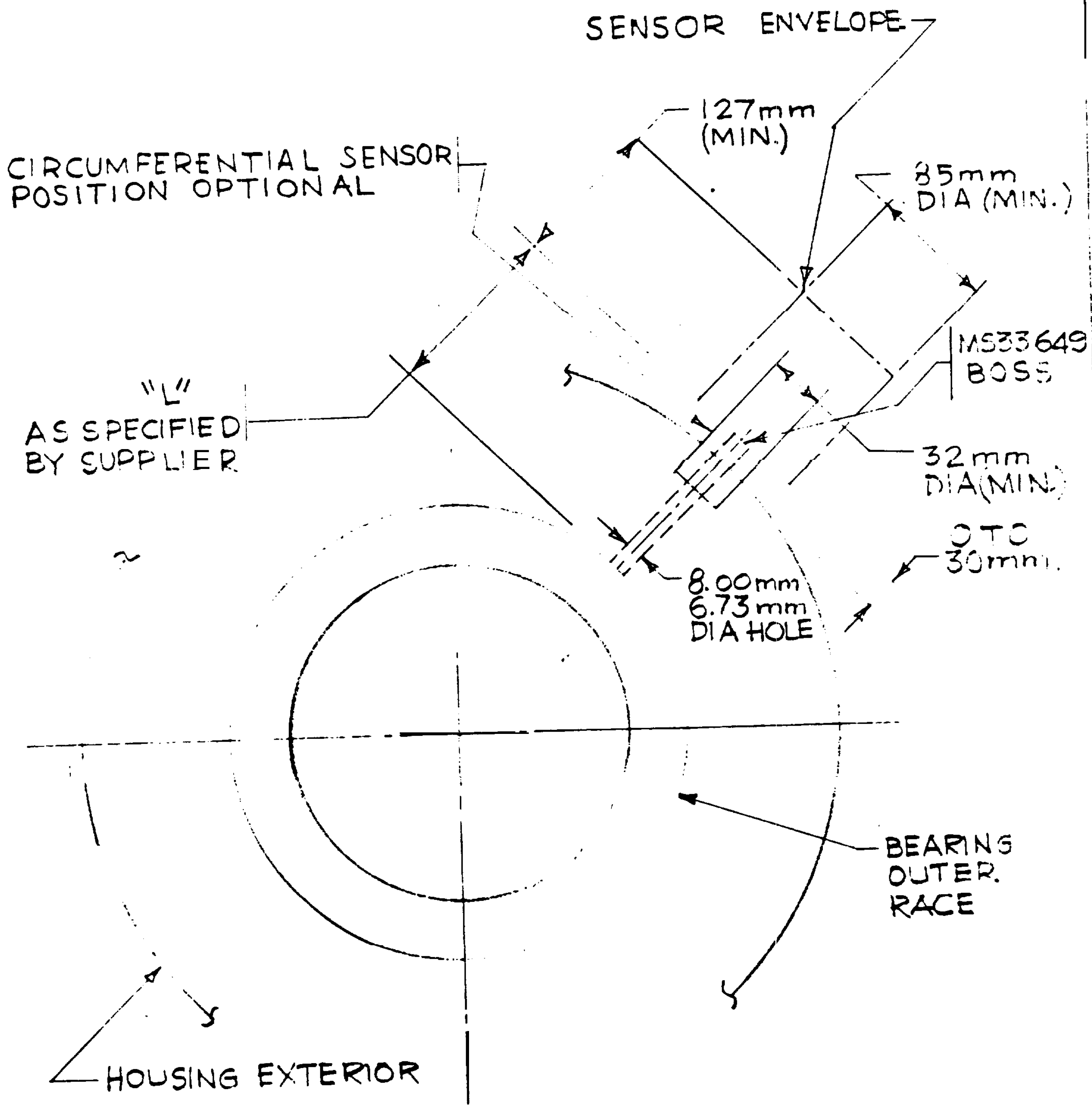
3.2.1.2.3.1 Bulkhead Seal Attachment. - A watertight bulkhead seal shall be MOD 4 provided on the gearbox housing at bulkhead 30. MOD 6

3.2.1.2.3.2 Mounting Flange Stiffness. - All attachments at the waterjet pump mounting flange interface are uniformly effective for in-plane shear. For axial or moment loads, only the attachment in the vertical rows shall be considered effective.

Plane sections shall be considered to remain plane for attachment effectiveness.

3.2.1.2.4 Input Shaft. -

a. Input shaft shall be designed per the following:



END VIEW
TYPICAL ROLLING ELEMENT BEARING
TEMPERATURE SENSOR PROVISION

FIGURE 3.2.1.2-3

1.241

Shaft rotation	CCW (looking at shaft)
Axial Load	±2225 Newtons at continuous speed 4165 New tons at shut down (tension)
Shear Load	1561.4 Newtons down
Moment	472 Newton-meter
Temperature	71°C ambient air locally around input flange 121°C Engine Coupling Face

3.2.1.2.5 Output Shafts. - Output shafts shall be designed per the following:

Shaft Rotation	CCW (looking at shaft)
Axial Load	0
Shear Load	0
Moment	0
Temperature (local)	10°C - 60°C ambient air

3.2.2 Article Identification

The article shall be identified in accordance with MIL-STD-130. An identification tag shall be permanently affixed to the housing and shall include at least the following information.

a Supplier's Name MOD 2
b. Supplier's Model Number
c. Serial Number
d. Government Contract Number
e. Weight

3.2.3 Weight

The article dry weight shall not exceed 2407 kilograms. MOD 4, MOD 6

3.3 DESIGN AND CONSTRUCTION

The article shall meet the indicated requirements and the interface definitions shall be in metric units, with International Metric System dimensions as the basis for design.

The article and its components shall be designed in accordance with the structural requirements of Section 3.4.

3.3.1 General Design Features

3.3.1.1 Drains. - The article shall be provided with drain ports and plugs which are located to allow complete fluid drainage in the installed attitude. MOD 4

3.3.1.2 Gears. - The gear train shall meet the following requirements: MOD 2

a. Gear ratios shall be selected to minimize non-uniform tooth wear. MOD 4 | HMR 4
b. The gear tolerances shall be per AGMA 390.03 Quality 12 when checked relative to bearing journals. MOD 4
c. The gear tooth root fillet radius shall be no less than the industry standard for the tooth size chosen. MOD 6
d. The gear tooth working profile surface texture shall be accomplished by grinding and/or honing and shall meet the following finish requirements:

   Roughness 0.63 micrometer RHR (0.00063 mm) HMR 174 / HMR 174R1

   Waviness 0.63 micrometer RHR (0.00063 mm)
e. The teeth shall have an involute form in the working area.
f. The gear tooth fillet root to working profile area shall blend to form a smooth surface free of sharp edges. The root area shall be unground. HMR 174 / MOD 2
g. The gear teeth and roots shall be shotpeened. Shotpeening shall be done before grinding of the working area of the gear teeth. MOD 6 / HMR 174
h. Handwork is not permitted on the working profile area of the gear teeth. Handwork to remove burrs and to break sharp edges in the non-working profile is permitted.
i. All gears (pinion, idler, gear) shall be made integral, solid or welded with their shaft.

j. The main drive train elements shall be double helical gears. MOD 2
k. Spur gearing shall not be used in the main drive but may be used in the accessory drive gearing.
1. Pinions in the main drive shall be fabricated from homogeneous forged material per Section 3.3.3.1. MOD 6 MOD 2, MOD 4
m. Bevel *gears* shall not be used.
n. The bore in each hollow pinion, gear, or shaft shall be provided with natural drainage unless plugged.
o. Gears and pinions shall be case harden 'in accordance with Section 3.3.3.2. MOD 2
p. Surface coating on gear teeth shall be "Black Oxide" or "Silver Plating" to provide for corrosion protection and wear pattern observation. Subtantiation of the choice of gear tooth surf ace coating shall be presented during the gear box design review. MOD 6, MOD 7
q. The main drive gear meshes shall have an effective face width to axial pitch ratio of greater than or equal to 4.0. MOD 6

3.3.1.3 Splines. - Splines other than accessory drives shall meet the following requirements:

a. Splines within the article shall be fillet root side or major diameter fit per ANSI B92.1-1970. HMR 4
b. Flexible couplings shall have fillet root OD fit teeth in accordance with ANSI B92.1-1970, and shall be crowned on both tip and flank as appropriate to provide for misalinement. MOD 2, MOD 6
c. Spline teeth shall have surface hardness of Rc 56 minimum and surface finish of 0.63 micrometer RHR . MOD 2
d. All working splines shall be provided with continuous lubricating oil flow through the spline teeth. MOD2 HMR 4
e. Splines shall not be used beneath or supporting gear elements and in

areas where bending deflections are present in the spline length.

3.3.1.4 Bearings. -

a. Anti-friction bearings shall have the following features:

Inner race to shaft fit shall be atleast0.001 mm/mm bore diameter interference. The outer race shall not rotate. Shaft journal surface finish shall be 0.81 micrometer RHR or better. MOD 4

The following rolling element bearing design characteristics shall be presented at the gearbox critical design review. MOD 6

1. Type, size, L/D compared to bearings used in PHM-1 gearbox.
2. Bearings internal clearance and inner and outer race fit compared to bearings used in PHM-1 gearbox.
3. B-10 life calculations.
4. Plot of shaft center loci in outer race circle versus transient and typical load-speed conditions.
5. Plot of gear and pinion relative position for each of the transient and typical load-speed conditions presented with the influence of load vector and shaft bending taken into account.
6. The stopped shaft, "brinnelling" pressure on the rollers compared to their capacity.
7. The range of bearing clearance and fit manufacturing tolerance and in-service wear acceptable to meet gear, pinion and bearing life requirements.

b. Journal type bearings shall have the following features:

Bearing shells shall be steel backed and lined with anti-friction material. Bearing shells shall be removable, and have anti-rotation retention. Bearing surface finish shall be 0.40 micrometer RHR maximum. MOD 2 Means for properly locating halves with respect to each other and with respect to the bearing seats shall be provided. These means shall be such that halves of a bearing cannot be inadvertently assembled incorrectly with respect to each other or with respect to their seats.

Journal bearings shall be designed in general accordance with NAVSHIPS 0943-015-6010 (6/70) "Standardization Manual Sliding Surface Bearings". The following Journal bearing design characteristics shall be presented at the gearbox critical design review: MOD 6

1. Bearing type: i.e. (plain, elliptical, etc.).
2. Bearing clearance and film thickness.
3. Lubrication oil flow.
4. Lubrication oil temperature rise.
5. Plot of minimum film thickness attitude angle, and load vector for transient and typical load-speed conditions.
6. Plot of journal center loci in the bearing clearance circle versus load-speed condition.
7. Plot of gear and pinion relative position for each of the transient and typical load-speed conditions presented with the influence of bearing attitude angle minimum oil film thickness, and shaft bending taken into account.
8. Bearing stability thresholds taking into account radial natural frequencies of gear and pinion.
9. The stopped shaft "brinnelling" pressure on the

babbitt compared to boundry lubrication film capacity.

10. The range of bearing clearance and fit manufacturing tolerance and in-service wear, acceptable to meet gear, pinion and bearing life requirements.

Journal bearings shall use babbitt per QQ T 390 grade II.

The designed oil film thickness shall be greater than or equal to 0.001 inches.

The designed babbitt temperature shall not exceed 250°F.

3.3.1.5 Shafts. -

a. Each journal for a bearing shall have a surface finish of 0.40 micrometer RHR or better, and a minimum hardness of RC 30. MOD 2

b. Shaft seals shall operate against replaceable wear surfaces. If elastomer seals are used, the wear surface shall have a hardness of RC 30 minimum.

3.3.1.6 Lubrication System. - The article shall be supplied lubricating oil from the ship system-per the arrangement shown in Figure 3.2.1.1-1. The article lubrication system shall meet the following requirements: MOD 6

a. The housing scavenge port shall be provided with a removable screen which will allow 1 mm maximum size particle through an area at least 3.5 times the drain passage. HMR 109

b. Baffles may be utilized to prevent gears from churning the oil in the sump.

c. All oil jets shall be externally removable and keyed to assure proper positioning. Bent tube oil jets are not permitted.

d. Gear mesh lubrication jets shall be positioned on the exit side of the mesh with at least two jets per main element mesh. Each bearing shall be

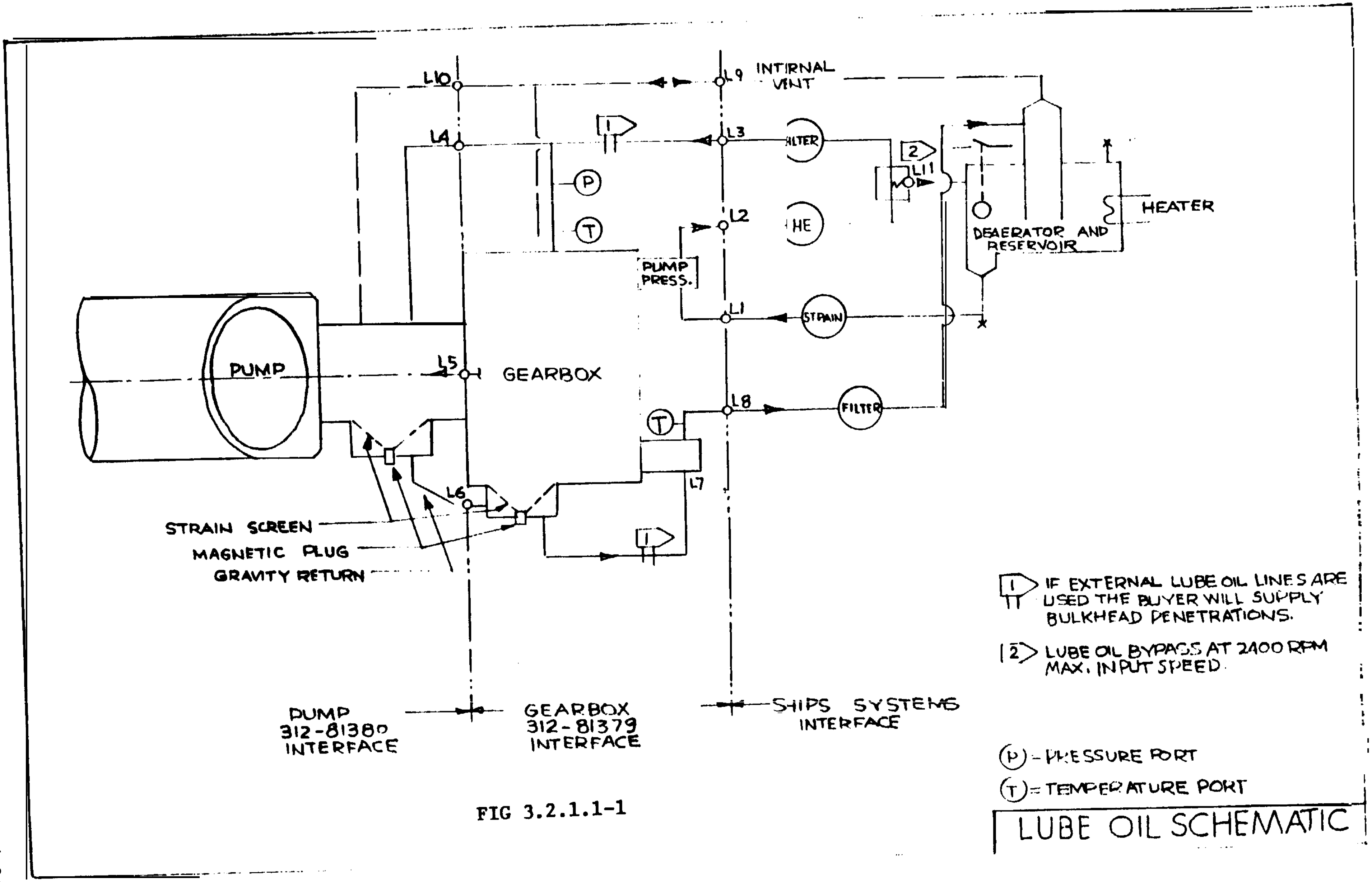


FIG 3.2.1.1-1

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lubricated by a minimum of two jets aimed at inner ring/cage land area. The minimum oil jet size shall be 1.3 mm diameter.

e. The lube oil pressure pump shall be sized to deliver at least 110 percent of gearbox and propulsion pump oil requirements, to permit continuous operation at all gearbox speeds from 20 to 120 percent speed. The scavenge pump shall be sized to have at least twice the capacity of the oil inlet flow to the article at 100 percent input speed. A shear section shall be provided in pressure and scavenge drive shafts to prevent drive spline *or* gear damage in the event of pump seizure. The failed part shall fall free of the rotation elements or otherwise satisfactorily clear itself from jamming. Access shall be provided to the shear section and lube oil pump so that replacement can be accomplished within the requirements of 3.1.2.2. HMR 19 MOD 4 MOD 4

f. All seals shall be compatable with MIL-L-9000 G and MIL-H-83282. O-rings shall be used for faying surf ace seals. Flat gaskets are not permitted.

g. All parts of the article, except external parts that may use individual grease fittings, shall be designed for pressure lubrication from the lubricating system. Orifices shall be used to regulate the flow of oil.

h. The oil supplied to each bearing and each other part shall be unused oil, in that it shall not have been used to lubricate or cool any other part (other than the oil pump rotating elements) during the immediate passage of the oil through the system.

i. One vent connection shall be provided for attachment of the ship's vent piping. This connection may serve one or more vent opening in the gear housing.

j. Scavenge screens inside the article which cannot be removed for in-place inspection are not permitted.

3.3.1.7 Balance. - The rotating elements shall be balanced within the limits specified per MIL-STD-167, Type II. Balance shall be achieved by metal removal.

3.3.1.8 Fasteners. -

a. External fasteners shall use self-locking or positive locking features.
b. Fasteners inside the article shall use self-locking features.
c. Spring type lockwashers, cotter pins and lockwire are not permitted.
d. Threads in aluminum housings shall be provided with steel inserts (helicoil or equivalent). MOD 4

3.3.1.9 Housings. -

a. The housings shall withstand 30 KN/m^2 internal pressure, continuous.
b. Inspection covers shall be provided at each gear mesh on the exit side to provide viewing of the entire gear mesh and lube oil spray pattern.
c. Intentionally not used. MOD 2
d. Bearing bores for rolling element bearings within aluminum housing shall have replaceable steel sleeves with a surface finish of 1.6 micrometer RHR maximum and a surface hardness of RC 30 minimum. MOD 6
e. Aluminum housings shall be anodized inside and outside.
f. Bolted flanges shall be provided with at least three jacking points to allow housing flange separation without special tools or techniques.
g. Casings shall be designed so as to limit the change in bore parallelism from stopped to full MOD 6

power to not more than ,005 mm/mm. The calculations to substantiate meeting the design shall be provided at the critical design review. | HMR 19

3.3.1.10 Snap Rings. - Snap rings shall not be used to secure bearings. MOD 4

3.3.2 Selection of Specifications and Standards

Standards shall be selected in a manner which results in the fewest sizes and types of parts. The order of precedence **for** selection of standards shall be:

a. Military
b. Federal
c. Society
d. Commercial.

Metric standard parts shall be used to the greatest possible extent. Use of U.S. Standard is permitted when no equivalent metric standard is available.

3.3.3 Materials, Parts and Processes

Materials, parts, and processes shall be selected to give the greatest assurance that the article will meet its service life in the environment and duty cycle specified herein. The order of precedence for identification of components shall be per MIL-STD-143.

3.3.3.1 Materials. - The following article components shall be fabricated from the following materials: MOD 4

Housing	A356-T6 Aluminum Casting per W-A-601	MOD 4
All gear rims and shafts	CEVM-AISI 9310 steel forging per AMS6265 (optional AMS6260 and AMS6470 for accessory gears and shafts only)	MOD 1, MOD 6
Shafts not integral with gears	4340 steel forging per MIL-S-5000	MOD 4, MOD 6

The following materials are not permitted:

a. Non-ductile metals with less than 5 percent elongation except as specified herein.
b. Aluminum alloys with major alloy elements of copper, silicon and zinc in excess of that specified in paragraph 3.3.3.1. **MOD** 6
c. 400 series stainless steels.
d. Magnesium or magnesium based alloys.
e. Cadmium or zinc plating.

Materials not specified herein shall be selected to provide inherent corrosion resistance and galvanic compatibility.

3.3.3.2 <u>Processes</u>. - The following processes shall be applied as appropriate:

a. Welding MIL-STD-278
b. Aluminumanodizing MIL-A-8625
c. Nitriding MIL-N-22061
d. Carburizing Main drive gears shall be carburized in accordance with the recommended procedures for Grade 6 in AGMA 246.01A (Recommended Procedures for Carburized Aerospace Gearing). MOD 2, MOD 6
   Accessory gears shall be carburized in accordance with AGMA 246.01a, Grade 5, or nitrided in accordance with MIL-N-22061.
e. Heat treatment MIL-H-6875

3.3.4 Standard and Commercial Parts

3.3.4.1 <u>Bearings</u>. - Bearings shall meet the following requirements:

a. Anti-friction shaft bearings shall conform to AFBMA class 5 or better. The bearing materials shall be AMS 6444 or AMS 6490 with machined bronze cages. (Inner land riding cage preferred.)
b. Anti-friction bearings shall be selected for a minimum AFBMA B-10 life of at least 20,000 hours when operated for the range of its duty cycle. MOD 6 MOD 6

3.3.4.2 Fasteners, Studs, Inserts, and Threaded Parts. - Threaded parts shall be metric design, as a design goal, complying with ISO-R68, ISO-R724 and ISO-R965. However, where metric threads do not apply, U.S. Federal screw threads per handbook H-28 shall be specified. Metric fasteners' thread pitch and tolerance must comply with the following table:

Thread form must comply with ISO/R68.

Thread dimensions must comply with ISO/R724.

Fasteners sizes, thread pitch.

Critical Structure	Non-Structure
M6	M6
M8	M8
M10	M10
M12 x 1.5	M12
M16 x 1.5	M16
M20 x 7.5	M20
M24 x 2	M24
M30 x 2	M30
M42 x 3	

Tolerances per ISO/R465/1.

	Critical Structure	Non-Structure
External	6g	6g
Internal	6H	6H

HMR 109

Selection of fasteners shall be such as to minimize the number of sizes, styles and strength levels.

If spanner wrench slots are used, they shall be dimensioned in accordance with MIL-c-5503. Drilled hole type nuts requiring the use of pin-type spanner wrenches shall not be used.

Aluminum alloy bolts, screws, and nuts shall not be used. Drilled heads or drilled shank bolts shall not be permitted.

3.3.4.3 Fluid Fittings and Piping. - Lube oil piping shall be pressure tested to at least 2 times its maximum operating pressure or $344/KN/M^2$ minimum.

Taper pipe threaded connections shall not be used. MOD 4

3.3.5 This paragraph intentionally not used. MOD 4

3.3.6 Corrosion of Metal Parts

The article's external components shall be constructed using metals and alloys which are inherently corrosion resistant.

Surfaces shall not require plating or coatings (except anodic coatings of aluminum castings) to provide corrosion protection.

Dissimilar metals per MIL-STD-889, Type II, shall be isolated and/or protected to minimize galvanic corrosion.

3.3.7 Interchangeability and Replaceability

3.3.7.1 Interchangeability. - All parts or assemblies having the same manufacturer's part number shall be functionally and physically interchangeable. Where matched parts or selective fits are required such parts shall be separately identified or serialized and shall be interchangeable to this level.

3.3.7.2 Replaceability. - The following components of the article shall be replaceable without major article disassembly.

Input shaft seal
Lubrication jets
Bearing temperature sensors (rolling element bearings)
Accessory drive shaft seals
Lube oil supply and scavenge pumps
Lube oil scavenge screens and magnetic chip plugs.

3.3.8 Workmanship

Not applicable.

3.3.9 Electromagnetic Interference

Not applicable.

3.3.10 Identification and Marking

Label plates shall be provided to identify lubricating oil inlet and outlet ports, and type of oil used, and caution/warning notes.

3.3.11 Storage Life

The article's storage (shelf) life shall be at least two calendar years. Storage life shall not be included in article's useful life.

3.4 STRUCTURAL CRITERIA

The article shall be structurally designed per the following conditions and criteria.

3.4.1 Design Load Conditions

The article shall be structurally designed with a power split of 75 percent in the inner shaft and 30 percent in the outer shaft, at the design point, with the oscillatory loads and accelerations indicated below.

a. Stall torque shall be two times 100 percent input torque. MOD 4
b. 100 percent input torque plus accelerations of paragraph 3.1.2.4.2.
c. 100 percent input torque plus vibration of paragraph 3.1.2.4.4
d. 100 percent input torque ± 10 percent torque for 10^{10} cycles. MOD 4
e. 110 percent input torque ± 6 percent torque in accordance with paragraph 3.1.1.3. MOD 2

3.4.2 Design Factors

Unless otherwise specified, the following design factors shall apply:

a. The yield factor of safety shall be 1.5, with an ultimate factor of safety of 2.25 times the Operational loads of 3.4.1 except that for rotating elements and all torque reacting members, the yield factor of safety shall be 2.0, with an ultimate factor of safety of 3.0 times the operational loads described in paragraph 3.4.1 above.

b. Design fatigue curves shall be derived from material failure fatigue curves by using a safety factor of 2.0 on loads or 20 on cycles, of 1,000 cycles or less, whichever is greater at each point. Miner's equation for cumulative damage is acceptable. MOD 6 MOD 4

c. For castings, a casting factor (CR) of 2.0 is required for critical components in tension, with the minimum section properties due to tolerance effects.

Minimum values from material procurement specifications shall be used for material properties and allowables.

3.4.3 General Structural Requirements

Friction shall not be considered as a valid restraining force in the primary structural load paths except by the approval of the buyer.

3.4.3.1 Gears. - Gears shall be designed using AGMA 411.02, except for the following: MOD 2, MOD 4

Bending stress calculation factors:

$$\text{Derating factor} = \frac{K_m\, K_o\, K_s}{K_v}$$

Where:

Load distribution factor	K_m = 1.3 at 100% torque K_m = 1.8 at 33% torque	Both High Speed and Low Speed Pinion
Overload factor	K_o = 1.25	
Size factor	K_s = 1.0	
Dynamic factor	K_v = value of curve #2 of Figure 19 of AGMA 225.01	

The allowable bending stress shall be per Table 4 of AGMA 411.02.

Contact stress calculation factors:

$$\text{Derating factor} = \frac{C_m \, C_o \, C_s \, C_f}{C_v}$$

Where:

Load distribution factor	C_m = 1.3 at 100% torque C_m = 1.8 at 33% torque	Both High Speed and Low Speed Pinion
Overload factor	C_o = 1.25	
Size factor	C_s = 1.0	
Surface factor	C_f = 1.0	
Dynamic factor	C_v = value of curve #2 of Figure 6 of AGMA 211.02	

The allowable contact *stress* shall be per Table 5 of AGMA 411.02. And Table 3 shall be for carburizing. MOD 4

Tooth pitting index: Tooth pitting index shall be less than or equal to 550 at 100 percent continuous power. MOD 4

In addition the gear elements shall be designed in accordance with the following AGMA Standards, except as specified herein.

AGMA 210.02	Surface Durability (pitting) of Spur Gear Teeth
AGMA 211.02	Surface Durability (pitting) of Helical and Herringbone Gear Teeth
AGMA 217.01	Gear Scoring Design Guide for Aerospace Spur and Helical Power Gears
AGMA 220.02	Rating the Strength of Spur Gear Teeth
AGMA 221.02	Rating the Strength of Helical and Herringbone Gears for Enclosed Drives

AGMA 225.01	Information Sheet for Strength of Spur, Helical, Herringbone and Bevel Gear Teeth
AGMA 411.02	Design Procedure for Aircraft Engine and Power Takeoff Spur and Helical Gears

3.4.3.2 Splines. - Splines shall be designed in accordance with articles by D.W. Dudley, "When Splines Need Stress Control" and "How to Design Involute Splines" which appeared in Product Engineering October 1957 and Gear Design and Application by N.P. Chironis.

3.4.3.3 Lifting Lugs. - The article lifting lugs shall be capable of supporting the article under ± 3 g's acceleration loads in each of the three orthogonal axis.

3.5 DOCUMENTATION

3.5.1 Specifications

Specifications shall be prepared by the Seller covering the Reduction Gear Assembly, Foilborne Propulsion. A prime item product function specification shall be prepared in accordance with MIL-STD-490, Type CIA, covering the reduction gear assembly. A critical item product fabrication specification shall be prepared in accordance with Type C2B of MIL-STD-490, for each major assembly (housing, high speed gear and pinion assemblies, low speed gear and pinion assemblies, lube oil system, accessory drive system, etc.). MOD 4

3.5.2 Drawings

The drawing package shall include drawings for each item addressed above. The drawing shall identify materials, manufacturing and testing processes used in the manufacture of the elements and shall include the number of teeth, diametral pitch (transverse and normal), pitch MOD 4 diameter, addendum, dedendum, whole depth, normal circular pitch, normal pressure angle, helix angle and hard, chondal tooth thickness (range for production), details of profile modification and reliefs, limits on tooth accuracies, an isometric view of one face of each helix showing end relief and contact length - the acceptable tooth contact band (height and length) and reliefs under no load - 75 percent torque - 100 percent torque, minimum root fillet radius, permissible amount of residual unbalance in ounce-inches, tooth hardness, tooth surface finish, weight of parts, shaft dimensions.

a. Outline of reduction gear assembly including dimensions, weights, CG, moment of inertia, etc.

b. Assembly and arrangement of key components and systems and parts lists thereof.

c. The Seller shall provide a procedure for the installation of Seller-furnished equipment and, systems onboard ship.

d. Diagramma tic sketches of piping sys terns indicating pipe sizes, fittings, components, instrumentation, operating parameters, settings, etc., as required to describe sys tern design and operation.

e. Control, instrumentation and wiring schematics with notes as required to describe system design and operation.

f. Main tooth element and coupling stress analysis chart. Design data tabulation shall include: MOD 4

1. Gear tooth design data
2. Tooth hardness
3. Unit load
4. Bending stress
5. "K" factor if applicable
6. Compressive stress
7. Coupling tooth data
8. Coupling tooth hardness
9. *Hertz* stress of coupling teeth.

Drawings shall be prepared in accordance with the requirements for Type II of MIL-D-100012. Contents shall include categories B, D, E, G and H, Form 2 of MIL-D-1000.

3.5.2.1 <u>Certification Data Sheets</u>. - Certification data sheets in accordance with Type III, MIL-D-100012 shall be available for Buyer review.

3.5.2.2 <u>Drawing Revisions</u>. - Drawing changes shall be in accordance with MIL-D-1000.

3.5.3 Technical Manuals

3.5.3.1 <u>New Manuals.</u> - Technical manuals for new equipment shall be in accordance with MIL-M-15071.

3.5.3.2 <u>Commercial Technical Manuals</u>. - Commercial manuals provided by the Seller, either as part of an equipment/system manual, shall meet the requirements of MIL-M-7298.

3.5.4 Program Plans

3.5.4.1 <u>Reliability Program</u>. - The Contractor shall implement a reliability MOD 4
program which shall-include: MOD 4

a. Reliability management procedures which shall include:
   1. Reliability organization
   2. Management and control
   3. Subcontractor and Supplier reliability program
   4. Program review
   5. Status reports.

b. Reliability design procedures which shall include:
   1. Design techniques
   2. Reliability analysis. The Contractor shall perform reliability prediction (based on a reliability analysis) in accordance with MIL-STD-756. Prediction methods, failure rate data, and their sources

shall be fully documented. The predicted reliability shall be compared with the required value and if noncompliance is indicated, a corrective action plan shall be formulated for review and acceptance.

3. Parts reliability
4. Failure mode and effect analysis. The Contractor shall perform a Failure Mode and Effect Analysis (FMEA) of the Foilborne Reduction Gear in accordance with MIL-STD-1629. The analysis shall be conducted to the lowest replaceable unit level for all failure modes with an assigned level of severity of 4. For all other failure modes, the analysis level shall be to the major subassembly level (i.e., lubrication). All failure modes with a level of severity of 4 shall have a probability of occurrence of 3 or less (see paragraph 5.10 of MIL-STD-1629), or shall have a compensating provision, such as a backup safety shut down to limit the effect of the failure mode.
5. Reliability critical items
6. Effect of storage, shelf-life, transportation handling and maintenance
7. Design reviews.

3.5.4.2 Maintainability Program. -The Contractor shall implement a maintainability program which shall include at least the following elements of the detailed requirements of MIL-STD-470: MOD 4 MOD 4

a. Maintainability analysis
b. Inputs to the detailed maintenance plan
c. Design trade-offs
d. Maintainability prediction per the appropriate prediction method of MIL-HDBK-472. The prediction

method together with the supporting rationale shall be unidentified in the program plan. A maintainability prediction report shall be prepared. The predicted maintainability shall be compared with the required value and if noncompliance is indicated, a corrective action plan shall be formulated for review and acceptance.

e. Implementation of maintainability requirements in Subcontractor and Vendor specifications.
f. Implementation of data collection, analysis and corrective action system.
g. Maintainability demonstration.
h. Status report.

3.6 CONFIGURATION CONTROL MOD 4

A configuration control program shall be established by the Contractor for both class I and class II engineering changes in accordance with MIL-STD-480. Class II engineering changes shall be submitted in accordance with MIL-STD-480.

4.0 QUALITY ASSURANCE PROVISIONS

The Supplier shall verify that the article meets all the requirements of this specification. The Contractor shall pro- MOD 4 vide and maintain a quality assurance program in accordance with the requirements of MIL-Q-9858A.

4.1 ARTICLE DESIGN VERIFICATION

All test instrumentation shall be cali- MOD 4 brated and certified per MIL-C-45662.

The following data shall be recorded:

a. Shaft speed - (RPM)
b. Shaft torque (newton-meter)
c Oil in temperature (°C)
d: Oil out temperature (°C)
e. Oil inlet pressure (KN/m^2) (for both pressure and scavenge elements of the main lube pump)

f. Gear case pressure (mm H_2O)
g. Vibration - three axis (20 to 300 Hz)
h. Bearing temperatures (°C)
i. Oil flow into gear box (liters/minute)
j. Oil pressure and flow at the water-jet pump interface (kn/m² and liters/minute)
k. Accessory pad torque (newton-meter)

The following data parameter accuracy at full scale is required:

Parameter	Accuracy
Vibration	± 10%
Temperature	± 1°C
Pressure or head	± 2%
Oil flow rate	± 5%
Speed - rpm	± 0.5%
Shaft torque	± 2.0%
All other data	± 2.0%

4.1.1 Engineering Test and Evaluation

These tests shall be performed to verify the functional adequacy of the article and its subsystems, and shall be conducted after Article Acceptance Test but prior to Endurance Testing. HMR 90R2

4.1.1.1 Lube Oil System Test. - The following parameters shall be determined for the lube oil system with lube oil reservoir, pressure regulator, filters, and heat exchanger installed simulating ship interface:

a. Pressure and flow rates from startup to maximum intermittent speeds
b. Regulator valve setting
c. Pressure and scavenge pump flow margins
d. Equivalent jet orifice size
e. Pressure at lube jet spray orifice manifolds. MOD 4

4.1.1.1.1 Operating Attitude Verification - The Contractor shall verify that the article is capable of operation at 30 degrees roll by analysis. The analysis shall show that the lubrication oil will HMR 82 HMR 4 flow from the article without churning by the main drive gears. The analysis shall be submitted to the Government.

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MOD 4

4.1.1.2 Internal Vibration. - With the article operating at 100 percent speed and no load, the displacement in each of its principal axes shall not exceed 0.051 mm. The article shall be attached to mounts simulating the ship interface.

4.1.1.3 Gear Tooth Stress Test. - Test shall be performed to verify that the root bending stresses for the main drive pinion gears do not exceed 379.2 MN/m^2 when loaded at 100 percent input torque. Bending stresses shall be determined with the gears in the article and with instrumentation at a minimum of 4 teeth equally spaced around the circumference of each input and output gear. Each tooth shall be instrumented with one strain gage at each end and with one at its center. Gears shall be rolled to obtain data collection during each gear mesh.

4.1.1.4 Efficiency. - The article shall be operated at the continuous design point speed and torque to establish the efficiency. No more than 1.5 percent of the input power shall be rejected into the lube oil. Housing thermal radiation may be neglected.

4.1.1.5 Oil Supply and Scavenge. -The article shall be operated at continuous input speeds from 20 to 110 percent and start-up from 0 to 20 percent in an interval of 30 to 60 seconds to demonstrate the adequacy of the lubrication system.

Inspection of the article critical internal components such as (but not limited to) interconnect splines, bearings, gears, and lube oil jets shall be demonstrated during testing by using access covers and/or boroscopes.

4.1.2 Endurance Teats |HMR 90R2

One article shall be submitted to an endurance test. Prior to conducting |HMR 90R2 the endurance test, the test article |HMR 90R2 shall have passed the acceptance requirements described in paragraph 4.2. |HMR 90R2

4.1.2.1 <u>Inspections</u>

4.1.2.1.1 Clearance and Fit Verification and Component Functional Test Actual component dimensions for critical components shall be measured and documented to determine fits and clearances before the test. The dimensions will be measured again after the test to determine wear and acceptance. The followingmeasurements shall be made:

1. Assembly
   a. Backlash of the high and low speed gear assemblies.
   b. Input flange face runout and pilot diameter runout.
   c. High and low speed assembly pinion end play.
   d. Accessory drive pads:
      (1) Concentricity of the drive splines to the accessory pilot diameter.
      (2) End play of shafts.
   e. Contact pattern.
2. Gears
   a. Pinion and gear tooth geometry - The following tooth geometry inspections shall be made on four teeth equally spaced around the circumference on each pinion and gear and on each hand helix of the double helical gear.
      (1) Tooth profile (*true* involute profile) at each end of the tooth and its center.
      (2) Lead (helix angle) at the tip, pitch diameter, and minimum form diameter.
      (3) Root radius.

(4) Index error - tooth to tooth pitch error and cumulative error.

(5) Profile surface finish (radial) and waviness along the tooth length, utilizing 1000 X magnification. MOD 2

(6) Measurement over wires (MOW) of all pinions and gears.

NOTE : All dimensions are to be measured in relation to their respective bearing journals.

b. Gear shafts:

(1) Journal diameters and roundness

(2) Surface finish

(3) Seal surface diameters and surface finish

3. Bearings:

a. Outside diameters

b. Inside diameters

c. Internal diametral clearance

d. Bore runout with the outer race stationary. HMR 90R2

4. Housings:

a. Shaft bore diameters

b. Shaft bore alinements and centerline parallelism

c. Bore surface finish.

5. All drive splines and/or gear couplings:

a. Surface finish (Radial and tooth flank)

b. External splines or gear couplings (outside diameter, measurement over pins)

c. Concentricity of the spline to the supporting journals

d. Internal splines or gear couplings

(1) Minor diameter

(2) Measurement between pins

(3) Concentricity of the spline to the supporting journals.

6. Lubrication oil jets:

a. Orifice diameters

b. Lube oil flow through the jet with lubrication with the normal rated upstream flow and pressure.

7. Lubrication and Scavenge pumps:
   a. Pressure pump oil flow versus speed
   b. Scavenge pump oil flow versus speed.

4.1.2.2 Test Set-Up

4.1.2.2.1 Mounting. - The test article shall be supported solely at mounting locations and in directions specified by the interface data. Shaft alinements shall not impose loads, or temperatures in excess of those specified.

4.1.2.2.2 Lubrication System. - The lubrication system for the gearbox shall be installed simulating the ship lube oil system per Figure 3.2.1.1-1.

4.1.2.3 Endurance Test. - A gearbox en- MOD 4&6
durance test shall be conducted for 400
hours at the suppliers facility. For this
test, also required by Table 1.0-1.4, the
gearbox shall be operated to all the per-
formance requirements specified in para-
graphs 3.1.1.1 and 3.1.1.2, omitting HMR 7
stall torque. The same unit shall be
operated an additional 200 hours at 100 HMR 9OR2
percent continuous power, and an addi- MOD 4
tional 200 hours as specified in Section MOD 4&6
1.200. If a gearbox failure occurs, due
to improper fabrication or a design
deficiency which degrades performance be- MOD 4
low the requirements of paragraphs
3.1.1.1 and 3.1.1.2, the above tests shall HMR 7
be repeated after repairing the failed MOD 4
component or incorporating the design
modification, unless a shorter duration
is approved by the Government. MOD 4

Also, if a gearbox failure occurs, due to improper fabrication or a design deficiency, which does not degrade performance, the above tests may continue if repairs can be made within two hours and HMR 7
the acceptance criteria can be met. If a longer repair period is required, the above test shall be repeated. HMR 7

Also, if a gearbox failure occurs due to test stand malfunction or operator error, which degrades performance below the requirements of paragraphs 3.1.1.1 and 3.1.1.2, the continuation or repeat of this test shall be subject to Governmental approval.

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HMR 7

Also, if a gearbox failure occurs, due to test stand malfunction or operator error, which does not degrade performance, this test may continue if the acceptance criteria can be met.

HMR 90R2

Provisions shall be made by the Contractor for detail reporting on every malfunction or performance degradation, its diagnosis, and any corrective action taken (design modification, etc.). A report shall be prepared covering all aspects of the endurance testing performed by the Contractor. Prior to conducting the endurance test, the article shall have passed the acceptance requirements described in paragraph 4.2. All accessory drive pads must be loaded per 3.1.1.2, omitting stall torque, during the entire test duration. All test data per 4.1 shall be recorded at startup, every 30 minutes of operation and during shutdown. During the endurance test, the gearbox shall be started and shutdown at least once every eight hours of operation. 50 percent of all starts must be made with the gearcase and lubricating oil at ambient temperature or 10°C, whichever is greatest. The lubricating oil shall be maintained at the maximum specified temperature +5°C and the minimum oil inlet pressure.- Torque input and respective hours shall be as indicated below:

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HMR 90R2
MOD 4

Input Shaft Power	Hours
Continuous, 100%	360
Maximum Intermittent, 115.8%	40

MOD 6
MOD 6
HMR 90R2

During testing bearing temperatures shall be monitored. A baseline shall be established during the first test and shall be used to gage increasing clearances, gear wear, and/or pending bearing failure. The supplier may elect to establish a baseline during Pre-Endurance or during the endurance testing.

HMR 90R2

For the duration of the test, supplier recommended maintenance shall be performed in accordance with documented maintenance procedures.

4.1.2.3.1 Disassembly Inspection. ▪ Inspections shall be performed during, and at the completion of endurance testing as indicated below. Checks for critical excessive wear, or any other early signs of failure shall be conducted.

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HMR 90R2

TYPE OF TEARDOWN	END OF ENDURANCE RUN HOURS
Partial	50
Partial	100
Partial	200
Full	400

For partial teardown, visual inspections are to be performed at all points of distress, with examination with dye penetrant per MIL-STD-271, if required.

At the conclusion of the endurance test, and after inspection, the test article shall be disassembled and inspected. All gears, splines, and shafts shall be dye penetrant inspected per MIL-STD-271, and critical running fits and clearances shall be measured.

MOD 4
MOD 4

Oil analysis shall be made for metallic contamination.

MOD 4

Additional inspection and/or tests may be required at Buyer discretion, depending upon results of tear down inspections. After each tear down inspection and evaluation, the article shall be reassembled with the same hardware except for expendables identified in the test plan.

HMR 90R2

4.1.2.3.2 Test Acceptance Criteria. ▪ Endurance test acceptance shall be based upon successful completion of the endurance run.

Acceptance criteria shall be used on the following:

a. No erosion or corrosion HMR 7
b. Gear contact area shall be equal to or greater than the area measured prior to test.
c. Gear teeth shall show no signs of scoring wear, surface fatigue, plastic flow, or breakage as defined in AGMA 110.03. HMR 7
d. Lube oil supply/scavenge flows and pressure, and lube oil scavenge temperature from the gearbox sump shall be within limits. HMR 7
e. Housing vibration does not exceed 1.1 times initial measured vibration amplitude. HMR 7

f. Bearing outer temperatures shall not exhibit more than a $10^{\circ}C$ temperature rise from the beginning to the end of the test. Bearings shall not show evidence of abnormal heat or wear. Wear shall be determined by dimensional measurement and high magnification examination of the bearing races and *rollers.* |HMR 7 MOD 6

g. No casing joint leakage shall have occurred, nor shall oil shaft seal leakage have exceeded 25 cc/hour.

h. Splines shall not exhibit fretting corrosion or severe metal removal. |HMR 7

4.1.3 Component Tests

The following test, with the exception of the pump qualification test, shall be performed for each deliverable article. These inspections and tests shall be conducted prior to acceptance test at the component level.

4.1.3.1 Lube Oil Pumps - The pressure and scavenge lube oil pumps shall be subjected to component tests, prior to installation on the article. The pumps shall be mounted simulating the article interface. The following parameters shall be met using oil per MIL-L-9000 at temperatures of $10^{\circ}C$ and $49^{\circ}C$.

4.1.3.1.1 Pump Endurance Test. - Lube oil pumps shall be subjected to 800 hours operation under pressure and flow conditions as installed on the gearbox at rated speed. |HMR 90R2 MOD 4

Pump inspection at end of test shall show *no* evidence of malfunction or excessive wear. This test shall be conducted one time only for each type pump.

4.1.3.1.2 Pump Pressure Test. - The lube oil pumps shall be pressure tested to at least 2 times the maximum working pressure. There shall be no evidence of leakage or housing permanent deformation. |HMR 90R2 MOD 4

The lube oil pumps shall be operated at rated flow and pressure for at least one hour, without an evidence of leakage at shaft seals.

4.1.3.2 Balance Test. - The article's rotating components shall meet the balance requirements of MIL-STD-167, Type II, as a part or subassembly. Balance must be achieved by metal removal.

4.1.3.3 Housing Pressure Test. - The article housing shall be pressure tested at 30.0 KN/m^2. There shall be no external visible leakage as evidenced by soap film test.

4.1.3.4 Magnetic Particle Inspection. - All rotating elements such as gears, pinions, and shafts, shall be subjected to magnetic particle inspection per MIL-STD-271 after final machining.

4.1.3.5 Ultrasonic Inspection. - All rotating element forgings shall be ultrasonic inspected per MIL-STD-271 prior to machining. Testing shall be in both radial and longitudinal directions using either a shear or longitudinal wave depending upon the geometry of the forging. Such forgings shall also be examined by the magnetic particle method (for steel) and by the penetrant method (for nonmagnetic material) in accordance with MIL-STD-271. Teeth of pinions and gears shall be inspected for surface defects by the magnetic particle method or the dye penetrant method in accordance with MIL-STD-271. This shall be done after grinding for teeth so finished and after the final heat treatment for all pinions and gears.

4.1.3.6 Dye Penetrant Inspection. -The article housing shall be dye penetrant inspected per MIL-STD-271, after final machining. I HMR 7

4.1.3.7 Nital Etch Inspection. - Gear and pinion teeth shall be Nital Etch inspected for evidence of grind burns per BAC 5436, after final grinding. HMR 7 MOD 6

4.1.3.8 Piping and Tubing. - Lube oil piping shall be pressure tested to at least 2 times the maximum working pressure or to 344/kn/m^2, whichever is greater. MOD 6

4.1.3.9 Castings. - Castings shall be inspected in accordance with the requirements of QQ-A-601E except that: MOD 6

1. A minimum of three attached test coupons from opposite locations shall be taken from each casting poured and they shall satisfy the acceptance criteria of QQ-A-601E.
2. The non-destructive and the repair requirements of MIL-STD-278 category 1 - subcategory A-1 shall be invoked in lieu of the non-destructive inspection and the repair requirements of QQ-A-601E.

4.1.3.10 Welding and Allied Processes. - Examinations and test procedures for welding, brazing, and allied processes shall conform to MIL-STD-278.

Liquid Penetrant inspection procedure and technique shall be as specified in MIL-STD-271, except delete reference to Group I in Para. 5.3.1, Line 5 through Line 7 and in Para. 5.4, Line 4 through Line 6 and add reference to Group III or Group IV. HMR 109

4.1.3.11 Pinion and Gears Geometry Error. - Tooth geometry error shall be measured in accordance with AGMA 390.03 for Class 12 gears, and using a MAAG Type TMA (Klingelnberg TBD optional) Pitch measurement instrumentation. HMR 90R2

Measurements are to include but not be limited to:

a. Involute form profile error
b. Tooth to tooth spacing, adjacent and cumulative
c. Helix angle (lead error)

d. Gear profile finish (Radial) and longitudinal with 1000 magnification

e. Gear surface waviness or undulation error.

Measurements shall be made on at least four adjacent teeth located at 90 degrees spaced around the gear.

4.1.4 RELIABILITY DEMONSTRATION

Reliability Demonstration shall be considered satisfied by successful completion of the endurance test per paragraph 4.1.2.3 of Section 1.241 and the test per Section 1.200, as specified in Table 1.0-1.4. HMR 7 HMR 90R2

a. <u>Failure data collection analysis and corrective action</u> - provisions shall be made by the Contractor for oomplete reporting on every malfunction or performance degradation, its diagnosis and any corrective action taken (design modification, etc.). Reporting shall be in accordance with Section 1.0-1.4.5.1(b) and CDRL item A05S. HMR 19

b. <u>Failure of Test(s)</u> - in the event of inability to reach an accept decision, the Contractor shall perform an analysis to determine the cause, perform corrective action, and propose appropriate modifications to the design. Verification test of any modification shall be repeated unless a shorter duration is approved by the Government. HMR 7

c. <u>Test Procedure</u> - See endurance test requirements in Section 4.1.2.3. HMR 7

4.1.5 Maintainability Test

The supplier shall submit a maintainability analysis for the recommended organizational and intermediate level maintenance actions. The Contractor shall conduct two maintainability demonstrations as follows: MOD 4

1. The removal, replacement, and alinement one time of the entire gearbox, and

2. all other maintenance actions on the gearbox in accordance with MIL-STD-471. HMR 7

4.2 ACCEPTANCE/VERIFICATION REQUIREMENTS

Each article shall be acceptance tested to verify the functional requirements of this specification have been met prior to delivery.

4.2.1 Inspections

4.2.1.1 Configuration and Component Test Verification. - Article configuration and component test verification is required by submittal of component, assembly, and installation inspection records prior to acceptance test of the article.

4.2.2 Demonstration

4.2.2.1 **Runouts.** - Accessory drive pads and input shaft **runouts** - radial and axial - shall be measured. The total indicator reading shall not exceed:

	Input shaft	Accessory Pads
Axialrunout	TBD	TBD
Radialrunout	TBD	TBD

4.2.2.2 Breakaway Torque. - The input shaft torque required to begin rolling the gears in the article shall be determined.

4.2.2.3 Gear Contact Pattern - Static. - Gear tooth contact areas shall be not less than 95 percent of face width contact at full torque and not less than 75 percent face width contact at one third torque. The contact pattern shall be demonstrated by slowly rolling the gear elements through mesh under these torques. Gearbox shall be attached to test bed utilizing all mounts specified in interface Drawing 201-4596607.

4.2.3 Performance Test

The following tests shall be conducted with article mounted per paragraph 4.1.2.2.1.

4.2.3.1 Overspeed Test. - The article shall be operated at 3600 rpm input speed at no load for at least five minutes. HMR 7

4.2.3.2 Full Load Test. - The article shall be subjected to continuous torque and continuous input speed for at least 24 hours. MOD 4

4.2.3.3 Acceptance Criteria

4.2.3.3.1 Vibration shall not exceed initial levels established prior to these tests or the endurance test. (HMR 90R2 There shall be no measured change in levels during the full load test.

4.2.3.3.2 Lubrication Oil System. - Lubrication oil flow and pressure shall be within the interface limits.

4.2.3.3.3 Seal Leakage. - External lubricant leakage across shaft seals shall be less than 25 cc per hour. No visible external leakage is allowed from any static seal or faying surface joint.

4.2.3.3.4 Bearing Temperature. - Bearing temperatures shall not exceed 120°C. HMR 90R2

5.0 PREPARATION FOR DELIVERY

5.1 APPLICATION

The following requirements shall apply to all shipments.

5.2 PRESERVATION, PACKAGING, AND PACKING

5.2.1 Preservation

The article components, and accessories shall be preserved in accordance with MIL-P-17286.

5.2.2 Shipping Container

The article, components, and accessories shall be packaged and packed in Contractor-furnished shipping containers in accordance with commercial practice for local cross-country or international shipment per MIL-P-17286. ,

5.2.3 Packing List

The supplier shall furnish a packing list with each shipment. All parts, accessories, and components which are not installed on the article but which are shipped with the article shall be included on the packing list.

5.3 MARKING OF SHIPMENTS

Interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129. The identification shall be composed of at least the following information:

a. Stock No. or other identification as specified in the purchase documents*
b. Specification (insert symbol and number)
c. Manufacturer's Serial No.
d. Contract or Order No.
e. Manufacturer's Name.

*NOTE: The Supplier shall enter the Federal Stock No. specified in the purchase document or as furnished by the procuring activity. When the Federal Stock No. is not provided or available from the Buyer, leave space thereof and enter the Stock No. or other identification as provided by the Buyer.

6.0 GENERAL NOTES

6.1 DEFINITION

6.1.1 Article/Gearbox

The term "article" shall be construed throughout the specification to mean the gearbox assembly.

6.1.2 SCD

SCD is an acronym for Specification Control Drawing.

6.1.3 Boeing/Buyer

The Boeing Marine Systems, a Division of the Boeing Company.

6.1.4 Supplier/Vendor

The term "Vendor" and "Supplier" can be used interchangeably. These terms describe the prime source from which the article described herein is purchased.

6.1.5 Useful Life

The total operating time between manufacture and the point at which further operational use or restoration is uneconomical.

1.245 PROPULSORS

1.245.1 HULLBORNE

Two hullborne propulsors shall be Aerojet Liquid Rocket Company waterjet pumps Model 1164000-39 (PHM-3) or 1189440-9 (PHM-4, -5, -6, and -2) per Boeing Specification 312-80140 utilizing thrust vectoring for steering and astern thrust. Each propulsor shall be connected to a reduction gear via a flexible coupling. Bearings and seals shall be continuously supplied with lubricant to allow concurrent operation with foilborne system. An overrunning clutch shall be provided between the coupling and the propulsor. HMR 4, 167 MOD 6

Lateral thrust vectoring for ship steering shall be provided by a movable steering tube. Astern thrust shall be provided by closing the steering tube with a movable visor to direct the exit flow forward.

Each propulsor input shaft bearing housing shall incorporate watertight shaft seals to provide for emergency operation of the propulsor with the aft machinery space flooded.

Both propulsor pumps shall be self-priming at all ship displacements above minimum operating condition in the hullborne mode. Installation shall be in accordance with NAVSHIPS Dwg. 201-4597754.

1.245.2 FOILBORNE

The foilborne propulsor shall be an Aerojet Liquid Rocket Company waterjet pump in accordance with the following:

CONTENTS

PARAGRAPH

LIST OF FIGURES

MOD 4

1.0 SCOPE

This drawing defines performance, operation, design and verification requirements for the waterjet pump assembly hereafter called the article.

Article hydraulic and mechanical configuration shall be based upon Aerojet Liquid Rocket Canpany pump supplied for the Patrol Hydrofoil Missile Ship Part No. 116400-99 less Part No. 1163352-19 gearbox. HMR 43 MOD 6

The article consists of all equipment from the water inlet flanges and power input connection to a fixed area exit nozzle with integral shaft thrust bearing assembly. External lubrication system components are shipbuilder-furnished. MOD 2

1.1 APPLICATION

The article shaft power is provided through a co-axial drive from a reduction gear per Section 1.241.2. MOD 2, MOD 4

1.2 ARRANGEMENT

The arrangement of the propulsion system is shown on Boeing Drawing No. 201-4668748. HMR 122

2.0 APPLICABLE DOCUMENTS

The following documents, of the exact issue shown, form a part of this specification to the extent specified herein. Where the document is not dated, the latest issue in effect on the date of invitation for bid shall form a part of this specification. The effective issue of referenced **subtier** documents shall be the exact issue shown therein and, if not shown, the effective issue shall be the latest issue in effect on the date of invitation for bid. Effective dates for military specifications and standards shall be as listed and published in DOD Index of Specifications and Standards dated July 1975 and Supplemented November 1975.

In the event of differences between this specification and the documents referenced herein, the content of this specification shall govern.

Subsidiary documents to those listed below form a part of this specification only to the extent that they are referenced within applicable portions of the below referenced documents, and they are in context with the original reference contained in this specification.

2.1 MILITARY STANDARDS

MIL-STD-129E, Marking for Shipment and Storage, 20 April 1970, (Change Notice, 28 January 1972).

MIL-STD- **130D,** Identification Marking of U.S. Military Property, 5 March 1971, (Change 1, 30 July **1971).**

MIL-STD-143B, Standards and **Specifications,Order** of Precedence for the Selection of, 12 November 1969.

MIL-STD-167B, Mechanical Vibrations of Shipboard Equipment, 11 August 1969.

MIL-STD-271E, Nondestructive Testing Requirements for Metals, 31 October 1973. **HMR** 43

MIL-STD-276 Impregnation of Parts, Non-Ferrous Metal Castings, 2 February 1956.

MIL-STD-278D, Fabrication, Welding, and Inspection and Casting Inspection and Repair for Machinery, Piping, and Pressure Vessels in Ships of the U.S. Navy, 26 January 1970.

MIL-STD-889A, Dissimilar Metals, Definition of, 5 May 1972.

MIL-STD-1472B, Human Engineering Design Criteria.

MIL-STD-470, Maintainability Program Requirements For System and Equipment, 21 March 1966.

MIL-HBK-2178, Reliability Prediction of Electronic Equipment, 7 September 1976. HMR 43

MIL-STD-480, Configuration Control, Engineering Changes, Deviations, and Waivers.

MIL-STD-756A, Reliability Prediction, 15 May 1963. HMR 43

MIL-STD-785A, Reliability Program For Systems and Equipment and Product Development, 28 March 1969. HMR 43

MIL-STD-1629, Procedure for Performing A Failure Mode and Effect Analysis For Shipboard Equipment, 1 November 1974.

MIL-HBK-472, Maintainability Prediction, 24 May 1966.

2.2 MILITARY SPECIFICATIONS

MIL-T-5624H, Turbine Fuel, Aviation, Grades JP-4 and JP-5, 30 October 1970.

MIL-C-6021H, Castings, Classification and Inspection of, 3 June 1976. HMR 43

MIL-I-6869D, Impregnation Material Specification, 14 January 1971.

MIL-H-6875, Heat Treatment of Steel, Aerospace Process for 14 January 1972.

MIL-A-8625C, Anodic Coatings for Aluminum and Aluminum Alloys, Amendment 1, 13 March 1969. HMR 43 HMR 43

MIL-L-9000G, Lubricating Oil, Shipboard Internal Combustion Engine High Output Diesel.

MIL-F-16884F, Fuel Oil, Diesel, Marine, Amendment 2, 15 December 1969.

MIL-P-17286C, Propulsion and Auxiliary Steam Turbine and Gears (including repair parts, **tools,** accessories, and instruments); Packaging of, 9 February 1968. HMR 43 HMR 43

HMR 43

MIL-L-23699B, Lubricating Oil, Aircraft Gas Turbines, Synthetic Base, Amendment 1, 25 September 1970.

HMR 43

MS 33649, Bosses, Fluid Connection, Straight Thread, Supplement and 10041, and 10050, 14 December 1966.

MIL-H-83282, Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft, 16 July 1970.

MIL-Q-9858A, Quality Program Requirements.

2.2.1 FEDERAL SPECIFICATIONS

FF-B-185 Bearings, Roller, Cylindrical and Bearings, Roller Self-Aligning, Amendment 4, 26 December 1963. HMR 43

OOH28/21 Screw Thread Standards for Federal Services, Section 21, Metric Screw Threads, 31 May 1977.

HBK-H28 Screw Thread Standards for Federal Services, March 1970.

2.3 PUBLICATIONS

NAVMATINST 4600.58 (ASTIC 068958), Department of Defense Engineering for Transportability Program, 29 December 1964.

"Assist" Users Manual dated May 1977. HMR 19

ANS B92.1-1970, "Involute Splines and Inspection", Metric Edition; Published by Society of Automotive Engineers, Inc., No. 2 Pennsylvania Plaza, New York, New York 10001.

INTERNATIONAL STANDARDS ORGANIZATION

ISO/R68 - ISO General Purpose Screw Threads - Basic Profile

HMR 43

ISO Recommendations 280, **Bearing Tolerances.** HMR 43

2.4 BOEING DOCUMENTS AND DRAWINGS

See Section 1.241.

3.0 REQUIREMENTS

3.1 PERFORMANCE

The article performance shall be based on the following standard conditions:

HMR 43

MIL-L-23699B, Lubricating Oil, Aircraft Gas Turbines, Synthetic Base, Amendment 1, 25 September 1970.

HMR 43

MS 33649, Bosses, Fluid Connection, Straight Thread, Supplement and 10041, and 10050, 14 December 1966.

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OOH28/21 Screw Thread Standards for Federal Services, Section 21, Metric Screw Threads, 31 May 1977.

HBK-H28 Screw Thread Standards for Federal Services, March 1970.

MIL-S-6090A, Steel, Carburizing and Nitriding, Process for, Amendment 1, 20 July 1972. KMR 92

MIL-P-18177C, Plastic Sheet, Laminated, Thermosetting, Glass Fiber Base, Epoxy Resin, dated 25 May 1960.

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MIL-C-45662A Calibration System Requirements, 9 February 1962.

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NAVMATINST 4600.5A (ASTIC 068958), Department of Defense Engineering for Transportability Program, 29 December 1964.

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ANS B92.1-1970, "Involute Splines and Inspection", Metric Edition; Published by Society of Automotive Engineers, Inc., No. 2 Pennsylvania Plaza, New York, New York 10001.

INTERNATIONAL STANDARDS ORGANIZATION
ISO/R68 - ISO General Purpose Screw Threads - Basic Profile HMR 43

ISO Recommendations 280, Bearing Tolerances. HMR 43

2.4 BOEING DOCUMENTS AND DRAWINGS

See Section 1.241. MOD 2

3.0 REQUIREMENTS

3.1 PERFORMANCE

The article performance shall be based on the following standard conditions:

Sea Water Density:	1022 Kg/m^3
Water Temperature:	30^oC
Vapor Pressure:	415 millimeters of sea water
Atmospheric Pressure:	10.11 meters of sea water

3.1.1 FUNCTIONAL CHARACTERISTICS

3.1.1.1 PRIMARY PERFORMANCE

The aricle primary performance design point shall be:

Continuous - 100 percent

Input power:	17000 Metric	MOD 4
Input Speed:	To be determined by the Supplier	MOD 2
Inlet Total Absolute Head:	40 meters of sea water	MOD 6
Flow Rate:	To be determined by the Supplier	MOD 4
Thrust Efficiency:	85.2% 2	MOD 6

2 With auxiliary bleed water flow of $0.03m^3$ per second MOD 6

3.1.1.2 SECONDARY PERFORMANCE

The article shall incorporate four auxiliary bleed ports capable of delivering 0.0726 cubic meters per second at a pressure of 1680 kilonewtons per square meter gage at the continuous design power. MOD 6 HMR 43

3.1.1.3 DUTY CYCLE

The article shall be capable of operation within the following load spectrum:

HMR 13

CONDITION	INPUT POWER	INLET TOTAL ABSOLUTE BEAD	PERCENT TIME 3
	percent	meter H_2O	
Battle Override (maximum intermittent)	115.8	45	.1
Rated (continuous)	100	40	4.5
Cruise	90	20	5.0
Takeoff	100	10	.4
Underway - Replenishment 4	35	10	.5
Idle Speed 5	1.5	10	6.6
Static	None	10	82.9

3 There is 1 start for each 2 hours of operation

4 Lowest steady state input shaft speed. Prime mover start time to attain this speed is 60 seconds maximum.

5 Moored dockside or underway with no input shaft rotation. Article approximately half full of sea water.

3.1.2 OPERABILITY

The article operability shall be based on the article being installed in a non-manned machinery space.

3.1.2.1 RELIABILITY

The article shall have a mean time between failures (MTBF) goal of 3200 hours and a MTBF requirement of 1600 hours when operated within the specified environment and duty cycle. MOD 4

3.1.2.2 MAINTAINABILITY

The article construction and design shall minimize requirements for special tools and test equipment for in-place maintenance, repair and inspection. Attachments, lift lugs, eyes or hoisting pads shall be provided for the article and components which weigh more than 20 kilograms. The article shall be capable of being handled to permit shipboard installation. The article shall have a mean MOD 4 time to repair (MTTR) goal and MTTR requirement as specified in Table 1.0-1.4 of these Specifications. HMR 90R2 & 92

3.1.2.2.1 INSPECTIONS

The article shall be provided with access ports for visual and borescope access such that internal components including the impellers, rotors, stators, bearings and critical clearances can be visually inspected.

3.1.2.2.2 SCHEDULED MAINTENANCE

The article shall require no preventive maintenance task, other than a visual inspection more than once each day of seven days or 72 hours of operation, after which 8 hours of inspection is permissible.

The article thrust bearing assembly shall be capable of removal and replacement without disturbing the article alinement or supports. Shaft seals of the thrust bearing assembly shall be capable of replacement with the thrust bearing assembly removed from the article and without disturbing the bearing or their preload. MOD 6

3.1.2.2.3 UNSCHEDULED MAINTENANCE

For unscheduled in-place repair, the article shall have a mean time to repair (MTTR) goal of 10.5 hours and a MTTR requirement of 21 hours, provided article access is available. MOD 4

3.1.2.3 USEFUL LIFE

The article useful life shall be 20,000 hours in an interval of 15 years, when operated within the specified environment and duty cycle.

The useful life criteria shall apply to article housings, impeller, inducer and shafts.

The article minimum time between overhaul (MTBO) goal shall be 4,600 hours. HMR 90R2

3.1.2.4 ENVIRONMENT

The article shall be capable of operation within the ship environment specified below without yielding or failure of the article or its attachments:

a. Internal water - sea water temperature from freezing (minus 2°C for sea water) to 29°C.
b. Ambient air temperature from 10°C to 49°C with relative humidity to 100 percent, including conditions when moisture freely condenses on the article exterior.
c. Maximum translational accelerations and rotational rates at the article center of gravity.

Vertical Acceleration	6.0 g's upward or 1.0 g's downward
Lateral Acceleration	2.0 g's to either side
Longitudinal Acceleration	0.5 g's forward or 0.5 g's aft
Pitch Rate	15 degrees per second
Yaw Rate	10 degrees per second

These accelerations and rates are considered to act simultaneously and will occur less than 100 times in the article's useful life.

d. The operational and non-operating vibration environment will be per MIL-STD-167B, Type I.
e. All exposed parts and external finishes on the article shall withstand continuous wetting by the following fluids in any combination:
   1. Sea Water
   2. MIL-F-16884, Diesel Fuel
   3. MIL-H-83282, Hydraulic Fluid

4. MIL-L-23699, Lube Oil -Turbine
5. MIL-T-5624, Fuel - JP-5
6. MIL-L-9000, Lube Oil

f. The article shall be capable of continuous operation in any combination of the following attitudes:

Permanent trim of the article centerline down or up 5 degrees from the installed attitude.

Permanent list of the article of 5 degrees to either side of vertical.

Momentary pitch of the article of 10 degrees down or up for 10 seconds.

Momentary roll of the article 30 degrees to either side of vertical for 30 seconds, 20 degrees to either side of vertical for 2 minutes.

3.1.2.5 TRANSPORTABILITY

The article shall be capable of being transported by air, rail, sea, or truck in accordance with NAVMATINST 4600.5A, and be consistent with standard military packaging for minimum cost, cube, and weight.

3.1.2.6 HUMAN PERFORMANCE

The article shall be designed for ease of operation, inspection, maintenance and handling using the human engineering requirements of MIL-STD-1472 as a guide.

3.1.2.7 SAFETY

The article rotating elements shall be capable of speeds to 120 percent.

3.2 Article Definition

The article shall meet the dimensional requirements and shall not exceed the space envelope defined in Boeing drawing 201-4596600.

3.2.1 INTERFACE REQUIREMENTS

Interfaces are defined on Boeing draw- MOD 2
ing 201-4596600. Interface requirements
not specified herein shall be as specified
by the supplier.

Article thrust bearings shall incor- MOD 6
porate provision for shipbuilder instal- MOD 2
lation of a resistance temperature
detection device to permit thrust bearing
temperature measurement during operation.
Location TBD by the shipbuilder. MOD 2

Clearance required for part or component replacement and maintenance shall be identified by the supplier.

The article shall have two static
pressure ports located at the article
water inlet section. MOD 4

The article shall have three static
pressure ports located to permit pump dis-
charge static pressure measurement. MOD 4

3.2.1.1 This paragraph intentionally not used.

3.2.2 ARTICLE IDENTIFICATION

The article shall be identified in accordance with MIL-STD-130. An identification tag shall be premanently affixed to the housing and shall include the following information:

(a) Supplier's Name
(b) Supplier's Model Number
(c) Serial Number
(d) Government Contract Number
(e) Dry Weight

3.2.3 ARTICLE WEIGHT

The article wet weight including the
contained sea water from inlet housing
flange face to the plane of the exit
nozzle shall not exceed 5890 kilograms, MOD 6
plus the weight increase from the reduced
stress stators design, inlet redesign, and
maintainability design changes.

3.3 Design And Construction

The article will be mounted shipboard utilizing the mounts shown on interface drawing 201-4596600 and will support a rigidly attached gearbox which provides suitable speed reduction *from* the prime mover. The gearbox is defined in Section 1.241.2. MOD 2

The article shall be self priming with a water level 0.3 meters below the centerline of the inlet as shown on Boeing Drawing 201-4596600.

The article shall not auto-rotate when subjected to a water inlet total absolute head equivalent to the maximum hullborne speed with the struts extended. MOD 5

The article and its components shall be designed in accordance with the structural requirements of Section 3.4.

International metric system dimensions shall be the basis for article design. Interface dimensions shall be in metric units unless the interface is part of an existing design which properly carries English dimensions.

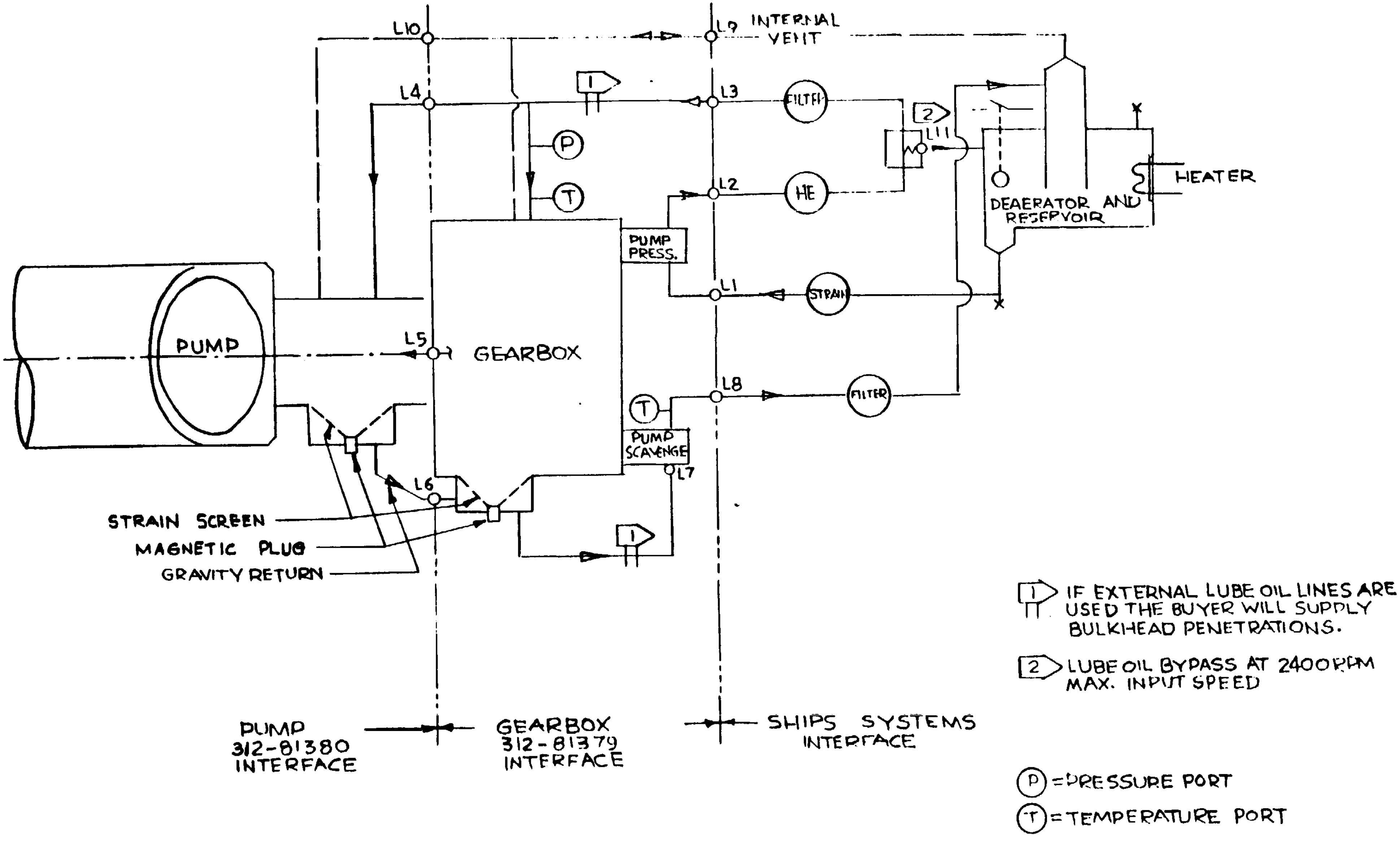
3.3.1 GENERAL DESIGN FEATURES

3.3.1.1 LUBRICATION SYSTEM

The article thrust bearing assembly shall use MIL-L-9000G lubricating oil. The article shall be supplied lubricating oil from the gearbox as shown on Figure 3.3.1.1-1. MOD 6

The thrust bearing assembly scavenge oil return shall be equipped with a removable screen and magnetic chip detector. The screen shall be located to insure that magnetic particles in the oil will contact the detector. Article lubricating oil return details are shown on Boeing Drawing 201-4596600. MOD 6 & 2

MOD.6 HMR 4



LUBE OIL SCHEMATIC
Figure 3.3.1.1-1

For all rolling element bearings, the bearing heat generation rates and lubrication oil flow rates shall be calculated at the continuous design point conditions.

3.3.1.2 BALANCE REQUIREMENTS

All rotating components shall be balanced within the balance limits of MIL-STD-167B Type II. Component elements comprising a balanced assembly shall be permanently marked to indicate correct assembly orientation. Balancing shall be accomplished by metal removal.

3.3.1.3 GALVANIC ISOLATION

Galvanic isolation between dissimilar metals as defined in MIL-STD.889 shall be provided. A physical separation between dissimilar metals is required of at least 0.7 millimeters, and minimum dry resistance of 50,000 ohms.

Isolation materials shall be water and creep resistant similar to MIL-P-18177 (NEMA Grade G-10) glass/epoxy material or equivalent.

Aluminum housings in contact with sea water shall be protected with renewable sacrificial anodes. Anodes shall be inspectable and replaceable without article disassembly.

3.3.1.4 SEALS

3.3.1.4.1 Static Seals

O-rings shall be utilized to seal at the article internal pressure boundary flanges.

Flat gasket seals are not permitted.

3.3.1.4.2 Dynamic Seals

Shaft seals shall be provided to minimize water and oil leakage from the article. Oil leakage shall not exceed 25 cc/hour, when operating or stationary. Adjacent oil and water seals shall be separated by an air cavity vented to atmosphere with a deflector plate to prevent spray from a defective water seal from impinging on an oil seal.

Compression packing type shaft seals -are not permitted.

O-ring seals shall not be used for dynamic seals.

Labyrinth type seals shall have galvanic isolation between the seal and housing when dissimilar metals are specified.

The article shall be designed to minimize water leakage during removal of the forward (water inlet end) shaft seal. Leakage shall be less than 20 liters per minute.

3.3.1.5 SHAFT FEATURES

3.3.1.5.1 Wear Sleeves

Wear sleeves shall be provided between rubbing seals and shafts with a surface finish quality of 0.5 micrometer RHR or better and a hardness of Rockwell "C" 30 minimum. Sleeves utilized at shaft water seals shall be fitted with an o-ring static seal between the shaft and sleeve. Wear sleeves shall be securely anchored to prevent slippage or movement.

MOD 6

3.3.1.5.2 Bearing Races

Article radial anti-friction bearings shall utilize fitting practices for rotating shafts and stationary housings in accordance with specifications FF-B-185, as applicable. Fitting practice for the spherical, roller thrust bearing shall be as specified by the bearing manufacturer. Anti-friction bearing cages shall be fabricated of machined bronze material.

MOD 6 HMR 4

3.3.1.6 SPLINES

Shaft splines shall be per ANS B92.1-1970 with fillet root side fit form.

Spline teeth shall have a surface hardness of at least Rockwell "C" 52 and surface finish shall not exceed 3.2 micrometer RHR maximum roughness and they shall meet the useful life and reliability requirements of para. 3.1.2.3 and para. 3.1.2.1 of Section 1.245.2.

HMR 43
MOD 6

Splines made from corrosion resistant material may have surface hardness compatible with the material capability. HMR 4

3.3.1.7 FASTENERS

Bolt materials and finishes shall be selected to provide resistance to galvanic action and resultant corrosion.

Fasteners shall be provided with a self-locking means such as self-locking nuts or bolts, as appropriate to the design function and environment of the assembly.

Safety wire shall not be used. Lock-washers and star washers shall not be used.

Drilled hole type nuts requiring the use of pin-type spanner wrenches are not permitted. MOD 2

Aluminum alloy bolts, screws, and nuts shall not be used. Drilled head or drilled shank bolts are not permitted.

3.3.1.8 HOUSINGS

The inlet housing (Y-duct) shall be in accordance with Boeing Dwgs. 201-4596667 and 201-4596694. All other propulsion inlet housing requirements and/or references contained in these specifications, which conflict with these drawings do not apply. HMR 5

Steel bearing liners shall be fitted between aluminum housings and rolling element bearing outer races. The liners shall be renewable with a surface finish quality of 1.6 micrometer RHR or better and a hardness of Rockwell "C" scale 30 minimum. Wear sleeves and liners shall be securely anchored to prevent slippage or movement.

Snap rings shall not be used to secure bearings or seals.

Article housing internal flow passages shall be smooth and continuous with no greater than 1 millimeter forward facing step at housing interfaces. MOD 6

Bolted flanges shall have jacking provisions to permit joint separation without special tools or techniques.

Tapped holes for fasteners in aluminum or aluminum alloys shall be fitted with a stainless steel insert with suitable galvanic corrosion protection. Bottom tapping shall be avoided where possible. HMR 43 MOD 6

The following material selections are not permitted:

(a) Non-ductile metals, with less than 5 percent elongation except as specified herein.

(b) Aluminum alloys with copper, silicone or zinc as the primary alloying elements except as specified per 3.3.3.1. MOD 6

(c) 400 series stainless steel

(d) Magnesium or magnessium based alloys.

(e) Cadmium or zinc plating.

Materials not herein specified shall be selected to provide inherent corrosion resistance and galvanic compatibility.

3.3.3.2 PROCESSES

The following processes shall be used as is appropriate.

(a) Welding Aluminum and Steel	MIL-STD-278D	
(b) Welding, Titanium	To be developed by the shipbuilder	MOD 4
(c) Anodizing, Aluminum	MIL-A-8625	
(d) Impregnation, Aluminum castings	MIL-STD.276	
(e) Heat treatment	MIL-H-6875	
(f) Plating	To be developed by the shipbuilder	MOD 4
(g) Nitriding	MIL-N-22061	
(h) Carburizing	MIL-S-6090	

The inducer and impeller blade areas shall have a metal surface finish of 6.3 micrometer RHR or better. The inducer-shaft assembly and impeller-shaft assembly shall have a paint treatment consisting of Navy formula 1B53 primer and PR 1654 polyurethane top coat. Bearing and spline surfaces shall be uncoated. HMR 4 HMR 57 MOD 2 HMR 186

3.3.4 STANDARD AND COMMERCIAL PARTS

3.3.4.1 BEARINGS

Anti-friction bearings shall be Class P-6 per IS0 Recommendation 280 or better and shall be selected to have a calculated B-10 life per AFBMA of at least 20,000 hours operated over its duty cycle. HMR 43 MOD 6

3.3.1.9 DRAINS

The article shall be provided with drain ports and caps which have provisions for draining water and lubricating oil to facilitate inspection, servicing and repair. HMR 43

Lubricating oil drains shall be positioned to prevent collection of water or sediment in low spots.

3.3.2 SELECTION OF STANDARDS

Standards shall be selected in a manner which results in the fewest sizes and type of parts.

The order of precedence for selection of standards and specifications shall be per MIL-STD-143.

3.3.3 MATERIALS AND PROCESSES

Materials, and processes shall be selected to give the greatest assurance that the article will meet its service life in the environment and duty cycle specified herein.

3.3.3.1 MATERIALS

The following preferred materials shall be employed for the designated components unless the contractor determines that the design criteria cannot be met or that other alternate materials are recommended by the contractor to meet the design criteria. In such cases, approval shall be obtained from the Government prior to the release of manufacturing the components from the proposed material, based on a submittal by the contractor substantiating the recommendation.

Component	Material	
Impeller	17-4 PH CRES	MOD 6
Inducer	17-4 PH CRES	
Shafts in sea water	17-4 PH CRES	
Stator Housing	A356 Cast Aluminum	
Impeller Housing	6AL4V Forged Titanium	
Inducer Housing	6AL4V Forged Titanium	
Inlet Housing	535 Cast Aluminum	HMR 5

3.3.4.2 FASTENERS, STUDS, INSERTS AND THREADED PARTS

All threaded parts shall be metric design, complying with ISO-R68, or Federal Standard 00H28/21. However, where metric threads are not available, U.S. Federal screw threads per Handbook H-28 shall be specified. All fluid fitting bosses shall be American Standard, complying with MS 33649. HMR 43

Selection of fasteners shall minimize the number of sizes, styles and strength levels required to fulfill design objectives. MOD 2

3.3.5 Moisture And Fungus Resistance

Organic materials used on the article shall be moisture and fungus resistant. Also, exposure to fungi and bacteria growth conditions, such as encountered in tropical regions, shall cause no effects detrimental to operability or' maintainability.

3.3.6 Corrosion Of Metal Parts

The article shall be constructed using metals and alloys which are inherently corrosion resistant.

Continuous wetting by fluids specified herein shall not cause corrosion or degrade continuous operation.

Surfaces shall not require plating or coatings (except anodic coating of aluminum castings) to provide corrosion protection.

Aluminum alloy parts shall be anodized as listed below:

	Anodize
(a) Parts in contact with sea water	Hard Anodize per MIL-A-8625 Type III
(b) Parts not in contact with sea water	Anodize per MIL-A-8625, Type II, III
(c) Article Exterior, Flanges, O-Ring Grooves and Pilot Diameters Adjacent to Sea Water Passages	Anodize per MIL-A-8625, Type II optional to MIL-A-8625, Type III

Aluminum alloy castings shall be impregnated **per** MIL-STD-276 using materials per MIL-I-6869.

3.3.6.1 SEA WATER CORROSION RESISTANCE

The article shall be designed to minimize galvanic corrosion, pitting, and crevice attack. Internal environmental conditions, shall consider both partial immersion in quiescent sea water and expected operating velocities with appropriate solution potentials. MOD 6

The 17-4 PH rotating elements shall be galvanically isolated from titanium and aluminum **stator** housings. HMR 43

The article strength shall not be be degraded below the structural limit due to corrosion and the article performance shall not be degraded below the acceptable minimum over the MTBO of the article. HMR 43

3.3.6.2 HYDROGEN **EMBRITTLEMENT/STRESS** CORROSION MOD 4

The metallic elements shall be designed to minimize the **susceptability** to hydrogen embrittlement and stress corrosion cracking considering the minimum solution potential of the elements. MOD 6

3.3.6.3 EROSION

All metallic elements shall be designed to minimize erosion due to cavitation such that the article strength shall not be degraded below the structural limit and performance shall not be degraded below the acceptable minimum over the MTBO of the article. HMR 43

3.3.6.4 CREVICE/PITTING CORROSION

All metallic elements shall be designed to maximize their **resistence** to crevice/pitting attack. Passive cathodic protection may be used to obtain corrosion resistance. MOD 6

3.3.7 INTERCHANGEABILITY AND REPLACEABILITY

3.3.7.1 INTERCHANGEABILITY

The article shall be completely interchangeable. All components having the same manufacturers part number shall be interchangeable with any other component with the same part number in regards to form, fit and function. Where matched parts, selective fits or balanced assemblies are required, such parts shall be separately identified, serialized and interchangeable to this level. The pump assembly shall be interchangeable with PHM 1 pump at its interfaces with the ship and gear box.

3.3.7.2 REPLACEABILITY

The article thrust bearing assembly, bearing temperature sensors and input shaft seals shall be replaceable without disassembly of the gearbox from the pump. Thrust bearing shaft seals shall be replaceable without removal of bearings and shafts and without changing the bearings preload and/or clearance.

HMR 4

MOD 6

Article lubricating oil scavenge screens and magnetic chip detectors shall be replaceable without article disassembly.

3.3.8 WORKMANSHIP

The article exterior shall be free of sharp edges and corner protrusions and other features which would constitute a hazard to personnel.

3.3.9 ARTICLE MARKING

Article interfaces shall have label plates which define appropriate features and requirements such as inlet, outlets, lubricating oil type, special torque values adjustment instructions, water bleed flow, drains, and temperature sensor ports.

3.3.10 STORAGE LIFE

The article storage (shelf) life shall be at least two calendar years. Storage life shall not be included, or be part of, the article's useful life.

3.4 STRUCTURAL CRITERIA

The article shall be structurally capable of continuous operation with input power and speed as specified in 3.1.1.3. MOD 2, 4, 6

3.4.1 HOUSING AND ATTACHMENT POINTS

3.4.1.1. STATIC STRENGTH

The article housing filled with sea water shall withstand 1.5 times the following load combinations without yielding, deformation or loss of utility and 2.0 times the following combinations without failure or exceeding the material ultimate stress: MOD 6 MOD 6

(a) Rated Thrust with Acceleration
Loads due to accelerations of paragraph 3.1.2.4 plus the loads due to the battle override condition of paragraph 3.1.1.3 and two times the corresponding gear box interface loads. MOD 6 MOD 6

(b) Takeoff Thrust
Loads due to one gravity vertical plus loads due to the takeoff thrust condition of paragraph 3.1.1.3 and with the corresponding gearbox interface loads. MOD 6 MOD 6

(c) Chopped Throttle
Loads due to one gravity vertical plus loads due to 45 meter inlet total head.

For purposes of analytical substantiation of strength, material allowables shall be minimum material specification values. In addition, for castings, a casting factor of 1.25 for stress is required for tension critical components. For castings, minimum section properties which include the effects of tolerance shall be used. HMR 58

The hoisting and lifting provisions shall be capable of ±3 g's applied along each of three orthogonal axes.

3.4.1.2 FATIGUE STRENGTH MOD 6

The article housing shall withstand, without loss of structural integrity, combined steady state and alternating loads specified as follows:

(a) 100 percent continuous power condition of paragraph 3.1.1.3 combined with one gravity vertical and alternating stresses superimposed on the steady state stress as follows:

Design R Values $\left(R = \frac{\text{Minimum Stress}}{\text{Maximum Stress}}\right)$

	CYCLES/HOUR	Y-Duct* CENTER	Y-Duct* ELBOW	Y-Duct* TOP STIFFENER	INDUCER HOUSINGS	STATORS 1ST ST	STATORS 2ND ST	IMPELLER HOUSING	
1	100	.41	.29	.58	.41	.76	.87	.81	HMR 58
2	900	.43	.33	.61	.42	.77	.88	.82	
3	9000	.47	.38	.65	.45	.79	.90	.84	
4	90000	.58	.49	.74	.55	.83	.94	.88	HMR 7
5	270000	.82	.75	.89	.80	.93	.98	.95	

*CENTER = 300 mm wide band on top and bottom centerline in the area of concave surface. .

*TOP = 300 mm wide band centered on each longitudinal external stiffener.

*ELBOW = All other areas of Y-duct housing.

Stator blades shall meet this condition using corresponding blade pressure loads including pressure fluctuations due to blade passing.

The design shall not permit material flaw propagation to the extent where housing leakage occurs prior to article mean time before overhaul (MTBO) per Section 3.1.2.3 and also shall not permit material flaw propagation to a critical size in an interval less than twice the MTBO. Initial material flaw size determination, flaw growth rate data and analysis procedure shall be presented at the critical design review for Government review.

(b) Maximum thrust and chopped throttle torque, thrust and casing pressure excursions from 100 percent to 0 to 100 percent load per Section 3.1.1.3 with 45 meters total inlet head at zero thrust. The number of design cycles for this condition shall be 1,000.

Stator blades shall meet this condition using corresponding blade pressure loads.

The cumulative damage factor from load conditions (a) and (b) above shall not exceed 1.0 per.

$$\text{Where } \frac{n_1}{N_1} \text{ --- } \frac{n_5}{N_5} + \frac{n_b}{N_b} \leq 1.0$$

$n_1 - - n_5$ = Number of design cycles for condition (a), blocks 1 through 5

n_b = Number of design cycles for condition (b).

$N_1 - - N_5$ = Number of available cycles for condition (a), blocks 1 through 5

N_b = Number of available cycles for condition (b)

Design fatigue curves shall be derived from failure fatigue curves tested in air (external surfaces) and in salt water (internal surfaces) at the appropriate R ratio with a factor of safety of 2 on stress. In absence of actual test fatigue data beyond 10^7 cycles the fatigue data may be extrapolated from the 10^7 data point with a 5 percent reduction for each decade of cycles.

3.4.1.3 BENDING STIFFNESS

The first bending frequency of the article mounted on the attachment lugs with the gear box attached shall be at least 25 percent above the prime mover (General Electric LM 2500 Gas Turbine) shaft rotational frequency at 120 percent continuous speed.

3.4.2 SHAFTS, IMPELLER AND INDUCER MOD 6

3.4.2.1 STATIC STRENGTH

The rotating parts shall withstand the following conditions without yielding and 1.5 times the conditions without exceeding the material ultimate stress.

(a) Two times the torque for rated power

(b) Centrifugal loads of all rotating parts for up to 120 percent continuous RPM.

3.4.2.2 FATIGUE STRENGTH

The article shafts, impeller, and inducer, shall withstand the following fatigue loads without loss of structural integrity in a seawater environment: MOD 2, 5 & 6

(a) 100 percent continuous torque plus a ± 10 percent alternating torque for 10^8 design cycles. Impeller, and inducer, blades shall meet this condition using corresponding blade pressure loads including pressure fluctuations due to blade passing.

(b) Excursions from 100 percent to 0 to 100 percent of rated power with constant 45 meter total head at zero thrust for 1000 cycles. Impellers, and inducer, blades shall meet this condition using corresponding blade pressure loads.

(c) Centrifugal loads shall be considered on all rotating components from 0 to 120 percent to 0 percent continuous rpm for 1000 cycles. Also, inertia loads shall be considered for a maximum input shaft acceleration of 690 rpm/second for the inducer shaft and 1500 rpm/second for the impeller shaft for 1000 cycles.

The calculated cumulative fatigue damage, from conditions a, b, and c above, on the article components shall not exceed 1 using Miners Equation:

$$\frac{n_1}{N_1} + \frac{n_2}{N_2} + \frac{n_3}{N_3} \leq 1$$

Where: n_1 = number of design cycles for condition (a)

n_2 = number of design cycles for condition (b)

n_3 = number of design cycles for condition (c)

N_1 = number of available cycles for condition (a) from design fatigue curves. Design fatigue curves shall be derived from failure fatigue curves tested in saltwater at the appropriate R ratio with a factor of safety of 2 on *stress.*

N_2 = same as N_1, except for condition (b)

N_3 = same as N_1, except for condition (c)

(d) Centrifugal loads of all rotating parts from 0 to 120 percent back to 0 percent, continuous rpm for 1,000 design cycles. MOD 2

The cumulative usage factor from load conditions (a) thru (d) above shall not exceed one (1), as calculated using the equation in paragraph 3.4.1.2 for six (6) load conditions (n_1 to n_6 and N_1 to N_6). MOD 2

3.4.3 MISCELLANEOUS STRUCTURAL REQUIREMENTS

3.4.3.1 FRICTION

Friction shall not be considered as a valid restraining force in the primary shaft torque load path. MOD 6

3.4.3.2 SPLINES

Splines shall be designed in accordance with articles by D.W. Dudley, "When Splines Need Stress Control" and "How to Design Involute Splines" which appeared in Product Engineering, October 1957 and "Gear Design and Application" by N.P. Chironis.

3.4.3.3 ARTICLE GEAR BOX MOUNT FLANGE

The article's vertical beams and the mount flange for the gear box shall provide adequate stiffness so that the interface moments and axial loads are reacted in the vertical beams and the section remains a plane. Torque shall be reacted by the article to gear box attachment bolt pattern. MOD 2

3.5 CONFIGURATION CONTROL

A configuration control program shall be established by the contractor for both Class I and Class II engineering changes in accordance with MIL-STD-480. Class II engineering changes shall be submitted in accordance with the provisions in MIL-STD-480.

4.0 QUALITY ASSURANCE PROVISIONS

The supplier shall verify that the article meets all requirements of this specification. Verification may be by tests, analyses, demonstrations and inspections.

4.1 ARTICLE DESIGN VERIFICATION

4.1.1 ENGINEERING TEST AND EVALUATION

Engineering tests and evaluations shall be conducted to verify the *performance* and article design changes from the **Aerojet** Pump Part Number **1163400-**99 (less the part number 1163352-19 gear box). The tests may be conducted individually or simultaneously as defined in the suppliers test plan(s). HMR 43

4.1.1.1 Not Used. HMR 14

4.1.1.1.5 **STATOR** HOUSINGSTRAIN DETERMINATION HMR 43

The article **stator** housing strains shall be measured at locations determined by stress analysis and approved by the Government. The number of strain data channels shall be 45 or less. Strain data shall be acquired over the inlet head range available and at rotative speeds between 30 percent and 105 percent of continuous speed. The **stator** strain data shall be used with the duty cycle of 3.1.X.3, suitable materials data and fatigue analysis methods to predict a structural life expectancy for the stators.

4.1.1.2 TEST DATA REQUIREMENTS

Data measuring instrumentation shall be calibrated and certified per **MILC-**45662. The following parameters shall have the specified accuracy or better during any and all testing:

PARAMETER	ACCURACY	
Temperature	$\pm 2^{\circ}C$	HMR 43
Pressure or head	$\pm 1\%$	
Input shaft speed	$\pm 0.2\%$ or 5 RPM	
Water flow rate	$\pm 1\%$	
Oil flow rate	$\pm 5\%$	
Input shaft torque	$\pm 1\%$	

Parameters not critical to article performance may be recorded with $\pm 5\%$ accuracy.

4.1.1.3 LUBE OIL HEAT REJECTION

Heat rejection to the lubricating oil shall be measured at the continuous design point after article operation for at least 30 minutes. MOD 6

4.1.1.4 HOUSING VIBRATION SURVEY

A housing vibration survey shall be performed at shaft speeds from minimum (MOD 6) achieveable to 100% with the inlet total absolute head varied from 8 to 12 meters (MOD 6) of sea water.

4.1.1.5 WATER LUBRICATED BEARING TEST

The article shall be tested to verify adequate water supply to the water lubricating bearings. The following conditions shall be met:

Inlet total absolute head	8 to 12 meters of sea water	MOD 6
Input shaft speeds	75 to 100 percent	
Lubricating water flow rate	Within bearing manufacturers design requirements for all input shaft and inlet heads	

4.1.1.6 THRUST BEARING LOAD TEST

The article shall be tested to verify the calculated thrust bearing loads. The following test condition as a minimum shall be utilized.

Input Shaft Speed	Inlet Total Absolute Head	
100 to 105 percent	8 to 12 meters of sea water	MOD-6

The measured bearing loads, corrected to duty cycle conditions, shall be used to update the bearing life analysis. HMR 43

4.1.1.7 INPUT SHAFT TORQUE TEST

The article input shaft's torque shall be measured between minimum achievable and 100 percent speed. Input shaft power shall be divided 30, +0-5 percent for the inducer shaft and 70 +5-0 percent for the impeller shaft.

MOD 6

MOD 4

4.1.1.8 THIS PARAGRAPH INTENTIONALLY LEFT BLANK

MOD 6

4.1.1.9 THIS PARAGRAPH INTENTIONALLY LEFT BLANK

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MOD 2

HMR 43

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MOD 6
HMR4

HMR 43

MOD 6

HMR 43

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HMR 43

HMR 43

HMR 43

HMR 90R2

4.1.2 RELIABILITY

The Contractor shall develop, implement and maintain a reliability program conforming to MIL-STD-785. The program shall include:

(a) Reliability management procedures:
   (1) Reliability organization
   (2) Management & control
   (3) Subcontractor & supplier reliability programs
   (4) Program review
   (5) Status reports

(b) Reliability design procedures:
   (1) Design techniques
   (2) Reliability analysis - the Contractor shall perform reliability prediction based on the reliability analysis in accordance with MIL-STD-756 and MIL-HDBK-217. Prediction methods, failure rate data and their sources shall be fully documented. The predicted reliability shall be compared with the required value and if non-compliance is indicated, a corrective action plan shall be forwarded for review and acceptance.
   (3) Parts reliability
   (4) Failure mode and effects analysis (FMEA) - the Contractor shall perform an

FMEA to MIL-STD-1629 (NAVY) and provide a report of the results. The analysis shall be conducted to the functional subassembly level (see 5.3.1 of MIL-STD-1629) except for those failure modes with a level of severity of 4. For those failure modes, the analysis shall be expanded to the individually replaceable level. The FMEA shall identify the design provisions that have been incorporated to inhibit or limit the frequency of occurence of failure modes with a level of severity of 3 or 4.

(5) Reliability critical items

(6) Effects of storage, shelf-life, transportation, handling and maintenance.

(7) Design reviews.

4.1.3 MAINTAINABILITY

The Contractor shall develop, implement and maintain a maintainability program conforming to MIL-STD-470. The program plan shall include the following elements of the detailed requirements: MOD 4

(a) Maintainability analysis

(b) Inputs to detailed maintenance plan

(c) Design trade-off's

(d) Maintainability value prediction — per the appropriate prediction method of MIL-HDBK-472. The prediction method shall be identified together with supporting rational in the maintainability program plan. The Contractor shall provide a maintainability prediction report. The predicted maintainability shall be compared with the required value and if non-compliance is indicated, a corrective action plan shall be formulated for review and acceptance.

(e) Implementation of maintainability requirements in subcontractor and vendor specifications
(f) Integration of other items
(g) Participation in design reviews
(h) Implementation of data collection, analysis and corrective action system
(i) Maintainability status reports
(j) Maintainability demonstration

4.2 ACCEPTANCE TEST REQUIREMENTS

Each article shall be tested to verify that the requirements are in accordance with this specification and are *met.*

4.2.1 INSPECTIONS

The supplier shall perform the inspection requirements specified herein.

The article components/parts listed below shall be inspected to the extent specified as a minimum:

Castings, Shafting, Impellers, Inducer, and Welding:	Liquid Penetrant inspection procedure and technique shall be as specified in MIL-STD-271, except delete reference to Group I in Para. 5.3.1, Line 5 through Line 7 and in Para 5.4, Line 4 through Line 6 and add reference to Group III or Group IV.	HMR 109
Castings:	Radiographic per MIL-C-6021 Class 2	
Shafting:	Magnetic Particle per MIL-STD-271	(HMR 109
Welding:	Inspection and procedures shall be in accordance with MIL-STD-278.	HMR 109

4.2.2 FAILURE DATA COLLECTION ANALYSIS AND CORRECTIVE ACTION

HMR 90R2

Provisions shall be made by the Contractor for complete reporting on every

HMR 90R2

malfunction or performance degradation, its diagnosis and any corrective action taken (design modification, etc.). Reporting shall be in accordance with Section 1.0-1.4.5.1(b) and CDRL item A05S.

HMR 19
HMR 89

4.2.3 DEMONSTRATIONS

HMR 90R2

The article input shaft's radial run out and concentricity shall be demonstrated to be within interface limits.

MOD 4&6

HMR 43

HMR 19

MOD 4

Inspection access through external covers and/or borescope ports shall be demonstrated.

MOD 4

4.2.3.1 MAINTAINABILITY DEMONSTRATION

MOD 4

The Contractor shall develop and implement a maintainability demonstration of the removal, replacement, and alinement one time, and shall report demonstrated times to the Government.

HMR 43

4.2.4 ACCEPTANCE TEST

The article acceptance test shall be performed using a gearbox meeting the requirements of Section 1.241.2. HMR 90R2

4.2.4.1 PERFORMANCE

The article shall be operated at the continuous design power input speed *over* a range of inlet total absolute head from 8 to 12 meters of sea water, for 30 minutes minimum operating time. HMR 43 MOD 6

The article shall also be operated at between 98 to 102 percent of the continuous rated design power for at least 10 hours. HMR 43

4.2.4.2 THRUST EFFICIENCY

Article thrust efficiency shall be measured at between 98 to 102 percent input speed and inlet total absolute head ranging from 10.6 to 11.4 meters of sea water. Thrust efficiency shall be at least 85.2 percent, neglecting the thrust bearing heat rejection. MOD 6

4.2.4.3 VIBRATION

Housing vibration, measured at the inducer and impeller housing, shall not exceed the acceptable value determined by the shipbuilder under operating conditions of 98 to 102 percent input speed and an inlet total absolute head of 8 to 12 meters of sea water. MOD 4

HMR 4

4.2.4.4 LEAKAGE

No visible lubricating oil or water leakage from the housing joints or connections shall be permitted. HMR 4

4.2.4.5 BEARING TEMPERATURE

Article bearing temperatures shall be measured and recorded. The lubricating bulk oil temperature at the casing outlet shall not exceed 85 °C. MOD 6

4.2.5 COMPONENT TESTS

Components of each article shall be subjected to tests to determine compliance with the requirements of this specification.

4.2.5.1 PROOF PRESSURE TEST

The article pressure housings shall be proof pressure tested for at least 15 minutes using water as the test medium. The proof test pressure shall be at least 1.5 times the maximum internal pressure including the inlet pressure. No permanent deformation, damage of any kind, or visible leaks shall occur as a result of this test. The test setup shall not restrain flanges which are not normally restrained during article operation.

4.2.5.2 OVERSPEED SAFETY TEST

The article rotor elements containing blades shall be subjected to a speed of at least 120 percent speed for at least 30 seconds duration. Dye penetrant inspection shall verify component integrity, following the overspeed test.

4.2.5.3 ROTATING COMPONENT BALANCE

Article rotating components shall be balanced within the limits of MILSTD-167B, Type II. Rotors must be balanced to extent that balancing vibration envelopes of the specification are not exceeded for operational speeds up through 120 percent continuous speed. MOD 6

4.3 QUALITY ASSURANCE PROGRAM

The contractor shall provide and maintain a quality assurance program in accordance with the requirements of MIL-Q-9858A.

5.0 PREPARATION FOR DELIVERY

5.1 APPLICATION

The following requirements apply to all shipments.

5.2 PRESERVATION, PACKAGING, AND PACKING

5.2.1 PRESERVATION

The article, components, and accessories shall be packaged and preserved in accordance with MIL-P-17286.

5.2.2 SHIPPING CONTAINER

The article, components, and accessories shall be packaged and packed in shipping containers in accordance with commerical practice for local cross-country or international shipment per MIL-P-17286.

5.2.3 PACKING LIST

The supplier shall include a packing list within the shipping container. All parts, accessories, components, and tools which are not installed on the article but which are shipped with the article shall be included on the packing list.

5.3 MARKING OF SHIPMENTS

Interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129. The identification shall be composed of at least the following information:

(a) Stock No. or other identification if specified in the purchase documents.

(b) Suppliers Part No.
(c) Supplier's Serial No.
(d) Contract Or Order No.
(e) Manufacturer's Name

6.0 NOTES AND DEFINITIONS

The following definitions of terms used herein shall be used:

6.1 THRUST EFFICIENCY

Thrust efficiency, n_{th} =

$$\frac{C_P Q_s (K_f H_n n_n - H_{st})}{T_1 N_1 + T_2 N_2}$$ HMR 88

C	=	Constant = 93.65	MOD 6
P	=	Water Density, Kg/m^3	
Q_s	=	Suction Flow Rate m^3/sec	MOD 6
K_f	=	Ratio of Discharge to Suction Flow Rate	
H_n	=	Discharge Total Head, m	MOD 6
H_{st}	=	Pump suction total head, m	
T_1	=	First Stage Input Torque, N-m	
N_1	=	First Stage Speed, rpm	
T_2	=	Second Stage Input Torque N-m	
N_2	=	Second Stage Speed, rpm	
n_{th}	=	Thrust efficiency	
n_n	=	Nozzle efficiency	

6.2 DISCHARGE TOTAL HEAD (PRESSURE)

The discharge total head is to be determined by the RMS average of the total pressure survey at the second stage stator discharge. The total pressure survey will have at least two circumferential MOD 6 locations and radial depths per PHM-1 technique.

6.3 INLET TOTAL HEAD (PRESSURE)

The article average inlet total head as derived from two inlet static pressure ports, the average flow velocity as determined from the flow rate and atmospheric pressure.

6.4 FLOW RATE

The article inlet flow rate as measured by a flowmeter which has been calibrated MOD 6
throughout the flow and pressure range to be utilized.

6.5 INPUT SHAFT TORQUE

The article input shaft torque as measured by a torquemeter which has been calibrated throughout the speed and torque range. MOD 6

6.6 INLET DISTORTION

The article inlet flow local velocity maximum deviation relative to the mean flow velocity as measured by an equal area cruciform pressure rake with at least 13 total pressure taps and four equally spaced static wall taps.

6.7 USEFUL LIFE

Useful life is defined as the total operating time between manufacture and the time at which further operational use or restoration is uneconomical. MOD 6

1.246 PROPULSOR INLET AND OUTLET DUCTS MOD 1

1.246.1 HULLBORNE

Hullborne propulsor inlet ducts shall consist of a rectangular bellmouth penetration in the hull deadrise to which the propulsor shall be attached. The inlet duct shall be provided with an inlet screen of approximately 75 mm (3 in.) clear opening spacing. The hullborne propulsor inlet ducts shall be provided and installed in accordance with NAVSEC Dwg. 800-4596527 "Shell Expansion Scantling". The strainer grillage shall be similar to that shown on NAVSHIPS Dwg. 112-4596576. MOD 3

1.246.2 FOILBORNE

Foilborne propulsor inlet ducts shall be provided to carry the water from the top of the struts to the propulsor inlet.

At the point where the duct penetrates bulkhead 30, a flexible watertight seal MOD 2 shall be provided. The inlet ducts, bellows joints, and watertight diaphragms shall be in accordance with NAVSHIPS Dwg. 800-4596534. The inlet duct expansion joint shall be similar to item 10 of NAVSHIPS Dwg. 201-4597718.

A foilborne watertight propulsor outlet duct shall be provided between the MOD 2 propulsor exit nozzle and the transom. The outlet duct shall be in accordance with NAVSHIPS Dwg. 201-4668748. MOD 3 HMR 122 There will be no interference between the waterjet and the seal water from the aft end of the pump.

1.251 COMBUSTION AIR SYSTEM

1.251.1 COMBUSTION AIR INTAKE AND SALT SEPARATION

The combustion air inlet and salt separation systems shall be installed in accordance with NAVSHIPS Dwg. 2044597726 for the foilborne engine, NAVSHIPS Dwg. 300-4597365 for the fwd. SSPU, and NAVSHIPS Dwg. 300-4597375 for the aft SSPU.

1.251.2 ENGINE ANTI-ICING

A bleed air anti-icing system shall be provided for all gas turbine combustion air inlet systems. The anti-icing shall be accomplished by mixing bleed air with combustion air upstream of the salt separating panels. Installation shall be in accordance with NAVSHIPS Dwg. 201-4597734. MOD 7

A by-pass system shall be provided for engine start-up or emergency if the primary anti-icing system is inoperative.

1.251.3 ENGINE COOLING

Exterior case cooling of the foilborne engine shall be provided for by employing an engine exhaust eductor which shall induce secondary cooling air flow through the engine compartment.

Cooling after engine shutdown shall be provided by electric fans.

Installation shall be in accordance with NAVSHIPS Dwg. 204-4597732. Fans shall be Airesearch Model 606360-3-1. HMR 75

1.252 PROPULSION CONTROL SYSTEM

A propulsion control system shall be provided to start, stop, control, and monitor all ship propulsion, electrical and auxiliary machinery functions by one man while underway, both hullborne and foilborne, from the Engineering Operating Station (EOS). The EOS shall be provided on the platform deck, portside forward of and adjacent to the machinery space.

Selected engine controls and instruments shall be located at the bridge to provide selection of engine speed with visual display of engine speeds for both foilborne and hullborne systems and hullborne thrust direction. (See Section 1.560). It shall be possible to shutdown the foilborne engine directly from the bridge.

The design shall preclude simultaneous operation from the EOS and the bridge. Transfer of control between EOS and the bridge by the normal method shall require initiating transfer at one station and having receipt of control acknowledged at the other station. For hullborne control, transfer shall occur in the normal method only when propulsion controllers are matched in position in both stations so that transfer is free of propulsion changes during and after transfer until control settings are changed by the station in control. For foilborne control, transfer shall occur only when in the low power idle detent position.

For emergency operation during casualty at remote control center(s), the hullborne engine shall be capable of manual control from within the engine machinery compartment. Controls and instruments shall be provided sufficient to start, stop, monitor and regulate the speed of the propulsion engine and to reverse propulsion thrust.

1.252.1 HULLBORNE

The hullborne control system shall provide for start-stop-monitoring of each hullborne system from the EOS with engine throttle control from the bridge.

A local station shall be provided at each engine with essential instruments to allow emergency operations from the diesel machinery space. Packaging of hullborne control system electronics shall minimize weight to the extent practicable, through individual component enclosures and mounting. MOD 4

1.252.2 FOILBORNE

The foilborne control system shall be an Electra-Development Corporation part number 9-180-01 in accordance with Boeing Spec. 312-80322, except that packaging of the foilborne control system electronics shall minimize weight to the extent practicable, through individual component enclosures and mounting. MOD 4

This system provides the necessary start-stop-safety sequencing and permissions to take control for both the foilborne engine and propulsor as an integrated module. MOD 2

Start-stop-monitoring functions shall be provided at the EOS with throttle control from the bridge. Installation shall be in accordance with NAVSHIPS Dwg. 206-5330877. HMR 140

1.252.3 EOS

The EOS shall be capable of operation by one man with provisions for a second operator to assist during certain conditions or for crew training functions. Provision shall be made in the forward section of the EOS for the Damage Control Officer's station. An EOS console shall be provided and installed in accordance with NAVSHIPS Dwg. 206-4597920.

The general panel arrangement shall provide for the power plant controls on the main console, electrical and fuel controls on the inboard cabinet and the hydraulic panel placed diagonally at the corner. The console and cabinet shall be as shown on NAVSHIP Dwg. 206-5330959 and 206-5330961. HMR ,122

Input/output signals to the EOS shall be through electrical connectors. These electrical connectors shall be distributed on the EOS to prevent restriction of personnel passageways by the interfacing electrical cabling set. MOD 2

Interior communications equipment shall be provided in accordance with Sects. 1.432 and 1.423.

All meters shall be 50.8 mm (2 in.) diameter, front mounted and clamp held. Dial faces shall be white with black scale markings. Dials shall be configured as required to provide a normal operating pointer position at the 9:00 o'clock position when practical. All legend type annunciators shall be designed to MIL. Spec. MIL-S-22885. Flow lines shall be shown on fuel, electrical, hydraulic seawater, fresh water and bilge flooding panels and shall be continued through certain annunciators as part of the display. Alarm annunciators shall light up in conjunction with an audible alarm when an alarm indication is received. Upon pressing the lighted annunciator, the audible alarm shall be silenced and the visual alarm shall stay on until alarm condition is cleared. Anytime the alarm indication becomes normal, the lamp shall be extinguished. Action cutout (ACO) switches MOD 2 shall be installed in a system, where it is necessary, in the event of a casualty or malfunction of a portion of the system to isolate that portion and retain the remainder of the system operative.

The control console in the EOS shall consist of the following component panels. Panels shall be installed in accordance with NAVSHIPS Dwg. 206-5330877. |HMR 140

A.1 FOILBORNE ENGINE CONTROL PANEL

The control panel shall be arranged in mimic format with instruments and controls grouped for clarity, into engine operation monitoring, starting system, fuel system, lubricating oil system, compressor water wash and engine bleed air control.

An operating mode selector switch shall provide manual and automatic starting capabilities. In addition to the manual control of engine starting functions, control of compressor water washing, fuel system purging, engine ignition and fuel system testing shall be available only when the switch is in the manual mode (AUX switch position).

Starting air from the forward or aft ship service power unit shall be selected from the panel, and shut off automatically by a speed signal from the engine.

Start interlocks, which must be satisfied before the starting circuitry will function, shall be the starting system reset, and the power lever in the idle position. Start permissives, which are displayed by indicator lights and shall be met before a start is initiated, are: starting air pressure, power to engine ignitors and propulsor gear oil pressure. HMR 7

Normal engine stops can be made: while in the manual mode **(AUX),** by closing the fuel valve switches; while in the automatic mode (RUN) by moving the mode selector to "**AUTO** STOP", and following a time period at idle to cool and stabilize the engine, it shall automatically stop.

Continuous display shall be provided for gas generator speed, power turbine speed, power turbine inlet gas temperature and pressure.

Gages and selector switches shall be provided for readout of vibration and selected pressures and temperatures.

Automatic engine shutdown shall be provided, without the capability of battle override, for power turbine overspeed, and engine flameout.

Automatic engine shutdown with the capability of battle bypass shall be provided for engine lube **sump** high temperature, lube system low pressure, power turbine high inlet gas temperature, **gas** generator high vibration, power turbine high vibration, fire detection and extinguisher release, and loss of power turbine speed signal from both channels "A" and "B".

The requirement for bleed air to prevent engine icing shall be indicated by an amber light from an ambient temperature sensor, and engine bleed shall be controlled manually.

The foilborne engine control panel shall be in accordance with Boeing SCD 312-80322 as revised to reflect the deletion of the propulsor nozzle closure controls.

A.2 FOILBORNE PROPULSOR PANEL

The panel shall be segregated to monitor the propulsor gearbox and the propulsor pump section.

I. Gearbox

The gearbox instrumentation shall monitor oil pressure, oil temperature in and out of the gearbox and bearing temperatures of the eight main drive bearings. Individual oil and bearing temperature readouts will be on one gage with a selector switch for a specific temperature.

Warning lights and alarms shall be provided for low oil pressure, low oil quantity and high oil in and out temperatures.

Warning lights for all high bearing metal temperatures shall be provided.

A start permissive signal for low oil pressure shall be indicated on foilborne engine control panel.

A manual control switch and operational light shall be provided for the gearbox oil heater to heat the oil prior to starting.

No automatic shutdown provisions shall be included for any alarm condition.

II. Propulsor

The propulsor instrumentation shall monitor static water pressure at each pump inlet and at the pump outlet before the exhaust *nozzle.* Thrust bearing metal temperature shall also be monitored.

A warning light and alarm shall be provided for high thrust bearing temperature with no automatic shutdown.

The foilborne propulsor panel shall be in accordance with Boeing SCD 312-80322 as revised to reflect the deletion of the propulsor *nozzle* closure controls.

B.l HULLBORNE ENGINE PANEL

Meters shall be provided for monitoring the following conditions:

(a) Cooling water temperature
(b) Lube oil temperature
(c) Lube oil pressure
(d) Exhaust gas temperature -- a twin indicator meter to monitor both cylinder banks simultaneously
(e) Engine speed.

Annunciators shall be provided to announce alarm for the following conditions:

(a) High lube oil temperature
(b) High cooling water temperature
(c) Low lube oil pressure
(d) Low seawater pressure.

Engine and gearbox controls shall be provided:

(a) Switch, start and stop
(b) Emergency stop -- guarded switch to supply a d.c. signal to the air inlet valve solenoid and also to the fuel shutdown solenoid
(c) A switch to engage and to disengage the gearbox clutch
(d) Switch -- preheater for cold start.

Annunciators will indicate when the clutch is in the "engaged" position- and when the preheat is on.

The hullborne engine panel shall be in accordance with NAVSHIPS Dwg. 206-4597903, except that the battery selection switch is deleted. | HMR 57

B.2 HULLBORNE GEARBOX AND PROPULSOR PANEL

Meters shall be provided for the following conditions:

(a) Lubricating oil temperature
(b) Lubricating oil pressure
(c) Thrust bearing temperature.

High oil temperature, low and high oil pressure annunciators shall be provided.

The hullborne gearbox and propulsor panel shall be in accordance with NAVSHIPS Dwg. 206-4597909.

C. SHIP SERVICE TURBINE PANEL

Instruments shall be provided to indicate:

(a) Oil Temperature
(b) Oil Pressure
(c) Exhaust Gas Temperature
(d) Percent Speed.

Indicators shall display the power unit shutdown cause. Fault shutdown for high lubricating oil temperature, low lubricating oil pressure and high exhaust gas temperature shall have a battle override provision. Fault shutdown for overspeed and flameout shall not have battle override capability. Indicators shall also be provided to show when bleed air is required and exhaust door fault. An alarm shall be provided, activated by the high temperature discharge from the SSPU bleed air cooler/condenser.

Power unit controls shall consist of start-run-stop switch, fuel heat switch, and a guarded battle override switch to by-pass the previously specified fault shutdown signals. Wash and deicing switches shall also be provided.

The ships service turbine panel shall be in accordance with NAVSHIPS Dwg. 206-4597904.

D. ELECTRIC PLANT CONTROL PANEL

The electric plant control panel shall be in accordance with NAVSHIPS Dwgs. 302-4597205, 302-4597206 and 206-4597913. Mimic diagrams and flow bar indicators shall be employed to indicate the system status.

Each generator shall be provided with an ammeter, voltmeter, frequency meter, and KW meter. By operation of the meter Select Switch to "Shore", the generator ammeter, voltmeter and frequency meters shall also monitor shore power amps, volts and frequency, respectively. MOD 3

Each generator shall be provided with the following controls and indications:

(a) Field control switch - to activate or de-activate generator excitation
(b) Field off indicator - indicates field circuit opened by generator fault
(c) Overload indicator - indicates generator load exceeds maximum continuous rated value
(d) Generator contractor control switch - to connect generator is connected to its load bus
(e) Generator contractor flow bar indicator - indicates generator is connected to its load bus
(f) Generator contactor trip indicator - indicates generator disconnected from load bus due to generator fault
(g) Frequency adjust control - adjust generator frequency to enable unparalleled generator phase relationship to be adjusted to facilitate paralleling.

The following controls and indications shall be provided for paralleling the two main buses:

(a) Generator bus tie control switch - employed in conjunction with other generator bus tie control switch to connect load buses together
(b) Generator bus tie flow bar indicator - indicates bus tie contractor closed
(c) Generator bus tie trip indicator - indicates bus tie breaker opened by fault between paralleled generators or feeder fault.

Generator synchronization indication shall be provided:

(a) Synchro ON/OFF switch-activates synchroscope and synchronizing lights for use when paralleling generators

(b) Synchroscope and synchronizing lights - indicates phase relationship between unparalleled *generators.*

Ground test lights and pushbutton shall be provided at each generator bus if, when pushbutton is pressed, intensity of lights change in relationship to each other, a ground fault is indicated by reduction of the intensity of the associated phase light.

Availability of shore power at proper voltage, frequency, and phase sequence, shall be indicated by the shore power available indicator. If the generator load bus is dead, operation of the shore power switch to "ON" causes the indicated shore power to be connected to the generator load bus. Connection of shore power to the load bus shall be indicated by the shore power flow bar indicator. Should the quality of the shore power fall outside of system requirements, the shore power shall become disconnected from the generator bus and the shore power trip indicator shall indicate this condition.

The power conversion equipment shall be provided with the following controls and indications:

(a) Electronic transformer source selector - selects input source to electronics transformer

(b) Electronic transformer source selector flow bar indicator - indicates sources selected

(c) Electronic transformer source selector fail indicator - indicates failure of selected input

(d) Lighting transformer sources selector - selects input source to lighting transformer

(e) Lighting transformer source selector flow bar indicator - indicates source selected

(f) Lighting transformer source selector fail indicator - indicates failure at selected input. Automatic transfer to normal source is provided.

(g) Electronic transformer ground lights and pushbutton - used to detect ground fault in circuits connected to electronics transformer output

(h) Lighting transformer ground lights and pushbutton - used to detect ground fault in circuits connected to lighting transformer output

(i) Converter selector switch - selects converter to supply ships 60 Hz loads

(j) Converter on indicator - indicates converter supplying 60 Hz system

(k) Converter fail indicator - indicates failure at selected converter

(l) 120 volt ground lights and pushbutton - used to detect ground fault on 120 volt, 60 Hz, 3 phase system

(m) Converter Fan Fail indicator is provided to indicate failure of any one of three fans in each converter.

(n) Standby converter source selector selects input source to standby converter. MOD 2

(o) Standby converter source selector flow bar indicator - indicates source selected.

(p) Missile transformer source selector - selects input source to missile transformer

(q) Missile transformer source selector flow bar indicator - indicator source selected.

(r) Missile transformer source selector fail indicator - indicates failure of selected input.

(s) 450 volt ground lights and pushbutton used to detect ground fault on 450 volt, 60 Hz, 3 phase system. MOD 7

(t) Standby converter load selector switch - selects distribution panel to be energized by converter.

A battery ammeter, voltmeter and battery meter selector switch shall be provided for monitoring the condition of the two ships battery systems and the hullborne engine driven d.c. generators.

Each generator shall be provided with a guarded battle override switch (located below ship's Service Turbine Control Panel) which, when operated overrides: overvoltage, under-voltage, and under frequency protection.

E. HYDRAULIC SYSTEM PANEL

The following functions shall be provided at the hydraulic system control panel:

(a) Hydraulic reservoir fluid quantities (four per ship)
(b) Low level warning each reservoir (four per ship)
(c) Hydraulic pump control switches (eight per ship)
(d) Pump activation (flow line) and low pressure (amber light) warning lights (eight per ship)
(e) Hydraulic system supply pressure meter (four per ship)
(f) Hydraulic system low pressure warning and high temperature warning lights (four per ship)
(g) Normal and alternate hydraulic power source display lights for the following foilborne functions: forward, port and starboard flaps(3); strut steering, hullborne nozzle and reverser (2) (for position hold); emergency hydraulic driven fuel pump (1)
(h) Switches for transfer to alternate supply and reset to normal for the (6) foilborne functions. The automatic transfer is by pressure switch signal. Pressure must drop on normal loop and pressure must be available in the alternate loop before transfer can occur
(i) Normal and alternate hydraulic power source display lights for

the following hullborne functions: forward strut and doors, bow thruster, and aft strut (3)

(j) Switches for normal and alternate modes of the three hullborne hydraulic functions described in (i) above.

(k) Hydraulic reservoir quantity required indicator lights (8).

(l) Normal and alternate hydraulic power source display for auxiliary lube oil pump drive. HMR 21

The Hydraulic System Panel shall be in accordance with NAVSHIPS Dwg. 206-[illegible].

F. FUEL SYSTEM PANEL

The Fuel System Panel shall include:

(a) Fill valves manual open and close switch with automatic override to close for preventing overfill of Tanks 1, 2, and 3 (three per ship)

(b) Fuel transfer control switches for filling Tank 4 from Tank 1, Tank 2, and Tank 3, respectively (three per ship). Each switch shall open a valve and start an a.c. fuel pump. Filling of the clean tank shall stop when the tank is full. The fuel pump control circuitry incorporates fire cutout interlocks.

(c) Overfill indicating light for each tank (four per ship)

(d) Water contamination indicating light for each tank (four per ship)

(e) Fuel quantity gage for each tank (four per ship)

(f) A.C. fuel pump control switches (four per ship)

(g) Low pressure warning light for each a.c. pump. Note warning lights are armed by pump start switch. Flow bar indicates pump is energized (four per ship)

(h) Fuel system pressure dial indicators, port and starboard (two per ship)

(i) D.C. fuel pump on-off switch (two per ship)

(j) D.C. pump low pressure warning light and flow bar (two per ship)

(k) Hydraulic emergency fuel pump switch (one per ship) two positions:

1. Permanent "Automatic" normally on, in readiness to start hydraulic fuel pump in a foilborne a.c. power emergency
2. Off
3. Test/Run

(l) Emergency (hydraulic fuel pump low pressure) warning light and flow bar (one per ship) MOD 2

(m) Prefilter differential pressure gages (two per ship)

(n) Prefilter high differential pressure warning lights (two per ship)

(o) Filter separator differential pressure warning lights (two per ship)

(p) Filter separator high differential pressure warning lights (two per ship)

(q) Water contamination at filter separator discharge, warning lights (two per ship)

(r) Propulsion plant fuel **supply** cross-feed valves (two per ship)

(s) Engine fuel shut-off valve switches (five per ship)

(t) Engine **supply** low pressure warning light and flow bar (five per ship).

The fuel system panel shall be in accordance with NAVSHIPS Dwg'. **206-**4597915, modified as necessary to reflect all approved changes to the fuel system.

G.l FIRE SYSTEM PANEL

The following functions shall be provided at the Fire Detecting and Extinguishing Panel:

(a) Test of temperature and ultraviolet (UV) *sensors*

(b) Test of primary and secondary fire extinguishing discharge soleniod.

(c) Fire warning (amber) and alarm (red) indicating lights. One sensor sets off a warning, two sensor3 an alarm. An alarm automatically discharges a fire extinguisher unless inhibited.

(d) Manual discharge of primary and secondary fire extinguishers or inhibiting of automatic solenoid actuation. Guarded switches are provided for this purpose

(e) Indicating lights 'to display the fire extinguishing agent **(Halon)** being discharged (amber) and the fact that a flask has been discharged (white).

(f) Magazine sprinkling valve switch - See also seawater system panel.

(g) Magazine **high** temperature **(41°C/105°F) warning** indicator (amber and alarm. MOD 4

(h) **Magazine** high temperature (70°C/158°F) indicator (red) and alarm.

(i) Magazine smoke indicator (amber) and alarm

(j) Magazine sprinkler system water flow indicator (red) and alarm.

(k) Storeroom **high** temperature **(41°C/105°F) warning** indicator (amber) and alarm.

(l) **Storeroom** high temperature (70°C/158°F) indicator (red) and alarm.

(m) Storeroom smoke indicator (amber) and alarm.

(See Section 1.555.5 for system operation)

Note: Machinery Space 1 Fire Extinguisher shall be supplied **from Machinery** Space 2 for primary and secondary. Gas turbine space shall be supplied from Machinery Space 2 **for** primary and secondary. Machinery Space 3 shall **be** supplied from diesel space for primary and secondary. Machinery Space 2 shall be supplied from Machinery Space 2 **for** primary and secondary. Diesel space shall be supplied from diesel space for primary **and** secondary. HMR 55R1

The Fire System Panels shall be in accordance with NAVSHIP Dwgs. 206-4597916, 206-4597917, modified as necessary to reflect all approved changes to Fire System Panel. MOD 2 & 4

G.2 MACHINERY SPACE VENT, HEAT AND ENVIRONMENTAL CONTROL PANEL MOD 2

The following indication and control shall be possible from the control panel: HMR 88

(a) Machinery space ventilation fans on and off

(b) Compressor ON and FAILURE indications HMR 88

(c) Compressor RESET

(d) Chiller FAIL and NO COOLING.

The fans in the machinery space shall be automatically shut down on detection of a fire.

The machinery space vent, heat and environmental control panel shall be in accordance with NAVSHIPS Dwg 206-4597907.

G.3 SEAWATER SYSTEM PANEL

The following functions shall be provided at the Seawater Control Panel:

(a) Seawater pumps on-off/LVP reset switches MOD 3

(b) Pumps on (flow line) and low pressure warning (amber) annunciators

(c) Low pressure annunciator in the seawater crossfeed line

(d) Firemain pressure gage

(e) l-Low pressure alarm and indicator (amber) for seawater crossfeed

(f) l-Low pressure alarm and indicator (amber) for foilborne lube oil cooler seawater supply.

The following functions shall be provided at the Seawater Control Panel for the Fire Mains Systems.

(a) l-Fire main pressure gage

(b) 3-Fire pumps on-off/LVP reset switch

(c) l-Pressure gage with pump discharge pressure selector switch for fire pumps (three positions).

(d) l-Fire pump automatic start selector switch. This switch selects which two fire pumps will operate in the event of automatic actuation of the magazine sprinkler system, (refer to Section 1.520.1-5 for sprinkler system operation).

A guarded switch is provided on the firemains forward panel to close the seawater system line forward panel to close the seawater system line forward of the machinery spaces.

The seawater system panel shall be in accordance with NAVSHIPS Dwg. 206-4597906, as modified to reflect the above functions.

G.4 BILGE FLOODING PANEL

The following functions shall be provided at the Bilge Flooding Panel:

(a) Bilge flooding annunciators (thirteen spaces)

(b) Fixed bilge drainage pump controls (four spaces)

(c) Bilge water holding tank annunciators - (95%, with alarm), (50%), and (5%). HMR 11

(d) Holding tank overboard dump pump control.

(e) Annunciator/Switch illumination should be configured to indicate pump operation.

(f) Annunciator light to indicate sewage evaporator tank requires service. HMR 10, 19

The bilge flooding panel shall be in accordance with NAVSHIPS Dwg. 206-4597905.

G.5 FRESH WATER SYSTEM PANEL

The Fresh Water System Panel shall consist of:

(a) Distiller on-off switch and annunciator

(b) Dump valve actuated, high-salinity, distiller off, and system low pressure alarm annunciators

(c) Two pump on-off switches and two tank inlet valve open-close switches

(d) Two tank level meters.

The fresh water system panel shall be in accordance with NAVSHIPS Dwg. 206-4597912, modified as necessary to reflect all approved changes to the fresh water system.

HMR 36 + 88

H.1 BATTLE OVERRIDE AND MASTER CAUTION PANEL

The battle Override Panel shall provide five guarded switches for overriding certain safety shutdown functions. These switches are provided for:

(a) Main Foilborne Turbine
(b) Both Ship Service Turbines
(c) Both Electrical Power Generator Systems.

The Master Caution Panel shall provide summary information of the status of each of the identified systems:

(a) Fire Detection
(b) Bilge Flooding
(c) Seawater System
(d) Electrical System
(e) Hydraulic System
(f) Fuel System
(g) Fresh Water System
(h) Hullborne Propulsion
(i) Foilborne Propulsion
(j) Ship Service Turbine
(k) Chiller and Air Conditioning.

A critical fault in one of the identified systems shall be repeated on this panel. The battle override and master caution panel shall be in accordance with NAVSHIPS Dwg 206-4597910.

H.2 THROTTLE CONTROL PANEL

The Throttle Control Panel shall provide the ability to transfer control of the foilborne turbine and hullborne engines between the Helm Station and the EOS. Annunciators shall identify the station having control. Toggle switches shall be provided for normal transfer which requires that both stations concur before transfer occurs. The throttle control panel shall be in accordance with NAVSHIPS Dwg. 206-4597911.

I. DUMMY LOG PANEL

Dummy log capability shall be included as an integral part of the Underwater Log System. (See Section 1.426). The dummy speed signal shall be inputted at either the EOS or Navigator's Station (CIC). Capability in the EOS shall be provided for by the 1023D0045 remote control and indicator. | HMR 55

The simulated speed signal shall be distributed to the entire underwater log system. The dummy log shall be in accordance with NAVSHIPS Dwg. 206-4597908. | HMR 55

1.256 MACHINERY SEAWATER SYSTEMS

Seawater systems shall be provided to serve the following equipment: hullborne diesel engines, distilling unit, ship service power units, foilborne reduction gear MOD 2 lube oil cooler, hydraulic packs, hullborne propulsion bearings, and air conditioning unit condenser. The systems shall be in accordance with drawing NAVSEA No. 802-5000472 and the following drawings:

PHM-505-4596833	Piping and Equipment Installation Machinery Space No. 1 and Deck House
PHM-505-4596834	Piping and Equipment Installation Machinery Space No. 2, Bhd 25 to 30
PHM-505-4596835	Piping and Equipment Installation Diesel Machinery Space, Bhd 30 to 33
PHM-505-4596836	Piping and Equipment Installation Machinery Space No. 3, Bhd 33 to Transom

The seawater supply to the foilborne MOD 2 reduction gear lube oil cooler shall contain a low-flow switch which shall actuate an indicator light on the Foilborne Engine Control System Panel.

Strainers shall be provided in the seawater supplies to the hydraulic packs, air conditioning unit condenser, MOD 2 hullborne propulsion bearings, ship service power units, and the foilborne reduction gear lube oil cooler. Seawater source for hullborne diesel engines when hullborne shall be via an attached engine-driven pump with independent seachest and strainer. MOD 2

When foilborne, the hullborne diesel MOD 4 seawater pump shall be supplied from two independent diesel cooling lines which are branches from the second stage propulsor bleed manifold.

Thermometers shall be installed in the suction piping to each hullborne diesel seawater pump, in the supply branches to the foilborne lube oil cooler and distiller unit, and in the discharge piping from each heat exchanger and the distiller unit. Thermometers shall be selected and installed in accordance with drawing, NAVSHIPS No. 810-1385917, except that thermometer well installation shall be modified to suit glass reinforced plastic piping.

A pipe *line* strainer shall be installed in any sea water cooling system wherever the sea chest strainer perforation area is equal to or greater than the cross-sectional area of the smallest flow path in that system. Should this result in an excessively large strainer size, basket performations may be sized for protection of major *components* in the system (such as heat exchangers), and additional strainers installed upstream of orifices, or other components with ‘small flow passages. In all other cases, attempts shall first be made to size components adequately so that strainers are unnecessary. The total clear area of basket perforations shall not be less than three times the area of the strainer discharge connection. In order to avoid rapid and unnecessary clogging of strainers, strainer perforations shall not be smaller than one half the size of the smallest flow path served.

A differential pressure gage shall be installed to indicate the pressure drop across each seawater strainer.

The cross-sectional area of a pump suction line may be less than the cross-sectional area of the pump suction nozzle, provided that the combination of size and configuration assure pump operation that meets the design requirements of the *system* served.

Unless otherwise specified for a particular application, high points in piping or equipment where air could accumulate shall have local valved vents. All seachests shall have vent piping terminating above the full load waterline. Seachest vent piping shall have gate valves installed at the hull penetrations. Seachest vent piping shall permit complete evacuation of entrained air during transitions from foilborne to hullborne modes to prevent loss of prime or air binding in pumps served.

Gate valves shall be installed as hull valves for allseachest and overboard discharge connections.

Overboard discharges shall be combined to the maximum extent practicable to minimize the number of shell connections. Overboard discharges shall be designed and located to avoid discharging flow into suction seachests, and areas for boat handling and accommodation ladders.

A minimum length of straight piping equivalent to 10 i.p.s. diameters shall be installed downstream of all orifices.

Orifices shall be sized to ensure adequate flow to the loads considering propulsion pressure variation, and variation in downstream pressure and flows requirements. Orifices shall be installed in a flanged joint. They shall have a part protruding beyond the adjacent pipe flanges, and beyond insulation, if installed so that presence of the orifice is evident. The size of the Orifice hole shall be stamped on this protruding part. MOD 7
Orifices in the seawater systems shall be nickel-copper or titanium. HMR 133

Polyvinylchloride (PVC) shall not be used in the seawater system.

1.259 EXHAUST SYSTEMS

1.259.1 HULLBORNE ENGINE

An exhaust system shall be provided for each hullborne engine and installed in accordance with NAVSHIPS Dwg. 205-4597759

1.259.2 FOILBORNE ENGINE

The exhaust system for the foilborne engine shall be provided and installed in accordance with NAVSHIPS Dwg. 205-4597736.

1.259.3 SHIP SERVICE POWER UNIT (SSPU)

The forward SSPU exhaust system shall be in accordance with NAVSHIPS Dwg. 300-4597367.

The aft SSPU exhaust system shall be in accordance with NAVSHIPS Dwg. 300-4597378.

1.260 FUEL AND LUBRICATION SYSTEM

See Sections 1.262 and 1.540.

1.262 LUBRICATING OIL SYSTEM

1.262.1 GENERAL

This section contains requirements for those portions of the machinery plant lubricating oil systems furnished by the Contractor. For general requirements applicable to piping systems, see Sect. 1.0-2.7. MOD 1

Paint, plastic, and zinc coatings shall not be applied to any surface that will be in contact with lubricating oil.

1.262.2 LUBRICATING OIL SERVICE SYSTEMS

Separate service systems shall be provided for (1) each hullborne engine, reduction gear and propulsor, (2) each ship service power unit, (3) the foilborne gas turbine, and (4) foilborne reduction gear and propulsor. Foilborne systems shall be installed in accordance with the following drawings except the arrangement shall be as shown on NAVSEA Dwg. 802-5000459. MOD 1

NAVSHIPS No.	Title	
PHM 211-4668876	Lubo - System Installation, Foilborne Engine	HMR 122
PHM 21 l-5330969	Equipment Instl. - Lubo System, Foilborne Propulsor	HMR' 140

Lube oil service, except for oil coolers, for ship service power units, and hullborne engines, reduction gears, and propulsors shall be self-contained. MOD 2

1.262.3 STOWAGE

Stowage for the following quantities of lubrication oil shall be provided:

MIL-L-9000 - 135 Liters (35.5 gallons) MOD 4
MIL-L-23699 - 70 Liters (18.5 gallons)

1.262.4 CLEANING AND PRESERVATION

Lubrication oil system for hullborne engines, reduction gear and propulsor, the foilborne gas turbine, reduction gear and **propulsor** and the ship service power units shall be cleaned and flushed in accordance with NAVSHIPS Drawings as follows:

Foilborne Engine	NAVSHIPS Dwg. 245-4668755
Foilborne Propulsor	NAVSHIPS Dwg. 245-4597784
Ships Service Power Unit	NAVSHIPS Dwg. 345-4596500

MOD 2

1.290 MACHINERY REMOVAL

Propulsion machinery and ship service power unit removal routes shall be as follows:

(a) Foilborne Engine. - divided into the gas generator and power turbine it is removed through the air inlet plenum and a soft patch in the 01 deck.

(b) Foilborne Propulsor Reduction Gear. - through the foilborne engine exhaust opening in the main deck.

(c) Foilborne Propulsor Pump. - through a soft patch in the main deck between BHD 30 and BHD 33.

(d) Hullborne Diesel Engines. - through a soft patch in the main deck between BHD 30 and BHD 33.

(e) Hullborne Reduction Gear. -removed attached to the hullborne engine.

(f) Hullborne Propulsors. - through transom. Alternate, through a main deck soft patch between BHD 33 and FR 35.

(g) Main Deck Ship Service Power Unit. - through a soft patch in the 01 deck.

(h) Aft Ship Service Power Unit. - through a soft patch in the main deck between BHD 33 and FR 35.

Machinery, piping, equipment, ducting, outfitting, etc. shall not be mounted in machinery removal routes as a design goal. Items mounted in removal routes shall be detachable by hand tools for removal to clear the machinery removal route and lifting/guide support equipment.

The fittings and padeyes required shall be installed as permanent items and shown on appropriate drawings. See Section 1.0-1.4.4 for specific maintainability requirements.

1.296 NOISE CONTROL

Acoustic insulation for the foilborne engine air intake shall be in accordance with Section 1.635, Hull Insulation. MOD 2

1.297 FOILBORNE ENGINE DRAIN SYSTEM

Fluid drain collection and disposal shall be in accordance with NAVSHIPS Drawing 201-4668873. HMR 122 MOD 6

1.300 ELECTRIC PLANT

1.300.1 GENERAL

This section describes the ship's electric plant, including power generation, distribution, and lighting.

A ship service electrical power system shall be provided as shown on NAVSEA Drawing 802-5000461, "Electric Power System One-Line Diagram."

The electrical plant shall (1) generate and distribute electrical power as required by the ship's subsystems, (2) provide ship's lighting and convenience receptacles, (3) provide equipment for connecting the ship to a shore power supply and to sister ships, and (4) provide all electrical cabling for powering and controlling the ship's subsystems.

Alternating current and d.c. power is provided for normal ship's use, for engine cranking and for emergency. The characteristics of these power supplies at the termination of load equipment are as shown on Table 1.300-1, "Electrical Power - Service Classes."

Redundant ship's generator sets, each consisting of a turbine and a 400 Hz, 450 volt, 3-phase brushless generator shall provide the basic a.c. power to the ship. The generators shall each supply a separate switchboard which also serves as a central point for power distribution. A tie bus between the main switchboard buses shall allow the generators to supply the ship's systems individually, split plant, or in parallel. Automatic bus transfer equipment shall be installed for selection between the two power supplies for the ship's lighting and emergency navigation lighting systems. Manual bus transfer units shall be provided for all other loads which require two sources of power. The determination of which load functions are to be connected to each switchboard shall be based on an analysis of operating requirements during casualty conditions. In general, duplicate ship loads shall be supplied from different switchboards.

Weapon loads shall be connected so that a failure of one switchboard will not disable both the primary gun and the missile systems. Three banks of batteries and two battery chargers shall be provided for Engine starting and for supplying the ship's DC power requirements. Power conversion equipment shall be provided to supply 60 Hz, 120 and 450 volts, and 400 Hz, and 120 volt. Generators powered by the hullborne engines and batteries shall supply 24 volt dc power for emergency radio, automatic control system and emergency lights.

MOD 3 & 6

HMR 19

An inverter supplied by the emergency dc bus shall provide the 120 volts required by navigation lights.

System capacities shall be provided as follows:

Two ac generators	200 KW, 0.8pf each	
Three Frequency Converters, 400 HZ to 60 HZ, 120 V and 450 V	20 KVA each	
Lighting Transformers, 3-Phase Bank	22 1/2 KVA	
Electronic Transformers, 3-Phase Bank	45 KVA	
Three Starting Battery Banks	One 225 ampere hours Two 150 ampere hours	MOD 3,6
Two Emergency Generators	60 amps at 24 V	
Emergency Inverter	1 KVA	
Harpoon Transformer Bank	9 KVA	
Receptacle Transformers 3-Phase Bank	9 KVA	

The system shall be controlled and monitored from the EOS. The EOS shall be in accordance with Section 1.252 of this document. Controls and essential meters for emergency operation shall also be provided at the main switchboards. Generator paralleling capability at the main switchboards is not required.

DESCRIPTION	PHASE	CHARACTERISTICS
400 Hz, 45V	3	MIL-STD-1399, SECTION 103, Type I
400 Hz, 450V	1	MIL-STD-1399, SECTION 103, Type I
400 HZ, 120V	3	MIL-STD-1399, SECTION 103, Type I
400 Hz, 120V	1	MIL-STD-1399, SECTION 103, Type I
400 Hz, 120/280V	3&N	FOR HARPOON
60 Hz, 450V	3	MIL-STD-1399, SECTION 103, Type I
60 Hz, 120V	1	MIL-STD-1399, SECTION 103, Type I
60 Hz, 120V	3	MIL-STD-1399, SECTION 103, Type I
24 V DC (NOMINAL)		MIL-STD-704, CAT.B 28.2 V DC (NORMAL) Maximum
24 V DC CRANKING		8 V to 28.2 V

TABLE 1.300-l
ELECTRICAL POWER - SERVICE CLASSES

1.300.2 INSTALLATION

Prior to shipboard installation all electrical equipment shall be subjected to a careful examination to determine whether the equipment or its insulation has been cut, bruised, or otherwise damaged as a result of handling or storage, whether any small parts have been bent, broken or lost, or whether the equipment has been damaged by weather, dirt, moisture, lubricating oil, or other deleterious substances. The Contractor shall correct such deficiencies.

Electrical equipment shall be located in accordance with NAVSHIPS Drawing No. 831-4596577, "Electrical Systems, Equipment Locations." Installation shall be in accordance with NAVSHIPS Drawing 345-4597200, "Electrical Plant Installation." The location of equipments and automatic protection features shall eliminate any single point of failure which would result in loss of the entire system. Protective shielding is not required to protect against small arms fire.

The multiple generators, switchboards, starting batteries, and battery chargers shall be placed in separate compartments such that flooding of any two adjacent compartments will not result in loss of ship's electrical power. MOD 3,6

A power cable raceway shall be provided on each side of the ship to separate cables of the port and starboard power systems. Two raceways for control and signal level wires shall be provided separately from the two power raceways to reduce EMI.

Insulating barriers, coatings, and potting shall be used to maintain creepage distance between high voltage gradients. Enclosures shall be designed to prevent splashing of bilge water and sea water into the equipment and to prevent accumulation of fluids within the enclosures. Power and lighting panels which contain multiple buses of more than one voltage or frequency fed from separate sources shall be designed with physical barriers separating the buses. Separate access doors shall be provided so that maintenance can be performed safely on each power panel without de-energizing the entire panel.

All exposed metal surfaces of electrical equipment shall be grounded to the ship's structure. Bonding and grounding shall meet the requirements of MIL-STD-1310.

A detailed power analysis, by line item, shall be prepared which shows operating loads under the following ship operating conditions: shore, anchor, hullborne cruise, hullborne battle, foilborne cruise, and foilborne battle. Design Data Sheet DDS 310-1 shall be used as a guide for operating load factors.

1.300.3 INSULATION RESISTANCE MEASUREMENT TESTS

Insulation resistance measurements tests shall be made on all motors, generators, line voltage regulators, transformers and static power conversion equipment after installation prior to operation. Precautions shall be taken to insure that circuits and parts of regulators and rectifiers which have a voltage rating less than the test voltage are disconnected before the test voltage is applied. The initial point of measurement shall be on the equipment side of the closest circuit breaker or contactor to or from the equipment. If the insulation resistance is equal to or greater than four megohms or the value specified in the individual equipment specification and/or purchase order for that equipment, whichever is less, no further measurements are necessary. If the measured value is less than the above, separate measurements shall be made on the connecting cable, the load equipment, and for rotating electrical machinery, the armature and field windings. Windings shall be thoroughly discharged before applying test voltage. Circuits or groups of circuits of equal voltage above ground shall be connected together. Circuits or groups of circuits of different voltages above ground shall be tested separately. Insulation resistance shall be measured with an insulation resistance indicating ohmmeter, 500 volt. type. For those circuits that would be damaged by a 500 volts insulation tester, a low voltage ohmmeter may be used. The test voltage shall be applied for not less than 60 seconds. The temperature of the component shall be noted and insulation resistance measurements shall be corrected to 25 degrees C (77 degrees F).

Corrections shall be based on insulation resistance doubling for each 15 degrees C (27 degrees F) decrease in temperature.

1.300.4 SHIPBOARD TESTS

Satisfactory operation of the ship service and emergency distribution systems shall be demonstrated. The loss of each ship service switchboard shall be simulated by tripping the generator circuit breaker. With the ship service switchboard de-energized, loads normally supplied from it that have an alternate source shall be transferred to the alternate source. The switchboard shall be re-energized by means of the bus tie connections.

The operation of special switching arrangements intended to accomplish an unusual operation or sequence of operations shall be checked. This shall include interlocks, automatic controls, and special design features such as differential protection.

Receptacles, including each outlet of duplex or multi-outlet receptacles, of grounding types shall be tested for continuity and resistance of the grounding path. This test shall be conducted with any metal-cased, portable, electric equipment (or dummy equipment) plugged into the outlet. The portable or dummy equipment shall be wired with 7.6 m (25 ft.) of No, 14 A.W.G. flexible cable and mating plug. Using a volt-ohmmeter and with the portable or dummy equipment insulated from ship structure, the resistance from the metal case of the portable or dummy equipment to the ship structure shall be measured; this resistance value shall not exceed 0.1 ohm.

1.303 PROTECTIVE DEVICES FOR ELECTRIC CIRCUITS

1.303.1 DEFINITIONS

Maximum normal inrush current. - The maximum effective inrush current which can occur in a circuit under normal operation, including motor starting currents and similar inrush currents, but neglecting transients of less than approximately two cycles duration.

Resultant load current. - The product of the total connected load current and an approved demand factor application to the toal connected load.

Steady-state motor starting current (as applied to synchronous and induction motors.) - The effective current flowing in the motor branch under starting conditions following the transient currents existing during the first two cycles.

Sustained short circuit.current. - The effective value of the steady state short circuit current. The minimum sustained short circuit current shall be determined on the assumed condition of a 3-phase short circuit at the line terminals of the generator circuit breaker and shall include the effect of the generator voltage regulator, using the value of field resistance with the field hot. This value is required to determine the pick-up current setting of the short time delay overcurrent trip device on ac generator circuit breakers.

Maximum short circuit current of each ac generator. - This current is the rms value of the asymmetrical short circuit current during the first one-half cycle after inception of the fault on the phase having the maximum asymmetrical current. In determining this current, the following conditions shall be assumed:

(a) The generator is short circuited while operating at rated load and power factor with cold field.

(b) The short circuit is three-phase and located on the line terminals of the generator circuit breaker.

(c) The fault is applied when the terminal voltage of one-phase is passing through zero.

Maximum short circuit current of each dc generator. - This current is the peak value of short circuit current occurring after inception of the fault. It shall be considered as 10 times rated full load current for generators with ratings more than 60Kw and 12 times rated full load current for generators with ratings of 60 Kw or less. MOD 1

Minimum available short circuit current at the point of application of each circuit breaker on ac systems. - This current is the rms value of the fault current during the first one-half cycle after inception of the fault on the phase having the maximum asymmetrical current. In determining this current, the following conditions shall be assumed:

(a) One generator of the lowest rating is connected to the system.

(b) The motor load contribution is negligible.

(c) A line-to-line fault is located on the line side of the next protective device beyond the one in question or at the load end of the cable supplied from the protective device.

Minimum available short circuit current at the point of application of each circuit breaker on dc systems. - This current is the peak value of short circuit current occurring after inception of the fault with minimum generation. It shall be determined on the basis of no rotating motor load on the system and only one generator contribution. The generator with the largest total circuit resistance, including generator resistance, to the fault shall be used. The value used shall not exceed five times the rated full load generator current.

Maximum available short circuit current at the point of application of each protective device on ac systems. - For the interrupting requirements of fuses, this current shall be the rms value of fault current during the first one-half cycle after inception of the fault on the phase having the maximum asymmetrical current. For the interrupting requirements of circuit breakers, this current shall be the maximum average rms value of the currents in the three-phase during the first one-half cycle after inception of the fault. In determining the current, the following conditions shall be assumed:

(a) A three-phase fault is located on the line terminals of the device in question.

(b) The maximum number of generators having the largest total capacity which are to be operated in parallel are connected to the system.

(c) The generators are operating at rated output and rated power factor before inception of the fault.

(d) The maximum motor load contribution is included.

Maximum available short circuit current at the point of application of each protective device on dc systems. - This is the peak value of current occurring after inception of the fault. This current shall be determined on the basis of the current contributed by the generators and storage batteries in parallel and the maximum motor load connected to the system.

Fully rated system. - This is a-system in which all protective devices are applied within their individual interrupting ratings.

False non-tripping. - This is the condition in which the protective device nearest the fault on the source side fails to open while a breaker nearer the source opens. This condition increases the difficulty of locating and clearing faults.

1.303.2 GENERAL REQUIREMENTS

Each unit of equipment and all circuits shall be protected from short circuit currents and thermal overloads as indicated in this section. The selection, arrangement, and performance of the various protective devices shall provide a complete, coordinated protective system having the following characteristics:

High speed **clearing** *of* all low impedance faults.

Maximum continuity of service under fault conditions to be achieved by the selective operation **of** the various protective devices. (i.e. protective device nearest the point of fault shall trip first.)

Maximum protection **for** electric apparatus and circuits under fault conditions by coordination of the thermal characteristics of the **circuit** or apparatus with the circuit interrupting characteristics of the protective device.

Adequate interrupting capacity in all circuit interrupting devices, to provide a fully rated system.

Adequate thermal rating in all of the various circuit protective and switching devices for operation under all service conditions.

Short circuit current carrying capacity of circuit breakers, **contac**-*tors* and bus transfer equipment in excess of the maximum available short circuit current within the maximum time limitations of circuit opening.

Phase failure protection shall be provided for fused circuits to open all phases if one fuse opens.

1.303.3 SELECTION OF PROTECTIVE DEVICES

Ratings shall **be** determined in accordance with the following criteria:

The voltage rating shall not be less than the highest rms alternating current line-to-line voltage, or the maximum direct current voltage of the circuit in which the device is applied.

The continuous current rating shall be approximately equal to but not less than the resultant load current of the circuit.

Since cascading may result in loss *of* continuity of power and damage to the device protected, fully rated systems shall be provided. Protective devices applied to power systems shall be selected to prevent false non-tripping. For guidance, refer to Design Data Sheet No. DDS 311-3.

Fuses used in control, indicating, and dc power systems shall be as specified in MIL-F-15160.

1.303.4 THIS PARAGRAPH IS INTENTIONALLY NOT USED

1.311 GENERATORS

1.311.1 SHIP SERVICE GENERATORS

Two identical ship service generators, manufactured by Westinghouse Electric Corporation, part no. 977J031-3, except as modified herein, shall be provided and installed in accordance with NAVSHIPS Dwg. 300-4597362 and 300-4597372, as part of the power unit assemblies per Section 1.312. Generator sets shall not be used prior to delivery of the ship, except for ship trials, tests specified in section 1.300, and test of equipment and systems that require power characteristics as supplied by the ship's electrical plant. HMR 44 HMR 4

Each ship service generator shall be an 8,000 RPM, 400 Hz, 450 V, 3-phase, ungrounded brushless type, rated at 200 Kw (250 KVA). Each generator shall be driven by a gas turbine engine through a gear box.

The generator system shall consist of the generator, control unit, reactive load division controls, metering current transformers and differential current transformers (Westinghouse Part No. 9002D46-1) described in Boeing Dwg. 312-80173. MOD 1 HMR 44 device protected, fully rated systems shall be provided. Protective devices applied to power systems shall be selected to prevent false non-tripping. For guidance, refer to Design Data Sheet No. DDS 311-3.

Fuses used in control, indicating, and dc power systems shall be as specified in MIL-F-15160.

1.303.4 THIS PARAGRAPH IS INTENTIONALLY NOT USED

1.311 GENERATORS

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HMR 44

HMR4

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The generator system shall consist of the generator, control unit, reactive load division controls, metering current transformers and differential current transformers (Westinghouse Part No. 9002D46-1) described in Boeing Dwg. 312-80173.

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MOD 4

The generator shall be air cooled via a self-contained fan mounted on the shaft. The real load division controls shall be a part of the turbine power unit.

For generator environmental protection a minimum of three varnish treatments shall be given to the windings. The varnish cure schedule (time and/or temperature) shall be adjusted to eliminate or reduce to a minimum the bubbling of the varnish at the end of the slots. The slot cells shall extend beyond the end of the laminations 9.5 mm (3/8 in.) or the maximum amount possible.

1.311.2 GENERATOR CONTROLS

The generator protection and control system shall be as shown in NAVSEA Drawing 802-5000462. A functional description of each system item shall be as presented on the above drawing. Basic control of the generator system shall be from the EOS in accordance with Section 1.252 with emergency control at the local switchboard in accordance with Section 1.322.

An automatic power-ready function shall be provided which prevents closing the generator circuit breaker if either voltage or frequency is outside of safe limits.

The following automatic protective devices shall disconnect the generator from the power distribution system:

Overvoltage*
Undervoltage*
Underfrequency*
Overcurrent*
Differential Current
Reverse Power

*"Battle By-Pass" switch in EOS deactivates these protective functions (upon failure) during battle conditions.

Generator control and protective functions shall operate the GCB's, BTB and the generator control relay as required, Power to perform these functions shall be provided by the generator PMG backed up by the ship's dc system.

1.311.3 EMERGENCY GENERATORS

Two emergency generators, with characteristics as specified in Boeing SCD 312-80141 as modified herein, shall be provided. The generators shall be provided with voltage regulators to maintain the dc output voltage within 24 MOD 1 to 28.5 volts over the output load range of 0 to full load. These generators, powered by the hullborne engines shall provide emergency 24 VDC electric power as follows:

Navigation lights required by "Regulations for Preventing Collisions at Sea"

Emergency Radio

Automatic Control System - required from loss of one ship service generator until start of other generator.

MOD 3

1.312 SHIP SERVICE POWER UNITS

Two Airesearch ME831-800 units shall be installed as part of the main ship service power assembly, Garrett Industrial Engines and Products No. 3400850-1, per Boeing Spec. 312-80005 and the following: MOD 3 HMR 74

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HMR 74

(a) The Contractor shall develop, implement and maintain a reliability demonstration plan inclusive of the following: KMR 74

1. <u>Definition of failure</u> - inability to meet the power output requirements of Boeing Specification 312-80005. All failures are classified as either relevant or non-relevant. The classification of failures is based on its cause. The following list of causes is defined as relevant:

(a) Seller equipment design defects

(b) Seller equipment manufacturing defects

Indeterminate failures clearly demonstrated to be solely due to any of the following causes are non-relevant: HMR 19

(a) Accident, mishandling or improper storage

(b) Operator or procedural error

(c) Failure of an item as the direct result of a non-relevant failure of another item

(d) Maintenance induced failure due to accident or mishandling

(e) Ingested foreign object damage.

2. Failure data collection analysis and corrective action - nrovisions shall be made by the Contractor for complete reporting on every malfunction or performance degradation, its diagnosis and any corrective action taken (design modification, etc.). Reporting shall be in accordance with sect. 1.0-1.4.5.1(b) and CDRL item A05S. HMR 19

3. Failure of Test(s) - in the event of inability to reach an acceptable decision, the Contractor shall perform an analysis to determine the cause, perform corrective action, and propose appropriate modifications to the design. Verification of any modifications shall be accom- A

plished by a period of *re-test* to be determined by the NAVSEA Ship Acquisition Project Manager (SHAPM).

(b) The Contractor shall develop and implement a maintainability demonstration plan in accordance with paragraph 4.2 of MIL-STD-471. The Contractor shall conduct a maintainability demonstration test in accordance with test method number 1B from appendix B of MIL-STD-471. Proposed maintenance tasks shall be selected by the Contractor in accordance with the procedure outlined in appendix A of MIL-STD-471 and shall be included as part of the maintainability demonstration test plan. Actual test selection shall be made by the NAVSEA Ship Acquisition Project Manager (SHAPM) prior to the time of the test. HMR 74 MOD 4

(c) The Contractor shall conduct an 1100 hour accelerated endurance test on ME 831-800 Engine S/N 801001 or a 3000-hour endurance test on one production unit as per Section 10.2.2.4.1. The 1100 hours of engine operation shall consist of 500 cycles of the following accelerated test cycle. HMR 74

Step	Time (Minutes)	Percent Power
	2	No Load
2	30	100
3	4	160
4	25	100
5	4	No Load
6	30	100
7	4	160
8	30	100
9	3	No Load
10	60	Shut Down

The teat setup shall be described in SCD **312-80005,** paragraph 10.2, Unit Qualification Tests.

Success Criteria shall be not more than two non-catastrophic failurea and no catastrophic failure during the 500 cycles of operation.

Definition of failure: Unit fails to start or to provide proper power output as demanded during the teat cycles, or to reach required speeds or powers within the specification time3 during the cycle, or power output or fuel consumption at completion of the teat cycles degrades more than 3 percent from the values obtained during the calibration run. A catastrophic failure is a failure where the destroying action of the failure would render the unit non-repairable on-board PHM within the maintenance concept.

(d) The units shall be arranged as shown on NAVSEA Drawing No. 802-5000459, the forward and aft SSPU shall be installed in accordance with NAVSHIPS Drawing 300-4597360. HMR 74 HMR 4

1.312.1 SAFETY DEVICES

The SSPU shall be provided with automatic engine shutdown without the capability of battle by-pass in the event of overspeed, overspeed switch signal loss, engine flame-out, or excessive starting time. SSPU automatic shutdown with battle by-pass capability shall be provided for the following malfunctions:

(a) High lube oil temperature
(b) Low lube oil pressure
(c) High exhaust gas temperature

1.312.2 LUBRICATING OIL SYSTEM

Lubricating oil systems shall be provided for the SSPU's.

The lubricating oil systems shall be installed in accordance with NAVSHIPS Drawing 300-4597370.

1.312.3 CONTROL

Normal operation of the SSPU shall be from the EOS. For emergency operation a local station shall be provided to allow operation with the EOS inactive. Operation from local control shall automatically activate the automatic shutdown battle by-pass.

1.312.4 COMBUSTION AIR INLET

See 1.251.1 and 1.251.2 for salt separation and anti-icing description.

1.312.5 EXHAUST

See Section 1.259.3.

1.312.6 NOT USED

1.312.7 FUEL

See Section 1.540 for fuel oil system description.

1.312.8 WASH AND DRAIN

An engine was and drain system shall be provided to internally water wash the SSPU for engine wash system requirements see Section 1.530.5. The drains shall collect waste water and fuel as a result of engine shut down. The wash and drain system shall be as shown on NAVSHIPS Drawing 201-4668873. MOD 2

HMR 122

System material selection shall be compatible with the chemical characteristics of the engine washing solvent B&B 3100. MOD 2

1.313 STORAGE BATTERIES

MOD 1,3,4

Three lead-acid storage battery banks shall be provided.

One battery bank shall be rated at 225 AH, and shall consist of six 12-volt, 75-ampere hours series-parallel connected batteries located in Aux. Mach. Rm. No. 1. Two battery banks shall be rated at 150 AH, and shall each consist of four 12-volt, 75-ampere hour series-parallel connected batteries. Batteries shall be Prestolite Part No. 7441X. Battery banks shall be rated at 24 volts, nominal. One battery bank shall be installed in accordance with NAVSHIPS Drawing 301-4597244 and two battery banks in accordance with NAVSHIPS Drawing 301-4597246.

The batteries shall provide power for the ship's dc power systems, a nominal, 24-volt, dc, two wire, ungrounded system with power quality conforming to MIL-STD-704, Category B. The system shall also be supplied by two ac to dc battery charger/transformer-rectifier units. The system shall be subdivided into the starting and emergency systems. Under normal conditions, the batteries shall supply the starting system and the transformer-rectifier shall supply battery charging and other dc systems. The hullborne engine mounted dc generators will normally provide battery charging for battery set-diesel and pump machinery room. Under emergency conditions, the main deck starting batteries shall supply the starting system for one SSPU, the second set of starting batteries shall supply the starting system for the two hullborne diesel engines, and the third set of starting batteries shall supply the emergency system, with back-up from the main deck batteries. Hullborne engine mounted dc generators shall provide supplemental emergency system dc power as described in Section 1.311.3. System interconnections shall be in accordance with NAVSEA Drawing 802-5000461. The direct current system shall be sized to supply the following dc services:

Ship's Service Power Unit Starting
Hullborne Engine Starting
Emergency System

Engine start capability shall be provided for the ship service and hullborne engines from either the EOS or for the Emergency Local Control Station.

1.313.1 BATTERY CHARGERS

Two battery charger/transformer rectifier power units shall be installed. The units shall be Avtech Corp. part No. 1266-1. The units shall be installed in accordance with NAVSHIPS Drawings 301-4597244 and 301-4597246.

The dc system shall be supplied from the two battery charger/transformer rectifier units which are sized to supply the ship's dc power requirements plus recharge the batteries. Battery charger capacity shall be 300 amperes each..

DC system protection, control, and functions shall be provided as indicated in Table 1.313.1.

ITEM	INPUTS	OUTPUTS	FUNCTION
BATTERY - MAIN DECK	CHARGING CURRENT FROM BATTERY CHARGER - MAIN DECK	24V (NOMINAL) DC	PROVIDE STARTING POWER FOR S.S. TURBINE NO. 1 AND TO LOADS CONNECTED TO THE DISTRIBUTION PNL., D.C. - MAIN DECK
BATTERY - PLATFORM DECK	CHARGING CURRENT FROM BATTERY CHARGER - PLATFORM DECK AND DIESEL ENGINE GENERATORS	24V (NOMINAL) DC	PROVIDE STARTING POWER FOR S.S. TURBINE NO. 2; BACK-UP STARTING POWER FOR HULLBORNE DIESELS NO. 1 OR NO. 2 AND TO LOADS CONNECTED TO THE DISTRIBUTION PNL., D.C. - PLATFORM DECK
BATTERY - DIESEL AND PUMP MACHINERY ROOM	CHARGING CURRENT FROM DIESEL ENGINES GENERATORS AND BATTERY CHARGER - PLATFORM DECK	24V(NOMINAL) DC	PROVIDE STARTING POWER FOR HULLBORNE DIESELS NO. 1 OR NO. 2; BACK-UP STARTING POWER FOR S.S. TURBINE NO. 2; AND TO LOADS CONNECTED TO THE DISTRIBUTION PANEL - D.C. POWER EMERGENCY
BATTERY CHARGER MAIN DECK	450V, 400Hz, 3 0 FROM SWITCHBOARD NO. 1	28V REGULATED DC	PROVIDES CHARGING CURRENT TO BATTERY - MAIN DECK AND ASSISTS BATTERY IN SUPPLYING LOADS CONNECTED TO DISTRIBUTION PNL., D.C. - MAIN DECK
BATTERY CHARGER PLATFORM DECK	450V, 400 Hz, 3 0 FROM SWITCHBOARD NO. 2	28V REGULATED DC	PROVIDES CHARGING CURRENT TO BATTERY - PLATFORM DECK AND ASSISTS BATTERY IN SUPPLYING LOADS CONNECTED TO DISTRIBUTION PNL., D.C. - PLATFORM DECK. PROVIDES BACK-UP CHARGING CURRENT TO BATTERY DIESEL AND PUMP MACHINERY ROOM.
DIESEL ENGINE DRIVEN GENERATORS - PORT AND STARBOARD	MECHANICAL INPUT FROM DIESEL ENGINES PORT AND STARBOARD RESPECTIVELY	28V REGULATED DC	PROVIDES CHARGING CURRENT TO BATTERY - DIESEL AND PUMP MACHINERY ROOM; BACK-UP CHARGING CURRENT TO BATTERY - PLATFORM DECK AND TO SUPPLY LOADS CONNECTED TO DISTRIBUTION PANEL - DC POWER EMERGENCY

TABLE 1.313-1 DC PROTECTION & CONTROL - FUNCTIONAL DESCRIPTION

1.313

ITEM	INPUTS	OUTPUTS	FUNCTION
SELECTOR SW. ON EMERGENCY DC POWER DISTRIBUTION PANEL (1E)	HMR 57 OPERATOR SELECT	BATTERY - PLATFORM DECK TO BATTERY DIESEL AND PUMP MACHINERY ROOM TIE	ENABLES BATTERY - PLATFORM DECK AND BATTERY - DIESEL AND PUMP MACHINERY ROOM TO SUPPLEMENT EACH OTHER. ALLOWS BATTERY CHARGER PLATFORM DECK AND DIESEL ENGINE GENERATORS TO CHARGE BOTH PLATFORM DECK AND DIESEL AND PUMP MACHINERY ROOM BATTERY SETS.
SELECTOR SW. ON DIS-TRIBUTION PANEL D.C. POWER EMERGENCY	OPERATOR SELECT	BATTERY - PLATFORM DECK TO BATTERY DIESEL AND PUMP MACHINERY ROOM TIE	WHEN EOS CONTROL IS INOPERATIVE AND EMERGENCY CONTROL IS ASSUMED IN DIESEL AND PUMP MACHINERY ROOM ENABLES BATTERY - PLATFORM DECK'AND PUMP MACHINERY ROOM TO BE TIED TOGETHER
REVERSE CURRENT RELAY AT "DC PWR PNL." CIC PORT AND CONTROL & INDICA-TION (2-23-2)	AUTO RESET	NONE	SHOULD A POSITIVE TO NEGATIVE SHORT OCCUR AT DC PWR PANEL PLATFORM DECK (COULD BE CAUSED BY A FLOODED COMPARTMENT). THE REVERSE CURRENT RELAYS AT D.C. PWR PNL'S CIC PORT AND CONTROL & INDICATION (2-23-2) WILL OPEN. THE SUPPLY TO THESE D.C. PWR PNL'S WILL THEN BE CONTINUED VIA THE TIES WITH DC PWR PNL'S CIC STBD AND CONTROL & INDICATION (2-22-2) RESPECTIVELY.
REVERSE CURRENT RELAY AT "D. C PWR PNL" CIC STBD AND CONTROL & INDICA-TION (2-22-2)	AUTO RESET	NONE	SHOULD A POSITIVE TO NEGATIVE SHORT OCCUR AT "D.C. PWR PNL. MAIN DECK" (COULD BE CAUSED BY BATTLE DAMAGE). THE REVERSE CURRENT RELAYS AT D.C. PWR PNL'S CIC STBD AND CONTROL INDICATION (2-22-2) WILL OPEN. THE SUPPLY TO THESE DC PWR PNL'S WILL THEN BE CONTINUED VIA THE TIES WITH DC PWR PNL'S CIC PORT AND CONTROL & INDI-CATION (2-23-2)

TABLE 1.313-1 DC PROTECTION & CONTROL - FUNCTIONAL DESCRIPTION (CONTINUED)

1.314 POWER CONVERSION EQUIPMENT

1.314.1 60 HERTZ ALTERNATING CURRENT SYSTEM

Three 400 Hz to 60 Hz frequency converters shall be installed in accordance with NAVSHIPS Drawings 301-4597244 and 301-4597246. The design of the frequency converter shall provide isolation between input and output and between each output to provide the galvanic isolation required. The Government shall be notified at least fifteen (15) working days prior to any design review meetings required by Boeing Drawing 312-80127, between the Contractor and the frequency converter supplier, so that a Government representative may have the option of attending. The converters shall be Bendix part no. 38 B67-2-A in accordance with Boeing Drawing No. 312-80127.

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A total of two (2) external analyzers shall be provided under this contract in accordance with Boeing Drawing 312-80253 for the corrective maintenance of the 20-KVA static frequency converters. The external analyzers shall be designed to accommodate the input power of 120 volts, 60 Hz and 220 volts, 50 Hz. The external analyzer shall operate and perform the required task when the input power voltage and frequency vary within the type I power steady state regulation bands in accordance with MIL-STD-1399, Section 103.

MOD 2

Each external analyzer shall have an eight-foot length cable and a receptacle at the end for electrical connection to the 20-KVA static frequency changer. Each external analyzer shall have switches to set up the proper signals and conditions for testing the static frequency converter. GO/NO-GO indicators shall be provided to identify the facility modules. The external analyzer shall be packaged in one enclosure such that other test equipment shall not be required when the external analyzer is used to test the static frequency converter.

MOD 3

The analyzer shall be designed for military rough handling application and shall perform in an ambient temperature of 0° to 50°C. Boeing Drawing 312-80253, Rev. 0, dated 27 April 1976 shall be modified as follows :

(a) Sheet 11, at the end of the first paragraph in 3.1, add “including the input and output transformers; each transformer shall be treated as one module.”

(b) Sheet 17, at the end of paragraph 3.1.2 6., add "The external analyzer shall be designed to avoid any interconnections between the analyzer 60 Hz (or 50 Hz) input power and the energized parts and circuits in the frequency changer which is energized by the 400 Hz input power. The operator shall not be required to take any special operational steps in order to avoid these interconnections.

(c) Sheet 16, delete paragraph 3.1.2.1 in its entirety and substitute the following:

"3.1.2.2 Useful Life - The analyzer shall have a useful life of 50 years."

The three 400 Hz to 60 Hz frequency converters shall be utilized to supply the ship's special power requirements. The isolated 60 Hz outputs shall be as follows:

Converter No. 1 - Main Deck
12 KVA, 450 v, 3-phase for receptacles
one 18 KVA, 120 V, 3-phase for galley equipment and a/c fans. | HMR 47

Converter No. 2 - Platform Deck
12 KVA, 450 V, 3-phase for weapons systems
one 18 KVA, 120 V, 3-phase for weapons and electronics systems. | HMR 47

Converter No. 3 - Backup
12 KVA, 450 V, 3-phase
one 18 KVA, 120 V, 3-phase | HMR 47
(Standby for Converter No. 1 and Converter No. 2)

The standby converter shall have two 400 Hz sources of input power. Source selection shall be controlled from the EOS. An overriding local control switch, located in Auxiliary Machinery Room #1, shall provide for local selection of the 400 Hz power sources. The selected source shall be indicated on the EOS control panel by means of an illuminated flow bar.

Each converter shall be capable of supplying 20 KVA which can be distributed among the outputs in accordance with the above.

Transfer of load from one converter to the other shall be manual upon failure.

1.314.2 (Not Used)

1.314.3 EMERGENCY ALTERNATING CURRENT SYSTEM

A dc to 400 Hz inverter shall be installed in accordance with NAVSHIPS Drawing 301-4597220. The inverter shall be Bendix part no. 39B169-5A.

The inverter shall provide emergency power for navigational lighting (masthead, side, stern, and task lights). MOD 1
Input power for the inverter shall be taken from the ship's 28 volt dc emergency power system. The inverter output ratings shall be 1.0 KVA at 120 volts, 400 Hertz.

1.314.4 120 VOLT ALTERNATING CURRENT POWER FOR LIGHTING

Three 7.5 KVA, 450/120 volt, 400 Hertz transformers shall be furnished and installed in accordance with NAVSHIPS Drawing 301-4597220.

The transformers shall be Jefferson Electric Co. part no. 244-001384.

These transformers shall be connected to form a 22.5KVA, 450/120 volt, 400 Hertz, three-phase, delta-delta bank, in order to provide 120 volt electric power for the primary lighting system.

1.314.5 120 VOLT, 60 HERTZ ALTERNATING CURRENT'POWER'POR RECEPTACLES

A 400 Hz to 60 Hz frequency converter described by Section 1.314.1 and three 3 KVA, 450/120 volt transformers installed in accordance with NAVSHIPS Drawing 301-4597245, shall be furnished. Transformers shall be Jefferson Electric Co. Part No. 221-001-279.

The converter and transformers shall be connected to form a 4.5 KVA, 120 volt, 60 Hertz, three-phase isolated power system for receptacles.

1.314.6 120 VOLT ALTERNATING CURRENT POWER FOR ELECTRONICS

Three 15 KVA 450/120 VAC, 400 Hz transformers shall be provided and installed in accordance with NAVSHIPS Drawing 301-4597220. The transformers shall be Jefferson Electric Co. Part NO. 221-001-261.

These transformers shall be connected to form a 45 KVA, 450/120 volt, 400 Hertz, three-phase, delta-delta bank in order to provide 120 volt power for electronics loads.

1.314.7 120/208 VOLT ALTERNATING CURRENT POWER FOR MISSILE SYSTEM

Three 3 KVA, 450/120/308 volt, 400 Hz transformers shall be provided and installed in accordance with NAVSHIPS Drawing 301-4597246. The transformers shall be Jefferson Electric Co. part No. 244-001-114.

These transformers shall be connected for form a 9 KVA, 120/208 volt, 400 Hertz, single and j-phase, 4-wire Wye power system for the missiles.

1.314.8 VOLTAGE BOOSTER

A voltage booster, Avtech Corp. Part NO. 1267, shall be installed in accordance with NAVSHIPS Drawing: 301-4597245 to maintain prower voltage to the foil-borne engine control system.

Voltage boosters, Avtech Corp. Part No. 1667, shall be installed in accordance with NAVSHIPS Drawings: Sol-4597244 and 301-4597246 to maintain proper voltage to the DC fuel pumps. HMR 199

1.315 SHORE POWER RECEPTACLES

Two shore power receptacles shall be provided for 400 Hz power. HMR 155

The 400 Hz shore power receptacle shall be M24368/2-009 per MIL-C-24368 except TSGU-150 cable shall be used. HMR 91

The two 400 Hz shore power receptacles shall be provided to receive 450 volts three-phase, 400 Hz shore power. Each receptacle shall be rated at 200 amperes minimum. One receptacle shall be located on the after side of the main deck superstructure. The other receptacle shall be located on the forward side of the main deck superstructure. The aft receptacle shall be located on the port side of the aft bulkhead and the forward receptacle shall be located on the starboard side of the fwd. bulkhead. A means shall be provided to strain relieve the shore power cable/plug interface when connected to the receptacle. HMR 155 HMR 91 HMR 91

The 400 Hz shore power protection and control system and its functional description shall be in accordance with NAVSEA Drawing 802-5000463. When the shore power is available at the shore power connector, a light in the EOS shall be energized. Automatic controls shall prevent closing the shore power contactor if voltage and frequency are not within safe limits or phase rotation is incorrect. Failure of the phase sequence detector shall prevent closure of the shore power contactor (SPC). HMR 155

One portable 400 Hz shore power cable assembly, 30 meters in length, shall be provided. THOF-150 cable and two MIL-C-24368/1-001 plugs shall be used for this assembly. This cable assembly shall also be used for connection to a sister ship. HMR 91 HMR 155

A 60 Hz shore power installation shall be provided as a kit. The kit shall provide for the following major items: HMR 155

(a) Housing and two receptacles on the stbd. side of the deckhouse aft BHD: (1) 450 volt, 30 amp, and (1) 120 volt, 100 amp.

HMR 155

(b) A contactor unit located in Aux. Machinery Room 1 on aft BHD, stbd. side, containing four circuit breakers, monitors for voltage, frequency and phase rotation, indicators, switches and contactors for selection of frequency converter power or shore power.

(c) A junction box assembly, cabling, and other components and materials for the installation.

(d) Two plugs which mate with the 60 Hz shore power receptacles, for assembly to the Government-supplied shore power cables.

(e) Engineering drawings shall be provided with the kit showing installation and assembly instructions for the 60 Hz shore power kit.

1.316 SISTER SHIP POWER CAPABILITY

The shore power receptacles shall also provide 450 volt, 3-phase, 400 Hz power to one or two sister ships. Feed-through capability is not provided. The control and protection system described on NAVSEA Drawing 802-5000463 shall also serve for sister ship operation.

1.320 POWER DISTRIBUTION SYSTEM

Power distribution system shall be provided in accordance with NAVSEA Drawing 802-5000461.

Main power distribution shall be made at 450 volts, 400 Hz from each of the two main generator switchboards located in the respective machinery compartments, through power panels to individual electrical loads. Installation of switchboard and power panels shall be in accordance with Section 1.322. Alternating current power at 60 Hz and 400 Hz, 120 volts as well as dc power shall be distributed from power panels. Power supply to redundant loads shall be provided from switch boards. The temperature sensing system shall include a minimum of three thermal sensors with associated electronics, which has been verified for operation in a 440 volt, 400 Hz system. Upon reaching the thermal detection system trip point, the motor power supply shall be interrupted prior to motor damage. The positive thermal coefficient (PTC) thermal sensors shall have a temperature coefficient of resistance at the trip point (expressed as ohms *per ohm* per ^{o}C or percent per ^{o}C) of no less than 15 percent per ^{o}C. High potential tests shall be performed on the installed sensors between the shorted leads of the sensor and ground, and between the shorted leads and the motor windings. The test voltage shall be twice the nominal system voltage plus 1000 volts. The protection shall be manually re-settable (non-automatic) remote from the motor. The sensor logic components shall be located in the respective switchboards. Motor-pump combinations installed in bilges and voids shall be capable of operation in air or submerged in salt water at a depth of three feet. Thermal and over current protection shall be provided for 400 Hz motors 1/8 HP and larger in accordance with Boeing Dwg. 312-81459 modified as follows: HMR 5 3

Paragraph 3.1.1.1.8 - after "1-35 mhz" add the following: "The controller and HMR 5 3 sensor shall be immune to the showering arc type of electrical noise when tested in accordance with the procedures of NEMA Standards Pub. ICS-1970 June 1976 Part ICS2-230."

HMR 53

Paragraph 4.3.1.4.7 - after "sensor input terminals" add the following: "The thermistor protection system shall also be tested for showering arcs in accordance with the procedures of NEMA Standards Pub. ICS-1970 June 1976 Part ICS2-230 as follows:

HMR 53

"Fixed-gap contacts such as Signalite UBD 2.0 and 4.0 for fixed peak 2000 volt and 4000 volt pulses, respectively, shall be used in lieu of those indicated in ICS2-230.43. Using the cable and cable assembly delineated in the above NEMA Standard attach *wires* labelled 1 and 3 to the output terminals of the showering arc generator and to the spark gap G as shown in the above NEMA Standard. Attach wires labelled 2 and 4 to the sensor connection of the controller and to the three series connected thermistors. Physically, the spark gap G should be located in the same package as the other electronics of the showering arc electrical noise generator. Schematically, the thermistor is connected to the same end of the multiconductor cable as the spark gap G, and the controller electronics are connected to the same end of the cable as the transformer, capacitor, etc., of the showering arc electrical noise generator. Physically, place the unshielded controller electronics' within 30.5 cm (one foot) distance of the unshielded showering arc generator. With the controller at room ambient ($25^{\circ}C \pm 5^{\circ}C$), *immerse* one of the three thermistors in the oil bath. Energize the controller with rated input voltage of 28VDC. Energize the showering arc generator using the 2000 volt spark gap for G. Apply heat to the oil bath and record the temperature at which the controller responds to an indication of overtemperature as sensed by the thermistor. Repeat the above for input voltages of 22.5 and 30VDC, substituting the 4000 volt spark gap for the, 2000 volt spark gap. Repeat the above tests for input voltages of 22.5 and 30VDC." HMR 53

Exposed motors located in machinery spaces above the grating shall be spray-tight in accordance with MIL-STD-108.

Control for motors shall be provided with protective features as determined by the requirements of the driven auxiliary and in accordance with the following:

Undervoltage protection (undervoltage lock-out) shall be used to provide the following protective features:

(a) Prevention of overloading the electrical system by excessive motor-starting currents upon return of voltage.

(b) Prevention of damage to driven auxiliaries.

(c) Prevention of injury to operating personnel.

Automatic restoration shall be provided wherever it is necessary to have immediate automatic restarting upon return of voltage after a voltage failure.

The electronics and missile transformers shall be supplied from either main switchboard by manual transfer contactors. The transfer of source shall be controlled at the EOS and at the local contactor panel.

1.321 ELECTRIC CABLE

This section contains requirements for electric cables required for power, lighting, interior communication, weapons control, and electronic systems described in other sections of these specifications.

Electric cables shall be furnished and installed in accordance with NAVSHIPS Dwg. 831-4596578, except that for reduced diameter, MOD 3 lightweight cable types the minimum installation bend radius shall be as follows:

(a) For cables with less than 1 inch OD - minimum bend radius 4 times the OD.

(b) For cables with 1 to 2 inch OD - minimum bend radius 5 times the OD.

The reduced diameter, lightweight cables shall not be used with conductor size larger than standard navy size 23 of MIL-C-915 and the current ratings shall be the same as MIL-C-915 type SGU family of cables for equivalent circular mil area as listed in Design Data Sheet DDS-304-2.

As a design goal, the use of lightweight cable shall attain a 25 percent MOD 4 weight-reduction in the allowable ship system cables.

For those cable types which have impedance and capacitance characteristics MOD 3 specified in MIL-C-915, comparable reduced diameter cables have lower characteristic impedance and higher capacitance. If the shipbuilder installs these reduced diameter cables and system operation is unsatisfactory due to impedance and characteristics of the cable, the shipbuilder shall replace the reduced diameter cables with the MIL-C-915 cables at no cost to the Government. Connectors for the MOD 4 reduced diameter, lightweight cables shall be selected in accordance with MIL-STD-242 where feasible. MOD 6

Cable installation shall be controlled to provide physical separation for redundant power feeders to the extent feasible to minimize loss of *power* from battle damage. Signal and control cables shall be routed separate from power cables. A power cable raceway shall be provided on each side of the ship to separate cables of the port and starboard power systems. Where sealing compounds are used in contact with electrical cables, they shall be in accordance with MIL-I-3064, Type HF, PR-615 only. MOD 6

Cable size for each circuit shall be based upon either thermal current rating or permissible voltage drop to maintain required voltage limits at the terminals of load equipment, whichever is limiting for that cable. The bus-tie cable shall be sized to carry the required switchboard loads with 30 percent allowance for load growth.

The methods shown on NAVSHIPS Dwg. 9000-S6202-73980 shall be used as a guide for cable installation. MOD 7 Installed cables that are in good mechanical and electrical condition may be spliced in accordance with the methods shown on NAVSHIPS Dwg. 9000-S6202-73980 where approved by the Supervisor. Radio frequency coaxial cable types, cables for repeated flexing service, cables in voids, and cables in normally inaccessible spaces, shall not be spliced. MS 3437, 3188 or 3189 type solid backshells with strain relief shall be used with all connectors on MIL-C-915 cable except where cable termination hardware is supplied by the Government. Where space limitations prevent the use of these backshells, alternate methods shall be submitted to the Supervisor for approval. Cattle raceways shall be designed to facilitate cable servicing and installation. The spacing of cable hangers shall not exceed 813 mm (32-inch), or if the headroom below the hanger is two meters (6 foot 7 inches) or less, the spacing shall not exceed 53 mm (21-inch).

Electrical cable EMI requirements shall be in accordance with Section 1 .0-1.5.2.8. Application of shielding shall be shown on detailed design drawings. Power cables shall conform to MIL-C-915E MOD 2 without external armor or may be reduced MOD 3 diameter, lightweight types conforming to the following:

(a) The conductor shall be stranded uncoated or tin-coated copper in accordance with ASTM B-286.

(b) Primary conductor insulation of cross-linked extruded polyalkene and insulation conductor jacket of cross-linked extruded polyvinylidene fluoride meeting the requirements of either MIL-W-81044/9 or MIL-W-8104412 depending on cable application.

(c) For watertight constructions, a water blocked conductor shall be used and the valleys between all components filled with a flame-retarded sealant.

(d) Cable jacket of extruded cross-linked modified polyolefin material.

MIL-C-915 cables shall be used for flexing-service applications and SGU and MSCU family of cables shall be used for all damage control, and get home functions as follows:

(a) Hullborne engine local controls.

(b) Hullborne engine DC emergency power distribution.

(c) Seawater pumps.

(d) Bilge pumps.

(e) Fire extinguishing and machinery space exhaust fan control.

The reduced diameter, lightweight cable types shall meet the following examination and test requirements when tested in accordance with the method given in Specification MIL-C-915.

Basic Electrical	Requirements
Voltage withstand - volts, rms, minimum	
Conductor to conductor	2,500
Conductor to shield (if applicable)	1,000
Shield to shield (if applicable)	500
Insulation resistance - megohms/1000 ft, minimum	(*)
Group A	
Watertightness (for watertight constructions only).	(***)
Crack resistance	No damage
Capacitance - at 1 MHz, Pf/ft. maximum	(**)
Grounded capacitance	
Mutual capacitance	
Capacitance unbalance - percent maximum	
Characteristic impedance - at 1 MHz, ohms	(**)

MOD 4

Group B	
Drip at 95 ±1° Celsius for watertight constructions only	Zero
Cold bending, cable - (*)	No damage
Attenuation - at 3 MHz, db/100 ft. max., required only where comparable MIL-C-915 type specifies attenuation.	3
Physicals (unaged)	
Insulation	
Tensile strength - psi, minimum	2,500
Elongation - percent, minimum	150
Jacket	
Tensile strength - psi, minimum	1,800
Elongation - percent, minimum	200
Group	
Physicals (aged) air oven heat, 168 hrs. at 136°C.	
Insulation	
Tensile - percent of unaged	75
Elongation - percent of unaged	75
Jacket	
Tensile - percent of unaged	75
Elongation - percent of unaged	75
Cable filler removabilty (if applicable)	
Permanence of printing (insulation) cycles, minimum	50
Permanence of printing (jacket) cycles, minimum	250
Flammability - IEEE 383, vertical tray, except 210,000 Btu/hr heat input. Burn length (jacket damage) in maximum	72

(*) Minimum value as specified for comparable MIL-C-915 type.

(**) Value dependent on cable construction. Applicable only where comparable MIL-C-915 type has requirements.

(***) See MIL-C-915 table for limits for water leakage.

Handling and Stowage of Electrical Cable. All cable, except portable and flexible (repeated flexing service) types and SGA or SGU family complying with MIL-C-915E shall be given the following special handling at temperature below 1.7 degrees C (35 degrees F): MOD 3

If the compartment in which the cable is to be installed cannot be heated, the cable shall first be stored in an ambient temperature of at least 10 degrees C (50 degrees F) but not above 49 degrees C (120 degrees F) until it is warm enough to be completely installed before it cools to 1.7 degrees C (35 degrees F).

If cable must be installed when its temperature is 1.7 degrees C (35 degrees F), or lower, extra care will be required. The radius of bends shall be no shorter than necessary and never less than the minimum values given in the ratings and characteristics tables. Before bending to the final radius, that portion of the cable comprising the bend shall be warmed thoroughly by a portable warm air blower.

Cable shall be stored in a dry place which is not subject to accidental flooding, is protected from the weather, and is subjected to a minimum variation of temperature.

Cable that has been in storage for prolonged periods may be installed provided a visual inspection shows that it has sustained no mechanical damage that would impair the watertight integrity of its outer sheath. MOD 6

1.322 SWITCHGEAR AND PANELS

Switchgear and panels shall be furnished and installed in accordance with NAVSHIPS Dwg. 831-4596577. The switchboard shall be Boeing Part Nos. 301-5330889-1 and 301-5330888-1 respectively (HMR 142 in the auxiliary machinery room No. 1 and the auxiliary machinery room No. 3.

Two main switchboards shall receive ac power from the ship's service generator sets or from shore/sister ship power and provide the main distribution for the ship's electrical loads. Remote control of the generator, bus-tie and shore power contactors, located in the main switchboards, shall be provided in the Engineering Operating Station (EOS). Emergency control of the local generator shall be provided at each switchboard as shown on NAVSEA Dwg. 802-5000464.

Each switchboard shall contain in part:

(a) Generator Control Unit HMR 101
(b) Contactor
(c) Bus-Tie Contactor
(d) Shore Power Fuses
(e) Shore Power Contactor
(f) Load Contactors HMR 101
(g) Real Load and Reactive Load Current Transformers
(h) EOS Metering Transformers
(i) Differential Protection Current Transformers
(j) Circuit Breakers for Loads HMR 101
(k) Generator Voltmeter and Ammeter (separate metering current transformers)
(1) Blown Fuse Detectors HMR 101
(m) Shore Power Monitor
(n) Relays.

A warning placard shall be conspicuously placed near the standby converter and on the converter source power control box and power panels which receive power from both switchboards (with source selected at the EOS), which notifies maintenance personnel that either switchboard is capable of providing input power to that panel or box.

Power panels shall contain buses, circuit breakers, contactors, relays, terminals, and connectors as required. On all panels, including main switchboards, controls shall be provided for all circuit breakers, **contactors** and controls they contain. Isolation barriers and separate access panels shall be provided to separate areas containing buses of different voltage and frequencies where fed **from** separate sources. Panels shall be in accordance with the following list:

Panel	Boeing Part No.	
Lighting Main Deck	303-4597208-14	HMR 119
60 Hz *Main* Deck	303-4597210-5	
dc CIC Starboard	301-4597213-l	
dc CIC Port	301-4597214-6	HMR 119
400 Hz CIC	301-5330770-1	MOD 1 HMR 167
60 Hz Comm Room	301-4597225-5	HMR a7
60 Hz CIC	301-4597216-8	HMR 119
dc Power	301-4597211-25	MOD 1 HMR 140
Lighting Plat. Deck	303-4597207-6	HMR 140
60 Hz Plat. Deck	30 3-4597209-34	HMR 167
Emergency dc	301-5330958-1	
H/B Starter	302-4597226-l	
dc Power	301-4597211-26	HMR 140

Panels and switchboards shall be of the dead front type, with hinged front panels for maintenance. Insulating material shall be placed on the deck below, in front of, and around switchboards and panels where maintenance personnel may stand for all panels containing voltage above 30 volts. All exposed metal parts of all electrical equipment shall be bonded to the ship's structure.

Fasteners for hinged and removable access panels on switchboards and power panels shall be fully captive and of sufficient mechanical strength to prevent bending *or* failure after repeated usage. MOD 1

1.331 LIGHTING DISTRIBUTION

Lighting distribution systems shall be provided in accordance with NAVSEA Dwg. 802-5000465.

Electric power for the primary lighting system shall be provided in accordance with Section 1.314. This transformer bank shall be supplied from either main switchboard via a contactor. This contactor shall be controlled at the EOS and at the local power panel. Transfer upon failure of a power source shall be automatic.

Lighting distribution shall be made from two main lighting panels, one located on the main deck and one located on the platform deck in accordance with Section 1.322. Three-phase distribution shall be utilized. MOD 6

To maintain exterior light security, a door switch, with disabling switch, shall be provided on the Auxiliary Machinery Room No. 1 door. The disabling switch shall be in the Auxiliary Machinery Room. A curtain shall be provided at the base of the pilothouse ladder to prevent light from the CIC entering the pilothouse.

A darkened-ship switch located in the pilothouse shall extinguish all exterior lights that are not normally controlled in the pilothouse.

To maintain dark-adaptation of eyesight in the CIC, a switch on the door between the communications room and the CIC shall control a light fixture in the communications room to turn off white lights and turn on a red light when the door is opened. HMR 37

1.332 ILLUMINATION REQUIREMENTS

1.332.1 SCOPE

This section covers requirements for general, detail, special, and low level illumination including application, selection, installation, and tests of ship's illumination equipment.

1.332.2 DEFINITIONS

Lighting fixture. - A complete illuminating device, including lamp, globe, reflector, refractor, housing, and such support as is integral with the housing, or any combination of these parts. Lighting fixtures are further defined as follows:

Permanent fixtures. - Fixtures nermanentlv installed and used for general illumination and for detail illumination applications.

Portable fixtures. - Fixtures connected by portable cables plugged into receptacle connectors and used for lighting applications not served by permanently installed fixtures.

Miscellaneous fixtures. - Fixtures used for special illumination applications that are not served by permanent or portable lighting fixtures.

Average illumination. - The average value of illumination in foot-candles over an area on a horizontal working plane 30 inches above the deck.

Initial average illumination. - The average illumination computed or measured when lighting fixtures and painted surfaces are new or in new condition.

Brightness contrast. - The ratio of the amount of light reflected from surfaces of two or more objects in the field of view.

General illumination. - The illumination provided from all lighting fixtures on the overhead and bulkheads, except low level illumination lights and detail lighting fixtures. Illumination shall be provided for specific seeing tasks, and as provided by lights on desks, log desks, berths, and machine tools.

Special illumination. - The illumination provided by miscellaneous fixtures for purposes other than covered by general and detail illumination.

Dark adaptation, - The physiological adjustment of the eye to a change in environmental conditions. Specifically, the condition of the eye which permits improved vision under faint light.

Low level illumination. - The low intensity red illumination provided for standing lights in berthing areas, minimum interference with dark-adapted vision, and certain special applications involving darkened-ship operation.

1.332.3 GENERAL

The ship shall be completely lamped throughout at the time of delivery of the ship. All lamps which show evidence of deterioration shall be replaced with new lamps. Fluorescent fixtures with eight watt lamps shall be used for detail illumination and for general illumination in locations where space is too restricted to accommodate fixtures with 15-watt or 20-watt lamps. The minimum number of fixtures required to provide the specified illumination shall be installed in each compartment. For example, 40-watt fixtures are preferable to a greater number of 20-watt fixtures, and 60-watt fixtures are preferable to a greater number of 40-watt fixtures. However, this does not affect requirements for other illumination factors herein, such as uniformity and contrast.

Where furniture or equipment requiring detail illumination is installed in spaces other than those indicated in Table 1, detail lights specified for similar installations in spaces shall be provided.

Incandescent and fluorescent lamps shall be of standard types in accordance with Military standards. Incandescent lamps installed shall not be of a larger wattage than that for which the fixture is designed.

All overhead lighting fixtures installed in spaces which are required to be sheathed shall be recessed in the sheathing. See publication NAVSHIPS 0964-000-2000 for typical method of installation. Cables supplying these fixtures shall be concealed by the sheathing wherever practicable.

1.332.4 GENERAL ILLUMINATION

Lighting fixtures of types specified in publication NAVSHIPS 0960-000-4000 modified for 400 Hz operation shall be installed in compartments and spaces in the number and location required to provide the initial average foot-candle values of general illumination specified in Table 1.

Incandescent or fluorescent lighting fixtures shall be used in accordance with the following:

Fluorescent fixtues shall be used in (See Notes 1 and 5):

Living and messing spaces (See Note 4)

Commissary spaces

Electronics spaces

Offices

Ship control and associated spaces

Sanitary spaces

Incandescent or fluorescent fixtures may be used in other spaces (See Notes 1 through 3):

Note 1. - Incandescent fixtures shall be used in refrigerated spaces and wherever explosion-proof enclosures are required.

Note 2. - Fluorescent fixtures, Symbols 74 and 75, shall be used in high bay spaces (such as hangar ships).

Note 3. - In all spaces having pressurized oil systems, with valves, flanges, or couplings in the oil systems, general overhead lighting fixtures shall have lenses or globes to protect the lamp from direct impingement of oil under pressure upon the lamp.

Note 4. - Standard Navy fluorescent lighting fixtures installed in messrooms, lounges, and CPO lounges shall be a fixture designed to the general requirements of MIL-F-16377/11 having a clear and white prismatic window instead of a diffusing window.

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Note 5. - In areas where the general lighting fixtures cause specular reflections on the glass faces of meters and gages, the fixture lenses shall be replaced with clear plastic lenses with the sides, ends, and bottom edges enameled black inside; black louvers, having an angle of cutoff of 30 degrees from the horizontal, shall be installed within the lens.

Suggested illumination calculation method and utilization factor tables for the fixtures specified are available in publication NAVSHIPS 0964-000-2000. However, the use of such suggested methods shall not relieve the Contractor of the responsibility for meeting requirements contained in these specifications.

The average foot-candle values of general illumination specified in Table 1, shall be calculated for a horizontal plane .762 meters above the deck.

The initial average foot-candle illumination specified shall be considered the minimum acceptable illumination. A minus tolerance in these values will not be permitted except in special cases, as approved by the Supervisor. A plus tolerance, to allow for variable factors in computing the required number of lighting fixtures, is permissible. Except as approved by the Supervisor, this plus tolerance shall not exceed 30 percent of the initial average illumination. In certain small spaces where the installation of one or two lighting fixtures will yield less than the required minimum illumination and the installation of an additional fixture will yield an initial illumination in excess of

130 percent of the specified maximum illumination, the specified tolerance limits shall be as follows: wherever the seeing task is not critical, such as in storerooms, the additional lighting fixture shall not be installed; where critical seeing is involved, such as in a small shop, the additional fixture shall be installed.

Where a compartment serves two or more functions, the level of illumination provided shall be for the primary function of the compartment. Higher levels of illumination, than that required by the primary function of the compartment, shall be provided only in those secondary function areas requiring a higher level of illumination.

In fulfilling illumination requirements, the ratio of maximum foot-candles under a lighting fixture to the minimum foot-candles between it and the nearest adjacent fixture shall not be greater than two to one, and for the best results should be close to unity, so that the level of illumination at the working level will be substantially uniform. If the number of fixtures provide a ratio greater than two to one, additional lighting fixtures shall be installed, or the installed fixtures shall be rearranged, subject to specific approval of the Supervisor, to obtain this ratio. This uniformity is particularly desired in offices, shops, and electronic spaces. In arranging fixtures to provide a uniform level of illumination, they shall be spaced to provide maximum illumination on working surfaces. Spacing between lighting fixtures and bulkheads shall provide substantially uniform illumination, without spotty light distribution, dark areas, or dark corners, on shelves or racks or vertical surfaces (such as cabinets). In general, spacing between a lighting fixture and a bulkhead shall be one-half the spacing between fixtures.

Fixtures shall be installed directly on the overhead to achieve maximum uniformity of illumination. If the overhead arrangement is such that one or more of the fixtures must be lowered to avoid obstructions such as ducts, pipes, or wireways, or to achieve satisfactory illumination, the remaining fixtures shall not be lowered.

In compartments where close visual tasks are performed, or where visual tasks are performed for long periods, the lighting fixtures shall be of shielded types located to eliminate glare sources from the normal field of vision.

Excessive brightness contrasts between seeing task and the background immediately surrounding such task shall be avoided, to minimize eye fatigue, particularly in compartments where continuous visual tasks are performed (such as in offices, chartroom, or control spaces). A brightness contrast ratio of unity is desirable and a ratio of three to one is good; however, the brightness contrast shall not be greater than ten to one, and fixtures shall be selected and installed accordingly.

1.332.5 DETAIL ILLUMINATION

General. - Wherever general illumination is inadequate for the efficient performance of specific tasks (such as shaving, office work, and plotting), detail illumination shall be provided with detail lighting fixtures designed for the specific functions, as specified under lighting requirements in Table 1. However, detail lighting fixtures shall not be provided where judicious location of general lighting fixtures will provide the required levels of detail illumination. Additional general lighting fixtures may be provided in those cases where a cost savings will result; however, this does not apply to berth lights or miscellaneous furniture with built-in illumination.

Where detail lighting fixtures are necessary, they shall be of types specified in publication NAVSHIPS 0960-000-4000, installed in the number and location MOD 1 required to provide the initial average foot-candle values of detail illumination specified in Table 1. These detail illumination values shall be calculated for the working levels.

Mirror lights. - Mirror lights shall be provided as follows:

Symbol Nos. 351, 351.1, 352 or 352.1 fixtures shall be used for mirror lighting.

Publication NAVSHIPS 0964-000-2000 shall be used as a guide for the installation of mirror lights and switches and receptacles for use in conjunction with mirror lights. In washrooms only, the mirror lights shall be considered as providing part of the general illumination in determining the number of overhead fixtures required. All mirror lights in sanitary spaces shall be controlled by the switch controlling the overhead lights.

Berth lights. - An individual berth light, of the type applicable to the berth, shall be provided for each berth. These lights shall be located in the berths to provide for head to foot bunking arrangements. The lights shall be located at the partition end of all double tiers of berths. Where the partition extends the full length of the berth *or* where no partition is provided, the berth light shall be located at the aft end of the berth. MOD 2

Spotlight. - In spaces normally operated darkened or under a reduced level of illumination, highly directional illumination shall be provided by spotlights, at such positions as DRT's, chart tables, and radio operator's positions.

1.332.6 SPECIAL ILLUMINATION

Weather deck lighting fixtures. -A limited number of permanent lighting fixtures shall be installed on the weather decks. The number provided shall be the minimum required to outline the following locations adequately to permit ready safe passage of personnel:

Frequently used ladders.

Main walkways subject to heavy traffic; to illuminate obstructions such as reels, capstans, low or narrow passageways, or abrupt changes in deck level. If walkways are long, straight, and free of obstruction, lights shall be spaced approximately 75 feet apart. Walkways having sharp bends or corners shall have a fixture located to permit visibility from both sides of the corner or bend.

Wherever practicable, bulkhead-mounted weather deck lighting fixtures shall be mounted at a height of seven feet above the deck to the center of the fixture globes. Wherever necessary, fixtures shall be supported on brackets extended out from bulkhead so that the light will not be obstructed by objec ts located in the vicinity.

Weatherdecklighting shallbeenergized from the darkened ship lighting circuit and shall be controlled locally by means of switches located inside access doors adjacent to the fixtures controlled, unless an overall weight saving or simplification of the wiring installation can be effected by controlling several fixtures on the same deck level and in the same general area of the ship from the same switch.

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Waterlines security lights. - Portable floodlights, Symbol 300.2 using lamp industry No. 300 PAR56/4WFL, with cable and plug, suitable for illuminating the waterline shall be provided on all surface combatant and auxiliary ships. Sufficient fixtures shall be installed to give complete coverage at one time with a small overlap of the light beam at the water surface. The lamps in the floodlights shall be installed to provide a beam spread of 30 degrees horizontal and 60 degrees vertical. A mounting bracket to permit aiming the light, and ready mounting and removal, shall be provided. Placement or shielding of fixtures shall be such that main security watches can observe the waterline without looking into the beam of the light. The floodlight circuit shall not be on a darkened ship circuit, and shall be controlled from the pilothouse. The receptacles for this circuit shall not be used for any other purpose. Receptacle symbol 1101 shall be used. Stowage facilities for floodlights shall be provided. Provisions for installing the ship's decorative dress ship lights shall be installed. The decorative dress ship lights shall be stored at the MLSG. MOD 1 MOD 2

Hand lanterns. - Hand lanterns with relay, Symbol 101.2, and without relay, Symbol 100.2, shall be installed throughout the ship to provide a limited amount of illumination when other lighting sources fail. In general, lanterns with relay shall be provided where continuous illumination is required for control and operation of the ship; lanterns without relay shall be provided for supplementing the relay type and for other stations where duties involve the operation of the ship's assigned functions.

Hand lanterns shall not be installed in locations where light therefrom would be visible from outside the ship under darkened ship conditions.

Hand lanterns shall not be installed in any location where explosion-proof enclosures are required.

Hand lanterns installed in red lighted areas shall have red lens in accordance with Mil. Std. MS-17127.

Hand lanterns installed in passageways and at the foot of ladders shall be mounted so that the light beam shines approximately 30 degrees below the horizontal eye level. In other locations, lanterns shall be mounted to illuminate the principal work areas and accesses or escape hatches for which they are intended without removing the lanterns from their mounting brackets.

Hand lanterns shall be mounted on shockproof brackets, in such manner that the handle or relay mechanism is uppermost.

Hand lanterns with relays. - Relay-controlled hand lanterns shall be installed to provide the minimum illumination necessary for the purposes listed below when other sources of illumination fail:

To prevent panic and personnel injury which might occur in total darkness.

To mark escape routes.

To permit restoration of electric power.

To permit emergency destruction of classified material in accordance with ship's destruction bill.

To permit performance of ship control functions or continued medical treatment where no delay can be tolerated. They shall not be installed solely to permit carrying on other ship's functional duties.

Relay-controlled hand lanterns shall be installed for the above purposes in accordance with the following:

Large spaces containing machinery shall have one lantern for each access, companionway, escape trunk, and essential passage.

Escape passages and companionways leading to the weather deck from compartments where personnel are stationed or quartered shall have one lantern for each access, ladder, companionway, or trunk, the deck area in way of escape scuttles, and one lantern for each unobstructed section of passageway. Long passageways shall have one lantern for each watertight division, or approximately each 40 feet. Structural or machinery arrangements that may be a hazard to the ready flow of traffic in an emergency shall have one lantern at each such location.

One lantern shall be installed at each applicable ship control station (such as electrical switchboards and generators, engine room gageboards, control benchboard, propulsion controls, and equipment associated with steering).

One lantern shall be installed in spaces containing hazards to personnel.

One lantern shall be installed to illuminate each safe or cabinet designed for stowage of classified material if not already provided by a previous requirement.

Relay-controlled hand lanterns shall not be installed to provide detail illumination, nor in the following spaces:

Spaces having door switch control light unless the lanterns can be located so that no light is visible outboard.

Hand lanterns without relay shall be substituted in the above spaces where lanterns with relay would otherwise be required.

The circuit to the lantern relay shall be connected in the lighting circuit in the space in which the lantern is installed, so that the lantern is automatically turned on only when the lighting supply fails, but not when the lighting is turned off by switch.

The fuses protecting the circuit shall be ample protection for the relay.

<u>Hand lanterns without relays (surface ships)</u>. - Lanterns without relay shall be installed where duties involve the functional operation of the ship, in accordance with the following:

Stations and small spaces manned only occasionally (except such spaces as staterooms and lockers), shall have one lantern if a lantern is required to meet the stated purposes of installing hand lanterns.

In ship magazines, hand lanterns shall be installed so that there is one to illuminate each access closure and one to illuminate each passing scuttle, if not already provided by a previous requirement. One additional lantern per 200 square feet shall be installed, preferably on stations to illuminate aisle spaces.

Lanterns shall be installed to provide detail illumination of items such as table tops, charts, and information displays, where such illumination is required to permit performance of ship control functions and where a slight delay can be tolerated.

1.332.7 LOW LEVEL ILLUMINATION

General. - Red light fixtures shall be installed for the following primary purposes:

To provide standing (low-level) lights in berthing areas.

To provide illumination that will afford the least practicable interference with dark-adapted vision in access routes to topside battle and watch stations and in special compartments and stations.

To provide illumination for special applications involving darkened-ship *operation.*

Red illumination shall be furnished by standard red lighting fixtures selected from publication NAVSHIPS 0960-000-4000, unless otherwise specified.

For fluorescent lighting installations, red illumination shall be accomplished by use of red filters over those lamps, as necessary to accomplish the desired illumination, except as noted herein.

For incandescent lighting installations, red illumination shall be furnished by standard red lighting fixtures, unless otherwise specified.

The red fixtures shall be located and spaced to provide sufficient illumination, with particular attention being given to the illumination of door sills, hatch coamings, ladders, and obstacles. Fixtures installed on bulkheads to illuminate door sills and hatch coamings shall be a minimum of two feet above the deck (to the bottom of the globe) and shall be as close to two feet as practicable. Red lighting fixtures, including those at replenishment stations, shall be installed so that no direct light is exposed to view outside the ship and also that any indirect light reflected from weatherdeck structures or passing through such openings as scuttles, is kept to a practical minimum. This shall be accomplished by judicious location and shielding of fixtures and by the application of black paint.

HMR 57

All indicator lights on equipment located in areas having low level red illumination shall be red.

Red light fixtures which are installed for the purpose of preserving dark adapted vision of personnel using optical instruments, shall be located outside the field of vision of operators occupying their normal working positions. The fixtures shall be shielded to reduce light in the working area to a minimum.

Installation of the required red lighting fixtures in compartments and passages shall not affect the number of white lights required.

Where necessary to adjust the degree of illumination and directional characteristics of a red lighting fixture (as for example, where located adjacent to the head of a berth or near the top of a ladder so that light shines directly into the eyes), the globe or lens shall be shielded.

All lights installed in pilothouse (including indicator lights) shall be located or shielded so that no light is reflected in any of the windows or windshield glass. This is particularly important when lights are installed on the after bulkhead of the pilothouse.

<u>Red light control</u>. - Double throw switches shall be used to energize either the red light circuits or the white light circuits. In addition, where operating conditions or personnel comfort make it desirable to reduce the amount of low level illumination, such reduction shall be accomplished through the use of integral or individual local switches.

Red light fixtures shall be supplied from the local ship service lighting circuits and connected to permit their control when the regular illumination is extinguished.

Surface ship requirements. -

Access routes. - Red lighting fixtures shall be installed along routes leading from stateroom and berthing areas to weather deck stations involved in navigation, weapons control, signaling, gunnery, and other essential activities. In general, the routes selected shall lead along main passageways and terminate at main accesses to weather decks. They shall permit personnel traffic within the ship, rather than on weather decks, insofar as practicable. Where such routes lead through large spaces such as shops or messing spaces, red lights shall be installed to illuminate only these routes. Companionways and ladders shall be provided with red illumination.

Red lighted access routes shall have a minimum exposure to white light, but total exclusion of white light is not mandatory; for example, door switches shall not be installed solely to keep white light out of these routes. Washrooms and water-closet spaces opening into such routes shall have red lights.

The number of red lighting fixtures shall be limited to the minimum number for safe, rapid movement of personnel under low level illumination conditions. In long, unobstructed passageways one fixture shall be provided for each watertight subdivision. However, where the passageway changes direction, a sufficient numer of fixtures shall be provided to illuminate the passage from either direction.

Living spaces. - Red lighting fixtures shall be installed as standing lights for living compartments that accommodate four or more persons and for washroom and watercloset spaces that are within or near living areas. A sufficient number of fixtures shall be provided to permit personnel to move from berths to access routes.

Special compartments and stations. - Red light fixtures shall be installed in compartments used by personnel preparatory to going to duty outside at night or compartments entered periodically in the course of carrying out such duties, and in stations in which optical instruments (such as range finders) are used. Each of these compartments having inboard accesses shall be made accessible from living areas via red light access routes utilizing, as far as practicable, the main red lighted routes specified above. Red light routes shall also be provided between these spaces and the weather decks where direct access outboard does not exist .

Replenishment-at-sea transfer station. - Red light fixtures specified in publication, NAVSHIPS 0960-000-4000 shall be installed for general lighting of these stations during night replenishment operations on ships fitted for delivering or receiving supplies such as fuel, water, or stores. A minimum of illumination necessary to enable operation of machinery and identification of cargo shall be provided. A maximum illumination level of two foot-candles shall be provided where seeing tasks are critical, such as, cargo MOD 6 handling and breakout areas, fuel transfer stations, and line handling stations. For other areas, illumination values ranging down to about 0.5 foot-candles will be satisfactory.

The red lighting fixtures for illumination of replenishment-at-sea transfer stations shall be located so they not obstruct or be subjected to damage by rigging or other cargo handling gear. MOD 6

1.332.8 CONTROL SPACE ILLUMINATION

General. - Lighting shall be provided in control spaces which contain cathode ray tube equipment and which are normally operated darkened or under a reduced level of illumination.

Illumination in spaces normally operated darkened. - Highly directional illumination shall be provided by spotlights at DRT's, chart tables, and radio operators positions in spaces indicated in Table 1. In locating spotlights, direct light shall not be permitted to fall on electronic equipment consoles and scopes. These lights shall provide illumination for specific equipment with the foot-candle range specified in Table 1. Consistent with the above, the following conditions shall be met:

In these spaces, general overhead lighting shall be provided for maintenance and in-port use.

The illumination level shall be as high as possible without uncomfortable contrast.

Highly directional illumination shall be provided for specific items which do not have adequate internal illumination, such as information plates and position markings of manually-operated switches.

Fixtures shall be judiciously located so that their images do not degrade scope operations.

Illumination in CIC's. -

The following specific requirements apply to the BBB lighting system:

Fixtures, Symbol 341, shall be used for this installation. The tubes in the fixtures shall be wired so that either of blue light or white maintenance lighting may be obtained.

The number of fixtures installed shall be sufficient to provide an optimum ambient illumination throughout the CIC. The uniformity requirements stated elsewhere shall be adhered to wherever practicable. The fixtures, however, shall be judiciously located, so that when operators are in their normal operating positions fixture images will not degrade scope operation and images in plotting and status boards will not be objectionable. In order to obtain illumination as uniform as possible and also eliminate glare sources, additional shielding may be provided.

The levels of BBB light given in the accompanying table shall be used as

TABLE 1

COMPARTMENT ILLUMINATION REQUIREMENTS (Note 2)

Functional group no.	General lighting requirements: Functional group	Lux average, initial	Detail lighting requirements: Equipment, or furniture	Lux average, initial	
	Living and messing spaces, except as follows:	150.7	Berths	Note 3	MOD 6
			Chiffonier with writing shelf	301.4	
	Staterooms	75.3	Mirror	Note 3	
			Writing tables	301.4	MOD 6
	Berthing areas	75.3			
	Messing tables	301.4	Secretary-Bureau	Note 3	
	Mess counters	226.0 Minimum			
	Commissary spaces	226.0	Food preparation counter	301.4	
			Range tops	301.4	
	Damage control spaces except as follows:	150.7	Damage Control Desk	301.4	
	Repair stations	75.3			MOD 6
	Electronic spaces	150.7	Desk, radio receiver	301.4	
	Machinery spaces	75.3	Gage and control boards	150.7	
			Switchboards (except weapons control)	150.7	
			Log desk	301.4	
			Switchboards, weapons control	301.4	
			Enclosed operating station	75.3	
			Machine tools	Note 3	
	Ammunition handling and magazines	75.3			MOD 1

TABLE 1 (Continued)

COMPARTMENT ILLUMINATION REQUIREMENTS (Note 2)

	General lighting requirements		Detail lighting requirements	
	Control Rooms (See 1.332.8)		Control rooms - operated darkened:	
			Chart table and desks	43.1
			Dead reckoning table	43.1
			Instruments not internally illum.	21.5
			Cathode ray screens	Note 1
	Pilothouse (for in-port use)	75.3	Chart table	301.4
	Sanitary spaces	**150.7**	**Mirrors**	**Note 3**
Misc.	Passageways, companionways, ladders, and vestibules	75.3		
	Scuttles, unattended equipment spaces, unassigned spaces, reserved spaces, and cargo spaces	75.3		

MOD 1,6

MOD 6

Note 1. - In providing lighting for miscellaneous equipment not supplied with internal lighting, glare and specular reflection on cathode ray scopes shall be prevented. Maximum illumination at scope face shall be within the optimum range of 1.1 to 2.2 Lux for master scope and may be up to 1.1 Lux for the repeater scope. Detail lighting fixtures shall be installed, as necessary, to obtain a uniform level of illumination as high as consistent with the above limiting values. All lights shall be positioned or shielded to prevent reflections from scope faces and glass dials with respect to operating positions of personnel.

Note 2. - Illumination requirements specified apply to white lighting except as specifically indicated.

Note 3. - Lux requirements for detail lighting are not specified. Amount of illumination shall be that achieved by proper installation of the specified detail fixture.

Note 6. - As specified for the area in which battle dressing station is located.

a guide and shall be achieved, providing all other requirements herein are satisfied. The bright levels indicated shall be achieved while both blue tubes are energized. Measurements shall be made with a visual or photo-electric photometer, color corrected for BBB, and using a magnesium oxide standard test plate having a reflection characteristic as close to unity as possible.

Broad Band Blue Lux levels

	Dim	Bright
Ambient illumination 76 cm (30 inches above deck)	4.3	6.5
On scope faces	0.6	1.7
On DRT's (with supplementary white light)	10.8	21.5
On other equipment, such as clocks and communication consoles (with supplementary white light)	7.5	10.8
On desks and tables	No specific Lux req't.	

Maintenance lighting shall be provided by the center tube of the fixtures and no additional fixtures shall be provided for this purpose unless the initial installation produces an average illumination level in the module, of less than 32.3 Lux of white light. If additional fixtures are required for maintenance, they shall be Symbol 77.3 or 331, as required.

Highly directional, supplementary illumination shall be provided on equipment such as chart table, communications consoles, clocks which are not internally illuminated, and DRT's through the use of spotlights, Symbol 147.2, installed in number to provide adequate illumination for tasks to be performed when all operators are at their normal position. Shield insert assembly, pc. 5, of this fixture may be reversed to provide a broader distribution pattern, if required. Where desired, the directional supplementary illumination on tables and desks may be achieved through the use of chartboard lights, Symbol 141.2 If chartboard lights are used, they shall be located so that no glare or reflection is evident in any area where operators are viewing or using cathode ray tubes or status and plotting boards. HMR 19

Control switching for lighting in each module shall be located in that module and shall be arranged so that one switch will energize all white maintenance lights, one switch will provide the **"bright"** level by energizing both blue tubes in each fixture in the module, and one switch will provide the **"dim"** level by energizing only those tubes necessary to achieve this level (preferably one blue tube in each fixture). This control may be combined in one selector switch with an "off" position.

1.332.9 NAVIGATION LIGHTING

Navigation lighting shall be installed in accordance with Section 1.422.

Emergency navigation lighting shall be supplied from the emergency bus and inverter power source. The emergency lights consist of the emergency navigation (port side, starboard side, masthead, and stern) and task (upper, middle, and lower) **lights.**

1.333 SWITCHES, RECEPTACLES AND OUTLETS

Switches, receptacles and outlets shall be furnished and installed in accordance with NAVSHIPS Dwgs. 303-4597203, 303-5330499, 303-5330507, and NAVSEA Dwg. HMR 140 802-5000466, except that detailed switch/receptacle locations shall be chosen to minimize wiring runs, maximize utility, with and not intrude on passageway space. Lighting switches and lighting junction boxes in the magazine shall meet HMR 42 NEMA-4 and MIL-B-5423 specifications.

Receptacle power shall be in accordance with Section 1.314. Power distribution shall be made from two panels: one located on the main deck and one located on the platform deck. Two 450 volt, three-phase 400 Hz outlets shall be provided for portable bilge pump use. A switch shall be provided adjacent to each portable bilge pump outlet for turning bilge pump power on and off at that outlet. A 120 volt, single phase, 400 Hz HMR 28, 28 R1 outlet shall be provided for security light and decorative light use. All receptacles and outlets shall be of the grounding type. The receptacles and switches shall be installed so as to be accessible for operation and maintenance.

Two 60 Hz, 115 volt watertight convenience outlets shall be provided on the main deck to weather (forward and aft). MOD 1, MOD 6

1.400 COMMAND AND SURVEILLANCE

This section contains requirements applicable to installation of command and surveillance systems. The systems are functionally grouped as follows:

- Command and Control
- Navigation
- Interior Communication
- Exterior Communication
- Surveillance (Radar Display and IFF)
- Electronic Warfare Support Measures
- Fire Control

1.402 SECURITY REQUIREMENTS

1.402.1 SECURE VOICE AND SECURE TELETYPE SYSTEMS

The secure voice and secure teletype systems shall be installed and protected in accordance with Mil-Std-1680, new construction metallic hull surface ships - Tempest related approved low-level systerns. MOD 5 | HMR 34

1.402.2 PAPER SHREDDER

A paper shredder shall be installed in the deckhouse. The shredder may be installed in that space presently reserved for the NBC protection system. This shredder shall meet the requirements of specification FF-S-1169, wherein the width of shreds shall not exceed 0.8 mm (1/32-inch) with a plus tolerance of 0.4 mm (l/64-inch), and cross-cut length shall not exceed 12.7 mm (1/2-inch). MOD 5

1.404 RADIO FREQUENCY TRANSMISSION LINES

1.404.1 GENERAL

Radio frequency transmission lines shall be installed to meet the requiremnts of Section 1.321.

Prior to installation, transmission lines, couplings, and fittings shall be stored in a cool dry location to reduce oxidation and corrosion. Wveguides shall be stored in a horizontal position and shall be supported to prevent buckling and bowing. The ends of each stored section shall be covered with heavy paper caps or lintless cloth to prevent the entrance of dust. Flange faces and edges of couplings shall be carefully protected to prevent damage.

Maximum storage temperature of coaxial cable is 65 degrees C (149 degrees F).

Unreeled cable shall not be hung from dowel sticks or pegs. Both ends of stored cable shall be wrapped with paper, Mil. Spec. MIL-B-121, grade C, for at least 100 mm (4-inches). Ends shall then be dip-coated with compound, Fed. Spec. VV-S-190, at least 25 mm (1 inch) beyond the paper wrapping. An overwrapping of kraft or glassine paper shall be applied at least 150 mm (6 inches) from the end of the cable. End sealing may be omitted when the interval between cutting a length of the cable and attachment of fittings is 48 hours or less and the exposed ends are not subjected to moisture or rapid temperature changes.

1.404.2 INSTALLATION

Radio frequency transmission lines shall meet the following requirements:

Located to provide maximum protection from mechanical abuse, battle damage, and heat damage.

Located to avoid physical or electrical interference with equipment, cables, or other radio frequency transmission lines.

Kept to a minimum length.

Installed so that they will not be disturbed by removal of deck plates, gratings, or machinery.

Electrically balanced wherever necessary.

Installed to preserve the characteristic impedance of each line.

Care shall be taken to prevent the entrance of moisture and dirt.

Non-solid dielectric lines shall be installed to preclude pockets in which moisture can collect.

Installed so as to retain the airtightness or watertight integrity of decks or bulkheads of compartments. Penetration of ship structure shall comply with requirements of structural sections of these specifications.

Installed to meet the shielding and grounding requirements of Mil. Std. MS-1310.

RF transmission lines which require pressurization shall have a purge fitting at the remote end of the pressurized portion of the line. The fitting shall be connected by tubing to a purging valve located near the transmitter to control the flow of dry air through the fitting.

Coaxial cable. When installing cable, force shall be avoided which changes the dimension of, or otherwise damages the cable.

For cable with a polyethylene dielectric, the maximum operating temperature is 85 degrees C (185 degrees F). This limit is reduced to 65 degrees C (149 degrees F) when flexing predominates over fixed orientation in any application. For cable with a polytetrafluoroethylene dielectric, the maximum operating temperature is 200 degrees C (392 degrees F). Special cooling shall be provided where the ambient temperature plus the center conductor temperature rise, exceeds the maximum temperature rating of the cable. Where practical, cables shall be routed on the inboard side of beams or other supporting structure to provide protection from battle damage.

Cables near hydraulic fluid piping shall have drip-proof shields or other barriers installed to protect cables from leak damage. In addition, cables installed in topside locations shall be installed to meet the shielding and grounding requirements of MIL-STD-1310.

Standard methods shown on publication NAVSHIPS 0967-000-0110 shall be used for:

Entry of coaxial cables to accessories, equipment, and wiring boxes.

Passing coaxial cable through bulkheads.

Protection of cable against heat, condensation, and mechanical damage.

Supporting and securing cable to decks and bulkheads.

Coaxial cables shall be installed so that equipment servicing, equipment deflection of bulkheads and maximum movement of expansion joints will not subject the cable to tension or shear damage. Sag between hangers shall be uniform for each row of cables in racks so that the clearance between rows will be the same throughout the cable run. Sag shall be limited to that allowed for electric cable in similar runs. Wherever cables enter stuffing tubes, the angle of approach shall be such as to allow tightening of gland nuts without the necessity of flexing cables.

Banding straps shall be used to secure coaxial cable to hangers. Banding straps shall not be tightened more than is necessary to hold the cable in place, and not more than 100 lbs. tension. Except where semi-solid core coaxial cable is used, prefabricated contoured straps shall be used. These straps may be fabricated from aluminum. MOD 2

Coaxial cable shall not be secured directly to shell plating, but shall be supported on beams or hangers.

Waveguide. - Publication, NAVSHIPS 0967-000-0110 shall be used for guidance in waveguide installations. Before installation, the interior of waveguide sections shall be cleaned and inspected for defects. After fabrication and before installation, interior and exterior of waveguides shall be coated in accordance with publication, NAVSHIPS 0967-000-0110.

Coupling between sections of a waveguide run shall be cover (flange) to choke, with the choke end of the section facing toward the transmitter end of the run. Cover-to-cover couplings shall not be connected together. Waveguide shall be preformed wherever possible in order to minimize the number of couplings.

MOD 2

In preparing waveguide sections for installation of couplings, the ends shall be square and free of burrs. Couplings shall be fitted over the ends of waveguides before brazing. Where necessary, the inside of flange couplings shall be machined to fit the waveguide. Faying surfaces shall not be machined. Couplings shall be brazed to all waveguides, except aluminum waveguides, with a silver base alloy, Fed. Spec. QQ-B-654, grade IV or VI. Couplings shall be brazed to aluminum waveguide with aluminum silicon alloy, Fed. Spec. QQ-B-655, class FS-BAlSi-4.

Waveguides shall be installed in sequence, beginning with the antenna assembly and ending at the equipment. Runs shall be electrically and mechanically continuous with smooth inner surfaces throughout their length. Waveguides shall *not* be welded to decks, bulkheads, or ship structure. Brackets or hangers used to support waveguides and their method of installation shall **be such that** galvanic action cannot occur. The waveguide shall be supported so that it is not deformed or the finish damaged. Bends in waveguides shall be kept to a minimum consistent with installation requirements. Bends and twists shall be formed from straight sections of waveguide in accordance with MIL-HDBK-660. Elbow (mitered corner) assemblies shall be prohibited. Two edgewise (H) **or** two wide side (E) bends shall not be connected directly together. Bends **shall be such** that the mean electrical length is an exact multiple of halfwave-lengths at the mid-frequency of the equipment with which it will be used. Length for 90 degree twists in waveguide shall be not less than 10 wavelengths at the lowest frequency of application.

In making bends or twists, or installing waveguide, the inner dimensions specified in Mil. Spec. MIL-W-85/1 shall be maintained.

1.404.3 QUALITY ASSURANCE

Before installation, coaxial cable shall be inspected and the insulation tested by measurement with a 500-volt megohmeter to determine that the cable is not damaged or has not deteriorated. Insulation resistance values of cables with polyethylene or polytetrafluoroethylene dielectric shall equal or exceed the following:

Length (meters)	Length (feet>	Insulation resistance (megohms)
30 (or less)	100 (or less)	40,000
60	200	20,000
150	500	8,000
300	1,000	4,000

Insulation resistance values of coaxial cables with synthetic rubber dielectric shall equal or exceed 1,000 megohms for lengths up to 300 meters (1,000 feet) at a temperature of 16 degrees C (60.8 degrees F). If the temperature at which the insulation resistance is measured differs from 16 degrees C (60.8 degrees F), the resistance value shall be adjusted to a temperature of 16 degrees C (60.8 degrees F), by multiplying the measured value by the temperature coefficient specified by the cable manufacturer for the type of cable being tested. In cables with a dielectric material arranged in layers of conducting and nonconducting rubber the insulation resistance shall exceed 500 megohms for lengths up to 300 meters (1,000 feet).

The insulation resistance of coaxial cables having magnesium oxide dielectric shall equal or exceed 10,000 megohms for lengths up to 300 meters (1,000 feet).

Coaxial cables which have not been installed within 18 months of the date of manufacture shall also be tested for attenuation and dielectric strength as specified in Mil. Spec. MIL-C-17. Those which do not meet the minimum requirements listed therein shall not be installed.

1.405 GENERAL REQUIREMENTS FOR ANTENNA SYSTEM ARRANGEMENT DRAWINGS AND INSTALLATION

Antenna arrangement shall be as shown in NAVSEA Drawing 802-5000469. Antenna installation shall be in accordance with NAVSHIPS Drawing 0967-177-3020 as modified herein.

Switches shall be installed near rotatable antennas to permit disabling the antenna prior to personnel entering the antenna swing circle.

1.406 GROUNDING AND BONDING

Equipment within the secure electrical processing system shall be grounded and bonded in accordance with MIL-STD-1680. Other equipment shall be grounded and bonded for EMI reduction and safety to personnel in accordance with MIL-STD-1310.

MOD 6

1.407 GENERAL REQUIREMENTS FOR CONTROL OF UNWANTED ELECTROMAGNETIC RADIATION

Own ship's electromagnetic radiation at the noted locations shall not exceed the following:

Location	Frequency	Maximum Level	
All personnel stations	>100 MHZ	10 milliwatts/cm^2	
Missile Launcher forward of forward support legs	<100 MHZ	100 volts/meter rms	MOD 1
Primary Gun Mount and Ammunition	<100 MHZ	200 volts/meter rms	
Chaff Launcher, Rocket and Projectile (in storage containers)	<100 MHZ	300 volts/meter rms	

HF transmitters operationally inhibited during launch.

In other areas accessible to ship's personnel where electromagnetic radiation exceeds the above levels, warning signs shall be posted in accordance with publication NAVSHIPS 0900-005-8000 and 0967-317-7010.

1.410 COMMAND AND DECISION

The Command and Decision system shall include equipment for distribution and display of radar information, data display, plotting and associated signal conditioning equipment.

A Tactical and Navigation Collison Avoidance (TANCAV) system shall be installed. A Ill-inch TANCAV monitor shall be located in the Pilothouse. The navigation radar PPI, TANCAV cameras, video equipment, lights and monitors shall be installed in the CIC. HMR 8

Command and control space and station equipment and furniture arrangements, and associated operational system, shall be installed in accordance with the table below:

Title	Drawing No.
General Arrangement, Pilothouse and External Conning Station	NAVSEA 802-5000499
General Arrangement CIC	.NAVSEA 802-5000500
Arrangement Communications Room	NAVSHIPS 445-4597402
Arrangement Electronics Equipment Room	NAVSEA 802-5000468
Topside Antenna System Arrangement	NAVSEA 802-5000469
Radar, IFF and ESM System	NAVSEA 802-5000470
Interface Control - IFF System (AIMS MK-XII)/ PHM ship	NAVSHIPS 803-4596501-101
Interface Control - Harpoon Weapon System/ PHM Ship	NAVSHIPS 803-4596505-101
Interface Control - MK92 MOD 1 Fire Control System/PHM Ship	NAVSHIPS 803-4596516-101
Interface Control Chaff System/PHM Ship	NAVSHIPS 803-4596515-101
Interface Control AN/SRN-17 Radio Navigation System/PHM Ship	NAVSHIPS 803-4596512-101

1.411 TACTICAL DATA DISPLAY MOD 2,3

Space reservations shall be provided for a tactical display console in place of the AN/SPS-25B and Vertical Plot Display currently used, in accordance with NAVSEA Drawing 802-5000500. HMR 7

1.415 TACTICAL DATA LINK

Space reservations shall be provided for a tactical data link in accordance with NAVSEA Drawings 802-5000468, 802-5000469, and 802-5000500. Temporary placement of portable equipment within a reserved space is permissible provided this equipment can be moved to a suitable permanent location when the reserved space is required.

1.421 NON-ELECTRICAL/NON-ELECTRONIC NAVIGATION AIDS

The Government-furnished **non-electrical/non-electronic** navigation aids listed in Schedule A of the contract shall be installed/stowed in accordance with NAVSHIPS Drawings 608-4596770, 613-5330674, 400-4597476, 410-4597140, and 400-4597448. Stowage and electrical interface shall be provided for Government-Furnished Stabilized Image Binoculars in the pilothouse. |HMR 122

The following items shall also be provided and installed/stowed in accordance with the above NAVSHIPS Drawings:

NOMENCLATURE	QTY	LOCATION INSTALLED
Magnetic Compass, C781 BKA Danforth	1	Pilothouse
Hand Lead & Line, 35 meter	1	CIC
Magnetic Compass Deviation Table Holder	1	Pilothouse

|HMR 7

A chart table shall be provided in CIC in the navigation area.

1.422 ELECTRICAL NAVIGATION AIDS

1.422.1 WIND DIRECTION AND SPEED SYSTEM

A wind direction and speed subsystem in accordance with Mil. Spec. MIL-W-22900 shall be provided and installed in accordance with NAVSHIPS Drawing 400-4597502 and NAVSEA Drawings 802-5000499, 802-5000468 and 802-5000500. The subsystem shall be supplied with 115 VAC, 400 Hz single-phase electrical power from the IC switchboard in the CIC.

1.422.2 NAVIGATION LIGHTS, SIGNAL LIGHTS, AND SIGNAL SEARCHLIGHTS MOD 3

1.422.2a Scope

This section covers requirements for control, application, selection, installation, and tests of navigation lights, signal lights and signal searchlights. MOD 3

1.422.2b Definitions

Navigation lights. - Those external lighting fixtures required by law to be displayed by ships to indicate their movement, direction, or condition.

Signal lights. - Those external lighting fixtures installed on Navy ships for the purpose of communicating visual information or signals to other ships or stations.

Signal Searchlights. - Those external lighting fixtures on Navy ships for the purpose of communicating visual information or for use as a searchlight with these capabilities combined into a single fixture. MOD 3

1.422.2c General

Navigation lights, signal lights, and signal searchlights, shall be installed in the number and location required for the type and function of the ship. MOD 3

Provision shall be made to facilitate the relamping *or* servicing of these lights.

The task, not under command, and aircraft warning lights shall be supplied HMR 7 from lighting circuits having an emergency source. The navigation lights shall be HMR 7 fed from control equipments and circuits as indicated on NAVSEA Dwg. 802-5000465. HMR 19 Supply and control panels for navigation and signal lights shall be located in the pilothouse.

1.422.2d Navigation Lights

The lights listed in Table 2 shall be installed in accordance with Regulations for Preventing Collisions at Sea, 33 USC (United States Code), Sections 1051-1094. The law empowers the Secretary of the Navy to issue a certificate of waiver of the Regulations in specific instances when, because of special construction, it is not possible for the ship to comply with the regulations.

Where the ship is constructed so that the lights cannot be located to conform to Regulations, and modification to the structure to insure compliance would seriously detract from the military characteristics of the ship, a complete description of the nonconforming features of the installation, together with recommendations, shall be submitted to NAVSEA not less than six months prior to the anticipated ship completion date. Locations for the lights shall be dimensioned the same as in the Regulations and the locations shall be selected to approach, as nearly as possible, the requirements of the Regulations. Upon receipt of this information, and if compliance is impossible, NAVSEA will initiate a waiver request. MOD 1

A dimmer control panel shall be installed in the pilothouse and connected for dimming of masthead light, port side MOD 1 light, starboard side light, and stern light (white). A separate dimmer control panel shall be installed in the pilothouse for dimming the task lights.

The masthead light shall be fitted with screens attached to the base of the fixtures if the locations of the lights are such as to permit direct or reflected light to fall into the eyes of the lookout. The screen size shall be determined as shown in publication NAVSHIPS 0964-000-2000, lighting on naval ships.

1.422.2e Signal Lights

Lights listed in Tables 3 and 4 shall be installed for purposes of communicating visual intelligence or operational information as required by the specific function and design of the ship.

1.422.2f Drawings

The following drawings shall be provided:

Navigation and signal lights

Elementary wiring diagram

Outboard profile of ship showing exact fully dimensioned locations of all lights including signal searchlights. This drawing may be combined with the antenna and rigging arrangement drawing. Included, also, shall be a note which attests that the installation conforms to the requirements of the Regulations for Preventing Collision at Sea. If there is any nonconformity to the Regulations, a complete description of the nonconforming features of the installation shall be indicated together with the reference to the applicable waiver certificate. MOD 3 & 6

Signal Searchlights MOD 3

Locations (should be shown on same drawing as navigation and signal lights).

Elementary wiring diagrams of signal searchlight installations shall be incorporated in the applicable elementary wiring diagrams of the systems from which they are energize! and controlled. MOD 3

TABLE 1 NAVIGATION LIGHTS

Surface Ships:

Supply, control and telltale panel

Masthead light
Port side light
Starboard Side light
Stern light, white

Supply and control
(no telltale panel)

Aircraft warning lights
Anchor light
Blinker lights
Not-under-command (breakdown) and man-overboard
Task lights
Wake light

Local lighting circuit

MOD 6

TABLE 2 NAVIGATIONAL LIGHTS - INTERNATIONAL RULES OF THE ROAD

Anchor light

Symbol No. 161.3

Rule No. - 11 (a), (b).

Function - Required to be shown from sunset to sunrise by ship at anchor, aground, or secured to a buoy.

Arcs of visibility and colors of signal.

Horizontal - An unbroken (white) light, visible as far as possible, and around the horizon.

Vertical - No special requirements.

Range of visibility (minimum) -For ships less than 150 feet in length - Two miles. For ships 150 feet or more in length - Three miles.

Position of fixture - For ships less than 150 feet in length - In the forepart of the ship, where it can best be seen.

Masthead light

Symbol No. 172.1 (for surface ships)

Rule No. - 12(a) (i, ii, iii).

Function - Required to be shown from sunset to sunrise by ship underway and making way to indicate presence and course to other ships except when ship is not under command.

Arcs of visibility and colors of signal.

Horizontal - An unbroken (white) light, visible from right ahead to either side (total arc 225 degree).

Vertical - Screens shall be fitted at base if glare or reflection interferes with navigation.

Range of visibility (minimum) - Five miles.

Position of fixture - On mainmast in line with and over the keel. Not less than 20 feet above the hull (see note). If the breadth of the ship exceeds 20 feet, then at a height above the hull not less than such breadth. However, the light need not be placed at a greater height above the hull than 40 feet.

Note: "Height above the hull" shall be considered the height above the uppermost continuous deck. In all circumstances this light shall be placed to be clear of and above all other lights and obstructing superstructure.

Not-under command (breakdown) and man overboard lights

Symbol No. 190.1

Rule No. - 4(a).

Function - Required to be shown on ship unable to maneuver. Also used (on U.S. Naval ships only) to furnish blinking "man-overboard" signal to warn other ships keep clear.

Arcs of visibility and color of signal.

Horizontal - Unbroken (red) lights, visible all around the horizon.

Vertical - No special requirements.

Range of visibility (minimum) - Two miles.

Position of fixtures - Same as two sets of red task lights. Vertical space between sets of red lights shall be not less than six feet when white task lights are not provided.

Means shall be provided to permit pulsating these lights from the Pilothouse as a "man-overboard" signal.

Side light - port

Symbol No. 182.1 (for surface ships)

Rule No. - 2(a) (v, vi).

Function - Required to be shown from sunset to sunrise by ship underway and making way to indicate presence and course to other ships.

Arcs of visibility and color of signal.

Horizontal - An unbroken (red) light visible from right ahead to 22-1/2 deg. aft the beam on the port side (total arc 112-1/2 deg.)

Vertical - No special requirements.

Range of visibility (minimum) - Two miles.

Position of fixture - Locate so as not to be in direct line of sight of lookouts on navigating bridge.

Note: Side light shall be fitted with inboard screen projecting at least three feet forward from the light, so as to prevent this light from being seen across the bow.

Side light - starboard

Symbol No. 183.1 (for surface ships)

Rule No. - 2(a) (iv, vi).

Function - Required to be shown from sunset to sunrise by ship underway and making way to indicate presence and course to other ships.

Arcs of visibility and color of signal.

Horizontal - An unbroken (green) light visible from right ahead to 22-1/2 deg. abaft the beam on the starboard side (total arc 112-1/2 deg.)

Vertical - No special requirements.

Range of visibility (minimum) - Two miles.

Position of fixture - Locate so as not to be in direct line of sight of lookouts on navigating bridge.

Notes: Side light shall be fitted with inboard screen projecting at least three feet forward from the light, so as to prevent this light from being seen across the bow.

Stern light (white)

Symbol No. 196.1

Rule No. - 10(a).

Function - Required to be shown from sunset to sunrise by ship underway to indicate presence and course to other ships.

Arcs of visibility and color of signal.

Horizontal - An unbroken (white) light visible 67-1/2 deg. from right aft on each side of the ship (total arc 135 deg.)

Vertical - No special requirements.

Range of visibility '(minimum) - Two miles.

Position of fixture - At the stern, on or near the centerline.

Task lights

Symbol No. 190.1
192.1

Rule No. - 4(c).

Function - Required to be shown on all ships engaged in laying or picking up a submarine cable or navigation mark, or a ship engaged in underwater operations, or a ship engaged in replenishment-at-sea, to warn approaching ships that it is unable to get out of the way due to the nature of its work.

Arcs of visibility and color of signal.

Horizontal - Unbroken (red, white, and red) lights visible all around the horizon.

Vertical - No special requirements.

Range of visibility (minimum) - Two miles.

Position of fixtures - Two sets of lights, three lights to a set, with all the lights in a set in a vertical line, one over the other, so that the upper and lower lights shall be the same distance from and not less than six feet above or below the middle light. The dual array of lights in the mentioned color sequence shall be installed with the corresponding lights in each set at the same level on the mast. A one foot long, eight-inch high straight shield, painted a dull black, Mil. Spec. MIL-E-24306 (formula No. 122-R01.8) (over vinyl or epoxy) or formula 104 shall be installed between each light and the mast. The shields shall be aligned parallel to the ship fore and aft centerline, with the midpoint of each shield located at the athwartship centerline of the mast and corresponding light. The horizontal separation between light arrays shall be kept to a minimum: in order to minimize the distance from the ship that they will appear as two sets of lights. These arrays shall be installed on a mast with a maximum diameter of 12 inches, high enough above the superstructure so that there will be no obstruction to the arcs of visibility of the lower lights (i.e., other masts, radar, or other electronic equipment). The middle lights shall be installed on the mast, above, below or between other equipment that of necessity may be mounted on the mast. The uppermost lights shall either be at the top of the mast or below other equipment of the mast top. Other equipment installed on the mast shall not obstruct the all-round visibility of the lights.

Note: The red lights shall be the same fixtures as those used for not-under-f command (breakdown) and man-overboard lights and the switching shall be arranged accordingly.

TABLE 3 SIGNAL LIGHTS - VISUAL COMMUNICATION

Blinker lights

Symbol No. 191.2

Function - For limited range visual communication.

Arcs of visibility -

Horizontal - An unbroken white light visible all around the horizon (360 deg. using two fixtures).

Vertical - Screens shall be fitted' at base to prevent glare or reflection from interfering with navigation of the ship.

Position of fixtures - On signal yardarms outboard, one port and *one* starboard.

Note - Lights shall be operable from a signal key controlled from inside the pilothouse. A four position switch, drawing NAVSHIPS No. S6202-74207, Unit No. 3, shall be installed in such manner as to provide for energizing the top light, the bottom light, or both lights, and provide an "OFF" position.

Two signal searchlights in accordance with MIL-S-16938, Type I shall be provided and installed on the 01 level.

MOD 3
HMR 7

TABLE 4 SIGNAL LIGHTS - 'STATION OR OPERATIONAL

These lights authorized by Rule 13(a) International Regulations for Preventing Collisions at Sea.

Aircraft warning light

Symbol No. 160.1

Function - To indicate the presence of an obstruction to low flying aircraft when ship is at anchor.

Arcs of visibility

Horizontal - An unbroken red light all around the horizon (360 deg.).

Vertical - No special requirements.

Range of visibility - Three miles

Position of fixture - One light installed at truck of each mast extending more than 25 feet above highest point on superstructure. Where impossible to locate one light for all-around visibility, two lights shall be installed. Where two masts, high enough to require these lights, are located less than 50 feet apart, lights shall be provided on only the highest mast.

Note: **Where** a red all-around light is already installed at the truck of a mast for another purpose, a separate aircraft warning light is not required.

Wake light

Symbol No. 200.2

Function - To illuminate the wake.

Arcs of visibility.

Horizontal - Spot light, white.

Vertical - No special requirements.

Position of fixture - Shall be installed on flagstaff or after part of ship, positioned to illuminate the wake and shall be so mounted that no part of the ship is illuminated.

1.423 ELECTRONIC NAVIGATION AIDS

1.423.1 LOW-LIGHT LEVEL TELEVISION SYSTEM

Space provisions for a low-light level television system shall be provided in accordance with NAVSEA Drawings 802-5000499 and 802-5000500. This television system is to be used for nighttime surveillance of the surface situation. Space shall be provided as follows:

Pilothouse -

Monitor - 300 x 300 x 300 mm
(12 x 12 x 12 in.>

Camera Control Unit - 300 x 300 x 300 mm
(12 x 12 x 12 in.)

Stabilizer Electronics - 150 x 150 x 250 mm
(6 x 6 x 10 in.)

Stabilizer Control - 150 x 150 x 75 mm
(6 x 6 x 3 in.>

The monitor shall be located in a visual relationship favoring the helmsman station but shall also be visible at the C.O. and O.D. positions. The camera control unit shall be located for operation by the helmsman but shall also be accessible for operation from the O.O.D. position. The stabilizer control is to be mounted for operation by the O.O.D. or the helmsman.

Pilothouse Top -

Sensor (Camera) - 200 x 200 x 500 mm
(8 x 8 x 20 in)

Stabilizer Element - 600 x 450 x 250 mm
(24 x 18 x 10 in.)

The sensor and stabilizer element space reservations shall be located so as to cause a minimum obstruction to the external conning station visibility, when equipment is installed.

CIC -

Video Tape Recorder - 450 x 450 x 275 mm
(18 x 18 x 11 in.)

Monitor - 300 x 300 x 300 mm
(12 x 12 x 12 in.)

The monitor space reservations shall be located so as to allow viewing of the monitor from both the navigation position (primary user) and the evaluator (secondary user) when the equipment is installed.

1.423.2 ELECTRONIC NAVIGATION SYSTEM, RADIO

The Government-furnished AN/SRN-17 Radio Navigation System listed in Schedule A of the contract shall be installed. Interfaces between the ship platform and the AN/SRN-17 components shall be in accordance with NAVSHIPS ICD 803-4596512-101.

The OMEGA antenna shall be located in accordance with the antenna arrangement NAVSEA Drawing 802-5000469.

1.424 ELECTRONIC NAVIGATION SYSTEM, ACOUSTICAL

This section contains requirements applicable to installation of an acoustic depth sounder system Raytheon Model DSF-600. HMR 80

The depth sounder system shall be capable of hullborne and foilborne operation. Capability shall be provided to select either foil or hull depth sounder transducers remotely from the Pilothouse overhead console.

The depth sounder system, shall include a depth indicator located in the Pilothouse Console, visible from the helm and OOD stations, a digital depth monitor unit and a recorder unit located in CIC. System Interconnect requirements shall be in accordance with NAVSHIPS Drawing 845-4597508. Transducer installation requirements are shown in NAVSHIPS Drawing 410-4597479.

1.426 NAVIGATION AIDS

1.426.1 DEAD RECKONING SYSTEM

This system shall provide a means of computing ship position by dead reckoning methods and shall provide a graphic trace of own ship movement relative to a fixed starting point; it shall continuously indicate ship position in latitude and longitude coordinates.

The following equipment shall be installed in CIC:

1 - Cheasapeake Instrument Co. dead reckoning tracer plotter (DRT), MK 6 MOD 4C — MOD 3

The appropriate N-S, E-W inputs shall be provided to the DRT and the **AN/SPA-25B's** by the gyro system. — HMR 34

The gyro system output signals shall be provided to the DRT and the AN/SPA-25B indicators in CIC. — MOD 3

MOD 3

1.426.2 UNDERWATER LOG SYSTEM

The EM log system shall provide a means of measuring, indicating, and transmitting ship speed (in knots) and distance (in nautical miles) traveled through the water, hullborne, with foils extended or retracted, and foilborne. The EM log system equipment shall meet the performance characteristics of the components listed in Table I, as manufactured by Chesapeake Instrument Division of Gould Inc. — MOD 1,2,3,4,5,6

TABLE I Component Units of the EM Log System

Equipment Title or Nomenclature	Chesapeake Instrument Div. Part number
Indicator/Transmitter	1023~0001
Speed Converter	1023D0650
Foil Sensor	1093D0120
Hull Sensor	1094D0045
Senser **Selecter** and Calibration Unit	1023D0652
Frequency to Digital Converter	1023D0648
Remote Control and Indicator	1023D0045

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HMR 70

IMR 70

The foil and hull speed sensors shall be installed in accordance with NAVSHIPS mig. 410-4597480. MOD 2

The speed indicator-transmitter, speed sensor calibration unit, and speed converter shall be installed in CIC.

The frequency/digital converter shall be installed in the pilothouse main console.

The dummy log panel shall be installed in EOS.

Capability shall be provided to select either foil or hull speed transducers remotely from the pilothouse overhead console.

Speed signals shall be supplied to the gyro compass, weapons control, dead reckoning system, OMEGA receiver, and pilothouse main console. MOD 3

1.426.3 GYRO COMPASS

The gyrocompass shall be in accordance with Boeing Dwg. 312-81391.

This system shall provide a means of ascertaining own ship heading, roll and pitch and transmitting this information to weapons control, DRT, radar ESM, and OMEGA. The system shall also provide ship heading signals to indicators at the following stations: MOD 3

HMR 34

Pilothouse Peloruses MOD 3

Pilothouse Main Console

The installation shall consist of the following equipment:

1 - LITEF gyro stabilized platform unit, part 103311, modified to output amplified (roll and pitch) signals. MOD 4 HMR 34

1 - Synchro signal amplifier (heading), LITEF part #450 901-4465 MOD 3, 4 HMR 34

1 - Control and display unit, LITEF part 100744 HMR 34 MOD 1

1 - Emergency power/power junction box, LITEF part 104193 MOD 1 HMR 34 + 109R

2 - Ship course indicators, LITEF lightweight for Peloruses use. MOD 3, 4, 5 MOD 3

1 - Ship course indicators, type F, LITEF part #450 901-7556 at helm station MOD 3

2 - Ship course indicators, digital, Master Specialties part #901A1B2RC10D5H. HMR 19 HMR 34 HMR 75

1 - Ship course indicator LITEF lightweight at OOD station MOD 3

The gyro stabilized platform, control and display unit, emergency power/power junction box, and synchro signal amplifier, shall be installed in CIC. One ship course indicator shall be installed at each of the following stations : Pilothouse (port and starboard) . The two ship course indicators and two digital ship course indicator shall be installed in the Pilothouse main cons0 le. MOD 3 HMR 34 MOD 3 MOD 3

A gyro failure alarm shall be provided at the Pilothouse overhead console.

The Contractor shall provide the computer program (fully documented) for operation of the gyro compass system. HMR 34

1. Reliability MOD 4

The Gyro Compass (GSPU and CDU) shall have a MTBF goal of 1400 hours and a MTBF requirement of 700 hours. HMR 109R1

Aquantitativereliabilityanalysis shall be conducted in accordance with MIL-STD-756 utilizing failure rate data obtained per MIL-HDBK-217. Other data sources may be used, as required, subject to customer approval. The analysis will show that the production design yields a predicted MTBF which is at least 1400 hours.

Compliance with the specified reliability requirement of 700 hours MTBF shall be demonstrated using Test Plan VIII of MIL-STD-781B with one unit of a production configuration in an ambient laboratory environment. The test set-up shall subject the unit to on-off cycling every 24 hours with an "off" time of at least one hour.

2. Maintainability

The supplier shall implement a maintainability program. The program shall include at least the following elements of the detailed requirements of MIL-STD-470:

(a) Maintainability analysis for the recommended on-board maintenance actions .

(b) Inputs to the detailed maintenance plan.

(c) Maintainability prediction using MIL-HDBK-472 Procedure II Part A for the onboard maintenance tasks. A maintainability prediction report shall be prepared.

(d) Implementation of a data collection, analysis and corrective action system.

The Mean-Time-To-Repair goal (MTTR) shall be 1.1 hour and the MTTR requirement shall be 2.2 hours.

Repair time does not include time to obtain replacement items, but shall include:

(a) Fault isolation time.

(b) Remove and replace time.

(c) Warm-up time and

(d) Repair validation time.

Repair time shall be based upon all the maintenance tasks being performed by two personnel with an IC2 rating. MOD 5

The onboard corrective maintenance tasks identified by the maintenance engineering analysis (MEA) shall be demonstrated using MIL-STD-471 test method 1B. Demonstration may be accomplished in conjunction with technical manual validation.

1.428 NAVIGATION INTEGRATION SYSTEM HMR 8

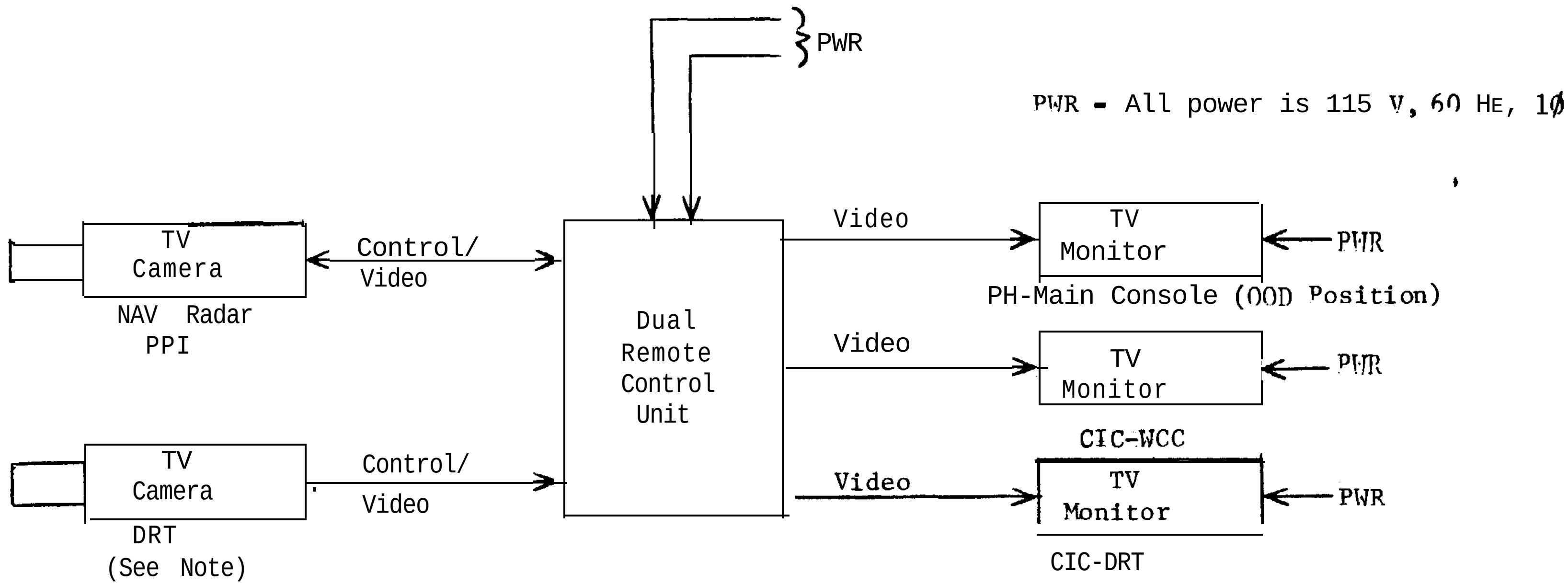
A Tactical and Navigation Collision Avoidance System (TANCAV) shall he installed comprised of two television cameras, lenses, signal mixing and distribution equipment and three television monitors. One television monitor shall be installed in the Pilothouse and two monitors in the CIC. The TANCAV system components shall be interconnected as shown in Figure 1. Components of the TANCAV system are listed in Table I.

TABLE I. Component Units of the TAN-CAV System

Location	Equipment	Manufacturer/Type	
CIC (Nav Radar PPI)	Camera	EDO Western Model 1400 Series (Modified)	HMR 126
	Vidicon	GEC TD-1306-002	HMR 148
	Lens	Vicon V25-1.4	HMR 126
CIC (DRT)	Camera	EDO Western Model 1400 Series (Modified)	HMR 126
	Lens	Cannon Manual TV Zoom Lens P/N 2-56202-00 with a plus one (+1) Diopter Lens and Adapter	HMR 19 & 126
CIC (DRT)	Spotlight	P/N 7644 Dramalux Framing Projector and Tempered Blue Filter	
CIC	Camera Control Unit	EDO 1272 Series (Modified)	HMR 126
CIC-WCC	TV Monitor w/Blue Filter	CONRAC SNA 9/C	
CIC-DRT	TV Monitor w/Blue Filter	CONRAC SNA 14/C	
Pilothouse SCC (OOD Position)	TV Monitor w/ Filter	CONRAC SNA 14/C	HMR 19

1.428

492b



Note : Spotlight with blue filter is provided at DRT and requires 115 V, 60 Hz, 1Ø.

Figure 1
TAN-CAV System Interconnect Diagram

1.428

1.429 NAVIGATION RADAR SYSTEM

A navigation radar subsystem, an **AN/SPS-63 (SMA-3TM20-H)**, modified, with performance as listed below, shall be provided and installed in accordance with NAVSEA Dwg. 802-5000500 and NAVSHIPS Dwgs. 401-4597465, and 410-4597140. Signal interfaces shall be in accordance with NAVSEA Dwg. 802-5000470. Simultaneous operation with the fire control radar is not required. The antenna arrangement shall be in accordance with NAVSEA Dwg. 802-5000469. MOD 1 HMR 34

The performance requirements for the radar system shall be as follows:

Frequency	X band
Peak Power	≥ 15 kw (17 kw nominal)
Noise Figure	<12 db
Min. Detection Range	≤ 18.3 meters ($1m^2$ target)
Horizontal Beam Width	<1.5 degrees at 3dB points
Blanking Provision Output	
Type Display	g-inches true motion with off centering and relative motion
Sweep Length	0.25 nautical mile minimum 40.0 nautical mile maximum
Range Resolution	$\leq$9.2m at 0.25 nautical mile sweep $\leq$366m at 40.0 nautical mile sweep
Antenna Rotation	25 rpm $\pm 10\%$ at 75 knots relative wind
Displays	Navigation radar data shall be capable of display on any CIC display and, conversely, surveillance radar data (60 rpm) shall be capable of display on the NAV radar display. Control of the NAV radar shall be from the CIC.

MOD 1 HMR 7 (Frequency, Peak Power); MOD 1 (Type Display); MOD 1 (Range Resolution); MOD 6 (Antenna Rotation); HMR 8, HMR 8 (Displays)

1.429.1 NAVIGATION RADAR (PPI) INDICATOR RELIABILITY/MAINTAINABILITY REQUIREMENTS

The NAV RADAR shall be in accordance with Boeing Dwg: 312-81387. HMR 45

1. Reliability

The Navigation Radar Indicator (PPI) shall have a MTBF goal of 1500 hours and a MTBF requirement of 750 hours.

A quantitative reliability analysis shall be conducted using the techniques specified in MIL-STD-756 and the derating methods and part failure rates of MIL-HDBK-217 or other approved data sources. The analysis shall indicate the design meets or exceeds the specified reliability requirement.

Compliance with the specified reliability requirement of 750 operating hours MTBF shall be demonstrated using Test Plan VIII of MIL-STD-781B with a minimum of two test units in an ambient laboratory environment.

2. Maintainability

The article shall have a MTTR goal of 1 hour and an MTTR requirement of 2 hours.

The supplier shall implement a maintainability program. The program shall include at least the following elements of the detailed requirements of MIL-STD-470:

(a) Maintainability analysis for the recommended on-board maintenance actions.

(b) Inputs to the detailed maintenance plan.

(c) Maintainability prediction using MIL-HDBK-472 Procedure II Part A for the on-board maintenance tasks. A maintainability prediction report shall be prepared.

(d) Implementation of a data collection, analysis and corrective action system,

1. Scheduled Maintenance. The article shall require no preventive maintenance task, other than visual inspection and/or normal operating adjustments more often than once each 6 days or 72 hours of operation at which time 4 hours of preventive maintenance will be permitted.

2. Accessibility. The design shall, within space and change limitations, provide

accessibility to parts which require routine examination, maintenance or replacement in service without the need for disconnecting or removing another part or assembly other than an access panel or cover. Each access panel or cover shall be openable and closeable, or reusable and replaceable, as applicable. The time required to open and close (secure) an access panel shall not exceed 3 minutes. The envelope of the minimum required space around the PPI shall be shown on the outline installation drawing.

3. Interchangeability. All parts, including repair parts, of corresponding equipment furnished under the same contract or order or manufactured to the same drawings shall be interchangeable without the necessity of further machining, selective assembly or hand fitting of any kind. Interchangeability of units and parts with those supplied previously under this specification is extremely desirable with particular reference to repair parts. Units and parts serving the same or similar function in different places of application shall be interchangeable where feasible.

4. Maintainability Demonstration. Selected on-board corrective maintenance tasks identified by the Maintenance Engineering Analysis (MEA) shall be demonstrated. Repair time to be demonstrated will be limited to removal, replacement and realignment/-adjustment/checkout IAW the

technical manual and in accordance with MIL-STD-471 Test Method 1B. The mean time to accomplish these repair actions shall not exceed 2 hours. The demonstration may be conducted in conjunction with technical manual validation.

1.430 INTERIOR COMMUNICATION (IC) SWITCHBOARD

An IC switchboard, part No. 701670-101, manufactured by Nelson Electric Co. shall be installed in CIC for energizing and controlling interior communications system. The switchboard shall contain power selection devices, buses, distribution switches, circuit protective devices, and action cutout and transfer switches. In addition, the IC switchboard shall contain the following equipment. (HMR 55

1 - Vernitron Corp. synchro signal converter, part #VSSC 231-46B2
1 - Vernitron Corp. synchro signal converter, part #VSSC 123-44J10 HMR 7
1 - Chesapeake Instrument Corp. speed converter part #1023D0650.
1 - Vernitron Corp. synchro signal converter, part #VSSC 123-46H8. HMR 7

A detailed schematic showing all electrical circuits, connectors, signal characteristics, wire locations and designations, and test points shall be provided.

Drawings shall be prepared which include an IC switchboard load summary showing the maximum connected load for each system and a summary of loads for the switchboard under typical ship operating conditions. Format shall be in general accordance with NAVSHIPS Dwg. 815-153336.

In addition, a diagrammatic (physical) wiring drawing of the IC switchboard (including inputs and outputs) shall be prepared and reduced to a size that is legible and suitable for mounting on inside of switchboard front panel or adjacent to switchboard. These drawings shall be type F or H in accordance with Mil. Spec. MIL-P-15024.

1.432 TELEPHONE SYSTEMS

1.432.1 SOUND-POWERED TELEPHONE SYSTEM

A separate sound-powered telephone system shall be provided as an alternative means of communication in the event of casualty to the normal interior voice communication system.

A switchbox shall be installed in the EOS and shall provide switching capability for seventeen separate soundpowered telephone lines. Jack box locations and stations inter-connect shall be in accordance with Table 1.432-l.

Equipment for the system shall comply with the following specifications and drawings:

Equipment	Drawing NAVSHIPS No., Spec. No., or FSN
Sound-powered telephone headsets	MIL-T-15514
Stowage boxes for sound-powered telephone headsets	815-1853040
Hooks for sound-powered telephone headsets	815-1853041
Switchbox, for sound-powered telephone, Type A-19A (20 switch)	S6501-74094
Jackbox assembly, for sound-powered telephone, Type G-15A (single) and Type G-15B (double)	S6501-74210
Extension Cord, Type A-567-l	5965-940-8699

1.432.2 SHORELINE TELEPHONE SYSTEM

System - provision for five (5) shoreline dial telephone instruments shall be installed as follows:

HMR 92 HMR 92 HMR 92 HMR 92 HMR 92 HMR 92 HMR 92

LEGEND:

J = JACKBOX

(1) In parallel with MK92 WCC stations via MK92 cabling /HMR 92

(2) Integral to MK92 WCC /HMR 92

SW POSITION	02 LVL: EXT CONN	02 LVL: CAS (INTERNAL)	01 LEVEL: CAS (PYLON)	01 LEVEL: MAST	01 LEVEL: PILOT HOUSE	01 LEVEL: EVALUATOR	MAIN DECK, CIC: VERT PLTR	CIC: WC CSL	CIC: TAO	CIC: ESM OPER	CIC: ATO/STO (WCC) (2)	CIC: NAV/SSO	MAIN DECK: FORECASTLE	COMM ROOM	EER	QTR DECK (P/S)	AMR NO. 1	FANTAIL	STRUT WELL	EER (RADAR CABINET)	SECONDARY DECK: MAGAZINE	RRS	RSS	AMR NO. 2 (P/S)	DAP MCHRY (P/S)	AMR NO. 3 (P/S)	EOS STATION
1	J				J																						
2			J																								
3													J						J								
4						J			J																		
5										J																	
6		(1)									J									(1)							
7							J																				
8												J															
9														J													
10				J											J												
11																J											
12																	J										
13																		J									
14																					J						
15																						J	J				
16																											J
17																								J	J	J	

/HMR 92 (row 4)

/HMR 92 (row 6)

TABLE 1.432.1 SOUND-POWERED TELEPHONE MATRIX

Location	Type Instrument	
Mess Deck	MIL-T-1943C, Type G Bulkhead-Mounted Non-watertight	HMR 55
Mess Deck	MIL-T-1943C, Type G Bulkhead-Mounted Non-watertight	HMR 92
CO SR	MIL-T-1943C, Type G Bulkhead-Mounted Non-watertight	
Quarter-deck	MIL-T-1943C, Type G Bulkhead-Mounted watertight (Portable, useable at either Port or Stbd Quarterdeck)	

The Contractor shall provide four telephone instruments with plug connectors to enable easy disconnection for stowage at MLSG when not required aboard ship. The permanent installation aboard ship shall consist of jackbox assemblies in each of the above spaces connected to a shore connection junction box. MOD 3 HMR 92

The installation shall provide for 4 separate telephone pairs to shore. The Port and Starboard Quarterdeck stations shall utilize a single pair. The shore connection J-box shall be provided on the deckhouse bulkhead weatherdeck (aft). HMR 92 MOD 3 HMR 93

1.433 ANNOUNCING SYSTEM

1.433.1 GENERAL

The ship's interior communication system shall employ Philips Communications Systems 'MCS 2000 assemblies for both electrically powered circuits and nets. The inter-coxmuunication (intercom) system shall be integrated with, and share cassette assemblies and cassette carriers with the general announcing and alarm systems and the voice radio remote control and audio distribution system.

1.433.2 INTERCOMMUNICATION ANNOUNCING SYSTEM

The intercom system shall provide two-way communication between two stations selected by the calling station.

Intercom selection and conference capability shall be provided as depicted in the Intercom Matrix, Table 1.433-1.

Cassette carriers for intercom stations located in weatherdeck locations shall be mounted in protective housing, Philips Communication System type LBD 3359/10, except for the VERTREP station HMR 50 cassette carrier protective housing, which shall be type LBD 3359/20 which includes Cassette Carrier LBD 3358/10, automatic Cassette LBD 3315/10, Power HMR 75 Supply Cassette LBD 3310/10, Battery Cassette LBD 3311/10 and Empty Cassettes LBD 3316/10.

The intercom station used at either HMR 32 | HMR 182 the port or starboard quarter-deck shall be portable. The quarter-deck and magazine handling room stations shall include LBD 3425/00 Loudspeakers and LBD 3347/10 Amplifiers.

Philips Communication System LBD 3322/20 Receptacle with Amplifiers shall be installed in the following spaces, in the quantities indicated.

TABLE 1.433-1: INTERCOM & TELEPHONE MATRIX

LOCATION	DIRECT LINES: CAPT. PILOTHOUSE 4C77	O.O.D. 4C78	HELM 4C79	TACT. EVAL. 2 POSITIONS	TACT. ACTION OFF. 2 POSITIONS	E.S.M. 4C82	AIR TARGET OPER. 4C83	SURF. TARGET OPER. 4C84	TACT. PLOT. (*) 4C85	SURF. SEARCH OPER. 4C86	COMMINICATIONS ROOM 4C87	C.O.S.R. 4C88	QTR. DECK (PORT & STBD) 4C89 HMR 182	HMR 182	HDLG. ROOM 4C91	MESS DECK 4C92	HMR 92	CPO QTRS. 4C95	EOS 4C96 2 POSITIONS HMR 75 & 182	DAMAGE CONTROL 4C97	ENGINE ROOM 4C98	SEC. CONN. (***)/MOD 3	NAVIGATOR 4C94	VERTREP HMR 50	GEN. ANNOUNCING	CONFERENCE: CONFERENCE LINE 1 (SHIP CONTROL)	CONFERENCE LINE 2 (WEAPONS CONTROL)	CONFERENCE LINE 3 (TRACKING)	CONFERENCE LINE 4 (VERTREP) HMR 50 & 50R1	RADIO LINES (+) HMR 50R1	RECORDER ADDRESSING (**)	
CAPT. PILOTHOUSE 4C77				X	X						X								X				X		X	X	X			2		
O.O.D. 4C78				X	X						X	X	X						X	X		X	X	X	X	X	X		X	4	X	
HELM 4C79																X		X	X							X				2		
TACT. EVAL. 4C80	X	X				X	X	X		X	X				X								X		X	X	X	X		4		
TACT. ACTION OFF. 4C81	X	X				X	X	X		X	X				X								X		X	X	X	X		4		HMR 182
E.S.M. 4C82				X	X						X																X	X		4		
AIR TARGET OPER. 4C83				X	X						X				X												X	X	X			HMR 92
SURFACE TARGET OPER. 4C84				X	X										X												X	X				
TACT. PLOT (*) 4C85											X																X	X				
SURF. SEARCH OPER. 4C86				X	X																						X	X		2		HMR 182
COMMUNICATIONS ROOM 4C87	X	X		X	X	X	X		X														X					X		4		
C.O.S.R. 4C88		X											X																			HMR 182
QTR. DECK (PORT & STBD) 4C89		X										X				X		X	X						X							
HDLG ROOM 4C91				X	X		X	X												X												HMR 92, 182
MESS DECK 4C92			X										X						X	X												HMR 75 HMR 92
CPO QTRS. 4C95			X										X							X												HMR 38
EOS 4C96	X	X	X										X			X				X	X		X		X	X					X	
DAMAGE CONTROL 4C97		X													X	X		X	X										X			HMR 182
AUX. MACHINERY RM.2 4C98																			X													
NAVIGATOR 2 POSITIONS/MOD 1	X	X		X	X						X								X							X		X				HMR 50&50R1
VERTREP		X																											X	2		

2 Position (POS) = 1 Station + 1 Substation 7

* JACKS
** THIRD TRACK PERMANENTLY CONNECTED TO CONF. LINE NO. 1
*** 1 SUB STATION TO OOD CALLED STATION CONTROLLED BY OOD/MOD 3

2 = UHF
+4 = HF & UHF

	QTY	
Diesel and pump machinery room	2	
Auxiliary machinery rm. No. 3	2	
Auxiliary machinery rm. No. 2	1	HMR 182 HMR 19
Auxiliary machinery rm. No. 1	1	

Intercom access to 2 UHF and 2 HF channels shall be provided from the intercom stations as indicated in the Intercom and Telephone Matrix, Table 1.433-l. Provisions shall be made to prevent inadvertant radio transmissions when using interior and exterior communications alternately from the same stations. MOD 2 HMR 55

Radio intercom stations shall be clearly and prominently marked "Caution - Not Secure" on the face of the intercom assembly.

Provisions shall be made to interface the EOS caution and warning horn with the EOS IC station such that caution and warning signals can be monitored from the mess deck or from a manned quarter-deck station via intercom direct line. HMR 38

A portable (belt-mounted) control unit, Phillips Communication System Type LBD 3408/10 with headset/microphone, Phillips Communication System Type LBD 3414/10 shall provide intercom and UHF radio connections as indicated in Table 1.433-1. The headset shall be provided with the capability to receive UHF radio audio in the left ear piece simultaneous with the receipt of intercom audio in the right ear. Selection of either the radio circuits or theintercomcircuits for the microphone and keying of the microphone shall be accomplished at the belt mounted control unit. Internal or external keying shall be accomplished at the headset. The headset shall provide 30 db sound attenuation of external noise. Connection for the portable unit shall be at a watertight housing on the forward face of the deckhouse. Stowage for the control unit, extension cable, Phillips Communication System Type LBD 3414/10 headset/microphone shall be provided in CIC HMR 50 HMR 75

1.433.3 GENERAL ANNOUNCING SYSTEM

This system shall provide a means of transmitting general orders and information, and alarm signals, to all areas within the ship and to all topside areas where personnel are stationed or may normally be located.

Announcing control shall be possible from the following locations:

Pilothouse, Captain
Pilothouse, OOD
CIC, Tactical Evaluator
CIC, Tactical Action Officer
Quarterdeck (Port & Stbd) electrical connections only, portable panel stowed at MLSG* HMR 182
EOS

The announcing system shall consist of 12 loudspeakers, DYNALEX Corp. Model 6170-007A and 21 loudspeakers, Pacific Electrodynamics, Inc. Model 412-2, located and wired by zones as shown on NAVSHIPS Dwg. 401-5330400, Table I, Table II, and Table III. HMR 7 HMR 140

One alarm control panel for activating the Chemical alarm, the Collision alarm, the General alarm, and the Navigation horn shall be provided in accordance with NAVSHIPS Dwg. 410-4597154 and shall be installed in the Pilothouse overhead console.

Alarm control panels for Collision, Chemical, and General alarms shall be provided in accordance with NAVSHIPS Dwg. 401-4597535 and shall be installed in the following locations:

*Only one IC Station for use at either quarterdeck shall be provided on the portable panel. HMR 182

Pilothouse
CIC
Quarterdeck (Port & Stbd) electrical connections only, portable panel stowed at MLSG* MOD 3 HMR 182 HMR 30 HMR 182

Alarm and announcing controls shall be prioritized such that higher priority alarms shall override all lower priority alarms or announcing. Priorities, starting with the highest, shall be in the following order: HMR 30

1. Collision Alarm
2. Chemical Alarm
3. General Quarters Alarm
4. General Announcing.

The ship announcing amplifier/alarm generator assembly shall be fabricated in accordance with NAVSHIPS Dwg 401-4597464 and shall be installed in CIC, in accordance with NAVSEA 802-5000500. HMR 7

The assembly shall consist of the following components: MOD 3

3 P.A. amplifiers Type 255-6
1 Power sypply cassette LBD 3310/10
1 Battery cassette LBD 3311/10
3 Signal generator cassette LBD 3305/20 HMR 32

and the following:

3 Leveling amplifier assemblies NAVSHIPS Dwg. 401-4597579 MOD 2 & 3 HMR 57
1 Control panel with ACO switches and speaker group control switches.

*Only one Alarm Controller for use at either quarterdeck shall be provided on Portable Panel. HMR 30 HMR 182 HMR 92

1.433.4 PORTABLE ANNOUNCING SYSTEM

For megaphone requirements see Sect. 1.443.

1.439 RECORDING SYSTEMS

A keyactuated tape recording and MOD 2 & 6 playback system with automatic time code shall be provided to annotate ship operations. The basic recorder shall consist of (1) Type RD-219C/U designed MOD 3 to the Mil. Spec. MIL-R22754 (SHIPS). The unit shall be installed as part of the intercommunication and announcing systems. Channel No. 1 is to be con- MOD 4 nected to the intercom system conference line No. 1. Channel No. 2 is to be connected to the OOD intercom station. Channel No. 3 is to be connected to the EOS intercom station. Channel No. 4 is to be permanently connected to the internal time code generator. The recorder/playback unit shall be installed in CIC. The basic RD-219C/U shall be modified as follows:

1.439.1 RECORDER

1. The multi-speed capability shall be deleted and replaced with a single speed of 15/16-inch per second. The code playback circuitry shall be deleted.
2. The tape speed accuracy shall be ± 2 percent.
3. The flutter and wow shall not exceed 1.25 percent r.m.s. at the HMR 186 tape speed of 15/16-inch per second.
4. The total harmonic distortion shall not exceed 5 percent r.m.s. when tested as specified in 4.3.6 of MIL-R-22754 (SHIPS).

1.439.2 KEYACTUATED CIRCUIT MOD 3

1. A keyactuated circuit shall be added to the equipment. This circuit shall be connected to three of the voice recording channels.

1.439.3 TIME CODE GENERATOR

1. A time code generator shall be added to the basic RD-219C/U increasing its vertical dimension only.
2. The clock accuracy shall be 0.005 percent (50 PPM) or approximately 4.32 seconds in 24 hours over a temperature range of 180°C (64.4°F) to 27°C (80.6°F). HMR 186
3. The code record format shall be modified IRIGB and shall be recorded on one channel of the recorder.
4. A display of hours (24), minutes, and seconds shall be provided on the front panel of the recorder. This display shall be in operation when in the recording mode and shall show the actual time being recorded. When in the playback mode, the time code readout shall be shown on the same display. During all other modes, the display shall show the real time. MOD 3
5. A thumbwheel control shall be provided for use in presetting the time in the time code generator. This control shall be accessible from the front panel. Once the time has been preset, the time shall be retained in the time code generator as long as power is applied regardless of whether the recorder is in record or playback mode.

1.439.4 ADDITIONAL REQUIREMENTS

1. The microphone input jack and the output jack shall be retained as part of this equipment. A low impedance dynamic microphone and monitoring headset shall be supplied. MOD 3
2. The weight of the equipment shall not exceed 24.5 Kg (54 pounds). HMR 186

3. The modification to this recorder shall be designed to meet the requirements of MIL-R-22754 (SHIPS) except that: MOD 6

a) Original design deviations of RD 219 may be used. HMR 186

b) Substitute parts may be used when parts used in RD 219 are no longer available.

c) Where no longer applicable due to changes noted in this modification description.

The recorder/playback unit shall have a 6 hour tape capacity. MOD 4

The tape record/playback system shall operate from 115V, 60 Hz, 1 phase power. The record/playback unit shall be installed in CIC.

1.440 EXTERIOR COMMUNICATIONS (GENERAL)

The exterior communication system shall include facilities for two-way radio communication, communication security equipment, teletype and teletype terminal equipment; and visual, optical, and audible signaling devices.

1.441 RADIO SYSTEMS

The radio equipment shall include two HF band (2-29.9999 MHz) transceivers, one VHF band (156-162 MHz) tranceiver, and two UHF band (225-399.95 MHz) tranceivers with associated control and coupling devices.

The following Collins Radio equipment shall be provided and installed to meet this requirement:

HF/UHF Radio Set, Part No. 622-1648001
HF/UHF Radio Set, Part No. 622-1649001

The VHF band radio equipment shall be located in the Pilothouse.

The UHF band radio equipment shall be capable of being switched from normal bandwidth to wide bandwidth to accommodate wide band secure voice signals. The UHF system shall also have the capabilities of teletype or data format transmissions. One of the UHF band radio equipments shall be controlled from a remote panel providing a selection of either conventional line-of-sight communications or satellite (single voice Channel) communications.

An exterior communication switchboard shall provide access to the HF band and UHF band radio equipment inputs and outputs from the following: selected intercom stations (see Section 1.4331, secure voice sub-systems, teletype terminals, the CW sub-system and to-be-installed data terminals.

Monitor speaker amplifiers, speaker assemblies and amplifier assemblies (Types AM 505-9, AM 505-9A, and AM 505-9B) with inputs connected to the exterior communication console as shown in NAVSHIPS Dwg. 845-4597508, shall be installed in HMR 19
the following spaces: two speaker amplifier units in the communication room, three speaker amplifier units in CIC, and two speakers in the pilothouse, with the two associated amplifiers in CIC.

A detailed schematic showing all electrical circuits, connectors, signal characteristics, wire locations and designations, and test points shall be provided.

The secure voice sub-system shall include the voice cryptographic equipments and ancillary units (see Section 1.446), and a remote switching control for connecting and disconnecting remote secure voice terminals. Each remote secure voice terminal in CIC and the Pilothouse shall consist of a TA-840/U Telephone Set and an audio amplifier-speaker. The secure voice terminal in the Communication Room shall consist of a TA-840/U telephone set.

The CW sub-system shall provide a hand key and phone jack for standard headphones.

1.443 VISUAL, OPTICAL, AND AUDIO SIGNALING EQUIPMENT

The Government-furnished signal flags listed in Schedule A of the contract shall be stowed in a light weight flag locker located forward of the base of the main mast, in the same location as the flag locker on PHM-1. Stowage is to be provided with a fabric weather cover in accordance with Section 1.614. MOD 3 MOD 7

Megaphone shall be stowed in accordance with NAVSHIPS Dwg. 400-4597461. The Contractor-furnished signaling equipment listed below shall be installed in accordance with the noted NAVSHIPS installation drawings.

Signaling Equipment	NAVSHIPS Installation Dwg.	
Ship Bell (1)	400-4597542	
Ships Whistle (1)	400-4597477 (Note 1)	HMR 31
Signal Searchlights (2)	400-4597523	
Yardarm Blinker Lights (2)	404-4597504 410-4597454	

Note (1): Ships whistle shall be capable of being controlled manually or by automatic means. A switch shall be provided to change the modes of operation; changing modes shall not cause the whistle to sound. HMR 31

1.445 TELETYPE SYSTEM

The Government-furnished teletype equipment listed in Schedule A of the contract shall be installed in accordance with NAVSHIPS Dwg. 409-4597425 and 409-4597512. An exterior communication switchboard, capable of supplying access to the HF and UHF equipment inputs and outputs, shall be provided and installed in accordance with NAVSHIPS Dwg. 409-4597426.

1.446 SECURITY EQUIPMENT

The Government-furnished security equipment listed in Schedule A of the contract shall be installed in accordance with NAVSHIPS Dwgs. 409-4597512 and 409-4597428. HMR 7

Provisions shall be available so that the equipment can be installed without alteration to the specified equipment or to the ship:

(a) UHF Secure Voice Equipment
(b) TTY Secure Simplex Security Equipment
(c) UHF Secure Voice Security Equipment
(d) TSEC/KY-75 (Space Provisions Only).

1.450 RADAR DISPLAY AND DISTRIBUTION SYSTEM

A Radar Display and Distribution System consisting of two standard Navy radar indicators, Navigation Radar Indicator (See Section 1.429), Gun Fire Control System", Weapon Control Console*, radar switching units, and ancillary amplifiers shall be installed in accordance with NAVSEA Dwg. 802-5000470. |HMR 99 MOD 3

A detailed schematic showing all electrical circuits, connectors, signal characteristics, wire locations and designations, and test points shall be provided.

*Not Applicable to PBM-6 |HMR 99

1.454 IFF SYSTEM

An IFF system consisting of the following Government-furnished equipment: one interrogator system, one transponder system, three decoders and ancillary amplifiers and switching units, shall be installed in accordance with NAVSEA Dwg. 802-5000470. The omni-IFF antennas shall be located topside in accordance with NAVSEA Dwg. 802-5000469 and NAVSHIPS Dwg. 803-4596501-101. Interface connections to other ship systems shall be installed as shown on NAVSHIPS Dwg. 803-4596501-101 and 803-4596516-101.

1.472 ELECTRONIC SUPPORT MEASURES SYSTEM

Space and weight reservations shall be provided for an ESM system conforming to the following constraints:

(a) Weight

Total System Weight Reservation 304 Kgs (670 lbs.). MOD 6

Mast System Weight Reservation 41 Kgs (90 lbs.) located at top of mast.

EER System Weight Reservation 35 Kgs (77 lbs.) located at oscillator in Dwg. 802-5000468

CIC System Weight Reservation 145 Kgs (320 lbs.) located at the ESM console in Dwg. 802-5000500

CABLES Weight Reservation 83 Kgs (183 lbs.) centered at the EER 6 ft above 01 Level.

(b) Volume

Mast - Antenna System shall not exceed .538 M^3 (19 $ft.^3$), and shall be consistent with mast weight and stability requirements.

EER - shall not exceed .142 M^3 (5 $ft.^3$).

CIC - Maximum console dimensions (not including maintenance envelope) are as follows:

Width: 81.28 cm (32")
Depth: 106.68 cm (42")
Height: 142.24 cm (56")

(c) Power - 1500w, 400 Hz, 3Ø, 115 V. MOD 3

(d) Heat Dissipation - 1000 W max.

1.474 CHAFF DECOY SYSTEM

The ship shall be fitted with a launcher system including Government-furnished equipment Rapid Blooming Chaff as specified in Section 1.700. Equipment to select and control the firing of chaff is to be installed *in* the CIC. Interface connection of the chaff equipment to other ship systems shall be installed as shown on NAVSHIPS Dwg. 803-4596515-101. HMR 55

1.480 FIRE CONTROL SYSTEMS

1.480.1 SCOPE

This section contains equipment and installation requirements for fire control systems.

1.480.2 DEFINITIONS

Fire Control System Mk 92 Mod 1 This system consists of a track radar and a track-while-scan radar, stabilizer, Control Console, Computer and conversion/interface equipment, to control selection and firing of projectiles from the Mk 75 Mod 1 76 mm gun mount and to provide target information to the HARPOON Fire Control System.

HARPOON Fire Control System - This system consists of weapons control equipment as listed in the Weapons Equipment List (WEL) NAVSEA OD 45524 to control firing of HARPOON missile.

1.480.3 GENERAL REQUIREMENTS

'The Fire Control System installation including Government-furnished equipment defined above, shall be in accordance with NAVSEA Dwg. 802-5000470 and Interface Control Dwgs. 803-4596516-101, 803-4596505101, 803-4596506-101 and 803-4596501101.

For PHM-6 only, the Government-furnished fire control system components will not be installed: the excluded components are identified in Contract Schedule A, Part I. Ship/Fire Control System interfaces shall be supplied in accordance with the preceding drawings modified to reflect PHM-6 construction without weapons. HMR 99

1.480.4 INTRASYSTEM AND INTERSYSTEM ALINEMENT

The Contractor shall make intrasystem adjustments and alinements on all equipment and systems within the weapon systems and within the systems and equipment which interface with weapons systems in accordance with Government-furnished information. Intrasystem alinement shall be in accordance with Section 1.189.

1.480.5 INHIBIT FIRING CIRCUITS MOD 3

HMR 93

HMR 93

HMR 94

1.480.6 WEAPON ASSIGN FUNCTION

The Contractor shall provide a target assign function to provide positive correlation of the Evaluator and Surface Search Operator (SSO) target display with the WCC display. This system will allow the Evaluator and SSO to coordinate targets for weapons or navigation functions respectively.

MOD 4

HMR 93

HMR 7

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